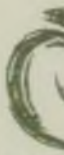

NRA

National Rivers Authority
Wessex Region

RIVER PACK

INFORMATION SHEETS ABOUT THE NRA AND THE WATER ENVIRONMENT

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NRA: 01

GUARDIANS OF THE WATER ENVIRONMENT

National Rivers Authority Wessex Region

NRA

THE NATIONAL RIVERS AUTHORITY

The NRA is the new non-departmental public body answerable to Parliament through the Secretary of State for the Environment. It is committed to the protecting rivers, groundwater, estuaries and coastal waters, seeking to improve these waters, their fisheries, flora and fauna, and to help protect people and their property from flooding. Its members are appointed by Ministers from the Department of the Environment, the Ministry of Agriculture, Fisheries and Food, and the Welsh Office.

The NRA is largely self-financing, its income arising by a levy on County Councils for flood defences, and charges for a variety of water uses eg. water abstraction and fishing licences. Charges for Discharge Consents will be introduced in 1990 and 1991. Any deficit is funded by Treasury Grant.

Set up under the Water Act 1989, the National Rivers Authority came into being on 11 July 1989, becoming operational on 1 September 1989, when the rivers units of the water authorities were transferred to the NRA. It has a small Central HQ which is primarily concerned with policy and organisation. The bulk of the staff are in ten regional units, total staff complement being 6500. Within the Wessex Region there are 400 staff. Each Region is served by three specialist committees: a Regional Rivers Advisory Committee, a Regional Fisheries Advisory Committee and a Regional Flood Defence Committee. In the Wessex Region there are three local Flood Defence and Fisheries Committees.

The Wessex Region of the NRA covers the counties of Avon, Dorset and Somerset as well as a large area of Wiltshire. It also includes parts of Devon, Gloucestershire and Hampshire. The main functions of the NRA are:

- the monitoring of water quality
- the control of pollution
- the strict regulation of discharges into rivers, streams, lakes and the sea.
- the management, and safeguarding of water resources for public supply by regulating abstraction from rivers, streams, lakes and from underground.
- the provision of effective flood defences including sea defences, for people and their property
- the maintenance, improvement and development of fisheries in inland waters.
- the continuing conservation of the water environment and its protection as an amenity.
- the promotion of recreational activities such as boating, fishing and walking by rivers.

The NRA also needs to constantly look ahead. It has a wide ranging planning function and a research and development programme to underpin all of its primary functions.

NRA: 02

MISSION STATEMENT

National Rivers Authority Wessex Region

NRA

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

NRA: 03

N R A OBJECTIVES

National Rivers Authority Wessex Region

NRA

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

NATIONAL RIVERS AUTHORITY

National Rivers Authority Wessex Region

NRA

The National Rivers Authority is an independent public body, set up in 1989. Members of its board are appointed by Ministers from the Department of the Environment, the Welsh Office and the Ministry of Agriculture, Fisheries and Food. Within the NRA are ten regions, employing the organisations workforce of 6,500 staff.

The aim of the NRA is to guard the water environment. This involves improving watercourses and coastal waters, their fisheries, flora and fauna, and protecting people and property from flooding.

The Wessex Region covers the counties of Avon, Dorset and Somerset, and a large part of Wiltshire. It also includes small areas of Devon, Gloucestershire and Hampshire. The region is blessed with good resources: its rivers such as the renowned Hampshire Avon, the historic Bristol Avon and the Tone all contribute to the regions water supply. The hill ranges, the Southern Cotswolds, the Mendips, the eastern slopes of Exmoor, and the Chalk downlands of Salisbury Plain and Dorset are all vital sources of water and the Somerset Levels and Moors have a unique wetlands character and landscape. Topography and geology varies throughout the Region giving a countryside that has a rich range of flora and fauna. About 15% of the Region is designated as areas to be protected because of their special natural features.

THE WATER CYCLE

The water cycle is the basis of all catchment management. Winter rainfall is stored in underground aquifers and released naturally to maintain river flows in summer. Water taken from rivers or underground aquifers and used for public supply, agriculture or industry is then taken away for treatment and returned to rivers and the sea.

In Wessex, about two-thirds of the region's water supply comes from groundwater. The priciple wells and boreholes are in the limestone and chalk hills like the Mendips, the Cotswolds, and the Wiltshire and Dorset Downs.

STANDARDS

The conflicting demands on the river system must be balanced if the water environment is to be kept healthy and be improved. The standards for river flow and water quality, which the NRA sets, impose conditions on new abstractions and discharges, which over a planned period will protect and improve the water environment.

Close liaison with planning authorities ensures that building development does not harm the environment, or be the cause of flooding, or pollution elsewhere. Anyone whose plans could cause problems by affecting the water cycle is given advice on avoiding or minimising adverse effects.

NATIONAL RIVERS AUTHORITY

National Rivers Authority Wessex Region

ISSUING CONSENTS

Consent is required for, amongst other things, the abstraction of water from rivers or from the ground, discharges of effluents into watercourses and the carrying out of engineering works on rivers. As with the NRA's work such operations may have an impact on the wildlife of an area and so it is important that the NRA consults with other environmental organisations before providing certain conditions to a consent, if appropriate.

In order that all of the above responsibilities and opportunities are taken up, it is vital that the NRA consults on a regular basis with outside conservation organisations such as the Nature Conservancy Council, County Wildlife Trusts and the Royal Society for the Protection of Birds. To that end, these organisations are sent copies of the various programmes of work for the year ahead, and their comments on the proposals are sought.

Following these early consultations, meetings and site visits are arranged, and where necessary modifications are agreed. In addition to these early consultations there are specific liaison arrangements with the NRA to ensure that all departments are aware of the organisations Conservation responsibilities and that they consult with the conservation staff at the earliest stages of any proposal.

COASTAL WATERS

The Dorset coast is famed for its holiday resorts and beaches, including Bournemouth, Christchurch, Poole, Swanage and Weymouth. There are also popular beaches on the Bristol Channel, such as Minehead and Weston-Super-Mare. Most of these beaches now meet European Community bathing water standards and several regularly win the Blue Flags, which are awarded each year, for their cleanliness and good facilities.

Over the last few years, many of the unsatisfactory short sea outfalls, have been replaced by well-sited long sea outfalls enabling pretreated liquid sewage to be purified naturally in the sea.

NATIONAL RIVERS AUTHORITY

National Rivers Authority Wessex Region

QUALITY CHECKS

The quality and flow of river waters are regularly monitored, with abstractions and discharges being checked. Appropriate legislation and EC directives are enforced and where necessary remedial action is taken to clean up pollutions, with offenders being prosecuted in the courts.

Laboratory services are being set up which will serve the the Wessex Region. The marine vessel, Vigilance, monitors and reports on the performance of sea outfalls in coastal and estuarine waters.

LAND DRAINAGE

This includes general maintenance ie trimming of riverbank vegetation, the cutting of weeds in river channels and dredging. Wildlife habitat surveys are carried out before any dredging work takes place and special working maps are drawn up for the excavator operator. These maps highlight areas of conservation value to be left alone, eg mature trees, important patches of scrub and reeds, rare plants and fish spawning beds etc. They also show where conservation enhancement schemes may be carried out by engineers whilst on site, ie, the pollarding of old willows, planting of reed beds and deepening of pools.

FLOOD ALLEVIATION

This usually involves larger scale engineering works, particularly in urban areas, and involves the widening or deepening of existing river channels, the creation of flood bypass channels, construction of flood walls and embankments, weir placements and river bank protection. All of these require environmental assessment before any design work is commenced and so detailed ecological surveys are undertaken in the areas to be affected.

At the same time other departments in the NRA such as Pollution Control, NFisheries and Recreation carry out their assessments, enabling them to discuss the various options open to them, and the details of the engineering design for the proposed works

There are many opportunities for habitat creation and enhancement as part of flood alleviation work and as with maintenance dredging, some of these opportunities are taken up by engineers whilst they are on site.

FLOOD PROTECTION

Flood defence works protect the land from river and sea flooding. Land drainage works on land next to watercourses control water levels, allowing land to be used more effectively for agriculture, and development.

Sea defences are particularly important along the Severn Estuary coast, where the tidal range is among the highest in the world. The NRA maintains 142 km of sea and tidal defences, protecting 635 sq km of land, which would otherwise be flooded by high tides. Behind these defences the water levels are kept under careful control to meet the needs of both farming and wildlife interests.

WARNINGS

The Regions control room liaises with the police and other public services. It gathers rainfall, tidal and river level information from 115 sites, issues flood warnings, and coordinates activity in the event of flooding from either rivers or the sea.

WILDLIFE AND FISHING

The Region's contrasting landscapes provide a wide choice of exceptionally good salmon, trout and freshwater fishing. Anglers can be sure of interesting and varied sport, but must obtain an NRA Wessex Region rod licence. A fisheries boat patrols coasts and estuaries, to enforce byelaws, and to deal with salmon poaching in particular.

The management of the fisheries is closely allied to the conservation of wildlife. The presence of fish in a river is a good indication of its health. The ecological balance of a river therefore plays an important part in the designing of drainage schemes, deciding abstraction and discharge licence consent, and setting standards.

CONSERVATION WORK

There is a fund of money available purely for conservation work, and unrelated to any engineering scheme. The budget for this is administered by the conservation section and in recent years has been spent on projects such as pond creation of NRA land and planting up of river meanders with native trees.

In carrying out its work the NRA pays special attention to landscape, amenity aspects and conservation. Where possible, new conservation areas are created to counterbalance the practical use of a river for the community and wildlife features are surveyed and mapped so that engineering schemes can be planned to conserve the best features, create new ones and still meet the land drainage objectives. Recreational activities are encouraged on rivers where they are appropriate and some of the NRA's own waters are used for a variety of water sports.

BEHIND THE SCENES SUPPORT

Engineering and scientific staff are fully backed up by professional support services. These include accountancy, administration, estates, law, personnel and public relations.

PUBLIC SUPPORT

Each of the NRA Regions service three consultative committees

- Regional Rivers Advisory Committee
- Regional Flood Defence Committee
- Regional Fisheries Advisory Committee

There are also local flood defence and fisheries committees, which provide valuable contact and communication with various groups whose interests the NRA serves.

FINANCE

The cost of running the Wessex Region is about £14 million a year. The main costs are for:

- Flood Defence (56%)
- Water Quality (21%)
- Water Resources (15%)
- Fisheries (8%)

NATIONAL RIVERS AUTHORITY

National Rivers Authority Wessex Region

The annual income is a little over £9 million a year, the principal sources of this being from:

- Flood defence levies from County Councils (71%)
- Charges for Water Abstraction (24%)
- Other charges and fishing licences (5%)

A grant from the treasury is relied upon for the balance of NRA funding.

Charges for Consents to discharge effluents will be introduced by 1991.
Capital investment is principally for flood defence works and is partly funded by grants from the Ministry of Agriculture, Fisheries and Food.

NRA: 05

WESSEX REGION - DATA

National Rivers Authority Wessex Region

NRA

Area 9, 918 km²
Population: 2. 5 million
Rate of population growth: 20, 000 per annum
Annual rainfall: 864 mm
Annual evaporation: 367 mm
Main river: 2, 312 km

FISHING RIVERS

Salmonid (game): 832 km
Cyprinid (coarse): 553 km
Number of fishing licences issued: 60, 000 per annum

RIVER WATER QUALITY

Good: 1396 km (61%)
Fair: 776 km (34%)
Poor: 86 km (4%)
Bad: 17 km (1%)

Net improvement between 1980 and 1988: 361 km
Number of samples taken: 44, 000 (1989)
Number of water quality contraventions: 2, 000 per annum (1989)

Length of coastline: 254 km
Sea and tidal defences: 142 km
Number of properties protected: 25, 600
Area of land protected: 635 km²
Number of planning applications considered: 5, 000 per annum (1989)

DATA NETWORK

Rain gauges: 309
River flow measuring sites: 175
Groundwater monitoring sites: 300
Sites with telemetry: 115

NRA: 05

WESSEX REGION - DATA

LICENCES TO ABSTRACT WATER

Number of Licences: 3,282 (inc CEGB)
Quantity authorised: 1,848 ml/d
Consented discharges: 6, 500
Number of licences and consents issued: 700 per annum (1989)

EC BATHING BEACHES

Number of beaches: 38
Number complying: 31
Blue Flag beaches: 4

NUMBER OF STAFF

Manual: 115
Non-manual: 262
Total: 377

FINANCIAL STATISTICS

Income:	£ 9. 3 million
Expenditure:	£ 13. 7 million
Capital Investment:	£ 6. 5 million

NRA: 06

AVON AND DORSET AREA

National Rivers Authority Wessex Region

NRA

The Avon and Dorset area covers 4,300 square kilometres of Dorset and South Wiltshire, as well as small parts of Hampshire, Somerset and Devon. The resident population is a little greater than three quarters of a million and is mainly concentrated along the coast, particularly in the Poole and Bournemouth conurbation. The principal centres inland are the market towns of Dorchester, Blandford and Salisbury. The principal industry of the area is agriculture, mainly arable in the north of the region, whilst in the south, dairy farming increases. Tourism plays an important role in the area's economy and seasonal increases in population in the order of 15% occur in the summer months. In recent years there has been a significant influx of high technology industries, attracted by the intrinsic amenity value of the area. Recently important onshore oil fields have been discovered.

The principal features of the region are: the Chalklands, the forest and heath lowlands of the Hampshire Basin, and the Jurassic clay vales. The Chalklands stretch from south west Dorset to the Salisbury Plain and are characterised by undulating downlands intersected by complex systems of coombes and dry valleys. To the east of the area they are replaced by low lying heathlands associated with outcrops of Tertiary Sands and gravels, and to the north and west bounded by the gently undulating clay vales of Wardour and Blackmoor.

PRINCIPAL RIVERS

The area is drained by three principal rivers, the Avon, the Stour and Frome.

- The Avon rises in the Vale of Pewsey, but the bulk of its flow is derived from the chalk of the Salisbury Plain. The Rivers Nadder, Wylye and Bourne join the Avon at Salisbury before it reaches Fordingbridge. Downstream of Fordingbridge the Avon is fed by several small New Forest streams, before discharging to the sea at Christchurch Harbour.

- The Stour, together with its major tributaries, the River Cale and River Lydden, rises at the edge of the Blackmoor Vale. Downstream of Sturminster Newton it crosses on to Chalk where it is fed by springs before being joined at Wimborne by the River Allen. From here it flows around the Poole and Bournemouth conurbation and discharges into Christchurch Harbour.

- The Frome rises in chalk valleys in West Dorset, and passes on to Tertiary deposits downstream of Dorchester. At its point of outfall at Wareham, it passes into Poole Harbour just to the south of the River Piddle.

AVON AND DORSET AREA

National Rivers Authority Wessex Region

GENERAL

The long term average rainfall for the area is 870 mm much of which falls on the high ground to the south west. Approximately 50% of this rainfall is lost due to evapo-transpriration and runoff in rivers. The rest helps to recharge the aquifers in the region these being the major source of water supply.

Avon and Dorset is fortunate in that it contains some of the better game and coarse fisheries in the country. Such amenity value demands river water of high quality requiring domestic sewage to be fully treated before discharge and agricultural and industrial wastes to be totally excluded. The rivers are mainly chalk streams containing, if unpolluted, water suitable for public water supply.

Away from the coastal centres of population, intensive agricultural production in the upper Stour catchment, and in West Dorset is a major problem, and has led to a lower water quality than desired. Also, rapid increases in fish farming in the region have created an additional load on the cleaner rivers within the last 10 years. Much of the NRA's effort is put into improving watercourses by improving treatment and controlling and apprehending unconsented discharges.

Being a centre for tourism, the South coast's influx of holiday makers causes seasonal fluctuations on the water supply and sewage treatment system. In addition, the South East Dorset conurbation is one of the fastest expanding in the country.

The quality of coastal bathing water is closely monitored and the expansion of industry in the region has led to the application of EC directives on environmental discharges. Poole and Portland Harbours are now subjected to strict environmental controls by EC Directives for Dangerous Substances and Shellfish. The discovery and development of the largest land-based oilfield in the UK at Poole Harbour has required detailed consultation to avoid pollution of local watercourses and coastal waters.

NRA: 07

BRISTOL AVON AREA

National Rivers Authority Wessex Region

NRA

The Bristol Avon area extends over much the County of Avon and those parts of Wiltshire and North Somerset which drain to the River Avon. Bristol and Bath, the regions two largest cities, and their populations, (together almost 0.6 million) are the main users of water. Bristol's river port, the lowest bridging point on the Avon, has been a major influence in the development of Bristol causing it to become the country's second city in the nineteenth century. Even the hot springs, at Hotwells, were a tourist attraction.

Navigation on the Avon extended to Bath, but was limited from going any further by the many mills on the river. The Kennet and Avon Canal provided freight communication with London until the railway came in the middle of the nineteenth century. About 0.6% of the land area is covered with water - one major water mass being Chew Valley Lake.

Two areas within the catchment are subject to relatively high rainfall due to orographic influences. The first area, the Mendip Hills, provide an average annual rainfall of 1200 mm. Surrounding the Mendips there are major supply sources all in the Somerset area. The second area is the Cotswold scarp edge, north of Bath, which provides an average annual rainfall of over 950 mm. Although this is not an area which is notable for large individual water supplies, Badminton is the source of four tributaries of the Avon, and groundwater feeds the Little Avon river in the Severn catchment. There are a number of groundwater sources in the Cotswolds particularly at and around Malmesbury and Chippenham which together make a significant contribution to public supplies.

Between these two high rainfall areas is the Avon Valley between Bath and Bristol where rainfall is comparatively low, less than 800 mm a year. The eastern part of the catchment is also comparatively dry, with large areas where average rainfall is less than 750 mm a year. The average rainfall for the whole catchment is 830 mm.

Due to the demands of the regions two cities there is a higher effluent output than in other areas. Until the end of the 19th Century the River Avon was a dead river,with untreated sewage being poured into it daily. Now,due to the building of treatment works and better methods of disposal, the River Avon is of a far higher quality, and fish have returned. Sea trout are also recolonising the River Chew.

BRISTOL AVON AREA

National Rivers Authority Wessex Region

TOPOGRAPHICAL FEATURES

There are three dominant features in the area:

- North-east of Bath there is the broad outcrop of Oolite limestones forming the southern end of the Cotswold Hills.
- The Mendip Hills which is a prominent flat topped ridge playing a vital role in the hydrology of the area. The combination of the low moors on the southern side of the hills with the prevailing south-westerly winds, gives relatively high average rainfall of up to 1200 mm annually.
- The Chalk escarpments of Salisbury Plain and the Marlborough Downs reach heights of about 240m. Because the escarpments run almost parallel to prevailing winds, they have virtually no effect on the rainfall patterns within the Bristol Avon catchment.

PRINCIPAL RIVERS

The Bristol Avon River has sources at Crowdown Springs, near Sherston, and at Tetbury. The Sherston Avon flows eastwards and over limestones to join the Tetbury Avon at Malmesbury. Below Great Somerford, the Avon turns southwards towards Chippenham, Melksham and Bradford on Avon, before turning westwards through Bath, Bristol, and the Bristol Channel. At Limpley Stoke, the river has cut a deep valley, while the carboniferous limestones of the Avon Gorge at Clifton provide spectacular scenery.
The Bristol Avon's principal tributaries include the Bristol Frome, Boyd, Box Brook (or By-Brook), Binkworth Brook, Marden, Semington Brook, Biss, Somerset Frome, Midford Brook and Chew.

SOMERSET AREA

National Rivers Authority Wessex Region

NRA

The main features of the Somerset are Exmoor, the highest point of land at Dunkery Beacon being 519m, and the extensive central lowlands known as the Somerset Levels and Moors. Less than 2% of the area is urban, 91% of the land is used for agriculture, and of this, 78% is grassland where dairy farming predominates.

Population in the Somerset Area is a little over 0.5 million, 30% of whom live in towns of over 10,000 residents, mostly in coastal resorts or market towns. The largest of these is Weston-Super-Mare with a population of 59,070. The industry of the area varies, tourism, particularly at Weston-Super-mare, Burnham-on-Sea and Minehead is responsible for the seasonal pressures on water services. Other industries include the manufacture of dairy products, cellophane and paper, leather and textiles, aviation, and power generation at Hinkley Point.

Long term average annual rainfall varies from 700mm in the central lowlands of the River Parrett basin to 1600mm near Dunkery Beacon. The average rainfall over the area is 859mm which is approximately 5% below the average for England and Wales. Of this, it is estimated that approximately 450mm is returned annually to atmosphere through evaporation and transpiration.

River quality is influenced by the physical and biological nature of a river and its environment. Many upland rivers virtually remain in their natural state and although rivers contain good quality water, they are used to dispose of wastes from industry, agriculture and domestic sewage plants. Sewage effluent from the main towns is often discharged to small rivers, causing a substantial impact on the quality of the water with discharged waste from industry and agriculture also having their effects. Because of the impact of these discharges there is little potential for achieving high water quality as slow moving water has little opportunity to purify itself.

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WATER

National Rivers Authority Wessex Region

NRA

WHAT IS IT?

Pure water is a compound that is composed of atoms of oxygen and hydrogen in a molecule. There are two hydrogen atoms to every oxygen atom, thus giving water the chemical formula H_2O. Water can exist in 3 forms as ice (solid), water (liquid) and as steam (gas).

The form in which it is present is at any given time or place, temperature and pressure dependent. Unlike any other chemical compound of a similar structure and chemistry, water is liquid at room temperature (and not a gas), boils at 100 °C and freezes at 0 °C.

HOW WE USE IT

Of all the water in the world only about 1% is available for use. If all the rain in England and Wales could be collected, it is estimated that there would be over 3600 litres of water per day per person.

It is estimated that the present need of the population for water is about 160 litres per person per day for household use.

Other major water users are manufacturing industry, agriculture, power production, waste disposal and recreation.

THE WATER CYCLE

National Rivers Authority Wessex Region

NRA

In whatever form it is found, water is part of a natural system called the water cycle. It is this system which we interrupt by removing water for our own uses in the home, industry and agriculture. The cycle starts and finishes with water in its liquid state, in rivers, seas and lakes.

- When a body of water is warmed up, some of it will evaporate and rise into the atmosphere. This vapour collects together in the form of clouds.
- These clouds are blown, by the wind, across onto the land where they will cool as they rise over higher ground, until they reach the dew point. At this temperature the vapour condenses to form water droplets. These droplets will grow in size until they fall as rain or snow.
- On falling to earth, the water will either soak into the ground or run off the surface into streams and rivers. Some will also evaporate back into the atmosphere.
- That which soaks into the land may be used by plants which will, by transpiration, return the water to the atmosphere as a vapour. Some of it will infiltrate through the soil and become groundwater. It will emerge later as springs which feed rivers.
- The run-off water will flow in rivers and streams back to the seas and lakes which were its original source.

WATER: 03

PHYSICAL CHARACTERISTICS OF A WATER BODY

National Rivers Authority Wessex Region

NRA

Streams and rivers pass through four stages of maturity,referred to as birth, youth, maturity and old age. Water quality is affected by the characteristics of its source, the land over which it flows, abstractions, discharges, and numerous other uses.

LAKES

Lakes can be classified as:

- Oligotrophic: deep, clear, lacking in nutrients and biological activity.
- Eutrophic: turbid containing nutrients, and supporting extensive life.
- Dystrophic: shallow, clogged with plant life and usually coloured: with a low pH.

RESERVOIRS

Storage reservoirs have a large volume relative to their inflow and outflow. Their physical, chemical and biological properties tend to be similar to those of lakes. When water is held in a reservoir, its quality may be affected by changes in velocity, surface to volume ratio, temperature and other factors. Some of these may be beneficial, such as decreases in organic matter, reduced turbidity, and decreased hardness. Others may be harmful such as decreased aeration, stratification, accumulation of pollutants and increased algal growth. The temperature-density-relationship exhibited by water often results in the formation of distinct layers of water in static bodies such as lakes and reservoirs.

DURING THE SUMMER

The top layer of water, known as the epilimnion is heated by radiation from the sun and floats upon the under-lying, colder, denser hypolimnion. When the temperature difference between these layers is large, they behave as two separate water bodies, the thermocline.

Each of these layers has a different chemical and biological property: The epilimnion will contain higher levels of dissolved oxygen, and be aerobic whereas the hypolimnion may well be anaerobic due to the effect of bacterial action on biodegradable organic material.

DURING THE AUTUMN

When the epilimnion cools, the temperatures of the two layers become equal and mix. This mixing is known as the overturn and results in a number of physical, chemical and biological changes which can cause disruption in water treatment processes.

WATER: 04

BIOLOGICAL CHARACTERISTICS OF A SALT WATER BODY

National Rivers Authority Wessex Region

NRA

ESTUARIES

Estuaries are those areas where mixing of fresh and salt waters take place at river mouths. This not only gives them unique scientific properties, but creates important breeding grounds for a wide variety of marine life.

THE OCEANS

The oceans of the world are also unique in their properties, because of the high salt content and great depths. Environmental interest in the oceans has increased in recent years because of waste dumping, shipping accidents and increased utilisation of natural resources.

WATER: 05

AQUATIC ECOSYSTEMS

National Rivers Authority Wessex Region

NRA

All natural waters, and a large number of waste waters, contain a wide variety of living organisms. A clean surface water supports a complex ecosystem. Organisms in such an ecosystem are either Autotrophic or Heterotrophic.

Autotrophic organisms utilise the sun's energy to fix inorganic materials into complex life molecules. Algae are typical of these autotrophs. Organisms which utilise energy to synthesise organic materials, are referred to as producers.

Heterotrophic organisms use the products of autotrophic organisms as raw material, from which they are able to gain energy. Contained within this group, the heterotrophs, is found a sub-class, known as decomposers or reducers. These consist mainly of fungi and bacteria which break down material of biological origin to the simple inorganic compounds which are fixed by autotrophic organisms.

WATER PRODUCTIVITY

National Rivers Authority Wessex Region

NRA

The productivity of a body of water is its ability to produce living material. This is dependent on its physical and chemical characteristics. High productivity is required for fish life however, if it is too high, weeds will grow and choke the watercourse, reducing the oxygen levels.

There are many important physical and chemical properties influencing aquatic life: some of the main ones are listed here

- Temperature: differences of only a few degrees can result in completely differing forms of aquatic life.
- Transparency: Important in determining growth of algae.
- Water velocity: Important for transport of organisms and nutrients and for removal of waste materials.
- Oxygen: The key chemical factor in determining the extent of life in water. Oxygen deficiency is fatal to many forms of aquatic life although its presence is fatal to anaerobic organisms.
- Carbon dioxide: Required for photosynthetic production of algal biomass. (High levels of carbon dioxide produced by organic degradation can result in excessive algal growth).
- Nutrients: Affect the production of aquatic plant life. Adequate supplies of carbon, nitrogen, phosphorus and trace elements are required for plant growth. (Phosphorus often limits growth and can be controlled in order to reduce productivity).
- Salinity: Important in determining the kind of aquatic life present. Marine life requires salt water for its existence whereas many freshwater organisms cannot tolerate salt.

Aquatic systems are very complex in their chemical characteristics, and a number of factors must be taken into account when attempting to describe them.

The chemical characteristics of a water body are affected by the life forms present, and are subject to the effects of a number of inputs and outputs of material and energy, for example, interactions with the atmosphere and bottom sediments.

True equilibrium conditions do not exist in natural water bodies, and an exact chemical description of a naturally-occurring water system, based on solubility, pH, and numerous other chemical factors, is not possible.

RIVER CHANNELS:

WATER: 07

RIVER WATER QUALITY

National Rivers Authority Wessex Region

NRA

The National Rivers Authority is committed to achieving a continuing improvement in the quality of river, estuarine and coastal waters, through the control of water pollution. An important element in securing these improvements will be the effective management of water resources to ensure that sufficient water is preserved in rivers to absorb permitted effluents. In discharging its duties, the National Rivers Authority has set and is reviewing, quality objectives for each stretch of inland and tidal water. These are formulated to take account of the various uses to which the river waters are put.

To ensure that the required standards can be achieved the NRA sets conditions for all permitted discharges of sewage or trade effluents to receiving water. These have regard to the nature and amount of the effluent, as well as the capacity of the receiving water to accept it. A regular programme of sampling and analysis enables the NRA to monitor compliance with consent conditions and quality objectives.

The Authority enforces standards in a number of ways. In the first instance, dischargers whose effluents do not comply consistently with consent conditions are pressed to implement properly planned and adequately financed schemes of improvement. Ultimately, the NRA is fully prepared to use the wide ranging legal powers conferred on it by the Water Act (1989) and seeks redress against polluters in the Courts.

WATER: 071

BATHING WATER QUALITY

National Rivers Authority Wessex Region

NRA

Along the 5,200 km of coastline around England and Wales, 380 beaches have been identified where the bathing waters have been designated under the EC Bathing Waters Directive. This Directive, which was adopted in 1975, was intended to safeguard the quality of waters where bathing is traditionally practiced by a large number of bathers. The Directive lays down bacteriological and other quality standards, prescribes a surveillance regime and obliges EC Member States to take necessary measures to ensure that bathing waters confirm to these standards.

THE NATIONAL RIVERS AUTHORITY'S ROLE

In order to monitor the quality of bathing waters, the National Rivers Authority regularly samples them during the bathing season and assesses the quality against standards set by EC Directives. These data are made available to local Authorities and the public so that they are aware of the current state of bathing waters along the length of coastline which is of interest to them. A minimum of 20 samples are taken for bacteriological analysis during the bathing season between May and September from each designated beach.

THE PROBLEM

Historically in the United Kingdom, the most convenient method of disposing of sewage from coastal communities has been by discharging it into estuaries and the sea. About one fifth of the United Kingdom's population is drained through some 2,000 or so marine outfalls, approximately 90% of which discharge less than 100m beyond low water and 45% discharge untreated sewage. It is not surprising, therefore, that the United Kingdom water industry has inherited a legacy of unsatisfactory marine outfalls which often give rise to bathing waters that do not comply with the requirements of EC legislation and worse still, may give rise to visible signs of sewage on some of the nation's more scenic beaches.

In 1988, two-thirds of the designated bathing waters in England and Wales complied with the EC Directive, whereas in the Southern Region, only 41% of the 65 beaches achieved the necessary standard. Many of those bathing waters which failed EC standards are in the vicinity of a short marine outfall extending only a short distance from the beach. It is in these areas that the UK water industry is at present making major investments to bring beaches into line by the middle of the next decade.

SOLUTIONS

The practice has been established in the United Kingdom in recent years to provide for well designed long marine outfalls. This follows the 10th Report of the Royal Commission on Environmental Pollution which concluded that such discharges are not only acceptable but, in many cases are environmentally preferable to other methods of disposal. Accordingly, long marine outfalls are regarded as a satisfactory method of disposal. These take sewage which has previously been macerated into deep water where there is no danger of wind or tide bringing it back on to the beaches. Provided an immediate dilution of 100 times is achieved, the sewage is readily oxidised by sea water and the coliform bacteria in the sewage are dispersed and killed off by the effects of sunlight to a far greater extent than in an inland, freshwater river. Support for this method of treatment has been received from the Anti-Pollution League, which has campaigned for clean beaches for the last 30 years.

Another EC Directive, currently in draft form, deals with municipal waste water treatment and will establish minimum standards for sewage treatment prior to marine disposal. All sewage effluents, over a certain volume, discharging to estuaries and coastal waters will be required to receive primary or secondary treatment depending on location. Primary treatment removes 30-60% of coliform bacteria, 0-50% of viruses; secondary treatment removes 90-99% of coliform bacteria, 75% of viruses. These additional requirements will undoubtedly modify future sewage disposal strategies in coastal waters.

It was originally proposed that the bacteriological and other standards set by the EC Directive should be attained within 10 years but the water industry has only in recent years been able to provide the necessary investment to provide adequate means of sewage disposal for coastal towns. This programme of work is intended to be completed by 1995.

BATHING WATER QUALITY

National Rivers Authority Wessex Region

THE EUROPEAN BLUE FLAG

The Blue Flag is awarded to beaches in the European Community member countries where bathing waters and beaches reach a certain standard of cleanliness and amenity.

In 1989, 22 United Kingdom beaches were awarded the Blue Flag of which two, Bexhill and Eastbourne, are in the Southern Region. The main requirements of the Blue Flag Award are:

- Bathing water must meet the requirement of the EC Directive in bathing waters.
- There must be an absence of litter both on land and in the sea.
- There must be no oil pollution.
- Beaches must be cleaned up after each day.
- There must be no unauthorised camping or dumping and there must be safe and adequate access to the beach.
- Dogs must be banned from part of the beach.

In the United Kingdom, the Blue Flag award is organised by the Tidy Britain Group.

RISKS TO HEALTH

It is internationally accepted that there is a risk of contacting minor infections when bathing in seawater contaminated by sewage. The bacteriological standards in the EC Bathing Water Directive are not based on public health related criteria, that is compliance to the standards does not guarantee you are safe from infection. The Department of the Environment and the NRA are funding epidemiological surveys at coastal holiday resorts to establish the relationships, if any, between ill-health in bathers and water quality. Pilot studies were carried out in 1989 and 1990 and the full survey should be completed by the end of 1992.

WATER: 08

CLASSIFICATION OF RIVER QUALITY

National Rivers Authority Wessex Region

NRA

The quality of the water is classified by measuring the amount of dissolved oxygen present (DO) and the biochemical oxygen demand (BOD), as well as other chemicals such as ammonia. The classification system is:

- Class 1: Water of a high quality suitable for potable supply abstractions, game and other high class fisheries and high amenity value.
- Class 1B: Used as the above but water is of a less high quality.
- Class 2: Suitable for potable supply after advanced treatment, and supporting a reasonably good coarse fishery with moderate amenity value.
- Class 3: Water is polluted so that fish are absent or only sporadically present. Used for low grade industrial abstractions. Considerable potential if cleaned up.
- Class 4: Grossly polluted waters, likely to cause a nuisance.

RIVER QUALITY

In the UK, 92% of rivers are in Class 1, the highest class. For just England and Wales the figure is 66%. These high figures compare favourably with the 39% which is Europes overall estimate. In France the figure is less than 35%, and in Germany it is 44.5%.

Of Class 1 and 2 rivers together, those of good reasonable quality, the Netherlands have 95%, England and Wales 94%, Germany 84.5%, Greece 80% and France probably less than 80%.

The standard of rivers in the Wessex Region is high. 93% of the rivers are in Class 1 and 2. Only stretches of the Stour, Bristol Avon, Sheppy and Cary are in Classes 3 and 4. The figures per km for water quality are:

- 1A: 664 km
- 1B: 858 km
- 2: 781 km
- 3: 156 km
- 4: 15 km

WATER: 09

RIVER POLLUTION

National Rivers Authority Wessex Region

NRA

River life normally reflects the quality of a river and its recent pollution history. Pollutants change the balance of flora and fauna between groups of plants and animals depending on their relative sensitivities to pollution. Regular invertebrate surveys are therefore carried out by the National Rivers Authority to complement data from water analyses. Fish life also reflects the quality of river water since some species are sensitive to pollution whilst others are tolerant and may survive for long periods in low concentrations of dissolved oxygen.

In order to maintain the high quality of water in our rivers, a watch must be kept for pollution and potential pollution risks. Rivers are affected by many factors, including farming, industry, weather and climate. Pollution falls into 3 main categories:

- Sewage
- Farm wastes
- Industrial wastes

As Wessex is mainly a rural area, farm waste is the largest of these categories. A recent development in the tracking of river pollutants has been an automatic sampler, nicknamed 'Sherlock', which is able to monitor levels of ammonia, dissolved oxygen, pH temperature, and other factors. When changes occur, an alarm is triggered which alerts Water Quality Officers of a possible pollution incident.

WATER: 10

POLLUTION MONITORING DEVICES

National Rivers Authority Wessex Region

NRA

SHERLOCK

The Wessex Region Sherlock monitoring system is a mobile, completely self-contained piece of equipment. It does not rely on external power sources and can operate in remote locations totally independent of any external inputs. It is capable of monitoring any parameter from a variety of instruments, eg dissolved oxygen and ammonia, temperature, pH, level/flow, conductivity, rainfall turbidity providing millivolt reading outputs. Having stored the readings from these meters in its data logger it is possible to download the results from the system remotely using a cellular telephone connected to a data logger via a modem and transferred to any other location, such as a control centre, office, car or home with the aid of a computer, modem and telephone line.

Not only is the system passive, awaiting interrogation, it can also be active in so much as when a reading from one of the monitors exceeds a preset alarm level a number of reactions can be triggered:

- A sampling machine can be made to start taking samples for laboratory analysis.
- A radio signal can be sent to other Sherlocks upstream and downstream simultaneously starting their associated sampling machines.
- An alarm can be sent via the cellular telephone to alert a standby Water Quality Officer or a control room of the occurrence of an alarm condition.

Since the development of Sherlock Wessex has carried out many investigations and it has proved particularly useful in monitoring effluent discharges from sewage treatment works, intermittent storm sewage overflows and farm effluent discharges. The flexible and modular system has enabled a variety of industrial discharges to be examined, including the effects on a watercourse of varying pH and soluble iron from mineral extractions, and the efficiency of industrial effluent pretreatment plants.

The ability to alert pollution control staff to pollutions enables the cause of the problem to be dealt with much more rapidly than response to the observed or reported effects caused by a polluting discharge. This represents an important advance in the prompt and effective investigation of pollution incidents by the NRA on other environmental protection organisations.

POLLUTION MONITORING DEVICES

National Rivers Authority Wessex Region

MERLIN

Merlin is the next generation of pollution monitoring devices developed within the Wessex Region. It incorporates a number of advantages over the Sherlock system eg:

- Merlin is substantially smaller. In fact Merlin is little bigger than the sampling machine module used by Sherlock.
- Merlin can be used where Sherlock would fear to tread. It floats and can therefore be used anchored in a river. It can also be used in the marine environment.
- Merlin can also be bank mounted where insufficient depth of water is available for flotation with the probes placed in the stream or watercourse.

WATER: 11

ENVIRONMENTAL QUALITY OBJECTIVES

National Rivers Authority Wessex Region

NRA

In the UK a quality objective defines the use of or uses for which a body of water must be suitable, eg potable water supply, agricultural abstraction, recreation. A quality standard is the concentration of a substance in the water which must not be exceeded if the quality objectives are to be realised.

Quality objectives are published for all the significant rivers, canals, streams and harbours. They are used to judge river quality and are also the basis for setting discharge consent conditions.

The standards have been derived from a number of National and European Community Directives, some of which are listed below:

EPA Water Quality Criteria 1972

National Water Council (NWC) Classification

European Inland Fisheries Advisory Commission Report 1982

EC Directive 75/440	Surface water for abstractions for drinking
EC Directive 76/464	Dangerous substances
EC Directive78/659	Freshwater fish
EC Directive 83/513	Cadmium
EC Directive 84/156	Mercury
EC Directive 84/491	Hexachlorocyclohexane
EC Directive 86/280	Carbon tetrachlorine, DDT, Pentachlorophenol
EC Directive 86/347	Hexachlorobenzine, Hexachlorobutadiene, Aldrin, Dieldrin, Endrin, Chloroform

Water Quality is assessed from a network of monitoring sites at significant points in the river system. The water samples taken are analysed for a range of determinants in order to assess compliance with quality standards.

The main determinants used to assess river quality are biological oxygen demand (BOD mg/1), dissolved oxygen (DO%) and ammoniacal nitrogen (NH3 MG/1). Biological data and the general health of a river should also be considered in assessing the quality. The 1990 River Quality Survey will be done using chemical data, and a biological assessment using the RIVPACS (River Invertebrate Prediction and Classification System) method will be made.

WATER: 12

CALCULATING DISCHARGE LIMITS

National Rivers Authority Wessex Region

NRA

Computer models can be used to calculate concentration limits for discharge consents. Models are useful for complicated river systems and estuaries where there is more than one discharge having effect and other factors may be involved such as abstraction of water. There is right of appeal to the Secretary of State for the Environment for those people that made representations against the discharge if they feel that the discharge should not have been allowed or the standards are not adequate and similarly the discharger may appeal against conditions imposed within the consent if it is felt they are too stringent.

Failure to comply with the consent conditions is an offence. Compliance is monitored by analysis of samples of the effluent. The frequency of sampling depends on the significance of the discharge. The results of the analyses are held on a register which is open to the public. Also held on the register are details of consent applications and consents.

Much of the NRA's work is a result of this legislation, for example, the bacteriological analysis of bathing beach water is very labour intensive and the NRA is presently looking for a faster analytical technique. The chemical analysis for the designated EC List 1 'blacklist' substances is also becoming increasingly complex and time consuming. Sampling exercises in tidal waters have been increased in an attempt to measure the effect of significant discharges from the Avonmouth and Severnside areas.

The EC has prescribed two methods for controlling the quantities of List 1 substances discharged to the aquatic environment. They are limit values and quality standards. Limit values specify maximum concentration limits for discharges containing these substances and so not specifically take into account dilution or use. Quality standards are based upon quality objectives obtained by considering the use requirements of the receiving water after allowing for dispersion in a mixing zone.

The quality standard for the List 1 substances must be met outside this zone . The British Government, through the DOE, has opted for the environmental quality standard approach, employing the use of environmental quality objectives for the receiving waters. This is consistent with the present system of control of pollution in inland waterways.

WATER: 13

VIGILANCE

National Rivers Authority Wessex Region

NRA

The Vigilance was built by the David Abels Yard in Bristol. The vessel is a twin-screw, all steel construction and is extremerly rugged, well able to dry out in small harbours in low water situations.

The Vessel's main programme of work from 1990 covers topics such as: carrying out off-shore benthic and biological sampling for the EEC Shellfish Directive, Long-Sea Outfall Survey Monitoring, Bathing Water Surveys, Sediment Sampling, Trace Metals, Tide Float Tracking. She is available for any contract work providing this fits within her work area and existing programme.

Vigilance has many sophisticated navigation and survey instruments giving her the capability of handling the most complex water quality and biological investigations that can be requested.

SPECIFICATIONS OF VIGILANCE

- Length overall: 15.77 metres
- Beam: 5.50 metres
- Draft: 1.40 metres
- Displacement: 39 tons
- Speed: 10 knots
- Endurance: 850 n miles
- Engines: 2 x 132 kW (180 hp) Sabre Diesels, vertical four stroke, overhead valve, 6 cylinders in line, turbocharged intercooled
- Propulsion: 2 x 4 bladed kaplan type 700mm propellors in fixed nozzles, spurs rope cutters fitted
- Auxilliary Winch: Lister CRK3 20 KVA, 240V AC, keel cooled 2 ton twin drum Spencer
- Carter trawl winch
- "A" Frame: Hydraulic capable of luffing 1 ton wt from deck over the stern
- Side Derrick: Effer hydraulic crane with winch (2.5 ton metre)
- Manoeuvrability: Will turn in own length. Full ahead to stop in 18 secs. Full ahead to full astern in 34 secs.

VIGILANCE

National Rivers Authority Wessex Region

NAVIGATION/SURVEY EQUIPTMENT

- Qubit TRAC/CHART V plotter, printer and helmsmans video
- Decca MK 53
- Raytheon V 700 echo sounder and log
- Raytheon V 700 Rayplot video plotter
- Raytheon R 41 daylight radar
- Cetrec autopilot with Fluxgate compass
- Jax 9 weather fax
- Danaplus wind speed and direction
- log\WS salinity/depth/temperature meter
- pHOXC dissolved oxygen, temperature, pH, salinity, turbidity meters

COMMUNICATION

- Sailor VHF
- Raytheon 90E VHF fitted with D F facility
- Mobira vodaphone
- Icon handsets

DOMESTIC

- Mess facilities for eight with overnight accommodation for three.
- Shower, toilet and sink (draining to inboard storage tanks)
- Galley, cooker, microwave, fridge,sink
- Heating throughout is electric
- Lighting throughout is 24V and 240V

VIGILANCE

National Rivers Authority Wessex Region

TYPES OF WORK UNDERTAKEN BY VIGILANCE

Sediment samples - by grab from vessel or by pole mounted sampler from Sea Rider Dinghy.

Chemical Water Samples - At specified locations, through tidal cycles, or composite. On site analyses can be taken for laboratory analysis to check compliance with EC Directives on shell fisheries, dangerous substances and bathing waters.

Bacteriological Analyses - Basic bacteriological analysis can be carried out on board - samples for more comprehensive bacteriological and viral analysis are taken to on shore laboratories.

Seaweed and Tissues Samples - For coast watch purposes.

Biological Background Samples - Using combinations of trawl and dredge samples of marine flora and fauna can be logged.

Visual Inspections - Using a remote operated submersible vehicle and /or divers, discharge pipes and outfalls may be inspected in detail.

Mathematical Modelling - Data can be obtained using bathymetry, side scan sonar, current and tide metering, float tracking dispersion exercises and buoy mounted monitoring stations. The on board navigation equipment assists precise locations.

INDEX

National Rivers Authority Wessex Region

NRA

WATERCOURSES

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RIVER CHANNELS & DRAINAGE PATTERNS

National Rivers Authority Wessex Region

NRA

RIVER CHANNELS:

One way for a river to gain its required longitudinal profile is to increase its channel length over the same straight line distance and vertical drop. One way of doing this is for it to meander.

- Meanders: These are the normal pattern for rivers flowing over lowlands, plains or shallow slopes. A meander is the name given to a sinuous bend in a river.
- Braided streams: Braided streams are a network of small interlinked channels that effectively comprise the same stream. They occur if the discharge is highly variable and the stream can not carry enough sediment to maintain a single channel. The sediment is often poorly sorted in size.

DRAINAGE PATTERNS

These depend on geology, structure and topography and will differ from place to place. No river will conform exactly to any one pattern.

RIVER CHANNELS

- Dendritic Patterns: These are very common usually occurring where rock strata lie horizontally or are gently dipping. A dendritic pattern is one where many streams flow into each other at acute angles to form a larger stream.

- Trellised Patterns: These are also common and usually occur where the rock strata dip in a direction 90° to the slope of the land. The river will flow straight across hard rocks but will flow along the line of softer rocks.

- Radial Patterns:- Where there is a dome of land, or similar, a radial drainage pattern may develop.This is simply when all waters flow away from one central point .i.e. the dome. Different parts of this pattern may take on trellised or dendritic patterns.

STREAM ORDERS

When considering a drainage pattern it is useful to classify each stream or tributary. One method of doing this is to allocate a numerical order.

A first order stream is a stream between its source and its first junction with another. When two first order streams meet a second order stream is created. Two second order streams make a third order stream and two third order streams make a fourth order. If two streams of different orders meet the resulting stream takes the higher of the two values.

THE MECHANICS OF A RIVER SYSTEM

National Rivers Authority Wessex Region

NRA

As a river flows downstream various properties it has change, and these changes affect other properties. Some of these are:

- Velocity: The velocity of a river is dependent upon the gradient of the river bed and the shape of the channel. Velocity will increase if the gradient or depth of the channel increases.
- Gradient: Through its history, a river will try to attain a specific profile between its source and its base level. The general longitudinal profile of most rivers is a concave curve. (The base level is the point where a river enters a large body of static water, such as a lake or the sea. Most rivers will be steeper at their upstream end than at their mouths). River gradient is achieved by erosion or deposition of sediment. If base level is changed a river will adjust its gradient to regain its preferred profile, e.g. if a dam is built.
- Sediment: In order for a specific sized grain of sediment to be moved, the river must have enough energy to move it. This depends on the velocity of the water. The velocity of a river usually decreases downstream, and so does its energy. The further a river flows along its course the finer the sediment it can carry, so by the time it reaches its mouth, it only has enough energy to carry the finest of particles. Larger particles are deposited further upstream, at a distance dependent on their size.

WATERFALLS

Where the river flows from a hard bedrock onto a softer one, a water fall may form. This can occur either where there are changes in sedimentary rock hardness, or if an igneous dyke cuts through a softer rock If the water flows over a horizontal bed of hard rock this will eventually come to an end and a softer rock will be reached. A waterfall may form as the softer rock is eroded away.

At some stage the hard rock may start to be undercut. This will eventually fall and in this way a waterfall will retreat upstream. If there is a rapid alternation of hard and soft beds a series of cascades may form.

WATERCOURSE: 03

RIVER CARY & KINGS SEDGEMOOR DRAIN

National Rivers Authority Wessex Region

NRA

From its source near Castle Cary, the River Cary flows across Cary Moor past Babcary. On approaching Kingsdon the river passes under the Fosse Way and then changes its direction towards the north west. It then passes to the north of Somerton, entering Somerton Moor, and on leaving the river becomes the King's Sedgemoor Drain, draining the Moor of the same name. After meeting the Eighteen Foot Rhyne and a relief channel from the River Parrett near Westonzoyland and Bawdrip, the drain enters the Parrett Estuary at Dunball.

The quality of water in the River Cary, and King's Sedgemoor Drain, varies between 2A and 2B, and is a well known for its coarse fisheries, being used for many competitions. The species of fish present include rudd, roach, bream, tench, perch and pike.

At a couple of locations along the route of the River Cary, there are discharges at Somerton and at Castle Cary from a sewage treatment works.

WATERCOURSE: 05

THE BRIDGWATER AND TAUNTON CANAL

NRA

The Bridgwater and Taunton Canal was opened in 1827 between Firepool Lock, in Taunton, and Huntworth. In 1841 it was extended to the new Docks in Bridgwater, giving it an overall length of 15 miles (approx 24.5 km). Major cargoes that were carried by barges were coal, timber and limestone.

The coming of the Great Western Railway signified the beginning of the decline in the traffic on the canal, which the railway bought in 1867. From then on, trade declined gradually, the last commercial barge trip being in 1907. Since then, the canal has been used mainly for land drainage, and as a water supply.

The canal begins its journey at Firepool Lock in Taunton. The other side of the lock is the River Tone. Winding its way towards Bridgwater, the canal runs alongside the railway line until it approaches Higher and Maunsel locks, each lowering the canal level by 5 ft. The next lock, King's Lock, is met at North Newton, and a mile further on, the Standard Lock is reached.

Having passed under the swingbridge at Fordgate, the canal passes under the final swingbridge at Somerset Bridge, before entering Bridgwater at Hamp. Here, a weir allows the excess water to run into the River Parrett, alongside of which the canal flows for part of its course. Having passed through Bridgwater the canal reaches its destination at Bridgwater Docks, which it enters via a lock.

In most places the canal is between 1 - 2 metres deep and it is known for its excellent coarse fishing. Species found are roach, bream, tench, rudd, perch and pike. A major water supply is afford at Bridgwater. Up to 18 megalitres per day may be pumped from the canal under certain conditions to the nearby Durleigh Reservoir, where it is treated for public supply.

WATERCOURSE: 07

BRISTOL AVON

National Rivers Authority Wessex Region

NRA

The River Avon has two sources, starting life as two separate rivers, the Sherston Avon and Tetbury Avon. Both are important trout rivers, with good quality roach and perch also present. At Malmesbury these two headwaters join to form the River Avon proper. Between Malmesbury and Chippenham the river flows in a wide valley, crossed by two major railways and one motorway, and passes the remains of the Wiltshire and Berkshire Canal. From Malmesbury to Dauntsey coarse fishing on the river improves, and the stretch of river between Chippenham and Bath provides good fishing. Reaching Chippenham, the River Avon flows under a single span road bridge, where a river channel and automatic gates constructed after the 1960's floods controls the water level.

The section between Chippenham and Staverton flows through a broad plain and apart from some ponds at Melksham, where more control gates are found, the river meanders through a pastoral setting. A mile or so below Bradford On Avon, the Kennet and Avon Canal crosses the river via an aquaduct, recrossing the Avon further downstream at Limpley Stoke. At the Roman city of Bath (Aqua Sulis), the famed hot spring waters flow out into the Avon below the Pulteney Weir. Pulteney Weir represents the highest navigable point in the river and a half mile below the weir is the entrance to the Kennet and Avon Canal.

Three miles outside Bath, Saltford and its series of locks is reached. The rivers course here is very popular, and the traffic on this stretch is heavy. Further downstream, Keynsham is the highest part of the river that is tidal. During the twice monthly spring tides, salt water can be found in the river up to this point. Below Keynsham Weir, the River Chew flows into the Avon. At Netham, the river splits, and provides flow to the Feeder Canal supplying Bristol's Floating Harbour protected from tidal influence and where in addition to watersports, coarse fishing is available. Reaching the Avon Gorge (fully tidal, with a range of some forty feet) the river flows under the Clifton Suspension Bridge, around Horseshoe Bend and into Avonmouth Docks before entering the Severn Estuary.

The two source rivers of the Avon are of 1A (Sherston Avon) and 1B (Tetbury Avon) class. The 1B standard continues downstream to Chippenham, apart from a short stretch of 2A quality where the Sutton Benger Brook enters. The river then alternates between 2B and 2A as it flow past Melksham and nearby Trowbridge. This alternation continues until the Box Brook joins it, before Bath,and the river reverts to a Class 1B quality which it retains until it becomes tidal at Bristol.

WATERCOURSE: 07

BRISTOL AVON

National Rivers Authority Wessex Region

During its 75 mile course the River Avon flows through two cities, six towns, and serves as a water source to a more than a million people. On the course of the River Avon there are two fish farms, at Dauntsey, and at Saltford (stock ponds for Wessex Water Plc). Water for public supply purposes is abstracted from the river at Monkton Combe. Except for public supply purposes, a total of 3500 megalitres of water are licensed to be abstracted per year from the River Avon. This water is used by industry and agriculture. Major Sewage Treatment Works that discharge directly into the River Avon can be found at Bradford-on-Avon, Didmarton, Great Somerford, Keynsham, Lacock, Malmesbury, Saltford, Sherston, Tetbury and Winsley.

At certain places along the Avon flood defence schemes have been built due to the occurrence of four extensive flooding incidents in 1925, 1932, 1960 and 1968. During these, most of the major towns along the river were affected from Malmesbury to Bath. In the years 1925, 1932 and 1960 flooding was due to continuous heavy rains, in 1968, 170 mm of rain during thunderstorms wreaked havoc, and the resulting floods caused three deaths and extensive damage to property. Because of these incidents several schemes were started in the late fifties and sixties at:

- Melksham: 1958.
- Chippenham: 1962.
- Bath: 1964 - 74.

The Bath Flood Prevention Scheme consisted of the widening, deepening and straightening of the River Avon, the construction of Pulteney Weir and sluice gates, the reconstruction of the Kennet and Avon Canal entry locks, and the replacement of the 'Old Bridge' by Churchill Bridge. These improvements now allow flows of 31,500 million litres (7,500 million gallons) per day without flooding the city.

The River Avon was an important feature in the region's prominence in Britain's wool trade in the 15th and 16th centuries. Structures ponded the river and created mill streams in several locations. These structures have been replaced by new ones retaining historic levels, but reducing the obstruction to flood flow.

WATERCOURSE: 08

RIVER BRUE

National Rivers Authority Wessex Region

NRA

From its source, about 5 miles East of Bruton, the River Brue flows through the village of South Brewham and then through Bruton itself. In these initial stages where water quality is 1B, the Brue is a trout fishery, with coarse fishing becoming common from Glastonbury, where quality drops to 2A, and a number of weirs provide deeper water.

From Bruton, the river runs almost parallel to the railway line, passing to the north of Castle Cary, after which it is joined by the River Alham. To the south of Glastonbury the river drains the Kennard and South Moors, before passing on to Street. At this stage along its course, the river water is used for industrial abstractions at three places: another two abstractions being at East Huntspill.

From Street, the Brue passes Meare and flows through Tadham and Mark Moors, joining the River Sheppey and North Drain, before going under the M5 motorway and through Highbridge, where it becomes tidal. The River Brue then enters the Parrett Estuary and on through Steart mudflats. During its course, from source to mouth, the river falls approximately 180 metres.

Major Sewage Treatment Works discharging into the Brue are at Ansford, Bruton, Butleigh and Lydford.

WATERCOURSE: 09

RIVER CAM

National Rivers Authority Wessex Region

NRA

The River Cam is a tributary of the River Yeo, near Yeovilton, Somerset. It has a catchment area of 45 sq. km and flows through six villages before joining the Yeo. Some 50 properties and public buildings lie within the River Cam's flood risk area many of which have been affected in recent years by several major floods due to the rivers rapid response to heavy rainfall.

A flood alleviation scheme costing £200, 000 was carried out in the 1980's and provides channel improvements and flood defences through Queen Camel, West Camel and Bridgehampton.

The design philosophy for this scheme was developed following an extensive survey identifying important landscape features and wildlife habitats, flora and fauna. The principle adopted was to:

- Produce minimum change wherever possible, particularly through villages.
- Channel improvements from one bank only leaving the other bank untouched.
- Use of natural stone in flood walls to blend with the landscape of these traditional villages.
- Conservation of natural features and habitats with enhancement wherever possible.

WATERCOURSE: 10

RIVER PARRETT

National Rivers Authority Wessex Region

NRA

The River Parrett rises in West Dorset near Chedington, and is preserved for trout fishing up to Petherton Bridge, where weirs and hatches create the deepness of water much loved by the wide range of coarse fish in the river. Water quality until the river meets the River Isle varies between 2B, 2A and 1B standard, which is maintained for much of the rest of the rivers meanderings.

Further downstream at Oath Sluice, the river becomes tidal, but just prior to this, a relief for the river cuts across the levels to King's Sedgemoor Drain. At Burrowbridge, the River Tone from Exmoor and Taunton joins the Parrett before passing under the M5 motorway, and enters Bridgwater, it meets the Bridgwater and Taunton Canal. From hereon the Parrett becomes estuarine, passing by Combwich, before entering the Bristol Channel near Burnham on Sea.

Whilst there are no major industrial abstractions from the Parrett nor any public supply abstractions major sewage treatment works discharge into the river at Chilton Trinity, Langport, West Huntspill and South Perrot.

WATERCOURSE: 11

RIVER PIDDLE

National Rivers Authority Wessex Region

NRA

The course of the River Piddle at Alton Pancras falls 122 metres as it travels 40 km to Poole Harbour. From its source, to Poole Harbour, the river, used as a salmonid fishery is of class A1 standard. Supplied by major springs at Alton Pancras the river flows through Piddletrenthide and Piddlehinton where further springs and winterbourne flows increase the flow of the crystal clear water seen at Puddletown. Sections of river above this point have been known to dry up in very warm and dry summers. From here the river passes through Athelhampton, where the Devils Brook from Dewlish and Chesilbourne, joins it.

Additional water comes from the Bere stream which it joins after passing through Affpuddle and Briantspuddle, before flowing into Poole Harbour, north of Wareham.

This top quality river supports an excellent salmon and trout fishery, much prized by anglers.

Treated discharges into this river include fish farm effluents (which abstract river water, use it and return it), and sewage works at Piddlehinton, Puddletown and Wareham.

Other activities which take place in the river catchment include farming, watercress production, army training, gravel and sand extraction, oil production, and abstraction of groundwater for public supply.

Interesting features include ancient watermeadow systems above Athelhampton, weir designs at Trigon with former mills, and wildlife havens in the lower reaches.

Additional reading:
History of Piddlehinton (David and Charles)

WATERCOURSE: 12

RIVER STOUR

National Rivers Authority Wessex Region

NRA

The Stour rises as springs known as Six Wells at Stourhead, Stourton. The 1B quality of the water, is maintained throughout much of its course and although there is a small run of salmon and sea trout in the lower reaches, it is as a coarse fishery that the Stour makes its mark its having good stocks of Roach, Chub and Dace with Barbel and Bream in the lower reaches.

Between its source and its mouth at Christchurch, there is a drop of 150 metres. From Gillingham, meeting the Cale, and the Lydden en route, and on to Sturminster Newton, the river crosses to Blandford Forum. The river then turns eastwards and as the conurbation of Poole and Bournemouth is reached the water quality drops slightly to 2A. At Wimborne Minster the River Allen joins the Stour, which then continues onwards to join the Avon in Christchurch Harbour.

Its importance as a fishery has given rise to a number of fish farms all along the Stour, these being found at Mere, Zeals, Bourton, Cann, Winterbourne Haughton, Sturminster Marshall and Wimborne Minster. Abstractions of water occur at two points in the river, for industrial cooling and processing, and for public supply.

Major sewage treatment works discharge directly into the Stour at ten places throughout its course, but only one trade effluent discharge to the river is licenced, this being cooling waters from an engineering works.

In past years serious flooding by the Stour has necessitated the carrying out of flood prevention schemes. In 1894, intense rainfall caused flooding at Wimborne, Sturminster Newton, Gillingham, and Motcombe. The Stour caused flooding yet again in July 1917 when an impounding dam upstream of Gasper Mill was breached. Bridges at several villages were washed away and in Gillingham, low lying properties were flooded to depths of 1.5 metres with water even flowing over the railway embankment.

The river drains an intensive dairy farming area, some 800 dairy farms are situated within this catchment. All farms are regularly visited by Water Quality staff to ensure they have adequate facilities for the collection and disposal of liquid farm waste.

The main tributaries that drain the farming area are the Rivers Lydden, Lodden, Cale, Develish, Caundle Brook and Manston Brook. The lower reaches include the Iwerne, the Tarrant, Allen, Moors River and North Winterbourne.

Shallow wells in the gravels at Longham, north of Bournemouth yield a potable drinking water supply for much of the conurbation of Bournemouth.

RIVER STOUR

National Rivers Authority Wessex Region

Activities within the catchment other than those mentioned earlier include agriculture, brewing, gravel abstraction, watercress production, milk processing (and cheese production) and light engineering.

Many parts of the catchment are in the Areas of Outstanding Natural Beauty and contain Sites of Specific Scientific Interest (SSSI's) and tourism is a major industry, generating problems associated with domestic sewage disposal.

WATERCOURSE: 13

RIVER TONE

National Rivers Authority Wessex Region

NRA

The source of the River Tone is in the Brendon Hills, near Raleighs Cross. Between this, and its confluence with the Parrett, the River Tone falls about 370 metres . Downstream of its origin, the Tone enters Clatworthy Reservoir. From here to Taunton can be found some twenty miles of fast flowing trout river and where the water deepens, grayling, dace and roach make their appearance. However, the further away from its source the river flows, the progressively lower the quality of the water gets.

From the outfall of Clatworthy reservoir, and past its only fish farm, the Tone runs south towards village of Greenham. It then does a U-turn, heading north for a short stretch, before altering direction again, turning east. The Tone skirts to the northern side of Wellington where water is abstracted for cooling and processing purposes. It then passes by Bradford-on-Tone and Norton Fitzwarren, before entering the county town of Taunton.

From Taunton, passing beneath the M5 motorway, the river flows past Creech St. Michael, and becomes tidal at New Bridge before joining the River Parrett at Burrow Bridge. From Bathpool to this point in the river is typically coarse,with species found being roach, carp, bream, tench and pike. Water quality in the River Tone is variable, the standard lowering progressively the further it becomes from its origin. Up until Firepool and Ham, quality is predominantly IB with a stretch of IA. From here onward, quality goes from 2B to 3. Major sewage treatment works can be found discharging into the River Tone at Tone Bridge, Wellington, Taunton, Sandylands, Nynehead and Bradford-on-Tone.

WATERCOURSE: 14

RIVER WYLYE

National Rivers Authority Wessex Region

NRA

The River Wylye, a major tributary of the Hampshire Avon draining the south west area of Salisbury Plain, is a trout fishery of the highest quality as demonstrated by its water quality which, apart from a short stretch, is class 1A. For approximately 5 km below the Warminster sewage treatment works the river water quality varies between 1B and 2B but the works are, at present, being uprated to produce a better quality effluent to maintain a class 1A river.

Between its source and where it enters the River Nadder in Salisbury, the River Wylye falls some 120m.

Arising at Kilmington it flows eastwards to Kingston Deverill, turning northward, to skirt the southside of Warminster. From here, it follows the Wylye Valley, past the village of Wylye itself, and is joined by the River Till before turning southwards. Between Wilton and Salisbury the Wylye flows into the River Nadder, which in turn, eventually enters the Hampshire Avon.

The high quality of the water makes the Wylye an ideal fish farming river and two major fish farms, growing trout and salmon, can be found at Longbridge Deverill and Bishopstrow. The high quality of the ground water in the catchment is suitable for potable water supplies and there are two major borehole sources at Brixton Deverill and Chitterne. Ground water is also suitable for growing cress and there are large cressbeds at Hill Deverill. The main farming activity in the catchment is arable with a few sheep farms on the chalk downs. At Wilton there is a well known carpet manufacturer who discharge their trade effluent to the foul sewer for treatment at Salisbury sewage treatment works. The carpet factory discharge uncontaminated cooling water into the river which also receives discharges of treated sewage effluent at Warminster and South Newton.

WATERCOURSE: 15

RIVER YEO

National Rivers Authority Wessex Region

NRA

From its origin at Seven Sisters Well, near Charlton Horethorne, this trout and coarse fishery, falls approximately 100 metres to its confluence with the River Parrett. Water quality throughout varies from 2A at source, to 1B past Yeovil, with only a short stretch at Goathill being class 3.

The Yeo runs in a southerly direction to Milborne Port and from thereon, to Sherborne Lake. This was reclaimed during the 1970's, after having been silted up and is used for controlling the river level.

The River Yeo then skirts the south side of Sherborne and is joined by the River Wriggle and Sutton Stream before reaching Yeovil. The river, flowing northwest past Yeovilton airfield, meets the River Cam, and the Roman town of Ilchester, before joining the River Parrett to the south of Langport.

WATERCOURSE: 16

SOMERSET FROME

National Rivers Authority Wessex Region

NRA

A main tributary of the Bristol Avon, this river and its water quality of 2A/2B standard, provides ideal conditions for trout besides being an important coarse fishery, with species such as Barbel, Bream, Carp, Eel, Perch, Pike and Tench.

Arising near Witham Friary it flows northeastwards to the town of Frome, where it is joined by the River Mells before turning northwards. Downstream of Rode, the river forms the county boundary between Somerset and Wiltshire, leaving it near Farleigh Hungerford for Freshford where it flows into the River Avon. As well as having two fish farms, the Frome receives discharges from sewage works at Rode, Beckington and Frome, and trade effluents eg cooling waters, boiler blowdown water, and treated dairy effluent.

The Frome takes the majority of the high runoff from the Mendips, and Frome Town Centre used to flood on frequent occasions.

Between 1954 and 1982, the channel through the centre was widened and deepened, and except for annual flooding of old Mill buildings and roads at Wallbridge, south of the town, significant flood flows pass through the centre without causing any damage.

Since Medieval times, the Frome's energy has been used by man via weirs and sluices throughout the River's length, and all these structures have been improved, retaining water levels, but reducing the obstruction to flood flow.

Five sewage treatment works discharge into the River Frome, Corsley, Frome, Beckington, Rode and Westwood, between them serving a population of approximately 50,000 people. In addition, the River Mells which enters the Somerset Frome just below Frome, conveys treated sewage effluent from the Somerset Frome from the villages of Gurney Slade, Stoke St Michael, Holcombe, Coleford, Leigh-on-Mendip, Mells, Upton Noble, Nunney and Cranmore, additional population of approximately 15,000 people. As well as these treated effluents, there is a large volume of industrial discharge into the River Frome from Staplemead Creamery. This discharge is of treated effluent arising from their various dairy product manufacturing processes.

The River Frome currently has a water quality on the modified river quality classification scheme of 2A upstream from Frome and 1B downstream from Frome.

WATERCOURSE: 17

BRISTOL FROME

National Rivers Authority Wessex Region

NRA

The Frome, arising at Dodington, is predominantly a coarse fishery, with brown trout joining species such as perch and roach. Between its source and Chipping Sodbury the water is of 1B class, which varies little for the rest of the rivers course. From Doddington the Frome flows through Chipping Sodbury and Yate, before the Ladden Brook enters upstream of Frampton Cotterell. The river then passes Winterbourne, flows under the M4 motorway and enters Mangotsfield and Bristol. At Eastville the river is culverted under the city to the Floating Dock.

Fear of flooding of the commercial centre of Bristol led to the construction of the Northern Stormwater Interceptor under Bristol built between 1951 and 1962. This tunnel can divert a proportion of flood flow from Eastville direct to the River Avon about 1 km downstream of the Clifton Suspension Bridge.

Proposals for significant increases in development draining to the River Frome led to works completed in 1986 to increase the capacity of the culverts under the Broadmead Centre, and the commissioning in 1982 of a large detention reservoir at Tubbs Bottom to store increased runoff from development in the Yate and Chipping Sodbury area.

Further changes in proposed development patterns have led to a current remodelling of the whole catchment.

WATERCOURSE: 18

DORSET FROME

National Rivers Authority Wessex Region

NRA

From its source in Evershot in West Dorset, the Frome falls about 160 km as it travels 60 km to its entry into Poole Harbour, east of Wareham. Over the majority of its length the river flows over chalk which predominantly controls the rivers discharge. The river is of very high, A1 Class quality providing the angler with salmon and trout fishing in its lower reaches, and limited coarse fishing. At Bradford Peverell, Dorchester, Evershot, Maiden Newton and Wool, sewage treatment works discharge into the Frome. There are also fish farms using the river water along its length.

A couple of miles southeast of its source the river meets a railway line, along which it flows until it reaches Maiden Newton. Here, the River Hooke enters the Frome and continues along its valley, following the A37 mainroad to the roman town of Dorchester where it meets the River Cerne and Sydling. On leaving Dorchester the River Frome alters its course to head due east, and meanders across a wide area of relatively flat tertiary gravel valley, passing Wool, and eventually reaching its destination at Poole Harbour.

The uses of water in this catchment includes fish farming, watercress production, abstraction for gravel washing and agricultural purposes. Other activities in the catchment include army training, oil production, gravel and ball clay extraction and farming.

An interesting feature is the ancient watermeadow system, with mills in the upper reaches. The lower end of the river at Wareham is used for amenity purposes with the wide Wareham Channel providing safe mooring for yachts.

WATERCOURSE: 19

WEST DORSET RIVERS

National Rivers Authority Wessex Region

NRA

The beautiful undulating countryside of West Dorset, created by erosion of Jurassic rock formations, contains fast flowing rivers which drain large steeply sloping areas. The River Char drains the catchment to the north and east of Charmouth. The river is of 1B quality and is susceptible to flooding, especially in its lower reaches. In May 1980 there was serious flooding in Lower Charmouth, which was caused by heavy rainfall. The river is a fishery of minor importance and does not have uses other than for stock watering.

The River Brit rises from springs to the north and west of Beaminster, and travels south through Bridport to the sea at West Bay. A major flood alleviation scheme for Bridport and the West Bay area will be completed in 1990. Just north of Bridport there is an emergency drinking water source.

Both the catchments of the Char and the Brit are intensively farmed. Pollution control is of a very high standard in these areas, as there is no filtering effect for surface waters that is experienced on chalk strata.

The River Bride emerges from fast flowing springs in the Litton Cheney, Little Bredy and Long Bredy areas, and travels over impermeable soils to the sea, east of Burton Bradstock. It is a good Class 1A quality river which renders it suitable for a fish farm at Modbury, where trout and carp are produced.

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National Rivers Authority Wessex Region

NRA

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POLLUTION CONTROL

DEFINITIONS OF TERMS USED IN POLLUTION CONTROL

National Rivers Authority Wessex Region

NRA

FORMAL SAMPLES/TRIPARTITE SAMPLES

When a sample of a polluting discharge is taken with the view to prosecution/warning action, the procedure is as follows:

A bulk sample of the effluent is taken and divided into three 1 1 bottles in the presence of the polluter. It is explained to the polluter that one sample will be taken for analysis at the laboratory, one retained for reference and the third is given to the discharger for his own purposes. This procedure is laid down in section 113 of the Water Resources Act, 1963. Formal and tripartite samples are one and the same thing.

INTERIM CONSENTS

When COPA 11 came into force there were numerous STW discharges which failed to meet their newly stringent consent conditions. A period of grace was granted for Water Authorities to 'put their house in order'. Interim consents were issued with relaxed standards on the understanding that limits would, in a reasonable time period, be tightened to a realistic level to protect receiving waters.

TIME LIMITED CONSENTS

Consents which are operative only over a fixed time period, after which time they must be renewed or they lapse.

RELAXED CONSENT

These are normally valid for a limited period, with conditions relaxed to allow compliance during a period of improvement works until the consent limit cna once again be tightened.

DEEMED CONSENTS

- Are applicable to unconsented discharges which are a continuation of a previous discharge lawfully made before April 30th 1974.

- On receipt of application, the authority was deemed to have given consent applied for unconditionally.

- a) until the authority gave consent unconditionally: or
- b) if refused to give consent or gave it subject to conditions, until expiration of 3 months from date when the authority served notice on applicant: or
- c) if in that period, the applicant appealed to the Secretary of State against decision, until the determination of that appeal.

DESCRIPTIVE CONSENTS

A descriptive consent can be issued if the following conditions are satisfied:

- Population served by STW is <250 people.
- Load to the works consists of completely domestic sewage (ie no trade effluent).
- There is adequate dilution by the river.
- There is no adverse effect on the watercourse (ie chemical and biological quality are unaffected).
- The works is satisfactorily maintained and operated.

AGRICULTURAL POLLUTION

National Rivers Authority Wessex Region

NRA

Pollution of waters arising from agricultural sources has gained more prominence in recent years. This is in part linked to the introduction of modern farm methods and the trend towards the intensification of stock on relatively small land holdings. In some parts of the United Kingdom and particularly the West, whole river catchments have become seriously affected by farm drainage such that river waters are no longer suitable and available for use as a source of water supply and as fisheries. Much of this category of river pollution arises from accidental discharges of farm waste. Regular effluents from farms have not normally been permitted by the National Rivers Authority or its predecessors.

DAIRY FARMING

Dairy farms are traditionally regarded as being the most likely source of pollution from agricultural activities. They tend to use larger volumes of water than other farming enterprises and produce large amounts of polluting organic waste. This is in the form of slurry from cattle housing and yards, 'brown water' mainly derived from rain water falling on scraped yards and dairy washings.

Slurry is some 100 times stronger that domestic sewage and comparatively speaking a herd of 100 dairy cows is the equivalent of a large village of some 400 houses in terms of organic waste produced.

Where surface water from roofs and clean yards is not separated from slurry, the volume of waste handled by the dairy farmer is subsequently greater and the problem of dealing with it exacerbated.

Low rate irrigation systems may be used to dispose of brown water and dairy washings. If safe daily disposal is not possible it may be necessary to provide above ground tanks or lagoons to store slurry over the winter months.

If a storage system fails, or the appropriate safeguards are not taken when spreading slurry the effects on the receiving watercourses can be catastrophic.

During the spring and summer on a typical dairy farm, hundreds of tones of grass will be made into silage in order to provide winter feed. The process produces an effluent which, although not toxic (cows like to drink it), is highly polluting and may have an oxygen demand of up to 200 times that of raw sewage.

The effluent should be collected and contained separately by the farmer and spread on the land after being diluted with water. The leakage of even a relatively small volume of silage effluent can have a devastating effect on a watercourse and the NRA takes a firm line with offenders.

AGRICULTURAL POLLUTION

National Rivers Authority Wessex Region

PIG FARMING

Pig farms produce highly orgainic waste in much the same way as dairy farms. An additional complication is that piggeries are often set up on very small holdings of land and without an adequate area on which to spread the waste arising from the enterprise.

FISH FARMING

There are now over 70 fish farms in the Wessex Region, each using large quantities of water each day. Although water is returned to the river from which it came, it is often of a poorer quality. This can lead to the deterioration of the general fishing of a river. Biologically active chemicals which benefit fish by preventing disease and improving growth, may also be present in the returned water. Therefore the levels of these chemicals must be monitored and restricted. Discharges from fish farms require Consent to Discharge and from April 1991 will require an abstraction licence for removing water from the river.

BEEF AND POULTRY FARMING

Beef herds and poultry houses are not regarded as posing such a grave risk to the aquatic environment as other farming enterprises. However, care must still be taken in the disposal of bedding and litter from these sites.

POLLUTION: 03

ORGANIC POLLUTION
NOT INCLUDING TOXIC ORGANIC CHEMICALS

National Rivers Authority Wessex Region

NRA

The most common source of organic pollution is the discharge of sewage effluents. Other common sources are industrial and agricultural discharges.

Up to a limit, rivers can absorb organic material as their biological systems can adjust to allow for the greater supply of food. If a discharge is accepted and given a Consent under the Water Act 1989, the discharge will be given certain conditions, including flow and chemical parameter limits. These limits will be set so that the discharge does not cause an adverse effect upon the receiving watercourse at any time.

Elements present in discharges of domestic sewage effluent can be assimilated in the receiving body of water if there is satisfactory dilution available.

Other organic discharges which could be included under this heading would be food processing factories, abattoirs etc where there are no toxic elements.

POLLUTION: 04

SEWAGE TREATMENT WORKS

National Rivers Authority Wessex Region

NRA

The majority of the treatment works are designed to produce an effluent quality as good as that suggested by the Royal Commission on Sewage Disposal in 1912 (20 milligrammes per litre of BOD [1], and 30 milligrammes per litre of suspended solids).

Where adequate dilution in the receiving watercourse is available some relaxation of the quality standard may be allowed, and conversely where the river requirements are more sensitive a more stringent limit is often imposed.

In order to set the consent standard for each treatment works the NRA considers the volume of sewage, quality of sewage and the type of treatment works required, as well as the suitability of the receiving watercourse.

VOLUME

An accurate estimate of volume is required at the design stage of a sewage works. Some of the older sewerage systems, contain both foul water and surface water from highways etc. Modern systems separate foul sewage from surface flows.

Most sewage works are designed to treat 3 x Dry Weather Flow [2]. Flow in excess of this are diverted to storm-tanks which usually hold up to 6 x DWF for two hours before overflowing. The overflow may direct to the river, but after at least 2 hours settlement. Occasionally, flows in excess of 6 x DWF can be experienced and excess flows may be directed to the river without any settlement. For new schemes, the NRA encourages all sewage to be fully treated.

Some sewage works, which discharge direct to estuaries or the sea provide primary settlement of the sewage eg Avonmouth and Thornbury. Most works provide primary settlement, biological treatment, secondary settlement and occasionally, tertiary treatment.

On the South Coast there are currently outfalls at Swanage, Lulworth, Weymouth, West Bay and Charmouth. These outfalls are monitored by the NRA, as well as the bacteriological effects of the discharge on adjacent bathing beaches.

In some areas trade effluents constitute a large proportion of the sewage. All significant trade effluents are controlled and monitored by the water services company and this may include a volume restriction. These trade effluents are not directly the responsibility of the NRA.

[1] *BOD - Biochemical Oxygen Demand* [2] *DWF - Dry Weather Flow*

SEWAGE TREATMENT WORKS

National Rivers Authority Wessex Region

QUALITY

The quality of domestic sewage is fairly predictable and is dependent on domestic water usage and also the quantity of the infiltration water. The strength of the sewage is usually expressed in terms of BOD and suspended solids loading. These figures are used to calculate the capacity of the sewage works.

The inputs from industrial effluent can have a strong influence on the design and performance of a sewage works. High levels of certain substances can adversely affect the biological treatment stage, and strongly acidic effluents can also have serious effect on the structure of the pipes leading to the sewage works. Although a significant proportion of toxic substances are removed during treatment, the final effluent can still contain harmful quantities to aquatic life if tight control is not maintained.

TYPES OF TREATMENT WORKS

Conventional Works: Employing the use of percolating filters, and requiring comparatively little technical control. These work better in the summer months, produce less sludge and also cope well with difficult industrial sewage. Such systems harness natural treatment processes, but require large areas of land. The word 'filter' is really a misnoma, as it is not a filtering method of treatment, but are where bacteria and fungi are harnesses to naturally treat the polluting matter in this sewage.

Activate Sludge Plants: These utilise various designs of oxidation ditches or tanks, taking up much less room, and requiring only a small head loss through the works. This treatment system involves air or oxygen being blown into tanks of sewage. After some two hours retention, the contents are allowed to settle, forming a supernatant clear and treated effluent, and a flocculent sludge which is returned to the inlet of the activated sludge tank. This sludge contains bacteria and protozoa which feed on sewage in an aerated atmostphere.

Package Plants: Smaller units, comprising variations of the above methods, are now manufactured for small hamlets or single dwellings. Discharge of effluents from all these systems require consent from the NRA, as outlined in the Water Act 1989.

SEWAGE SLUDGE DISPOSAL

National Rivers Authority Wessex Region

NRA

Although there is some loss of solid material during the treatment process, by gas production, a high proportion of the solid waste is remains. This has to be disposed of in a satisfactory manner and the following options can be employed.

DISPOSAL TO LAND

Sewage treatment is a useful fertilizer although inorganic supplements may be required. This sludge improves the structure of the soil and provides phosphate and nitrogen. In prolonged dry spells it can also be a valuable source of fertilizer for crops.

Use as a fertilizer for agricultural land is a common method of disposal for purely domestic sludge. Where trade effluents form part of the sewage, more care has to be taken with regard to the concentration of toxic metals in the sludge.

The Ministry of Agriculture, Fisheries and Food has recommended limits for levels of metals in soils, particularly that of cadmium, chromium, copper, nickel and lead.

LANDFILL

Sludge can be disposed of into landfill sites along with other waste products, although it is one of the least common. This would be one of the preferred methods of disposal for sludges with concentrations of metals higher than those suitable for disposal to land. It is subject to control by waste disposal authorities, usually county councils.

In order to improve the handling of the sludge and reduce the volume it may be concentrated by one of several techniques, such as belt pressing, vacuum filtration, liming or drying.

DIGESTION

This is achieved by maintaining the sludge at an elevated temperature, usually 80 - 95 °C in a tank. This is not only reduces the organic content and amounts of gas produced eg methane, but also the noxious state of the sludge. Digestion of sludge kills the pathogens and renders it more suitable for agricultural use.

DISPOSAL AT SEA

This method of disposal is restricted to areas with suitable access to sea. The sludge is usually disposed of into deep waters by specially adapted vessels. This disposal is licenced by MAFF. Levels of metals and EC blacklist substances are of primary concern. Some sludge from the Bristol area is disposed of by this method.

POLLUTION: 06

SEPTIC TANKS

National Rivers Authority Wessex Region

NRA

Many properties are still without mains drainage. These are usually rural or urban fringe locations. Also, there are an increasing number of building conversions carried out in rural areas, which invariably require an alternative means of sewage disposal.

Some older septic tank installations are found to have direct connections to surface water ditches and streams and in a few cases some cesspools have been found with holes knocked out, allowing the contents to discharge to watercourses. The present requirement for cesspools are that they be totally sealed, and that septic tank effluent be disposed of by means of sub-surface irrigation pipes.

Some developers have provided package treatment plants for residential developments. These are required to produce an effluent quality suitable for direct discharge to a watercourse.

POLLUTION: 07

STORM OVERFLOWS / CRUDE OUTFALLS

National Rivers Authority Wessex Region

NRA

The sewerage systems in many large towns and cities are very old. These sewers generally carry a combination of foul sewage and surface water from highways, and often have overflows which discharge directly to into rivers.

When new sewage works were constructed problems dealing with enormous increases in volume during heavy rainfall developed. Designing a works to deal with these high flows would be expensive and during dry weather the works would be significantly over capacity causing operational problems. In order to resolve these design problems overflows were built into the system diverting flows to rivers during wet weather thus avoiding overloading the sewage works during heavy rainfall.

Where development takes place it is normal practice to uprate the sewer capacity to cope with the additional flows. Seperate sewerage systems for foul and surface water are also laid.

However, in a few cases populations have increased above the expected levels resulting in the capacity of the existing sewers being exceeded, causing flooding to property. To relieve the problem in these exceptional circumstances overflows have been incorporated into the sewerage system as a temporary measure until the sewers can be uprated.

The combined effect of several overflows operating simultaneously could have a noticeable polluting effect despite them discharging a semi-dilute sewage. This situation is very rare but does occur during high intensity rainfall largely in industrialised towns and cities. Summer storms can result in significant discharges of dilute sewage to rivers as overflows tend to occur before the flow in the river has responded to the rainfall. Many overflows in the summer months occur due to blocked sewers caused by debris settling out in the sewers and restricting the flow through the system. This debris would normally be removed during routine maintenance by the local authority.

POLLUTION: 07

STORM OVERFLOWS/CRUDE OUTFALLS

National Rivers Authority Wessex Region

Crude sewage outlets to estuaries and the sea still exist in some parts of the country. However, on the Dorset coast there are outfalls at West Bay, Weymouth and Swanage. The West Bay system was uprated about 1980 and the Weymouth system was installed in the mid 1980's. Both have long sea outfalls which cause no environmental health risks on the beaches. The disposal of sewage at Swanage is at present being thoroughly investigated by carrying out tests into tidal flows etc to see if a suitable site is available for a long sea outf all to be considered or if an inland treatment works is required. In all three situations the sewage is screened so that only the liquid phase, and the finer solids are discharged to the sea. All the other towns along the Dorset coast have inland sewage treatment works.

The Government are actively pursuing the recently privatised Water Company's to eliminate all unsatisfactory discharges of sewage to the sea by 1998.

CONSENTS AND SAMPLING

National Rivers Authority Wessex Region

NRA

The idea of controlling discharges by consent was first introduced by the Rivers (Prevention of Pollution) Act 1951. This allowed control of new discharges of sewage and trade effluents to a stream, river, or inland water.

Discharges existing prior to 1951 and new discharges to tidal waters were brought under control by the Rivers (Prevention of Pollution) Act 1961, and discharges to underground strata were controlled by the Water Resources Act 1963.

The Control of Pollution Act 1974 embodied control of all types of discharges, including surface water, and this control is now exercised through the Water Act 1989.

The NRA is able to attach conditions to consents relating to their nature and composition, volume and maximum rate of discharge. Any application should not be unreasonably withheld by the NRA and a person who does not agree with the NRA's decision may appeal to the Secretary of State for the Environment. Failure to obtain a consent is also an offence. Compliance is monitored by analysis of samples taken at intervals depending on the significance of the discharge. The results of analyses are held on a register which is open to the public, along with details of the consents.

Quality restrictions imposed on the consents are arrived at after consideration of the environmental quality objective for the receiving water. In order to meet the objective a standard is set taking into account the dilution available and any other nearby discharges or abstractions. Computer models are used to calculate concentration limits for discharge consents. These produce an accurate prediction once the correct base data has been fed into the model.

Samples of consented discharges need to be taken in order to check that they comply with the consent conditions. It is also necessary to check that the quality objectives for rivers are being met. This is done by carrying out both routine and special surveys.

ROUTINE SAMPLING

Routine sampling is carried out at various sites on the river network at the points of discharge to rivers. The frequency of sampling varies from weekly to quarterly. Monitoring of other bodies of water such as the Bristol Docks and the Severn Estuary are carried out by special surveys which utilise boats and helicopters in order to obtain representative samples. The analysis of all routine samples is now carried out at a central laboratory under contract and an automated system of analysis is used to ensure confidentiality.

POLLUTION: 09

MEASURING POLLUTION

National Rivers Authority Wessex Region

NRA

There are a number of basic ways of measuring and assessing pollution in rivers:

VISUAL INSPECTION

This is carried out by Water Quality Officers of the National Rivers Authority (NRA). Visual inspection can reveal discolouration, foaming, oil presence, the growth of sewage fungus and evidence of the condition to the flora and fauna in the watercourse under examination. Members of the public also monitor rivers in this way, their information being extremely valuable.

DISSOLVED OXYGEN

The amount of dissolved oxygen in water is of paramount importance to aquatic inhabitants.

A clean unpolluted river will contain 9.2mg/L of oxygen at 20°C. The river is then fully saturated with oxygen (100%). During the daylight/night-time cycle (diurnal cycle) the dissolved oxygen (DO) value will fluctuate naturally, due to the activity of plants as a response to daylight (photosynthesis). Fish survival is dependent on DO levels, and British river classification is currently based on DO, BOD (biological oxygen demand) and ammonia levels. Trout can normally survive in DO levels down to 60% whereas coarse fish are more tolerant to reduced amounts.

When there is no DO, the river becomes anaerobic and septic and normal river life will die. This circumstance can occur following discharges of sewage, silage liquor or farm slurry.

ANALYSIS

Laboratory analysis will reveal pollution levels within river samples. A typical analysis of a river water sample would include BOD (biological oxygen demand), suspended solids, ammonia, nitrite, nitrate, phosphate, chloride and pH.

More exotic analysis can be performed on samples for oils, metals, organic chemicals, pesticides etc.

AUTOMATIC MONITORING

Combinations of sampling machines and instruments can be used at remote sites. On pollution sensitive sites (eg. supply intakes), continuous monitoring may be done, with alarms indicating the presence of undesirable levels of pollution.

INDUSTRIAL POLLUTION

National Rivers Authority Wessex Region

NRA

The nature of industrial pollution is dependent upon the type of industries present. As the authorities are aware of the industrial processes used they are are able to monitor rivers for specific chemicals and their levels.

Many industrial processes involve the use of water, a substantial proportion of which may be incorporated into the product. Some industrial processes, particularly power generation, involve the use of water for cooling, giving rise to the need to dispose of large quantities of water at a higher temperature than that at which it was abstracted. Other processes produce wastes that contain effluent. Some large sites which discharge to surface water, have come under close scrutiny recently due to EC legislation being implemented.

Factories licensed by the NRA to dispose of their effluent to rivers, have quality limits imposed on them, which they must not exceed. Some chemicals such as cadmium, mercury and lindane, present in some industrial discharges, are highly toxic and so are greatly restricted. One danger that can arise when industries discharge, is the formation of a chemical 'cocktail' caused when effluent from different outlets mix.

Occasionally the surface water outlets from industrial premises become contaminated as a result of spillages and accidents. These can pose a serious threat to the receiving waters as they sometimes involve concentrated toxic chemicals.

Where there are only small quantities of waste water or 'trade effluent', as it is often termed, it is usually practicable to discharge these into the foul sewerage system serving the local community. The effluents are then treated with domestic sewage at the sewage works prior to disposal to a watercourse. In other cases where an adequate sewage system is not available or if the volume of waste water is too great to be treated in admixture with domestic sewage, a direct discharge from the industrial premises to a watercourse may be the only option available for disposal purposes.

TOXIC POLLUTION

The major types of toxic pollution found fall into different categories.

- Metals: lead, copper, cadmium, mercury. The main source of these chemicals is industry, but there are other sources eg agriculture.
- Non-metallic: acids, alkalis, cyanide.
- Organic: pesticides and herbicides. These materials are generally a far greater potential pollution risk than the sources of organic pollution described above.

INDUSTRIAL POLLUTION

National Rivers Authority Wessex Region

Different species of aquatic life vary greatly in their toleration of different toxic pollutants. The situation is further complicated by the fact that effluent discharges may often contain a mixture of toxic chemicals. Also, concentrations found in a particular water may be below that required to kill a particular species, but may impair its growth and efficiency, affecting its long-term survival.

Accumulation of poisons in species is also an important factor to be taken into consideration as this will transfer the poison along the food web until it might eventually be ingested by a susceptible animal which might otherwise be isolated from the material.

Detergents are present in sewage and industrial effluent. Modern detergents are biodegradable, but large concentrations can cause problems with unsightly foaming.

ACID RAIN

This is formed when chemicals, such as sulphur dioxide and nitrogen oxides in the atmosphere react to form sulphuric acid and nitric acid. This then falls as rain and ends up in streams and rivers. Acid rain has several effects on water courses.

- The water becomes more acidic.
- Fish and other wildlife may be poisoned.
- Acidic groundwater increases leaching, which allows more fertilisers to enter river systems.

THERMAL POLLUTION

Heated discharges lower oxygen concentrations and the largest source of these discharges in the UK are electricity generating stations. Other sources may be cooling waters from the brewing industry or from those that are food related.

Temperature levels can be controlled by the consenting procedure governed by the Water Act 1989. Some species of aquatic life are more tolerant of increased temperatures than others. However the appearance of such a discharge could considerably alter the structure of a community.

POLLUTION: 11

OIL POLLUTION

National Rivers Authority Wessex Region

NRA

'Oil' is a general term used to describe the presence of one of a number of hydrocarbons which are largely immiscible with water and float on its surface. Those most commonly encountered in the environment are central heating oil, waste oils from vehicles and petrol. Occasionally pollution by aviation spirit, paraffin or white spirit occurs. Oil forms a film on the surface of river and lakes and may, in sufficient quantity, reduce the ability of water to take oxygen from the atmosphere.

Wildfowl and other birds living in, or near water, affected by oil pollution, can be severely contaminated and may damage their digestive tracts as a result of preening. Oil may also result in plants becoming coated so as to impair their ability to respire and photosynthesise. A small proportion of the oil may mix directly with water and have a direct toxic effect on aquatic organisms. It can also render rivers unusable for livestock watering.

Minute quantities of oil in water may be digested by fish at fish farms following a spillage causing the bonding of fuel fractions into their flesh. The taste of this flesh is most unpleasant, and can only be removed by provision of a clean water supply.

Oil spilled in large quantities at sea may cause catastrophic damage to shorelines and marine life. The largest of these was in Alaska in 1989, when the Exxon Valdez ran aground.

AUTHORITIES RESPONSIBLE FOR DEALING WITH OIL SPILLS

On inland waters, the National Rivers Authority is responsible for dealing with oil pollution incidents. In coastal waters, the County Council Pollution Officer is responsible for carrying out remedial work whilst the National Rivers Authority has a general duty within the 3 mile limit to oversee remedial works. Within these limits the National Rivers Authority can prosecute for pollutions emanating from land based installations. In addition, the Port or Harbour Authorities have powers under the Prevention of Oil Pollution Act (1971) in their areas of responsibility.

Oil spillage from vessels at sea within British Territorial Waters is under the control of the MPCU (Marine Pollution Control Unit).

OIL POLLUTION

National Rivers Authority Wessex Region

DEALING WITH OIL SPILLS

If large quantities of oil are spilt, a small portion of the soluble components in the make up of oil can mix directly in water and have a toxic effect on organic organisms. If dispersants are used to deal with spillages, a similar effect occurs because they allow the oil to mix, rather than allowing it to remain on the surface.

Techniques for dealing with oil spills depend on the character of the lake or watercourse into which oil has been spilled. In tidal-waters, oil dispersants are exclusively used subject to MAFF approval but are not normally suitable for use in inland watercourses or near shellfish beds, because they are to some extent toxic to aquatic life. Unlike most other pollutants, oil floats and clearance methods from lakes and non-tidal watercourses take advantage of this property. Booms to entrap a slick may be formed by a number of materials, most commonly wooden planks, inflated plastic tubing or long sacks containing oil absorbent materials. Oil can then be removed using a vacuum tanker, or can be pumped into drums through an interceptor or can be selectively absorbed by materials such as powders, foams and other oliophilic materials. Once removed, the oil is usually disposed of by incineration.

POLLUTION: 12

CAUSES OF OIL POLLUTION

National Rivers Authority Wessex Region

NRA

The causes of oil pollution incidents are many and varied. A significant proportion arises from the storage of oil in above-ground tanks used for heating or fuelling of vehicles and from the ancillary pipework. The filling of such storage tanks, their inadequate bunding and fractures in underground pipelines are the most common causes of oil spills. Accidents involving vehicles carrying hydrocarbons are another source of oil pollution. These incidents can involve substantial quantities of oil in circumstances where control and handling is difficult.

Oil contamination of water draining from car parks, and industrial estates, is controlled by the use of interceptor units. These remove surface films of oil and retain them inside the unit for periodic removal. A significant number of pollution incidents involving oil occur during refuelling of storage tanks. Large losses of oil are frequently caused by ruptured bulk oil tanks and ancillary pipework. In order to reduce the risks storage tanks that are above ground should be protected by impervious banks, known as bunding.

Spillages on tidal and estuary waters are usually dealt with by the Port Authority or Harbour which has specialist vessels for dealing with it. The Marine Pollution Control Unit is involved when coastal waters are involved.

The use of oil dispersants and emulsifiers is avoided as much as possible, as oil is more difficult to contain once mixed with these. However, under certain circumstances they must be used as in road spillages where the road surface requires a final clean up to prevent the risks of skidding. The worst of the contamination can however be removed first with sand or some other absorbent material.

Where there is a high risk to birdlife, and adequate dilution is available with water, dispersants may be the preferred option but they must be carefully used as the toxic effect may be as great as that of oil. This option is usually employed with major spillages at sea, as these usually involve crude oil which is difficult to contain by other methods. Swift dispersion is possible by the use of the chemicals with wave action

In dealing with spillages of petroleum spirit, safety aspects due to the danger of explosion are given the first priority. If it can be contained by booming in an open, ventilated area, it is usually left to evaporate.

POLLUTION: 13

MARINE OIL POLLUTION

National Rivers Authority Wessex Region

NRA

Since its inception in September 1989 the National Rivers Authority has has involvement in a number of incidents involving the release of oil to tidal waters. Notable amongst these were the release of oil from the Shell Pipeline to the Mersey Estuary, and the tanker accident off the South Devon coast which resulted in the release of 1, 000 tonnes of crude oil spilling into the English Channel. Both of these incidents threw into focus the NRA's role in dealing in oil pollutions in tidal waters.

RESPONSIBILITIES

A number of organisations have responsibilities in operational and advisory capacities in response to incidents or emergencies involving oil pollution in tidal waters. Their involvement, largely depends upon statutory obligations which can be summarised as follows:

LOCAL AUTHORITIES

Local Authorities have no specific statutory duty to deal with oil pollution. However, the Local Government Act 1972, Section 138, empowers both County and District Councils to deal with emergencies and disasters. Oil emergencies are thus included and Councils have the power to incur expenditure on the amelioration of the effects of such pollution. Generally, District Councils are responsible for activities involved in beach clean up while the County Council undertakes inshore spraying of oil dispersants and co-ordinates operations which involve the efforts of more than one District Council. The County Councils area of responsibility is generally taken to be to a limit of up to one mile seaward from the high water mark.

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD (MAFF)

MAFF is responsible for administering the Food and Environment Protection Act 1985 (FEPA), and also the safeguarding of fisheries which may be threatened either by the effects of the oil itself or by the use of chemical dispersants. MAFF licenses the use, by Local Authorities and the MPCU, of approved dispersants under the provisions of FEPA.

MARINE OIL POLLUTION

National Rivers Authority Wessex Region

MARINE POLLUTION CONTROL UNIT (MPCU)

The Department of Transport, represented by the MPCU arranges Central Governments response to oil pollution at sea. The MPCU undertakes a variety of functions including:

- oil clean up at sea (as far inshore as its ships and aircraft can safely operate):
- co-ordinating the onshore response to incidents involving more than one county
- providing technical advice and guidance to Local Authorities
- maintaining stockpiles of specialised equipment for clearing oil pollution
- providing an early warning system for oil pollution.

The MPCU has rapid response targets for mobilisation of aircraft for both dispersant spraying and aerial reconnaissance and are on thirty minute standby during the day and at two hours readiness at night.

THE NATIONAL RIVERS AUTHORITY (NRA)

The NRA has responsibilities under the Water Act 1989 to safeguard the quality of controlled waters and take action against any person polluting them. 'Controlled waters' generally include offshore waters to a three mile limit.

OTHER AUTHORITIES

A number of other organisations are also involved in dealing with a marine oil pollution. The Nature Conservancy Council, the National Trust and the County Trusts for Nature Conservation provide specialist advice when Authorities do not generally have statutory duties to undertake oil clean up operations when a spillage occurs in waters under their control but will deal with spills as necessary to allow safe operation of the port. They may call upon the support of the District Councils as required.

THE ROLE OF THE NRA

The NRA does have responsibilities to deal with oil pollutions in tidal waters within the three mile limit. Historically however, the role of the NRA and its predecessors has been largely consultative and advisory rather than operational. In general the MPCU has undertaken operational responsibility for dealing with oil at sea and Local Authorities have cleaned up oil when it has reached the coast. To a large extent this follows the guidance given in the Department of the Environment Circular of 21/81; 'Oil Pollution of Beaches' which outlines the responsibilities in dealing with tidal oil pollution clean up. In that document, the Water Authorities were required to take action to protect certain vulnerable areas and advise on water pollution control aspects of waste disposal. These functions now apply to the NRA.

MARINE OIL POLLUTION

National Rivers Authority Wessex Region

Acting upon the guidance given in the Department of the Environment Circular, Local Authorities and the MPCU have become the competent Authorities to deal with such incidents. However, the NRA does provide useful back-up resources.

The organisation has a variety of boats, land-based plant and skilled staff, all of which are vital in clean-up to both MPCU and more Local Authorities on request

The NRA pays particular attention to protecting estuaries. These often support important natural communities and, on the south coast of the Wessex Region, commercial shell fisheries. Action on estuaries is especially effective since protecting a short length of inlet safeguards a very much longer length of estuarine coast behind. Other authorities many neglect estuaries in favour of beaches which perhaps engender a greater demand from the public and media for clean up effort. This was evidenced in the South Devon oil spill by Local Authorities concentrating on beaches clean up and seemingly placing estuaries on a lower priority. Three estuaries were successfully boomed by South West Region preventing ingress of oil and despoliation of a long length of coast. This action provided a good example of what the NRA can do in such circumstances.

The Wessex Region of the NRA intends to prioritise the estuaries or areas of estuary where action is required by identifying areas of high amenity, conservation or fishery value, in consultation with MAFF, the NCC and other interested parties. In addition the feasibility of booming estuaries is to be studied since such operations are difficult, if not impossible, in the tidal regimes prevalent in the Region, particularly along the Severn Estuary. In the event of an incident occurring, the equipment required to undertake these operations is available from a variety of sources including the MPCU and Oil Companies.

The prosecution of offenders in the case of oil pollution and the involvement of the NRA is ill-defined. The fact that the NRA is not a toothless watchdog in tackling oil pollution was effectively demonstrated by the Mersey oil spill and the resultant £1 million fine. This action was brought under Section 107 of the Water Act 1989, the case being heard in the Crown Court where a higher level of fine was possible. Other organisations also have powers to initiate prosecution proceedings, under Section 2 of the Prevention of Oil Pollution Act 1971. A grey area exists in deciding which organisation will bring a prosecution. A pragmatic division of responsibility for bringing such action would appear to be the location of the discharge. Any land-based discharges would fall under the jurisdiction of the NRA, whereas those originating from ship spills/leakages would be the responsibility of the Port Authorities, MPCU or other interested party. Action would however, be outside the normal area of responsibility: for example the NRA South West successfully prosecuted a company for discharging oil from a ship within a port on an occasion when the Port Authority Officer was unavailable to deal with the incident.

POLLUTION: 14

WASTE DISPOSAL BY LANDFILL

National Rivers Authority Wessex Region

NRA

1 Solid waste disposal is under the control of the County Councils. In determining the NRA's attitude to any proposed landfill operation, the primary considerations are:

- The characteristics of the site.
- The types of wastes.

2 Except for wastes which are considered to be totally 'inert', the general policy is:

- Tipping directly on aquifers is discouraged wherever possible.
- Unless satisfactory evidence can be provided that a site is suitable for the 'dilute and disperse' or 'dilute and attenuate' approaches to be satisfactorily adopted, a policy of 'contain and treat' is followed.
- In practice, the NRA takes the view that there are few geological formations encountered within the Wessex Region where 'dilute and disperse attenuate' are acceptable. Such approaches are appropriate only if it can be demonstrated that the type of flow in the aquifer or geological formations concerned is intergranular rather than through fissures. In particular, the major aquifers within Wessex are chalk, oolitic limestone and carboniferous limestone, all considered to be generally fissured and therefore unsuitable for dilution techniques.
- Containment sites must be engineered to high standards.
- The NRA requires appropriate geological and hydro-geological data to support proposals. The collection of additional data is the responsibility of the applicant, although the NRA will assist in the specification of data collection programmes.

3 Inert wastes are usually taken to include:

- Demolition, excavation and construction wastes (excluding plasterboard, paint).
- Rejected concrete blocks or concrete works.
- Uncontaminated sand (not foundry sand).

There is a range of additional waste categories which may be accepted at 'inert' waste sites depending on the specific characteristics of the site. Some of these wastes may be considered on the basis that the percentage of the total tipped volume is controlled. The NRA does not accept that waste collected in skips is inert, and therefore will not be content with a proposal to dispose of skip wastes to a dilute and disperse site on an aquifer.

WASTE DISPOSAL BY LANDFILL

National Rivers Authority Wessex Region

4 Where leacheate has been contained, the preferred disposal arrangements is to a sewage works, which requires negotiations with the Local Water Services plc.

5 Within these general principles, proposals are considered on their merits. In some instances, a trade off between the engineering and method of operation of a site and the range of wastes may be acceptable. Some 16% of the area of the Wessex Region is within aquifers which are not considered suitable for other than inert wastes. There are, however, areas of various clays strata which offer potential for containment sites.

POLLUTION: 15

POLLUTION CONTROL IN NEW DEVELOPMENTS

National Rivers Authority Wessex Region

NRA

These notes set out the responsibilities of owners or developers with respect to the requirements of the National Rivers Authority controlling new development.

FOUL DRAINAGE

- Domestic Sewage: All discharges of sewage, trade or agricultural effluent to watercourses, to underground water or to soakaway require the consent of the National Rivers Authority under the provisions of the Water Act 1989. The purpose of this control is to protect the water environment and water quality. Consent may not be given if the discharge is likely to damage the environment. If the development will create a new discharge or increase an existing discharge other than to the public sewer or to a sealed tank then applicants are advised to consult the National Rivers Authority at an early stage.

- Agricultural Waste: All slurry, silage liquors and contaminated surface water should be conveyed to a total containment system for subsequent disposal in accordance with MAFF's Code of Good Agricultural Practice or other approved method. Any discharge to a watercourse or soakaway will require formal consent.

- Industrial Waste: In general, septic tanks/soakaways are unsuitable for industrial wastes. Discharges from private treatment plants require the NRA's formal Consent to Discharge. The National Rivers Authority will need to be satisfied that the proposed system will be capable of achieving any standards they may impose.

  Where premises are to be used for the storage, handling or use of pesticides, timber treatment formulations or any other potentially toxic chemicals (e.g. solvents or materials containing cadmium or mercury), the applicants must discuss the proposal with the National Rivers Authority.

- Fish Farms: Discharges from fish farms to a watercourse require formal consent; applicants are advised to contact the National Rivers Authority at an early stage.

POLLUTION CONTROL IN NEW DEVELOPMENTS

National Rivers Authority Wessex Region

SURFACE WATER

- General: All surface water discharges to any watercourse may require the consent of the National Rivers Authority and applicants are advised to check with the National Rivers Authority.

The discharge of roof water to a soakaway does not require consent.

- Car Parking Areas: All large (40+ spaces) car parks and any heavy goods vehicle parking areas should be surfaced with an impermeable material and drained by a positive system which incorporates a suitably sized oil/petrol interceptor.

- Industrial Areas: In general, industrial areas should be positively drained to a watercourse rather than directed to a soakaway. In some locations, some form of pretreatment prior to discharge may be required. Any high risk pollution areas should be drained to either the foul drainage system or to a totally sealed containment tank for subsequent disposal. Applicants are advised to consult the National Rivers Authority at an early stage.

- Oil/Chemical Storage: All above ground bulk oil/chemical storage tanks must be fully bunded. The bund capacity should be 110% of the largest tank and there should be no working connections outside the bunded area.

LAND DRAINAGE AND FLOOD DEFENCES

- Byelaws: Any development over or within 8 metres of a statutory 'main river' or 4 metres of a statutory floodbank will require a formal Land Drainage Consent from the National Rivers Authority, under the provisions of the Land Drainage Act 1976 (this includes any discharge pipe, structure, planting or fencing).

- Flood Plains: Development or tipping which will impede the flow or result in the loss of flood storage in any flood plain will not be permitted.

- Flood Prevention/Surface Water Disposal: Development will not normally be permitted which will worsen any existing flooding problems or where the proposed development will be at risk of flooding.

- Applicants should discuss proposals for development in proximity to watercourses prior to the application for planning permission. The National Rivers Authority will be pleased to discuss and advise applicants of necessary works where appropriate.

POLLUTION CONTROL IN NEW DEVELOPMENTS

National Rivers Authority Wessex Region

WATER RESOURCES

- Abstraction: The abstraction of water from any watercourse or borehole for any use may require an Abstraction Licence from the National Rivers Authority under the provisions of the Water Act 1989. Applicants are advised to discuss proposals with the National Rivers Authority.

- Source Protection: The use of septic tanks and soakaways or any other potential pollution risk may not be permitted in a water catchment protection area.

- Impounding: The formation of ponds or lakes may require an impounding and/or abstraction licence and applicants should discuss proposal with the National Rivers Authority.

- Construction of Wells: The construction, extension or modification of equipment in wells or boreholes requires the consent of the National Rivers Authority unless for domestic use of water within the household.

FISHERIES

The introduction of fish into any waters other than a fish farm requires a licence from the National Rivers Authority under the provisions of the Salmon and Freshwater Fisheries Act 1975.

GENERAL

Where work is proposed which is covered by this note, the initial contact with the Wessex Region of the National Rivers Authority should be made to the Planning Liaison Officer at: Rivers House, East Quay, Bridgwater, TA6 4YS.

General information for other purposes should be sought from the Public Relations Officer at the same address.

POLLUTION: 151

SPECIAL REQUIREMENTS IN NEW DEVELOPMENTS

National Rivers Authority Wessex Region

NRA

In executing the works the Contractor shall take all necessary precautions to secure the efficient protection of all rivers, streams and waterways and the like together with water in underground strata against silting, erosion and pollution which may be likely to contaminate water supplies or cause injury to fish or plant life.

FISHERIES AND RECREATION

The Contractor's attention is drawn to the Water Act 1989, the Salmon and Freshwater Fisheries Act 1975 and the Wildlife and Countryside Act 1981, and he shall take all reasonable precautions to ensure that no work in any watercourse is done in such a manner as to cause unnecessary damage.

In particular, but not by way of derogation from the generality of this Clause, the Contractor:

- Shall not remove bed material for use in construction.
- Shall stockpile, keep clean and replace on completion of works any bed material necessarily removed in the course of construction.
- Shall not remove vegetation other than fallen trees from or adjacent to any watercourse unless previously agreed with the Authority.
- Shall submit to the Engineer for prior approval by the Authority his proposals for maintaining at all times the free passage of fish.
- Shall take all reasonable measures in the preparation of his programme of works to ensure that the disturbance of channels is avoided in the period from the beginning of October to the end of March.
- Shall not, without the prior consent of the Authority, remove or spray aquatic weeds in the period from the beginning of May to the end of August.

If, notwithstanding these precautions, an incident occurs which may affect these interests, the Contractor will forthwith advise the Control Room of NRA, Wessex Region.

SPECIAL REQUIREMENTS IN NEW DEVELOPMENTS

National Rivers Authority Wessex Region

POLLUTION OF WATERCOURSES

The Contractor's attention is drawn to the Rivers (Prevention of Pollution) Acts 1951-1961 and the Water Act 1989. He shall take all reasonable precautions to ensure that no polluting discharges of solids or liquids are made to any watercourse and that work carried out in any watercourse is done in such a manner as not to cause pollution.

In particular, but not by way of derogation from generality of this Clause, the Contractor:

- Shall ensure that all fuel or lubrication oils stored in bulk on the site are located as far as reasonably possible from any watercourse and that such stores are surrounded with an effective bund capable of holding the full contents of the store; all stores shall be kept locked when not in use.
- Shall locate all equipment using fuel oil as far away as reasonably possible from any watercourse and shall surround them with oil-absorbent material to contain spills or leaks. A stock of oil-absorbent pads shall be maintained in stores on site.
- Shall provide for silted or discoloured water pumped from excavations either to be irrigated over grassland or settled in a lagoon prior to any discharge to a watercourse.
- Shall not use plant in a river, or ford the river with vehicles, without the prior consent in writing of the Engineer.
- Shall avoid the discharge or seepage of cement slurry from any concreting work into any watercourse.
- Shall agree with the Authority his plant and vehicle parking and servicing areas.

If, notwithstanding these precautions any pollution takes place, the Contractor will forthwith advise the Control Room of the Wessex Region of the NRA.

WATER RESOURCES

The Contractor's attention is drawn to the Water Resources Act 1963. The Contractor shall take all necessary precautions to secure the efficient protection of water abstractions whether licensed or not. The Contractor's attention is also drawn to the possible existence of domestic abstractions exempt from licensing.

National Rivers Authority Wessex Region

PLANT AND APPARATUS

The Contractor shall take all necessary precautions to secure the efficient protection and continued operations of all the Authority's plant and apparatus.

The Wessex Region of the NRA must be notified prior to the start of excavation affecting the Authority's apparatus so that the Authority's representative is given the opportunity of being present on site to inspect the works.

If, notwithstanding these precautions any damage to the Authority's apparatus is caused, the Contractor will forthwith advise the Control Room of the Wessex Region of the NRA.

LAND DRAINAGE

The Contractor's attention is drawn to the Land Drainage Act 1976 and the NRA,Wessex Region's Land Drainage Byelaws.

The programme for the works and the design of any temporary works to be carried out in or adjacent to a watercourse require the formal and prior consent of the Authority. The Contractor's proposals for temporary works within any channel or flood plain are to be submitted to the Engineer for examination by the Authority who will consider the probable effects on the river and other property. Any approval by the Authority will not relieve the Contractor of his responsibilities regarding temporary works and the Authority will not be held liable for any damage resulting from the construction thereof.

The Contractor shall take all necessary measures to ensure the continued operation of all drainage systems in the area affected by the works, either permanent or temporary.

Any material placed within the channel or flood plain during the construction of temporary works shall be removed by the Contractor as soon as its function has been fulfilled.

SPECIAL REQUIREMENTS IN NEW DEVELOPMENTS

National Rivers Authority Wessex Region

GENERAL REQUIREMENTS

Any works directly affecting any watercourse shall be notified to NRA, Wessex Region. The following warning periods shall be given by the Contractor:

- **Instream works: 7 days.**
- **Watercourse diversions - 2 working days. (c) Change of programme affecting watercourse - 2 working days.**
- **All notifications and general enquiries should, in the first instance, be addressed to: The Planning & Development Liaison Officer, National Rivers Authority, Wessex Region , Rivers House , East Quay, Bridgwater Somerset TA6 4YS**

All emergencies and/or out of normal work hours contact should be made to the Regional Control Room by telephoning:

Working hours - Bridgwater (0278) 457333
Out of normal hours - Linkline (0345) 078378

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National Rivers Authority Wessex Region

NRA

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CONSERVATION: 01

RIVER CORRIDORS - AN IMPORTANT WILDLIFE RESOURCE

National Rivers Authority Wessex Region

NRA

Rivers and the corridors of land through which they flow provide a major source for wildlife. In the predominantly rural National Rivers Authority (NRA) Wessex Region there are upland river types, meandering lowland rivers, swift chalk streams and by contrast the Somerset wetlands largely below sea level and served by a network of rivers and rhynes.

The diversity of habitats associated with the aquatic environment, which includes gravel shoals, muddy margins, islands, shallows, riffles, deep pools and steep cliffs, are all home to an infinite variety of creatures. The rivers and adjacent habitats, such as broadleaved woodland, old ox-bows, fens and marshes, form corridors for wildlife. They provide linear routeways across the farmed countryside and urban areas through which birds, plants and mammals can successfully disperse and colonise.

WHAT IS A RIVER CORRIDOR SURVEY?

A river corridor survey is a standard method for recording features and habitats of wildlife interest along the river and adjacent land.

WHY CARRY OUT RIVER CORRIDOR SURVEYS?

The NRA was established by the Water Act 1989. This Act requires the NRA to protect wildlife on rivers, promote conservation and enhance the beauty, flora and fauna of the Region's rivers and coastline.

River corridor surveys help us to fulfil these obligations by identifying important wildlife features which could easily be damaged or lost during river works. For example, uncommon bankside or river plants which are vulnerable during dredging can be identified and saved. Similarly, kingfisher cliffs which could be lost through bank regrading can remain undisturbed.

When developments are proposed within a flood plain, such as flood protection schemes, river maintenance or specific projects which require land drainage consent, a river corridor survey may be needed to assist in the consultation process. On major development schemes river corridor surveys will form part of an Environmental Assessment to satisfy statutory and EC directives.

RIVER CORRIDORS - AN IMPORTANT WILDLIFE RESOURCE

National Rivers Authority Wessex Region

HOW ARE RIVERS SURVEYED?

The Surveyor, a trained ecologist , will walk along selected stretches of rivers to map and photograph the existing vegetation structure, the different habitats, and the physical features present which add variety to the river. It is not the aim of the survey to gather a complete list of all plants and animal species although observations, including animal footprints or nest sites, are noted, The ideal time to survey rivers is between April and October.

HOW IS THE INFORMATION USED?

The Surveyor, Conservation Officer and Engineer discuss the findings of a river corridor survey to formulate an environmentally sensitive solution to river management, design or engineering works. Together they will secure an effective means of conserving the best river features and creating new ones whilst still meeting the engineering objectives of flood control. The Surveyors recommendations may include the most appropriate river bank to work from in order to avoid damage to trees and riverine habitats. In some cases partial dredging of a channel may be suggested to conserve a proportion of wildlife in the river and so aid the recolonisation of the disturbed areas.

Opportunities for the creation of new habitats are considered and implemented to with the cooperation of the landowner. This could include tree planting, the excavation of wildlife ponds, pollarding willows, creating otter havens or excavating shallow underwater shelves where aquatic plants can establish themselves and thrive.

DO RIVER CORRIDOR SURVEYS REALLY HELP US?

To judge whether or not River Corridor Surveys and the subsequent works have been efficient in the conservation of wildlife along our rivers, we carry out follow-up or 'Audit' surveys.

A simple scoring system is used to gauge the level of success of maintenance schemes in relation to the agreed working method. Results obtained are discussed with the engineers and prove invaluable by maintaining and where possible improving the standard of river management work throughout the NRA Wessex Region.

CONSERVATION: 02

SOMERSET LEVELS AND MOORS

National Rivers Authority Wessex Region

NRA

The Levels and Moors of Somerset are immensely rich in wildlife and have been described as the most important remaining area of wetland wildlife in Britain. Networks of rhynes (man-made ditches), and shallow flooding in the winter months, due to the high water table of the area, all contribute to create a habitat that is becoming increasingly rare internationally.

DRAINAGE

The area is surrounded by hill ranges, the Mendips, Blackdowns, Brendons and the Quantocks. Most of the run-off from these hills discharges through the lowland area, which is below sea level, and into the Bristol Channel.

Due to the relative levels of the land and sea, most of the Moors have to be pumped as gravity is not possible. To avoid the mixing of highland and lowland systems, as it is expensive to pump water, the highland run-off is transported through the lowland area in embanked channels, thus preventing spillage for the majority of the time into the adjacent lowland. During the high tide periods, even the embanked 'highland carriers' become tidelocked and have to store their own waters for three or four hours. When the run-off exceeds the storage capacity of the river, spillage into the Moors occurs with consequent flooding.

RECLAMATION

In the past, the Levels and Moors of Somerset were once an inlet of the sea. Marine clay was deposited along what is now the coastal belt forming the Levels. Inland, the drainage was impeded by the higher Levels leading to the forming of freshwater lakes. Decay of vegetation, and the build up of organic material caused the lakes to become marshes. Changes in the water levels, silting and vegetation decay produced successive deposits of peat and clay, forming the inland Moors.

In later centuries little reclamation took place and there was opposition to large scale drainage work as these would result in a loss of Commoners rights ie the cutting of turf for fuel. Low agricultural prices gave little incentive to drain land and by the 1600's only one third of the Levels were reclaimed and even these were subject to flooding. The 18th and 19th centuries saw the building of rhynes, and the draining and dividing of the area which was stimulated by the increased demand for food. A pattern of roads and farms was laid out, much of which still remains today. Water was channelled into newly enlarged and straightened river channels, such as the King's Sedgemoor Drain and South Drain, and tidal sluices were built.

SOMERSET LEVELS AND MOORS

National Rivers Authority Wessex Region

Between 1830 and 1930 many internal District Drainage Boards were set up. Steam and later developments using diesel, improved the efficiency of the pumping system and new drainage channels, such as the Huntspill River (1940) were created. Since this time there have been many more improvements in drainage and flood control enabling farmers to use their fields more productively. Farming has evolved with the improved drainage of the Levels. Traditionally little fertiliser was used, and productivity of the land was low, although cheap to run.

As drainage has improved the meadows have been reseeded, with cereal or vegetable crops now able to be grown. New farming procedures enabling the farmer to intensify his enterprise and maximise output have involved heavier usage of fertilisers, weed killers, new machinery, and deep drainage, but these damage the wetland habitat, killing plants and animals unique to the area. Recently, areas of the Levels and Moors have been designated as Environmentally Sensitive Areas (ESA's) by the Government, which allows farmers who agree to return to traditional methods of agriculture to be supported financially.

WILDLIFE

By the mid seventies concern was being expressed over the impact that changes were having on the wildlife of the area. Changes in the drainage and farming of the area were reducing the unique habitat found on the Levels and Moors and SSSI's were notified to protect some of the best areas. Large areas are now designated as Environmentally Sensitive Area's (ESA's).

Since these designations, the NRA and its predecessor has maintained a status quo in its drainage operations. No further schemes of drainage improvement have taken place.

BIRD LIFE

The Levels and Moors has a large breeding populations of wading birds, all requiring moist ground to keep the worms and insects they feed upon near the surface. Species commonly seen is the area are Lapwing and Curlew. Others not so common are the Redshank, Snipe, and the rare Black-tailed Godwit. Migrating birds from Africa, such as the Yellow Wagtail, Winchat and Sedge Warbler all nest in the area on their way to the continent, Asia or Africa.

SOMERSET LEVELS AND MOORS

National Rivers Authority Wessex Region

Depending on weather conditions and the extent of flooding, flocks of migrants such as Widgeon, Teal, Shoveler, Plover, Pintail, Bewick Swans and Thrush, overwinter in the area, increasing in number if weather conditions in Europe are severe. Birds of prey visiting during the winter months include the Merlin, Peregrine Falcon and some migrants one of which being the Whimbrel, arrive in the spring.

ANIMAL LIFE

The area supports an extraordinary wealth of mammals, amphibians, insects and a number of other creatures. Otters, though rarely seen, survive on the Moors and Levels, which is one of their last remaining haunts. An abundance of species of dragonfly and damselfly, some not so common, and some 22 kinds of butterfly, including the rare Marsh Fritillary can be found. However the area is of national importance for its many species of water beetle, 80 of which have so far been recorded, and for its grasshoppers and crickets.

MEADOW FLOWERS

Ragged-Robin, Marsh Marigold and Meadowsweet, and many of the plants growing in the wetter meadows of the area, are all direct descendants of marsh flowers found preserved in the peat. Fields in an unimproved state, may be home to 40 or 50 different plant species, some even holding as many as 100. Field management has a great effect on plant communities, causing them to vary if they are left for rough grazing or mown for hay during the summer. Intensive farming eliminates many of the meadow species due to the fertilisers and herbicides used.

RHYNES

Although man-made, these ditches have been colonised by the plants that once inhabited the existing marshes and pools. Floating species such as Duckweed and Frogbit, pool edge plants like Water Violet and the Bladderworts, and surface or emergent plants such as rushes and sedges, Great Water Dock and Marsh Horsetail, can all be found, and their variety depends on how recently and often the rhyne has been cleaned out. The more valuable ditches for wildlife are those that are cleaned regularly every few years or so.

SOMERSET LEVELS AND MOORS

National Rivers Authority Wessex Region

All these species make up the complex communities of plants and animals found on the Levels. Some areas have been set aside for nature reserves and others protected as Sites of Special Scientific Interest, but it is the overall value of the Levels and Moors that is of the greatest importance. Nature Reserves at Bridgwater Bay and Shapwick Heath can be visited with a permit from the Nature Conservancy Council, while the RSPB Reserve at Swell Wood, which includes a heronry, is freely available to the general public.

STEERING GROUP

A steering group of representatives from farming and wildlife conservation sponsored by the NRA Wessex Region has agreed that five trial areas should be set up where the water regime would be dictated by the needs of the wildlife. The impact on farming as well as the wildlife will be monitored for five years. The results could play a major part in the future of the area.

CONSERVATION: 03

WILDLIFE ALONG RIVERS

National Rivers Authority Wessex Region

NRA

Rivers provide very special wildlife habitats in the country side. Different rivers will support different habitats, and the diverse ranges of plants, insects, fish and birds that are found can be seen by the observant person.

Slow moving and still waters offer plants and animals very different conditions to those found in fast flowing rivers. In fast water any insects or plants not firmly anchored to the bed will be swept along by the currents. Sand and mud will also be swept away, leaving only rocks and gravel. The constant splashing and turbulence will ensure there is plenty of oxygen in the water, which is vital to most under water animals. In slow moving water, the sand and silt will settle out on the bottom and over the years will build up into a thick layer of mud.

Water plants grow well in slow water as they are able to root easily in the mud deposits and are not battered by fast flowing currents. They also provide plenty of shelter for insects and fish. Slower rivers cannot quickly replace the oxygen used up by animals, so they are especially susceptible to effluents from factories and sewage works that cause pollution, and use up oxygen. Unfortunately, most towns and factories are situated in the flatter parts of the country, where rivers become slower as they reach the 'old' stage of their courses.

WATERSIDE BIRDS

One of the most noticeable birds on Britain's rivers is the Swan. These majestic, graceful birds are easily recognised, and when roused can be highly aggressive, particularly if they have young to protect.

Other birds commonly found on rivers are moorhens, ducks and geese. One bird not so widespread, is the heron, which is not often seen. These stand motionless in the shadows waiting for their prey, small fish or frogs, to swim into range. At the slightest disturbance however, they take to the air, where they are easily recognised for their slow wingbeat, trailing legs and S-folded necks.

The riverside supports a range interesting smaller birds. One high point would be the brilliant flash of a kingfisher, or the white bib of the dipper. Wagtails can be observed searching for food along sandbanks continually wagging their tails up and down. In the summer, sand martins nest in these banks and can be seen darting in and out of their nest holes carrying titbits for their young. Many birds build their nests away from the shore out of reach from predators. In the nesting seasons of spring and early summer, rushes and reedbeds are the favourite nesting sites for many species. When young have hatched moorhen chicks or ducklings may be seen on the water.

WILDLIFE ALONG RIVERS

National Rivers Authority Wessex Region

PLANT LIFE

Vegetation is important not only for providing nesting sites for birds, it also provides cover for many insects and fishes. Pike, the predator of the fish world, is frequently to be found hidden amongst weed beds, waiting to rush out and grab an unsuspecting roach as it swims by. Many species of coarse fish use weed beds to spawn in and insects use the stems of plants to help them emerge from the water.

Plants perform one vital function for all water life. They use sunlight to build up water and carbon dioxide into carbohydrates, which power the plant's life processes. As a by-product they release oxygen into the water which is available for insects and fish to breathe. The food reserves built up and stored within plants as in the form of starch are eaten by many insects, which in turn are food for fishes.

As well as being a vital components in the food chain water plants can also be very attractive. A bed of yellow irises or a white carpet of water buttercup can be a memorable part of a walk or outing along a river.

INSECTS

Most insects have two active stages in their lives. After hatching from their eggs they are called larvae, or in the case of many aquatic species, nymphs. These are equivalent to the caterpillar stage of butterflies. They then undergo a dramatic change at the pupal stage and emerge as adults.

Dragonflies are brilliantly coloured, and like the smaller damselflies they can be seen darting around the waters edge on any summer's day. Their nymphs which can grow up to 5cm long live up to their name and are vicious underwater hunters. They capture many insects and worms, and may even eat small fish and tadpoles. As protection against dragonfly nymphs and any other small animals that see them as a tasty meal, one family of insects build shelters around themselves. These are caddisflies, which can be found underneath submerged rocks or stones in tubes which they construct out of sand, sticks or gravel.

WILDLIFE ALONG RIVERS

National Rivers Authority Wessex Region

ANIMALS ON THE RIVER BANK

Frogs and toads are usually found hiding in reed beds, or in the muddy margins of a river and are not often seen unless they are disturbed. Nooks and crannies hidden from view, overhanging banks and tree roots may often hide water voles, which are frequently mistaken for rats, and given the name 'water rat'. These are quite harmless and provide a comical sight as they feed, sitting up with their food between their paws. They are vegetarians and eat roots and shoots which they find along the river bank. They may occasionally be seen swimming along the surface until it dives with a distinctive 'plop'. Its underwater path can then be followed by the line of bubbles which rise to the surface. Otters may sometimes be seen on British rivers but are extremely shy creatures. They usually feed at night and by day hide amongst the riverside vegetation. Evidence of their presence ie paw prints, can sometimes be found along sandy banks.

FISH

There are two main groups of freshwater fish. 'Game fish' which include the trout and salmon; and 'coarse fish' which include most others ie the common roach, bream and carp.

The characteristics of a body of water determine the species of fish found. Game fish generally prefer cleaner, faster flowing water and need a sand or gravel bed on which to spawn. Eggs are laid in the late autumn and remain in the gravel until the following spring.

Fish that are feeding on insects and grubs on the surface tend to make circles of ripples across the water. This is known as a 'rise' and is used by fishermen to locate a fish presence. They then try to imitate the movements of insects by skillfully tying bits of fur and feather onto a hook, and casting it out to the feeding fish. This is known as flyfishing and is generally used to catch trout. Coarse fishing involves a different method. A baited hook is presented to the fish, suspended beneath a float or anchored to the bed with a lead weight.

WILDLIFE ON RIVERS

National Rivers Authority Wessex Region

ACCESS INFORMATION

In following rivers keep to the footpaths provided. There is no automatic right of way along any watercourse. To develop an interest in riverside wildlife join a local natural history or conservation group. Details on these groups can be obtained from the Royal Society for Nature Conservation and the Royal Society for the Protection of Birds:: see below for addresses.

Royal Society for Nature Conservation, The Green, Nettleham, Lincoln, LN2 2NR.

Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire.

CONSERVATION: 04

JAPANESE KNOTWEED

National Rivers Authority Wessex Region

NRA

Japanese knotweed is regarded as a troublesome pest in much of Wales and parts of northwest and southeast England. Field trials on methods of controlling this species have been conducted in Wales, and the Nature Conservancy Council has taken steps to control it on sites important to wildlife.

JAPANESE KNOTWEED

A member of the Polyonum family, the Japanese Knotweed is related to common waterside plants such as Water Pepper and Bistort. It is a large perennial growing up to 2.5 m, and forming dense clumps usually on disturbed ground and along the banks of watercourses. It is not an aquatic plant.

The plant dies back completely in winter and grows rapidly in the spring and early summer. In late August and early September it produces flowers, presently believed to be infertile in Britain, so colonisation is solely by means of underground rhizomes. The plant is unpalatable and once it becomes established it rapidly spreads, shading out other plants, covering large areas of land within a short time.

The most successful method of control is to cut the shoots in May or June and then to spray the regrowth with a translocated herbicide such as 'Round-up' or 'Spasor' (ie glyphosate). Both of these are licensed for use near watercourses. This treatment should be repeated for 2 to 3 years to eliminate the clump. Uprooting small plants and regular cutting or mowing also helps to deter the spread of the plants. Once suppressed the area should be reseeded to help prevent recolonisation or soil erosion.

Unlike the Creeping Thistle and Broad Leaved Dock the Japanese Knotweed is not a notifiable weed. However, it is included in Section 14 of the Wildlife and Countryside Act 1981 which relates to the introduction of alien species into Britain. It is thus illegal to deliberately plant or encourage growth of Japanese Knotweed in Britain.

As Japanese Knotweed is susceptible to trampling and mowing it tends to occur on waste ground and is rarely seen on managed sites. It has appeared along some of North Somerset's coastal streams. Control of the plant is, technically speaking, the responsibility of the landowner but the NRA will take appropriate measures when it is working on affected land. Control of Japanese Knotweed is particularly desirable in SSSI's but written consent from the NCC in accordance with all changes in management practice will be required.

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National Rivers Authority Wessex Region

NRA

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BURNHAM ON SEA WALL

Without sea defences at Burnham, the sea would have access to homes, factories, farmland and villages across more than 250 square miles of the Somerset Levels. Some form of sea wall has stood in this area since the early 17th century.

Defences replaced by the new Burnham Sea Wall, had been built in the latter part of the 19th, and early 20th centuries, and consisted of a sloping, reinforced concrete wall with a promenade on top. In December 1981 a westerly gale, one of the worst this century, combined with excessively high tides, drove the sea over the existing seawall to flood 350 properties. Damages totalled £1.5 million, but it was estimated that if the wall had been breached, costs could have exceeded £6 million. Hence, planning commenced on the design and building of new sea defences for Burnham.

The height of the wall and promenade was raised by 1 metre and a mile long stretch of steps now adorns the seafront of Burnham, from the mouth of the River Brue northwards. At the top of the steps is Britain's biggest wave return wall. The 3.2 metre high curve of concrete, rolls the powerful storm waves back the way they came, with the steps below absorbing their energy. Undercutting of the wall is prevented by sheet steel piles. The scheme cost £7 million and took five years to complete, starting in 1983.

In order that the new sea defences would not be outflanked to the south, by the tide entering the River Brue, it was necessary for the north bank of the river to be raised, at a cost of £80,000. To the north end of the wall there was a natural barrier of sand dunes.

One problem in designing the wall, concerned the section where the Pavilion stands. Detailed investigations revealed that the Pavilion was not strong enough to hold the new wall, as its foundations would sink under the weight. The cost of preventing this would have been £250,000. Because of this high cost the Pavilion has been left as it was, with short sections of the original wall on either side, these having been heightened. When the Pavilion does eventually go, the gap will be filled in in a similar style to the rest of the wall.

SAND BAY - SEA DEFENCE IMPROVEMENTS

National Rivers Authority Wessex Region

NRA

Sand Bay sea defences are vulnerable to heavy wave action combined with high spring tides. In the storm of 13th December 1981, the sea wall itself was badly damaged. Overtopping took place over the long lengths of the defence and 76 properties were flooded. Further damage to the sea wall occurred during storms in January 1983.

Various options were considered, but the solution to the problems at Sand Bay was to carry out a beach nourishment scheme. The principle is to raise the beach and destroy the waves before they reach the wall. 'A good high beach is the best sea defence' is a fact which has long been recognised by coastal engineers.

Schemes of this nature have regularly been carried out in the USA and Europe. In this country, schemes were carried out in the early 1970's in Edinburgh and Bournemouth, and have proved very successful. Further nourishments have been undertaken at Bournemouth in 1988 and 1989.

In July 1983 the works commenced. This involved the placing of 600,000 tons of sand and gravel almost to the top of the sea wall, to a depth of up to 10 feet, tapering down to existing beach level 230 feet away.

The method adopted was:

- Dredge material from a source located approximately 4 miles from Sand Bay.
- Dredger sails to Sand Bay and moors alongside pontoon.
- Material pumped via pipelines to beach.
- Material shaped to final profile.

The cost of the dredging contract was approximately £750, 000. This was grant aided in part by the Ministry of Agriculture, Fisheries and Food. On completion of the scheme in March 1984, the total cost was estimated to be £2.5 million.

FLOOD DEFENCE: 013

BLAKES POOLS

National Rivers Authority Wessex Region

NRA

Severe tidal flooding in December 1981 caused major damage to property and farmland. As a result, replacement of existing sea defence and new tidal embankments south of Clevedon, took place, giving the opportunity to provide a new wildlife site.

The project is an excellent example of cooperation between Wessex and the World Wildlife Fund and Avon Wildlife Trust.

'Blakes Pools' are quite simply excavations near to the coast for the winning of earth used to build new embankments to keep out the sea.

The use of earth from the Pools has saved thousands of pounds in costs which would have been incurred in importing earth. It has also avoided hundreds of heavy lorries travelling the narrow lanes, causing havoc for the local people.

The construction of the new sea wall left saltmarsh and mud flats untouched. In addition, the positioning of the new embankment inland from the old seawall has created a wave platform of marshy grassland which has attracted snipe and other waders, and flocks of finches.

The first borrow pit was landscaped to create a 12 acre wildfowl pool, providing a perfectly located roost for a wide range of water birds. Phragmites reed planted around the shallow edges adds shelter, whilst restricting wave erosion ,without enclosing the Pool, so essential for attracting wildfowl. In three years, 98 species have used the Pool. Mute swan, shelduck, mallard and coot have nested.

In constructing the second suite of pools 8 acres of land were purchased to allow shallow excavation, specially landscaped for wading birds. Two types of island have been created, one retaining the original tussocky grassland for breeding duck, whilst another, a gravel-topped island, constructed with help from Avon Wildlife Trust, will provide nesting for waders and hopefully, terns. Very shallow slopes provide feeding and roosting sites, and the eastern end will be colonised with phragmites to create a one acre reed bed and useful screening. The badgers residing in the old seawall were encouraged to new premises prior to construction. Young trees were saved and transplanted.

This is a first class example of a flood protection scheme with the subsequent creation of a wildlife reserve and enhancement of the landscape.

FLOOD DEFENCE: 014

STOLFORD SEA DEFENCES

IMPROVEMENT SCHEME 1988

National Rivers Authority Wessex Region

NRA

Stolford Sea Defences lie on the north facing coastline of the Bristol Channel in West Somerset, 10 km north west of Bridgwater and immediately to the east of Hinkley Point Power Station.

The original defences consisted of a shingle ridge backed by clay banks. In the 1950's and 1960's, continuing problems maintaining the defences led to various lengths being protected with concrete, masonry and steel pipes.

Overtopping of the defences occurred every year causing minor flooding of the agricultural land immediately behind the sea wall. During the storm of December 13th 1981, the defences suffered extensive overtopping, flooding 119 hectares of land and four cottages.

Storm tides in January 1983 highlighted the vulnerability of the defences when a length of 130 m collapsed.

The changing aspect of the coastline along this 1600 m stretch experiences very different conditions of wave attack and erosion. Over the western half, strong longshore currents divided the foreshore and shingle is swept further eastward to form a shingle ridge.

The sea defences protect 12 cottages, 3 houses and 4 farmsteads. The agricultural area protected is approximately 200 hectares. The main road to Hinkley Point Power Station is also below high tide level.

The total financial benefits are £2.2 million. The improvement scheme was constructed in 1988 at a capital cost of £1.1 million.

FLOOD DEFENCE: 015

WEST BAY SEA DEFENCE

COAST PROTECTION WORKS

National Rivers Authority Wessex Region

NRA

As a result of severe gales in February 1978, the western beach sea defences were extensively damaged at West Bay. Emergency works were carried out at a cost of £190,000 to secure the defences while investigations and long term solutions were undertaken by consulting engineers, Dobbie and Partners.

It was agreed that the cost of necessary sea defence works would be shared by Wessex Water and the West Dorset District Council after MAFF grant aid. Any necessary coast protection works would be funded by the District Council with support from the County Councils and at that time the DoE.

The following works were agreed:

- The provision of a sheet steel piled cut-off with stepped concrete apron.
- The reconstruction of the collapsed sea wall and promenade.
- The provision of a wave return wall.
- The construction of two rock bastions to retain beach material.
- The placing of heavy rock armouring to protect the car park/pier area.

The main construction works undertaken by Amey Roadstone Construction Ltd commenced in September 1981 and were completed in March 1983. The final project cost was £1.3 million split approximately £800,000 sea defence and £500,000 coast protection.

FLOOD DEFENCE: 016

CHESIL BEACH DEFENCE SCHEME

PORTLAND

National Rivers Authority Wessex Region

NRA

In December 1978 and again in February 1979, major sea flooding occurred at Chiswell, Portland. Some 94 properties were flooded together with the main Weymouth to Portland road.

Emergency works were undertaken to secure the sea defences, and consulting engineers, Dobbie and Partners were commissioned jointly by Wessex Water and the Weymouth and Portland Borough Council to advise on long term solutions.

After extensive investigations the consulting engineers reported in July 1980 with recommendations that works estimated to cost £5.0 million should be undertaken in four stages.

Stage 1 Modification to the Existing Sea Wall.

Stage 2 Interceptor drainage works.

Stage 3 Raising of the Weymouth to Portland Road.

Stage 4 Gabion Crest Protection to Chesil Beach.

In November 1982 work commenced on Stage 1 works, the modifications to the sea wall which included a steel sheet pile cut off, a stepped revetment and a wave return wall at the back of the esplanade. These works were completed in August 1983.

After detailed investigation, Stage 2 (Interceptor Drainage Works) commenced in May 1985. The works, comprising precast concrete box units, laid between the crest of the beach and the properties in Chiswell allowing a free discharge to Portland Harbour. The works were completed early in 1987.

Stage 3 works, the raising of the Weymouth to Portland Road, which allowed a free discharge of the design flood to Portland Harbour without flooding the road, started in October 1987 and was completed in May 1988.

It was agreed that Stage 4 of the works would be deferred until a gabion trial be undertaken to assess both the technical and environmental aspects of the proposal. The gabion trial was constructed in 1981 and is still being evaluated by regular monitoring.

The total cost of the project excluding Stage 4 works was £4.4 million. This scheme attracted grant aid from the Ministry of Agriculture, Fisheries and Food. The balance of the cost was shared between Wessex Water and the Weymouth and Portland Borough Council.

FLOOD DEFENCE: 02

LAND DRAINAGE AND FLOOD PREVENTION

National Rivers Authority Wessex Region

NRA

The NRA is responsible for improving and maintaining the main river system of the region and for coastal and inland flood protection. It also supervises, designs and carries out general land drainage works. This supervision is intended to:

- Avoid impediment to efficient drainage in watercourses.
- Avoid damage to watercourses and sea defences.
- Avoid flooding of land and property.
- Allow for any necessary future improvement of a watercourse drainage system and of sea defences.
- Prevent the creation of obstructions which limit access along watercourses to associated drainage works and to sea defences.
- Preserve the essential flood plains and washland areas and ensure that structures affecting watercourses have adequate hydraulic capacity.

Maintenance and improvement work is carried out by:

- The careful and selective removal of debris, shoals, overhanging branches and wood growth obstructing official drainage channels. This would commence after consulting with conservation experts to assess the need for such work and any practical enhancement measures, and to minimise environmental damage.
- Operating and maintaining pumping stations, services and other structures.
- Improving and repairing old and constructing new, works to alleviate the flooding of property and taking action to minimise any increase in risk due to accelerated run-off from proposed development (including the agreement to store stormwater on the side).

Any new works must be justified by making sure the investment is worthwhile economically whilst the cost of providing solutions to development run off problems is sought as contributions from developers.

Under the Water Act 1989, the NRA has a duty to further the conservation of wildlife and natural beauty when planning and carrying out any of its functions.

Records of flood levels and areas covered by floods, from main rivers and the sea, are available for public inspection. This may help with house purchase and insurance assessment.

Information on rainfall, soil moisture and river flows is telemetered back to the NRA Control Room, and is regularly updated and analysed by computer. Close liaison has been established with the Meteorological Office and the NRA has contributed to schemes to provide four weather radar installations which together cover the whole country.

LAND DRAINAGE AND FLOOD PREVENTION

If a flood is predicted, warnings are issued to police and District Councils, who are responsible for warning and assisting people who are at risk.

The Wessex Region, especially the Somerset Levels and Moors, presents particular problems with drainage and flooding, as much of the land is below sea level. This is not only a rich agricultural area having some of the finest pasture land in the country, but one of the last remaining areas of wetland habitat in Britain. The arising conflicts have to be reconciled, and the NRA has a manual of consultation and standards which relate to river and land drainage works in this area, and is also sponsors a group which promotes trials aimed at resolving the conflict.

In some parts of the region flooding is a great threat to urban developments, and an extensive programme of flood alleviation work has been undertaken. The long, exposed coastline in Wessex also requires constant vigilance and repair, with maintenance and improvement of sea defences continuing to be a large investment. The northern shoreline in particular is subject to the exceptional tidal range of the Bristol Channel, the southern shore is exposed to the violence of Atlantic storms.

FLOOD DEFENCE: 04

THE STORY OF THE FLOODS
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For the NRA's Wessex Region January and February of 1990 was the wettest eight week period on record. Since mid December 1989, over half an average year's rainfall had fallen on the Region, causing almost eight weeks of continuous alert, resulting in the flooding from rivers of over 70 houses, and threatening to inundate hundreds of other properties. In the same period high tides had flooded a further 40 properties.

FLOOD PATROLS

The first heavy rainfall for months rapidly brought river levels to bank full in mid December 1989. Throughout the Christmas holidays and the first six weeks of 1990 flood patrol duties became routine for much of the NRA's flood defence labour force.

'The great storm' of Thursday 25 January, brought devastation to Somerset and affected many of the Region's rivers. So many trees were blown down into rivers that heavy lifting gear was brought in to clear the channels. If left, this debris would have impeded the very high river flows being experienced at this time.

EXTENDED RAINFALL

The NRA's hydrologists had to contend with the very unusual pattern of rainfall. Previously, major flooding has been caused by less rain in shorter periods. In 1990, the daily rainfall brought rivers to their peak and maintained these levels as flood plains were inundated. At the peak of the floods, two areas in particular suffered.

In Somerset, at Muchelney near Langport, the village was cut off for almost three weeks. The ingenuity of the villagers, in overcoming obstacles brought them media attention which they faced with stoic patience. Supplies were taken in on tractors and the school bus was replaced by a farmer's trailer.

At Wilton and West Harnham, Salisbury, the Rivers Wylye and Nadder overflowed into their flood plains, bringing misery to over 30 families, some of whom were flooded on more than one occasion. Lower down the Hampshire Avon at Downton, Fordingbridge, and Ringwood, high river levels for three weeks, and successive storms, threatened flooding, keeping worried householders on their toes.

Flood alleviation schemes at Wilton, Fordingbridge and Salisbury undoubtedly saved these places from much higher river levels which may have endangered their town centres.

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At Christchurch, a caravan site was flooded while adjacent areas, which had chosen to be protected by flood banks, were saved. At West Bay, another caravan park was inundated by a combination of high tide peaks and peak river flows caused by 50mm of rain in only a few hours.

Elsewhere, areas which benefited from flood alleviation schemes built during the last 20 years, included: Bath, Bridport, Bruton, Ilchester, Taunton, Christchurch and Salisbury.

PUMPING ON THE MOORS

Pumping from stations normally draining the Somerset Levels and Moors had to be suspended when river channels became full, later overflowing onto the Moors and inundating some 20, 000 acres of farmland. The losses in agricultural production have yet to be calculated.

BEACH MOVES

The high tides in December, latter part of January and early February were accompanied by storm surges caused by the appaling weather conditions. Tide watches were mounted on both coasts on several occasions, and major sea defence works at Bridport and Burnham-on-Sea proved their worth.

At Chesil Beach the storms were so severe that the 10 metre high pebble ridge was reported to have moved landward by as much as 20 metres in places and damage done to the crest during this period, was repaired. At Portland, the recently completed sea defence scheme held against the tempest and reduced flooding in the vulnerable village of Chiswell.

CONTROL ROOM

While tide watches and river patrols were being mounted in the field, hydrologists and engineers manned control rooms continuously for a month. Hydrologists collected information from automatic river and rain gauges and used weather radar to make their flood predictions in all the major catchments. Engineers supported their field colleagues and dealt with hundreds of public enquiries. Staff from other functions were also drafted in to help man the telephones.

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FLOOD WARNINGS

In the course of the eight week flood, over 90 flood warnings were issued by the NRA's Wessex Region. The procedures whereby the NRA informed the Police, who in turn warned householders of possible incidents, worked well throughout this time. On one occasion a hoax message was widely circulated around the Melksham area before a denial could be broadcast on local radio.

STAFF AT WORK

Many staff worked long hours throughout the emergency, with field staff often operating a 12 hour shift system for 7 days a week. One engineer was heard to complain that on the one day he managed to get off in January, his wife made him go shopping. He would rather have stayed at work. For some of the peak periods, satellite control rooms were set up at Bath, (Bristol Avon area), and Poole (Avon and Dorset area), in order to monitor events and deal with enquiries.

MEDIA

The flood was the first major media event handled by the NRA in Wessex. Over 200 enquiries were handled in the peak two weeks from virtually every TV channel, radio station and newspaper in the region. At first, flood engineers were concerned not to compromise the official channels of communication. As the situation continued, broadcast interviews by Public Relations staff meant that general information about the extent of the floods was immediate, and regularly updated. Flood engineers also gave interviews in a conscious extension of the standard procedures. For many, this was the first live example of the work of the NRA.

FALLING SLOWLY

By the end of February, river levels everywhere were still high, but falling slowly. Long after public awareness of the flooding had subsided, the NRA interest has remained. River levels and the extent of flooding are being recorded by the NRA's surveyors. Flood alleviation schemes are also being examined to see how well they operated, and problem areas are being investigated with a view to the construction of new flood protection schemes. Throughout the course of the flooding photographs and videos were taken which will assist in the preparation of future schemes, and recording information which deals with enquiries about development near rivers.

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NAVIGATIONS: 01

SOMERSET NAVIGATIONS CIRCUIT

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INTRODUCTION

Sedgemoor District Council in conjunction with Somerset County Council has proposed that investigations should be made into the possibility of establishing a navigable waterways system in Somerset based upon Bridgwater. A Working Group was formed in 1989 comprising Officers representing Somerset County Council, Sedgemoor District Council, Taunton Deane Borough Council, South Somerset District Council, British Waterways Board and the National Rivers Authority.

The brief was to investigate the possibility of creating a boating circuit of at least 100 km in length as this is considered to be necessary to attract commercial interests. The boating would be mainly for pleasure and to attract tourism to the area.

PRESENT POSITION

During the course of its investigations, the Working Group identified a possible circuit. Officers have made preliminary estimates of the direct costs involved in creating the circuit and have also identified areas of concern where Feasibility Studies would be required before the full cost of the project and impacts upon interested parties could be ascertained. A draft Interim Report was been produced by Sedgemoor District Council.

FEASIBILITY STUDIES

Before any commitment to the project, a number of Feasibility Studies would be required and these would include:

- siltation problems
- flooding problems
- water quality (effluent disposal)
- fisheries including elvers
- wildlife conservation
- low flows and availability of water
- bank erosion
- foul water discharges
- ownerships
- environmental impact
- financial viability

SOMERSET NAVIGATIONS CIRCUIT

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COSTS

It has been estimated that there would be a minimum capital cost of £15 million which would be increased by a sum which can only be determined after feasibility studies have been carried out. Areas where substantial (perhaps multi-million pound) extra costs could be incurred could be in water quality aspects of the project and bank protection against erosion caused by boat traffic.

Feasibility Studies themselves were estimated to cost £1.2 million and should take place over a two year period. The full development of the project would be over a further 20 years. The financial viability of the project would comprise a major feasibility study.

FUTURE

Each organisation represented on the Working Group will have to make its own decisions as to participation in the proposed feasibility studies and the level of contributions to the finding required. By October 1990 no body had committed itself to significant contributions.

The NRA announced in September 1990 that it would not make a financial contribution to studies designed to test the feasibility of the proposed Somerset Navigations Circuit.

While the NRA is prepared to give advice and to contribute financially to works which benefit flood defences, its Regional General Manager, Nigel Reader, has announced that they will neither support nor oppose the concept of a navigable waterway in Somerset until the full effects upon the water environment are established by the various feasibility studies proposed by the working group.

The primary function of the NRA is to safeguard the water environment. To do this effectively, the NRA must be independent and objective. It would not therefore be appropriate to take part in the promotion of a particular scheme.

Feasibility studies should be undertaken, and the NRA would wish to give advice, within its own area of expertise, as to the form and content of these studies. It is likely that some of the works required to put the proposals into effect will need to be approved by the NRA, and the safeguarding of the water environment will be the controlling criterion.

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FISHERIES

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The Wessex Region is an exceptionally attractive area for game and coarse fishing. The varied geology of the region, the limestone and clay of the Bristol Avon catchment, the combination of peat moor and limestone which Somerset possesses, and the chalk and clay vales of Wiltshire and Dorset all afford a wide variety of river types, providing fishing opportunities to suit every angler.

The fishing of an area is affected by certain factors, determining the species of fish present in a river, major ones being water oxygen content and pollution.
Coarse fish will tolerate waters with a low oxygen content, often in slow moving waters or lakes. These include carp, roach, tench, bream, chub, gudgeon, perch and the pike. Game fish, such as trout and salmon require a higher oxygen content in water. These are more often found in rivers away from areas of high population, where pollution is more commonly found.

Before any fishing in the Wessex Region, a valid rod licence is required, together with any permissions and club permits. Certain fisheries byelaws must also be obeyed, including the annual close seasons for both game, and coarse fishing.

COARSE FISHING

The River Avon (Bristol) is an important coarse fishery that benefits from the weirs retaining its waters, of particular importance during the summer months. The Bristol Avon and its major tributaries, the Somerset Frome, Semington Brook, Bristol Frome, and the Chew, hold a wide range of fish including roach, bream, chub, dace, perch, pike, carp, tench and barbel which were introduced to the river during the 1960's.

In Avon and Dorset, the Hampshire Avon, and Dorset Stour, are well known for their excellent coarse fisheries. The Hampshire Avon, below Salisbury, is famed for its specimen roach, barbel, dace, grayling, and chub. The River Stour and its tributaries draining the Oxford Clays, provides excellent fishing for roach, chub, dace, bream and barbel.

Natural river systems, together with several artificial channels draining low moorland, provide Somerset with excellent coarse fisheries. Principal fishing rivers, where species such as roach, rudd, bream, chub, dace, pike, carp and tench can be had, are the Rivers Brue, Parrett, Tone, Yeo, and Axe, the King's Sedgemoor Drain, and the well known Huntspill River.

To the wide variety of river coarse fishing in Wessex must be added the Kennet and Avon Canal, the Bridgwater and Taunton Canal, and the many excellent lakes and ponds all of which provide the angler with yet more sites on which to practice their sport.

FISHERIES

River access for anglers in Wessex is very good, and in some places special facilities are available for handicapped anglers. Fishing is largely controlled by angling clubs, many of whom offer facilities to the visiting angler. The ability of the Bristol Avon and the Huntspill to accommodate National Angling Championships confirms this.

The coarse fishing season in the Wessex Region extends from 16 June - 14 March inclusive. This applies to all rivers and stillwaters in Wessex.

GAME FISHING

Fishing for salmon and sea trout is almost entirely restricted to the chalk streams of the Hampshire Avon, Dorset Frome and River Piddle, which provide some of the finest fishing in the South of England.

Both spring and summer run fish are found within the Frome and Piddle, yielding large salmon each year. In common with many salmon fisheries, the run of grilse, is becoming increasingly important as the spring run declines. The availability of day permits on these riparian controlled waters is limited.

Within the Wessex region excellent trout fishing is to be found in the upper reaches of the major rivers and in many of their tributaries. The chalk streams of Avon and Dorset, the Hampshire Avon, Dorset Frome and the Rivers, Piddle, Nadder, Allen and Wylye, are well-known fly fishing waters. Although strictly preserved by the riparian owners, limited fishing is available on these waters for the visiting angler.

The Upper Bristol Avon and its major trout tributaries, the By, Cam and Wellow Brooks, and the Somerset Frome and River Chew, as well as the upper reaches of the Rivers Brue, Parrett, Tone and Isle, together with some of the small west coast streams, all provide good sport for the trout fisherman in Somerset. The game fishing season in most of the Wessex Region extends from 1st April to 15th October, although there are variations to the general rule.

Of the rivers in the Wessex region, 837 km are designated as Salmonid waters, with 548 km designated as Cyprinid waters. This is a reflection of the high standard of water quality in Wessex. In order to keep the quality of angling in Wessex, there must be constant monitoring of stock levels, pollution and weed growth. Fish restocking takes place after serious pollutions resulting in a 'fish kill', and most trout fisheries are stocked on a put-and-take basis. Until recent years river weed was cut mechanically in order to alleviate flooding. However, cutting all weed can be detrimental to coarse fisheries and river margins are now left uncut to provide a haven for the fish and their fry.

* *Grilse - a young salmon that has been to sea once.*

GAME FISH

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SALMON *Salmo salar*

A migratory fish which starts life in freshwater, where it requires clean, fast flowing well oxygenated water. After about two years the young, termed smolts, travel downstream to the sea, where they remain for one or more years. Adult salmon return to their river of birth during the spring and summer gradually making their way upstream to spawn during the winter months; a large proportion of the adults die after spawning.
In the Wessex Region, salmon are mainly confined to the Hampshire Avon and the Rivers Stour, Frome and Piddle in the south east, although they are known to be present also in the River Tone. Salmon in excess of 20 lbs are caught and fish of ove 40 lbs have been recorded.

BROWN TROUT *Salmo trutta*

Widely distributed throughout the Wessex Region in rivers and streams which are clean and well oxygenated. As a popular sport fish it has also been introduced into a wide range of lakes and reservoirs. Brown Trout spawn during the winter, burying the eggs in gravels where the water is fast flowing. The wild Brown Trout varies greatly in its colour and growth rate according to the habitat. In small moorland streams it seldom attains weights in excess of 1 lb, whilst in a chalk stream it may reach 4 1b, and in reservoirs it may grow to more than 8 1b.

RAINBOW TROUT *Salmo gairdneri*

A North American species which has been widely introduced to rivers, lakes and reservoirs across the Wessex Region as a popular sport fish. It is generally more resilient than the native Brown Trout and is able to survive in water of poorer quality. Only in exceptional circumstances does this species spawn successfully in the wild. Generally it attains a greater weight than the Brown Trout, with fish in excess of 10 lb being caught occasionally.

SEA TROUT *Salmo trutta*

Although the Sea Trout and the Brown Trout are the same species, the Sea Trout has a life history similar to that of the Salmon, although Sea Trout may often return to the sea after spawning. It migrates to the sea at about two years of age where it remains usually for a year or more before returning to spawn in freshwater. It is often found in rivers which also hold Brown Trout and Salmon. In the Wessex Region it inhabits those rivers where Salmon are present, plus a number of other minor rivers including some on the north coast. A maximum weight of over 151bs may be reached.

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BARBEL *Barbus barbus*

This species of the carp family is not indigenous to the Wessex Region, but has been successfully introduced to the Hampshire Avon and Dorset Stour and more recently the Bristol Avon. Barbel prefer a moderately fast flow where the river bed is made of gravels.

Barbel are bottom feeders but are often difficult to observe as they tend to hide up under weed beds, venturing out to feed at dawn and dusk. Spawning usually takes place in May or June in fast flowing, gravelly shallows. Barbel in excess of 10 lb are occasionally caught, maximum weight being 13 lb to 14lb.

BLEAK *Alburnus alburnus*

A small surface feeding relative of the Bream which is often present in large shoals in slow flowing rivers. It is thought to have been introduced to many rivers in the Wessex Region through it's use as bait for pike. Bleak feed at or near the surface on insects and larvae. Spawning takes place in spring. A weight of 2 oz is about the maximum achieved.

BREAM *Abramis brama*

Widely distributed throughout the Wessex Region being found mainly in slow flowing rivers, lakes and canals. The Bream is a shoaling bottom feeding fish, which sometimes congregate in large numbers, often sending up clouds of silt as they forage for food items such as insect larvae, snails, algae and crustaceans. Bream spawn in weedy shallows during late spring. In rivers Bream seldom grow to more than 7 lb, but in lakes they may reach more than 10 lb in weight.

BREAM (SILVER) *Abramis bjoernka*

A smaller relative of the Common Bream, the Silver Bream is known to be present in the Wessex Region, where it is thought to have been introduced. It favours much the same habitat but rarely reaches 1lb in weight. Distribution of the Silver Bream is difficult to assess as it is almost identical to small Common Bream.

BROOK LAMPREY *Lampetra planeri*

A small eel like fish up to 15 cm long which lives among stones and gravel of stream beds throughout the Wessex Region. In the spring they congregate on shallow gravels creating a small depression where the eggs are laid. The young larvae, known as ammocoetes feed on organic matter and take three years to reach maturity. As adults they do not feed, and die after spawning.

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BULLHEAD *Cottus gobio*

The Bullhead is a small, rather ugly fish which lives on gravel beds and under stones in almost every river and stream in the area. It is an aggressive carnivore feeding on insect larvae, worms, shrimps and other small organisms. Spawning occurs during spring, and the eggs may be found adhering to the underside of stones where the male bullhead guards them until hatching.

CARP *Cyprinus carpio*

Carp is believed to have originated from Asia, but is now widespread in the UK. In the Wessex Region it is present in numerous ponds, lakes and some rivers. The appearance of the Carp varies considerably in its body shape, colouration and scale pattern. The Carp feeds mainly on the bottom probing and sifting through the silt for snails and a wide variety of insect, and plantlife.

In warm weather Carp often bask on the surface and feed amongst lilies and surface weeds. Spawning occurs in spring or summer among dense weed beds. In cold years spawning may not take place. Growth is very variable according to habitat and the species of carp. In ideal conditions Carp may grow to more than 30 lb in weight.

CARP (CRUCIAN) *Carassius carassius*

A close relative of the goldfish, this species also originated from Asia. The Crucian Carp is found mainly in ponds, lakes and canals in the Wessex Region, particularly in heavily weeded areas. A species which feeds at all depths on a wide range of foods items, it rarely grows to more than 2 lb in weight and is very tolerant of poor water quality. It will thrive in small farm ponds where other species might not. Spawning occurs amongst dense weeds in late spring.

CHUB *Leuciscus cephalus*

Present in many rivers and streams in the Wessex Region, the Chub inhabits a wide range of habitats from fast flowing shallow to deep sluggish areas, although it prefers areas with plenty of bankside trees or prolific weed growth for cover.

The Chub is a shoaling fish, feeding on the river bed or on the surface, on a wide range of insects, larvae and berries and can grow to over 5 lb in weight. Large individuals may become solitary and predatory. Spawning usually takes place in May on gravel and weed in fast flowing shallows.

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DACE *Leuciscus leuciscus*

A smaller relative of the Chub, the Dace frequently inhabits the same rivers. It is found throughout the Wessex Region, in rivers and streams in areas with a moderate or fast flow, where they congregate in shoals. Dace are predominantly mid water and surface feeders taking a wide range of insects, larvae and weeds. Spawning occurs in early spring on gravel, stones or weeds where there is a fast flow. The Dace is a small fish seldom reaching a weight of 1 lb.

EEL *Anguilla anguilla*

Present in many rivers, lakes and streams throughout the Wessex Region. Young eels known as elvers, ascend our rivers from the sea each spring, making their way upstream, sometimes reaching ponds via ditches and culverts. After a number of years, on reaching maturity, eels migrate in the autumn downstream to the sea. At this stage of their lives they are known as silver eels.

Adult eels feed on the river or lake bed. Being carnivorous, eels will eat almost any available animal matter, dead or alive but seldom attain more than 3 lb in weight.

GRAYLING *Thymallus thymallus*

A member of the salmonid family, this is an extremely sensitive species which is found only in unpolluted, fast flowing rivers and streams, where it lives in small shoals. Unlike other salmonids, the Grayling spawns during the spring in fast flowing gravelly areas.

In the Wessex Region the distribution of the Grayling is rather limited, but it has been successfully introduced into a number of rivers where the water quality and habitat are suitable. Occasionally it has been stocked into stillwaters.

GUDGEON *Gobio gobio*

A small, bottom feeding fish which lives in shoals usually in moderately fast flowing streams and rivers. The Gudgeon is widely distributed throughout the Wessex Region and is sometimes present in lakes, ponds and canals, although generally preferring flowing water, where it forages on the bottom for vegetable debris and small invertebrates. Spawning takes place in late spring when it lays its eggs on weeds and stones in the river bed. Gudgeon rarely grow to more than 2 oz in weight.

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MINNOW *Phoxinus phoxinus*

A widespread species found in most rivers and streams, particularly where the water is clear and well oxygenated. Food consists of algae and invertebrates and the Minnow itself is an important food item for larger fish such as Trout and Perch and also for Kingfishers and Herons. Spawning takes place in spring and early summer, with the eggs being adhered onto stones and weed.

PERCH *Perca fluviatilis*

A predatory species which is found in most rivers, streams, lakes, canals and ponds throughout the Wessex Region. The Perch is a gregarious fish which feeds on intervebrates and small fish. In the past their numbers seriously reduced as a result of Perch Ulcer disease, but populations are now increasing in most areas. Spawning takes place in spring, the eggs being laid in long ribbons which attach to weeds. Perch may sometimes reach more than 4 lb in weight.

PIKE *Esox lucius*

The Pike is widely distributed throughout the Wessex Region in lakes, rivers and canals. It is a predatory fish which spends most of its time concealed amongst weed or other cover waiting for prey. Pike become carnivorous when only a few inches long soon progressing to a diet which consists almost entirely of fish, although small mammals, frogs and birds are also taken. Pike grow quickly on their carnivorous diet and may in some waters achieve weights in excess of 30 lb. This species usually spawns during spring, often in shallow water where sometimes a large female may be observed being attended by several smaller males.

ROACH *Rutilus rutilus*

A widespread species of fish the Roach is found in most streams, rivers lakes and canals throughout the Wessex Region. It is equally at home in a wide range of habitats from small farm ponds to fast flowing chalk streams, although it generally avoids the fastest flows. A shoaling species it feeds on a mixed diet of algae, plants, insects, crustaceans and snails. Roach usually spawn in May on weed, stones, gravel or even tree roots depending on the habitat.

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RUDD *Scardinius erythrophthalmus*

This species is not thought to be indigenous to the Wessex Region but has been introduced to a number of ponds, rivers and canals. It prefers still or slow flowing water where it lives in shoals, and feeds at midwater or on the surface, on a wide range of plants and invertebrates. It rarely grows to more than 2 lb in weight. It is generally found in areas where there is prolific weed growth. Spawning usually occurs amongst weeds in late spring.

RUFFE *Gymnocephalus cernua*

Similar to the Perch the Ruff is not indigenous to the Wessex Region. This shoaling fish is known to be present in some slow flowing rivers in Avon and Somerset where it feeds near the river bed on invertebrates and small fish fry. Spawning takes place in May.

STICKLEBACK (THREE SPINED) *Gasterosteus aculeatus*

A small widely distributed fish the Stickleback is found in streams, rivers, ponds and lakes, and occasionally in brackish water. It feeds mainly on water fleas and insect larvae. During the breeding season in the spring, the males become brightly coloured, and build nests of weed held together with a sticky secretion which they produce. The eggs are laid in the nest by the female, which are then guarded by the male until hatching.

STICKLEBACK (TEN SPINED) *Pungitius pungitius*

A similar species to the three-spined stickleback, it is less well distributed, but is known to be present in the Wessex Region.

STONELOACH *Neomacheilus barbatulus*

Widely distributed throughout our rivers and streams the Stoneloach can be found living amongst and under stones on the river bed. They feed on small invertebrates and spawn in late spring.

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TENCH *Tinca tinca*

The Tench is found throughout the Wessex Region in ponds, lakes and canals. A resilient fish it is present in the more sluggish parts of many of our rivers, and is able to tolerate poor water quality. It feeds on the river bottom on insects, worms and snails. Although rarely observed the presence of the Tench is often given away by minute bubbles which rise to the waters surface as they sift through the mud for food. This is particularly noticeable at dawn or dusk when the tench are most active. Spawning takes place in late or early summer, usually in the weedy shallows where the water is warmest. Tench may reach a weight of 8 lb or more, particularly the females which tend to grow larger.