Cranfield UNIVERSITY

Evaluation of Weed Maintenance Activities on the River Idle

Silsoe College

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September 1993

NATIONAL RIVERS AUTHORITY

SEVERN TRENT REGION

LOWER TRENT AREA

EVALUATION OF WEED MAINTENANCE ACTIVITIES ON THE RIVER IDLE

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EXECUTIVE SUMMARY

Silsoe College was asked by the Lower Trent Area of the Severn Trent Region of the National Rivers Authority (NRA) to evaluate the current weed maintenance regime on the River Idle, north Nottinghamshire. The study required the assessment of the benefits of regular weed maintenance activities to users of the river and the disbenefits incurred if weed maintenance was not to be carried out.

The **aim** of the study is to assess the justification for weed maintenance activities on the River Idle with reference to the standards of service provided for all of the users of the river. The specific **objectives** of the study are:

- to assess, by field survey and collection and analysis of river water level data, the impact of alternative weed maintenance strategies, including no maintenance, upon river water levels;
- to estimate, through analysis of river water levels and survey of outfall structures, the influence of river water levels upon land drainage on land adjacent to the Idle;
- to establish, through user interviews, the uses made of the river and the requirements of each use in terms of river maintenance;
- to assess the implications for agriculture of changing weed maintenance activities.

The analysis and **results** can be aggregated to cover the whole of the sections downstream and upstream of Bawtry. The benefits of weed maintenance in these sections are equivalent to the avoidance of losses due to increased flooding and waterlogging which would occur if weed maintenance was not to be carried out.

The downstream section comprises South Axholme IDB, Everton IDB, Finningley IDB and part of the Idle & Ryton IDB which includes the SSSI washlands. The main consequences of reducing the intensity of weed maintenance are an increase in pump running costs, a small increase in flood risk in the long term and the possible loss of agricultural production on the SSSI washlands.

The section upstream of Bawtry which is down to agricultural production all lies within the Idle & Ryton IDB and is served by a variety of outfalls. The benefits of weed maintenance on the section upstream of Bawtry are different from those on the downstream section because of the different types of drainage into the Idle. There is a long term risk of siltation

leading to decreased channel capacity and an increase in flood risk if maintenance is not carried out.

Reduced river maintenance is likely to lead to increased pumping times and, hence costs, at Wiseton pumping station in the short and long term. There is also a risk of the gravity outfalls being closed for longer periods and water in the drains being unable to get away. This may lead to deteriorating drainage status and a decrease in agricultural productivity. This will depend on the level of fall between the adjacent land and the river channel and the soil types. The areas most at risk are between Bawtry Bridge and Mattersey. These outfalls should therefore be monitored more closely in the future.

The **conclusions** are derived from two sources, interviews with river users and from modelling techniques.

The **interviews** revealed that there are a variety of interests served by the river and that the weed maintenance activities do affect the interests. Almost all of the representatives of interested groups felt that present activities were excessive but that not to do any maintenance would have a significant negative impact. It is clear that no single option is going to satisfy all parties. The conclusions drawn are from the views expressed by the majority of interviewees.

The solutions put forward by the various interested parties were similar in terms of what to do and when to do it: **Timing** - Farmers would like to see first cut in early to mid-June, before irrigation started, and the second cut after irrigation had finished in late August. One cut at the end of the season would also suffice. Conservationists would like to see maintenance carried out after the end of the bird breeding season (late June) if the whole channel was to be cleared, or any time if partial channel clearance was to be carried out. Fisheries would like to see maintenance done before the start of the fishing season (early to mid-June) and at the end of August. **Type** - Farmers, conservationists and fisheries would all want to see only part channel clearance, accounting for about the middle half to two-thirds of the river's width. Upstream of Bawtry, the fishing parties would like to see a meandering cutting pattern swinging from bankside to bankside. The NRA fisheries department would like to be able to help in designing the meanders to make sure that they made maximum use of the existing channel habitat.

The conclusions from field data analysis and **hydrological modelling** are that the main disbenefits associated with a decrease in weed maintenance are the long term flood risk and the threat of closure of the outfalls most at risk (upstream of Bawtry Bridge). The soils generally respond well to drainage but if freeboard is allowed to decrease in the ditch

systems over a considerable length of time in spring and autumn, there is likely to be a deterioration in drainage status on some of the agricultural land upstream of Bawtry. The areas most at risk from decreased maintenance are those between Bawtry Bridge and Mattersey.

It is **recommended** that in 1993 the river weeds should be cut once in mid-summer (between late June and early August) with the cut being made mid-channel only. The width to be cut should be in the region of half to two-thirds of the total channel width. A meeting should then be held in late August/early-September between the NRA and Silsoe College to decide on whether a further cut is necessary this year. At this meeting specialist aquatic weed advice should be sought on cutting regimes suited to the achievement of desired standards of service for all river users. The specialist weed expert will be able to provide indications of the nature and extent of impacts of different weed maintenance strategies upon different weed types and upon long term channel features and capacity.

The gauge boards should continue to be read until the end of 1993. If possible, gauge boards and/or data loggers should be installed in the ditch immediately upstream of Bawtry Bridge (Drain 49) and in the River Idle close to the outfall. This will enable an evaluation to be carried out of the response of ditch water levels to river levels and to enable more accurate estimation of the drainage status on the land for given ditch water levels.

The provisional results indicate that in the short term the impact of changing/reducing weed maintenance activities is not significant. However, further research is required to determine the longer term impacts of different weed maintenance activities.

The risk and impact of floating weeds following a cut catching on weeds in the uncut sections of the channel should be monitored and assessed in 1993 and subsequent years. It is likely that the depth of flow at the time of weed maintenance will be a significant factor in the risk of floating weed catching on uncut sections of the channel.

Methods recently developed as part of Silsoe's ongoing River Maintenance Evaluation Study should be used in order to assess the longer term impacts of different weed maintenance strategies on the Idle.

EVALUATION OF WEED MAINTENANCE ON THE RIVER IDLE

1. INTRODUCTION

1.1 The Study

Silsoe College was asked by the Lower Trent Area of the Severn Trent Region of the National Rivers Authority (NRA) to evaluate the current weed maintenance regime on the River Idle, north Nottinghamshire. The study required the assessment of the benefits of regular weed maintenance activities to users of the river and the disbenefits incurred if weed maintenance was not to be carried out.

The study commenced at the beginning of July 1992 and was completed in May 1993. The study included the collection and analysis of field data and interviews with representatives of the major land-users with an interest in the management of the River Idle. This report contains the results from the study and recommendations for weed maintenance in 1993 and for further research on the River Idle.

1.2 Aim and Objectives

The aim of the study is to assess the justification for weed maintenance activities on the River Idle with reference to the standards of service provided for all of the users of the river.

The specific objectives of the study are:

- to assess, through field survey and collection and analysis of river water level data, the impact of alternative weed maintenance strategies, including no maintenance, upon river water levels;
- to estimate, through analysis of river water levels and survey of outfall structures, the influence of river water levels upon land drainage on land adjacent to the Idle;
- to establish, through user interviews, the uses made of the river and the requirements of each use in terms of river maintenance;
- to assess the implications for agriculture of changing weed maintenance activities.

1.3 The Study Site

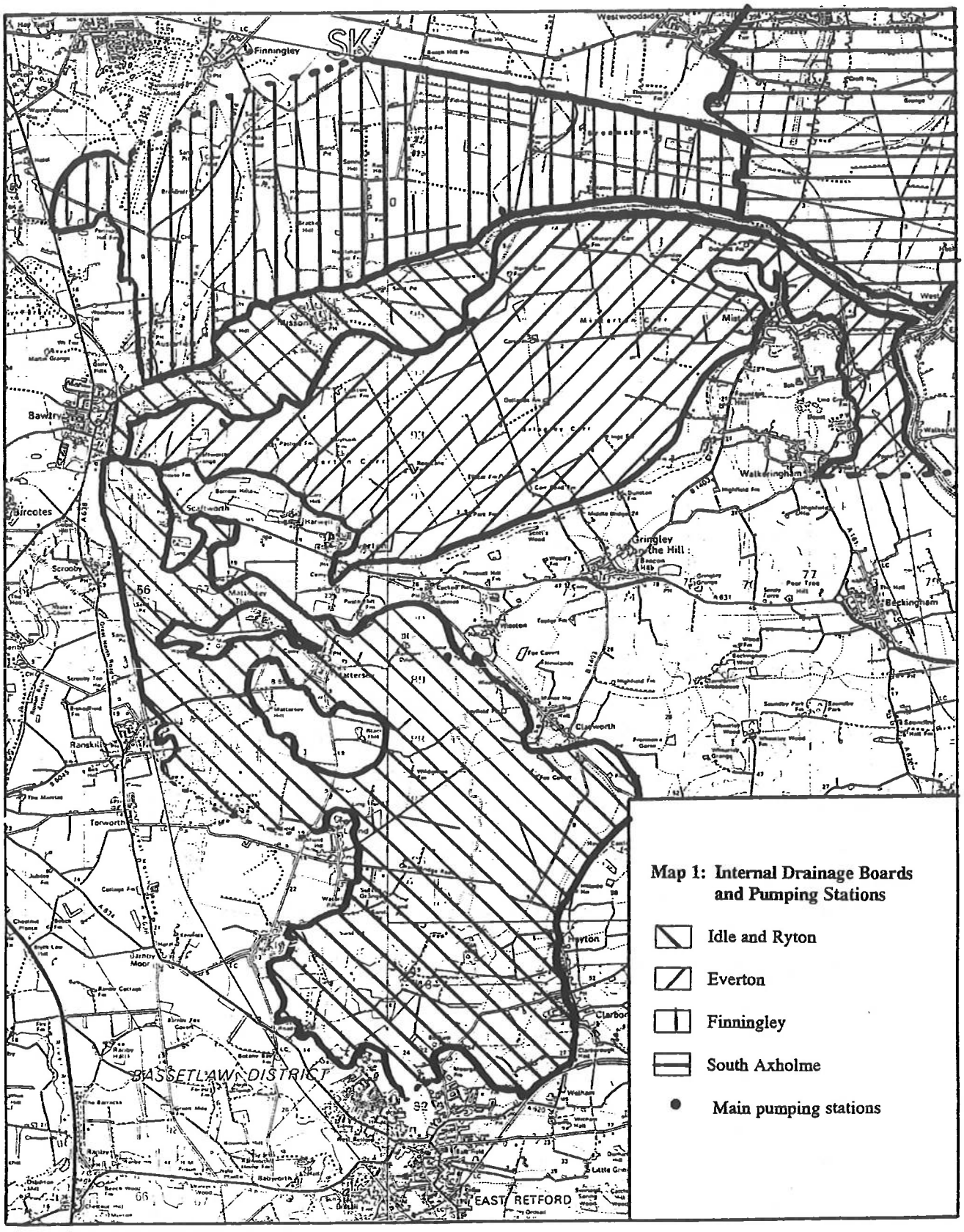
The study section of the Idle runs from Bolham Mill, downstream of East Retford, through Bawtry to the pumping station at West Stockwith (Map 1). A major capital scheme was carried out in the late 1970's and early 1980's to protect riparian land from frequent and long term inundations. A pumping station was installed at West Stockwith with two five foot (1.52 metre) and two eight foot (2.44 metre) diameter pumps with a total capacity of approximately 35 cumecs. A system of minor and major flood banks were constructed or improved which provided protection against either a three year or fifty year flood. The area upstream of Bawtry and small areas downstream of Bawtry receive three year flood protection and the majority of the area downstream of Bawtry receives fifty year flood protection.

The only areas which do not receive floodbank protection are four Sites of Special Scientific Interest (SSSIs) and narrow areas of grassland upstream of Misson. The channel was also widened, straightened and deepened along much of the study area.

The area is mainly farmed intensively with much of the area under cereals, root crops and vegetables. There are also areas of intensive and extensive grassland. The agricultural land along the study section of the Idle is divided into four Internal Drainage Boards (IDB's). These are the Idle and Ryton, Everton, Finningley and South Axholme IDB's (see Map 1). The river is embanked along almost the entire length of the River Idle from West Stockwith up to Bolham Mill. Therefore, land drainage into the River Idle is either through pumps or under gravity through flapped outfalls within the flood banks. A great deal of irrigation is also carried out on adjacent land with water taken from the Idle and fed into ditch systems for spray irrigation purposes.

Upstream of Bawtry extensive gravel extraction is carried out and, in areas where extraction has been completed, there are large deep lakes which are used by migratory birds. Downstream of Bawtry there are four small SSSIs (Newington, Misson West, Misson East and Misson Line Bank). These were reduced in size considerably during the installation of the capital scheme but still have the potential to be of significant conservation value both as a stop-over for migratory birds and as a breeding site. These areas do not receive floodbank protection but had not flooded (until the wet summer/autumn of 1992) since the scheme was put in. The sites were designed to flood at least three times a winter.

The River Idle is also used by anglers. There are seven angling clubs which use this stretch of river for either informal or match fishing.


SK
Finningley
Bawtry
Scrooby
Ranskill
Torworth
Gringley on the Hill
Walkeringham
Beckingham
Clayworth
Ryton
BASSETLAW DISTRICT
EAST RETFORD
Map 1: Internal Drainage Boards and Pumping Stations
Idle and Ryton
Everton
Finningley
South Axholme
Main pumping stations

1.4 Report Structure

The study site is described briefly in the Introduction. The data required and methods for collection are then summarised in Section 2, along with the methods used for impact assessment. The results are presented and discussed in Section 3 and recommendations for weed maintenance on the Idle in 1993, and for further research, are made in Section 4.

2. METHODS

2.1 Data Needs and Collection Methods

The data required for the Study included agricultural, hydraulic, hydrological, meteorological, conservation and recreation data.

2.1.1 Agricultural Data

Information was required regarding land use, productivity, and the influence of drainage and flood risk upon productivity. Additional information was needed in establishing the role played by the Idle in providing an outfall for drainage, providing flood protection and in the supply of water in the summer for irrigation.

The information was collected through farmer interviews carried out in spring/summer and autumn 1992 and spring 1993. A majority of the larger farms with land adjacent to the Idle were included in the farmer survey. During discussion, the farmers were also asked about the use they make of the river, the ways in which the management of the river affects them, how they feel about the present maintenance activities on the Idle, what would happen regarding their interest in the river if weed maintenance was not carried out, and what ideas they have regarding maintenance or management of the river.

2.1.2 Hydraulic, Hydrological and Meteorological Data

Data were required regarding channel dimensions, river water levels and rainfall in the catchment in 1991 and 1992. These data were used in a water table model developed at Silsoe College to assess the influence of rainfall and river water levels upon the water table levels of land adjacent to the river.

Cross-section surveys were carried out by the NRA at six sites along the Study section of the Idle. Gauge boards were installed by the NRA at 11 points along the Idle and were scheduled to be read once a week throughout the period of the Study. However, several of the boards were not installed until September 1992 and none of the boards were read between 9 June and 10 August 1992. The results from this source of data have, therefore,

proved to be of reduced value. Daily rainfall data for 1991 and 1992 was provided by the Hydrometric Department of the NRA (Severn Trent Region) and Solihull.

2.1.3 Conservation and Recreation Data

Data regarding conservation and recreation uses and requirements of the River Idle were collected through interviews with representatives of interested conservation and recreation organisations. These included NRA Area Recreation and Conservation Officers, NRA Fisheries Officers, fishing club committee members, English Nature and the Notts Wildlife Trust. The nature of the conservation and recreation interest on the Idle was examined during the interviews. In a similar vein to the farmer interviews, the users were asked about: the use they make of the river; the ways in which the management of the river affects them; how they feel about the present maintenance activities on the Idle; what would happen regarding their interest in the river if weed maintenance was not carried out; and what ideas they have regarding maintenance or management of the river.

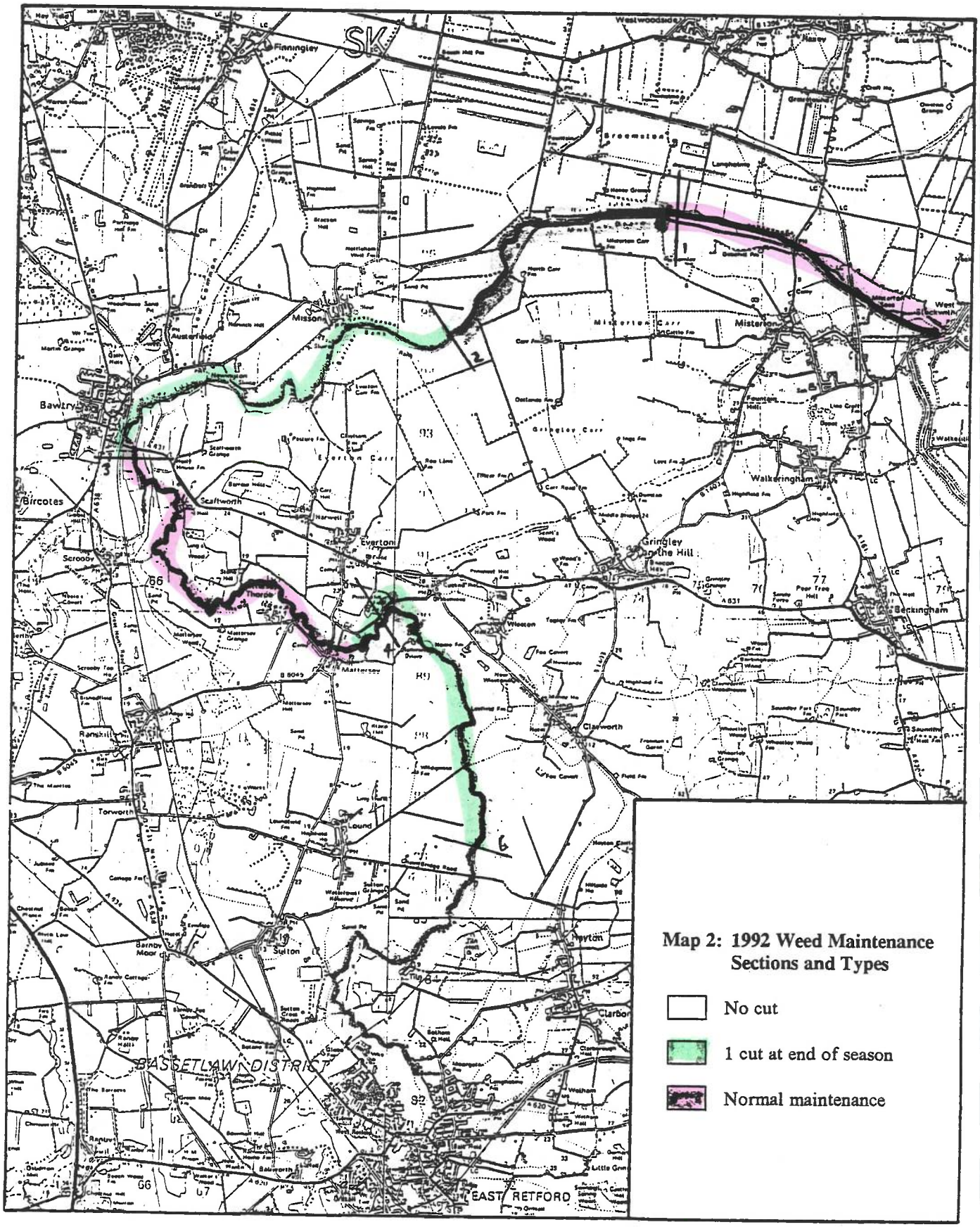
2.1.4 Additional Data

Further information was collected from secondary sources including the drainage history of the River Idle (from NRA Office in Gainsborough), designs for the capital scheme and drainage outfall structures (from NRA Office in Gainsborough), pump installation and running costs for pumps installed along the Idle (from IDB's), and weed characteristics and weed management (from Aquatic Weeds Research and Hydraulics Research Ltd).

2.2 Impact Assessment Methods

The sections from West Stockwith to Bawtry and from Bawtry to Bolham (near East Retford) were each divided into three sub-sections. In both sections (one upstream and one downstream of Bawtry), the downstream sub-sections were maintained as normal, the middle sub-section was cut once at the end of the summer and the upstream sub-section was not cut at all in 1992. Map 2 shows the location of the areas under different maintenance strategies and the location of cross-section surveys carried out.

The methods for impact assessment were divided into two main categories. The first category included analysis of river levels along the two sections in order to assess whether the different weed maintenance strategies carried out in the sub-sections had any influence upon river water levels and upon flood risk. The results of the interviews with conservation and fisheries organisations were also analysed and interpreted within this category. The second looked at each IDB in turn (where land drainage into the Idle was achieved through pumping) and, where land drainage into the Idle occurred under gravity, each outfall in


Map 2: 1992 Weed Maintenance Sections and Types
No cut
1 cut at end of season
Normal maintenance
BASSETLAW DISTRICT
EAST RETFORD
Bawtry
Misson
Misterton
Gringley on the Hill
Everton
Scrooby
Bircotes
Scaftworth
Walkeringham
Beckingham
Clayworth
Sturton
Torworth
Ranskill
Barnby Moor
Haxey
Finningley
Austerfield
Wiseton
Mattersey
Thorpe
Clarbor

turn, in order to assess the impact of the river water levels upon land drainage capability and, hence, agricultural productivity.

2.2.1 Impact of Weed Maintenance Activities Upon River Water Levels

The gauge board information collected by the NRA was logged, graphed and analysed statistically in order to establish whether there was any variation in river water levels at each gauge board which could be accounted for by different weed maintenance activities.

The implications of changes in river bed levels and river water levels as a result of alternative weed maintenance activities were considered through analysis of data prepared by the Mott MacDonalds Group (MMG, 1992). This data estimated the impact of changes in bed level and channel roughness upon flood risk for flows with given return periods.

2.2.2 Impact of River Water Levels Upon Drainage Conditions on Adjacent Land

The impact of river water levels upon adjacent land was assessed for each of the IDB's in turn (where drainage was provided by pumping into the Idle) and for each of the outfalls in turn (where land drainage into the River Idle was carried out under gravity). This is because the issues relating to, and consequences of, changes in river water level differ according to whether drainage is by pumping or by gravity.

The impact assessment methods in the cases where pumped drainage was present were used to assess the impact of changes in river water level upon pumping regimes and to assess the increases in pumping time as a result of increases in river water level. The resultant increases in pumping costs relate to both an increase in pumping time and an increase in the head against which the pumps are pushing. The opinions of the farmers and IDB managers were also sought and reported.

Several methods were used in the cases where drainage was carried out under gravity. River water level data were compared with outfall levels to assess the amount of time that the outfalls were submerged during the period of the study. The consequences of an increase in river water levels upon outfalls were also analysed.

The impact of different ditch water levels in the ditch systems behind the gravity outfalls upon the drainage status of the adjacent land was estimated. This was carried out through the use of a non-steady state water table model developed at Silsoe College (Youngs et al, 1989). The data used for this exercise were: rainfall data for the area for 1991 and 1992, and soils data from borehole data provided by the NRA and from Soil Survey of England and Wales sources (Hodge et al, 1984; Reeve et al, 1981). A variety of drainage intensities and ditch freeboard levels were used to create 'what if' drainage scenarios. These scenarios

were created because drainage system and ditch water level data were unavailable for this Study. Once the data are available (see Recommendations for Further Research) they can be compared with the 'what if' scenarios to assess the drainage status.

In addition to the modelled data, the farmers and IDB managers were interviewed and their thoughts concerning each outfall and the issues relating to it have been included.

3. RESULTS

The results are presented in a variety of formats. The impact of different weed maintenance activities upon river water levels along the entire study site are analysed. The implications of different weed maintenance strategies upon the uses made of the river itself, namely abstraction of water by farmers for irrigation, conservation interests and fishing are then examined. The impact of changes in river water levels upon drainage systems and, hence, upon agricultural production are then assessed for each IDB and outfall separately.

3.1 Impact of Weed Maintenance Activities Upon River Water Levels

The readings from the gauge boards at West Stockwith, the Bailey Bridge, Bawtry Bridge, Mattersey, Wiseton pumping station and Bolham Mill (see Map 3) have been processed and analysed to assess whether there are any significant discrepancies in water levels which can be attributed to different weed maintenance strategies. The results have been analysed in two groups, one downstream of Bawtry Bridge and one upstream of Bawtry Bridge. The weed maintenance activities which were carried out in the sections covered by the gauge boards are as follows:

Downstream of Bawtry:	- West Stockwith	Normal maintenance programme (Sept. and Nov. 1992)
	- Bailey Bridge	One cut at the end of summer (end Sept 1992)
	- Bawtry Bridge	No cuts made in 1992
Upstream of Bawtry:	- Mattersey	Normal maintenance programme (Sept. and Nov. 1992)
	- Wiseton P.S.	One cut at the end of summer (end Oct. 1992)
	- Bolham Mill	No cuts in 1992

The water levels recorded for each of the above gauge boards are shown in Table 1. The data set is not complete because the boards were not read by the NRA between June 9 and August 10 and two of the boards (Wiseton and Bolham Mill) were not installed until September. The results from the gauge boards are, therefore, inconclusive and further study will be required to provide a more accurate assessment of the impacts of different weed maintenance strategies upon river water levels.

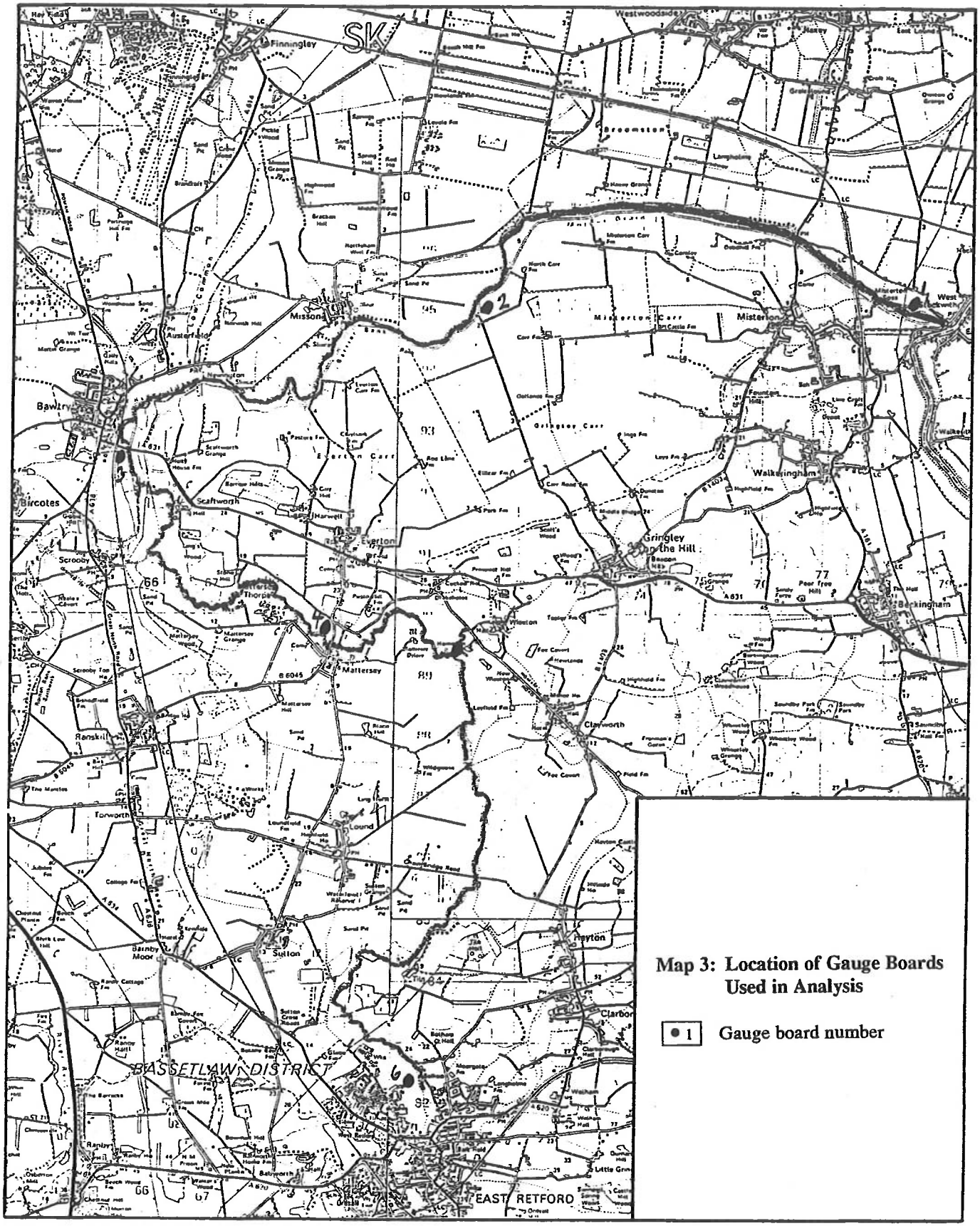

SK
Finningley
Misson
Austerfield
Bawtry
Bircotes
Scrooby
Scaftworth
Harwell
Everton
Mattersey
Misterton
Walkeringham
Gringley on the Hill
Clayworth
Retford
Ranskill
Torworth
Sutton
Haxton
Clarborough
BASSETLAW DISTRICT
EAST RETFORD
Map 3: Location of Gauge Boards Used in Analysis
1 Gauge board number

Table 1: Gauge Board Readings for Six Locations on the River Idle for May 1992 - January 1993

Date	West Stockwith	Bailey Bridge	Bawtry Bridge	Mattersey	Wiseton P.S.	Bolham Mill
27-May-92	1.55	1.7	1.5 (*)	3.06		
3-Jun	1.78	1.8	1.8	3.38		
9-Jun	1.95	1.94	2.09			
10-Aug	1.7	2.15	2.37	3.65		
17-Aug	2.25	2.3	2.27 (*)	3.3		
24-Aug	2.1	2.25	2.38	3.2		
1-Sep	2.4	2.4	2.41	3.29		
7-Sep	2	2.17	2.25	3.23		
14-Sep	1.88	2.2	2.48	3.3		10.26
21-Sep	1.64	1.9	2.14	3.23	4.15	10.32
28-Sep	2.49	2.59	2.69	3.6		10.64
5-Oct	1.8	2.38	2.7	3.68		10.69
12-Oct	2.28	2.4	2.41	3.3		10.39
19-Oct	1.58	2	2.3	3.3	4.09	10.24
26-Oct	2.39	2.46	2.44	3.55	4.27	10.6
2-Nov	1.5	1.9	2.06	3.25	4	10.4
9-Nov	2.19	2.17 (*)	2.3	3.2	3.9	10.35
16-Nov	2.19	2.47	2.58	3.57	4.29	10.6
23-Nov	2.1	2.5	2.69	3.7	4.4	10.67
30-Nov	2.1	2.5	2.59	3.47	4.15	10.47
7-Dec	2.38	2.65	2.97	4.19	4.97	11
14-Dec	2.3	2.41	2.55	3.67	4.3	10.5
22-Dec	2.1	1.85 (*)	2.16	3.48	4.15	10.4
30-Dec	1.968	2.12	2.21			
5-Jan-93	1.74	1.96	2.19	3.4	4.1	10.35
12-Jan	2	2.24	2.5	3.7	4.35	10.47
18-Jan	1.8	2.07	2.3	3.55	4.19	10.5
25-Jan	2	2.1	2.29	3.5	4.2	10.5

(*) Anomalies in the data, possibly due to time delay on reading u/s boards on days when pumping at West Stockwith was carried out. Boards with levels marked (*) were read nearly two hours later than the other boards.

The data which were collected are shown in graph form in Figure 1 (downstream of Bawtry Bridge) and Figure 2 (upstream of Bawtry Bridge). The figures show the river water levels at West Stockwith and Mattersey (at the downstream ends of the two sections, where normal maintenance activities were carried out) and the variation in river water levels at the other sites relative to these.

The figures suggest that there is no significant variation in water levels which can be attributed to different weed maintenance strategies. This view is supported by statistical analysis of the data. Correlation tests (using Student's t-test) were carried out based on the null hypothesis that the water levels at each of the gauge boards in each section throughout the study period were significantly the same (ie there was no significant difference in water levels which could be attributed to anything but chance).

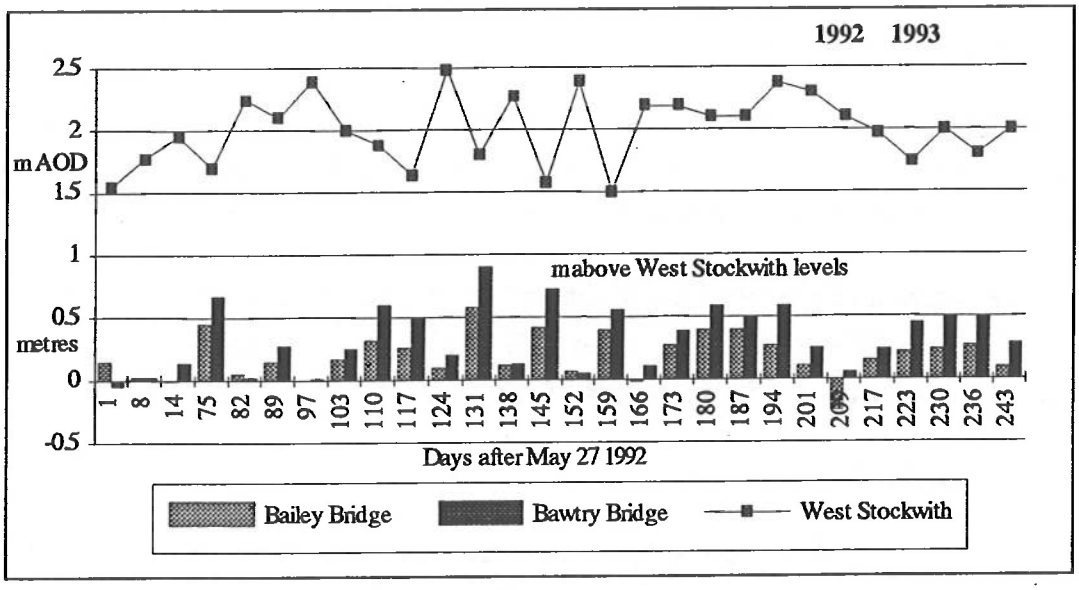


Figure 1: River Water Levels at West Stockwith and Change in Levels at Bailey Bridge and Bawtry Bridge relative to West Stockwith

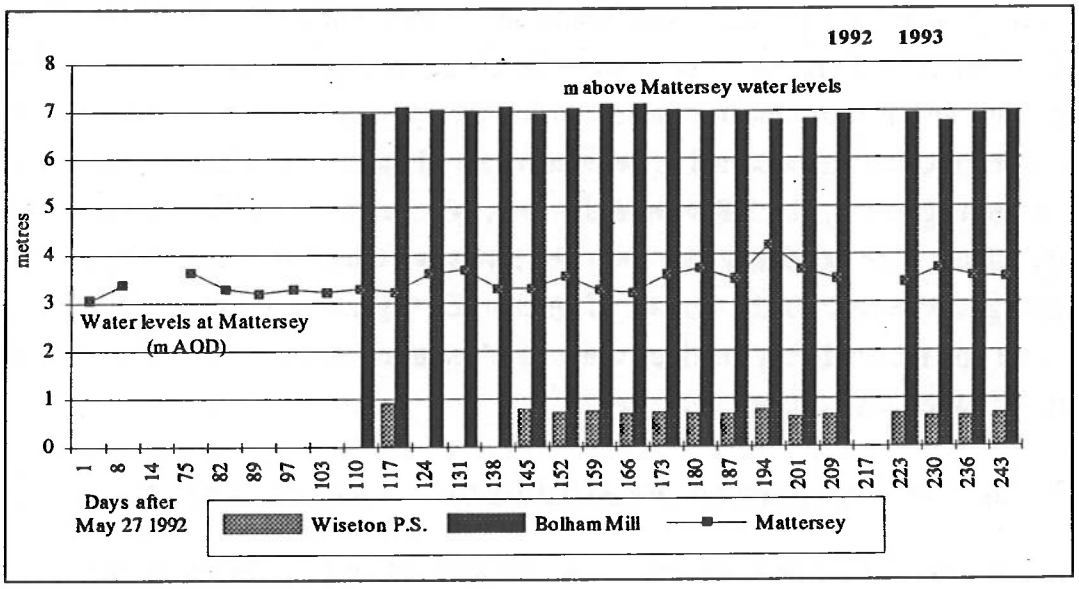


Figure 2: River Water Levels at Mattersey and Change in Levels at Wiseton Pumping Station and Bolham Mill relative to Mattersey

The results showed that:

(i) Downstream of Bawtry:

- river water levels at West Stockwith and the Bailey Bridge, and at the Bailey Bridge and Bawtry Bridge are significantly correlated at 99.9% confidence levels (ie. there is no significant difference in river water levels);

- river water levels at West Stockwith and Bawtry Bridge are not significantly correlated at 99.9% confidence levels but are at 95% confidence. Therefore, there is still no significance difference in the pattern of river water levels at the two sites.

(ii) Upstream of Bawtry

- At 99.9% confidence levels the relationship between the river water levels at Mattersey, Wiseton Pumping station and Bolham Mill are all significant, thereby suggesting that there are no significant differences in the pattern of river water levels at the three sites.

These results indicate that in the latter part of the year the different weed maintenance strategies have had no impact upon river water levels on the River Idle. However, there are several points which call into question the significance of these results. (a) The data set is not complete and the period missed (mid June to mid August) is one of considerable weed growth and the differences in river water levels between those sites which were maintained and those which were not maintained during that period would have been at a maximum. (b) Weed growth was reported to be considerably less in 1992 along the whole of the Idle. the reasons given by the NRA were the cool, wet summer. (c) Late summer, autumn and early winter were extremely wet and river levels were high for most of this period. As the discharge increases, so the impact of in-channel vegetation decreases. These points may account for the similarity in river water level patterns at all sites on the Idle, despite the different weed maintenance strategies.

3.2 Impact of Weed Maintenance Activities Upon Users of the River Channel

The uses made of the river channel itself are: abstraction of water by farmers for irrigation, conservation, recreation (particularly fishing) and navigation. The results for this section are from interviews carried out with representatives of the interested parties. The interviews were carried out in the summer and autumn of 1992 and the spring of 1993.

3.2.1 Water Abstraction for Irrigation

The number of licences granted for abstraction for irrigation on this section of the Idle is 26 (13 between East Retford and Bawtry and 13 between Bawtry and West Stockwith). These allow for a total daily abstraction of 26,905m^3 (14,042m^3/day upstream of Bawtry and 12,863m^3/day downstream of Bawtry) and total annual abstraction of 739,647m^3 (358,344m^3/year upstream of Bawtry and 381,303m^3/year downstream of Bawtry).

Most of the farmers said that weed growth does not affect irrigation operations significantly and in some cases it is seen as a positive feature. The main positive features are where the weeds act as a filter for water entering the pumps and where they increase the summer water levels in the river. However, when weed growth becomes excessive, two farmers said that this prevents sufficient water getting to the pumps and so they are unable to draw adequate water for irrigation.

The farmers said that the cutting of the weeds causes two particular problems. The first is that the loose cut weed blocks the pumps and does not allow sufficient water to be abstracted. The second is the lowering of the water levels in the river (since the weeds have the effect of holding back water and increasing water levels), particularly in the summer, which affects the quality and quantity of water available for irrigation. The farmers suggested that the inconveniences resulting from weed maintenance are shorter lived and less significant in their impact than the negative impacts of excessive weed growth.

One of the farmers with land which is gravity drained suggested that irrigation requirements would fall if summer water levels in the river and, hence, ditches were higher as a consequence of less intensive weed maintenance activities. If the water levels are high, then gravity drains are unable to run and so retain water levels. This is because summer water table levels would be higher as a result of higher ditch water levels. This would be of particular benefit in dry summers since without weeds the river water levels would be very low and all the water in the ditches would drain, resulting in possible droughtiness on adjacent land. However, as in 1992, if the summer is particularly wet, then high river water levels and, consequently, ditch water levels may result in poorly drained adjacent land.

3.2.2 Conservation

The results of the interviews with representatives from conservation organisations with an interest in the management of the River Idle have been separated into two sections. The river water levels pre 1992 had been insufficient to enable Sites of Special Scientific Interest (SSSIs) to flood the designed three times a winter. In the summer of 1992 the

rainfall was exceptionally heavy and flows were sufficiently high to flood the SSSIs several times. Therefore the views of the conservation organisations are considered pre and post the summer 1992 floods.

a) Views of Conservationists (Pre Summer 1992 Floods)

Three people were interviewed representing English Nature, the Nottinghamshire Wildlife Trust and the Conservation Department of the NRA.

The main points of conservation interest on the River Idle are the four SSSIs (Newington, Misson East and West and Misson Line Bank), see Map 4. These sites were reduced in size at the time of the capital scheme. It was reported that these sites have declined considerably in botanical interest since the capital scheme was installed in the early 1980s. The main areas of interest are round the ditches in the SSSIs and the neighbouring IDB's (particularly those IDB's whose land was in the larger SSSIs which existed before the capital scheme).

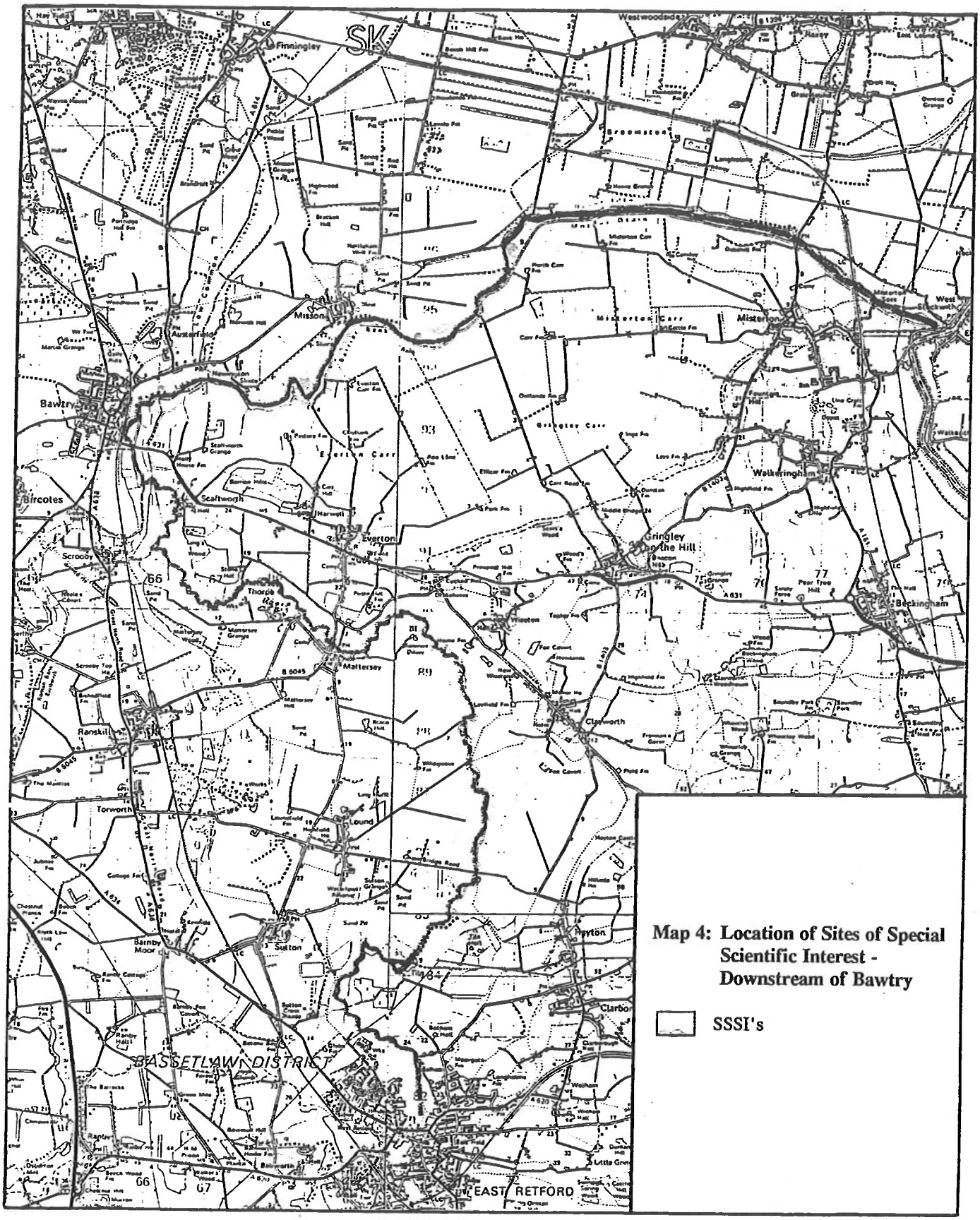
The SSSIs were, and still are, valuable as a wetland breeding site for many birds including snipe, Bewick swan and lapwing and as a visiting site for many migratory birds. The number of visiting birds has been reduced since the capital scheme. However, with the exception of recent floods in 1992, the washlands have not flooded since the scheme was installed and they are predominantly dry.

The conservation interested parties are not satisfied with the present situation, since they would like to see the washlands flood at least three times a winter for many days at a time (once early in the winter to get the ground wet and twice later on). This has not happened in the last ten years.

b) Views of Conservationists (Post Summer 1992 Floods)

Most of the washlands forming the SSSIs on the Idle flooded several times in the summer and early autumn of 1992 and the water remained on the land for a considerable length of time (weeks rather than days) following the event. The flooding resulted from the combination of high rainfall and retained summer water levels at the West Stockwith pumping station.

The response of one of the conservationists to the summer flooding was positive (ie. it was felt that the flooding was a good thing from the conservation point of view). However, it was felt that permanent or long term inundation of the land in spring and summer would inhibit grass growth for grazing (for swans and other grazing birds). The view of the conservationist was that damp land was good for grass growth and slowing the growth of


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Finningley
Misson
Bawtry
Austerfield
Scaftworth
Everton
Scrooby
Thorpe
Mattersey
Ranskill
Torworth
Sutton
Barnby Moor
Clayworth
Gringley on the Hill
Walkeringham
Beckingham
Misterton
Clarbor
BASSETLAW DISTRICT
EAST RETFORD
Map 4: Location of Sites of Special Scientific Interest - Downstream of Bawtry
SSSI's

nettles and weeds which had accelerated in the recent dry summers. Therefore, it was preferable for river water levels to be lowered at West Stockwith in the short term following a flood event to allow excess water off the land. However, the levels should be raised again after the excess water has gone in order to prevent the land from drying out.

c) Conservationists Views on Weed Maintenance and the Retention of River Water Levels

The conservationists do not see the River Idle itself as an important conservation site, except at the margins where there is a reasonable variety of weed growth. They would like to see weed maintenance carried out to prevent the river from choking, but would want only the central section of the river cleared, leaving wide margins. If it is felt necessary by the NRA to clear all of the channel of weeds, then timing is seen as being an important issue. The last birds finish breeding at the end of June (tufted ducks) so maintenance should be delayed until the breeding has been completed. If only the centre of the channel is to be cleared the timing is not so important.

The important issues according to the conservationists concern the retention of high water levels throughout the year. This would maintain and/or increase the diversity of marginal and bankside vegetation and would enable greater retention of water levels on the washlands. One person argued that higher water levels in the summer would encourage grass growth and so benefit the farmer as well.

All of the conservation people interviewed felt that the retention of water levels by the use of the pumping facilities at West Stockwith was a more important issue than weed maintenance both for the washlands and for marginal and bankside habitats. They are monitoring the effects of the change in pumping regime at West Stockwith to see what impact this has on the drainage and flooding conditions on the washlands.

One point of view was that sections of weed growth just downstream or in the parts of the river running through the SSSIs could remain uncut so as to encourage siltation in the channel at these points. These points would then act as natural weirs to hold up water levels. The installation of bunds and/or sluices on the wetlands to prevent drainage was also raised as a possible aid, in addition to retention of water levels, to increasing the wetness of the washlands.

There was tentative speculation that there may be a possibility for compensatory payments, under the Countryside Commission's Stewardship Scheme, if a change in weed maintenance regime and West Stockwith pumping regime led to a loss of summer cattle grazing on the SSSIs .

The main priority for river management was seen as the management of river water levels rather than the weed maintenance programme, ie the impact of the river water levels upon adjacent SSSIs, rather than the impact of weed maintenance upon the limited conservation value of the channel itself.

3.2.3 Fisheries

Six people were spoken to who have involvement with fishing on the River Idle, five from angling clubs and one from the Fisheries Department of the NRA.

The River Idle is a river which supports breeding fish stocks. It is not restocked by any of the interested parties. The river was an important roach habitat but since the capital scheme was installed roach are no longer found in this river.

The River Idle is used a great deal by anglers for both leisure fishing and for matches. The two types of fishing have different requirements of the river. Match fishing requires a uniform channel which gives all competitors as equal a chance as possible. More informal fishing requires a diversity of conditions which provides a variety of habitats for different fish. Some of the clubs are pushing for management of the river for match fishing in places where the NRA Fisheries Department feel match fishing should not be taking place.

In the case of match fishing the clubs expressed a wish to see a uniform channel cut in the centre of the channel each year at times which do not interfere with fishing. They felt that fishing was impaired considerably by cut weeds floating down the river. However, if no weed maintenance is done the channel becomes unfishable, particularly when the water levels are low. One match was reported to have been called off because of low water levels and excessive weed growth. They expressed a preference for weed maintenance being carried out before the start of the fishing season (mid-June) and late in August, though they recognised that maintenance had to be carried out and accepted it (if reluctantly by some). They also wanted water levels kept higher where possible. Cutting only part of the channel would help with this. However, the depth of water should not be excessive. One club, fishing in the Idle Stop area, complained strongly about the high water levels retained at West Stockwith. They said that when water was deep there was virtually no lateral movement, making the river practically unfishable, and that pegs were covered. Matches were reported to have been cancelled because of the deep water.

Another club reported that three years ago too much weed maintenance was carried out and that the water was too low, referring to the channel as a "watery grave". The same club, which fish downstream from Bolham Mill, reported that the lack of weed maintenance in

1992 had resulted in too much weed growth. As a result, by the end of July the river was clogged and the fishermen could not get at the fish.

A further club, which fishes in the Tiln area, said that until about fifteen years ago they had their own equipment and did their own maintenance along the stretch of river where they had the fishing rights. They said that they would like to start a similar system now.

Two of the clubs said that they would be willing to provide manpower to help with maintenance operations and one club said they would be willing to consider seriously some financial contribution to the costs of weed maintenance.

The Fisheries Department of the NRA expressed the view that the river should be managed in accordance with the existing channel features. They said that the section downstream of Bawtry was suitable for match fishing (on some of this section the NRA have the fishing rights and hold matches). However, the section upstream of Bawtry is seen as suitable for habitat creation for a variety of fish and that weed maintenance would encourage the variety of habitats. The NRA Fisheries Department advocated the use of Huet's Classification of European River Zones in assessing the potential of the section upstream of Bawtry for different fish types and in creating habitats accordingly. In the case of weed maintenance, the opportunities are limited but the correct use of meanders in a mid-channel weed cut would help in the enhancement of some of these habitats.

3.2.4 Navigation

There is no navigation authority, so the NRA do not have any statutory obligations. However, there are ancient navigation rights on the river and there is an annual boat festival. Consideration needs to be given to providing adequate facilities for the festival or else there would be public protests from the people of Bawtry and East Retford.

3.3 Advice from Aquatic Weed Specialists and Hydrologists

3.3.1 Aquatic Weed Specialists

Experts in aquatic weeds management were contacted and interviewed about weed management on the River Idle. They were only able to provide general information on weed management, since they were not aware of the detailed weed distribution and composition. The views given suggested that weed maintenance activities may be governed by the amount of 'spare capacity' in the channel. Siltation in the long term, rather than year round changes in water levels, was seen as the main issue, particularly in the Idle where at present there is a significant amount of 'spare capacity'. Weeds, particularly emergent weeds, can be managed in ways which reduce the potential for siltation by

influencing and changing flow patterns in the channel. The greatest risk for the increase in siltation is where flows are low and emergent weeds encroach further into the channel. This is a situation which does exist in places on the River Idle.

A report produced by HR Wallingford Ltd earlier this year (Fisher, 1993) looked at the impact of weed maintenance upon weed growth. The main points presented in the report were: (i) with regular weed maintenance over a period of time, all plants achieve maximum biomass simultaneously; (ii) weed maintenance in the summer can lead to regrowth in the autumn and a higher overwintering plant population; (iii) cutting in the late summer can mean little regrowth and a substantially lower crop in the following year; (iv) the variability in growth patterns of different plants and the same plants in different years causes a problem for weed maintenance managers; and (v) regular assessments of rivers and their weeds should be carried out in planning weed maintenance strategies (ie the weed maintenance regime should be flexible and responsive to demands made upon it).

It is suggested that later in 1993 a visit to the River Idle should be organised with a specialist aquatic weeds research group in order to further assess the risks of alternative weed maintenance strategies.

3.3.2 Hydrologists Reports

A recent study was carried out by the Mott MacDonalds Group (MMG, 1992), which assessed, through the use of hydrological models, the impact of changes in channel roughness and siltation upon the risk of flooding for flows with a given return period.

The results indicated that even if sedimentation of 1m occurred and roughness was high, water levels would not be within 0.5 - 2m of the top of the major flood banks (along the flood banks' entire length) for a 10 year event. Some of the minor flood banks would be breached for the ten year event. The minor flood banks, however, were originally designed to cater for smaller flows than the 1 in 10 event used in the study. This does suggest that there is 'spare capacity' in the system. Weed maintenance could be reduced and channel capacity allowed to decrease to a certain extent without risk of major flooding. However, the rate of sedimentation and the costs of desilting work (relative to annual weed maintenance) would be significant factors in consideration of such a strategy.

3.4 Impact of Idle River Water Levels Upon Adjacent Drainage Systems

The impact of alternative weed maintenance strategies upon river water levels were inconclusive because of incomplete data and the exceptionally high rainfall during the summer period. Therefore, it is not possible at this stage to say exactly what would happen

to the adjacent drainage systems for given weed maintenance strategies. The method adopted is to consider 'what if' scenarios, so that for a given set of variables the impact upon drainage status can be assessed.

The assessment of agricultural benefits derived from the weed maintenance activities carried out on the River Idle needs to take into consideration the way in which a land drainage facility and flood protection are provided for adjacent land. Along the stretch of the River Idle from Bolham Mill (just downstream of East Retford) to the confluence with the River Trent at West Stockwith, land drainage facilities are provided for discrete areas and by different methods (pumped and gravity). Therefore, each discrete area served by different outfalls into the River Idle is analysed separately. This means that each IDB area served by pumped drainage is analysed separately and each area served by gravity outfall is analysed individually. Photographs of most of the outfalls are included.

The discussion will consider two separate sections, one upstream of Bawtry Bridge (where the impact of the pumping regime at the West Stockwith pumping station is not greatly significant), and one downstream of Bawtry Bridge (where water levels are significantly affected by the water levels at West Stockwith).

The land area adjacent to the River Idle is served by four different IDB's: South Axholme, Everton, Finningley and the Idle and Ryton IDB (see Map 1).

3.4.1 South Axholme IDB

The South Axholme IDB is protected by major flood banks on the River Idle (design return period 1 in 50 years) but does not discharge into the Idle. The main issue relating to this IDB is flood protection. The IDB is immediately upstream of West Stockwith pumping station and it is highly unlikely that this area is affected by the weed maintenance programme. The Mott MacDonalds study (op cit.) suggested that even if sedimentation of 1m occurred and roughness was high then water levels would still not be within 2m of the top of the flood banks for a 10 year event on this stretch of the river. Therefore, there are, at this stage, assumed to be no agricultural disbenefits on this stretch of the river if the intensity of weed maintenance is reduced. Further modelling using the design 50 year return period should be carried out to confirm this view.

3.4.2 Everton IDB

The Everton IDB is protected from flooding by the Idle by major flood banks (1 in 50 year return period) and drains into the Idle through Gringley pumping station and another, more recently installed pumping station opposite the Misson West SSSI (Plates 1 and 2). The

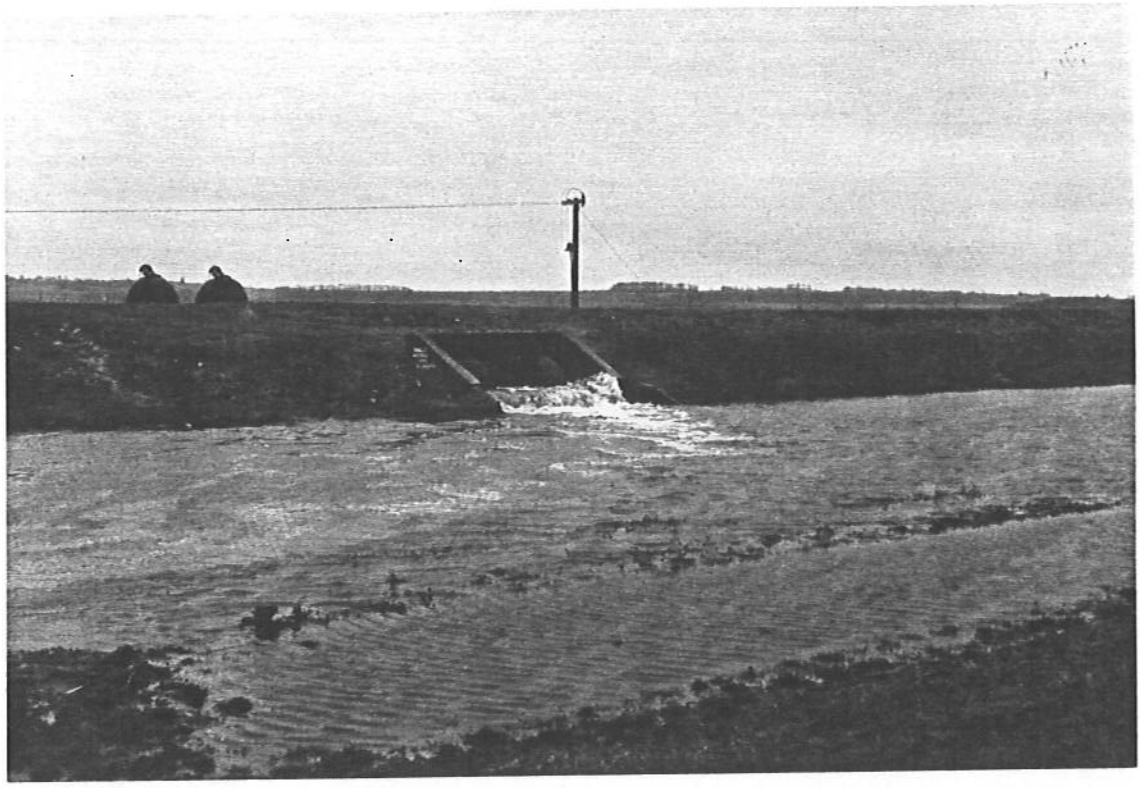


Plate 1: Gringley Pumping Station (Everton IDB) in action - July 1992



Plate 2: Everton IDB Pumping Station - July 1992

main issues relate to the long term effects of not doing weed maintenance and the impact upon channel capacity and, hence, flood risk. The Mott MacDonalds study showed that in this area there would have to be a very large reduction in channel cross-section area and increase in channel roughness for a risk of flooding to occur.

A further cost relates to the increase in pumping costs at Gringley pumping station should a reduction in weed maintenance lead to an increase in water levels. This would lead to the pump pushing against a greater head of water in the river and an increase in energy/running costs. In the case of Everton IDB, the only disbenefits of a less intensive weed maintenance regime are an increase in pumping costs, and these are likely to be minor.

3.4.3 Finningley IDB

The Finningley IDB is protected by minor (1 in 5 year) and major (1 in 50 year) flood banks and drains in to the Idle through two pumps, one at Newington (Plate 3) and one at Idle Stop. In both cases the pump outfalls are set back from the river channel and flood storage is provided in the form of washlands (the Newington and Idle Stop Sites of Special Scientific Interest (SSSI's)). There are no perceived disbenefits from less intensive weed maintenance to land within the IDB, either concerning flood risk or an increase in pump running costs.

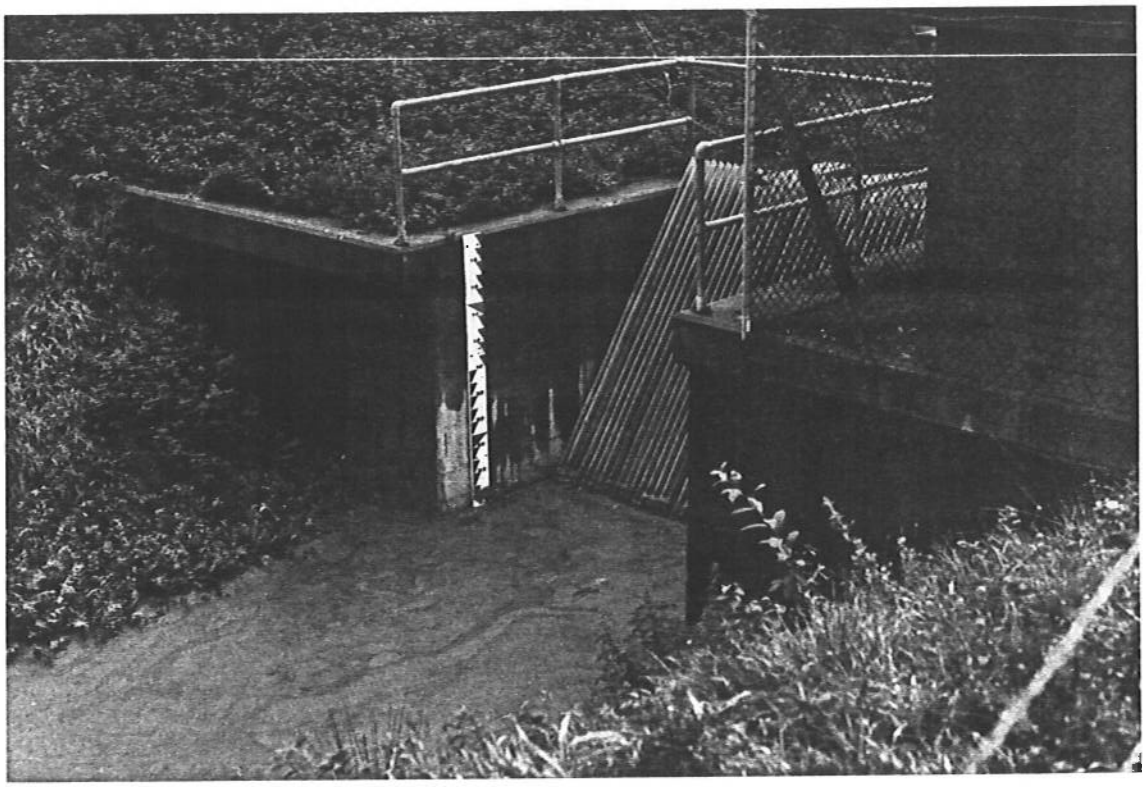


Plate 3: Finningley IDB Pumping Station at Newington - December 1992

As a point of interest, if those farmers who farm land which is drained under gravity at present were to decide to drain through a permanently installed pump, the costs for a pump similar to that used by Finningley IDB at Newington would be in the region of:

Installation £70 500 (in 1985/6 prices)

of which	£41 000	structural
	£17 000	pump, equipment electricity
	£12 500	electricity supply

Annual running costs £2 200 approximately (in 1992/3 prices)

(included are manning and electricity costs)

3.4.4 Idle and Ryton IDB

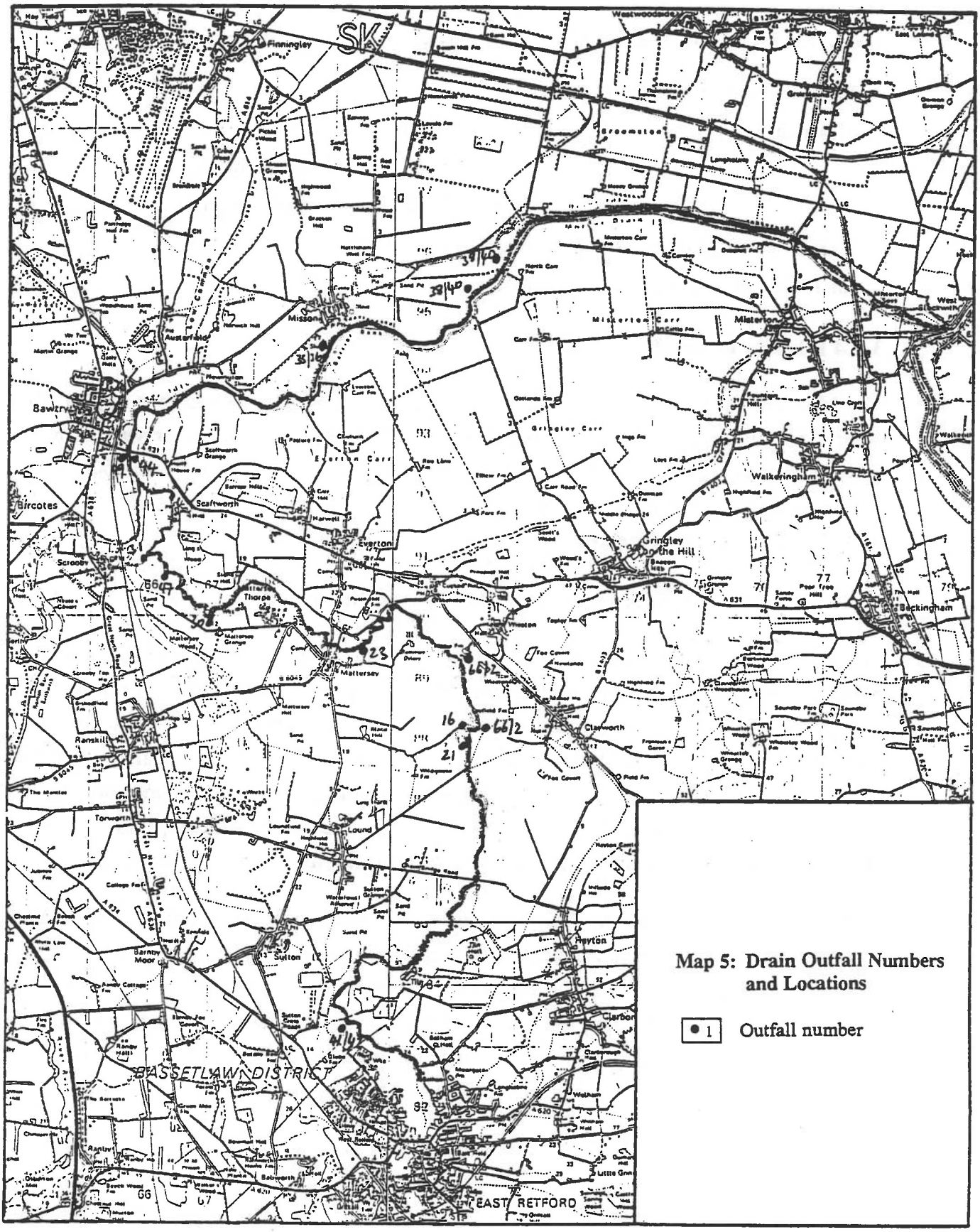
The Idle and Ryton IDB is more directly affected by river water levels than any of the other IDB's because most of the drainage into the river occurs under gravity through flapped outfalls. Each of the major areas within the IDB served by different outfalls have different features relating to them and are discussed separately. The outfalls are identified by the drain number and the locations are shown on Map 5.

a. SSSI Washlands at Idle Stop, Misson and Newington

The Washlands are used for the grazing of cattle. The land is let on a summer grazing agreement renewed annually (running from April through to September). The land was designed to flood three times each winter in the interests of maintaining a habitat for bird breeding and as a stop over for migratory birds. Until 1992 the land had not flooded at all since the scheme was put in. In 1992 the land was inundated several times and for several weeks on each occasion (Plates 4 and 5). This was due to a combination of the high extended rainfall in 1992 and the alteration of the pumping regime at West Stockwith.

The main points of note are that the farmer who grazes his cattle and the interested conservation organisations are in agreement that flooding is not a bad thing in itself. Both parties would like to see the river water levels lowered for a brief period following a flood event so that surface water may get away and then reinstated to keep the land moist. Both parties also agreed that weed growth is a minor influence upon the immediate flood risk to the washlands and that the major influence is the control of water levels at West Stockwith.

There is a threat that agricultural productivity may be lost on the washlands, ie. the summer grazing agreement will not be renewed, which would be a major disappointment to both the farmer and the conservationists. It is unlikely, however, that a change in weed maintenance activities will be responsible for this, at least in the short to medium term. In


SK
Finningley
Misson
Bawtry
Scaftworth
Everton
Gringley on the Hill
Walkeringham
Mattersey
Clayworth
Ranskill
Torworth
Sutton
Leyton
BASSETLAW DISTRICT
EAST RETFORD
Map 5: Drain Outfall Numbers and Locations
1 Outfall number

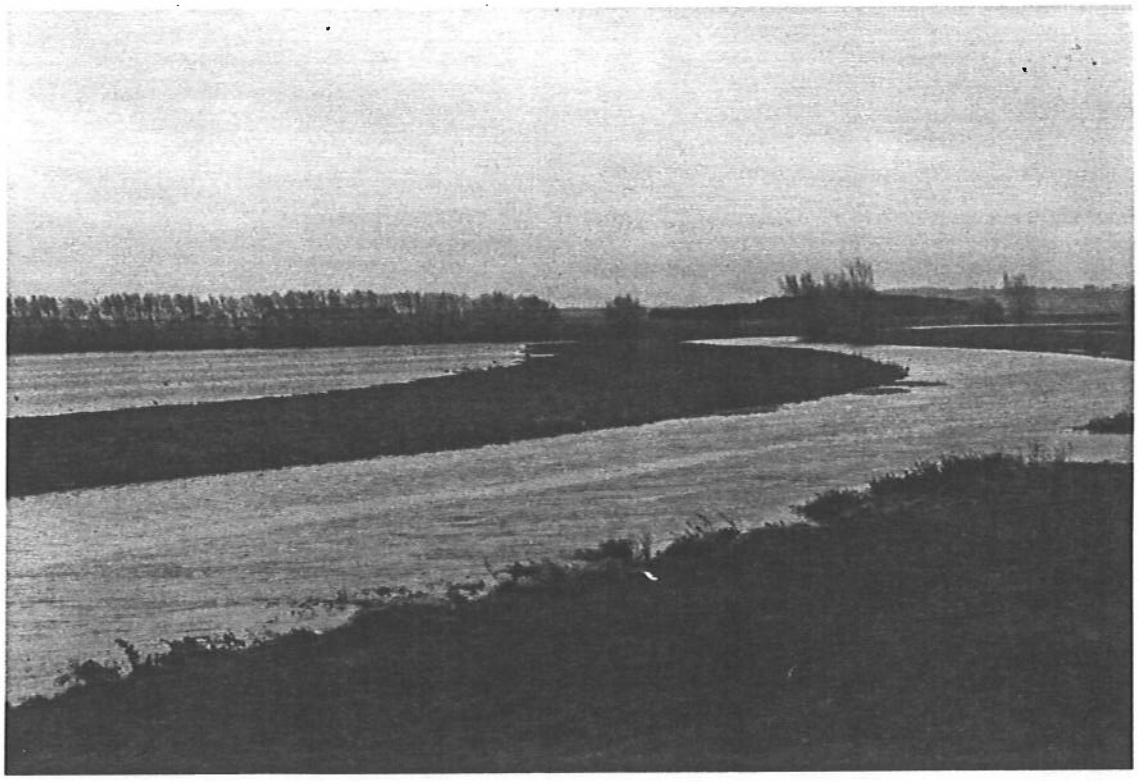


Plate 4: Flooding on SSSI at Idle Stop - December 1992

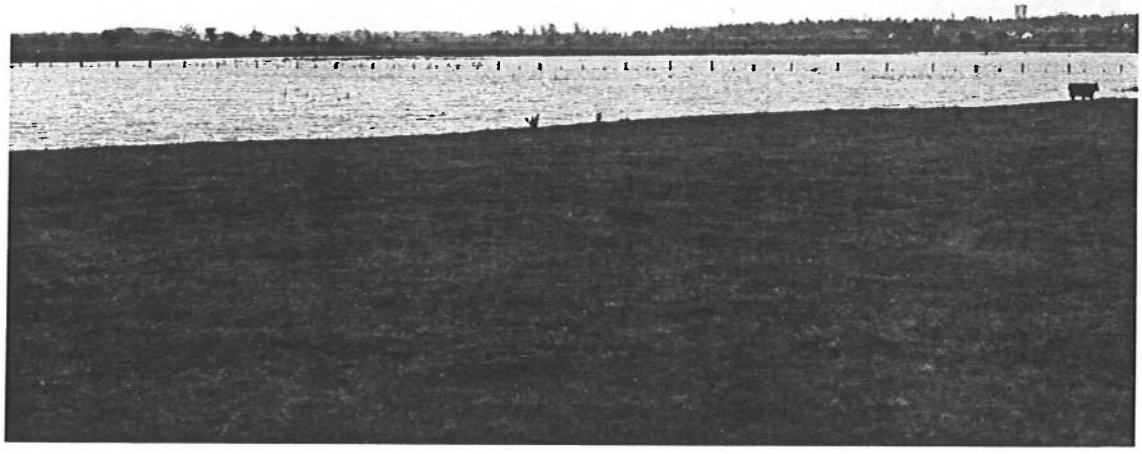


Plate 5: Flooding on SSSI at Newington - December 1992

the long term there may be a change if channel capacity is reduced significantly as a result of less intensive weed maintenance activities.

b. Drains 38/40 and 35/36 - Downstream of Bawtry Bridge

These drains are the most downstream drains of the Idle and Ryton IDB and they discharge into the Idle under gravity through three different outfalls. Drains 38/40 drain through two outfalls, one near Idle Stop (Plate 6) and one about 1.5 km further upstream. Drains 35/36 drain through one flapped outfall between Misson village and Misson West SSSI (Plates 7 and 8). The outfalls are at a level where they are greatly affected by the water levels held at West Stockwith. The impact of weed maintenance activities is of secondary importance when compared to the retained water levels.



Plate 6: Outfall for Drains 38/40 near Idle Stop - December 1992

The monitored water levels for gauging boards at Idle Stop and Misson Lane have been compared with the levels for the outfalls to estimate the amount of time that the doors are prevented from opening. The results are shown in Figure 3 (for the outfall from Drain 38 near Idle Stop), Figure 4 (for the outfall from Drain 38 towards Misson) and Figure 5 (for the outfall from drain 35 upstream of Misson).

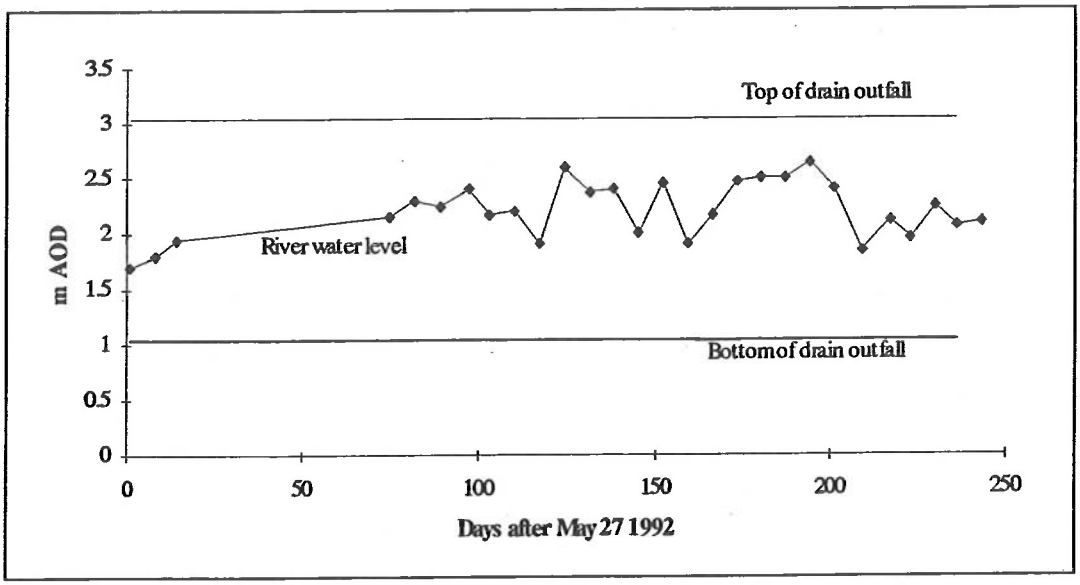


Figure 3: River Water Levels and Outfall Levels - Drain 38 (nr Idle Stop)

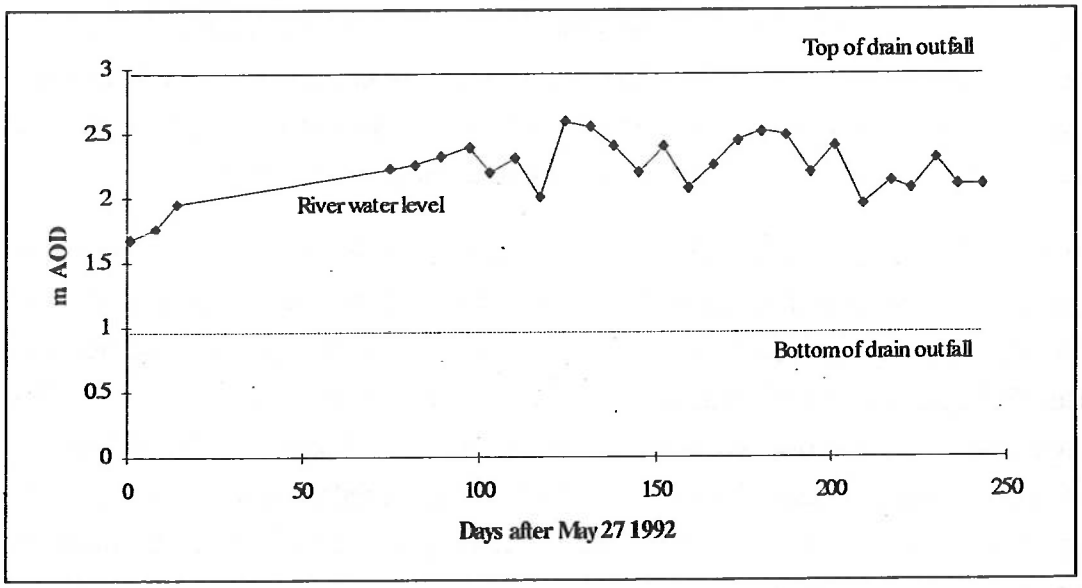


Figure 4: River Water Levels and Outfall Levels - Drain 38 (near Misson)

The results indicate that the river water levels were too high for the doors to open for the entire period of the study. The farmer who manages the land that drains via Drain 38 through the outfalls at Idle Stop and near Misson said that the doors had not opened at all since they had been installed in the early 1980s. Given that this is the case and that river water levels are also significantly affected by levels at West Stockwith, there are no immediate disbenefits associated with a change in weed maintenance regime.

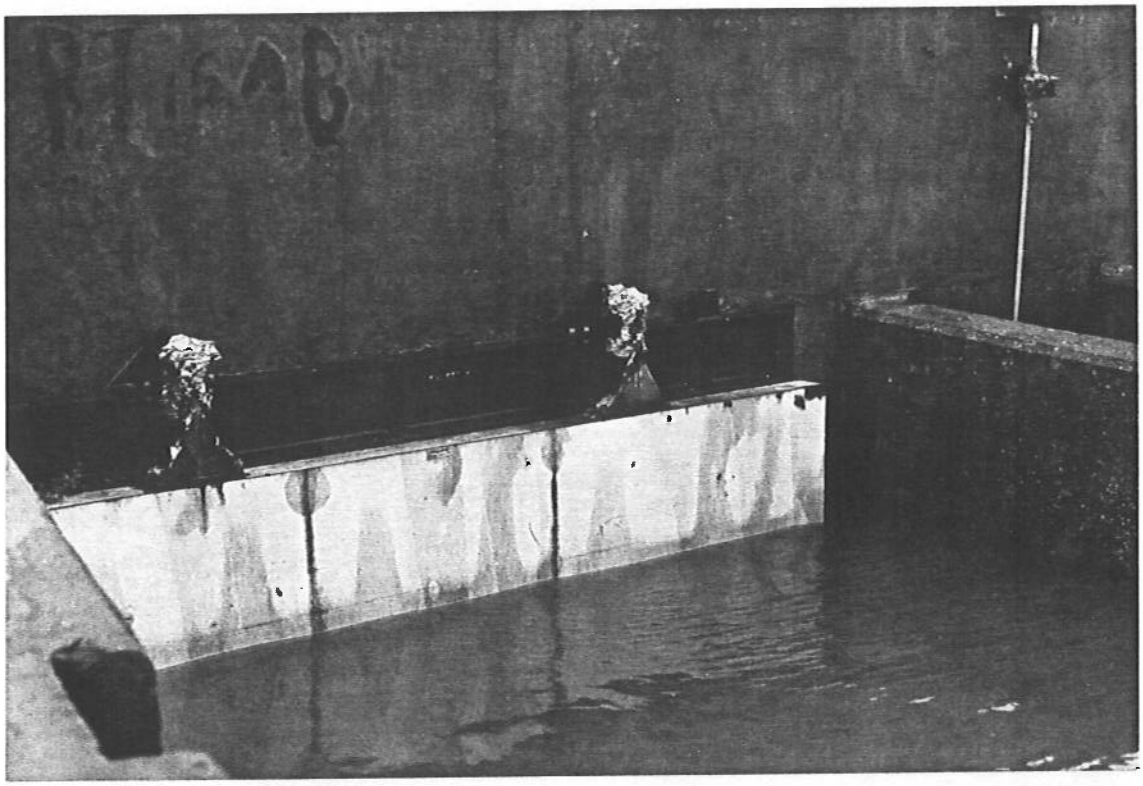


Plate 7: Outfall for Drains 35/36 near Misson (River Idle side) - Dec. 1992

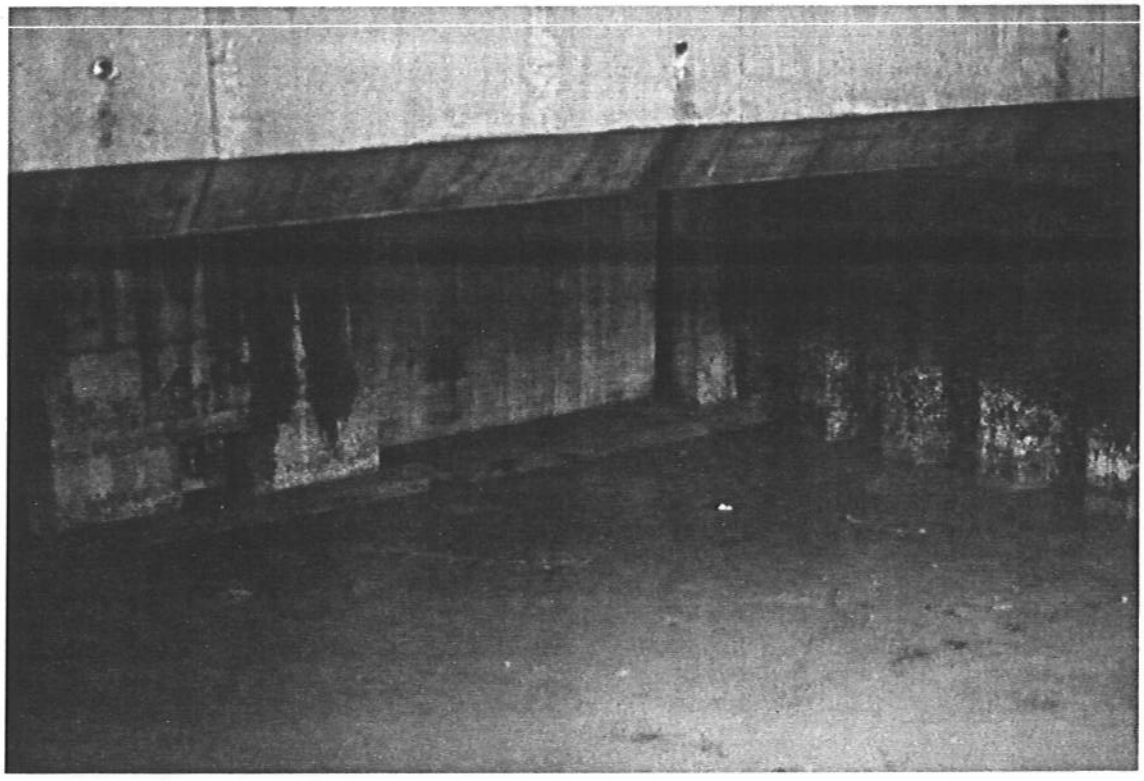


Plate 8: Outfall for Drains 35/36 near Misson (land side) - Dec. 1992

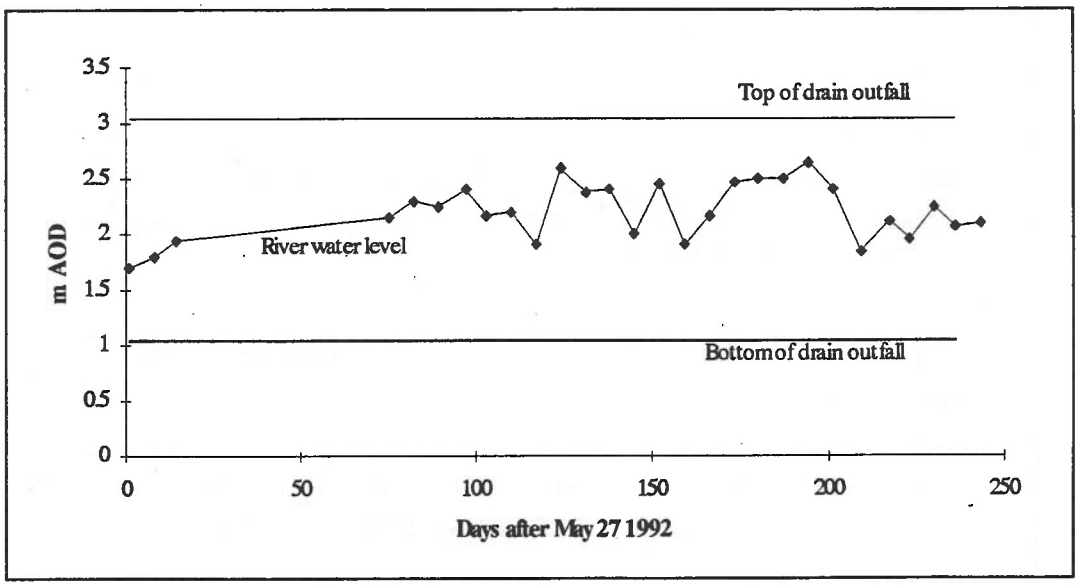


Figure 5: River Water Levels and Outfall Levels - Drain 35 (u/s of Misson)

The consequences for the farmer of the doors never having been open is that he needs to pump out the water from Drain 38 into the Idle at time of high rainfall. When pumping the farmer needs to place and remove the pumps every day because of the high risk of theft and vandalism, so time and energy costs are incurred. However, in the summer and early autumn, if rainfall is high the farmer saves irrigation pumping costs.

The impact of water levels in the ditches upon land drainage status has been estimated for three different freeboard levels (0.5 m, 1.0 m and 1.5 m) and for three different drainage densities (50 m, 100 m and 150 m) using a non-steady state water table model developed at Silsoe College. The model used rainfall data for the Idle area for 1991 and 1992, one drier than average year and one wetter than average year (see Appendix 1 for details of rainfall). The soils are very variable alongside the Idle, but the predominant soil series is Altcar 2 (a peaty soil). The data used for the model, including soil description, and input and output from the model are shown in Appendix 2.

The results indicate that for freeboards in excess of 1.5 m (the usual situation at present) the drainage status is Good throughout the spring, summer and autumn months of 1991 and 1992. For a freeboard of 1 m the drainage status is Good in drier than average years and Good for drainage densities of 50 m or 100 m. If drainage density is 150 m or more, then drainage status is Bad to Very Bad in wetter than average years. For a freeboard of 0.5 m the drainage status is still Good in drier than average years but Very Bad in wetter than average years. During the field visits in 1992 and 1993 the freeboards were in excess of 1.5 m, suggesting that drainage status was Good for the entire study period, except in the very wettest periods. This freeboard was maintained through pumping.

c. Drains 44, 49, 47 and 31 - Upstream of Bawtry Bridge

These drains also allow water to enter the Idle under gravity. The impact of water levels at West Stockwith is reduced and the impact of weed maintenance activities upon river water levels and upon the ability of the drain outfalls to open is more significant. River water levels have been compared to the outfall levels for Drains 44 (Plate 9) and 49 (Plate 10), immediately upstream of Bawtry Bridge (see Figure 6) in order to estimate the time that the flaps are able to open. The outfall level data for drains 47 and 31 were not available. The figure shows that in 1992 the river water levels were high and that gravity drainage was impeded and at times not possible.

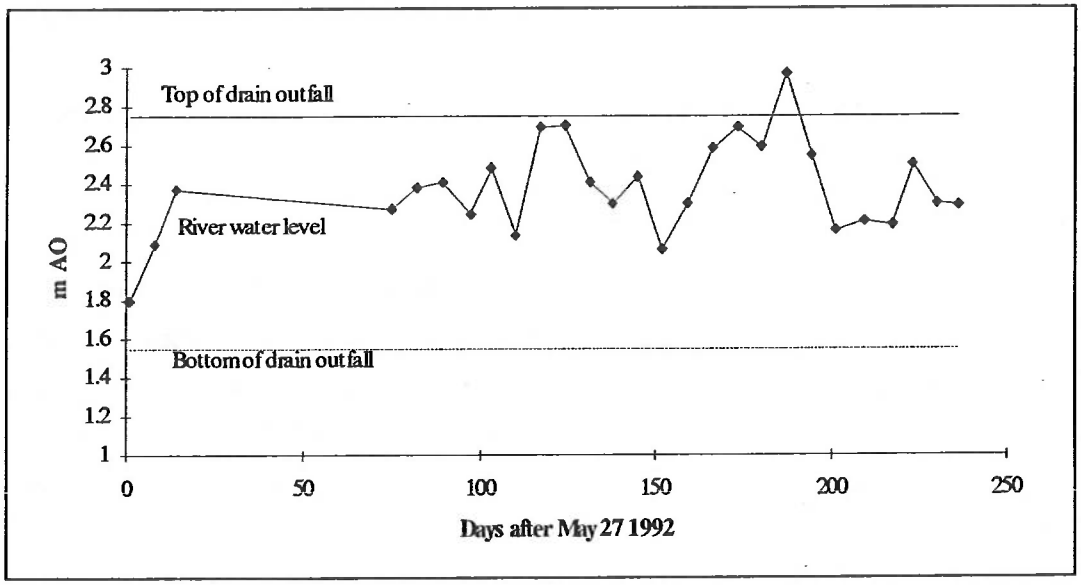


Figure 6: River Water Levels and Outfall Levels - Drains 44 & 49 (u/s Bawtry Bridge)

The water table model was used to assess the impact of different retained water levels in the drains upon drainage status and so identify the drain water levels which should not be exceeded if a deterioration in drainage status is to be avoided. The same data and approach was used as in **a.** above. However, the predominant soil series in this area is Newport (a medium sandy soil). The data used in the model, including soil description, and the output from the model are shown in Appendix 3. The soils data are 'typical' values and that because of the large variation in soils in the area the results are not specific and should be treated with some caution. The Newport soils are typically better drained soils than the Altcar 2 soils and the results show that drainage status is Good unless freeboard in the ditches falls to 0.5m or less for any length of time (a situation which may occur if water levels in the River Idle increase due to a cessation of weed maintenance).



Plate 9: Submerged outfall for Drain 44 at Bawtry Bridge - December 1992



Plate 10: Drain 49 behind outfall at Bawtry Bridge - December 1992

The results indicate that weed maintenance may have an influence upon the amount of time that the outfalls are able to function and, therefore, some influence upon drainage status at certain crucial times of the year (late spring and early autumn).

The farmers response in this area was mixed. One farmer was unhappy with the time that during which gravity drainage into the Idle was not possible and said that in 1992 the drainage status was significantly worse than at any time since the scheme had been put in. The land use had been changed from rough grazing land before the scheme to cereal and root crop production after the scheme. The farmer still managed to get a sugar beet crop off the land in the late summer of 1992 and was able to drill wheat. In this section of the river normal weed maintenance activities were carried out, although the section immediately downstream of Bawtry Bridge was left uncut throughout 1992. How much of the deterioration in drainage status was due to river water levels because of changes in weed maintenance regime and how much was due to the wet weather is uncertain. It is suggested that because this area is marginal in its capability to drain under gravity that more intensive study of this area should be carried out.

One farmer, interviewed in 1993 after the wet summer and autumn of 1992, with land on the other side of the river (east bank), said that he was entirely happy with the drainage situation, although if anything the summer river water levels were too low. He had previously blocked up another outfall further upstream to prevent the water from the ditches draining into the Idle. This was done to maintain summer water levels and prevent the land drying out too much.

This stretch of river is one where the benefits of weed maintenance are potentially most significant and more intensive study of this stretch of river should be carried out in 1993/4.

d. Drains 30, 16, 21, 41, 42

These drains enter the Idle under gravity but serve areas of land which are used for gravel extraction. They, and their associated land areas, have not been included in the agricultural benefit assessment, since land drainage is not a major issue.

e. Drain 23

This drain enters the Idle near Mattersey under gravity and is in an area where the West Stockwith levels are no longer having a direct influence on water levels. The weed maintenance activities have an influence on water levels and the ability of the drain to flow into the Idle. The farmer through whose land the drain runs does not feel that the lack of weed maintenance would be a major threat to drainage on his land and would be more concerned about the impact upon channel capacity and flood risk in the long term. The



Plate 11: Outfall for Drain 23 near Mattersey - December 1992

farmer felt that, despite the wet year and high river water levels in 1992, the drainage status of his land was still good enough to carry out planned agricultural operations.

The water table model has been used in the same manner as shown for the drains listed above for the Newport soil series which is the dominant soil series in the area. The results are as for Drains 44 and 49 above which indicate generally good drainage status unless freeboard is allowed to fall to or less than 0.5 m for any length of time.

f. Drains 66 and 2

The area served by these drains has both a gravity and a pumped outfall. If the water levels in the Idle are too high to allow gravity drainage and the water levels in the drains rise above a threshold determined by the IDB, then the Wiseton pumping station pumps the excess water in to the Idle (Plates 12 and 13). The issues in this area are, therefore, those of increased pumping costs (if the lack of weed maintenance results in higher river water levels and the prevention of gravity drainage) and of increased flood risk in the long term.

Data concerning pumping costs and length of pumping time were made available from the Idle and Ryton IDB. The costs were only available on an annual basis and do not give a

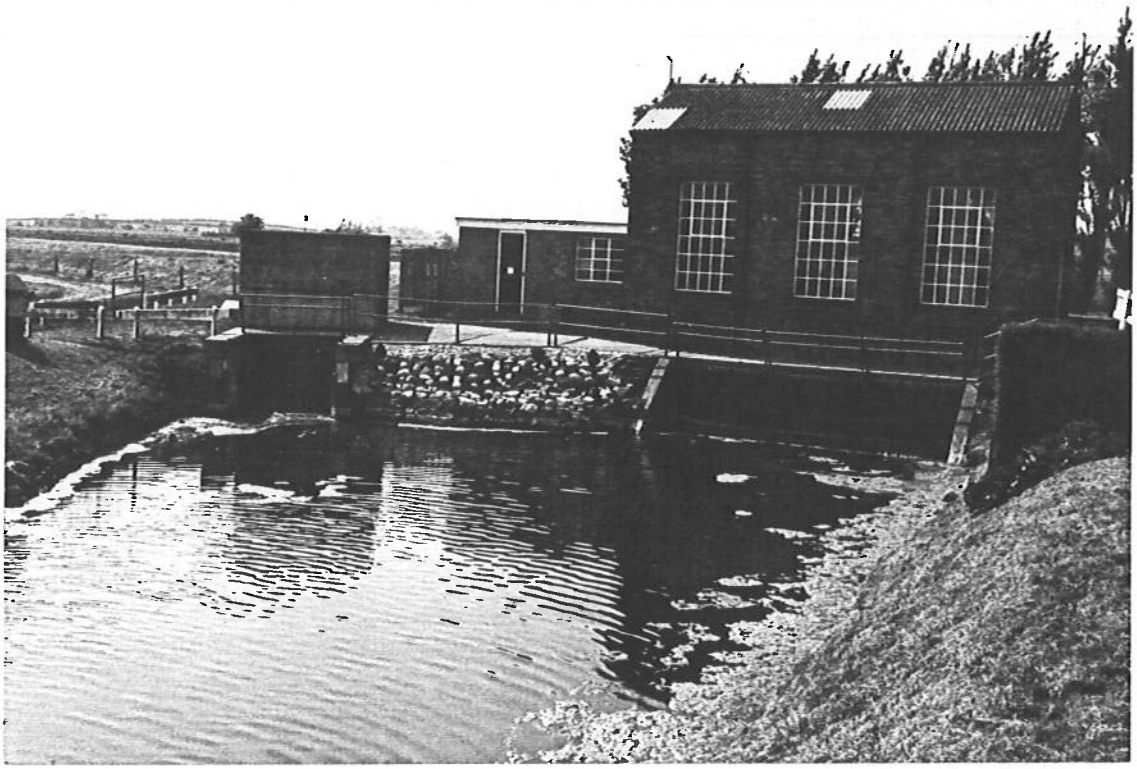


Plate 12: Wiseton Pumping Station (Idle & Ryton IDB) - July 1992

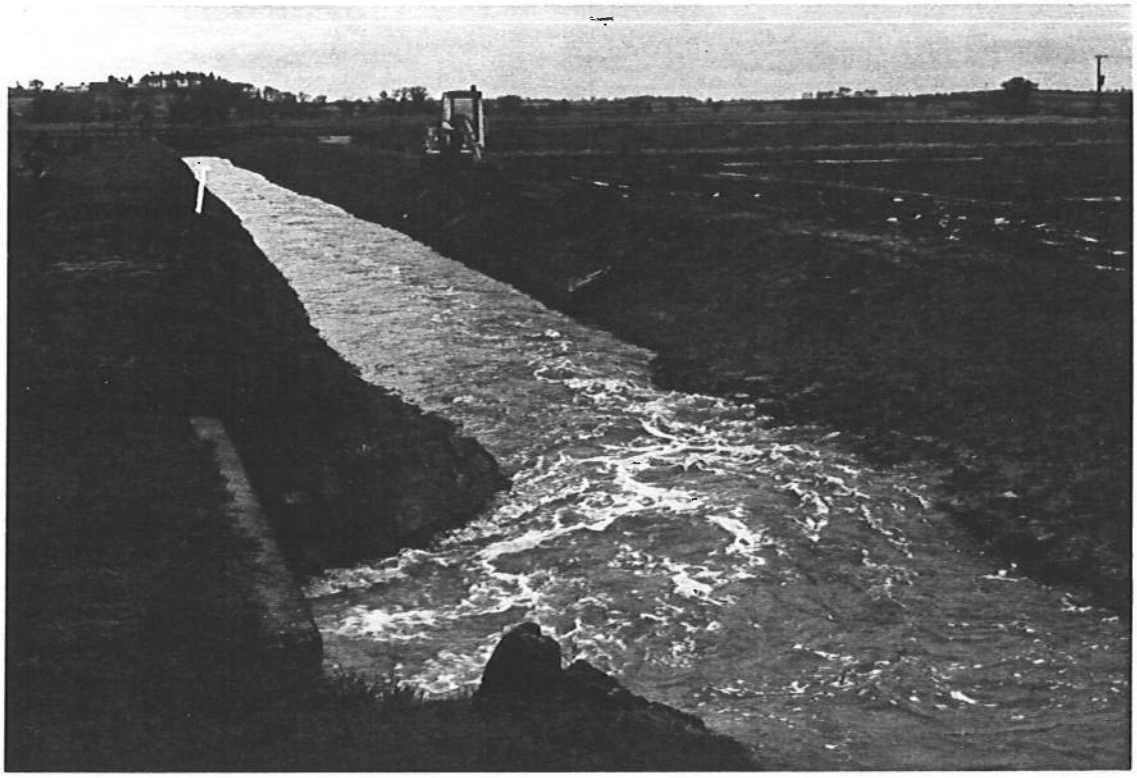


Plate 13: Wiseton Pumping Station in operation - December 1992

true indication of running costs because maintenance and repairs are included. The costs of pumping from March 1991 to March 1992 were £18,359 and between March 1992 and March 1993 the costs were £13,601. However, the former costs include those for major overhaul of the pumps. A more accurate representation of running costs is provided by the pumping times. There are six pumps at the Wiseton pumping station, which start to operate at different levels, ranging from 15 feet 6 inches (4.7 m) AOD to 16 feet 2 inches (4.9 m) AOD. The pumping times for each pump in 1991 and 1992 are shown in Figure 7. A monthly breakdown of pumping times is provided in Appendix 4. Figure 7 shows that pumping times for all pumps in 1992 were 89% greater than in 1991 and implies an 89% increase in pump operating costs.

The main measurement of disbenefits associated with a change in weed maintenance activities would be the greater reliance upon pumping. For 1992, the increase in pumping costs cannot be attributed entirely to the change in weed maintenance activities because of the significantly higher rainfall in 1992. The rainfall in 1992 (111% of the long term annual average) was 131% greater than the rainfall in 1991 (85% of the long term annual average). This led to higher river water levels, so preventing gravity drainage. A longer term analysis of rainfall levels and pumping times, alongside study of the impact of

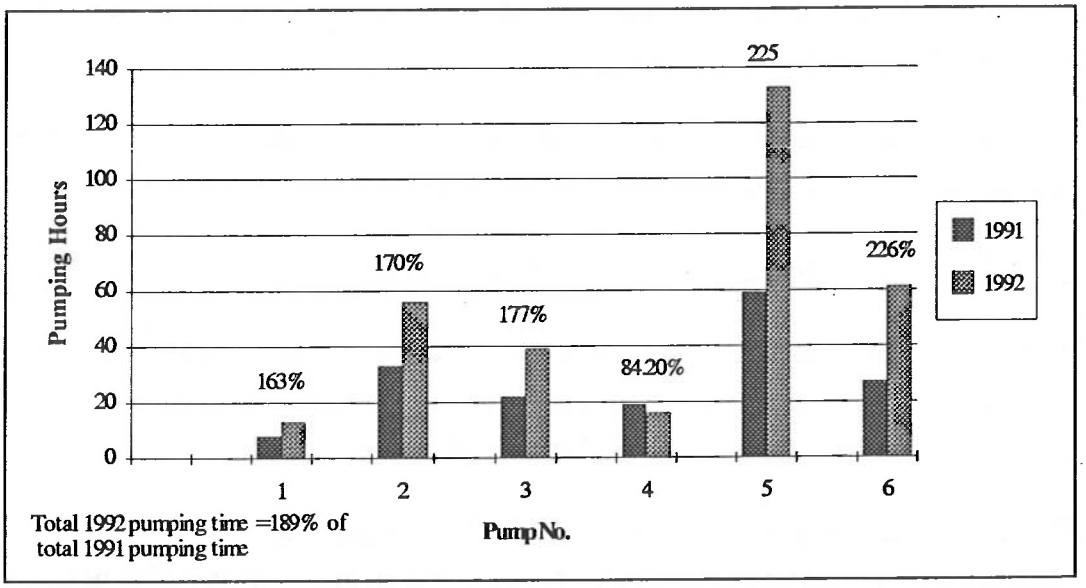


Figure 7: Pumping Times at Wiseton Pumping Station (1991/1992)

alternative weed maintenance strategies upon river water levels is necessary to assess accurately the impact upon pumping costs.

3.5 Comments from the Farmers About Weed Maintenance Activities

Eleven farmers and four representatives of the Internal Drainage Boards (IDB's) were interviewed, one of whom was an NRA engineer overseeing the maintenance of IDB channels in the Idle & Ryton IDB.

3.5.1 Land Use

The farmers first of all commented on the significant improvement in drainage conditions since the completion of the capital scheme in the early 1980s. There has been no flooding, except on the SSSI washlands in 1992, and drainage status has improved significantly. There are areas where field drainage has been installed and more intensive land uses have been adopted since the scheme. The land use is now intensive on most of the land receiving flood protection, with rotations which include winter cereals, oil seed rape, sugar beet, potatoes and field beans. Little of the protected land is down to grass except as a break crop in arable rotations. Most of the grassland in the protected area is not grazed but cut several times a year for silage.

The areas which are not protected from flooding are entirely down to grass and are farmed extensively, with typical grazing seasons from the April to September/October for beef cattle grazing and no grass conservation.

Much of the land on the left bank upstream of Bawtry has been, or is being, used for gravel and sand extraction and has no agricultural use.

3.5.2 Influence of the River Idle on Land Drainage

(a) Where areas drain into the Idle through pumps, the water levels in the River Idle do not have any direct impact on drainage status and, hence, agricultural practice. Flooding would affect the land, but the land has not flooded since the scheme was installed.

(b) Four of the farmers interviewed had land which drained into the Idle under gravity. All of the farmers expressed the view that changing water levels in the Idle would have an influence upon water levels in their ditches and, consequently, upon the water table levels on their land. Two of the farmers felt that the water table had fallen so much in the last few years that increasing water levels to allow recharge in their fields was a welcome prospect. On the whole, however, the feeling was that higher water levels in the summer were acceptable (even beneficial), provided that flooding was not a result. One farmer complained to the NRA recently that, until the late summer of this year (1992), water levels in the Idle had been far too low upstream of Bawtry. Winter water levels should be

lowered to enable reasonable water table levels to be maintained. If higher summer water levels were achieved through less intensive weed maintenance strategies then this would be acceptable, with certain provisos (listed in section 3.5.4).

(c) One farmer was interviewed who grazes livestock on two of the SSSIs. These areas are not protected from flooding by flood banks. Drainage into the Idle occurs naturally through gravity either directly or through ditches. Drainage status is not seen as a great constraint by the farmer provided water levels are sufficiently low to enable water to get away. In 1992, for the first time since the capital scheme was carried out, the farm land on the SSSIs was flooded on several occasions. The fact that flooding occurred (even though it occurred in summer) was not seen as a problem by the farmer. What was causing a problem was that the flood waters were not able to get away. This was because water levels on the Idle were kept high throughout the summer as normal. This was done by holding the water level at the West Stockwith pumping station and not through the halting of weed maintenance along this stretch of the river.

The impact of weed growth upon water levels in the Idle was seen by the farmer as minor compared to the measures taken at West Stockwith.

3.5.3 Views on weed maintenance activities

Many of the farmers were satisfied with the present regime, although all except one felt that the regime was a little too intensive. One farmer felt that weed maintenance need not be carried out at all and that if siltation occurred as a result of this, incurring the risk of flooding, then desilting should be carried out on an as and when basis. Two other farmers felt that no maintenance should be done in the short term, adopting the 'wait and see' approach.

The other farmers felt that weed maintenance was necessary and that if it was not carried out there would be a significant fall in the standard of service for agricultural activities. Negative consequences of not carrying out maintenance were: (i) siltation (the greater expense of doing maintenance on a 'fire brigade' basis), and the effect on channel capacity and freeboard; (ii) excessive weed growth preventing water from getting to pumps for irrigation and getting away downstream during high flows; and, (iii) higher water levels restricting drainage in areas where the land is drained under gravity.

Whilst most felt that maintenance was necessary, there were no strongly held views as to how and when the weed maintenance should be carried out (so long as flooding was prevented and sufficient flows of water were maintained). Two farmers felt that the whole channel should be kept clear. The rest felt that partial channel clearance would suffice. All

of the farmers were inconvenienced by weed maintenance activities, mainly through blockage of pumps whilst irrigating. However, there was a feeling that the work needed to be done and that it was worth the short term inconvenience (about 1 day on average). One farmer also pointed out that some IDB's in the area were themselves reducing weed maintenance to one cut a year. The reasons for this were given as cost-cutting (present costs could not be justified) and insufficient weed growth.

3.6 Summary

The analysis and results can be aggregated to cover the whole of the sections downstream and upstream of Bawtry.

The downstream section comprises of South Axholme IDB, Everton IDB, Finningley IDB and part of the Idle & Ryton IDB which includes the SSSI washlands. The benefits of weed maintenance in these sections are equivalent to the avoidance of disbenefits if weed maintenance was not to be carried out. The short and long term impacts for each of the IDB's shown above are shown in Table 1. The main consequences of reducing the intensity of weed maintenance are an increase in pump running costs and a small increase in flood risk in the long term.

Table 1: Consequences of Reducing Weed Maintenance Intensity - downstream of Bawtry

Internal Drainage Board	Short Term Disbenefits	Long Term Disbenefits
South Axholme	None	Small increase in flood risk
Everton (pumped)	None	Pump running cost increases Small increase in flood risk
Finningley (pumped)	None	Small increase in flood risk
Idle & Ryton (gravity)	None	Small increase in flood risk
SSSI Washlands	None	Increase in flood risk. Loss of production

The section upstream of Bawtry which is down to agricultural production all lies within the Idle & Ryton IDB and is served by a variety of outfalls. The short and long term impacts at each of the outfalls is shown in Table 2.

The disbenefits associated with not carrying out weed maintenance on the section upstream of Bawtry are different from those on the downstream section. There is a long term risk of siltation leading to decreased channel capacity and an increase in flood risk.

Table 2: Consequences of Reducing Weed Maintenance Intensity - upstream of Bawtry

Drain/outfall Number	Short Term Disbenefits	Long Term Disbenefits
44 & 49 (Bawtry)	Possible decrease in time outfall open	Decrease in time outfall open - possible deterioration in drainage status. Increased flood risk.
31 &47	Possible decrease in time outfall open	Decrease in time outfall open - possible deterioration in drainage status. Increased flood risk.
23	None	Increased flood risk.
66 & 2 (Wiseton PS)	Possible increase in pumping time (running costs)	Increase in pumping time and, hence, costs. Increased flood risk.

Regarding land drainage disbenefits, the main issues are of increased pumping times and, hence costs, at Wiseton pumping station in the short and long term. There is also a risk of the gravity outfalls being closed for longer periods and water in the drains being unable to get away. This could lead to an deterioration in drainage status and a decrease in agricultural productivity. This will depend on the soil types and the fall between the adjacent land and the river channel. The areas most at risk are between Bawtry Bridge and Mattersey, particularly outfalls from Drains 44, 49, 31 and 47. These outfalls should therefore be monitored more closely in the future.

3.7 Economic Consequences

General estimates of the monetary consequences of the reduction in weed maintenance intensity are identified in order to indicate the scale of benefits attributable to weed maintenance.

Two viewpoints can be taken: a financial viewpoint which estimates impact on farm incomes, and an economic viewpoint which estimates the impact on the national economy, after allowing for Government support to agriculture. Furthermore, the analysis recognises that the benefits of maintenance will vary according to prevailing weather conditions. The expected annual benefits due to maintenance have been identified given the relative 'probability' of wet, normal and dry conditions and the response to drainage standards of service in these types of weather conditions.

The disbenefits have been divided into those downstream and those upstream of Bawtry Bridge and are summarised in Table 3.

(a) Downstream of Bawtry

The main monetary consequence of reducing weed maintenance downstream of Bawtry would be the likely loss of production on the SSSI washlands. If the extensive grazing on this area was completely lost then the approximate annual value of the loss to the farmer would be £110/ha. The area of the SSSIs accounts for about 88 ha. Therefore, the total loss of agricultural production would be approximately £9 500 per year. The economic loss to the nation would be negligible because the loss of output would be largely offset by savings in support payments to the farmer (see Map 6 for location of these areas).

(b) Upstream of Bawtry

The main economic consequences of reducing weed maintenance upstream of Bawtry would be: (i) an increase in the ditch levels on the land served by gravity drainage into the Idle (mainly ditches 49, 31 & 47 (area b on Map 6) and 44 (area c on Map 6)), and (ii) an increase in pumping costs at Wiseton pumping station.

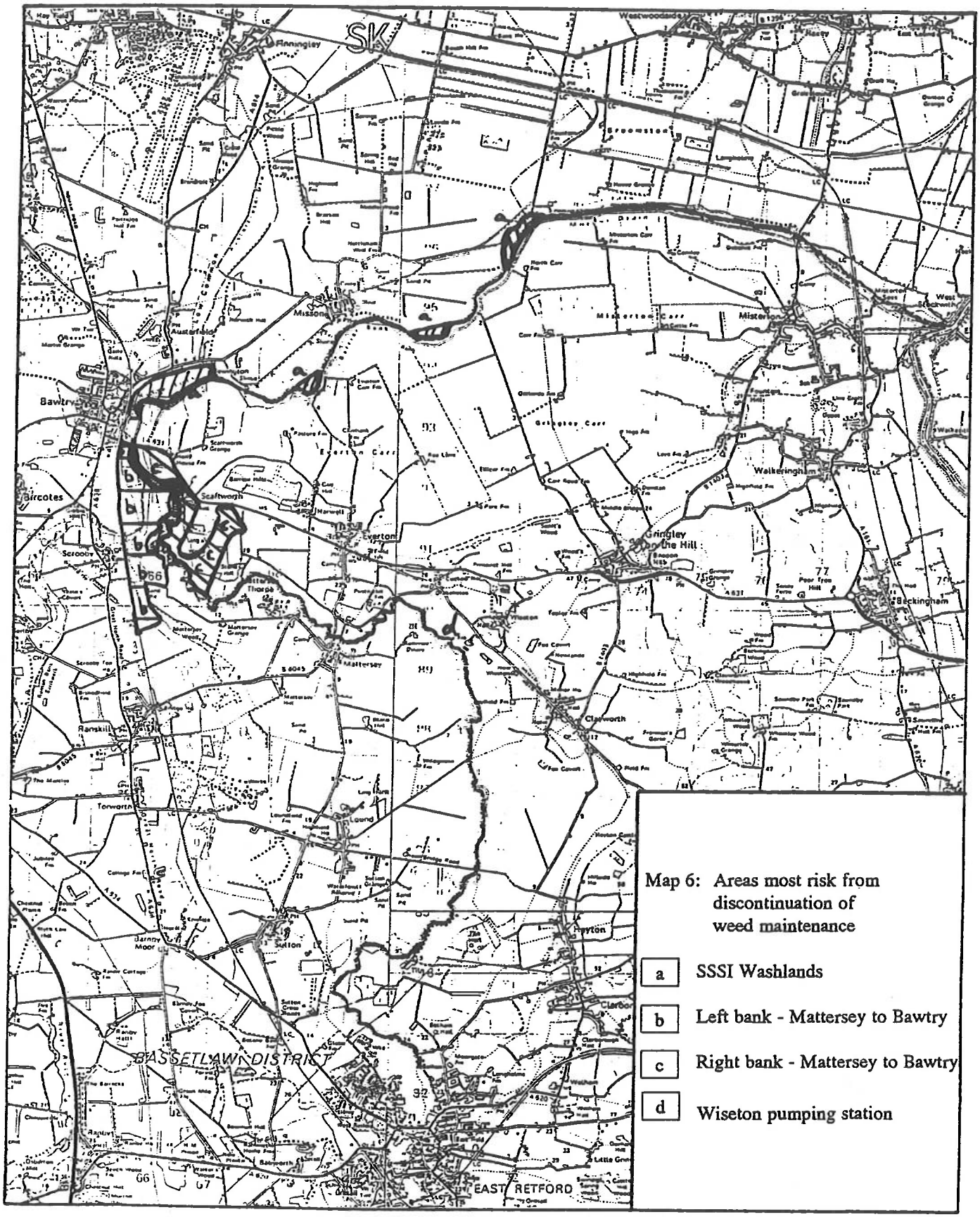
In order to carry out the analysis of economic benefits on the gravity drained land, it has been assumed that: (i) half of the land is intensively drained with field drains and half the land is naturally drained into arterial ditches; (ii) land use is exclusively arable (75% all cereal rotations and 25% cereal/root crop rotations or vegetable production), and (iii) spring and autumn ditch freeboards are at present in excess of one metre.

If freeboards decrease to approximately 0.5 m as a result of higher river water levels (due to reduced weed maintenance intensity) in the spring and autumn, then:

- drainage status is likely to deteriorate from Good to Bad with higher than average and average rainfall on intensively drained land (staying Good with lower than average rainfall);

- drainage status on naturally drained land is likely to deteriorate from Good to Bad with lower than average and average rainfall, and from Good to Very Bad with higher than average rainfall.

The loss to farmers depends on cropping regime. On winter cereals, financial losses to farmers of a deterioration from Good to Bad would average £225/ha/year, and from Good to Very Bad in excess of £300/ha/year. Financial losses on root and vegetable crops would exceed £400/ha/year (for Good to Bad drainage status - these crops would not be grown


SK
Finningley
Misson
Austerfield
Bawtry
Misterton
Misterton Carr
Gringley Carr
Everton Carr
Scaftworth
Everton
Gringley on the Hill
Walkeringham
Beckingham
Scrooby
Bircotes
Mattersey
Ranskill
Torworth
Clayworth
Sutton
Jarmy Moor
Retford
BASSETLAW DISTRICT
EAST RETFORD
Map 6: Areas most risk from discontinuation of weed maintenance
a SSSI Washlands
b Left bank - Mattersey to Bawtry
c Right bank - Mattersey to Bawtry
d Wiseton pumping station

under Very Bad drainage status). In economic terms, the losses average about £115/ha/year (for Good to Bad drainage status) and £290/ha/year (for Good to Very Bad drainage status) for all arable cropping. The value reflects the reduced output value from winter cereals assuming that root and vegetable cropping would relocate elsewhere in the event of continued deterioration in drainage standards.

Table 3: Summary of the Disbenefits of Discontinuing Weed Maintenance on the River Idle

Location	Area (ha)	Disbenefits	
		Financial prices (1992/93)	Economic prices (1992/93)
a. SSSI Washlands downstream of Bawtry	88	9 500	-
b. Left bank upstream of Bawtry Bridge	130	35 100	14 900
c. Right bank upstream of Bawtry Bridge	70	18 900	8 100
d. Wiseton pumping station	1240	6 500	6 500
TOTAL		**70 000**	**29 500**

Given the above, the monetary consequences of the changes in drainage status, resulting from a decrease in freeboard, would be a loss of approximately £250/ha/year to the farmers and approximately £115/ha/year to the nation. The areas most at risk from a discontinuation of weed maintenance have been identified mainly from farmer and IDB manager interviews. The total area upstream of Bawtry in the gravity drained areas at risk from deterioration in drainage status is approximately 200 hectares. This means that the approximate disbenefits of discontinuing weed maintenance are approximately £54 000 to the farmers (approximately £23 000 to the nation).

In the case of Wiseton pumping station, the direct costs of running the pumps in 1992 (according to the Idle & Ryton IDB) were approximately £10 000 (for the total of 318 hours for all six pumps). This suggests that, if the six pumps were run in the same configuration each year, the extra cost of every extra hour of pumping would be approximately £30. The pumps ran for 219 hours more in 1992 than in 1991 due to the higher water levels in the River Idle. If this sort of increase in pumping times was due to increased river water levels because of reduced maintenance, then the approximate increase in pumping costs would be £6 500.

The total disbenefits for all of the River Idle from East Retford to West Stockwith are estimated to be £70 000 to the farmers and £29 500 to the nation.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

4.1.1 Conclusions from interviews

The interviews revealed that there are a variety of interests served by the river and that the weed maintenance activities do affect the interests. Almost all of the representatives of interested groups felt that present activities were excessive but that not to do any maintenance would have a significant negative impact. It was clear that no single option was going to satisfy all parties and the conclusions drawn below are the views expressed by the majority of interviewees.

The solutions put forward by the various interested parties were similar in terms of what to do and when to do it:

Timing: Farmers would like to see first cut in early to mid-June, before irrigation started, and the second cut after irrigation had finished in late August. One cut at the end of the season would also suffice;

Conservationists would like to see maintenance carried out after the conclusion of the bird breeding season (late June) if the whole channel was to be cleared, or any time if partial channel clearance was to be carried out;

Fisheries would like to see maintenance done before the start of the fishing season (early to mid-June) and at the end of August.

Type: Farmers, conservationists and fisheries would all want to see only part channel clearance, accounting for about the middle half to two-thirds of the river's width. Upstream of Bawtry, the fishing parties would like to see a meandering cutting pattern swinging from bankside to bankside. The NRA fisheries department would like to be able to help in designing the meanders to make sure that they made maximum use of the existing channel habitat.

4.1.2 Conclusions from field data analysis and hydrological modelling

The main disbenefits associated with a decrease in weed maintenance are the long term flood risk and the threat of closure of the outfalls most at risk (upstream of Bawtry Bridge).

The soils generally respond well to drainage but if freeboard is allowed to decrease in the ditch systems over a considerable length of time in spring and autumn, there is likely to be a deterioration in drainage status on some of the agricultural land upstream of Bawtry. The areas most at risk from decreased maintenance are those between Bawtry Bridge and Mattersey.

4.1.3 Economic Conclusions

In the absence of weed maintenance annual losses to farmers would increase to about £70 000, mostly upstream of Bawtry. The economic loss to the nation is estimated at about £29 500. These losses justify the costs of the existing regime (about £22 500). The study has shown, however, that modifications to the existing maintenance regime would be acceptable and, indeed, desirable to most of the river users who were interviewed.

4.2 Recommendations

The recommendations refer to river weed maintenance in 1993 and to issues requiring further research.

4.2.1 Weed maintenance

It is recommended that in 1993 the river should be cut once in mid-summer (between late June and early August) with the cut being made mid-channel only. The width to be cut should be in the region of half to two-thirds of the total channel width. A meeting should then be held in late August/early-September between the NRA and Silsoe College to decide on whether a further cut is necessary this year. At this meeting specialist aquatic weed advice should be sought on cutting regimes suited to the achievement of desired standards of service for all river users.

2.2 Further research

The gauge boards should continue to be read until the end of 1993.

If possible, gauge boards and/or data loggers should be installed in the ditch immediately upstream of Bawtry Bridge (Drain 49) and in the River Idle close to the outfall. This will enable an evaluation to be carried out of the response of ditch water levels to river levels and to enable more accurate estimation of the drainage status on the land for given ditch water levels.

The provisional results indicate that in the short term the impact of changing/reducing weed maintenance activities is not significant. However, further research is required to determine the longer term impacts of different weed maintenance activities.

The risk and impact of floating weeds following a cut catching on the uncut sections of the channel should be monitored and assessed in 1993 and subsequent years. It is likely that the depth of flow at the time of weed maintenance will be a significant factor in the risk of floating weed catching on uncut sections of the channel.

A meeting should be organised on site with the NRA, Silsoe College and a selected specialist weed expert later in the year. The specialist weed expert will be able to provide indications of the nature and extent of impacts of different weed maintenance strategies upon different weed types and upon long term channel features and capacity.

Methods recently developed as part of Silsoe's ongoing River Maintenance Evaluation Study should be used in order to assess the longer term impacts of different weed maintenance strategies on the Idle.

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APPENDIX 1

RAINFALL DATA FOR 1991 AND 1992

(Data from Carlton-in-Lindrick Station - M.O. Reference 125581)

Period	Actual Rainfall (mm)	Average Rainfall (mm)	% Average Rainfall
Spring 1991	51.4	137.0	37
Summer 1991	102.7	172.0	60
Autumn 1991	168.3	169.0	100
Spring 1992	103.0	137.0	75
Summer 1992	302.6	172.0	176
Autumn 1992	214.8	169.0	127
Total 1991	529.5	625.0	85
Total 1992	694.2	625.0	111

APPENDIX 2

ALTCAR 2 SOIL ASSOCIATION - ALTCAR SERIES

SOIL DESCRIPTION AND INPUT AND OUTPUT FROM SILSOE COLLEGE WATER TABLE MODEL

DESCRIPTION

These are peaty soils developed in various thicknesses of fen peat over mineral substrates. The Altcar series, which belongs to the earthy eu-fibrous peat soils, has an earthy, peaty topsoil over partly humified semi-fibrous or fibrous peat, with recognisable remains of grasses and sedges.

The soils are generally well drained (Wetness Class I) except where the peat rests on an impermeable substratum where they are occasionally waterlogged (Wetness Class II).

Pipe drainage is needed in larger fields to assist water table control, though the effectiveness can sometimes be impaired by ochre deposits. Peat soils are mainly non-droughty.

INPUT DATA USED IN THE WATER TABLE MODEL

The data input into the water table model to assess the impact of freeboard levels upon the drainage status of adjacent land were as shown in the table below. The model was run for freeboard levels of 0.5m, 1.0m and 1.5m. In each case, drainage densities of 50m, 100m and 150m were used.

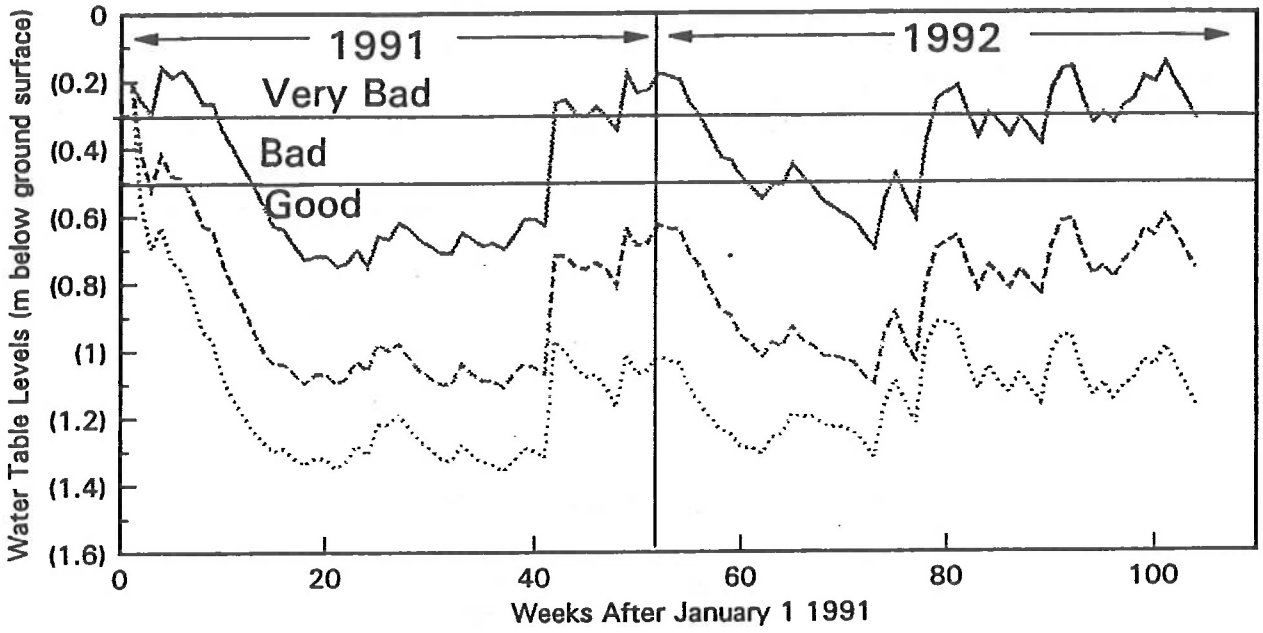
Ditch spacing (m)	50
Depth to impermeable layer (m)	2.5
Geometrical factor for ditch system	1
Initial water table depth (m)	0.2
Hydraulic conductivity of the topsoil (m/day)	1
Hydraulic conductivity of the subsoil (m/day)	1
Soil boundary depth (m)	0.3
Specific yield (topsoil) (m/m)	0.2
Specific yield (subsoil) (m/m)	0.2
Unsaturated hydraulic conductivity exponent	6.4
Surface elevation (m AOD)	1.5
Ditch base elevation (m AOD)	0.45

The graphs on the following pages show the output from the model (ie. water table levels) for the freeboards and drainage densities shown above. The output is shown for the recorded weekly rainfall in 1991 and 1992. The rainfall data is for the Carlton-in-Lindrick weather station.

Water Table Levels for Different Freeboards

Altcar 2 Soil Series - Drainage Density 50m

Weather Data for 1991 and 1992

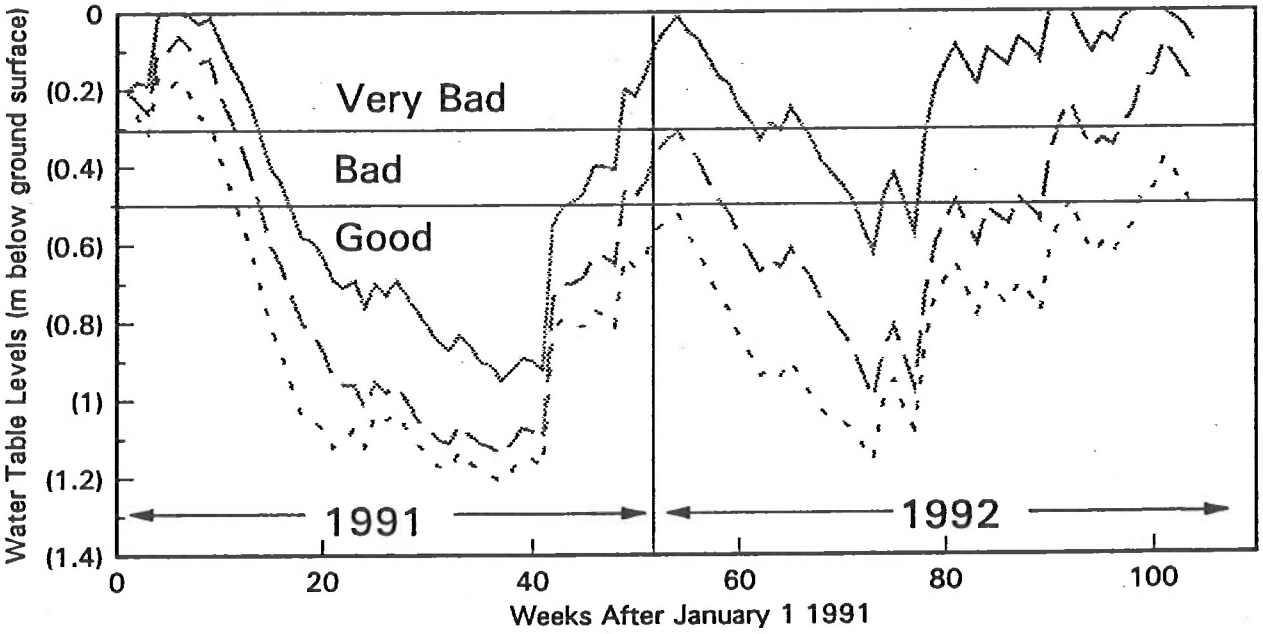


Freeboard 0.5m Freeboard 1.0m Freeboard 1.5m

Water Table Levels for Different Freeboards

Altcar 2 Soil Series - Drainage Density 100m

Weather Data for 1991 and 1992

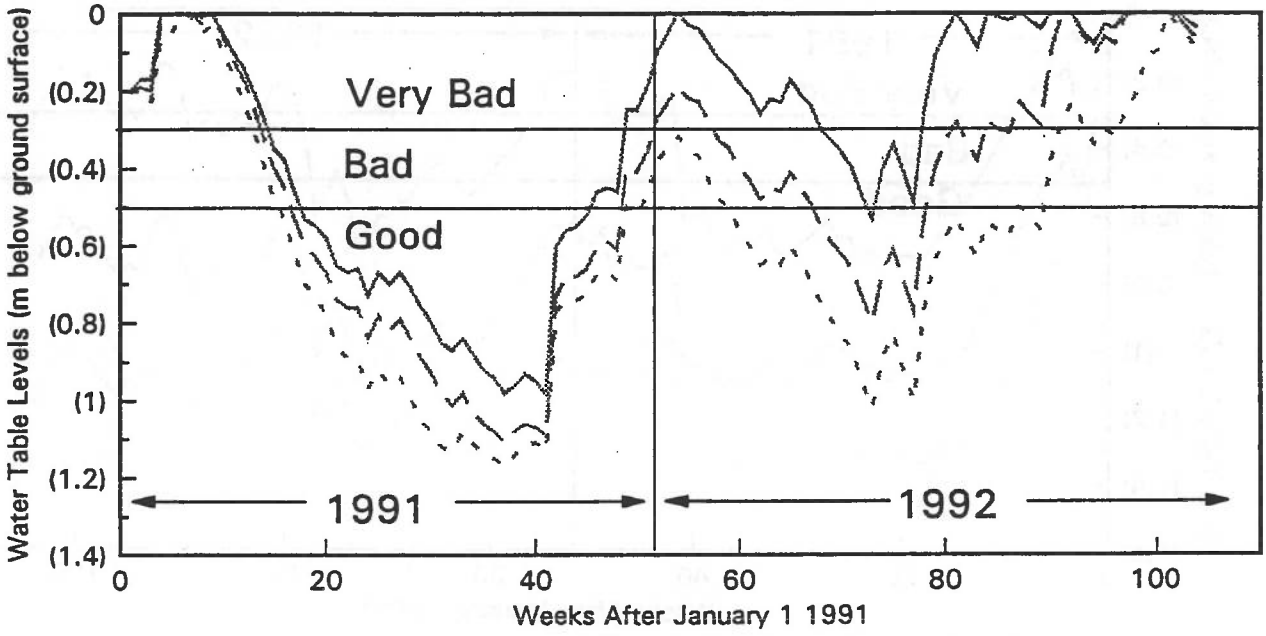


Freeboard 0.5m Freeboard 1.0m Freeboard 1.5m

Water Table Levels for Different Freeboards

Altcar 2 Soil Series - Drainage Density 150m

Weather Data for 1991 and 1992



Freeboard 0.5m Freeboard 1.0m Freeboard 1.5m

APPENDIX 3

NEWPORT 1 SOIL ASSOCIATION - NEWPORT SERIES

SOIL DESCRIPTION AND INPUT AND OUTPUT FROM SILSOE COLLEGE WATER TABLE MODEL

DESCRIPTION

The Newport Association consists mainly of well drained, medium sandy soils formed in glacio-fluvial and river terrace deposits and, in a few places, stoneless aeolian sand. The Newport series belongs to the typical brown sands. Free drainage, summer droughtishness and poor natural fertility are the outstanding features of most of this land (Wetness Class II).

INPUT DATA USED IN THE WATER TABLE MODEL

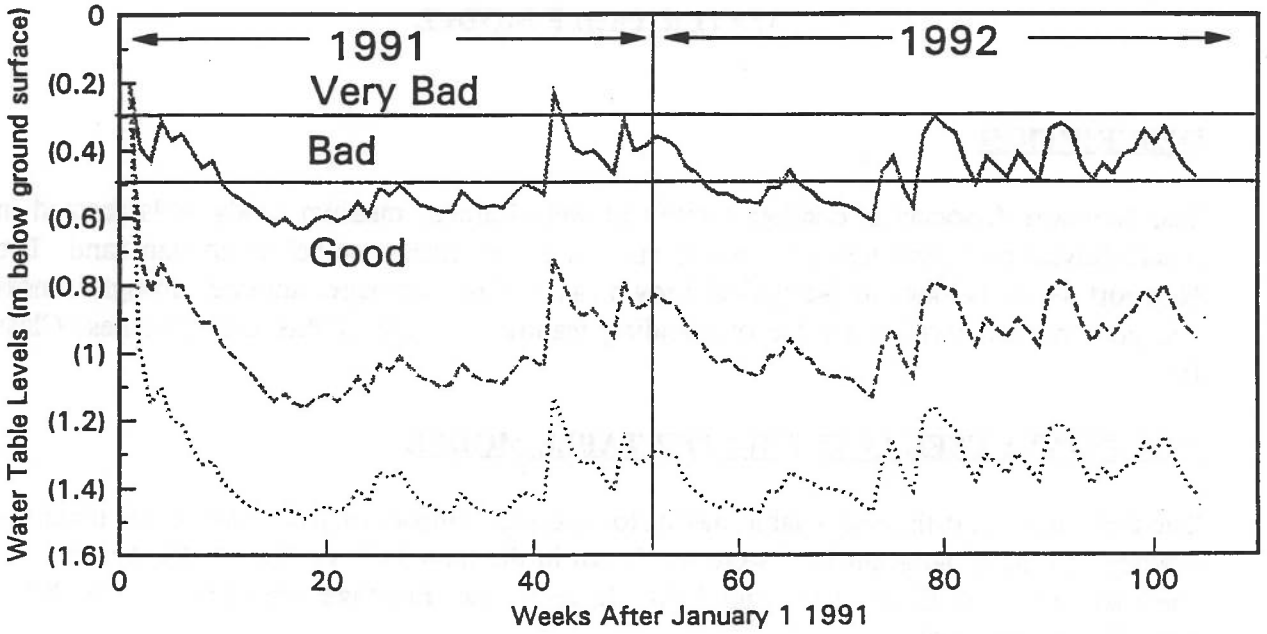
The data input into the water table model to assess the impact of freeboard levels upon the drainage status of adjacent land were as shown in the table below. The model was run for freeboard levels of 0.5m, 1.0m and 1.5m. In each case, drainage densities of 50m, 100m and 150m were used.

Ditch spacing (m)	50
Depth to impermeable layer (m)	2.5
Geometrical factor for ditch system	1
Initial water table depth (m)	0.2
Hydraulic conductivity of the topsoil (m/day)	1.5
Hydraulic conductivity of the subsoil (m/day)	3
Soil boundary depth (m)	0.25
Specific yield (topsoil) (m/m)	0.2
Specific yield (subsoil) (m/m)	0.2
Unsaturated hydraulic conductivity exponent	6.4
Surface elevation (m AOD)	1.5
Ditch base elevation (m AOD)	0.45

The graphs on the following pages show the output from the model (ie. water table levels) for the freeboards and drainage densities shown above. The output is shown for the recorded weekly rainfall in 1991 and 1992. The rainfall data is for the Carlton-in-Lindrick weather station.

Water Table Levels for Different Freeboards

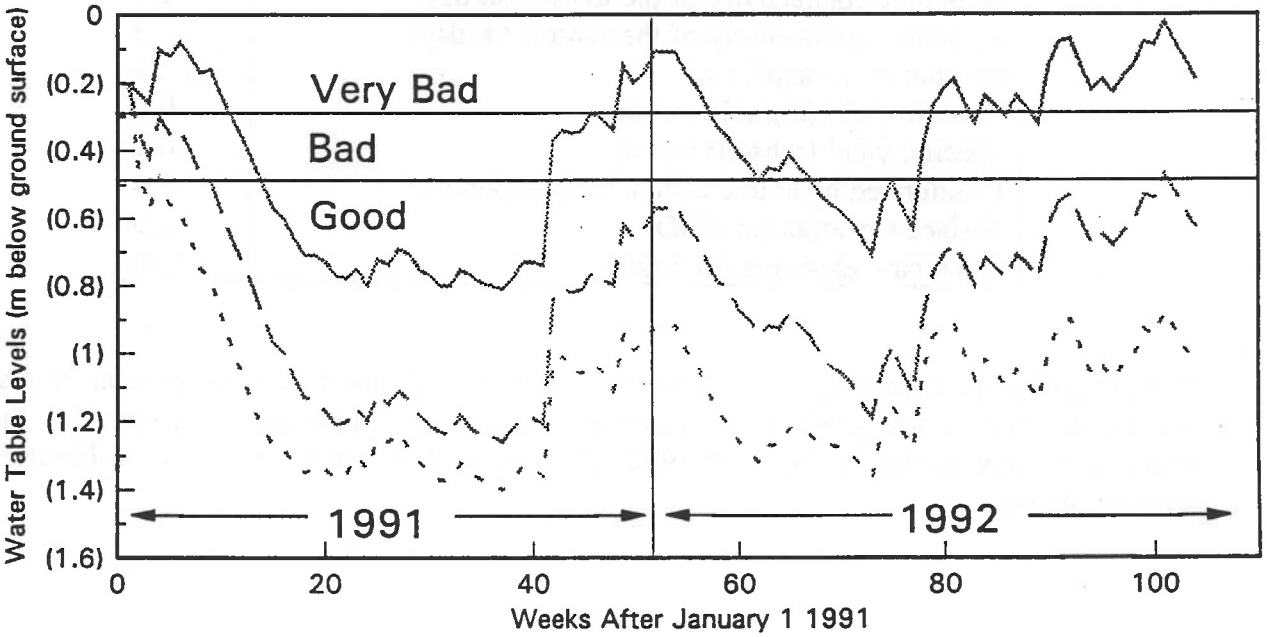
Newport Soil Series - Drainage Density 50m
Weather Data for 1991 and 1992



Freeboard 0.5m Freeboard 1.0m Freeboard 1.5m

Water Table Levels for Different Freeboards

Newport Soil Series - Drainage Density 100m
Weather Data for 1991 and 1992

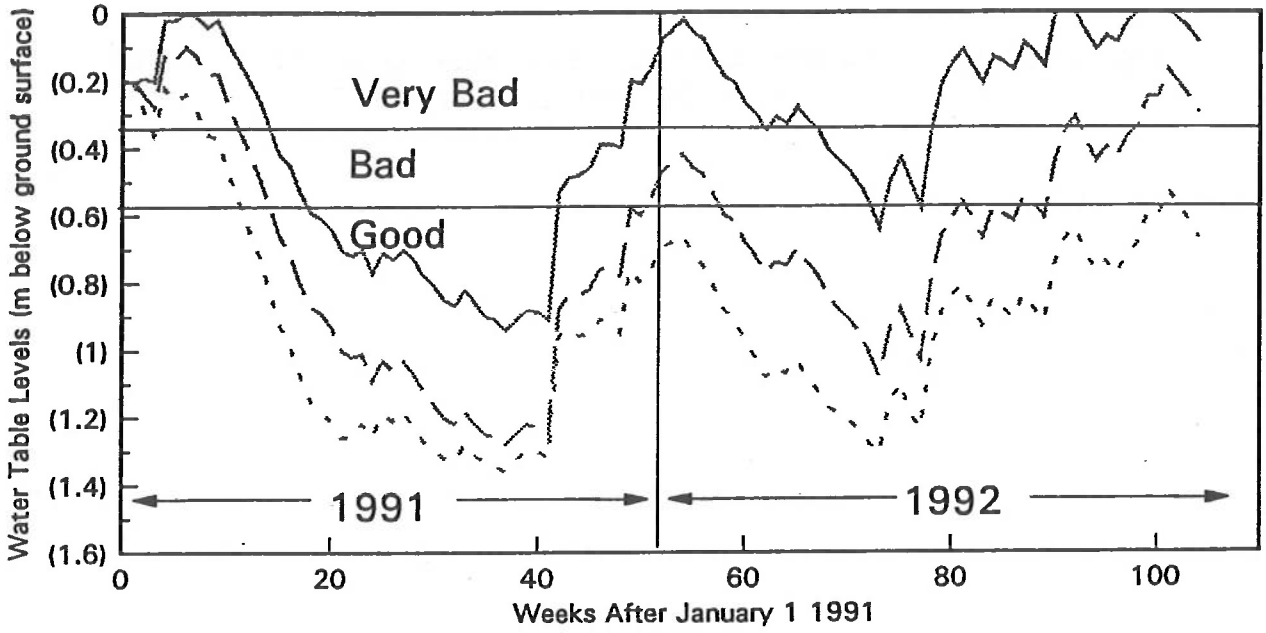


Freeboard 0.5m Freeboard 1.0m Freeboard 1.5m

Water Table Levels for Different Freeboards

Newport Soil Series - Drainage Density 150m

Weather Data for 1991 and 1992



Freeboard 0.5m Freeboard 1.0m Freeboard 1.5m

APPENDIX 4

MONTHLY BREAKDOWN OF PUMPING TIMES AT WISETON PUMPING STATION, 1991 AND 1992

PUMP HOURS 1991

Pumps →	1	2	3	4	5	6
JANUARY	00010	00019	00048	00004	00607	01201
FEBRUARY	00012	00023	00052	00017	00608	01206
MARCH	00014	00035	00061	00018	00613	01211
APRIL	00014	00035	00062	00018	00614	01211
MAY	00014	00035	00063	00018	00614	01211
JUNE	00014	00035	00063	00018	00614	01211
JULY	00014	00035	00063	00018	00614	01211
AUGUST	00014	00035	00063	00018	00614	01212
SEPTEMBER	00017	00046	00065	00019	00614	01213
OCTOBER	00017	00046	00066	00019	00614	01214
NOVEMBER	00017	00048	00066	00020	00615	01216
DECEMBER	00018	00049	00066	00021	00617	01217
TOTALS	8 HRS.	30 HRS.	18 HRS.	17 HRS	10 HRS	16 HRS

1991 99 HRS.

RIVERS IDLE & RYTON IDB

PUMPING HOURS

1992 /

MONTH	PUMP 1	PUMP 2	PUMP 3	PUMP 4	PUMP 5	PUMP 6
JANUARY	00024	00035	00061	00021	00617	01221
FEBRUARY	00026	00064	00067	00021	00618	01221
MARCH	00027	00069	00069	00022	00621	01221
APRIL	00027	00069	00069	00022	00621	01221
MAY	00027	00069	00069	00022	00621	01221
JUNE	00027	00069	00069	00022	00621	01221
JULY	00027	00069	00069	00022	00621	01222
AUGUST	00029	00071	00069	00023	00622	01222
SEPTEMBER	00031	00097	00079	00030	00630	01244
OCTOBER	00031	00097	00086	00035	00642	01253
NOVEMBER	00031	00100	00101	00036	00671	01261
DECEMBER	00031	00103	00105	00037	00750	01279
TOTAL 3184	13	56	39	16	133	61



https://dspace.org/

Evaluation of weed maintenance activities on the river Idle

Sutherland, D. C.; Morris, J.

1993-09
Cranfield University
https://dspace.lib.cranfield.ac.uk/handle/1826/21251
Sutherland DC, Morris J. (1993) Evaluation of weed maintenance activities on the river Idle, report for the National Rivers Authority, September 1993

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