

# **RIVER CATCHMENT PLANS RIVER STORT EVALUATION REPORT**

**November 1989**



**NRA**

*National Rivers Authority  
Thames Region*



NRA THAMES 251

110

- RIVER CATCHMENT PLANS

FOR

FLOOD DEFENCE AND LAND DRAINAGE

RIVER STORT

EVALUATION REPORT

Catchment Planning Officer (Waltham Cross)  
Technical Planning  
Technical Services  
National Rivers Authority Thames Region

November, 1989

ENVIRONMENT AGENCY



123204

## CONTENTS

		Page No.
	CONTENTS/FIGURES	(i)
	ABBREVIATIONS	(ii)
Section 1	EXECUTIVE SUMMARY	
	1.1 Introduction	3
	1.2 Key Details	4
	1.3 Key Issues	5
	1.4 Key Investigations	5
Section 2	CATCHMENT PLANNING	
	2.1 Introduction	9
	2.2 The Evaluation Report State	9
	2.3 Specific Requirements of the Study	10
Section 3	DATA ASSESSMENT	
	3.1 Catchment Description	13
	3.2 Principal Function Analysis	14
	3.3 Catchment Attribute Analysis	17
	3.4 Influence of Corporate Considerations	20
Appendix I	Principal Functions - Analysis Sheets	23
Appendix II	Catchment Attributes - Analysis Sheets	51

## FIGURES

		Following Page No.
Figure 1	Location Plan	4
Figure 2	General Features	14
Figure 3	Drainage Features	16
Figure 4	Land Use Features	18
Figure 5	Levels of Service Features	20

## ABBREVIATIONS

BWB	British Waterways Board
EA	Environmental Assessment
EEC	European Economic Community
ER	Evaluation Report
FAS	Flood Alleviation Scheme
FRQSIM	Acronym for a Computational Hydrological Model
IGR	Implementation Guidelines Report
LCCB	Lee Conservancy Catchment Board
NRA	National Rivers Authority
ONDA	Acronym for a Computational Hydraulic Model
RCP	River Catchment Plan
RORB	Acronym for a Computational Hydrological Model
STW	Sewage Treatment Works
TR	Thames Region
TW	Thames Water
SI	Statutory Instrument

**SECTION 1**

**EXECUTIVE SUMMARY**

## SECTION 1

### EXECUTIVE SUMMARY

#### 1.1 Introduction

Catchment planning is a process which balances society's need for development with the need to conserve and enhance the river environment. It is the result of a coordinating approach by the Technical Services Sector of the NRA Thames Region to ensure an efficient and effective response to flood defence and land drainage problems within river catchments.

River Catchment Plans produced during the process will set out a framework for managing the flood defence and land drainage aspects of individual river systems. These RCPs will help the NRA meet its statutory obligation and fulfill its guiding principle:

"The NRA Thames Region is dedicated to maintaining and enhancing the total river environment".

The River Catchment Plans will be produced by the Catchment Planning Section in accordance with the 'River Catchment Plans for Flood Defence and Land Drainage. Implementation Guidelines Report' (NRA Thames Region, September, 1989). This report provides, inter alia, an explanation of catchment planning, the method of approach, the proposed extent of investigations and reporting and monitoring procedures.

The first stage in producing a River Catchment Plan for the river Stort (see Figure 1) is the production of an 'Evaluation Report' and a 'Supporting Memorandum to the Evaluation Report'. Respectively, these two documents present in qualitative and quantitative terms what information exists on the catchment, and what investigations - and hence resources - are required to produce the River Catchment Plan.

This River Stort Evaluation Report presents a review of available information on the Stort 'catchment against a check-list of 16 'principal functions' and 17 'catchment attributes' (see Sections 3.2 and 3.3 respectively). Until the River Catchment Plan is produced this Evaluation Report can be used as a catchment handbook, providing as it does an overview of the Stort catchment for those involved in flood defence and land drainage.

For the Flood Defence and Land Drainage function, this River Stort Evaluation Report is, along with those for the Lower Colne and Marsh Dykes, the first of its kind to be produced. As such it is one of the first key steps in the achievement of the NRA Thames Region Business Plan Key Plan Area for River Catchment Plans:

"Production of flood defence river catchment plans for all significant urban catchments by March, 1994".

## 1.2 Key Details

### A. Location Details

- (a) Area: Lee (b) Zone: Upper Lee  
(c) Sub-Zone: River Stort (d) Code: 1316

### B. Catchment Details

- (a) Area (Km<sup>2</sup>): 278.2 (b) Population (est.): 130 000  
(c) Main River Length (km): 183.9 km  
(d) Main River Designations: River Stort Stort Navigation  
Pincey Brook Stansted Brook  
Stickling Green Brook Ugley Brook  
Canon's Brook Sawbridgeworth Brk  
Pole Hole Brook Hunsdon Brook  
Fiddler's Brook etc.

### C. Administrative Boundaries

- (a) County Councils: Essex, Herts, (Cambs)  
(b) District Councils: East Herts, Epping Forest, Harlow, Uttlesford,  
(South Cambs.)

### D. Authority Function Areas

- (a) Flood Defence and LD: Lee (b) Fisheries: Thames East  
(c) Statutory Planning: Lee (d) Pollution Control: 5  
(e) Groundwater Protection: North East (f) Biology: East

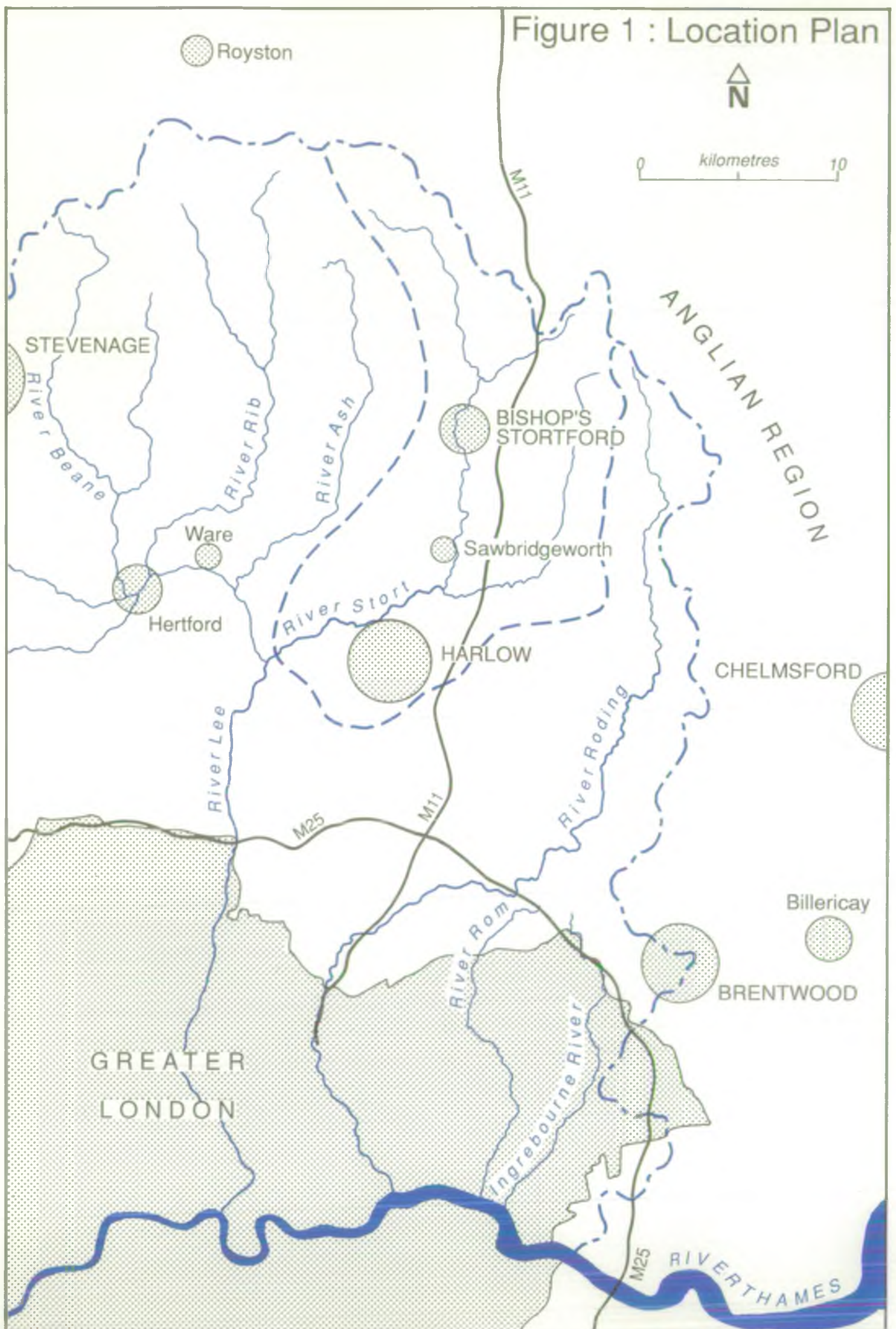
### E. Levels of Service

Number of Reaches in Land Use Band A: 2  
Number of Reaches in Land Use Band B: 2  
Number of Reaches in Land Use Band C: 2  
Number of Reaches in Land Use Band D: 3  
Number of Reaches in Land Use Band E: 23

Percentage of reaches where Level of Service is inadequate: 16



Figure 1 : Location Plan





### 1.3 Key Issues

The following are key issues to be addressed in the River Catchment Plan for the River Stort.

- \* Evaluate standards of urban flood protection at Bishop's Stortford, Harlow, Sawbridgeworth and Roydon and identify need for future flood defence works.
- \* Prepare river control strategy for the Stort Navigation with the British Waterways Board and riparian owners.
- \* Renegotiate with British Waterways Board the agreement for the apportionment of maintenance costs on the Stort Navigation.
- \* Ensure NRA interests, including surface water runoff management, floodplain control and river habitat management, are properly catered for both internally and within the statutory forward planning system (i.e. local plans etc.).
- \* Identify effect on NRA interests of development pressures associated with Stansted airport and the M11 corridor.
- \* Ensure the ecological value of the Stort catchment is properly recorded and its future protection and enhancement catered for.
- \* Identify means for NRA achieving closer quality control on third party flood defence and land drainage works within the catchment.

### 1.4 Key Investigations

The following are key investigations required to achieve the aims of the River Catchment Plan and address the Key Issues detailed above.

- \* Undertake a topographical survey of the Stort Navigation and associated watercourses.
- \* Update the RORB hydrological model of the catchment and develop FRQSIM hydrological models of the major urban drainage systems (i.e. Harlow and Bishop's Stortford).
- \* Prepare an ONDA hydraulic model of the Stort river system between Bishop's Stortford and Feildes Weir to investigate flood defence, river control and river operations activities.
- \* Undertake an ecological river corridor survey of the Stort watercourse system between Bishop's Stortford and Feildes Weir.
- \* Undertake a morphological assessment of the Stort river system.

SECTION 2

CATCHMENT PLANNING

## SECTION 2

### CATCHMENT PLANNING

#### 2.1 Introduction

Awareness of the possible interactions which the flood defence and land drainage function has with a variety of catchment related 'functions' and 'attributes' has increased significantly over recent years. Wider appreciation of these interactions has reinforced the need to view individual problems and/or opportunities in the context of the catchment as whole, in order to properly ensure the future well-being of the river environment. Put very broadly therefore, Catchment Planning is a process which balances society's need for development with the need to conserve and enhance the river environment.

The Implementation Guidelines Report provides a framework within which River Catchment Plans can be produced by the Catchment Planning Team, which forms part of the Technical Planning Group within the Technical Services Sector of the NRA Thames Region. Responsibility for production of the Stort River Catchment Plan will lie with the Catchment Planning Officer (Waltham Cross).

This Evaluation Report forms an important part of the Stort River Catchment Plan process since it provides the background to the problems and opportunities within the catchment, and through the Supporting Memorandum to the Evaluation Report, an assessment of the resources and programme of work required to achieve it.

During the production of the RCP, the Catchment Planning Officer will produce a six-monthly Situation Report which will detail progress, future workload, and performance measures. This will ensure that Catchment Planning is efficient, business like and meets quality assurance aims.

#### 2.2 The Evaluation Report Stage

The purpose of the Evaluation Report stage is twofold. Firstly, it presents in qualitative and quantitative terms what information exists for the catchment in respect of each of the 16 principal functions (i.e. River Operations, Flood Defence and Land Drainage etc.), 17 catchment attributes (i.e. ecology, landscape etc.), and several corporate considerations (i.e. health and safety, information technology etc.). At this stage the problems, issues and opportunities that need to be addressed in the River Catchment Plan are identified. Secondly, it identifies what investigations - and hence resources - are required to meet the aims and objectives of the catchment planning initiative.

Presentation of the technical aspects of the Evaluation Report stage is through the Evaluation Report itself. The resource and programming aspects, however, are detailed in the Supporting Memorandum to the Evaluation Report. Separation of the technical and resource aspects allows the Evaluation Report to be used as a catchment handbook. However it must be appreciated that the Evaluation Report is essentially a desk study and consultation exercise, and is therefore, limited to listing, rather than evaluating, the interactions between individual catchment functions and attributes.

### - 2.3 Specific Requirements of the Study

In January, 1989, three Evaluation Reports (then called Concept Reports) were prepared for the Lower Colne, River Wandle and Upper Lee catchments. The scope of these reports was limited to those principal functions and catchment attributes that were the direct responsibility of the Technical Services Sector.

The current group of Evaluation Reports for the Lower Colne, Marsh Dykes and River Stort catchments have proceeded hand-in-hand with discussions with staff throughout the NRA Thames Region on the scope and format of the River Catchment Plans for Flood Defence and Land Drainage. These discussions have allowed the Evaluation Report stage investigations to cover the full range of principal functions and catchment attributes.

To meet recommendations made by the Technical Services Policy Group the level of detail within the Supporting Memorandum to the Evaluation Report has been extended. In particular, a range of options for the more extensive technical investigations has been provided. To ensure that the resource implications of particular investigations (e.g. hydraulic modelling) were robustly assessed, extensive discussions have been held with staff in the appropriate NRA sections. Where necessary, cognisance of studies already in NRA programmes of work has been taken into account in preparing the 'Supporting Memorandum to the Evaluation Report' (NRA Thames Region, December, 1989) for the Stort.

### SECTION 3

#### DATA ASSESSMENT



## SECTION 3

### DATA ASSESSMENT

#### 3.1 Catchment Description

The Stort catchment is the largest of the six upper tributaries of the river Lee and contains over 180 km of main-river watercourse. Apart from the Stort valley itself, which contains the towns of Stansted Mountfitchet, Bishop's Stortford, Sawbridgeworth and Harlow, the catchment is predominantly rural (see Figure 2). Surface water runoff rates from the Boulder Clay which covers most of the catchment are relatively high, typically 25 to 50%.

Transport links have, and are continuing to, influence the nature of the Stort catchment. The oldest of these links, the Stort Navigation linking Bishop's Stortford to Feildes Weir, was built in 1769 in order to allow the local malting trade to compete with that at Hertford and Ware which was already served by the Lee Navigation. Completion of the London to Cambridge railway in 1842 quickly led to the decline of waterborne trade, however. This rail link follows the valleys of the river Stort and Stansted Brook through from Feildes Weir to Elsenham via Roydon, Harlow, Sawbridgeworth, Bishop's Stortford and Stansted Mountfitchet. The M11, completed in the 1970's, follows higher ground between the river Stort and Pincey Brook. Currently, Stansted airport, located at the headwaters of the Pincey Brook, is being extended to cope with 8 million passengers per annum.

The M11 (which links Cambridge and London's Docklands) and Stansted Airport are presently acting as a magnet for investment in the area. This is reflected in the nature of the Town and Country Planning applications that are being processed for the area: large residential developments at Harlow and Bishop's Stortford; major industrial and commercial developments at Stansted airport and Harlow; and, infrastructure proposals such as the airport rail link and A414 to M11 road link. These third party works are the greatest threat to the NRA's interests in the Stort catchment at present.

The Stort Navigation, which is the responsibility of the British Waterways Board, no longer carries commercial traffic. It does, however, still dominate the drainage network in the Stort catchment since many of its 15 locks and more than 30 control structures are incapable of safely passing flood flows. At the upper end, between Bishop's Stortford and Spellbrook, improvement works have been undertaken to provide urban areas with a 1 in 70 year standard of flood protection. However, further works to improve the drainage of agricultural land and provide urban areas at Sawbridgeworth, Harlow and Roydon with similar standards of flood protection had to be abandoned in 1982 at the design stage. Objectors to the £5 M scheme included the Nature Conservancy Council, Essex and Herts County Councils, several local councils and a variety of environmental interest groups, all of whom were concerned at the impact of potential agricultural land use changes on the ecology of the Stort valley.



Wetlands and grasslands in the Stort valley are considered to be of major ecological significance since they represent a regionally rare assemblage of habitats. The Stort valley supports several Local Nature Reserves, Sites of Special Scientific Interest and conservation areas, including the Spellbrook flood lagoon. The true value of the valley, however, lies in the sum of its parts which are the result of both the natural and artificial flood and water table regime in the valley.

Although water quality in the upper catchment is deteriorating gradually, the river is still classified as Class 1B in quality terms. The Stort, therefore has a high fisheries potential although this remains at risk from surface water runoff pollution from urban areas during summer thunderstorms and lack of dilution of sewage treatment work discharges during low flow periods. The underlying chalk aquifer is confined and therefore has limited inter-action with the surface water system. Water supply is provided by Lee Valley Water, who use a mixture of local ground water sources and imported surface water sources.

For almost 25 km downstream of Bishop's Stortford the river Stort forms the boundary between Herts and Essex. As a consequence management of the river system and its catchment is split between a number of bodies with different aims and policies in such key areas as Town and Country Planning and statutory and non-statutory ecological protection. The NRA must help ensure that these different groups act in a co-ordinated fashion.

### 3.2 Principal Function Analysis

Details for each of the 16 principal functions outlined below are given in the analysis sheets in Appendix I.

#### 3.2.1 Customer Services/Public Relations

Production of a River Catchment Plan will focus fresh attention on issues that have already affected the Stort catchment (i.e. the River Stort FAS Phase II) as well as identifying new areas of public interest. If the NRA is to accommodate the views of the public, local interest groups and statutory bodies - all of which are the NRA's customers - it will be essential to encourage them all to play a part in the process of producing the River Catchment Plan.

#### 3.2.2 Catchment Drainage

The River Stort is the largest of the upper six tributaries of the river Lee and contains over 180 km of main-river watercourse. The Boulder Clay catchment, which is predominantly rural, contains the towns of Harlow, Bishop's Stortford, Sawbridgeworth and Stansted Mountfitchet, all of which are located on the banks of the river Stort. The main drainage feature of the catchment is the Stort Navigation but there are also several significant ornamental ponds (i.e. Pishiobury Broadwater and Hunsdonbury Park lake) and surface water storage ponds (i.e. Stansted airport balancing ponds, Spellbrook flood lagoon and Brenthall Park at Harlow) which affect the regime of the drainage system.



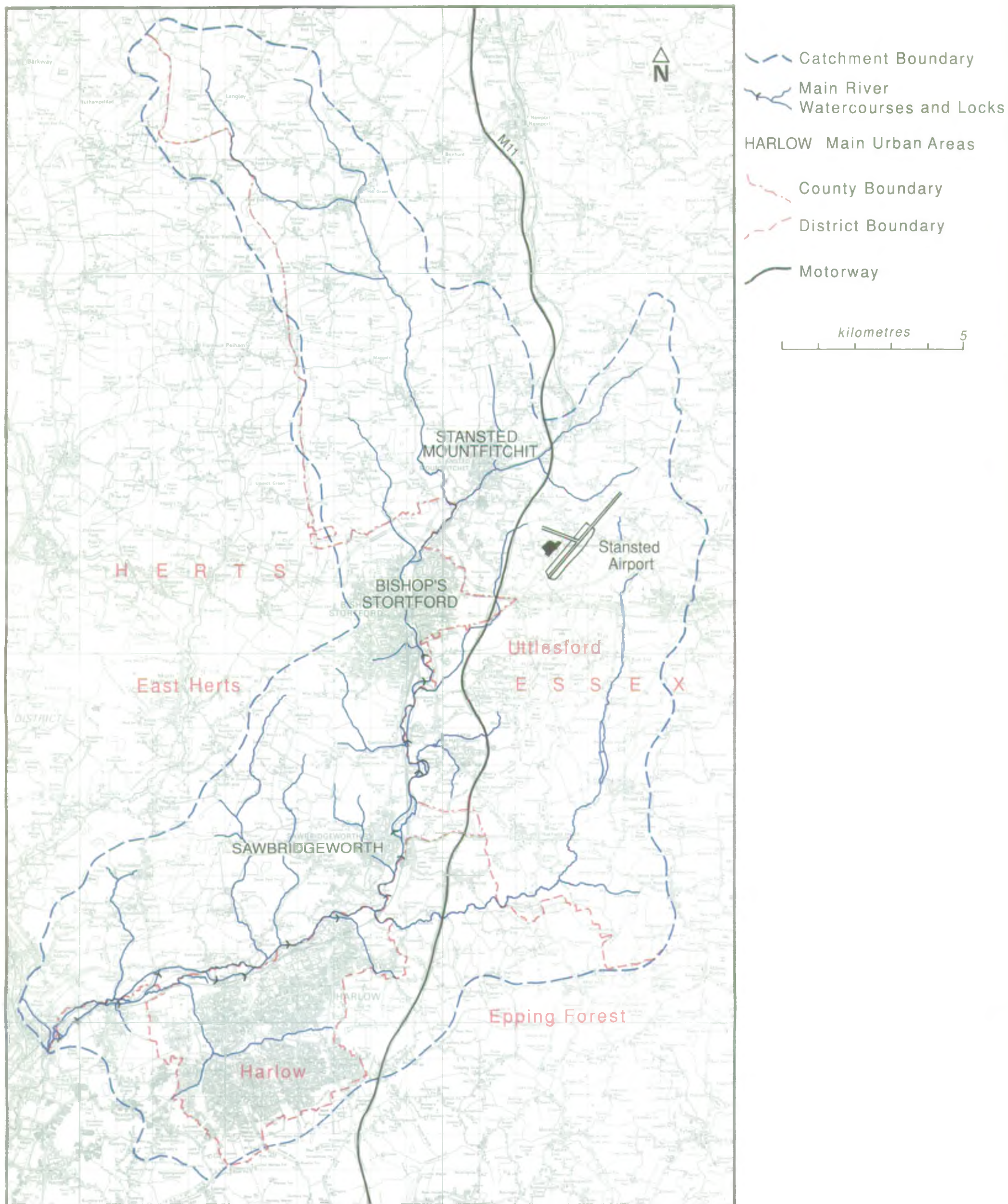


Figure 2 : General Features





### 3.2.3 River Control

Between Bishop's Stortford and Feildes Weir there are 15 locks (see Figure 4) and over 30 weirs, sluices and other flow control structures. River control in this part of the catchment is, therefore, both complex and very important if the navigation, flood defence and land drainage, recreation and amenity, and environmental needs are to be successfully reconciled.

### 3.2.4 Flood Defence and Land Drainage

Works completed between 1967 and 1980 have provided Bishop's Stortford with a 1 in 70 year standard of flood protection. The £5 M River Stort FAS Phase II was designed to provide a similar level of urban flood protection to properties in Sawbridgeworth, Harlow and Roydon and to improve the agricultural potential of farmland through improved land drainage. However, this scheme was abandoned in 1982 as a result of the concerns expressed by the Nature Conservancy Council, Essex and Herts County Councils, East Herts and Harlow District Councils and local environmental interests in the lower Stort valley.

### 3.2.5 Statutory Planning and Control

Due to the expansion of Stansted airport (which is at the headwaters of Pincey Brook) and the proximity of the M11 (which links Cambridge to London's Docklands) the Stort catchment has seen - and will continue to see - very high levels of development pressure. This is reflected in the provision of large residential developments at Bishop's Stortford and Harlow, commercial and industrial development at Harlow and Stansted airport, and infrastructure such as the Stansted airport rail link and A414/M11 road link. The impact of these third party works on the Stort river environment is much greater than that of the NRA's own works. However, at present site inspections by NRA staff to assess third party compliance with the agreed details of Land Drainage Consents and Town and Country Planning applications are at a very low level.

### 3.2.6 River Operations

Maintenance of the Stort Navigation is undertaken by British Waterways Board but since the navigation is also a main-river watercourse, the NRA contribute 50% of the costs. Elsewhere, the river system is predominately rural (23 of the 32 reaches identified for the Levels of Service System for Urban and Rural Flood Defence are within land use band E). Much information and experience located within the Lee Area River Operations Group will be of direct use to other parts of the NRA when properly disseminated.

### 3.2.7 Navigation

The Stort Navigation has not carried commercial traffic since 1972 and despite its scenic qualities is only lightly used for recreational purposes at present. During the last five years 9 of the 15 locks have been substantially renovated. However, many of the locks are still not capable of dealing with floodwaters (i.e. Harlow Lock) and are therefore a primary cause of flooding to residential, commercial and industrial premises in Sawbridgeworth and Harlow in particular.

### 3.2.8 Emergency Planning

It is important that information held by those involved in flood defence is properly disseminated to the Emergency Planning Officer and consistent with that held by others including Flood Warning to ensure that responses to emergencies are timely and appropriate.

### 3.2.9 Flood Warning

Several locations within the catchment benefit directly from flood warnings including Clavering and Harlow. At present the real-time observational (i.e. weather radar and telemetry stations) and real-time predictive (i.e. computer based hydrological flood forecasting models) capabilities of the warning system used on the Stort catchment are being improved.

### 3.2.10 Flood Monitoring

During 1987 and 1988 the flood monitoring system at Waltham Cross was successfully implemented on the Stort catchment. Much useful information, including an aerial video, was obtained which will be of use in verifying hydraulic modelling studies and in identifying the extent of the floodplain to local authorities and developers.

### 3.2.11 Water Resources

The chalk aquifer underlying the Stort catchment is substantially confined and therefore does not interact with the surface water drainage network. Direct abstractions from the river Stort and its tributaries are not significant. Water supplies provided by Lee Valley Water to the 130 000 inhabitants within the catchment are a mixture of local groundwater supplies and imported surface water supplies.

### 3.2.12 Water Quality

The Stort is classified as a Class 1B river and although in the upper parts of the catchment surface water quality is deteriorating the overall river water quality is generally good. Groundwater quality in the confined chalk aquifer is not at risk from shallow surface water soakaways which will normally discharge to superficial deposits of gravel and alluvium.

### 3.2.13 Water Pollution Control

Agricultural surface water pollution in the upper parts of the catchment is increasing but sewage treatment work pollution in the Stort valley is generally improving. Several urban watercourses including Todd Brook and the Thorley Tributaries are suffering from a mixture of reduced base flows and unconsented discharges.

### 3.2.14 Environmental Assessment

The NRA have not yet been required to produce any Environmental Assessments under SI 1217 and 1199 for works in the river Stort catchment. It will be essential to ensure that data collected for the River Catchment Plan is compatible with the requirements of potential future environmental assessment work.

### 3.2.15 Fisheries

The Stort is designated as a cyprinid fishery but supports a migratory trout population as far upstream as Feakes lock.

In spite of occasional fish kills (i.e. Summer 1977) the Stort is a good fishery with a high potential. Several of the tributaries (i.e. Pincey Brook and Great Hallingbury Brook), which act as spawning sites, may benefit from enhancement measures such as habitat improvement and sediment control.

### 3.2.16 Consultation and Liaison

During production of the River Catchment Plan existing lines of consultation and liaison with the public, interest groups and statutory bodies will be used to ensure the Plan receives a wide exposure. Where necessary on-going formal/in-formal lines of communication will be set up for the benefit of all NRA functions undertaking initiatives in the catchment.

## 3.3 Catchment Attribute Analysis

Details for each of the 17 catchment attributes outlined below are given in the analysis sheets in Appendix II.

### 3.3.1 Topography

Detailed topographical surveys of the Stort Navigation and its associated drainage channels were completed in 1951, 1962 - 1968 and 1980. Completion of a hydraulic modelling exercise on the Stort Navigation would require new survey information, however. Aerial photography for much of the catchment is available commercially.

### 3.3.2 Geomorphology

The river Stort and its tributaries are generally low energy clay bed watercourses which if left undisturbed are inherently stable. However, where the streams have cut into the glacial deposits there is evidence of instability. This is particularly true where the natural systems have been disturbed: urbanisation has increased runoff in Todd Brook and Canon's Brook; resectioning on the upper Stort has reduced bed slopes; and, overwidening has taken place upstream of Hockerill Bridge in Bishop's Stortford and on the Thorley Tributaries.

### 3.3.3 Hydrology

A RORB hydrological model has been developed for the entire catchment (the runoff control zones are shown on Figure 4) and a number of flood flow evaluations prepared for several points on the river network. The current hydrological gauging network comprises 6 flow gauging stations, 2 water level recorders and several raingauges. The influence of urbanisation on the hydrological response (i.e. increased flood flows, reduced base flows, more frequent floods etc.) of the Canon's Brook at Harlow is currently being re-evaluated.

### 3.3.4 Hydraulics

The Stort Navigation is a very complex hydraulic system and contrasts quite dramatically with the rest of the Stort catchment watercourse system which is relatively simple. Backwater calculations have been completed for the Stort Navigation but the model used is incapable of readily assessing the range of navigation, river control, flood defence, and environmental inter-actions. An unsteady state ONDA hydraulic model of the lower Stort is therefore required.

### 3.3.5 Land Use

In the upper reaches of the catchment land use is predominantly agricultural with small pockets of woodland. In the Stort floodplain water meadows have been retained and traditional pastoral farming is still significant. The Stort valley also contains significant urban areas and gravel abstraction areas, however. Land use change is accelerating within the catchment due to development pressures associated with Stansted airport and the M11. The Metropolitan Green Belt stretches up the Stort valley to Bishop's Stortford.

### 3.3.6 Landscape

The landscapes to the south of Bishop's Stortford are strongly influenced by the river and navigation and the associated stretches of relatively unspoilt lowland valley. Both the Essex and Herefordshire County Structure Plans offer protection to the landscape of the Stort valley.



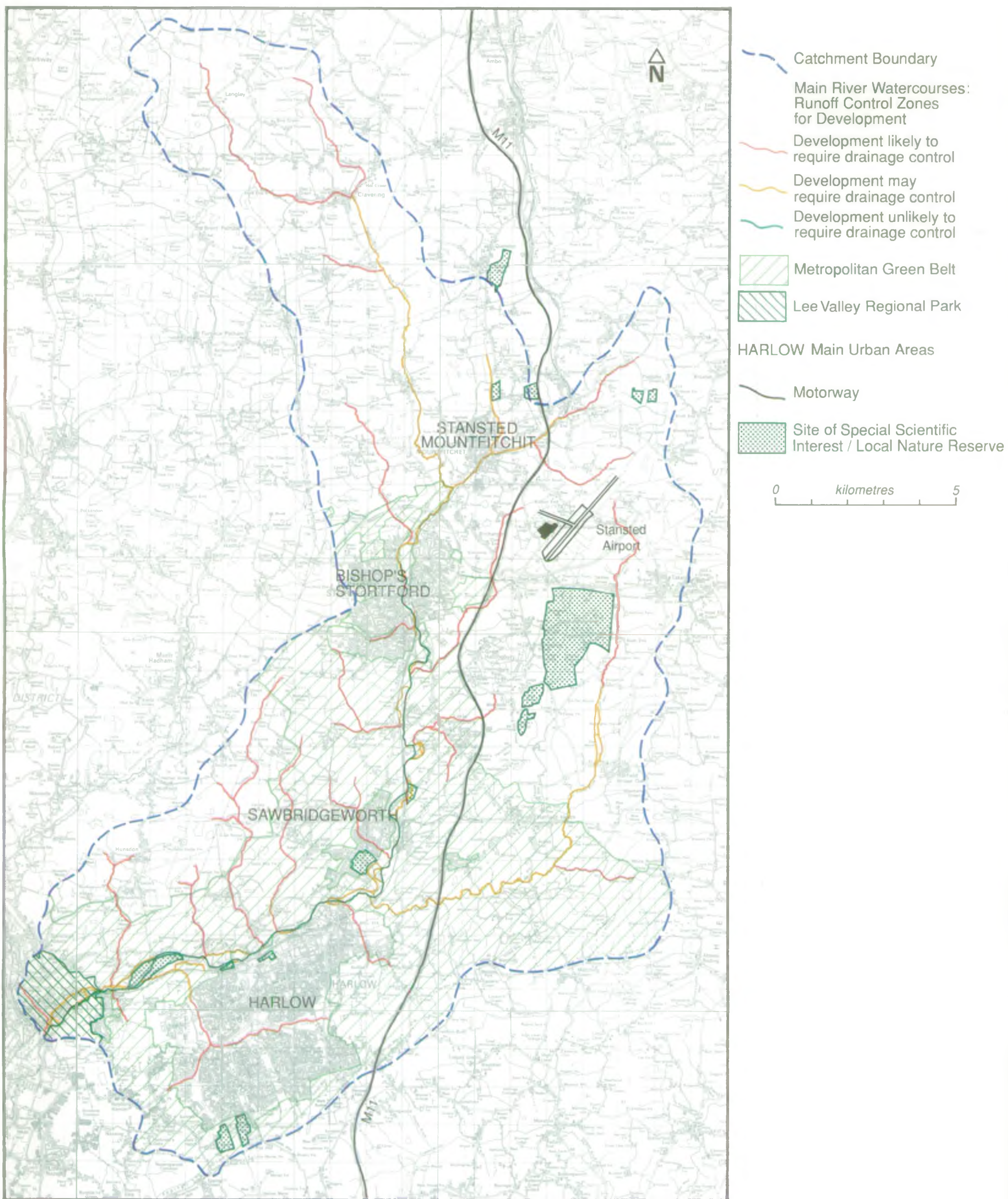


Figure 4 : Land Use Features





### 3.3.7 Agriculture

Agriculture is the predominant land use in the catchment and with the exception of the Stort valley the land is either grade 2 or 3a. Arable farming is therefore predominant and as in other areas, features such as hedgerows and ponds have been lost. Abandonment of the River Stort FAS Phase II, which was justified principally on agricultural benefits, has ensured that the Stort valley has not been converted to arable land in the same way.

### 3.3.8 Built Environment

The main feature is the navigation itself and its associated structures (i.e. locks, mills, weirs etc.). Several recent residential and commercial developments at Bishop's Stortford, Sawbridgeworth and Roydon have capitalised on this feature of the built environment.

### 3.3.9 Heritage

Hatfield Forest, once part of the Royal Forest of Essex, the traditional landscape of the lower Stort Valley, and the towns of Bishop's Stortford and Sawbridgeworth are the principal heritage features in the catchment. Several landscaped gardens developed in the 18th and 19th centuries contain artificial water features on main-river watercourses.

### 3.3.10 Archaeology

The Stort valley has acted as a focus for settlement since Iron Age (i.e. Wallbury Camp at Spellbrook) and Roman (i.e. Harlow) times. Very little excavation within the Stort valley has been undertaken, however.

### 3.3.11 Land Ownership

These records are retained on a piece-meal basis by the NRA. By drawing on these various sources of information a database can be prepared to assist in the undertaking of many NRA functions.

### 3.3.12 Development Plans

The NRA's interests are not comprehensively covered by the two County Structure Plans and five District Local Plans relevant to the Stort catchment. An important part of the River Catchment Plan process will be to establish with forward planning teams at the various planning authorities the need for appropriate land use related policies (i.e. floodplain protection, surface water runoff control from new developments, protection of the water environment etc.) so that they may be readily incorporated at the next review stage.

### 3.3.13 Damage Potential

Bishop's Stortford has been provided with a 1 in 70 year standard of flood protection to avoid £4 M of potential flood damages. Downstream of Bishop's Stortford capitalised urban flood damages are thought to be in the order of £2 M. In addition there are significant urban flood damages at Clavering, Ugley and Manuden.

### 3.3.14 Ecology

The ecological value of the Stort valley lies in its assemblage of regionally scarce wetland and flood meadow habitats (see Figure 5). Thorley Wash (Spellbrook flood lagoon), Hunsdon Mead, Harlow Marsh and Sawbridgeworth Marsh are all important ecological sites for flora and fauna. The valley also functions as a major bird migration corridor. The Stort Valley Conservation Group has recently been set up to help protect and enhance this important area. The impact of farming practices and heavy dredging on watercourses in the upper catchment has been of environmental concern in the past, but in the future gravel extraction and water quality are seen to be the major threats to the water environment in the catchment.

### 3.3.15 Recreation and Amenity

Cruising, boating, canoeing, angling and walking are all important recreational features of the Stort Navigation which is also a prime amenity in the region. Harlow District Council are keen not only to promote small scale recreational features (i.e. riverside walks and nature trails) but also major schemes such as a sailing and water skiing facility. British Waterways Board have a Project Officer promoting recreation on the Stort and Lee Navigations.

### 3.3.16 Human Impact

Under SI 1217 and SI 1199 the human impact of works undertaken by the NRA has to be included within the environmental assessment procedure. This impact relates not only to all the attributes of the catchment described above but also includes noise pollution, disruption to access etc.

### 3.3.17 Customer Perception

The public concern for the environment is reflected in the NRA Thames Region's guiding principle stated earlier in Section 1.1. It is essential that the River Catchment Plan reflects the views of the public and that the NRA is seen to be achieving its prime objectives through any guidance, initiatives or policy contained within the River Catchment Plan.

## 3.4 Influence of Corporate Considerations

Corporate considerations is a heading intended to embrace all the activities which act as a control in respect of the manner in which the principal functions are discharged.









#### 3.4.1 Legislation

A key interaction here is between the legislation covering the NRA's interests (i.e. Water Act 1989, Land Drainage Act 1976 etc.) and that pertaining to the British Waterways Board. The interface between the two should be defined to provide clearer guidance to those working in the catchment. It will also be important to clarify what activities of the NRA constitute 'functions' and are therefore covered by the general environmental duties of Section 8 of the Water Act 1989.

#### 3.4.2 NRA Policies

As national policy is developed this will have to be incorporated into the River Catchment Plan. In the absence of national policy, policy developed by the Thames Region will be assessed to see how it directly impinges on activities in the Stort catchment. From the River Catchment Plan a number of catchment-specific policies or guidelines may be developed which will require the agreement of the Regional Flood Defence Committee as well as regional management.

#### 3.4.3 Business Planning

Catchment Planning will be conducted within the agreed management systems of the NRA Thames Region which include:

- (i) Business Planning: the preparation of River Catchment Plans for urban catchments such as the river Stort is a Key Plan Action within the Region's Business Plan. Monitoring in respect of the detail of the Business Plan will therefore be an important factor;
- (ii) Project Management: the Project Management Manual recently approved by the Regional Management Team will be followed in the preparation of the River Catchment Plan for the river Stort;
- (iii) Scheme of Delegation: the River Catchment Plan for the River Stort will require the use of external consultants. The letting of contracts to consultants will be in accordance with the Scheme of Delegation but since catchment planning is a new initiative, it is likely that the number of consultants able to offer appropriate services will be limited;
- (iv) Performance and Monitoring: the overall programme for River Catchment Plans will be monitored by the Technical Services Programme and Monitoring Control Team. Close liaison between the Catchment Planning Officer (Waltham Cross) and this team will be required to ensure the internal resource needs of the initiative are available at the right time or provision is made for extra use of external consultants;

- (v) Situation Report: overall progress on the catchment planning initiative will be reported in the six-monthly Situation Report to be prepared by the Catchment Planning team. This report will present clearly and openly the activities of the team in a standard format which enables business and operational activities to be assessed.

#### 3.4.4 Information Systems

The availability of a geographical information system (GIS) and relational database is a pre-requisite to effective and efficient catchment planning. A GIS is not seen solely as a means for storing information collected during the preparation of the River Catchment Plan for the River Stort but also a means of assessing catchment interactions and understanding the constraints and opportunities for maintaining and enhancing NRA interests. The IBM 'TAMESIS' system adopted by NRA Thames Region has been specified in order to meet the expected needs of the catchment planning team.

#### 3.4.5 Health and Safety

The River Catchment Plan will offer the opportunity to review health and safety procedures in respect of the flood defence and land drainage activities undertaken in the Stort catchment. Preparation of an asset register for the river system will enable similar types of risks (e.g. culvert maintenance) to be identified. A programme for assessing the structural and operational safety of structures attended by NRA Thames Region staff should be agreed with the River Operations Group at Ware.

#### 3.4.6 Urban and Rural Flood Defence Levels of Service

The River Catchment Plan for the river Stort will support this initiative by providing clearer details on the extent of the floodplain, the land uses at risk within the floodplain and the expected frequency of flooding under a range of maintenance strategies. It will also enable the causes of symptoms such as increasing flood risk, to be identified.

## APPENDIX I

### PRINCIPAL FUNCTIONS - ANALYSIS SHEETS

Customer Services/Public Relations  
Catchment Drainage  
River Control  
Flood Defence and Land Drainage  
Statutory Planning And Control  
River Operations  
Navigation  
Emergency Planning  
Flood Warning  
Flood Monitoring  
Water Resources  
Water Quality  
Water Pollution Control  
Environmental Assessment  
Fisheries  
Consultation And Liaison



## CUSTOMER SERVICES/PUBLIC RELATIONS

- Importance: No major works or problems associated with the water environment are to the public fore in the catchment at present. Production of a River Catchment Plan for the catchment will focus fresh attention on past issues (see FLOOD DEFENCE AND LAND DRAINAGE), however. If handled properly this attention may be used to stimulate mutual respect and confidence between the NRA and the general public and its representatives in the catchment. Public Relations will play a key role in ensuring the success of the River Catchment Plan.
- Information: (1) Public Relations Sector, NRA TR.  
(2) Customer Consultative Committee Minutes.
- Evaluation: The experience of the Public Relations Sector in formulating ideas for encouraging public interest, will enable the public's views to play an important role in formulating the River Catchment Plan. Similarly, procedures must be developed for ensuring that the public are able to comment on the draft River Catchment Plan and continue to play a full part in its on-going revision. Such procedures should enable future NRA initiatives to be implemented more efficiently.
- Requirement: (1) Preparation of a Public Relations policy and programme for the implementation of the River Catchment Plan Process.  
(2) Preparation of appropriate leaflets, brochures and advertisements to promote the initiative and the River Catchment Plan Policy Report and its findings.  
(3) Review of River Catchment Plan Customer Services/Public Relations process adopted.  
(4) Identification of possible improvements to existing channels of communication with external groups.

## CATCHMENT DRAINAGE

**Importance:** The river Stort is the largest of the six<sup>2</sup> upper tributaries of the river Lee and drains an area of 278km<sup>2</sup>. Runoff rates from the predominantly rural Boulder Clay catchment are relatively high (typically 25% to 50%). Although superficial deposits feed the drainage network during dry periods there is no substantial continuity between the river system and the underlying chalk aquifer. Several tributaries, including the Stort upstream of Stansted Springs, dry up during periods of low rainfall.

There are several lakes and storage ponds in the catchment which attenuate and store floodwaters. However, the main drainage feature of the catchment is the Stort Navigation downstream of Bishop's Stortford. This complex system of locks, bifurcations, weirs, by-pass channels etc. poses many problems (and opportunities) and was instrumental in the development of the present environmental and landscape interest of the lower Stort valley.

Few non-main river drainage problems are thought to exist in the non-urban parts of the catchment. This may be a reflection of the relatively high density (0.66 km/km<sup>2</sup>) of main-river watercourses within the catchment.

**Information:**

- (1) Thames Water Utilities Plc (North East Region, Sewerage and Sewage Treatment).
- (2) Local Authorities (East Herts D.C, Epping Forest D.C. and Harlow D.C.).
- (3) Highway Authorities (Essex and Herts C.C.).
- (4) Reservoir Act 1975 Register (Essex and Herts C.C.).
- (5) Storage Pond Survey. Appendix 3 Stort Catchment (Howard Humphreys and Partners, January 1988).

**Evaluation:** The production of a broad-brush hydrological model (RORB) for the catchment (see HYDROLOGY) has enabled the sensitivity of the drainage system to change, and its current response, to be assessed.

Closer links with drainage authorities (i.e. Harlow D.C. and East Herts D.C. for Bishop's Stortford) are required, however, to ensure that more detailed FROSIM models for urban areas are properly calibrated. This will also ensure that appropriate information is more readily passed between interested parties.

Detailed information on storage ponds is available, but reservoirs/ponds etc. within the catchment (i.e. Pishiobury Broadwater, Hunsdonbury Park lake, Hatfield Forest lake etc.) are less well detailed. The development of new gravel pits in the lower Stort valley will obviously affect drainage in this part of the catchment.

- Requirement:
- (1) Prepare register of all storage ponds, reservoirs, ponds etc. detailing their influence on the river system, control structure operation, ownership etc.
  - (2) Prepare watercourse system schematic.
  - (3) Reinforce liaison links with Thames Water Utilities Plc and local authority drainage engineers.
  - (4) Collect details of urban drainage systems including details of sewerage networks, soakaways, storm water overflows, etc.

## RIVER CONTROL

- Importance: Between Bishop's Stortford and Feildes Weir there are 15 locks, several mills and over 30 weirs and sluices which can influence the distribution of river flow, especially during flood events. Consequently, river control is both complex and important. Operation of these river controls is made particularly difficult since ownership is shared between British Waterways Board, several private owners, Bishop's Stortford Town Council and the NRA itself. The passage of floodwaters, notably in the reach between Harlow Mill and Parndon Mill, is very sensitive to the operation of control structures. The ecological interest of the lower Stort valley is very dependent upon the retention of a high water table.
- Information: (1) BWB Records (Lock keepers at Roydon Mill, Burnt Mill and Harlow Mill).
- (2) Individual operators/owners of control structures.
- (3) Flood monitoring records.
- Evaluation: At present the operation of river control structures is based on an informal policy developed through experience. The British Waterways Board provide a co-ordinating influence but individual private owners remain free to operate as and how they wish. Most private owners, however, are aware of their responsibilities and operate control structures in an appropriate manner.
- Many of the major control structures have been repaired in the last 3-4 years by BWB. Although the NRA contributes 50% towards the cost of such works little influence has been exerted by the NRA on the direction and form these works should take. Several problem sites still require repairs including the sluices at Sheering Mill, sidespill weirs at Hundson Lock, the sidespill weir at Lower Lock and Roydon Lock sluice by-pass.
- The sometimes conflicting need to retain pound levels, as well as be able to cope with floodwaters, makes river control around sensitive areas such as Burnt Mill a difficult problem to solve. This situation is exacerbated by the lack of on-site staff and any overall assessment of the most appropriate approach to reconciling the needs of navigation, flood defence and land drainage and ecological interests. The potential for using a greater number of automatic sluices (currently used at Harlow and Latton Mill sluices) in tandem with greater fixed crest capacity has yet to be evaluated in a systematic manner.
- Requirement: (1) Evaluate and record the current river control systems jointly with the BWB.

- (2) Identify through the use of a numerical hydraulic model for the Stort Navigation (see HYDRAULICS): the influence of individual structures on flow regime; the influence of control structures on the water table; the optimum capacity of the existing system; and, outline options to overcome critical constraints.
- (3) Identify the risks of failures to operate moveable control structures or blockages to structures.
- (4) With all interested parties, develop an agreed set of operating policies for river control structures on the river Stort/Stort navigation.

## FLOOD DEFENCE AND LAND DRAINAGE

Importance: The provision of flood protection (to the 1 in 70 year return period standard) to Bishop's Stortford through a scheme completed in three phases between 1967 and 1980 has significantly reduced the overall urban flood threat in the Stort catchment. Areas at risk do remain, however, notably at Roydon, north-east Harlow, several of the lock/mill sites (i.e. Parndon and Hunsdon) and at Clavering upstream of Bishop's Stortford.

Protection to the urban sites at risk downstream of Bishop's Stortford would have been afforded by Phase II of the River Stort FAS. This scheme (approximate cost of £5 M at 1989 prices) would have 'improved' agricultural land as well as protecting urban areas. However, this scheme was abandoned in 1982 because of its potential impact on the significant environmental interests in the Stort valley between Spellbrook and Feildes Weir.

Information:

- (1) LCCB Minutes (1930 - 1974)
  - 1930:River Stort at Sawbridgeworth (channel improvements)
  - 1930:River Stort at Pardon Mill
  - 1931:River Stort at Hunsdon Mill
  - 1935:River Stort at Burnt Mill
  - 1940:River Stort at Hallingbury Mill
  - 1967:Bishops Stortford FAS - PhaseI
  - 1969:Bishops Stortford FAS - PhaseII
  - 1969:Spell Brook Improvement Scheme
- (2) LCCB Micofilm Records (1948 - 1980)
  - 100(1948) Stansted Brook Channel Improvements
  - 103(1949) Culvert Works on Pincey Brook at Hatfield Broad Oak
  - 203(1950) Improvements at Burnt Mill
  - 319(1960) Spell Brook Improvement Scheme
  - 331(1962) Bishops Stortford FAS - Phase I
  - 346(1963) Harlowbury Brook Diversion
  - 414(1967) Culvert Works on Pincey Brook at Ealing Bridge
  - 416(1967) Bishops Stortford FAS - Phase II
  - 675(1980) River Stort FAS - Phase I
  - 728(1980) River Stort FAS - Phase II
- (3) TW (Rivers Diversion) Records
  - 1003(1982) River Stort at Clavering
  - 1015(1983) River Stort at Langley Lower Green
- (4) River Stort FAS Phase I (1975 - 1980)
  - Engineers Report (TWA (Lea Division), November 1976)
  - Survey/Hydrology/Hydraulics/Economic Assessments
  - Design and Contract Documentation
  - Pre and Post scheme Photographs

- (5) River Stort FAS Phase II (1978 - 1982)
  - Engineers Report (TWA (Lea Division), 1981)
  - Survey/Hydrology/Hydraulics/Economic Assessments/Land Use Survey/Environmental Assessments
  - Design Documentation
  - Contract Documentation for Spellbrook Lagoon
- (6) Ugley Brook Study (Flynn and Rothwell, October 1987)
- (7) Local Authority Records
  - East Herts D.C. Technical Services Department
  - Epping Forest D.C. Engineers Department
  - Harlow D.C. Development Services Department
  - Uttlesford D.C. Housing and Building Services Department

Evaluation: Comprehensive details are available for the completed (and proposed) major works between Bishop's Stortford and Feildes Weir on the river Stort. The proposed hydraulic modelling studies (see HYDRAULICS) will enable actual standards of protection to be estimated and areas of potential urban flood protection works to be identified. The only scheme in the current Land Drainage and Flood Defence capital programme is D7140: Ugley Brook (minor culvert improvements). Minor works at several other locations may be appropriate to overcome local problems.

On the river Stort downstream of Bishop's Stortford the River Stort FAS Phase II identified £2 (at 1989 prices) of capitalised urban damages.

In assessing the need for flood alleviation measures in the Stort valley two aspects require particular attention:

- (i) their environmental impact;
- (ii) the need for consultation and liaison with British Waterways Board and riparian owners because of the need to co-ordinate mill/weir operations.

Non-main river flooding problems are thought to be negligible, although East Herts D.C. are currently progressing a culvert improvement scheme at Dolphin's Way, Bishop's Stortford.

- Requirement:
- (1) Preparation of data summary sheets for past flood defence and land drainage works.
  - (2) Identification of areas for possible future flood defence and land drainage works.
  - (3) Review of main river designations.

## STATUTORY PLANNING AND CONTROL

Importance: Development pressures within the Stort catchment have probably never been greater. This situation is likely to continue for the foreseeable future for two reasons: the expansion of Stansted airport and the attractions of the M11 corridor which links Cambridge and London's Docklands, two areas of exceptional growth in themselves. These pressures will increase the workload (i.e. Town and County Planning applications and Land Drainage consents) in this area. These will be more readily handled if a strategic overview of the whole catchment has been undertaken.

Information: (1) Land Drainage Consent and Town and County Planning Comments Records (CAMS & CAPERS).  
(2) Land Liable to Flood Statutory Maps (TW, December 1981).

Evaluation: Application of the Statutory Planning and Control functional responsibilities within the Stort catchment is likely to become very much more onerous as development pressures continue to grow. Two sites currently being developed are Brenthall Park at Harlow (140ha of residential property) and Bishop's Park at Bishop's Stortford (1100 residential units).

Both the Herts and Essex Structure Plans offer direct protection to the floodplain and land drainage interests but these policies are not taken up in a consistent way by the local councils operating within the catchment. Some offer considerable support but others neglect the NRA's interests totally. Increased liaison with forward planning teams (as well as development control teams) will ensure a greater level of awareness and consistency in local councils' approach to flood defence and land drainage interests in particular.

The quality of the NRA's service is currently impaired by the lack of a coherent database, and to a lesser degree the adoption of clear guidelines on the approach to applications and consents in the catchment. Current discussions on the adoption of storage ponds has also highlighted the lack of clear internal guidelines on this matter.

Requirement: (1) Review 'formal' and 'informal' planning policies applied to the catchment.  
(2) Review existing floodplain at risk information and prepare composite plans with appropriate level information.  
(3) Review existing structure/local plan flood defence and land drainage policies.



- (4) Undertake consultation and liaison with planning authorities to encourage the adoption of policies aimed at providing enhanced protection of the NRA's interests.
- (5) Review existing Town and County Planning application and Land Drainage consent records for background data.

## RIVER OPERATIONS

**Importance:** Maintenance of the Stort main river system is undertaken by both the NRA and British Waterways Board (in the case of the Stort Navigation) as well as riparian owners. The NRA contribute 50% of the costs of BWB's 'maintenance' operations on the Stort Navigation.

The rural nature of the non-navigation main river system is highlighted by inspection of the land use bands evaluated for the levels of Service systems: of the 32 reaches, 23 are within land use land E.

**Information:**

- (1) Lee Area River Operations Group Records
  - work summary sheets
  - maintenance corridor survey sheets (inc photographs)
  - reach specification and standard time sheets.
- (2) Levels of Service for Urban and Rural Flood Defence
  - land use band definitions
  - monitoring scores
  - levels of service assessments
- (3) LCCB/TW/NRA Board/Committee minutes
- (4) Structural Appraisal of Timber Footbridges in the Lee Area of Thames Water. Volumes I and II. (Douglas Rose and Partners, August 1987).

**Evaluation:** Discussions with the Lee Area Manager and his staff have highlighted a number of problems which should be addressed in the River Catchment Plan for the river Stort. These include: sections with constricted flow (i.e. Tye Green Road culvert on Tye Green Brook, West Road culvert on Sawbridgeworth Brook and culverts on Thorley Tributaries); siltation and erosion problems (e.g. The Druce at Clavering on the river Stort and Netteswell pond on Todd Brook); lack of understanding of drainage system operations (e.g. channels in the vicinity of Rye Meads sewage treatment works and the discharge arrangements at the downstream end of Canon's Brook); and, perennial drainage problems and/or flood risks (e.g. Riverside works at Harlow, backing-up of tributaries discharging to the Stort Navigation such as Roydon Brook, and operation of sluices as at The Causeway, Bishop's Stortford).

Of great use to others within the NRA will be the knowledge and experience of the river system held - but often not formally recorded - by staff in the River Operations group. The reach specification and corridor survey sheets contain valuable information on the main-river watercourses and one aspect of the River Catchment Plan will be to re-interpret this information so that it can be more readily used by groups such as Technical Planning, Emergency Planning and Flood Warning.

- Requirement:
- (1) Establish historic scope of maintenance works and future priorities to enable studies in GEOMORPHOLOGY, HYDROLOGY and HYDRAULICS to be appropriately targetted.
  - (2) Produce register of main-river watercourse structures identifying location, ownership, operational responsibility etc.
  - (3) Establish status of operational links between the NRA and other interested parties (i.e. BWB, local authorities, county councils etc.). Reinforce links as necessary.
  - (4) Integrate knowledge gained from other River Catchment Plan investigations into the Levels of Service system.
  - (5) Establish greater awareness of the respective needs of River Operations and Technical Planning to ensure effective and efficient management of the drainage system.
  - (6) Reconsider agreements between BWB and NRA with respect to maintenance costs on the Stort Navigation.

## NAVIGATION

**Importance:** The Stort Navigation is an integral (and dominant) part of the land drainage system downstream of Bishop's Stortford. In many cases it follows the line of the original river Stort, which is now a backwater in comparison. Many of the left and right bank tributaries discharge into the navigation directly, leading to backing-up and hence flooding problems.

Since 1963 the navigation has been the responsibility of British Waterways Board. Recreational use of the 22.5 km of narrow 'cruising' waterway is currently on the increase but is still very light. The long-term future of the navigation is favourable since the system is one of the most picturesque stretches of navigation in the country.

**Information:**

- (1) BWB records (Historical, Engineering, Recreation and Amenity etc.) 1963 - present.
- (2) Lee Conservancy Board Records 1911 - 1962.
- (3) The Canals of Eastern England.
- (4) Inland Waterways Association.

**Evaluation:** Substantial repairs to the fabric of several locks have been completed in recent years: Sawbridgeworth and Southmill Locks were repaired in 1984; Sheering Mill Lock in 1985; Spellbrook Lock in 1986; Brick Lock and Harlow Lock in 1987; Lower Lock in 1988; and, Roydon Lock and Latton Lock this year. Feakes Lock and Burnt Mill Lock are due to be repaired in the next two years. Extensive repairs are also likely to be necessary at Twyford Lock in the immediate future. The increased emphasis on maintenance of the Stort Navigation is due to a number of factors. Firstly, there has been a need to overcome a chronic backlog of work on the navigation. This is coupled with a wish by BWB to promote greater use of the waterway. Of perhaps the greatest importance, though, has been the BWB's wish to maximise the NRA's financial contribution towards the upkeep of the navigation, since under an old Lee Conservancy agreement with BWB, 50% of costs are attributable to the NRA. Over the last 3 or 4 years these contributions have been between £100k and £150k per annum. Particular attention is currently being paid by the NRA to the form and scope of this agreement which appears to yield greater benefit to navigation interests than flood defence and land drainage levels of service.

Commercial traffic has not used the navigation since 1972. The original purpose of the navigation, built in 1769, was to allow the malt trade in Bishop's Stortford compete with that in Ware, which was already served by the Lee Navigation. Trade on the river declined rapidly after the opening of the London to

Bishop's Stortford railway in 1842. Ownership of the navigation passed to the Lee Conservancy in 1911 on the payment of a nominal sum after the total failure of Brick Lock earlier that year. Most recreational users of the waterway are locally based.

- Requirement:
- (1) Reconcile with appropriate interest groups needs of flood defence and land drainage with navigation needs for the Stort Navigation.
  - (2) Identify future maintenance needs for the Stort Navigation with BWB.
  - (3) Identify medium and long-term plans for the navigation. Identify joint policies for the assessment of third party works etc.

## EMERGENCY PLANNING

**Importance:** It is essential that the Region have in place general management systems for dealing with emergencies such as fluvial flooding and water pollution incidents. These systems apply to a variety of situations on all the catchments. However, by incorporating local knowledge with regards to the type and nature of possible emergencies in a particular catchment it is possible to respond more effectively and efficiently. There is therefore a need for awareness of potential local problems to be disseminated to the Emergency Planning Officer.

**Information:** (1) NRA Thames Region Emergency Planning Officer (i.e. emergency procedure manuals, lists of potential danger areas etc.).

(2) British Waterways Board Emergency Planning Officer.

**Evaluation:** Emergency procedures for the non-tidal river Thames identify details of locks, bridges, landing stations etc., which may be of use in responding to an emergency situation. Dissemination of existing and proposed databases would enable similar information to be provided for the river Stort. In addition information on the location and extent of potential flood risks within the Stort catchment can be compiled for use by Flood Warning, Emergency Planning and Flood Monitoring teams.

**Requirement:** (1) Provide the NRA Emergency Planning Team with a register of main-river watercourse 'assets' ( i.e. bridges, culverts, trash racks, locks etc.).

(2) Identify with the NRA Emergency Planning Team potential flood defence and land drainage related emergency incidents in the Stort catchment and modes of response.

(3) Ensure information on floodplain extent, areas at risk etc. held by interested parties is consistent.

## FLOOD WARNING

Importance: Several locations within the catchment (i.e. Clavering, Harlow and Roydon) benefit from the Flood Warning procedures and arrangements operated by the Catchment Control section for main-river watercourses in the Thames Region. This system also ensures that the River Operations Group at Ware and Flood Monitoring team at Waltham Cross are aware of the location and magnitude of impending flood events.

Information: (1) Catchment Control (Flood Warning Team) Records:

- evaluations of hydrological records at telemetry stations
- hydrological modelling for the Stort and Pincey Brook catchments (development stage)
- composite flood risk maps
- local authority emergency planning contacts

Evaluation: Over the last two years there has been a concerted effort to improve the real-time observational and predictive elements of the flood warning procedures applied to the upper Lee. Although hydrological models are not yet used to provide flood warnings on the catchment, early results from the model under development are encouraging. Increasing use of technology will enable warnings for specific reaches to be telexed to local authorities automatically.

To ensure the best use of the Flood Warning system it is essential that appropriate information held by the Flood Defence and Land Drainage and Technical Services Sectors is disseminated to the Flood Warning Team. This may include: updates on the standard of and/or extent of flood protection offered by capital works; results of hydrological or hydraulic modelling; and location and, nature of structures on the watercourse system known to provide an enhanced risk through blockages etc.

Requirement: (1) Ensure Flood Warning, Flood Monitoring and Emergency Planning response procedures are complementary and based on the same assumptions (i.e. extent of floodplain etc.).

(2) Disseminate information held by Technical Services and Flood Defence and Land Drainage to Flood Warning on the extent to which capital and revenue schemes have provided particular levels of flood protection.

(3) Ensure hydrological calculations used to define flood warning alerts (at the 2, 5 and 10 year return period events) are complementary to flood frequency calculations prepared by Technical Services for capital and revenue works.

## FLOOD MONITORING

**Importance:** The flood monitoring system run by the Technical Services Sector at Waltham Cross was extensively tested during the flood events of 1987 and early 1988. Much useful data (e.g. video, photographs, levels etc.) was collected. The current system covering the river Stort catchment is thus well proven and effective.

However, for none of the recent flood events has monitoring throughout the river Stort catchment been possible, due primarily to the distances between the many node points. This precludes the 'whole picture' being ascertained and also requires good communications to ensure staff are sent to the most appropriate locations.

- Information:**
- (1) Flood incident Files 1946-1984  
(Refer particularly to:  
1946, 1947, 1950, 1951, 1953, 1955, 1958, 1959, 1960, 1964,  
1968, 1974, 1975, 1977, 1978, 1979, 1980, 1981, 1982 and  
1983)
  - (2) LCCB and TW Minutes  
(1930 to present day)
  - (3) Report on the flooding in the Lee Valley during March 1947  
(LCCB, 1947)
  - (4) Floods of September 1968 with particular reference to flood  
alleviation work and flood warnings (LCCB, 1969)
  - (5) Fluvial Flood Warning System - Maps for Upper Reaches (TW  
(Lea Division), October 1974)
  - (6) Report on Flooding - 5th to 7th May 1978  
(R.Smith, TW (Lea Division), 1978)
  - (7) Flood Monitoring Node Manual - Nodes 58,65-73, 176-179  
(TW (Rivers Division), 1986-1988)
  - (8) Re: Flood Report for 25th August 1987  
(A.J.Stewart, TW(Rivers Division), 27/8/77)
  - (9) Lee Area - Flood Monitoring  
Flood Report 2nd September 1987  
(M.Pomfrett, TW(Rivers Division), 7/9/87)
  - (10) Report on Flooding 9th and 10th October 1987  
(J.Meekings, TW (Rivers Division), ? )
  - (11) Report on Flood Event 29th/30th January 1988  
(G.Cowell, TW(Rivers Division), 17/2/88)



- (12) Flood Monitoring Gauge Board Installation (Contract)  
(TW (Rivers Division), April 1988)
- (13) Flood event photographs. 1960 - present day  
(Refer particularly to 21/2/77, 8/12/77, 5/5/78, 2/2/79, 28/12/79, 18/3/80, 30/12/81, 22/10/82 and 10/12/82)
- (14) Flood event video  
(Refer particularly to: 9/10/87 and 2/2/88)
- (15) Information held by British Waterways Board, Local and County Councils

**Evaluation:** The location and nature of the Stort catchment's 34 flood monitoring nodes are adequately detailed. However, the numbering of the nodes needs to be rationalised and up-to-date photographs of the sites (where gauge boards have recently been installed) are required. There is also a need to re-assess the location of the node points because of their widespread locations, which makes monitoring very time consuming, and the difficulty of both parking and making visual inspections at many sites.

During area-wide events resources are severely stretched. This problem has two aspects to it. Firstly, in the immediate post-event period, areas which were not visited during the actual event ought to be checked. In many cases useful information can still be collected (e.g. local people often take photographs, flood marks might still be visible etc.) and it also gives local people the chance to meet and talk with NRA staff.

The second aspect is the efficient use of the resources of the NRA, British Waterways Board and local authorities during flood events. For this to be achieved each group must be aware of each others responsibilities, priorities and procedures. The circulation of appropriate information (i.e. the location of flood monitoring nodes) to other parties would encourage co-operation and may improve data collection coverage.

Many of the problems highlighted by the 60 years of flood records are long-standing. Several though are more recent and maybe symptomatic of land-use changes and/or local circumstances. Such information will provide useful feed-back for other principal functions.

**Requirement:**

- (1) Up-dating of flood monitoring node manual, especially photographic records of gauge boards recently installed.
- (2) Re-assessment of flood monitoring node locations to maximise ease and safety of monitoring during flood events.

- (3) Transfer of flood event data into a catchment-specific format.
- (4) Promotion of a joint monitoring procedure with British Waterways Board and Local Authorities.
- (5) Liaison with BWB and Local Authorities to ensure all relevant results (including those for non-main river) are circulated.

## WATER RESOURCES

- Importance: There are no significant interactions between water resources interests and flood defence interests in the Stort catchment. Although there is hydraulic continuity between surface deposits in the catchment and the drainage network, the chalk aquifer is substantially confined. Direct abstractions from the river Stort are limited. The Lee Valley Water Company operate several borehole supplies but also import surface water from outside the catchment.
- Information: (1) Abstraction and Impounding Licence Register (NRA).  
(2) Groundwater Borehole Monitoring Records.  
(3) Lee Valley Water Company.  
(4) Catchment Control Section of NRA Thames Region.  
(5) Low flow information, i.e. November 1989 low flow survey of the river Stort upstream of Stansted Mounfitchet undertaken by Hydrological Services (East).
- Evaluation: Very few abstractions/impoundings materially affect the natural flow regime of the river Stort drainage system. The confined chalk aquifer is closely controlled with time limits being placed on all abstraction licenses. No significant water resource schemes are envisaged in the catchment and no detailed hydrological assessments of low flow parameters are available. However, inspections of several of the Stort's tributaries have been made this year to identify perennial heads and the extent of dilution at several sewage treatment works.
- Requirement: (1) Prepare a schedule indicating the location of direct abstractions and impounding licenses which may influence flood defence and land drainage and environmental interests.  
(2) Identify perennial heads of watercourses.  
(3) Evaluate low flow parameters (i.e 95% exceedance flows) for main-rivers likely to be the subject of NRA or third party works.

## WATER QUALITY

**Importance:** Although there appears to be a gradual deterioration in surface water quality in the upper Stort catchment the river system still maintains its class 1B River Quality Objective status. Since surface water quality in the catchment is relatively good it is essential that flood defence and land drainage works maximise their environmental potential. It is also important that any new surface water drainage facilities are designed to protect both quantity and quality aspects.

Groundwater quality in the confined aquifer is not considered to be at risk from surface facilities including shallow soakaways.

**Information:**

- (1) Surface water quality monitoring records (6 sites on the river Stort, 3 sites on the Pincey Brook and 2 sites on Great Hallingbury Brook).
- (2) Groundwater quality monitoring records.
- (3) Reports prepared by NRA Biology (East) (i.e. report for Harlow D.C. on water quality of Canon's Brook).
- (4) Public Perception of River Water Quality. River Stort at Harlow (Middlesex Polytechnic, 1988 and 1989).

**Evaluation:** Although surface water quality is generally good there are situations which could lead to sudden drops in water quality. These include low flow periods when the dilution of sewage treatment works' discharges is insufficient and summer storms over urban areas which may lead to high inputs of suspended solids and hence high biological oxygen demands. The latter scenario is likely to lead to high fish kills (e.g. Stort Navigation in 1977).

The needs of Biology and Groundwater Quality need to be properly appreciated by Planning Liaison to ensure appropriate comments are included on proposals for soakaways, waste disposal sites etc. Policies and guidelines with regard to soakaways need to balance quality and quantity criteria.

**Requirement:**

- (1) Identify policies and guidelines for use by flood defence and land drainage interests to maintain and enhance ground and surface water quality in the Stort catchment.
- (2) Ensure location of Surface Water Quality Monitoring points are known to all groups likely to affect the nature of such sites.
- (3) Identification of enhancement measures which will improve water quality as well as flood defence and land drainage interests.

## WATER POLLUTION CONTROL

- Importance: The control of water pollution (surface and ground) has a high public and political profile at present. Incidents in the Stort catchment are primarily surface-water related and associated with agricultural discharges, sewage treatment discharges and industrial related discharges. Surface water runoff (which may have a high oxygen demand) has also been known to cause problems in exceptional cases, however.
- Information: (1) Control of Pollution Act Discharge Consents Register (NRA).  
(2) Controlled Waters Statutory map (NRA).  
(3) Surface and ground water pollution monitoring database.
- Evaluation: Pollution control and land drainage consents control officers often work together closely in the catchment since many third party development proposals require the consent of both groups. There is considerable scope for closer liaison between these groups in the policing of the NRA's interests in the field. This is especially true in rural parts of the catchment which might be infrequently visited. There may also be a case for the reconciling of main river and designated controlled waters to provide greater protection of the NRA's interests. Several small sewage treatment works in the catchment currently discharge to non-main river watercourses for instance.
- Requirement: (1) Dissemination of existing water pollution control data into an appropriate format to ensure flood defence and land drainage interests are aware of the types and location of potential pollution incidents and reporting needs.  
(2) Preparation of working guidelines to allow staff making site/field visits to cover NRA rather than just functional interests in the catchment.  
(3) Identification of constraints to be applied to infiltration techniques for surface water drainage in the catchment.  
(4) Preparation of list of water pollution control monitoring points and requirements for protection from third party works.

## FISHERIES

**Importance:** For the purpose of fisheries the catchment is divided into three areas: the river Stort; the Stort Navigation; and, the tributaries. Despite a severe fish mortality in 1977 - as a result of overflow from Bishop's Stortford STW and urban runoff during a summer storm - the river and its tributaries retain a high potential for fisheries.

Although designated as a cyprinid water under EC Regulation 78/659/EEC the Stort supports migratory trout as far upstream as Feakes Lock and an organised put-and-take trout fishery upstream of Bishop's Stortford. Due to the clarity of the water the river is a testing one for anglers.

**Information**

- (1) A fisheries survey of the River Stort, Stort Navigation and Stort Tributaries is scheduled for the period Autumn 1990 - Spring 1991. This survey will form part of the Fisheries Team's rolling 5 year programme and will thus provide a comprehensive status report on the diversity, frequency and size of the fish population.
- (2) Existing 'older style' fisheries surveys (i.e. Investigations into Fish Populations in the Upper Stort Navigation (Twyford-Spellbrook) (April 1977)).
- (3) Match returns of the Bishop's Stortford, Stort Valley, Globe and Lee Angling Clubs.

**Evaluation:** Immediately downstream of Bishop's Stortford the water quality is inhibited by discharges from the local STW. Although water quality is a major inhibitor of fisheries, several factors associated with flood defence and land drainage and navigation also inhibit the development of the fisheries potential. These include:

- (i) lack of full-width dredging of the Stort Navigation to remove polluted silt deposits;
- (ii) need for enhanced liaison between fisheries and flood defence interests on maintenance matters;
- (iii) local enhancement measures, notably on the tributaries such as the Great and Little Hallingbury Brooks and Pincey Brook, all of which are spawning sites as well as elver stocking areas.

Trout are able to find their way up the Stort via the original course of the river. Several of the locks are particularly deep and it is not considered practicable or necessary to provide fish passes to aid the migration of salmonids.

Gilston Park Lake on Fiddler's Brook is noted for its population of golden tench.

- Requirement:
- (1) Compilation of Fisheries Survey Data into a suitable format for use by flood defence and land drainage interests.
  - (2) Identification of Riparian Rights and extent of Angling Club interests.
  - (3) Identification of Flood Defence and Land Drainage related constraints to improving the quality of the Fisheries.

## ENVIRONMENTAL ASSESSMENT

- Importance:** The introduction of statutory legislation on environmental assessment, namely SI 1217 (Land Drainage) and SI 1199 (Town & Country Planning), has meant that a wide range of flood defence and land drainage works need to be accompanied by an environmental assessment and/or statement. Environmental assessment in the Stort catchment is particularly important given the sensitivity of many of the areas. For example, the Stort valley contains a number of SSSI's and local nature reserves and includes many areas of landscape value.
- Information:**
- (1) River Stort FAS Phase Two - Environmental Implications (September, 1980). This report details information on land use, water status, nature conservation, recreation and navigation, angling and archaeology and human influence for the area from Feildes Weir to Bishop's Stortford and includes general comments on the wider riverine environment.
  - (2) Environmental Assessments prepared for and by local authorities for highway schemes (i.e. A414 and A120) and major developments (i.e. Stansted Airport).
- Evaluation:** For the purposes of producing a reliable EA, the existing information is somewhat outdated and spatially inconsistent. No specific environmental assessments for flood defence and land drainage works in the catchment have been undertaken to date. For the purposes of environmental assessment, under SI's 1217 and 1199, information on, for example, agriculture, recreation and amenity, water quality, archaeology, fisheries, geomorphology, heritage, land use, and ecology would be required for each specific work or development.
- Any environmental assessment should also make recommendations over furthering the conservation value of the catchment and improving the riverine environment.
- Requirement:**
- (1) Collate existing environmental assessment work completed for and by local authorities etc.
  - (2) Ensure River Catchment Plan investigations are consistent with needs for possible future SI 1217 and 1199 statements.
  - (3) Undertake an outline post-project appraisal of past flood defence and land drainage schemes.



## CONSULTATION AND LIAISON

Importance: Failure to consult and liaise with statutory authorities, interest groups and members of the public over proposals can often lead to misunderstanding and confrontation and hence delays and wasted resources. The River Catchment Plan process will seek to ensure that, at all stages, interested parties play a full role in formulating guidelines and policies affecting their interests.

Information: (1) Parish Council, Local Authority and County Council Committees.  
(2) Representative and Interest Groups.  
(3) NRA Sectors involved in Consultation and Liaison.

Evaluation: The River Catchment Plan studies will seek to enhance and reinforce existing lines of consultation and liaison and develop these links both to prepare the River Catchment Plan and ensure future NRA initiatives proceed smoothly.

Requirement: (1) Preparation of guidelines (internal and external) for ensuring appropriate Consultation and Liaison for Flood Defence, Land Drainage and Environmental works.

## APPENDIX II

### CATCHMENT ATTRIBUTES - ANALYSIS SHEETS

Topography  
Geomorphology  
Hydrology  
Hydraulics  
Land Use  
Landscape  
Agriculture  
Built Environment  
Heritage  
Archaeology  
Land Ownership  
Development Plans  
Damage Potential  
Ecology  
Recreation and Amenity  
Human Impact  
Customer Perception

## TOPOGRAPHY

Importance: The floodplain of the river Stort downstream of Bishop's Stortford is complicated by the presence of the navigation channel. Realistic definition of the floodplain, and its associated channels and structures, is therefore difficult but essential if evaluation of the flood envelopes through computational hydraulic modelling is considered necessary. Elsewhere in the catchment channels and their floodplains are more readily defined.

- Information:
- (1) LCCB Microfilm Records (1948-1980)
    - 100 (1948) Stansted Brook
    - 103 (1949) Pincey Brook (Hatfield Broad Oak)
    - 151 (1949) Spellbrook
    - 191 (1951) River Stort (Hockerill Bridge to Feildes Weir)
    - 198 (?) River Stort (Ryemeads STW)
    - 319 (1960) Spellbrook
    - 323 (1961) Eastwich Meads
    - 331 (1962) Bishop's Stortford FAS Phase I
    - 346 (1963) Harlowbury Brook
    - 372 (1964) River Stort (Langley)
    - 374 (1964) River Stort (Clavering)
    - 381 (1965) Pincey Brook (Takeley)
    - 392 (1966) Fiddler's Brook
    - 416 (1967) Bishop's Stortford FAS Phase II
    - 431 (1968) River Stort (Bishop's Stortford)
    - 675 (1980) River Stort FAS Phase I (Hockerill Bridge to Twyford)
    - 728 (1980) River Stort FAS Phase II (Twyford to Feildes Weir).
  - (2) TW(Rivers Division) Records (1982-1983)
    - 1003 (1982) River Stort (Clavering)
    - 1015 (1983) River Stort (Langley Lower Green)
  - (3) British Waterways Board Survey Records for the Stort Navigation.
  - (4) Aerial Photographs
    - 286601/286100 Stort Valley
    - 362869/383075 Bishop's Stortford
  - (5) Proposed BWB in-bank survey of the Navigation Channel in 1990.
  - (6) Ordnance Survey Records including aerial survey register and Series 1 to 4 mapping (1917 to the present).

Evaluation: Negligible survey work has been carried out in the river Stort catchment since 1984 . The comprehensive surveys of the Stort and its floodplain downstream of Bishop's Stortford completed in 1951, 1962-1968 and 1980 are invaluable, however, since much of this information will still be relevant. Care must be taken in interpreting channel data for the navigation, however, because of dredging activities.

Vertical and oblique aerial photographs of the valley are available from the early 1980's. More recently (February 1988) aerial video film of the floodplain just after a flood event has been obtained. This information is useful in enabling flow paths to be identified. Significant parts of the catchment are covered by commercially available vertical aerial photography.

In-bank hydraulic modelling of the channel systems downstream of Bishop's Stortford and in the vicinity of known isolated problem areas (i.e. Clavering, Manuden etc.) is possible without extensive further surveying. However, the wide spacing of existing river cross-sections and the fact that this data is now 10 years out of date indicates that it would be preferable to re-survey the whold system if unsteady state hydraulic modelling is to be undertaken. A full floodplain model would undoubtedly require extensive survey investigations. There would be most economically gained through an aerial survey with ground control.

- Requirement:
- (1) Purchase of commercially available aerial photographs of the floodplain and watercourse system and production of composite plans.
  - (2) Undertake aerial survey of the Stort floodplain downstream of Bishop's Stortford in order to provide data for the hydraulic model.
  - (3) In-bank topographical survey of the river Stort drainage system downstream of Bishop's Stortford.
  - (4) Preparation of floodplain contours for the Stort floodplain downstream of Bishop's Stortford.
  - (5) Survey register of structures on main rivers.
  - (6) Summary of available topographical data for use by NRA staff.

## GEOMORPHOLOGY

**Importance:** The river Stort and its tributaries are generally low-energy clay bed streams which, if left undisturbed, are inherently stable. However, where these streams have cut into lenses of glacial sands and gravels or into head deposits there is evidence of instability. Such activity is often initiated by resectioning or straightening for land drainage purposes which leads to adjustment upstream and downstream. Erosion is also evident in some of the urban streams (e.g. Todd Brook) where the flow rates have increased due to urbanisation. These streams also exhibit signs of sedimentation, particularly where overwidened or channelized. The lower reaches of the river Stort downstream of Bishop's Stortford, through Harlow to Feildes Weir have been substantially modified for navigation purposes. Here the problem is mainly one of long-term sedimentation and corresponding on-going maintenance. A more immediate problem is the release of construction sediment from development sites, such as the expanding Stansted airport where the Pincey Brook is suffering from discolouration and deposition for a considerable length downstream.

**Information:**

- (1) Preliminary Geomorphological Corridor Survey: Upper Stort, Cannon's Brook, Todd Brook and Pincey Brook (NRA Thames Region, December 1989).
- (2) Lee Area Operations Records.
- (3) Aerial Photography and Topographical Survey (see TOPOGRAPHY).
- (4) British Geological Survey (Sheet 240 at 1:50 000 scale).
- (5) Soil Survey of England and Wales (South-east England at 1:250 000 scale).

**Evaluation:** The majority of the Stort catchment is underlain by Boulder Clay which overlies the Upper Chalk of the Cretaceous period. The river valleys are composed of drift material, mainly glacial sands and gravels and recent head deposits. The Stort itself cuts into the alluvium of a drift-filled buried channel. Sub-glacial meltwater eroded this buried channel to a maximum depth of 11m below present sea level. The valley is filled with boulder clay, lacustrine deposits, soft tills and sands and gravels produced by the melting ice sheets. These are overlain by more recent alluvial deposits.

The main problems in the Stort catchment are likely to be localised erosion and siltation. Areas susceptible to erosion can be identified at the broad scale from studies of local geology and soils. Detailed site investigation would only be necessary when individual works are proposed. Many of the urbanised (i.e. Canon's Brook and Todd Brook etc.) and straightened agricultural reaches (i.e. Stort between Clavering and Manuden) could benefit considerably from enhancement works.

Very few undisturbed reaches, such as the Stort immediately upstream of Clavering, remain and these ought to be protected wherever possible.

An undergraduate investigation of the geomorphological implications of urbanisation at Harlow is likely to be completed in late-1990.

- Requirement:
- (1) Outline Geomorphological Corridor Survey for all main river watercourses.
  - (2) Morphological review of all significant past flood defence and land drainage works to assess and evaluate siltation/erosion problems.
  - (3) Assessment of possible improvements to structures on the Stort Navigation to minimise siltation/erosion problems.
  - (4) Evaluation of current river operation procedures and preparation of guidance notes if appropriate.
  - (5) Identification of enhancement/remedial measures.
  - (6) Identifications of reaches in their natural state which ought to be protected.

## HYDROLOGY

Importance: Although urbanisation has not seriously altered the overall hydrological response of the lower Stort catchment (the clay surface naturally produces high rates of run-off) individual tributaries (i.e. Canon's Brook, Harlowbury Brook, upper parts of Pincey Brook, and the Thorley Tributaries) have been affected adversely despite the construction of balancing ponds. In the lower Stort the canalisation of the channel system is much more important since operation of locks/sluices can alter the timing and shape of otherwise similar events.

Development of realistic design flood hydrographs for the river Stort is therefore difficult and this is reflected in the relatively high density of flow-gauging stations in the catchment.

Groundwater hydrology is not an important factor in the design of river flood flows (cf. the importance of maintaining the existing water-table regime to conserve the environmental richness of the valley).

- Information:
- (1) The effect of urbanisation on floods in the Canon's Brook, Harlow, Essex. (K.J. Gregory and D.E. Walling, 1974).
  - (2) Report on Suitable Bridges for Flow Measurement (18/9/78)
  - (3) River Lee Flood Routing study (H.S. Wheater and J.G. Lotufo Comejo, Imperial College, October 1979).
  - (4) The Effect of Urbanisation and Channel Modifications on the Flood Hydrograph (P.M. Edmeades, Imperial College, September 1980).
  - (5) River Stort FAS Phases I and II - hydrological calculations comprising statistical analyses of gauging station data, application of Flood Studies Report procedures to individual sub-catchments, derivation of catchment unit hydrographs etc.
  - (6) Catchment Runoff Control Pilot Study. Report on the Evaluation of the Hydrological response of the Upper Lee and Stort Catchments (R.J.E Hawnt, September 1986)
  - (7) Ugley Brook Study ( Flynn and Rothwell, October 1987)
  - (8) Managing the effects of urbanisation in the Upper Lee (C.H. Woolhouse, September, 1989).

- (9) Records maintained by the Hydrological Services Group (East) of the Catchment Control Sector for: the Stansted Springs, Stansted Brook, Burnt Mill, Sheering Hall, Canon's Brook and Glen Faba flow gauging stations; the Grange Paddocks and Druce water level stations; and numerous rainfall gauges.
- (10) Meteorological Office Rainfall Records.

**Evaluation:** The whole of the Stort catchment has been subject to hydrological modelling using RORB, both for flood estimation and runoff control zoning purposes. In both cases satisfactory results were achieved. Further testing of the model using more recent events would be in order due to the poor quality of earlier calibration data at the Glen Faba gauging station.

A whole host of techniques have been used to assess flow-frequency relationships for the lower Stort. These provide a range of potential results for any given site. It will be necessary to resolve some of the conflicts inherent in these results in order to provide a coherent basis for detailed hydraulic modelling.

For the tributaries of the Stort, most studies have made use of the Flood Studies Report empirical techniques. These are well suited to the homogenous and predominantly rural catchments feeding the tributaries. Detailed investigations of the effect urbanisation has on flows in the Canon's Brook have been completed (this aspect is currently being further investigated by an MSc student at University College London).

No detailed low flow studies have been completed.

- Requirement:**
- (1) Definition of the characteristic critical rainfall parameters (i.e. duration, profile and seasonal trend) at points along the river system.
  - (2) Calculation of design flows/hydrographs for the Stort downstream of Bishop's Stortford.
  - (3) Summary of rainfall and flow gauge details for sites in the catchment.
  - (4) Flood-frequency calculations for key control points on the main river system using the Flood Studies Report, RORB and analytical regime methods.
  - (5) Refinement of the flood zoning procedures for urban areas at Harlow and Bishop's Stortford using FRQSIM.



## HYDRAULICS

Importance: A clear understanding of the hydraulics of the channel system between Bishop's Stortford and Feildes Weir is essential to the formulation of a successful River Catchment Plan. This part of the Stort system is dominated by the Stort Navigation channel but also contains parts of the original river channel, many tributaries and backwaters. Flow distribution is complex, being controlled by fifteen locks, several by-pass channels, fixed weirs, sluices and storage ponds as well as significant natural floodplain attenuation.

Elsewhere in the catchment the channel system is less complicated, although local constrictions (i.e. fords, culverts etc.) do influence the frequency and extent of flooding (e.g. River Stort at Clavering and Ugley Brook at Stansted Mountfitchet).

Information: (1) River Stort FAS Phase I - Hydraulic calculations.  
(2) River Stort FAS Phase II - Hydraulic calculations.  
(3) Ugley Brook Study (Flynn and Rothwell, October 1987).  
(4) Technical Planning Files (i.e. site specific studies etc).  
(5) Middlesex Polytechnic Post - Project Appraisal Study for Bishop's Stortford (due early 1990).

Evaluation: Backwater calculations (steady state non-uniform flow) have been undertaken (1978-1982) for the channel system between Hockerill Bridge in Bishop's Stortford and Feildes Weir. These calculations are primarily for proposed in-bank conditions (1 in 70 year return period in urban areas and 1 in 10 in agricultural areas) and therefore do not give any indication of the role of the floodplain.

The computational model used is very cumbersome since hand calculations are required at all structures (for which comprehensive stage/discharge curves have been produced).

The lack of flexibility offered by the existing model prevents several key areas being investigated readily. These include standards of protection, possible improvements in structure operating procedures so as to reduce flood risks, and the definition of floodplain envelopes to ensure appropriate application of catchment control policies. The hydraulic studies should also investigate the nature of the drainage system in areas such as that adjacent to Rye Meads STW, which are poorly understood.

Calculations completed for a culverted section of Ugley Brook were made using the WASSP hydraulic program.

- Requirement:
- (1) Develop an ONDA model for the river/navigation system between the A120 (Bishop's Stortford) and Feildes Weir which will incorporate tributaries within the urbanised areas. This model will be for the in-bank situation and will enable standards of protection to be evaluated, control structure operational sensitivity to be gauged, the influence of dredging on land drainage interests to be evaluated , and give assistance in flood warning evaluation.
  - (2) Extend the above model as necessary to provide full floodplain definition in areas of urban flood risk.
  - (3) Collate and check structure function calculations.
  - (4) Investigate seasonal (i.e vegetation, blockages, recreation and amenity etc.) constraints on flow capacity.
  - (5) Summarise all past hydraulic calculations.
  - (6) Investigate the operation of Spellbrook Flood Lagoon.

## LAND USE

- Importance: Land use planning policies are stated in the County Structure Plans for Hertfordshire and Essex and detailed in the Local District Plans. Within the catchment there are areas of differing interest; some areas are under considerable pressure to change whilst others are relatively static. Land use is currently a contentious issue, especially in urbanised areas where there are a range of development demands on the land, particularly around Harlow and Bishop's Stortford. One important local land use policy is the retention of 'green corridors' along the urban streams of Harlow. The implications of land use changes in the upper catchment due to the expansion of Stansted airport must be considered.
- Information: (1) River Stort FAS Phase II. Environmental Implications (September 1980).
- (2) Structure and Local Plans (see DEVELOPMENT PLANS).
- (3) Herts County Council. Report of Survey 6.10 Aggregates.
- (4) Herts County Council. Report of Survey 6.4 Physical Environment.
- (5) Various planning application/appeal statements such as : Stansted Airport Inquiry (Various Dates); 'Green Belt Inner-Boundary to Bishop's Stortford, East Herts: Environmental Appraisal' (LUC, June 1989); and, 'M11 Birchanger Service area: Evidence on behalf of East Herts' (LUC, May 1988).
- Evaluation: In the upper reaches land use is predominantly agricultural (i.e. intensive arable production) with small pockets of woodland and urban development. In the Stort floodplain, occasional flooding has meant that water meadows have been retained and traditional pastoral farming still remains the major land use. This pattern of land use, and the associated landscape features, are of considerable historic value in their own right but particularly so since the valley slopes are under intensive arable production. Land use significance has a different emphasis in the lower catchment owing to the differing pressures on the land. This area is characterised by a diversity of land use types including urban and industrial development and mineral extraction. The Metropolitan Green Belt has recently been extended to prevent Bishop's Stortford expanding and coalescing with surrounding villages. Downstream of Harlow pressure to allow further gravel extraction is seen to be of particular significance by many environmental groups.
- Requirement: (1) Identify areas of potential land use change and assess impacts on NRA Thames Region interests.

## LANDSCAPE

Importance: The landscapes to the south of Bishop's Stortford are strongly influenced by unspoilt stretches of traditional lowland valley which form one of the few such remaining features in south-east England. Long standing and often ancient farming practices are still in evidence as indicated by the quality of the grassland and the relatively undisturbed hedgerow system. The valley areas contrast starkly with the surrounding area which is mainly under arable cultivation.

The landscape value of this area is therefore extremely high given that it represents a relatively scarce resource. In most areas river improvements and changes in farming practices have destroyed the historic water meadows and pasture lands found on the valley floor. The areas between Roydon Lock and Pardon Lock, around Pishiobury, and between Sawbridgeworth and Spellbrook are all denoted as Special Landscape Areas in the Essex Structure Plan. Policies for protection and enhancement apply in these areas where there is a strong presumption against development.

Pishiobury Park is a remnant 17th Century landscape, with water meadows, willow and alder carr, numerous small streams and watercourses.

- Information:
- (1) Herts County Council. Report of Survey 6.4 Physical Environment.
  - (2) Herts County Council. Report of Survey 6.8 Landscape Development.
  - (3) Essex County Council. Survey Report for Landscape and Supporting Guidelines.
  - (4) Countryside Commission Review of the Stort Valley Landscape (1980).
  - (5) Council for the Preservation of Rural England.

Evaluation: The upper reaches of the catchment are characterised by open rural landscapes dominated by intensive arable farming with pockets of relatively constrained development in the form of small villages. The Uttlesford Local Plan has designated most of the upper tributaries of the Stort as areas of 'Special Landscape Value'. Further downstream towards the confluence of the Stort with the river Lee landscapes become predominantly urban with extensive areas of gravel extraction. The Stort valley itself is a major landscape feature central to the catchment. Areas of the Stort valley within the Harlow D.C. boundary are designated as 'Special Landscape Areas.'

Landscape policies within the Essex Structure Plan are framed to protect natural beauty, amenity and traditional quality. There is a presumption against development which would cause permanent loss or damage to the landscape. In Hertfordshire the Stort valley is designated as both an 'Amenity Corridor' and a 'Landscape Development Area'. These policies include a commitment to the promotion of the interests of wildlife conservation and management of woodlands as well as landscape protection and development. The importance of preserving the wetland areas of the Stort catchment cannot be over-emphasised. Any flood defence and land drainage schemes in this area must avoid altering the character of these areas by lowering the water-table or reducing the frequency of flooding of agricultural land.

- Requirement:
- (1) Collate, review and summarise relevant information available from County Councils, Countryside Commission and the Council for the Preservation of Rural England on the landscape value of the Stort catchment.
  - (2) Undertake specific site surveys of flood defence and land drainage works undertaken within the catchment to assess potential landscape enhancement measures.
  - (3) Prepare outline guidance notes for ensuring future works, including third party works, are undertaken in a manner appropriate to their surroundings.
  - (4) Identify the impact changes in existing land drainage systems will have on the landscape (inc. lowering of the water-table).

## AGRICULTURE

**Importance:** Agriculture is the predominant land use in the Stort catchment, being characterised by intensive arable production on the upper and middle catchment slopes and areas of traditional lowland valley farming in the Stort valley itself. The latter areas, occurring mainly to the south of Bishop's Stortford, are considered to be one of the few remaining landscapes of this type in south-east England. The landscape has survived mainly because relatively sympathetic farming practices have left water meadows, hedgerows and field systems intact. River improvements have been largely avoided leaving occasional flooding to control land use. The area is mainly used for livestock grazing and hay meadows which contrast starkly with the intensively farmed arable land which comprises the majority of the remaining agricultural land in the valley.

**Information:**

- (1) MAFF Agricultural Land Classification Survey.
- (2) Reports by ADAS, NFU and CLA.
- (3) River Stort FAS Phase II - Agricultural Land Use and Benefits Survey (Thames Water, 1980).
- (4) Soil Survey of England and Wales (1984).

**Evaluation:** Soil types are dominated by the Hanslope Series found on the chalky till of the upper slopes. These are low permeability calcareous clayey soils which suffer a slight risk of water erosion. Typically the land has been graded as 2 or 3a. Areas of the poorly drained Thames series (grade 4) are found on the alluvium of the Stort valley. This land is usually left as meadow land or used as rough pasture due to the high water table and the risk of flooding. The Melford Series are also predominant in the upper Stort Valley and along the tributaries. This group is characterised by well drained loamy clayey soils generally of better quality, for example grades 2 and 3a.

The abandoned River Stort FAS Phase II would have facilitated improved drainage of the Thames series soils thus enabling a change in land use in the lower valley. Current farming pressures, however, are towards extensification and diversification, thus reducing the need for arterial drainage schemes. This is reinforced by lack of funding from MAFF. The water quality implications of farming practices is clearly an important area of concern.

**Requirement:**

- (1) Collation of data from appropriate (i.e. NFU, ADAS, MAFF, etc.) bodies to define current and potential land uses and the role of arterial drainage in agricultural practice in the catchment.

- (2) Identify interactions between soil erosion, land drainage, farm management practices, and water pollution and the NRA.
- (3) Identify location of fish farms and NRA policy with regards to such facilities.
- (4) Review the impact of on-going and likely governmental/EEC changes in farming policy on land use change.



## BUILT ENVIRONMENT

- Importance: The Stort Navigation is a linear built environment in its own right and supports a variety of structures (i.e. mills, weirs, tow-paths etc.) which together form an important aspect of the Stort catchment. Harlow New Town (20th Century), Bishops Stortford (15th Century) and Sawbridgeworth (12th Century) all have different riverside characteristics which should be reflected in the nature of any works undertaken in these areas.
- Information: (1) Local Council and County Councils (various publications and guidelines).
- (2) Yesterdays Stortford (V.Sparrow, 1982).
- (3) Bishop's Stortford, A Short History (Bishop's Stortford and District Local History Society).
- Evaluation: Pressure for development in the Stort catchment, both in the post-war period and over the last 10 years, has radically altered the shape and form of its built environment. Many recent developments (e.g. the Maltings redevelopment at Sawbridgeworth) have positively used their riverside/navigation setting to enhance their value. Such third party works, as well as the NRA's own works, should be encouraged to enhance the local environment as well as be technically appropriate.
- Many towns and villages within the Stort catchment contain designated conservation areas. Such places include: Roydon, Sawbridgeworth; Old Harlow; Netteswell Pond; Hunsdon; Bishop's Stortford; Stansted Mountfitchet; Hatfield Broad Oak; Great Hallingbury; Manuden; and, Clavering.
- Requirement: (1) Plot the principal built environment character areas in the river corridors and note their historical context.
- (2) Note those areas of the built environment subject to statutory control and/or local guidance measures.

## HERITAGE

- Importance: The Stort catchment does not contain areas of national heritage value but does contain several features of regional and county significance. Hatfield Forest (owned by the National Trust) was once part of the Royal Forest of Essex; the lower Stort valley is one of the few remaining valleys in the region to retain significant tracts of water meadow and wetlands; and, Sawbridgeworth (12th century) and Bishop's Stortford (15th century) are both towns of County importance.
- Information: (1) County Council/Local Council Planning Departments (various publications and surveys).  
(2) Register of Parks and Gardens of Special Historic Interest.  
(3) English Heritage.  
(4) Countryside Commission.  
(5) National Trust.
- Evaluation: Water is an important feature of many parks in this area (i.e. Hunsdonbury Park, Hallingbury Park and Hatfield Forest) and has also helped form and sustain many other heritage features in the catchment (i.e. Stort valley and its Navigation). The interaction between the water environment and these features, and the role water plays in their value should be identified.
- Requirement: (1) Identify those heritage features given statutory or planning protection and additional sites considered of county or local significance.  
(2) Identify role of the water environment in the above features and possible enhancement measures.

## ARCHAEOLOGY

- Importance: The Stort valley has acted as a focus for settlement since Iron Age (e.g. the fortified settlement of Wallbury camp adjacent to the Stort navigation at Spellbrook) and Roman ( i.e. Harlow was a significant Roman Settlement) times. Most archaeological interest is likely to be in the valley of the Stort which has always been an important communication route. An above average number of sites of interest are located within the Stort catchment.
- Information:
- (1) Hertfordshire County Council Planning Department (various publications and survey documentation including Report of Survey. 6.4 Physical Environment).
  - (2) Essex County Council Planning Department (various publications and survey documentation including Archaeology in Essex to 1500 AD).
  - (3) Bishop's Stortford and District Local History Society.
  - (4) East Hertfordshire Archaeological Society.
  - (5) Harlow Museum.
- Evaluation: The Stort valley is likely to contain both Iron Age and Roman archaeological remains which have not yet been located or excavated. Data and information held by the County Councils and local interest groups will be adequate to identify key sites of interest and areas of potential finds.
- Requirement:
- (1) Prepare schedule of sites covered by the Ancient Monuments Act 1979 and sites of regional or local importance.
  - (2) Identify areas of potential archaeological finds associated with possible works (NRA or third party) close to the drainage system.

## LAND OWNERSHIP

Importance: Land ownership records formed an important aspect of the River Stort FAS Phase II since the scheme affected all agricultural land use holdings in the river corridor. Benefits also depended very much on an assessment of how individual farms would change their working practice in response to improved drainage conditions.

On a day-to-day basis, knowledge of individual landowners is of great benefit in ensuring appropriate consultation and liaison with landowners is completed efficiently prior to entry being sought or works/investigations undertaken.

Information:

- (1) NRA Asset Register
- (2) River Stort FAS Phase I Lands Records
- (3) River Stort FAS Phase II Land Ownership Survey
- (4) Details held by River Operations, Fisheries, Technical Planning, Projects etc.
- (5) County Council and Local Authority Asset Register
- (6) BWB Asset Register
- (7) Water and Sewerage Utility Asset Register.

Evaluation: Compilation of a land ownership database for the river corridor will involve data being drawn from a wide range of sources. Coverage will neither be complete nor up-to-date, but will provide a valuable resource of use to the NRA. Ownership of riparian rights will also be investigated. An exhaustive assessment of ownerships is unlikely to be cost effective but a procedure for identifying and recording ownerships will be included in the River Catchment Plan.

Requirement:

- (1) Prepare land ownership database for the river corridor using existing data.
- (2) Identify riparian rights for main rivers.
- (3) Identify major land holdings in the catchment likely to influence land use changes in the future.
- (4) Identify ownership of structures in, over, under or adjacent to the main rivers.
- (5) Identify ownership of all flood defence and land drainage structures, including flood banks and storage ponds, in the catchment.

## DEVELOPMENT PLANS

**Importance:** During the promotion stage of the River Stort FAS Phase II the opposition of the County and Local Councils to the proposals was built around existing policies contained within the relevant development plans. Development plans can therefore be seen to be powerful tools which may work for or against the NRA. Both the Herts and Essex Structure Plans contain policy statements aimed at preventing floodplain development. All the plans for the area also contain much more powerful land use constraints which the NRA must both understand (and seek to influence in the future) if the NRA's interests are to be achieved effectively and efficiently.

**Information:**

- (1) Essex County Structure Plan (1982,1987)
- (2) Hertfordshire County Structure Plan (1975,1986,1988)
- (3) East Hertfordshire District Plan (At consultation stage)
- (4) Epping Forest District Local Plans (On deposit)
- (5) Harlow District Plan (At consultation stage)
- (6) Uttlesford District Local Plans (1984,1987)

**Evaluation:** Both the relevant Structure Plans contain general floodplain protection statements. These are expanded upon within several of the district plans although there are considerable differences in the form and strength of the adopted policies. All the development plans contain a variety of policies which explicitly and implicitly influence the NRA's interests in the floodplain and the catchment as a whole.

In the past the NRA has reacted to development plans rather than proactively present its own views on catchment issues. Through a programme of on-going consultation (i.e. Land Drainage Catchment Groups) and well founded studies it should be possible to influence planning authorities more effectively, with consequent benefits for all aspects of the NRA's interests.

Changes in the processes for producing Structure and Local Plans are currently under discussion by government. It will be essential to ensure that the views of the NRA are contained within the proposed County Statements and District Development Plans from their outset. Consultation at this stage will ensure that the NRA can readily liaise with the planning authorities at the appropriate time.

**Requirement:**

- (1) Review of current planning documents produced by the relevant authorities.

- (2) Preparation of specific policies/guidelines by which the NRA will assess Town and County Planning Applications and Land Drainage Consents in the catchment.
- (3) Assessment of the implications of strategic planning documents/guidance (e.g. SERPLAN, mineral needs) for the catchment.

## DAMAGE POTENTIAL

- Importance:** Although Bishop's Stortford has already been provided with flood protection up to the 1 in 70 year standard the potential for urban flood damages in the catchment is still significant. Those areas which remain at unnecessary risk include industrial units in north-east Harlow, residential/holiday units at Roydon, commercial/ residential premises at Parndon Mill and small numbers of properties at Clavering, Ugley, Manuden and Sawbridgeworth. The likely capitalised value of these potential damages is at least £2.5M (1989 prices).
- Information:**
- (1) Benefit - Cost studies for River Stort FAS Phase I (urban).
  - (2) Benefit - Cost studies for River Stort FAS Phase II (urban and agricultural).
  - (3) Middlesex Polytechnic Post - Project Appraisal Study for Bishop's Stortford (due late 1989/early 1990).
- Evaluation:** The River Stort FAS (Phases I and II) was estimated to generate approximately £9M of capitalised benefits (1989 prices). About £2M of these benefits were for urban areas downstream of Bishop's Stortford. Data used for the historic analyses is expected to provide an underestimate of true urban damages because of subsequent pressures on the floodplain for development, recent upward revision of the standard depth/damage data and under appreciation of indirect costs and intangibles.
- Appropriate hydraulic modelling will enable residual damages (as well as actual standards of protection) to be evaluated. Land use data collected for previous studies can form the basis for any re-assessment of damage potential.
- Requirement:**
- (1) Review the existing land use data sets and update as necessary to provide a comprehensive urban flood risk register.
  - (2) Establish residual urban damage potential, and undertake sensitivity analyses.
  - (3) Identification of residual intangible flood damage.
  - (4) Summarise historic agricultural damages investigations.



## ECOLOGY

Importance: The Stort valley has large areas of wetlands and grasslands of major ecological significance, including Sawbridgeworth Marsh, a Site of Special Scientific Interest supporting over 200 plant species and reported to be an otter site. Harlow Marsh, also a SSSI includes two marshes rich in ornithological, botanical and freshwater biological interest.

The valley also functions as a major bird migration corridor in Britain and NW Europe and snipe are noted at Sawbridgeworth Marsh. In Hertfordshire the valley is designated as an amenity corridor which includes a commitment to the promotion of wildlife conservation.

Conservation groups are especially anxious to conserve what remains of the former semi-natural habitats of the lower Stort valley. The Stort Valley Conservation Group has been set up by the Herts & Middlesex Wildlife Trust and Essex Naturalist Trust amongst others. Concern arises from strong development pressures in the catchment, e.g. the M11, Stansted airport and sand and gravel extraction. The impacts of farming on woodlands, hedgerows and ditches in the headwaters is also of concern.

- Information:
- (1) No comprehensive summary of the ecological importance of the entire catchment exists. The NRA holds details of Sites of Special Scientific Interest in the catchment, including Thorley Wash, Hunsdon Mead, Harlow Marsh and Sawbridgeworth Marsh. In addition the NRA holds a listing of sites of ecological interest within Hertfordshire in the floodplain of the Stort and associated tributaries. A similar listing is available for the Essex area. Essex Naturalists Trust is completing a 'Phase I' survey of Essex over the next two years. This will provide an overview of sites of conservation interest but will not detail the river ecology. Although short lengths of the Stort and tributaries may have been surveyed, no comprehensive corridor survey exists.
  - (2) Biological Assessment of the Stort Valley from Roydon Lock to Spellbrook Lock (Essex Naturalists Trust and Hertfordshire and Middlesex Trust for Nature Conservation, 1980).
  - (3) River Stort Improvement Scheme Phase II Environmental Implications (NCC, Herts CC and Essex CC, September 1980).
  - (4) The Impact of Land Drainage Works - An Ecological Study: The river Stort Navigation and other impounded watercourses in the Lee Catchment (Water Research Project 7/11, 1982).
  - (5) Essex and Herts and Middlesex Wildlife Trusts.

- (6) Stort Valley Conservation Group.
- (7) North Hertfordshire Museum Records Centre.
- (8) Bishop's Stortford Natural History Society.
- (9) Harlow and District Wildlife Society.
- (10) Essex Field Club.
- (11) Bishop's Stortford Bird Group.

Evaluation: The Phase II 'Environmental Implications Report' provides valuable ecological information on reaches between Feildes Weir and Twyford Lock. Detailed River Corridor Surveys need to be completed, however, to ensure that the data used by the NRA is of the appropriate detail and up-to-date. Completion of surveys and desk studies to integrate available records held by several environmental groups, will allow a comprehensive database for the river environment of the Stort catchment to be completed. This database will help ensure that the NRA meets its environmental duties under the Water Act, 1989.

Requirement:

- (1) Desk Study to gather existing data and formulate need for River Corridor Surveys.
- (2) River Corridor Surveys to supplement those already in the Fisheries, Recreation and Conservation programme.
- (3) Identification of enhancement and protection measures.
- (4) Preparation of guidelines for future Flood Defence and Land Drainage works.

## RECREATION AND AMENITY

- Importance: The Stort Navigation is the main water recreation and amenity feature in the catchment. In recreation terms, it supports waterways cruising with yards at Sawbridgeworth and Roydon, boating at Harlow, canoeing at Bishop's Stortford and Harlow, and walking and angling throughout its entire length. The amenity attraction of the Stort valley is reflected in the restoration of mills (i.e. Parndon, Great Hallingbury and Twyford) for residential and commercial purposes and pressure for development along the banks of the navigation.
- Information:
- (1) British Waterways Board, Lee and Stort Project officer.
  - (2) National Rivers Authority, Recreation and Amenity officer.
  - (3) County Council/local council (various reports and publications including definitive rights of way maps, nature trail leaflets, reports of survey etc.).
  - (4) East Anglian Tourist Board.
  - (5) Regional Council for Sport and Recreation.
- Evaluation: British Waterways Board are currently promoting the recreation facilities on the Stort Navigation. However, the interaction of the whole river environment with recreation and amenity facilities and values in the catchment has not been addressed. Harlow D.C., for instance, are currently considering enhancing access to the Canon's Brook but are aware that water quality and geomorphological problems are constraints to achieving their proposals.
- Requirement:
- (1) Identify recreational facilities within the main-river watercourse corridors including public rights-of-way and major open spaces.
  - (2) Identify amenity aspects of the main-river watercourse corridors and their sensitivity to possible flood defence and land drainage works.

## HUMAN IMPACT

- Importance: Under SI 1217 and SI 1199 the NRA is obliged to take into account human impact when assessing the environmental effects of any engineering works. The significance of human impact resulting from flood defence works will depend on the extent and nature of human occupation across the catchment. As a considerable proportion of the Stort drainage system is semi-rural in nature the direct human impact of any land drainage works will be minimal.
- Where development has occurred, such as urban and industrial expansion and gravel extraction, it is generally confined to the areas peripheral to the main river valley. This is particularly so in the lower catchment. Here the engineering impacts of any works are likely to be of more significance, as population densities are greater.
- Information: (1) Local Authority environmental assessment reports.
- Evaluation: Such factors as short-term noise pollution, disruption to access, the location of compounds and working hours, together with the longer-term impacts such as loss of amenity value, when assessing proposals. The documentation which accompanies any proposals must detail mitigation measures and enhancement opportunities that will be implemented during and after the works.
- Requirement: (1) Identification at a broad scale of particularly sensitive areas for human impact associated with NRA and third party works associated with main-river watercourses.

## CUSTOMER PERCEPTION

Importance: During the promotion phase of the River Stort FAS Phase I works considerable attention was focused on the NRA's flood defence function. The range of responses the scheme attracted clearly reflect particular interests of individuals, groups and statutory bodies. However, cutting across all these views was a common concern for the 'environment' in the area. Any future proposals for major works in this area would no doubt attract even greater interest than before.

Information: (1) Land Drainage Files LD0/100F Flooding General  
LD6/100 River Stort Series

(2) River Operations and Catchment Control Records

(3) River Stort FAS Phase I Correspondence Files

(4) Local Resident Groups (i.e. Roydon Society)

(5) Local/County Council Surveys/Records

(6) Records of the Eastern Consumer Consultative Committee

(7) Public Perception of River Water Quality. River Stort at Harlow (Middlesex Polytechnic, 1988 and 1989)

Evaluation: Customer Perception does not appear to have been objectively evaluated in the catchment other than in terms of water quality issues at Harlow. However, from the additional considerable amount of anecdotal and written background information available, it should be possible to undertake a subjective analysis to identify key issues. Understanding the diverse range of customer interests in this catchment will be difficult, but of vital importance if future flood defence/enhancement schemes are to be successfully progressed.

Requirement: (1) Review existing information from internal and external sources. Further investigate into availability of information.

(2) Initiate a programme of studies to assess the need for detailed customer perception studies in the Stort Catchment.

(3) Identify the perceptions and aims of local groups with an interest in the Stort Catchment.



*National Rivers Authority  
Thames Region*

Kings Meadow House  
Kings Meadow Road  
Reading  
Berks  
RG1 8DQ  
Tel: Reading 0734 535000  
Before December 1989  
Tel: 0734 593333