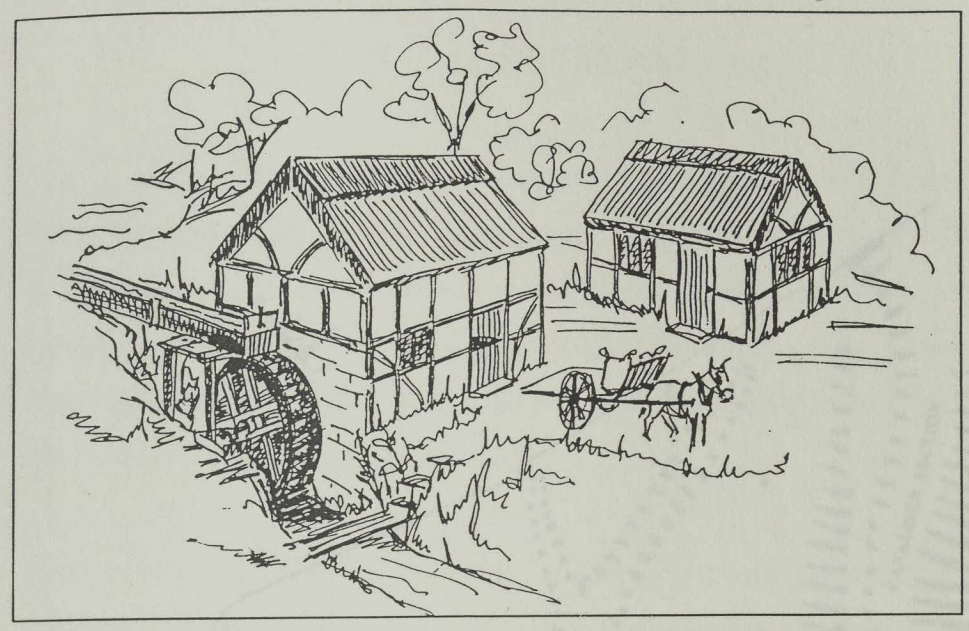

Dissertation

The heritage and improvements of the archaeological and ecological features within Cryfield Grange

By

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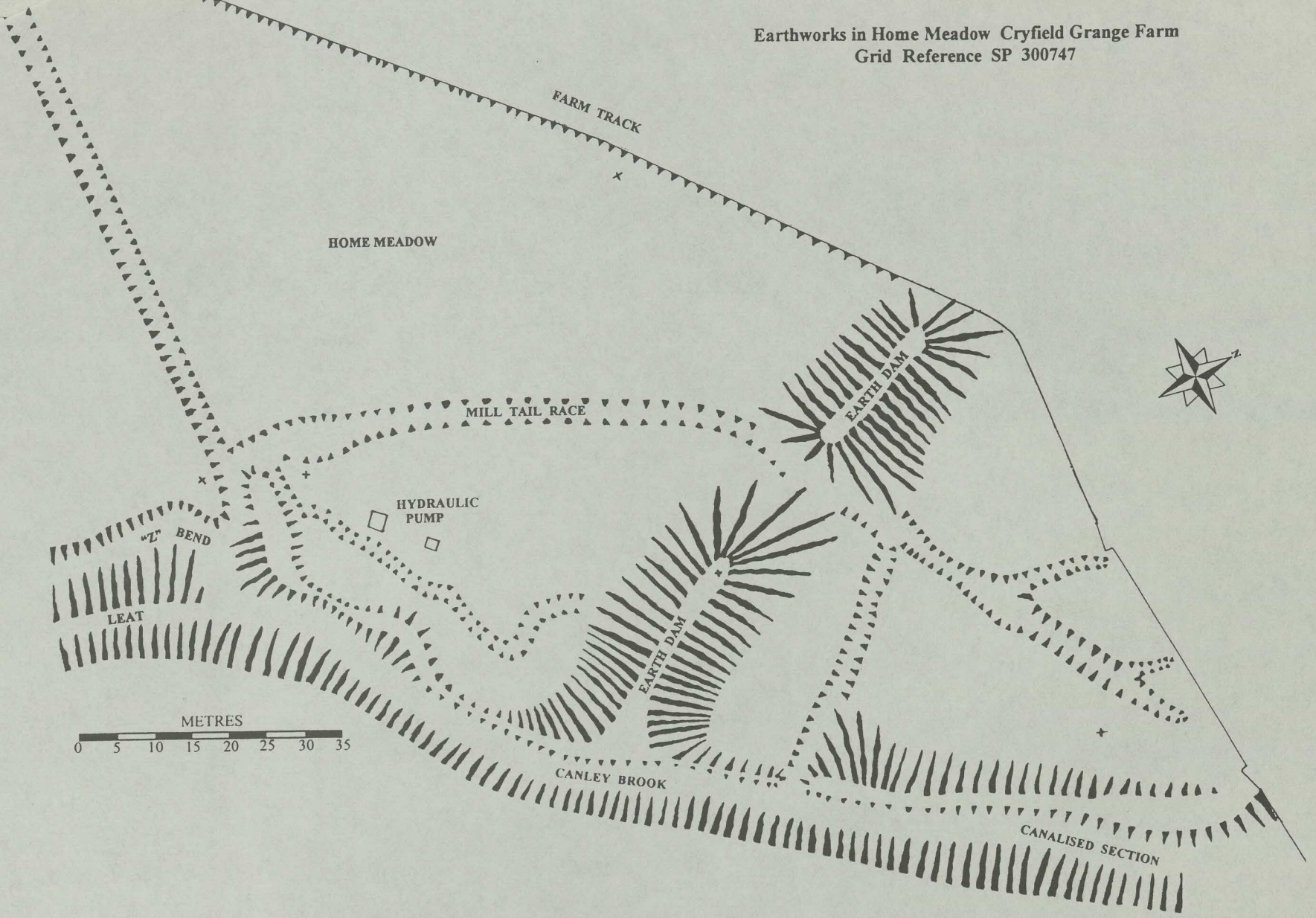
University of Warwick

BSc Environmental Studies



2. Survey plan of Home Meadow 1997 by C. Sumner.

1 ABSTRACT

Our current landscape shows many archaeological features which are relics of how early man adapted the environment to suit his needs and facilitated settlement. The existence of these features can cause conflict with modern farming methods which lead to their removal, resulting in a loss of record of man's innovation. In addition, present farming practices serve to detract from the ecological richness of the countryside.

This study started with the view that co-existence of the archaeological and ecological features within an area of Warwickshire known as Cryfield Grange revealed an area of considerable heritage potential. Work was undertaken to ascertain the extent to which the site warranted protection and conservation. A field survey was undertaken and together with informed research, the conclusion was drawn that there is a clear case for an application for heritage status on archaeological grounds. Owing to the wealth and complexity of data together with the identification of related features within a neighbouring area, less evidence was collected to substantiate a case on ecological grounds. The study looks at sympathetic and sustainable management of the area and concludes with some recommendations and suggestions for further areas of study.

2 ACKNOWLEDGEMENTS

I would like to thank Stephen Hill and Dan Smith of the Open Studies department at Warwick University, without whose help and advice this work would never have got off the ground. My thanks also go to Tim Booth an expert and writer on the subject of ancient water systems and mills who acted as consultant on the Cryfield and Millburn sites and this work benefited greatly from his expertise. Mrs Jean Field whose lovely book 'The Ash Grove' revealed the similarities between the Whitnash site and Cryfield and who helped with information and contacts and has been a source of encouragement. Thanks go to lecturers Martin Bradley and David Cessford who have also given time and advice in their fields and to Dr. Duncan Jeffray who has been a source of help and advice concerning the ecology of the Cryfield area. Thanks are also extended to local farmer Paul Hunt and family who have contributed their time, local knowledge and permission to work on their land. Lady Follett gave me local information and encouragement in this work and my thanks go to her.

My thanks go to Mr Jim Rushton for information concerning the purchase of Cryfield Grange, and to Anton Irvine and Amantha Summers of English Heritage who found the time to give very helpful relevant advice. The same help was given to me by Jane Powick of AD.A.S., Peter Thomson and David Summers of The Game Conservancy Trust to whom thanks are extended.

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3 INTRODUCTION

In order to assess the suitability of the Cryfield Grange site (Ordnance Survey map number 140, Grid Reference: 300 747) for heritage status, a research programme was undertaken. The County archaeologist Emma Jones had indicated that the archaeological and historic richness might be adequate to achieve heritage status. Local archaeological lectures supplied information concerning research methods, and sources of information. This directed research into literature, gathering local information, consultation with experts and drawing comparisons with other sites. Field and desktop surveys were conducted to determine the presence and purpose of features, how they contributed to the land uses and their chronological order.

This area does not appear to have been very well recorded, and what references could be found included were found in literature such as The Victoria County History and The Stoneleigh Leger Book English Translation (ed 1968). The 1766 Stoneleigh Estate Map and the Nathias Baker Map (1766) revealed features for which there may no other record. Also the plan of Home Meadow which is found in M. Astons 1988 work and appears to be accurate and reasonably complete.

The recent studies of the University of Warwick Landscape Working Group including research by Doctor Duncan Jeffray have been referred to with regard to the ecology of the site. This work has required the compilation of information plus original material.

3.1. Ecology

The brook and its banks offer a corridor for wildlife in an otherwise somewhat inhospitable area of intensive agriculture. The type and number of species give an indication of the ecological health of the area and the National Rivers Authority conservation officer Paul Hoban gave this stream a high quality rating

(seven out of ten). concluding that this stretch of brook offers good potential habitat for otter (Jeffray 1996a). A sighting has been claimed by Dr S. Hill (Jan 1997). The presence of such a scarce top predator would strongly endorse the ecological value of this area.

Anton Irvine of English Nature (E.N.) did not consider the ecology of this area to be adequate to warrant this as a Site of Special Scientific Interest. (S.S.S.I.) notification at present. This study has considered the problems and the remedies that would enhance the ecological richness, and increase the possibility of heritage status being granted on ecological grounds. Problems include industrial and /or farming pollution, damage or destruction by farming practices, and local development.

3.2. Site Description

Cryfield Grange lies within a mile south- west of the main Warwick University buildings, and this land was purchased by the university in 1995 to "protect its boundaries" though it is not inconceivable that this could become a growth area. Field research started in a small, shallow, north to south laying valley, that contains Canley brook, which now runs past the Grange and hugs the eastern edge of the valley. Forming the valley floor is Home Meadow which contains a slightly raised farm track which splits the meadow into two halves (see appendix 2 fig 1 p.45, showing plan of Home Meadow, Cryfield Grange by M. Aston 1988, annotated by D. Smith 1997).

A recent increase in the soil level of the northern half has covered historic features but the southern half remains undisturbed. This section has been used for grazing for a great many years which is why the historic earthworks remain, to offer clues concerning man's influence and the historic land use of this area.

During research a measure of uniformity in the methods of achieving a water supply was noted, this included dams, ponds and ditches. Earthen dams derived from the water mill technology of the Anglo-Saxons (Rackham 1990). Multiple dams and canalised leats existed on each side of the valley and a similar

arrangement existed in nearby Bockendon Grange (Aston 1988). A site at Whitnash also has many features similar to those found at Cryfield (Field 1996). A question arose whether the uniformity was due to normal progress or to what extent it was due to monastic influence? The comparison of examples helps in the differentiation of examples of standard practice and those where unusual innovation had been applied.

The combination of surveying, researching the archaeological features and consideration of ecological improvements has formed the basis of this study. This research has explored the innovation that was employed in obtaining a water and power supply. The dry stream beds, banks, ditches of this area indicate the use of a lot of physical work and possibly over various periods. Records also reveal the use of water mills locally and that their use was eventually changed. Determining the date of manufacture of these features is difficult due to the complexity, some could be pre- monastic, monastic or much later and there is the possibility that Cryfield may be a palimpset.

A general and local history background is included in order to compare how Cryfield Grange and its progress fits normal patterns including population trends, water supply methods i.e. mills, dams, leats.

3.3. General Historical Background.

Over many centuries man had developed from hunter gatherers, through nomadic herdsman to eventually become settlement farmers. This degree of permanence brought an ever increasing need for suitable land. Due to economic and population pressures the demand meant that eventually hostile or unsuitable land was required. This land sometimes required the introduction of basic requirements such as food and water.

Anglo Saxon technology included the diverting and damming of streams, creating pools and the digging of ditches, to arrange a supply of water. In this period water mills were also used, thought to be a Roman introduction and they had certainly been employed in other countries for many centuries. Early mills

could function even on a small water supply, such as those engineered by man. The pools also provided a source of food by attracting water fowl and containing fish stocks.

The rate of progress was probably increased by the introduction of the monastic influence in the 11th and 12th century. At that time the religious fervour was strong and monasteries were able to exert great influence, they were organised, knowledgeable, powerful and wealthy. Subservient local labour was organised and combined thus enabling larger and more difficult projects to be undertaken (demesne duty). These often then become an integral part of the local economy, and water systems and mills were included. Cryfield offers an example of this practice for it became a Grange or monastic dwelling in 1145. The features that remain add to the understanding about the land use and lifestyles of people possible through various eras.

In 1225 the distribution of wealth was concentrated in a band of counties running from the Severn to the Wash but a century later this prosperity band was much wider. Due to this vigorous growth of the economy populations rose and with that areas under cultivation. More people were producing more wealth and the cloth industry played a major part for it was a main export and the industry was flourishing in the late 12th and early 13th centuries. Competition existed and wages rose, because weavers had formed protected guilds, withdrawal of labour occurred. This encouraged employers to move their operations to the countryside, where labour was cheap and less organised. Following the plague in the 1350's there was an increase in demand for labour and this competition saw improvements for some people. The flourishing cloth industry brought an increased need for mill capacity at a time when demand for grain grinding lessened, so many mills were adapted to suit this purpose (fulling) (Saul, 1994).

3.3.1. Depopulation.

Between years 1300 and 1500 over 3000 settlements disappeared changing demand and altering land use. Differing reasons have been given to explain this

desertion, one being the Black Death of 1348 -9 which reduced populations from 5 -6 million down to 3—4 million, this plague returned later affecting the young which prevented populations from recovering. There was a high incidence of desertion in the Avon valley and there were local examples including the granges of Cryfield, Millburn, Bockendon, Helenhull.

Areas of most acute desertion were those which specialised in arable husbandry and after the plague grain demand fell and there was an increase in mixed husbandry and in pasture. (Saul, 1994 p140). Of 12 houses recorded at Cryfield by the beginning of the reign of HENRY VII only the grange remained. At the same time only one remained at Millburn from a previously recorded 19 holdings. The same source wrote that, "The monks agricultural activities were not entirely beneficial," (Stephens, 1969 p230). This comment suggested changes in farming practice.

Depopulation of this area, may have involved the Lucy family of Charlecote because they reverted to sheep farming. This required far less labour thus bringing local unemployment, forcing people to look for work elsewhere. John Hales probably referred to this practice when quoted as saying " sheep do eat up men". (Hill et al 1990).

Alternatively the plague was blamed for lower populations so therefore there were less rents being paid and sheep farming offered an alternative way of generating income. There may also have been climatic influences for wetter conditions may have made ploughing difficult on heavy clayey soils, and also famines were recorded possibly due to crops being washed away.

Local history records also indicate changes in agricultural trends for in 1535 mills were converted from grinding to fulling use so indicating a connection with the cloth industry. Also that in 1546 the property granted to Katherine duchess of Suffolk included a walke or fulling mill in Cryfield which was in the tenure of one William Alyson (Stoneleigh Leger Book).

3.4. Local Historical Background

The name of Cryfield is thought to come from "Crulfeld" which has been interpreted as the fork in the clearing. At the position of the grange the geology map of the area indicates a fork where two arms of alluvium meet. This has resulted in a different soil type as shown on the soil map and would therefore be capable of supporting different tree species, which may offer an alternative reason for the name.

Underlying Kenilworth sandstone contributes to the slightly clayey form of the fertile red soil. In the lower land there are fingers of alluvium in which the stream and its tributaries run. These being suitable soils with plenty of local water, conditions were suitable for settlement, though there is little recorded. Documentary evidence (Dugdale, 1656 p 263 - 6) reveals that pre 11th century the Cryfield Grange was a royal residence called Burystede, and that this area was used as a royal hunting forest, therefore settlement would certainly be discouraged.

In 1154 a group of monks who were established at Radmore in Cannock felt that they were interfered with by the foresters. King Henry II granted their request for an exchange and they moved first to Cryfield, which they found to be distracting so they moved again to a site nearer to the present abbey. The abbot became the lord of the manor so beginning a regime of monastic management (see The Stoneleigh Leger Book).

Radiating around the central abbey outlying settlements existed that included granges these were used for local organisation, administration and farming and examples included Bockendon, Canley, Millburn, Hurst and Cryfield.

The abbot remained lord of the manor until the dissolution in 1541, and in 1561 the estate was bought by Sir Thomas Leigh. Other land and farms were acquired and ownership of some 7,500 acres lasted until very recent times (see The Stoneleigh Leger Book p xxiii).

3.5. Mills and Water

Monastic regimes unified local labour which enabled larger projects to be undertaken, streams were dammed to create ponds perhaps more for reasons of economic gain rather than for convenience. Systems were altered to suit demand sometimes covering the original one when a larger dam was built, a practice that may have occurred at Cryfield Grange. The resulting ponds also provided food in the form of wildfowl, fish and eels (Rackham 1990). The water formed the power source for driving mill wheels (see appendix 3 Fig 1 p. 50, showing a dammed stream containing fish traps to make a mill pond to supply an overshot wheel by means of a chute / launder, drawn by Luttrell Psalter c 1338).

The mills were an early example of man engineering and their usefulness was indicated by their numbers. The domesday book recorded that between 1080 and 1086 there were 5624 water mills in use (Marwick 1978 p148).

Mills were versatile for their circular motion could be converted by the fitting of tappets to also give a hammering action. This enabled other uses including, the forging of metal and for fulling material, which was a process that pounded the woven cloth into a thicker compressed mass, thus making it stronger and smoother.

The mill became a part of the economy and when private hand mills (or querns) used for grinding corn were found they were smashed and people found using them were fined or imprisoned.

The mills belonged to the lord of the manor and a toll had to be paid for grinding the grain. Following the end of feudalism the mills were owned or privately rented and people had to pay a contribution of one-sixteenth of their flour to the miller! (Holt 1986 p2 -3.) This amount was difficult to check and open to abuse and the miller was often painted in a bad light. An epitaph in an Essex graveyard to a miller named Strange notes "here lies an honest miller and that was Strange." (Drive Publications Limited 1978, p 286).

4. AIMS and OBJECTIVES of the STUDY

4.1 Aims

To explore the heritage potential of archaeological and ecological features within Cryfield Grange.

4.2 Objectives

- To identify and explore the archaeological features and consider the interest they may offer.
- To consider ways of protecting and enhancing the ecology of the area.
- To consider methods of harmonious and sustainable management within Cryfield Grange.

5 MATERIALS AND METHODS

The surveying equipment used was manufactured by Sokkia and included a total station, tripod, data logger and a reflective prism on an adjustable pole.

The procedure used was firstly to determine the features that required surveying, then to sketch ghost and station plans in order to achieve this in an economic way. By keeping site stations to a minimum, movement of equipment was reduced and therefore less time was wasted.

Initially station 1 was set up; this required the equipment to be levelled and fixed points taken for later use if needed. A backsight point was chosen and the settings logged. This provided a datum point to refer to when resetting the equipment or as an ongoing periodic safety check. Other stations were set up by checking forward and backwards and it was advised to have a closed system in which the settings of a later station could be checked with two or more others. The position of the last one enabled a check to be made back to station 1. This will verify the accuracy of all the intermediate stations.

The position of the features were checked by placing the siting pole on it and then reflecting a light beam back to the theodolite. The data logger displayed two distance readings which were 90 degrees to each other and the measurements related to station 1. In this way they can then be plotted on to a piece of graph paper of chosen scale and with the inclusion of fixed points the whole site can then be placed correctly on a map.

6 FINDINGS

In view of the wealth of archaeological features on the site more time was spent on archaeological than ecological features. The area surveyed and the data obtained enabled a map to be produced (see survey map of Home Meadow showing leat, dried up river bed ,"Z" bend and raised land (appendix 2 fig 2 p. 46.)

6.1. Canley Brook

Canley brook runs under Cryfield Grange Road at the north east of the site. It then separates Home meadow from Cryfield Grange, running fairly straight and at even speed for a couple of hundred metres before being crossed by a bridge that carries a farm track. Beyond this crossing the brook continues to run reasonably straight and does not follow contours. The banks grow unnaturally steep and there is evidence of soil tumbling into what becomes a five metre deep gorge. In places the banks are nearly vertical and local sandstone and some conglomerate can be seen. Along the western bank of the gorge the ground is built up with earth, which has the effect of artificially increasing the bank height. (See reference survey map appendix 2 fig 2 p. 46).

Also in the cutting the flow rate speeds up, only slightly checked by a small weir at which point the brook is bridged by a weak wooden plank structure. The gorge section runs for approximately one hundred metres and ends with the stream entering a sharp 'z' bend around the now vulnerable root system of a large oak. The banks that enclose the bend are comparatively narrow and high, and there is a great number of large sandstone blocks laying in or just below this point. (See appendix 1, photographs 1 and 2 p. 36, illustrating the gorge, and illustrating large sandstone blocks at the site of stream dam).

At the bend the brook is joined by a ditch which forms the field boundary of Home Meadow. Below this point Canley brook continues southerly direction

towards Millburn Grange, meandering more and returning to a more leisurely pace. The banks are lower and shallower and have varying thickness of trees and scrub predominant on the southern bank. Clean water indicator species are present in the stream.

6.2. Leat

Where the gorge section ends but in line with it, there is a ditch entrance which is curiously more than two metres higher than the present stream level (see appendix 1 photograph 3 p. 37, illustrating entry of leat from Canley Brook at end of canalised section).

The humus it contains has a different texture and colour and some of the profile remains making it easy to recognise. On the brook side of the ditch a sandstone wall has been built which is over half a metre high and approximately 50 metres long. The blocks lie back at an 80 degree angle and appear to contain the overgrown and humus filled ditch. (See reference in appendix 1 photograph 4 p. 37, showing portion of sandstone wall that retains the leat).

Evidence of this ditch can be found periodically to the Coventry to Kenilworth Road but it is largely absent having been filled in and ploughed over. It is to be noted that it was marked on the 1766 Stoneleigh Estate Map. (See appendix 2, Map 3 p. 47, 'The 1766 Stoneleigh Estate Map including field names by Nathias Baker').

Oak trees stand at various points along the route of the ditch and these were measured to give an indication of age. Rackham (1986 p13) includes a table by Alan Mitchell suggesting that the age of trees can be assessed by measuring the girth at a height of 5 feet. The growth rate of oaks in open aspects is approximately 1 inch per year. The oak numbered 1 is sighted on the bend with the other trees numbered by their position downstream thus giving Table 1 which reveals the girth of trees that are positioned beside the leat. (See appendix 4, Table 1 p. 54, to give data regarding age of trees).

South of the Kenilworth road lies Millburn Grange farm, which has been used predominantly for grazing land over many years. This has allowed the ditch to remain intact and it can be clearly seen up to the embankment of the Coventry to Kenilworth railway line. On the far side of the railway the ditch reappears, it runs closely past the moated Millburn Grange and meanders through grazing meadows. Oak trees are positioned in close proximity to the ditch throughout this farm. The farthest certain place found so far where the ditch is visible is in meadows behind Dalehouse farm, a distance exceeding one mile from its starting position. The 1766 Stoneleigh Estate map indicates that it is continues further than this point.

6.3. Earth Dam and Mill Site.

Within the portion of Home Meadow that lies below the farm track a meandering dry stream bed is visible. The direction it comes from suggests that it started close to, or on the path of the present brook. It meanders through the meadow interrupted by a three metre high earth bank to eventually meet the ditch that forms the south west boundary of Home meadow. (See appendix 1, photographs 5 and 6 .p. 38, illustrating the natural meandering stream bed used prior to canalisation).

The large earth bank spans the meadow from Canley Brook to the farm track where it can still be seen laying under the hedge. At approximately the middle point of this bank there is a deep incision. Behind this a virtually straight ditch runs via a fording place to also meet the field boundary ditch. Both north and south borders of the meadow rise slightly, containing many surface undulations. In and around the meadow there are dressed sandstone blocks, some still positioned in courses. (See appendix 1 photograph 7 p.39, to illustrate sandstone blocks in the mill tail race at site of earth dam).

6.4. The Hydraulic Pump.

In the meadow there are two low red brick structures that house rusty workings of 20th century hydraulic pump which was fed by water from Canley brook taken

from the canalised section. Pumps of this type are self acting using a larger amount of water to lift a smaller amount, they are called a force pump and were operating between the years of 1870 and 1940. (Robinson 1980, p16, 1988, p14).

(See appendix 1 photograph 8 p. 39, illustrating position of hydraulic pump in Home Meadow, and also photograph 9 p. 40, illustrating the pump machinery).

(See also appendix 3 diagram 2 p. 51, illustrating the components of the hydraulic/ force pump).

6.5. Ecology

Surveying in this area took place in winter, so evidence of species was limited. Details of actual species can be found in Appendix 6 p 61.

6.6. Threats

Development could affect both the archaeology and the ecology. Loss of features due to farming practice are less likely now that the land is owned by the university and restraints can be built in to any future tenancy agreement. But the threats from development, pollution, farming practices and water abstraction are possible.

Mr Jim Rushton of Senate House University of Warwick who was involved in the acquisition of the Cryfield land states that this area was purchased to protect the university's borders and that development was not an intention. But there are now playing fields placed on Cryfield and this has proved to be a fore runner of university development in the past, e.g. the Claycroft residences. This practice is a point of concern to local residents and farmers.

Development and the demands of the university have seen an increase in business but the local road system is often inadequate and lost time could act as a deterrent to potential custom. Cryfield land could offer an alternative through route and past economic necessity has seen this form of development override

the value of archaeological and ecological features on many occasions before, such as the A 4 near Twyford, the A 46 into Bath and the A 34 Newbury bypass.

Pollution incidents have regularly occurred on Canley brook for industrial Coventry lies upstream. Engineering cutting oil is highly concentrated and when diluted it turns from thick brown to milky white and emits a very strong smell. The brook has displayed this same milky white discoloration with an oil slick and a strong oily stench when examined between 18th and 25th Jan. 1997.

Engineering businesses have diminished upstream and more stringent legislation is now in place. Although policing is limited, improvements in efficiency, awareness and levels of responsibility are to be hoped for and some local opinions feel that pollution has generally lessened. Unsightly litter builds up regularly and grid traps are used upstream i.e. behind Sir Henry Parks road. It is noted that the debris is periodically removed and dumped beside the stream where examination invariably reveals a coating of oil which does indicate pollution in this part of the brook.

Canley brook runs under the main A45 road and run off can include petrol, oil, salt, with the possibility of chemical spillage from accidents and the resulting remedial treatment. Accident figures have been reduced on this stretch of road in relation with generally slower traffic speeds. This fact proves the effectiveness of installing cameras capable of photographing speeding motorist automatically.

A further threat of pollution emanates from farming due to Canley brook running through an agricultural basin. Pesticide, herbicide and fertiliser run off can easily enter the brook where a lack of water due to high abstraction levels reduces dilution. Pesticides such as isoproturon (IPU) are used to control weeds in winter cereals. This chemical could easily cause European Union water quality standards of 0.1 ppb to be exceeded in a ditch 100m long x 1 m

wide x 1 metre deep if an operative merely washed his gloves after a days spraying! (see appendix 7 leaflet 1 IPU Task Force, 1997).
Fertiliser applications can lower water quality by causing eutrophication, this is a process in which enrichment plus sunlight promotes algal growth, and increases biological oxygen demand (B.O.D.). This prevents light penetration and reduces the oxygen available for other aquatic species thus affecting the food chain and the variety and number of species.

Lower rainfall in latter years has not helped but the local soil suits potato growing. This crop has a high water demand particularly at times when there can be a high rate of fertiliser release.

Lack of rainfall in recent years has caused continual low water levels in this brook this has compounded the previous problems, which will only be worsened by the fact that three abstraction licences are presently held on this length of brook.

A study of the annual flow figures supplied by the Environmental Agency reveal that the brook is hardly capable of supplying enough water to enable the permitted abstraction.

Assistant Isometric Officer Andy Roberts agreed that present abstraction rates are a cause of concern (flow and abstraction charts may be found in appendix 5 chart 1 p. 56).

High pressure demand is required not just to abstract water from a source and then to spray but also to bring about a rotary action. The abstraction rates are dependant on nozzle diameter and the bar pressure achievable. An average demand for crops such as potatoes would require a 24 mm nozzle and 5 bar of pressure which would provide 30,000 galls per hour. A four inch piece of abstraction pipe was found in the gorge section of the brook (see appendix 1

photograph 10 p. 40, showing four inch abstraction pipe found in the gorge section of Canley brook.).

This flow rate is easily achieved by pumps such as those manufactured by Godiva Pumps of Warwick. Agricultural equipment company Andrew Sykes hire out pumps specifically for agricultural spraying that could easily achieve 15,000 galls per hour.

Present intensive farming practices on Cryfield have reduced or eliminated farming headlands, hedgerows and woodland. A manure pile is sited close to a ditch that runs along the southern boundary thus enabling slurry to enter Canley brook, (see appendix 1 photograph 11, p. 41, illustrating site of manure pile in close proximity of ditch).

7 DISCUSSION

7.1. Canley Brook

There are many reasons that suggest the gorge section of Canley brook is a man made canal, for it cuts through the contours and has unnaturally steep banks. These are so steep that there is evidence of soil tumbling into the cutting, which over a long time would fill up the gorge. A dry stream bed is visible laying in a more natural, lower, meandering path through the meadow, this is likely to be the original line that the brook took prior to canalisation (see appendix 1, photograph fig 5, p. 38, showing dry stream bed).

Within the 5 metre deep "gorge" sandstone and conglomerate is revealed that still displays the appearance of being cut, having sharp edges remaining. This is surprising considering the erosive speed of the flow would round the sandstone edges (see appendix 1 photograph 12 p. 41, illustrating lower sandstone level in gorge displaying sharp corners which demonstrate lack of erosion).

Beside the gorge the ground level is higher than in the rest of Home Meadow, this suggests that it is spoil that was dug out during excavation, for this offers the most likely dumping place being the closest convenient site. M. Aston's 1988 drawings showing canalisation on both sides of Home Meadow, and both T. Booth and S. Hill agree that this stretch has been excavated by man.

It is possible that the spoil served two purposes, one it allowed higher water levels in the gorge and two it could have formed a bank to enclose a pool in the meadow. The answers may help to establish whether or not these features formed part of one scheme or whether they are part of a palimpset. The Cryfield dam is presently higher than the brook bank which meant that on reaching a certain level some of the water which headed back up the meadow could escape into the cutting. This is unlikely, for spoil would be washed back into the gorge and also fish could escape. It may be that the water level did not reach the top

of the spoil, therefore more of the dam was above water. Perhaps the excavated earth was subjected to settling, packing down by animals, or some did tumble or wash back into the gorge. This is an area for further research.

T. Booth (22 1 1997) felt that the "Z" bend at the end of the gorge was a dam site. Water would have built up in the cutting and the dam height could be set to encourage it to enter the raised ditch, a hypothesis strengthened by the alignment of the ditch. The water contained in the gorge would have been deep and would have been slow flowing which could account for the lack of sandstone erosion.

There are many reasons why the dam would be positioned in the middle of the "Z". The banks here are comparatively high and narrow therefore requiring a small span. This would result in reduced stress on the dam, and also less building work would be required. If this area had been composed of stone it would have been unnecessary to dig this section out as it would have been strong enough to form a dam. But upper soil levels consists of softer alluvial deposits therefore it is likely that some reinforcement would have been needed. The blocks required for reinforcement were probably available from excavation of the lower level of the gorge.

Both of the bends are unnaturally sharp but following the same line of thought this could have been deliberate for the raised ditch would then be in line with the gorge thus directing flow. This would also allow the dam to be positioned on an angle which help to deflect the force and encourage water to enter the ditch. Reinforcing blocks would have been required under and around the ditch mouth to prevent erosion, which has occurred at this point since the dam was breached (see appendix 1 photograph 13 p. 42, illustrating undermining of oak tree; also possible dam foundations on the "Z" bend of Canley Brook).

The hypothesis that the "z" bend formed the dam site is strengthened by the presence of suitably positioned sandstone which served as a foundation. A large amount of sandstone rocks litter the area and a pile rests against the bank just

below the bend. This is the most likely position for stone to accumulate when the dam was breached, for they were too heavy to be swept far (see appendix 1 photograph 2 p. 76, illustrating large sandstone blocks at site of stream dam).

At this point the bank has been scoured out revealing the roots of the oak tree that stands there. This erosion could have only occurred since the dam was breached for only then would the water become fast flowing. When in spate it will hit this point at speed, then swirl around, which has caused undermining of the oak tree. The age of this tree is approximately one hundred and fifty years old. (See table 1 in appendix 4 p. 54). The roots being visible suggests that the dam was breached while the tree was maturing and that the soil was eroded away later. Before breaching occurred, water was trapped in the gorge and movement was restricted either to entering the ditch, over topping or circumventing the dam.

7.2. The Leat

Evidence is strong that the raised ditch which starts from the bend is actually a cleverly engineered leat and that the height of the entrance allows water to be transported for a long distance. The 80 degree angle of the sandstone wall suggests that its purpose was to retain the leat. This was necessary for the brook is less than three metres away and three metres below, causing the leat to be vulnerable to collapse. At a point where the brook and the leat are far enough apart to allow natural stability the wall ends.

The leat contains humus, but the depth and shape of the former base can be roughly determined by pushing a stick through the litter and noting the depth at which resistance increases. There is potential for a mill site in this locality for there is adequate height and area but no evidence has yet been found to support this idea and no record of any building or settlement on this site has been found.

The leat is fairly complete for 75 metres but it eventually disappears having been ploughed out. Two roughly parallel water courses are shown on the 1766

Stoneleigh Estate Map. **(See figure 16)**. One appears on modern Ordnance Survey map Sheet 140 as the present stream, Grid Reference 299 747. The other is more gently curved and is probably the leat. To maintain a gradual gradient it was necessary for it to track away from the brook in places. Fields are now bigger and reach to the brook and therefore the leat must have become an obstruction and so it was filled in. The fragments that are still visible occur at field boundaries. Grid reference 302 742 (see appendix 1 photograph 14 p. 42, illustrating leat forming a field boundary).

The 1766 Stoneleigh Estate Map illustrates two roughly parallel waster courses running south towards Kenilworth (see appendix 2 map 3, p. 47, 1766 Stoneleigh Estate Map illustrating two roughly parallel water courses).

On the north west side of the Coventry to Kenilworth road eight oaks stand beside the track of the leat. Their purpose is not really known but they appear to act as markers, and as figures in appendix 4 p. 54, show they post date the leat. (This could be seen as a further area of research).

On south east side of the Kenilworth Road lies Millburn Grange Grid Reference 303 735 and within it's land the leat is clearly visible until it reaches the Coventry to Kenilworth railway embankment Grid Reference 300 737. Where it reappears on the other the side of the railway the height difference between the leat and the stream is at it's maximum within this area, and this fact suggested to Tim Booth that this offered a good potential mill site.

A fulling mill was known to exist on the site in 1546 it being referred to in the Stoneleigh leger book, and the name of "Millburn" also suggests that one was present probably at a much earlier time. Tim Booth (1997) felt further evidence is provided by the existence of a flat platform beside the leat at this point. Also a dry water course runs from the platform down the slope and directly to the brook, Tim Booth (1997) felt that this was indicative of a mill tail race.

The leat continues on further as depicted on the 1766 Stoneleigh Estate Map appearing to supply a moat which surrounds Millburn Grange. Canley Brook forms the nearest surface water supply and the Grange owner felt that localised subsidence in his garden was due to old wells therefore the leat could have provided water for irrigation, stock drinking or to provide a supply of fish and fowl. From the Grange the leat meanders around the Grange land where three more oaks of similar age are positioned at various points. The furthest point that the leat has been located with certainty is a few hundred metres south of the Grange in close proximity to possible foundations of buildings from a deserted settlement. Desertion had occurred at Millburn before the reign of Henry VII. (V.C.H. p 230)

On the Ordnance Survey Map No 140 the 75 metre contour line can be running through Cryfield Grange, the leat entrance, through Millburn Grange, Grid reference 303 736, and close to Dalehouse farm. When the leat is superimposed onto this contour line they follow the same path, and this raises the question whether the leat may be considerably longer than this research has found (see appendix 2 map 4 p. 48, tracing of 1990 O.S. Map 140 including the 75 metre contour line with leat overlaid.

The 1766 Stoneleigh Estate Map appears to show the leat ending beyond Dale House farm, at approximately grid reference 312 735. (Ordnance Survey map number 140). At this point four field boundaries appear to meet. One boundary runs down to the nearby Finham brook, but there is another boundary that continues directly away from leat. It has a sinuous path and follows the 75 metre contour line, therefore could be a continuation of the leat (see appendix 2 map 3 p. 47, The 1766 Stoneleigh Estate Map including field names by Nathias Baker.)

Millburn Grange owner Mr Paul Hunt had heard rumours that the leat reached as far as Stoneleigh Abbey. This hardly seems possible due to geographical difficulties and the distance it would involve. A lot of complex work would have been required and as yet no purpose can be established. The owner of Brook

farm may allow access onto his land which borders Finham Brook to approximately Westley Bridge in order to search for evidence of the leat.

This leat may not be unique but it certainly offers an unusual example of ingenuity and the long sinuous contour hugging path displays a clever feat of engineering, considering its possible age. The full purpose and length of this leat are uncertain and definitely suggest an area for further research.

7.3. The Earth Dam and Mill Site

The three metre high earth bank within Home meadow could have been little other than a dam. The remains are extensive enough to be certain that this structure spanned the valley before a portion was removed to make way for the present farm track. At that point the profile of the dam is visible under the hedge that separates the track from home meadow. Tim Booth (22 1 1997) suggested the dam met the valley slope at a point where their heights were similar, though any evidence of this is now covered by a large amount of rubble.

Enough similarities exist between the features at Whitnash and Cryfield to encourage comparisons to be drawn. These include estimates that the Whitnash pool was nearly a third of a mile long, and that it was held back by a dam of which there are now four mounds remaining (see appendix 3 diagram 3, p. 52, showing drawing of great pool at Whitnash, Field and Booth 1996).

There are many similarities between the Home Meadow site and an artist's impression found in "The Ashgrove" (Field 1996). This drawing depicts a dam with an incision where water would exit from the pool, behind the dam at this point lie a water mill and a cottage. Carrying the water is a duct which is described as a half timbered launder/chute, and the drawing shows this to be built out and over the mill wheel. An opening in the launder/chute floor allowed the water to escape into the wheel buckets below, and the weight caused the wheel to rotate downwards (Field 1996) (see appendix 3 diagram 4, p.53, showing a diagram of a site including dam and an overshot water mill).

The quantity of dressed sandstone blocks that are laying behind the dam at Cryfield could be explained by the amount of stone that would have been required for building, supporting and to provide protection from erosion. The features and the approximate position in which they have been found at Cryfield appear to be identical to the drawings and descriptions of the Whitnash site (Field 1996). This suggest that the more detailed descriptions of features may also apply at Cryfield.

The features and comparisons give strong reason to suspect that there may have a mill site just behind the Cryfield dam, as indicated by (Booth 1997). There is documentary evidence of a water mill at Cryfield and this offers one of very few possible site options. The presence of a tail race also supports this hypothesis.

The Whitnash site was manorial so does not add support to the hypothesis concerning a generalisation of monastic design. The similarities point to one site being a copy of the other, the reason for this are ascertained but may indicate a local design, thus indicating an area for further research).

There are examples of shallow fish pools being positioned below a dam, Rackham (1990), and this possibility is considered at Home Meadow. On opposite sides of the meadow below the dam there are banks that could be artificial, and there are strange undulations in the grounds surface. It is not impossible that low banks were built to contain a pool behind the main dam and that the undulations were a feature that developed in soft ground that lay underwater.

Opposing this line of thinking however, there is no visible evidence of a retaining bank along southern boundary, though there could be agricultural reasons for its later removal, such as ploughing out the headlands for maximisation of agricultural land. There are also references to the possibility of theft from pools, Rackham (1990). Due to this pool being some distance from the Grange and

hidden by the main dam theft would be hard to see and this gives further reasons to doubt that was a pool site.

This part of the meadow is low and therefore in wetter times it may have been marshy or alternatively this may have offered a route away from the mill site possibly in the direction of nearby settlements such as Hurst. Both possibilities could give reasons for the undulations. It is felt that evidence is weighed against the likelihood of a pool below the dam, but the uncertainties that exist here suggest an area for further research.

7.4. The Hydraulic Pump

The hydraulic pump is of 20th century manufacture; it is not unusual and appears to be adequately recorded.(Robinson 1980 p 16, 1988 p 14) These pumps are self acting and capable of lifting water to a high level. They could be used for pumping water for storage in reservoirs, and may offer environmental benefit to this area. This example appears to be complete and offers an interesting restoration project.

7.5. Dating

Dating these features remains elusive: was the construction of the canalisation, dam and leats concurrent or in various stages? The amount of material removed from the canal may have been adequate to supply the dam and still allow the build up of the banks. The canal on the west side of the valley could have fed the pool or pools or possibly it could have also been used for overflow control.

For these features to be used simultaneously the height of the banks and the dam would have been roughly similar, otherwise it would have been pointless to build the dam up to the extent it is. It is possible that the bank has settled, eroded or been packed down by centuries of trampling and that it was once higher than at present. In which case, this could all have been constructed simultaneously. The record in the Stoneleigh Leger Book states that mills existed at Cryfield and at Millburn in 1154, and that both were rented for five shillings per year. Occupation of Cryfield and Millburn occurred at similar times and would have

had similar milling requirements. In conclusion these points suggest that the features, including the dam canalisation and leat, formed component parts to a major scheme built to utilise local water resources at approximately the same time.

7.6. Recommendations – Remedies

i The present farming methods are seen as intensive and unsustainable. They threaten archaeological features and are destructive to the ecology. Many basic improvements could be made including expanding field headlands to the brook. Advice on these matters can be found in appendix 7 in leaflets 3 and 4 from The Game Conservancy Trust and Ministry of Agriculture, Farming and Fishing.

A further remedy would be compliance with spraying recommendations see appendix 7 leaflet 1, prepared by IPU UK Task Force and the containment of the slurry presently stored beside a ditch. But these suggestions do not address the main problem.

ii Most remedial ideas may be economically unpopular because they require the return of lucrative presently tenanted land. Due to the present five year tenancy agreement major changes may be economically impractical.

Any interference in the tenant's farming activities might require some form of compensation, for presumably his operation must make a set profit, and therefore some of this project may have to be placed on hold. But the price tendered for farming this land far exceeded expectations and the purchase price will be returned sooner than anticipated. Therefore implementation of the recommendations in this text may mean that the time required to repay the purchase price would be returned to the former period.

iii There are sources for funding heritage schemes which include English Nature or Ministry of Agriculture Farming and Fishing, and the lottery, schemes could include an archaeological theme park, a heritage or wildlife area. Use of this land for a golf course might help attract businesses to the University and could generate an income. There are many successful local courses suggesting that there is a market for such leisure pastimes. This scheme would have limited ecological potential and is seen merely as a compromise! Design could prevent access to the certain features and areas so creating undisturbed oasis. Nearby Stoneleigh golf course offers an example for the public are excluded from a central area. This area of some 26 acres comprises of the former gamekeepers cottage and is privately owned and environmentally managed by Mr Paul Cadden.

iv This land would make an excellent practical environmental teaching area which would not only be a demonstration of environmental responsibility but would add credibility to related courses run by the university. Any scheme would require a cessation or at least a reduction of chemical applications.

Many forms of habitat creation could be tried including grassland and water meadows, pools, protective corridors, woodland, heath, hedgerow reinstatement and areas left for wildlife. Planting schemes could be introduced and the provision of bird and bat boxes and otter holts.

v Warwick University's environmental adviser Dr Duncan Jeffray has suggested the use of reservoirs to store excess water for release at times of high demand. This is common practice in the vale of Evesham and particularly relevant considering the present dry period. There is also a self acting hydraulic pump present on the site which could act as a model

for the engineering departments to develop. Besides offering ecological benefits the presence of mini reservoirs could also be visually attractive, and at suitable times offer a potential income from water sports. The universities present water features are in keeping with the campus and are beneficial for quiet contemplation.

vi If the land was genuinely bought to protect the university's boundaries and profit was not the motive it could remain as farmland but be managed in an environmentally acceptable way. This is the preferred option and therefore advice was sought from an organisation which offer a practical guide to integrated crop management. This organisation is called L.E.A.F. (Linking Environment And Farming) it is based at the NAC show ground at Stoneleigh and is funded by subscription from farmers.

LEAF is committed to the concept of viable agriculture which is environmentally and socially acceptable and ensures the continuity of supply of wholesome, affordable food while conserving and enhancing the fabric and wildlife of the British countryside for future generations. Evidence of the suitability and success of running a farm using I.C.M. as a management tool is offered at GUITING POWER where there is coincidentally a site of archaeological interest, which is being explored at the moment (see appendix 7 section 5, leaflets from Linking the Environment and Farming (L.E.A.F.), project co-ordinator Caroline Drummond.)

vii Agreement should be sought immediately with the farmer concerning the suitable management of Home Meadow. Also the scheduling of a site requires the existence of standing remains and historic documentation and that limited excavation is carried out, the latter must therefore be undertaken.

8 CONCLUSION

8.1. Overview

Some of the archaeological features of Cryfield Grange are at least unusual if not unique and they can reveal further information. Because they can be of great further benefit heritage protection is seen as important and this is generally accepted by officers at The Sites and Monuments Records Office and many people in the University of Warwick. This research would support any application for heritage status on archaeological grounds. It is recognised that Millburn Grange similarly offers great potential and suggests that this area could also warrant heritage status.

The ecology does not carry the same rating but there are people including Dr Duncan Jeffray and Lady Follet who recognise the potential that could be achieved. It is widely considered that less intensive agricultural methods would quickly result in the development of a richer ecology. This opinion is endorsed by sightings of passing predatory indicator species such as weasel, otter and sparrow hawk.

This study supports the view concerning threats to the areas ecology which require remedial action come from the present farming methods including chemical applications and run off, coupled with excessive water abstraction rates. (Jeffray 1996 b) Therefore it is my opinion that by adopting the L.E.A.F. integrated management methods an excellent option is offered for this area. It also has the potential to offer itself as a fine example of a LEAF demonstration farm, which could be of benefit to the environment, LEAF, and to Warwick University for whom the loss of income may only be temporary as the Guiting Power farm project demonstrates.

It is hoped this research will highlight some of the value and the vulnerability of the heritage of this area. Natural features such as those found in Cryfield have

been recreated at huge cost within built environments. One example is found at Conoco's Warwick headquarters, where £1.25 million pounds has been spent on a landscape project (see appendix 1 photograph 15 p. 43, illustrating Conoco water features).

When forward thinking companies such as Conoco, who have survived in a competitive business environment for years spend so much it is perhaps prudent to consider what benefits they expect from such expense! If the University of Warwick wishes to demonstrate its environmental awareness, it can decide to protect what already exists, rather than investing vast sums of money in attempting to recreate such a landscape.

8.2. Difficulties

This study of the heritage potential has become vaster and more complex than envisaged and therefore the level of detail has had to be limited.

This could to some extent have been alleviated by earlier selection of the subject. Further information could have been accessed thus increasing accuracy and detail. The subject was much more complex than first thought and this meant that time demands could only be met by restricting the amount and depth of research. Information sources were scattered and sometimes hard to find: some of the features are either damaged, not known or are little documented. This required original research particularly with reference to the some of the archaeological features and aspects of the leat.

8.3. Improvements

The quantity of readings were not necessary for this research and time spent surveying could have been better used by studying the unusual features of this site. It is unlikely that areas for further study would be reduced because when more information was gathered it generally resulted in more mysteries.

8.4. Areas for Further Research

The areas for further research include :-

Archaeology

1. The spoil beside the gorge, whether it contributed to the dam and what or how many purposes did it serve?
2. Did a pool exist behind the dam?
3. What was the purpose of the oaks beside the leat (they were obviously planted and at a much later date than the leat was used)?
4. The full extent of the leat and the purposes that it served. Did it reach Stoneleigh and if so why?
5. There is still much to determine with regard to dating the features.
6. There are features on the Cryfield Grange land that this work has not discussed, i.e. possibly further dams.
7. Why mill sites are similar?

Ecology

1. Regular monitoring of the brook for the amount and type of pollution will help safeguard the ecology of the area.
2. Seasonal ecological surveys and species lists.
3. Investigation of pollution types and sources
4. Monitoring of pollution levels in stream around the year,

8.5. Scope for the Future

The scope for the future is many fold for Cryfield can offer the university a practical experimental and learning area with potentially many years of work.

This is relevant for both fields of archaeology and the environment. For the archaeological features offer much to be discovered, and the site is an ideal proving ground for conservation management. This area can offer the university a proving ground for experiments aimed at solving conflicts between economics and the environment.

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11 APPENDICES

APPENDIX 1

LIST OF PLATES

(All photographs taken by C. Sumner).

1. Photograph illustrates the gorge.
2. Photograph illustrates large sandstone blocks at the site of stream dam.
3. Photograph to show entry of leat from Canley Brook at end of canalised section.
4. Photograph to show portion of sandstone wall that retains the leat.
5. Photographs to illustrate the natural meandering stream bed used prior to canalisation.
6. As above.
7. Photograph to illustrate sandstone blocks in the tail race at site of earth dam.
8. Photograph to show position of hydraulic pump in Home Meadow.
9. Photograph illustrating the pump machinery.
10. Photograph showing four inch abstraction pipe found in the gorge section of Canley Brook.
11. Photograph showing the site of manure pile in close proximity of ditch.
12. Photograph illustrating lower sandstone level in gorge displaying sharp corners which demonstrate lack of erosion.
13. Photographs illustrating undermining of oak tree; also possible dam foundations on the "Z" bend of Canley Brook.
14. Photograph illustrating leat running along the field boundary.
15. Photograph illustrating Conoco water features.

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3. Photograph illustrating show entry of leat from Canley Brook at end of canalised section.

4. Photographing to show portion of sandstone wall that retains the leat.

5. Photographs to illustrate the natural meandering stream bed used prior to canalisation (looking northwards).

6. Photograph illustrating the natural meandering stream bed used prior to canalisation (looking southwards).

7. Photograph illustrating sandstone blocks in the tail race at site of earth dam.

8. Photograph illustrating position of hydraulic pump in Home Meadow.

9. Photograph illustrating the pump machinery.

10. Photograph illustrating four inch abstraction pipe found in the gorge section of Canley Brook.

11. Photograph illustrating the site of manure pile in close proximity of ditch.

12. Photograph illustrating lower sandstone level in gorge displaying sharp corners which demonstrate lack of erosion.

13. Photograph illustrating undermining of oak tree; also possible dam foundations on the "Z" bend of Canley Brook.

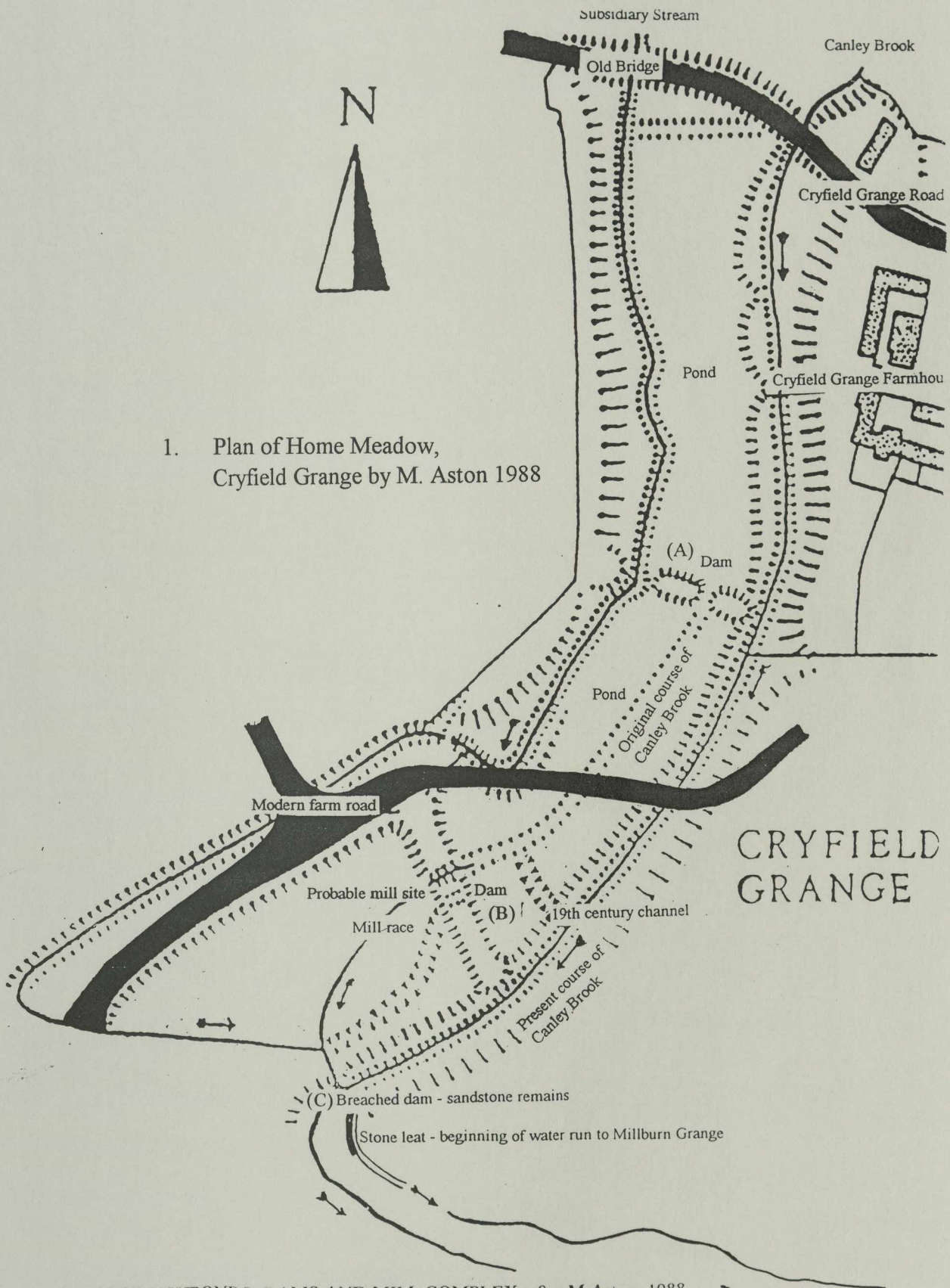
14. Photograph illustrating leat running along the field boundary.

15. Photograph illustrating Conoco water features.

APPENDIX 2

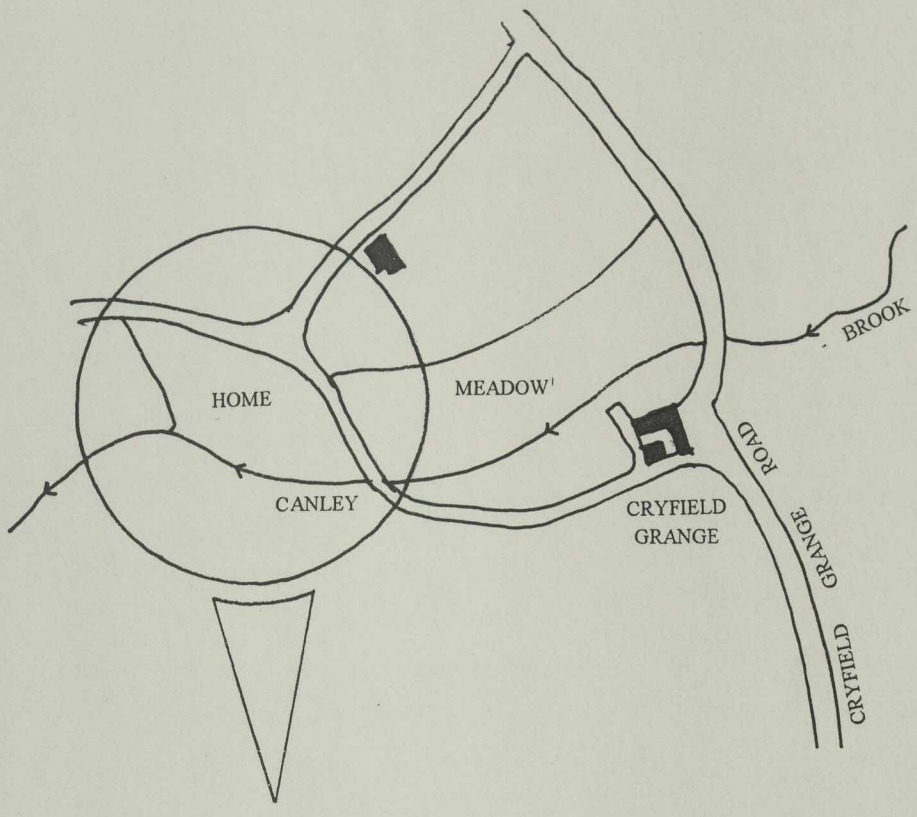
MAPS AND PLANS

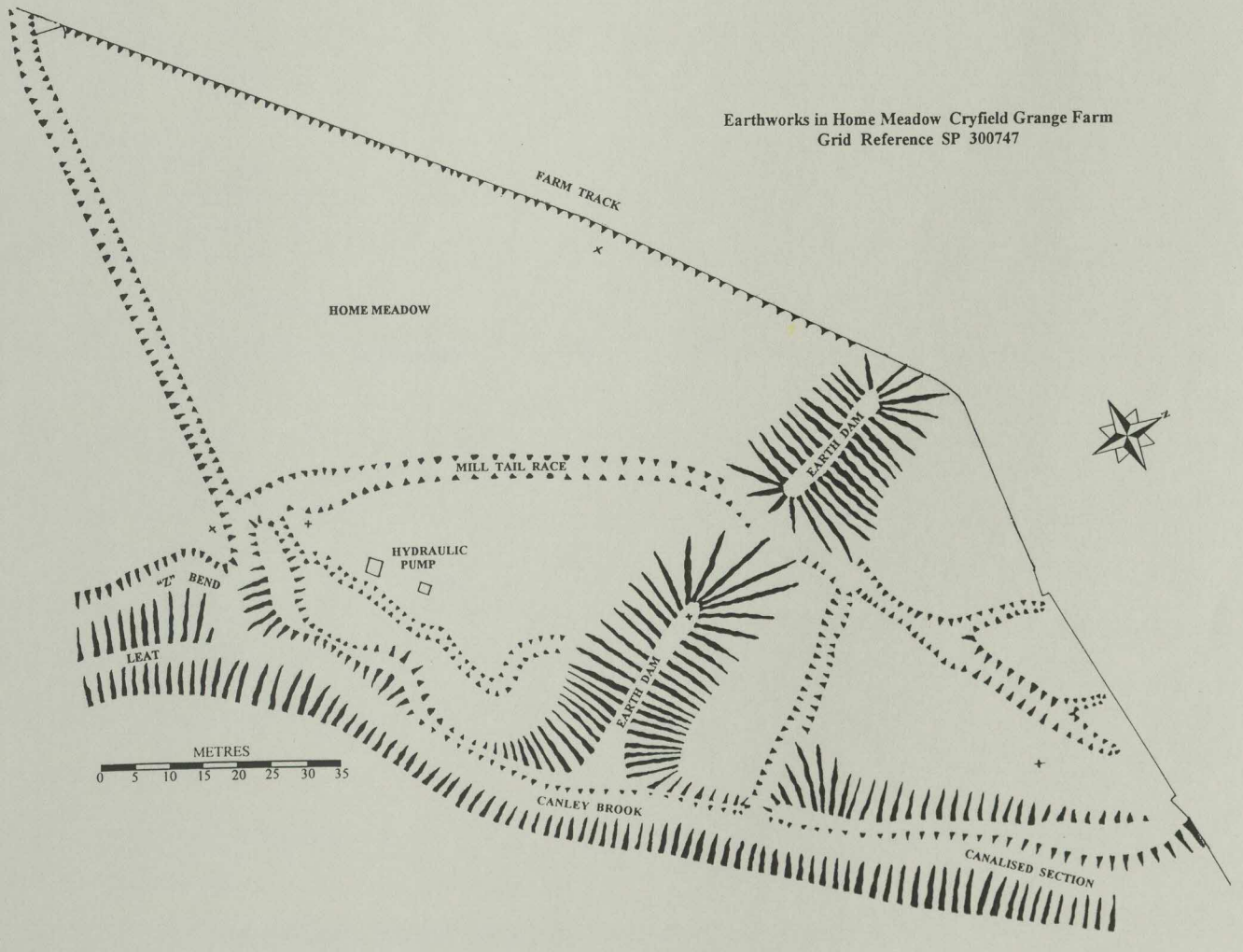
1. Plan of Home Meadow, Cryfield Grange by M. Aston 1988.
2. Survey plan of Home Meadow 1997 by C. Sumner.
3. Stoneleigh Estate Map 1766 illustrating two roughly parallel water courses (including work by Nathias Baker. Parts a.& b).
4. Adapted from 1990 O.S. Map (sheet number 140), with the leat (from Nathias Baker's 1766 map) superimposed.



1. Plan of Home Meadow, Cryfield Grange by M. Aston 1988

. PLAN OF FISHPONDS, DAMS AND MILL COMPLEX, after M.Aston, 1988.
CHANGES ARE APPROXIMATE AND ALL ANNOTATIONS ARE BY D. Smith





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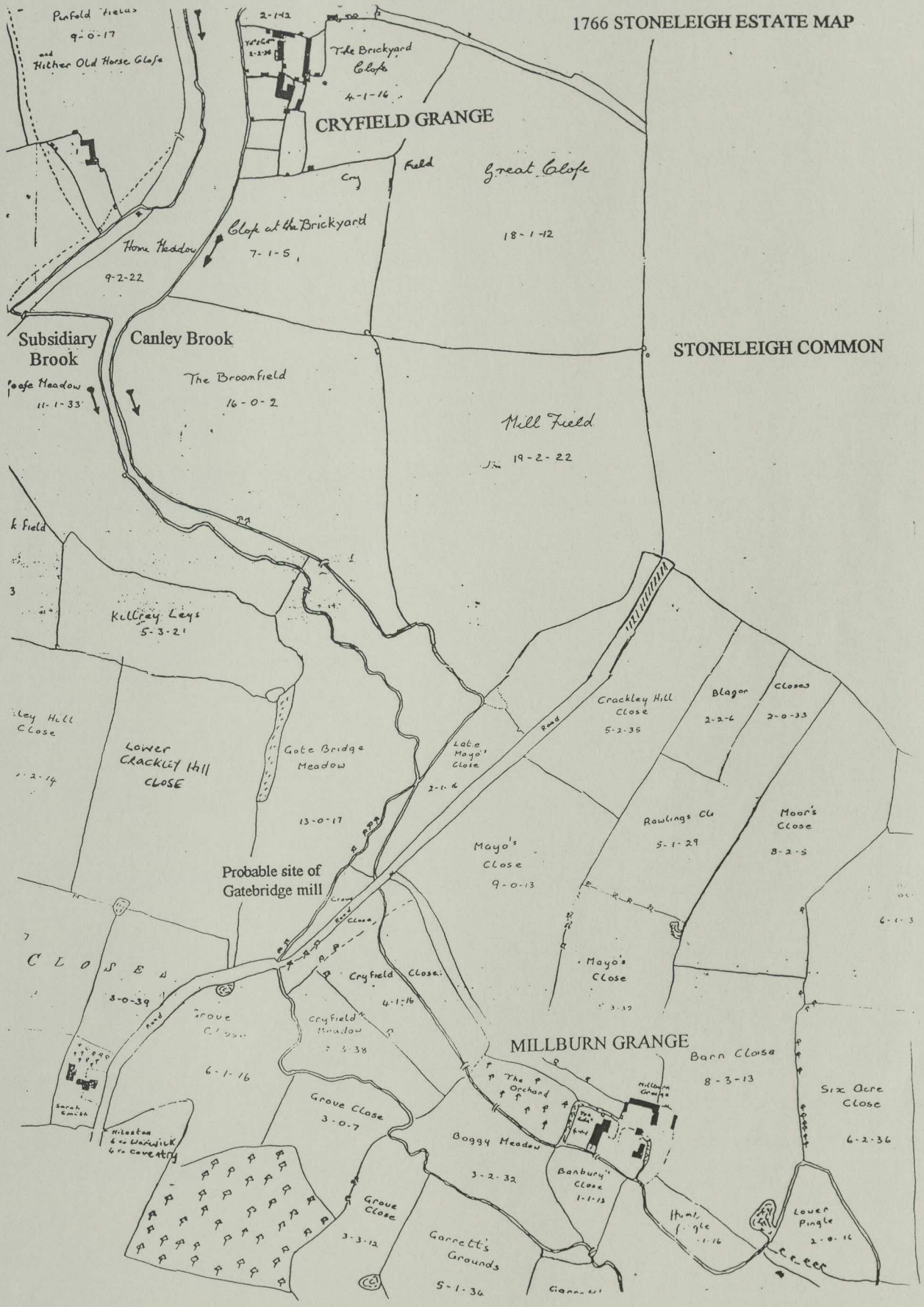

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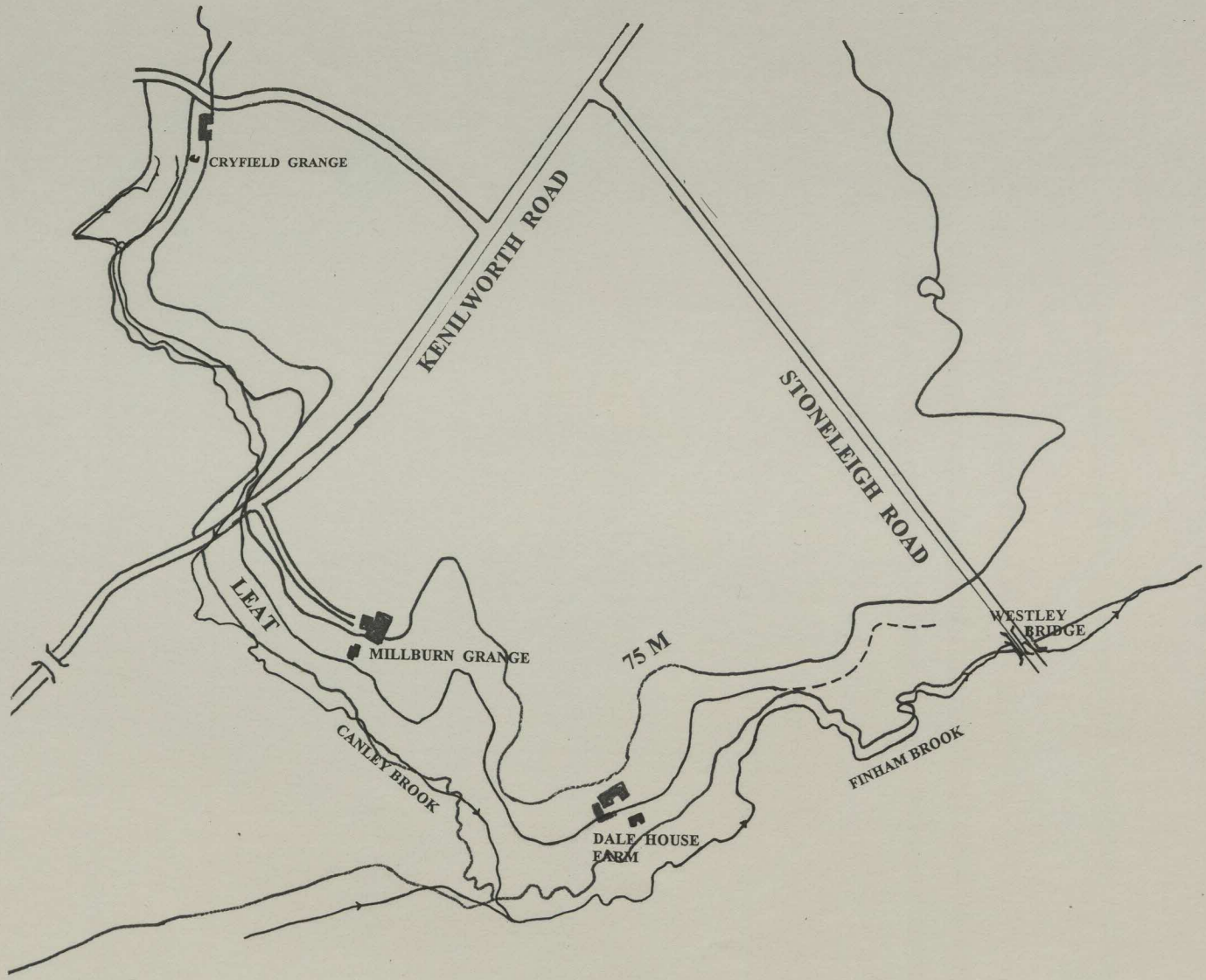
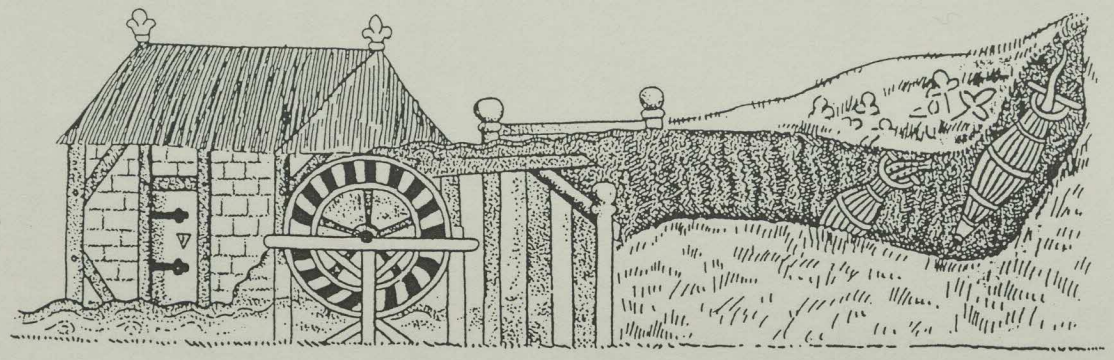


4. Adapted from 1990 O.S. Map (sheet number 140), with the leat (from Nathias Baker's 1766 map) superimposed.

APPENDIX 3

DIAGRAMS

1. Diagram showing stream with fish traps dammed to make a mill pond to supply an overshot water mill by means of a chute / launder by Luttrell Psalter c 1338).
2. Diagram illustrating the operation of the hydraulic/ force pump. (Robinson D.H. 1988)
3. Diagram of the great pool at Whitnash. Field and Booth. 1996
4. Artists impression showing a diagram of a site including dam and an overshot water mill. (Field and Booth 1996). Diagram drawn by Rosemary Booth, also shown on frontispiece.



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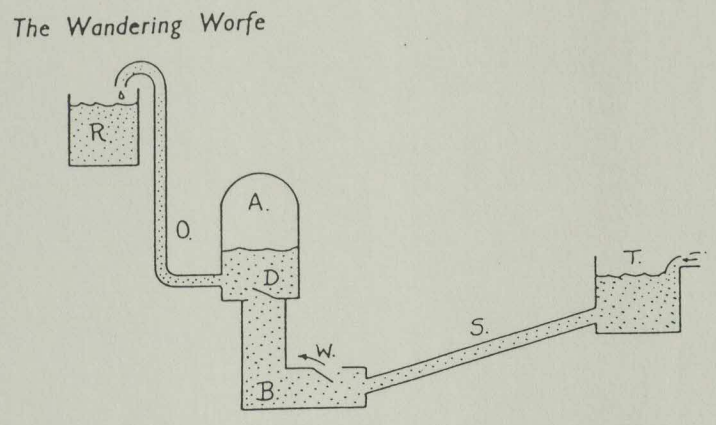
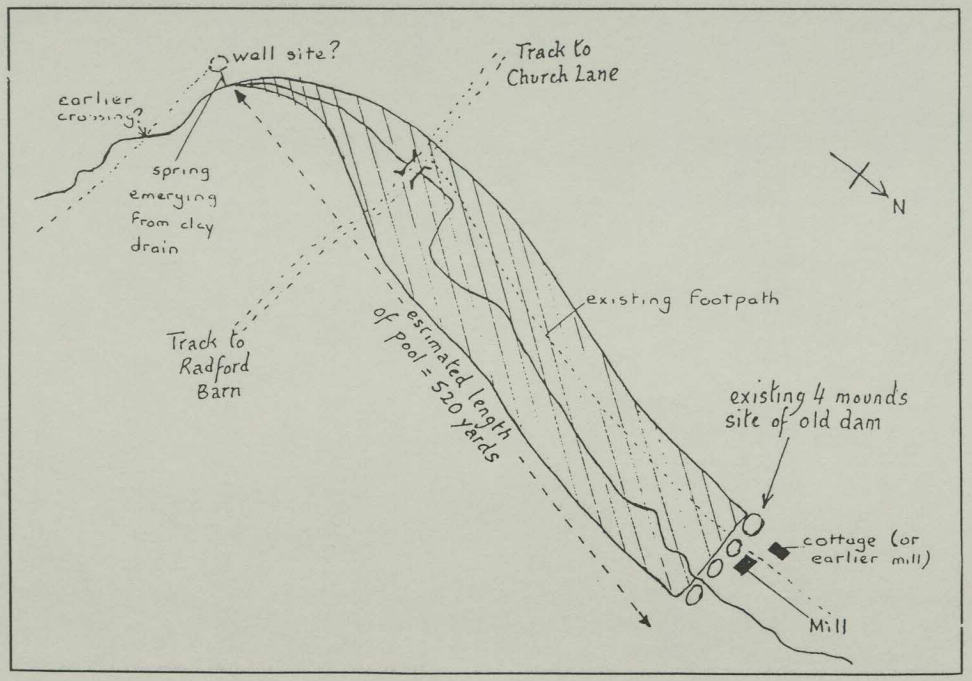
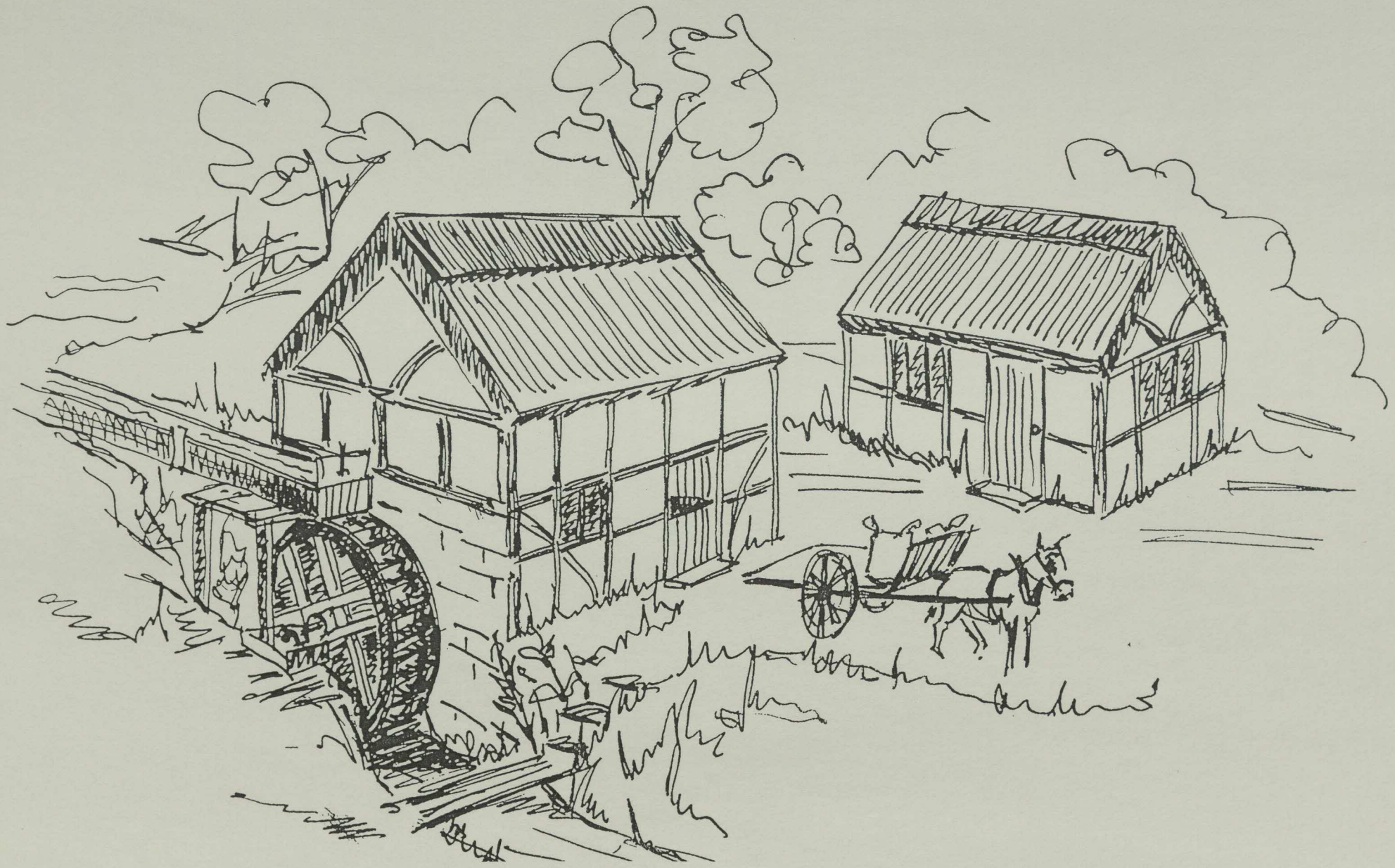


2. Diagram illustrating the operation of the hydraulic/ force pump. (Robinson D.H. 1988)

"Water from tank T, fed by a spring or brook, goes down the inclined supply pipe S. into the body B of the pump and escapes through waste valve W. As the velocity of the water increases, the impact suddenly lifts and closes the valve. There is an immediate rise in pressure in B, which causes the delivery valve D to open and force some of the water into the air chamber A as soon as the momentum is all expended there is a slight recoil or rebound of the water in the supply pipe S, which allows valve W to drop and reopen. The whole cycle of operations is repeated from 40 to 200 times a minute, each time driving a little more water into air chamber A, compressing the air in it : as there is only one outlet, the delivery pipe O, water is gradually forced along it until it emerges and drops into the storage tank or reservoir R.



3. Diagram of the great pool at Whitnash. Field and Booth. 1996



4. Artists impression showing a diagram of a site including dam and an overshot water mill. (Field and Booth 1996) Drawing by Rosemary Booth

APPENDIX 4

TABLES

1. Table to show the girth of trees that are positioned beside the leat.

Appendix 4, Table1 to give data regarding age of trees.

TREE	GIRTH in inches (and therefore indicating years)
1 -	132
2 -	130
3 -	106
4 -	147
5 -	97
6 -	123
7 -	85
8 -	141

APPENDIX 5

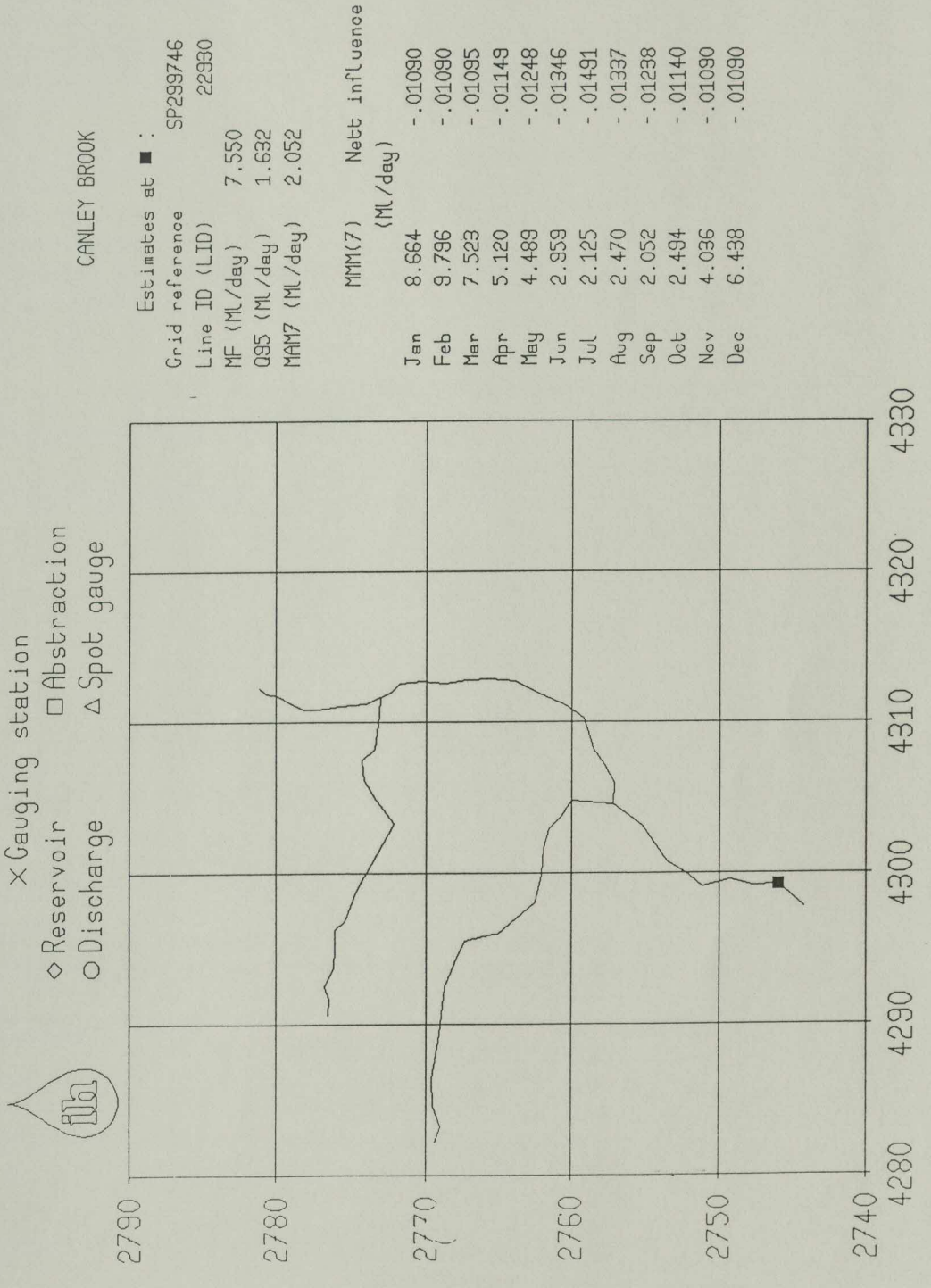
CHARTS

1. Flow / Abstraction statistics for Canley Brook provided by The Environmental Agency.

RIVER NAME	NGR	LOCATION	DATE	Q (cumecs)
CANLEY BK.	SP30057395	A429 CRACKLEY	28/02/85	0.094
CANLEY BK.	SP30057395	A429 CRACKLEY	29/10/85	0.053
CANLEY BK.	SP30007421	A429 CRACKLEY	17/03/86	0.081
CANLEY BK.	SP30007386	A429 CRACKLEY	17/03/86	0.078
CANLEY BK.	SP30007395	A429 CRACKLEY	02/05/86	0.122
CANLEY BK.	SP30007386	A429 CRACKLEY	16/06/86	0.073
CANLEY BK.	SP30007382	A429 CRACKLEY	28/01/87	0.162
CANLEY BK.	SP30007382	A429 CRACKLEY	24/02/87	0.184
CANLEY BK.	SP30007370	A46 RD.BDGE	24/05/73	0.335
CANLEY BK.	SP30007370	A46 RD.BDGE	12/07/73	0.063
CANLEY BK.	SP30007370	A46 RD.BDGE	24/07/73	0.107
CANLEY BK.	SP30007370	A46 RD.BDGE	09/08/73	0.126
CANLEY BK.	SP30007370	A46 RD.BDGE	22/08/73	0.067
CANLEY BK.	SP30007370	A46 RD.BDGE	21/09/73	0.067
CANLEY BK.	SP31187617	CANLEY CANNON HILL	17/03/86	0.052
CANLEY BK.	SP31187617	CANLEY CANNON HILL	02/05/86	0.046
CANLEY BK.	SP31247630	CANLEY CANNON HILL	28/01/87	0.07
CANLEY BK.	SP31187617	CANLEY CANNON HILL	24/02/87	0.046
CANLEY BK.	SP31207695	CANLEY FORD	17/03/86	0.035
CANLEY BK.	SP31207695	CANLEY FORD	02/05/86	0.048
CANLEY BK.	SP31207695	CANLEY FORD	01/10/86	0.023
CANLEY BK.	SP31207695	CANLEY FORD	28/01/87	0.066
CANLEY BK.	SP31207695	CANLEY FORD	24/02/87	0.047
CANLEY BK.	SP31107610	CANNON HILL RD.	01/03/89	0.06
CANLEY BK.	SP31167612	CANNON PARK RD.	01/10/86	0.25
CANLEY BK.	SP29957495	CRYFIELD GRANGE	29/10/85	0.034
CANLEY BK.	SP29957495	CRYFIELD GRANGE	28/02/86	0.069
CANLEY BK.	SP29957495	CRYFIELD GRANGE	17/03/86	0.078
CANLEY BK.	SP29957495	CRYFIELD GRANGE	02/05/86	0.076
CANLEY BK.	SP29957495	CRYFIELD GRANGE	16/06/86	0.05
CANLEY BK.	SP29957495	CRYFIELD GRANGE	28/01/87	0.098
CANLEY BK.	SP29957495	CRYFIELD GRANGE	24/02/87	0.081
CANLEY BK.	SP29927475	CRYFIELD GRANGE	01/10/87	0.047
CANLEY BK.	SP29927478	CRYFIELD GRANGE	04/07/95	0.0385
CANLEY BK.	SP29927478	CRYFIELD GRANGE	09/08/95	0.0254
CANLEY BK.	SP29927478	CRYFIELD GRANGE	20/09/95	0.0458
CANLEY BK.	SP29907478	CRYFIELD GRANGE	16/10/95	0.0376
CANLEY BK.	SP30107537	GIBBET HILL	17/03/86	0.053
CANLEY BK.	SP30107537	GIBBET HILL	02/05/86	0.094
CANLEY BK.	SP30107537	GIBBET HILL	16/06/86	0.055
CANLEY BK.	SP30107537	GIBBET HILL	01/10/86	0.036
CANLEY BK.	SP30147511	GIBBET HILL	28/01/87	0.094
CANLEY BK.	SP30107537	GIBBET HILL	24/02/87	0.065
CANLEY BK.	SP30007370	SITE 2	28/04/73	0.065
CANLEY BK.	SP30707310	U/S CONF	11/06/70	0.0672
CANLEY BK.	SP30507310	U/S CONF	01/10/70	0.041
CANLEY BK.	SP30507310	U/S CONF	06/11/70	0.061
CANLEY BK.	SP30507310	U/S CONF	09/11/70	0.066
CANLEY BK. (TRIB.RB)	SP29607640	KIRBY CORNER	17/03/86	0.005
CANLEY BK. (TRIB.RB)	SP29607640	KIRBY CORNER	02/05/86	0.008
CANLEY BK. (TRIB.RB)	SP29607640	KIRBY CORNER	16/06/86	0.004
CANLEY BK. (TRIB.RB)	SP30457585	TOCIL HOUSE	17/03/86	0.01
CANLEY BK. (TRIB.RB)	SP30457585	TOCIL HOUSE	02/05/86	0.018
CANLEY BK. (TRIB.RB)	SP30407560	TOCIL HOUSE	16/06/86	0.056
CANLEY BK. (TRIB.RB)	SP30587570	TOCIL HOUSE FM.	17/03/86	0.036
CANLEY BK. (TRIB.RB)	SP30587570	TOCIL HOUSE FM.	16/06/86	0.034

1. Flow / Abstraction statistics for Canley Brook provided by The Environmental Agency.

Part 1



1. Flow / Abstraction statistics for Canley Brook provided by The Environmental Agency.

Part 2

CANLEY BROOK

Estimates at grid reference	SP299746
Line ID (LID)	22930
Catchment area (sq km)	13.250
SAAR (1941-1970) (mm/yr)	682
Actual annual evaporation (mm/yr)	445
Mean daily flow (Ml/day)	8.587 e=3.109
Q95 (Ml/day)	2.753 e=1.196
MAM7 (Ml/day)	3.111 e=1.361
Q95 (%MF)	32.06 e= 2.47
MAM7 (%MF)	36.23 e= 3.22

Influenced estimates at	SP299746
Line ID (LID)	22930
Mean daily flow (Ml/day)	7.550
Q95 (Ml/day)	1.632
MAM7 (Ml/day)	2.052

	MMM(7) (Ml/day)	Nett influence
Jan	8.664	-.01090
Feb	9.796	-.01090
Mar	7.523	-.01095
Apr	5.120	-.01149
May	4.489	-.01248
Jun	2.959	-.01346
Jul	2.125	-.01491
Aug	2.470	-.01337
Sep	2.052	-.01238
Oct	2.494	-.01140
Nov	4.036	-.01090
Dec	6.438	-.01090

egative flows in

CANLEY BROOK

IH Spot gauge number: 540945
Grid reference SP300749

CANLEY BK.		CRYFIELD ORANGE	
870224	6.998	18433CRYFIEL	N
870224	5.616	18440GIBBET	N
870224	1.555	19676CRYFIEL	N
870128	8.467	18432CRYFIEL	N
870128	8.122	18439GIBBET	N
870128	2.678	19675CRYFIEL	N
861001	3.110	18438GIBBET	N
860616	4.320	18431CRYFIEL	N
860616	4.752	18437GIBBET	N
860616	4.838	56536TOCIL H	N
860616	1.037	19673CRYFIEL	N
860502	6.566	18430CRYFIEL	N
860502	8.122	18436GIBBET	N
860502	2.160	19672CRYFIEL	N

1. Flow / Abstraction statistics for Canley Brook provided by The Environmental Agency.

860228	1.296	19670CRYFIEL	N
851029	2.938	18427CRYFIEL	N
851029	.950	19669CRYFIEL	N

IH number 542662 Type S
NRA number: 18/54/11/0059
Licence holder:
CRYFIELD GRANGE LTD
Date of issue: 1900
Revocation date:
Number of sites: 1

TOTALS	Annual (Ml/day)	Daily
Licenced Abstraction:		
Actual Abstraction:		

IH abstraction number 542662 Site 1
Grid reference SP301754
Name: CRYFIELD GRANGE RD
GW unit Bore dist. 22.283
%S= T= %return 0.
MRF: Thresh.(Ml/day)
Max.Lic.annual daily

Purpose	Lic.annual (Ml/day)	Lic.daily	dates (mths)
SI	.098	.955	4 10

Monthly Values

	Actual Site	Licence so far (Ml/day)	Predicted Site
Jan		.0	.0
Feb		.0	.0
Mar		.0	.0
Apr		.0261	.0261
May		.0783	.0783
Jun		.131	.131
Jul		.215	.215
Aug		.131	.131
Sep		.0783	.0783
Oct		.0261	.0261
Nov		.0	.0
Dec		.0	.0

IH number 542669 Type S
NRA number: 18/54/11/0086
Licence holder:

1. Flow / Abstraction statistics for Canley Brook provided by The Environmental Agency.

TOTALS Annual Daily
(Ml/day)

Licenced Abstraction:
Actual Abstraction:

IH abstraction number 542669 Site 1
Grid reference SP300753
Name: PER W WHITFIELD
GW unit Bore dist. 35.453
%S= T= %return 0.
MRF: Thresh.(Ml/day)
Max.Lic.annual daily

Purpose	Lic.annual (Ml/day)	Lic.daily	dates (mths)
SI	.0467	.205	4 10

Monthly Values

	Actual Site	Licence so far (Ml/day)	Predicted Site
Jan		.0	.0
Feb		.0	.0
Mar		.0	.0
Apr		.0124	.0124
May		.0371	.0371
Jun		.0619	.0619
Jul		.102	.102
Aug		.0619	.0619
Sep		.0371	.0371
Oct		.0124	.0124
Nov		.0	.0
Dec		.0	.0

1. Flow / Abstraction statistics for Canley Brook provided by The Environmental Agency.

APPENDIX 6

Trees and shrubs include :-

- Oak *(Quercus robur).*
- Ash *(Fraxinus excelsior).*
- Alder *(Alnus glutinosa).*
- Hawthorn *(Crataegus monogyna).*
- Blackthorn *(Prunus spinosa).*
- Hazel *Corylus avellana.*
- Bramble *(Rubus fruticosus).*
- Dog rose *(Rosa canina)*

Ground cover species include :-

- Primrose, *Primula vulgaris,*
- Campion Red, *Silene dioica,*
- Docks, *Rumex,*
- Common nettle, *Urtica dioica,*

Fauna observed include :-

- Rabbit, *Oryctolagus cuniculus,*
- Fox, *Vulpes vulpes,*
- Weasel, *Mustela erminea,*
- Frog, *Rana tempoaria,*
- Fish including Stickleback, *Gasterosteidae aculeatus,*
- Evidence of Deer, *Cervidae,* and
- Badger, *Meles meles,* as supplied by digging, bark scraping and droppings.

Birds observed include :-

- Crow, *Corvus frugiegus,*
- Bullfinch, *Pyrrhula pyrrhuhula,*
- Chaffinch, *Fringilla coelebs,.*
- Greenfinch, *Carduelis chloris,*
- Great tit, *Parus major,*
- Blue tit, *Parus caeruleus,*
- Long tailed tit, *Aegithalos caudatus,*
- Greater Spotted woodpecker *Dendrocopus major,*
- Green woodpecker, *Picus viridis,*
- Kestrel, *Falco tinnunnculus,*
- Sparrow hawk, *Accipiter nisus,*
- Blackbird, *Turdus merula,*
- Starling, *Sturnus vulgaris,*
- Song thrush, *Turdus philomelos,*
- Mistle thrush *Turdus viscivorus,*
- Redwing, *Turdus iliacus,*
- Fieldfare, *Turdus Pilaris,*
- Wren, *Troglodytes troglodytes,*

- Pigeon Wood, *Columba palumbus*,
- Robin, *Crithacus rubecula*,
- Kingfisher, *Aledo atthis*,
- Grey heron, *Ardea cinerea*,
- Moorhen, *Gallinnus chloropus*,
- Siskin, *Carduelis spinus*,

Later season observation included butterflies:-

- Orange tip, *Anthocharis eardamines*,
- Brimstone, *Gonaptery rhamnir*,
- Tortoiseshell, *Aglais urticae*,
- Peacock, *Nyphalis io*,

APPENDIX 7

LEAFLETS

1 Isoproturon A stewardship programme to protect water quality. A practical guide for farmers spray operators and advisers.

2 Leaflets from The Game Conservancy Trust

(i) The management of field margins and conservation headlands.

(ii) Guidelines to the management of field margins.

3 Management of arable field margins. Leaflet from The Ministry of Agriculture Fisheries and Food.

4. Leaflets from Linking the Environment and Farming.

(i) Information leaflet.

(ii) The LEAF environmental audit.

(iii) The integrated arable crop alliance.

Key stewardship action reminder

ISOPROTURON (IPU)

Good housekeeping

PREPARE CONTINGENCY PLAN FOR ACCIDENTS.
CHECK STORAGE AND FILLING POINTS.
CLEAN UP SPILLAGES IMMEDIATELY.
CHECK OPERATOR TRAINING AND REFRESHER COURSES.
PLAN SYSTEM FOR CONTAINER DISPOSAL, CONTAMINATED MATERIAL FROM SPILLAGES, TANK WASHINGS AND PROTECTIVE CLOTHING.
CHECK THAT SPRAYER IS WELL MAINTAINED AND THAT HOSES ETC. DO NOT LEAK.

Dosage and application

PLAN PRODUCT PROGRAMME WELL IN ADVANCE.
DO NOT APPLY PRE-EMERGENCE TO BARLEY AND WHEAT.
DO NOT EXCEED THE MAXIMUM DOSE.
CHECK SOILS ARE MOIST BUT NOT WATERLOGGED.
WHAT ABOUT FORECAST AND HEAVY RAIN?

Manage clay soils

PLAN MOLE DRAINAGE PROGRAMME IN RELATION TO IPU USE.
TRY TO GET RID OF CRACKS IN SURFACE LAYERS.
CREATE AS FINE AND CONSOLIDATED A SEEDBED AS IS PRACTICAL.

Spray operation

TAKE SPECIAL CARE OF WHERE AND HOW YOU FILL UP SPRAYER.
DO NOT OVERFILL SPRAYER.
TAKE CARE TO AVOID SPILLS AND CLEAN UP IMMEDIATELY.
DO NOT ALLOW SPRAY TO GET INTO WATERCOURSES BY DRIFT OR CARELESS OVERSPRAY.
FOLLOW YOUR AGREED SYSTEM FOR DISPOSAL OF CONTAINERS, AND WASHINGS FROM SPRAYER UTENSILS AND PROTECTIVE CLOTHING.

PROTECT WATER AND PROTECT IPU FOR BLACK-GRASS CONTROL

A stewardship programme to protect water quality

A practical guide for farmers, spray operators and advisors
prepared by the IPU UK Task Force

1 Isoproturon A stewardship programme to protect water quality. A practical guide for farmers spray operators and advisers.

How does IPU get into water?

When IPU is sprayed onto cereal crops in autumn or spring, a proportion of the spray reaches soil where it is adsorbed onto soil particles. Most of the chemical remains in the top 2 cm of soil where it is eventually broken down by soil microbes. Only 1 – 3% leaches down through the soil. Despite only moderate leaching characteristics and persistence there are 3 possible routes by which IPU can contaminate water. These require understanding in order that best management practices are adopted to minimise their effect.

DIRECT CONTAMINATION (POINT SOURCE)
MOVEMENT THROUGH SOIL CRACKS
SURFACE RUN-OFF

Direct contamination

Direct or point source contamination of water occurs as a result of accidental spillage during mixing and transport, washing down sprayers and protective clothing, and misuse (e.g. careless disposal of unrinsed containers and tank washings). Overspray or spraydrift may also contribute to point source contamination.

There is mounting evidence that this source of contamination is more important than is often appreciated and care in preparation, application and cleaning is critical. Page 8 gives examples of how small amounts of product can contaminate water.

Movement through soil cracks

Clay soils are prone to cracking, especially during dry summers and after mole draining. These cracks, along with worm holes and those derived from decaying roots or straw, can provide a link for rainfall to field drains. Until normal wetting occurs which enables clay particles to swell and close cracks, rainfall may move rapidly and directly to field drains.

This is referred to as macropore flow or "by-pass flow". Such water by-passes the main body of the soil and is able to carry chemicals to the drains and into surface waters. IPU and other pesticides, particularly those with similar properties can be transported in this water. Destruction of these cracks (macropores) close to the soil surface by preparation of a fine seedbed, will remove the "by-pass route" for water, and help prevent IPU reaching streams and rivers.

Surface run-off

Run-off is not usually an important route of contamination under UK conditions, but farmers should take action in areas on their farm where, following heavy rain, they routinely observe water flowing across the soil surface of fields and into adjacent ditches and other surface water. IPU can be transported in this run-off water especially if the flow is sufficient to carry suspended soil particles.

How to avoid IPU getting into water

At all stages – planning, application, transport and clean-up, assess the best practice for your particular farm and crop. It is not reasonable to expect that every action can be achieved, but you should undertake as many as are practical. Attention to detail will help towards reducing local contamination of water which feeds into downstream areas where drinking water abstraction may occur.

This booklet has been specifically designed to be a reference document to the farmer, his advisor and spray operator. Following the decision path will refer you to the appropriate section.

WHAT ARE YOUR RESPONSIBILITIES?

ARE YOU INVOLVED IN CROP AND HERBICIDE TREATMENT PLANNING?

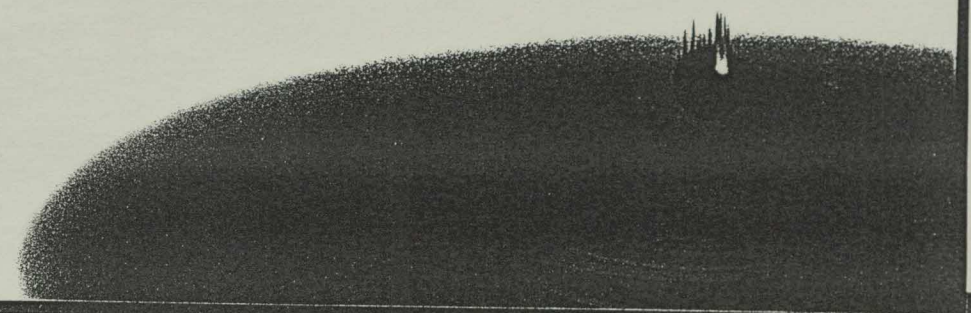
Refer to management planning 5

DO YOU MAKE THE DAY-TO-DAY DECISIONS TO APPLY IPU?
(OR OTHER CROP PROTECTION PRODUCTS)

Refer to application guidelines 6

ARE YOU RESPONSIBLE FOR SPRAYING AND FOR THE CLEANING OF CONTAINERS AND EQUIPMENT?

Refer to best practice for spray operators 7



Management planning: farmers, managers, advisors

Good housekeeping

Check store bunding and filling point hard standing.

Is it sited safely?
Is it well away from watercourses?
Will it contain any spillage and cleaning up fluids?
Is there a contingency plan in case of spillages and other emergencies?
Have absorbent material for spillages and plastic bags been strategically placed?

Set up a designated site for washing down sprayer and other equipment which is sited safely, well away from watercourses.

Ensure spray operator is trained and committed to the stewardship programme.

Make plans for disposal of container and tank residues, washing down spray equipment and protective clothing.

Check that clean-up equipment and materials are available.

Getting the dosage right

Plan the spray programme. Do NOT apply more than a total of 2,500 g a.i./ha of IPU to any crop and WHERE POSSIBLE take advantage of a reduced rate of 1,500 g a.i./ha through the use of formulated mixtures, tank mixes or a sequence of IPU with other herbicides.

REMEMBER: IPU IS NO LONGER APPROVED FOR PRE-CROP EMERGENCE OF WHEAT OR BARLEY OR AERIAL APPLICATION ON ANY CEREAL CROP.

Management of clay soils

When planning field drainage, remember that mole drains can aid transport of water containing IPU to field drains. Therefore, where possible AVOID mole-draining land prior to a cereal crop on which it is intended to apply IPU.

ALWAYS PLOUGH OR CULTIVATE AS DEEPLY AS PRACTICABLE prior to drilling to remove cracks in the soil.

ON CLAY SOILS CREATE FINE CONSOLIDATED SEEDBEDS to slow the downward movement of water, improve IPU adsorption, and maximise the efficiency of the IPU. On sandy soils this should be avoided since it could lead to capping and excessive run-off.

Preventing run-off from sloping fields

WHERE POSSIBLE, and only if safe to do so, drill across and NOT down the slope. This forms an additional barrier to help reduce run-off and prevent soil erosion.

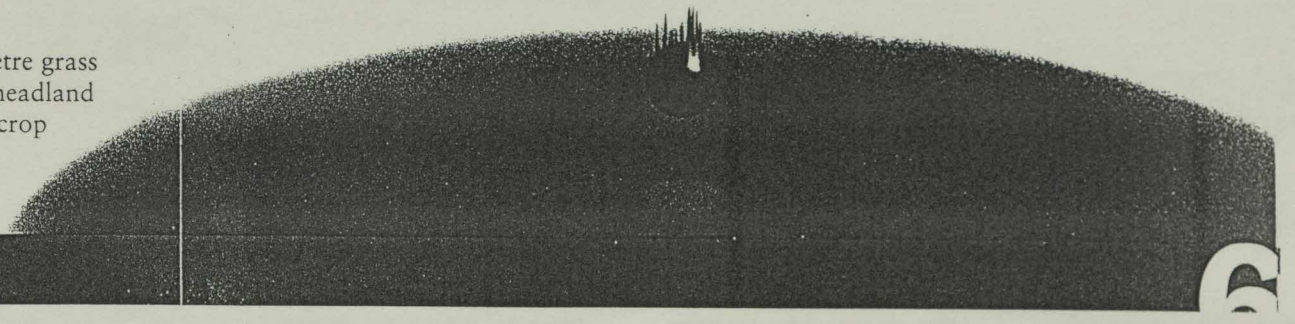
AVOID having tramlines or wheelings down the slope. Where this is unavoidable sow a wide crop headland at the bottom of the slope.

Consider planting a 2 – 6 metre grass buffer strip or conservation headland strategically placed between crop and watercourse. Set-aside should also be considered.

Application guidelines

When making the decision to apply IPU, use the following guidelines:

- **APPLY ONLY when wheat or barley crops have emerged.**
- **APPLY TO MOIST SOILS as they will have fewer and smaller cracks, and in addition the weed control performance of IPU is better under such soil conditions.**
- **DO NOT APPLY if forecast indicates heavy rainfall; wait until after the event when the soil has returned to a moist, rather than a very wet condition.**
- **DO NOT apply to very wet or waterlogged soils.**
- **TAKE PARTICULAR PRECAUTIONS in sloping fields that are already at field capacity, as heavy rainfall may cause rapid run-off or even soil erosion.**



Best practice guidelines for spray operators

- TAKE CARE NOT TO SPILL THE CONCENTRATE. If an accident occurs use sawdust or other absorbent material to clean up. DO NOT WASH DOWN into drains or streams. Any dry residues should be swept up before rainfall occurs. Bag up contaminated material and dispose of along with other pesticide waste via a licensed waste contractor.
- THOROUGH CLEANING OF PACKS e.g. triple rinsing is essential and add rinsate to the spray tank.
- CHECK CONTINUALLY FOR DRIFT into water and DO NOT overspray a watercourse.
- TAKE SPECIAL CARE WHEN FILLING FROM A STREAM OR DYKE as even small spillages, leaking equipment etc. can result in contamination. (See page 8.)
- FOLLOW AGREED PROGRAMME FOR DISPOSAL OF TANK RESIDUES. The best method is to apply to an area of unsprayed cereal crop away from the headland.
- WASH DOWN SPRAYER ONLY in the field or in the designated area and ensure washings do not enter drains, streams or find their way to a watercourse.
- WASHINGS FROM GLOVES OR OTHER PROTECTIVE CLOTHING ALONG WITH UTENSILS ETC. should not be allowed to run into drains but should be disposed of via the designated area for tank washings. It is preferable to use the disposable type overalls.
- STORE EMPTY CONTAINERS SAFELY AND UNDER COVER. Dispose of them as soon as possible in accordance with Code of Practice for the Safe Use of Pesticides on Farms and Holdings.

Importance of the IPU Stewardship Programme

Drinking water standards in the UK are based on those set by the European Union and cover various aspects of water quality such as lead, nitrate and bacteria. A very stringent standard has been set for pesticides of 0.1 parts per billion (ppb). Although not based on health risks, this is a standard that water companies are obliged to meet. Where water drawn from rivers and aquifers contains levels of pesticides above 0.1ppb, companies must take measures to reduce the concentration. Treatment using activated carbon and ozone is used but is very expensive and cannot be guaranteed to remove peak concentrations of pesticides.

The examples shown right illustrate how small amounts of IPU arising from routine activities can result in the pesticide standard being exceeded in raw water. They show the importance of good housekeeping and careful application. (It is also important to remember that the quantities of IPU are cumulative and the widespread use of IPU can mean small amounts being lost from a large number of farms.) The concentration of IPU at a water abstraction point will depend upon all the upstream activities and "losses" of IPU.

The 0.1ppb standard could be exceeded in the following stretches of water from your farm

Washing from gloves after a day's spraying
A ditch 100m long x 1m wide x 1m deep

Washing down from the outside of a sprayer after treating 20 hectares
A stream 250m long x 5m wide x 2m deep

Allowing a single nozzle with standard IPU mixture to spray for 1 second over a watercourse
A stream 250m long x 5m wide x 2m deep

Spray tank washings of 50 litres
A river 3km long x 10m wide x 5m deep

100ml concentrate spill all washed into the watercourse
A river 10km long x 10m wide x 5m deep

50 litres of spray residue of standard field dilution
A river 125km long x 10m wide x 5m deep

The message is clear. In order that products containing IPU can maintain their Approval and continue to be used by farmers, it is essential that water contamination be reduced. Good housekeeping and application, management of clay soils, getting the dosage right and preventing run-off are the key steps to ensure this happens.

The IPU UK Task Force comprises:

- AGREVO UK CROP PROTECTION LIMITED
- CIBA AGRICULTURE
- RHÔNE-POULENC AGRICULTURE LIMITED

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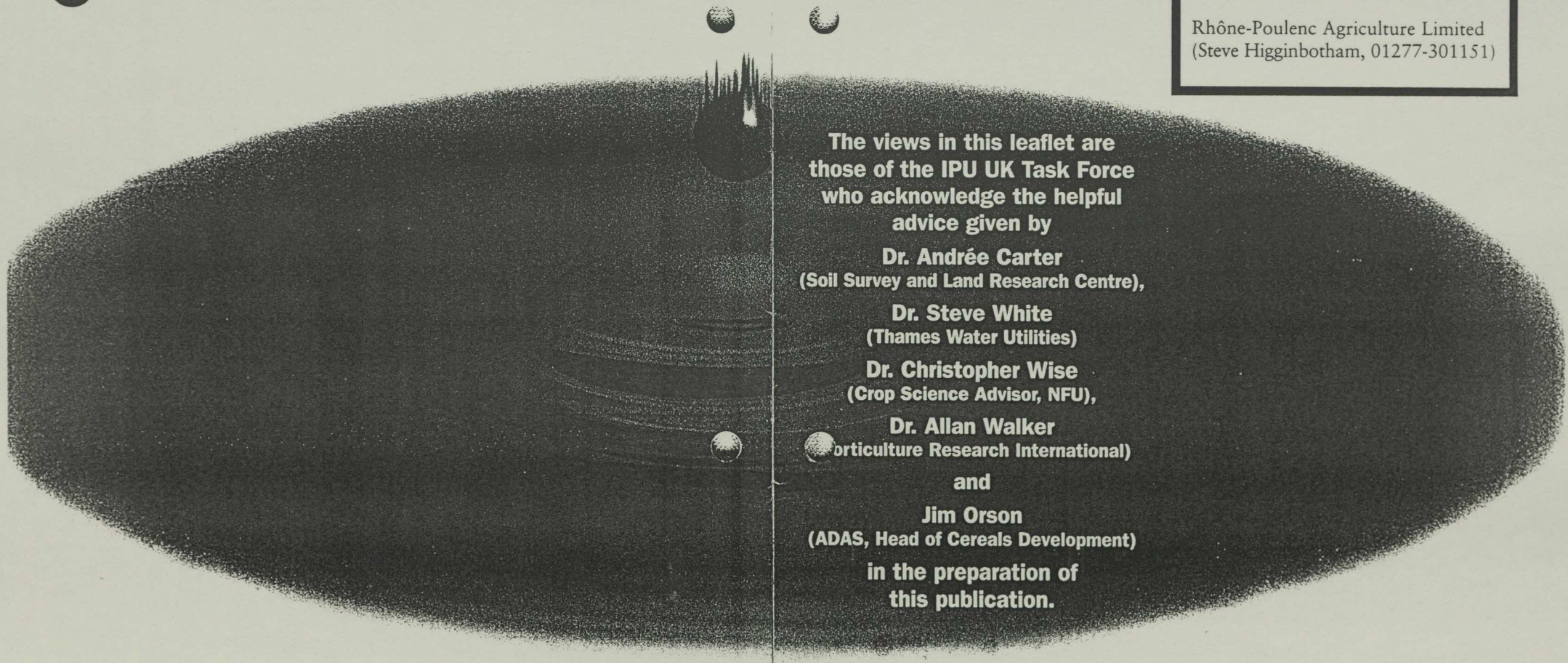
Rhône-Poulenc Agriculture Limited
(Steve Higginbotham, 01277-301151)



The views in this leaflet are those of the IPU UK Task Force who acknowledge the helpful advice given by

Dr. Andrée Carter
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Dr. Steve White
(Thames Water Utilities)

Dr. Christopher Wise
(Crop Science Advisor, NFU),

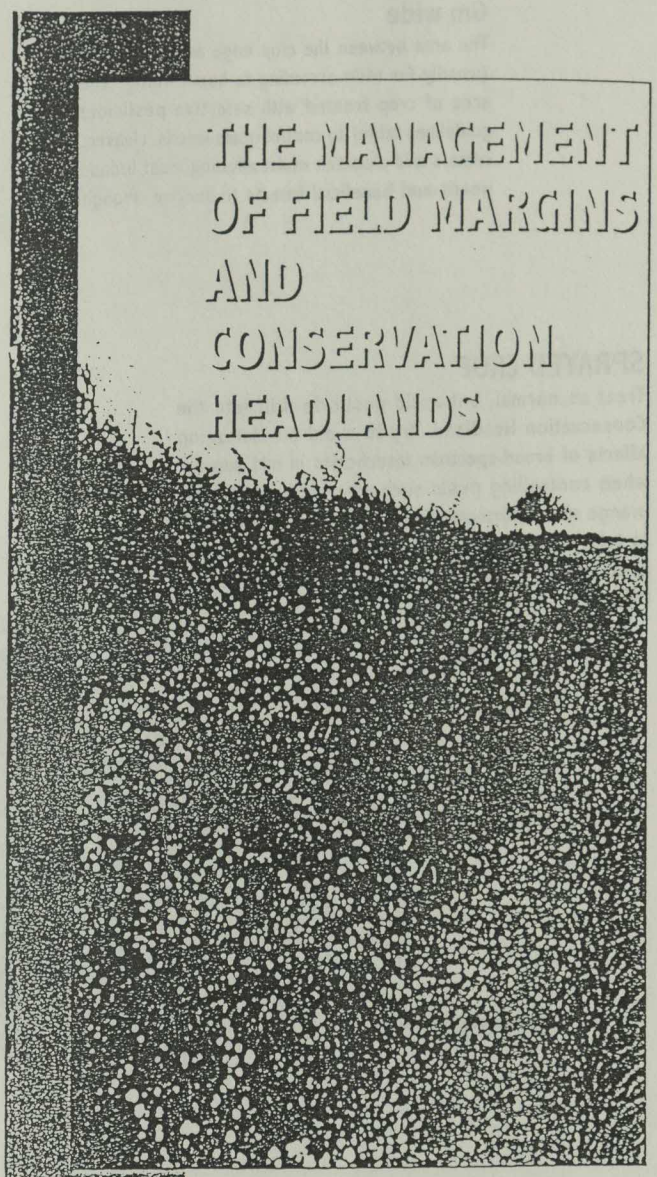
Dr. Allan Walker
(Horticulture Research International)

and

Jim Orson
(ADAS, Head of Cereals Development)

in the preparation of this publication.

READ THE LABEL BEFORE YOU BUY: USE PESTICIDES SAFELY



The Game Conservancy Trust
Burgate Manor, Fordingbridge,
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Registered Charity No. 279968

The Game Conservancy Trust

"Conservation through wise use"

2 Leaflets from The Game Conservancy Trust

(i) The management of field margins and conservation headlands.

CONSERVATION HEADLAND
6m wide

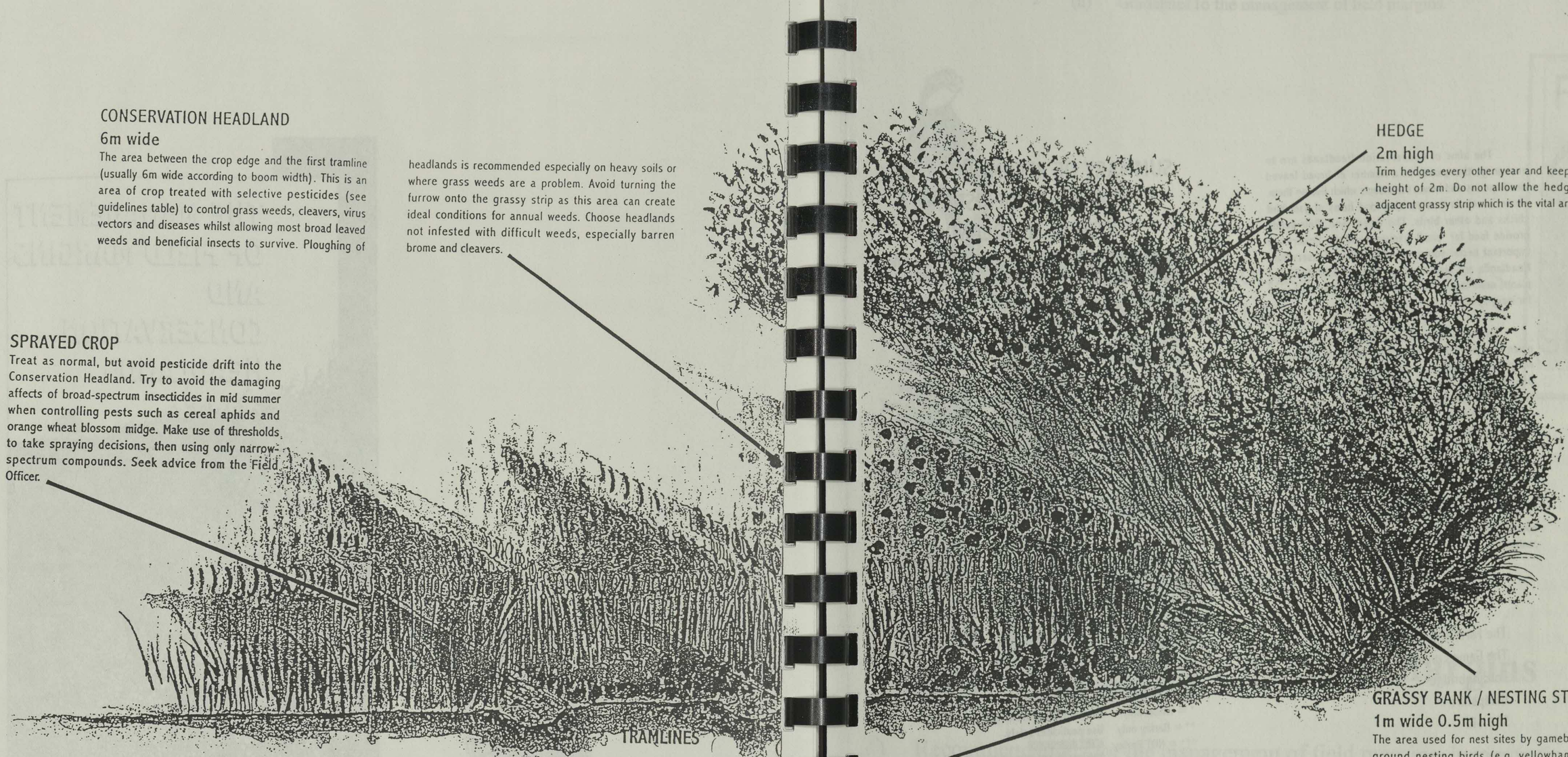
The area between the crop edge and the first tramline (usually 6m wide according to boom width). This is an area of crop treated with selective pesticides (see guidelines table) to control grass weeds, cleavers, virus vectors and diseases whilst allowing most broad leaved weeds and beneficial insects to survive. Ploughing of headlands is recommended especially on heavy soils or where grass weeds are a problem. Avoid turning the furrow onto the grassy strip as this area can create ideal conditions for annual weeds. Choose headlands not infested with difficult weeds, especially barren brome and cleavers.

SPRAYED CROP

Treat as normal, but avoid pesticide drift into the Conservation Headland. Try to avoid the damaging affects of broad-spectrum insecticides in mid summer when controlling pests such as cereal aphids and orange wheat blossom midge. Make use of thresholds to take spraying decisions, then using only narrow-spectrum compounds. Seek advice from the Field Officer.

HEDGE
2m high

Trim hedges every other year and keep to a maximum height of 2m. Do not allow the hedge to overgrow adjacent grassy strip which is the vital area for nesting.



BOUNDARY OR STERILE STRIP
1m wide

Its purpose is to prevent invasion of the crop by cleavers and barren brome spreading from the hedge bank where they have become abundant. It should be at least 1m wide and maintained by rotovation or herbicides (e.g. Kerb) between October and January. Do not create this strip out of the grassy bank. Instead drill crop further out into the field to leave an area of bare cultivated ground for the sterile strip. Avoid spray drift by shielding the nozzle down to ground level. This strip is not essential for conservation purposes, it is purely intended for weed management.

GRASSY BANK / NESTING STRIP
1m wide 0.5m high

The area used for nest sites by gamebirds and other ground nesting birds (e.g. yellowhammer) and for overwintering by beneficial insects and spiders. At least 1m wide and preferably sited on a bank. Ground cover should be composed of perennial grasses and other non-weedy herbaceous species. Avoid spray and fertiliser drift into this area. Allow the build up of dead grass material essential for successful nesting. but top the vegetation every 2-3 years to avoid scrub encroachment. Do not plough too close to the bank each spring.

Diagram not to scale

The aims of Conservation Headlands are to encourage the growth of a number of broad leaved weed species and hence the insects which live on them. These insects in turn are vital food items of gamebird chicks and other birds. The weeds and their seeds provide food for small mammals and the flowers are important nectar sources for butterflies. Conservation Headlands are also a refuge for rare and declining plants, once common members of the arable flora, and for many species of beneficial insects.

For maximum benefits, attention should also be given to adjacent field boundaries. Correct management will provide nesting sites for gamebirds and songbirds, breeding sites for butterflies and other insects, overwintering habitat for beneficial insects, and help to prevent these areas from becoming potential sources of weed infestation.

The information contained in this leaflet results from ten years of scientific research. It is supported by a free on-farm advisory service from The Game Conservancy Trust's Farmland Ecology Unit on boundary and headland management. For advice please contact:-

The Farmland Ecology Unit
The Game Conservancy Trust
Fordingbridge
Hampshire
SP6 1EF

Telephone: 01425 652381

SUMMARY OF RECOMMENDATIONS FOR PESTICIDE USE ON CEREAL HEADLANDS

	AUTUMN-SOWN CEREALS	SPRING-SOWN CEREALS
INSECTICIDES	Only until 15th March	NO
FUNGICIDES	YES	YES
HERBICIDES (Grass weeds only)	Avadex BW, Avadex BW granular, Avenge 2, Challenge, Cheetah R*, Cheetah Super*, Commando, Grasp, Hoegrass, Muster, Roundup, Tigress**, Topik**, Wildcat*.	Avadex BW, Avadex BW granul(Avenge 2, Challenge, Cheetah R*, Cheetah Super* Commando, Grasp, Hoegrass, Muster, Roundup, Tigress**, Topik**, Wildcat*.
HERBICIDES (Broad leaved weeds)	Eagle. Broadleaved weeds are a problem contact the Field Officer	Eagle
GROWTH REGULATORS	YES	YES

* = Wheat only
** = Barley only
*** = NOT Barley

Read the label before you buy.
Use pesticides safely.

ACTIVE INGREDIENTS

Avadex contains tri-allate, Avenge contains difezoquat, Challenge contains glufosinate-ammonium, Cheetah R contains fenoxaprop-ethyl, Cheetah Super contains fenoxaprop-p-ethyl, Commando contains flamprop-M-isopropyl, Eagle contains amidosulfuron, Grasp contains tralkoxydim, Hoegrass contains diclofop-methyl, Kerb contains propyzamide, Muster contains glyphosate, Roundup contains glysophate, Tigress contains diclofop-methyl and fenoxaprop-p-ethyl, Topik contains clodinafop-propargyl, Wildcat contains fenoxaprop-p-ethyl.

TRADEMARK ACKNOWLEDGMENTS

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Avadex, Muster and Roundup are trademarks of Monsanto plc
Avenge and Commando are trademarks of American Cyanamid Co
Grasp is a trademark of Zeneca Ltd
Kerb is a trademark of Rohm & Haas Co Philadelphia USA
Topik is a trademark of Ciba Giegy plc

2 (ii) Guidelines to the management of field margins.

The Game Conservancy Trust's Farmland Ecology Unit

Fact 2 sheet

Guidelines for the management of field margins

Recommendations for the management of field margins, incorporating the field boundary, boundary strip and the outer few metres of the cereal crop.

The Game Conservancy Trust
Fordingbridge, Hants, SP6 1EF

June 1995

'Conservation through wise use'

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INTRODUCTION

This document contains The Game Conservancy Trust's recommendations for the management of field margins, incorporating the field boundary (hedge, fence, wall etc and associated herbaceous vegetation), the boundary strip (cultivated area between field boundary and crop), where present, and the outer few metres of the cereal crop, known when selectively sprayed as the Conservation Headland.

MANAGEMENT OF CONSERVATION HEADLANDS

The aim of Conservation Headlands is to encourage the growth of broadleaved weed species and the insects which live on them. These insects are the food of gamebird chicks and other farmland birds such as skylarks and corn buntings. Weeds and their seeds also provide food for birds such as finches and buntings and the flowers are important nectar sources for butterflies, predatory and pollinating insects. Conservation Headlands are also a refuge for species of rare arable plants.

To achieve these aims, insecticides should not be used on the outer 6 m of crop after 15 March. Grass weeds may be selectively controlled using specified herbicides, but use of herbicides which control broadleaved weeds should be avoided wherever possible. Headlands which are known to have severe infestations should not be chosen as Conservation Headlands. Therefore, although some pesticides are not used on Conservation Headlands **THEY ARE NOT UNSPRAYED.**

SIZE AND SITING

If the sprayer cannot be conveniently switched off in 6 m sections, a slightly wider or narrower headland is acceptable e.g. 5 or 8 metres.The area of a 6 m wide headland as a proportion of the field will vary with the size of that field, as shown in the table below. These figures are for square fields. If the field is not square, the proportion contained in the headland will be greater, so that in a long narrow field the headland will occupy a large part of the field.

Field size (ha)	Field size (acres)	Proportion contained in 6 m headland (assuming field is square)	
20	50	5.4	i.e. all headlands need to be in the regime
16	40	6.0	
12	30	6.9	
10	25	7.6	
8	20	8.5	only 3/4 of the headlands need be selected
6	15	9.8	
4	10	12.0	only 1/2 of the headlands need be selected
2	5	17.0	

The aim of the Conservation Headland technique is to carry out the guidelines on about 6% of the cereal area. Therefore if the average field size is smaller than 16 ha (40 acres) it is not essential to apply the technique to all headlands. From the table, it can be seen that with square fields averaging 8 ha (20 acres) only three-quarters of the headlands need be considered; with fields averaging 4 ha (10 acres) the figure is only half of the total headlands. In practise, not all fields are square and extra allowance can be made for fields of a rectangular shape.

It can be seen that unless all fields are large there is some scope for choosing where Conservation Headlands can be sited. Concentrate on avoiding areas infested with difficult weeds, especially cleavers and barren brome. Where these are not problems, **Conservation Headlands are best sited next to good nesting habitats (see below)**.

CULTIVATIONS

Ploughing of headlands is recommended wherever possible, especially on heavy soils and where black-grass and barren brome are problems. Ploughing helps to keep grass weeds and cleavers under control, and encourage the more useful broadleaved weeds. However, care should be taken not to turn the furrow onto the grass strip at the edge of the field, as this creates ideal conditions for annual weeds such as barren brome and cleavers to establish and take a hold. Once this happens you have problems so do not spoil good quality grass strips in field boundaries - cherish them (see later).

INSECTICIDES

Autumn aphids - vectors of disease

Insecticides may be used on Conservation Headlands in autumn to control Barley Yellow Dwarf Virus (BYDV), but **great care should be taken to avoid drift into hedgerows or other field boundary structures, as this could affect overwintering populations of beneficial insects.** If it is at all windy the sprayer should be switched off for at least the outer 12 m when travelling the outer tramline on the downwind side of the field.

WARNING NOTE

Please also be careful with insecticide use on the remainder of your cereal fields. These areas are also important for brood survival. Returns from our most recent aphicide survey are showing an alarmingly high use of dimethoate at growth stages that would imply insurance treatment of crops. We have a growing body of evidence that this practice is detrimental to the survival of wild gamebirds. Always try and respond to known threshold numbers and aphids. Then where aphid control is necessary in the summer, always try to use compounds containing pirimicarb (Aphox, Phantom, Pirimicarb 50 DG), **but NOT on the Conservation Headland.**

Summer aphids

No insecticides should be used on Conservation Headlands after 15th March.

Pyrethroid insecticides given approval for summer use in cereal fields for example, *Decis* (deltamethrin) and *Fastac* (alphacypermethrin) have been tested, and have been found to be highly toxic to sawfly larvae, a very important group of chick food insects. Although pyrethroids appear to have a narrower-spectrum of activity against non-target beneficial insects compared to the organophosphate compounds such as dimethoate, both groups are considered too toxic if you wish to conserve chick-food insects. However, given only a choice between the two, the rule would be to use pyrethroids rather than organophosphates. Taking into account such experiments, we still recommend the use of pirimicarb for aphid control whenever possible **but NOT on the Conservation Headlands.**

Orange Wheat Blossom Midge

A major problem arises if orange wheat blossom midge needs to be controlled, as pirimicarb does not control this pest. The recommended compounds for midge control **should not be used on Conservation Headlands.** In a situation where you are considering spraying for midge follow this simple step by step procedure.

1. Listen carefully to local ADAS advice to decide whether a damage warning is in operation in your area.
2. If a warning is in operation spend time inspecting your crops at dusk or even after dark looking for female midges flying around wheat ears looking to lay eggs. In this way you can better assess threshold levels.
3. If you have threshold levels in crops at susceptible growth stages spraying will be necessary.
4. If spraying is necessary leave 12m-wide headlands unsprayed around all field edges.

Remember, spraying cereals with broad-spectrum insecticides at this time of year can be extremely damaging to beneficial insects and the species of farmland birds that depend on them, especially gamebird chicks. Also remember that populations of these insects also take many years to recover from such sprays.

FUNGICIDES

All fungicides may be used on Conservation Headlands.

HERBICIDES

Wild oats

The following herbicides may be used to control wild oats in autumn or spring:

Avadex BW (tri-allate)
Avadex BW granular (tri-allate)
Avenge 2 (difenzoquat)
Cheetah R (fenoxaprop-ethyl) (wheat only)
Cheetah Super (fenoxaprop-P-ethyl) (wheat only)
Grasp (tralkoxydim)
Hoegrass (diclofop-methyl)
Tigress (fenoxaprop-P-ethyl + diclofop methyl) (barley only)
Topik (clodinafop-propargyl) (not barley)
Commando (flamprop-m-isopropyl) (in spring only)

Certain precautions are necessary with some wild-oat herbicides to avoid crop damage. Please read the label carefully before use.

Black-grass

The recommended treatments for black-grass are:

Cheetah R (fenoxaprop-ethyl) (wheat only)
Cheetah Super (fenoxaprop-P-ethyl) (wheat only)
Tigress (fenoxaprop-P-ethyl + diclofop methyl) (barley only)
Topik (clodinafop-propargyl) (not barley)

Where *Avadex*, *Hoegrass* or *Grasp* are used for wild oat control, some control of black-grass will also be achieved, but these herbicides may not give complete control when used alone.

Where *Commando* (flamprop-m-isopropyl) is used to control wild-oats, it will also suppress black-grass and onion couch, but will not provide complete control.

Barren brome

Headlands with barren brome infestations should not be chosen as Conservation Headlands if at all possible. Effective control of this weed in cereals can only be achieved at present by ploughing followed by a herbicide sequence. Good control of brome can be achieved in broadleaved break crops, and full advantage should be taken of this opportunity. Careful use of such a programme should eliminate barren brome from the crop in 2-3 years, after which re-invasion should be prevented by ploughing headlands wherever possible and using a sterile strip between crop and field boundary (see section on sterile strips).

Selective Control of Barren Brome with 'Fusilade 250 EW'

Barren brome can be a serious problem in field margins and Conservation Headlands may be impractical where it has invaded the cropped area. Serious infestations of barren brome can now be selectively controlled within grassy strips next to hedges and fences by applying *Fusilade 250 EW* in

late autumn, thus reducing the risk of ingress into crops not already affected. Selectivity is achieved by applying the herbicide when the target plants are present as seedlings or young plants, and are actively growing , whilst non-target perennial grasses are present as large well-established plants, and are making little or no growth. (See section on Management of Field Boundaries).

Perennial weeds

For couch, onion couch and black-bent, see pre-harvest and stubble weed control.

Cleavers

Although broadleaved weeds should not generally be controlled, cleavers are a special case in view of the damage they can cause. **Wherever possible, headlands with known cleavers infestations should not be chosen as Conservation Headlands, since there is at present no truly selective chemical control for cleavers.**

Eagle (amidosulfuron) is effective against cleavers as early as February or March, which allows the valuable *Polygonum* species to germinate unharmed in April. Alternatively, a spray at the lower rate of 20g/ha towards the end of May will give good control of cleavers but still leave some chickweed, mayweed etc for chick-food insects. Earlier spraying will have a greater effect on broad-leaved weeds other than cleavers, so if the weed population is too dense the spray can be timed accordingly.

Where *Avadex BW* (tri-allate) is used for control of wild oats and grass weeds, it will also give partial control of cleavers.

Other broadleaved weeds

In general, **use of herbicides which affect broadleaved weeds is to be avoided, and if possible headlands which are known to suffer from high weed infestations should not be chosen as Conservation Headlands.** However, there is scope for using *Eagle* to reduce excessive infestation without eliminating them by careful timing. Ring Peter Thompson at The Game Conservancy Trust, Fordingbridge, for specific advice. **A thorough check of headlands should be made at the end of March and in early May to assess any problems that may be occurring.**

Pre-harvest and stubble weed control

Roundup, *Muster* etc. (glyphosate) may be used pre-harvest to control couch, black bent, onion couch, creeping thistle, docks, field bindweed, perennial sowthistle, volunteer potato etc. It may also be used at a lower rate to clean up the crop before harvest if desired. (NB the valuable *Polygonum* weeds are not susceptible to the lower rate). *Challenge* (glufosinate-ammonium) may also be used, however for common couch, docks, nettles and other deep-rooted perennials, two applications pre-harvest may be needed for complete control. The manufacturers instructions should be carefully followed when using these products.

Commando (flamprop-m-isopropyl) may also be used for control of onion couch. *Sting C.T., Roundup Biactive, Muster*, etc. (glyphosate), *Touchdown, Clarion* (glyphosate trimesium) and *Challenge* (glufosinate-ammonium) may also be used to clean up stubbles where needed.

PLEASE NOTE:

All recommendations for herbicide use refer to the manufacturers recommended rates unless otherwise stated.

Please also note that if crops are going for malting markets, the use of such products may make the headland sample ineligible.

"CONSERVATION HEADLANDS" ON SET-ASIDE

Conservation Headlands (or their equivalent) can be achieved on both Rotational and Flexible Set-aside land. Ground following a cereal crop that is put into Rotational Set-aside can be allowed to naturally regenerate, and providing there are reasonable numbers of volunteer cereals, it will make ideal brood rearing cover. The outside 6-12 metres can be left unsprayed, or a selective non-residual herbicide can be used to spray out any major weed problems. The main part of the field could be "killed off" with glyphosate, leaving green "Conservation Headlands" around the outside. Contact the Field Officer for further details. A full Factsheet on the best management of set-aside for Game and Wildlife is available free from The Game Conservancy Trust.

Conservation Headlands (or their equivalent) can also be created on Flexible Set-aside land, under the "Wild Bird Cover Option". However this can only be achieved successfully if the land set-aside is spread (ideally in 20 metre strips) throughout the arable acreage.

The Set-aside rules state that the cover planted must be a combination of two crop types, therefore the cereal must have another crop mixed with it, such as rape. Oats or triticale are good choices for the cereal. Wheat or barley can be used, but do less well under the low fertility conditions of set-aside. Brood-rearing cover can be sown in spring or in early autumn e.g. using forage rape as a companion crop.

PLEASE NOTE:

If set-aside land is NOT spread throughout the arable acreage, then Conservation Headlands within cereal crops should continue to be practiced

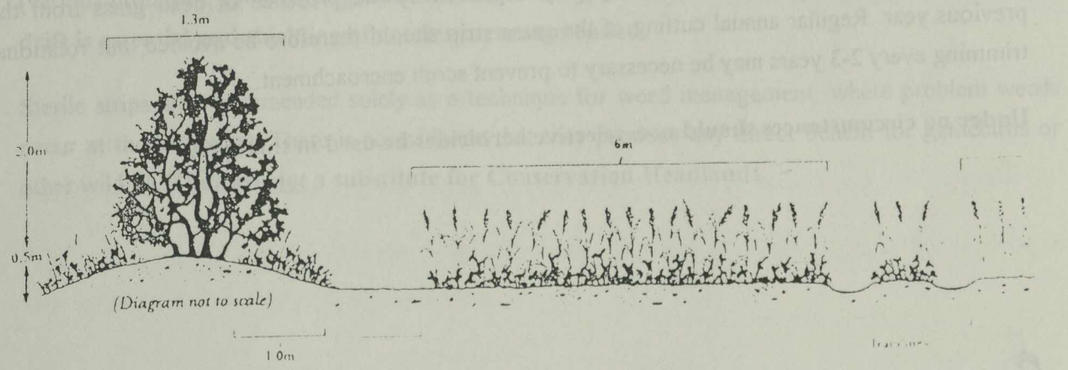
SUMMARY OF RECOMMENDATIONS FOR PESTICIDE USE ON CONSERVATION HEADLANDS

	Autumn-sown cereals	*Spring-sown cereals*
INSECTICIDES	Only until 15th March	NO
FUNGICIDES	YES	YES
HERBICIDES (grass weeds only)	Avadex BW, Avadex BW granular, Avenge 2, Cheetah R*, Cheetah Super*, Commando, Grasp, Hoegrass, Tigress**, Topik***	Avadex BW, Avadex BW granular, Avenge 2, CheetahR*,Cheetah Super*., Commando, Grasp,Hoegrass, Tigress**, Topik***
HERBICIDES (broad-leaved weeds)	Eagle	Eagle
	If broadleaved weeds are a problem, contact the Field Officer, Peter Thompson, at The Game Conservancy Trust	
HERBICIDES (pre-harvest/stubble clearing)	Challenge, Muster, Roundup Biactive, Sting C.T. and other glyphosate products and Touchdown	
GROWTH REGULATORS	YES	YES

* wheat only
** barley only
*** not barley

Read the label before you buy: Use pesticides safely

CREATION OF A CONSERVATION HEADLAND



(Diagram not to scale)

MANAGEMENT OF FIELD BOUNDARIES

Most of the animals which benefit from Conservation Headlands also make use of the more permanent habitat of the field boundary. Most partridges and many wild pheasants nest in grassy strips in field boundaries. Larvae of butterflies, moths and other insects feed on plants growing there, and many predatory beetles overwinter in field boundaries before dispersing into the field in the spring, where they become important aphid control agents. Hedgerows provide nesting sites for songbirds and, in winter, berries can be an important food source.

HEDGEROWS

Berries are formed on the previous year's wood, and so are encouraged by trimming every third year, or every other year if cutting can be postponed until the months of January/February. Cutting should not be carried out during spring and summer when birds are nesting and insects feeding.

Partridges avoid tall hedges and hedges with too many trees, therefore nesting hedges should be kept approximately two metres high. The hedge should not be allowed to grow over the adjacent grassy strip which is where nesting takes place. For this reason, trimming sides vertically is more appropriate to game management than trimming to an 'A' shape. If hedges are 'A' shaped, then it is still important to still have a grass strip at least a metre wide beside the hedge.

GRASS STRIP OR HEDGE-BANK

This is the area used as nest sites by gamebirds and overwintering areas by beneficial insects. It should be at least 1 metre wide and preferably sited on a bank. Grassy banks are used even where no hedge is present.

The vegetation should be composed of perennial, non-invasive grasses and herbs, preferably including tussock-forming species such as cock's -foot.

Nesting success of grey partridges is greatly improved by the presence of dead grass from the previous year. Regular annual cutting of the grass strip should therefore be avoided, but rotational trimming every 2-3 years may be necessary to prevent scrub encroachment.

Under no circumstances should non-selective herbicides be used in this area.

Non-selective herbicides not only the destroy the habitat, but ideal conditions are created for the establishment of annual weeds such as barren brome and cleavers, which are usually present as a minority component of the herbaceous flora in even the best managed hedgerows.

Herbicide disruption **(even drift from adjacent fields)** will make these weeds major components of the vegetation causing problems for adjacent crops and drastically reduce the value of the boundary. Unless the label specifically allows it, or there is off-label approval (see next section on *Fusilade 250 EW* and brome control) it is illegal to use herbicides in field boundaries.

Likewise avoid spray and fertiliser drift into field boundaries. Cleavers in particular are very responsive to fertiliser and thrive under high nutrient conditions.

On mixed farms, keep livestock away from hedge-bank vegetation.

Try to get into the habit of NOT taking the plough right up to the bottom of the hedge, fence or wall etc.

BOUNDARY STRIP OR STERILE STRIP

Where barren brome, cleavers or other weeds have become abundant in the field boundary, a strip of bare ground may be created either by rotavation or application of a broad-spectrum, residual herbicide to prevent encroachment into the crop. This strip should be created **in the cultivated ground**, not from any existing boundary area leaving at least 1 m of undisturbed herbaceous vegetation in the field boundary.

The crop should be drilled so that an area of bare ground is left between the crop edge and the edge of the cultivated land for creation of the sterile strip. This should be about 1 metre wide, as both barren brome and cleavers are able to bridge anything less.

Herbicides with a label recommendation for sterile strips include: *Kerb* (propyzamide), glyphosate (various products), *Challenge* (glufosinate-ammonium), and *Weedazol-TL* (amitrole). **Avoidance of drift is essential and shielding of nozzles is recommended.**

Sterile strips are recommended solely as a technique for weed management, where problem weeds occur at the field edge. There is no evidence that they produce any direct benefit for gamebirds or other wildlife. **They are not a substitute for Conservation Headlands.**

BARREN BROME CONTROL IN HEDGE-BANKS

Barren Brome can be a serious weed problem in field margins and, because it cannot be selectively controlled in cereals, Conservation Headlands may be impractical where it has invaded the cropped area. Serious infestations of barren brome can now be selectively controlled within grassy strips next to hedges and fences by applying *Fusilade 250 EW* in late autumn thus reducing the risk of ingress into crops not already affected. Selectivity is achieved by applying the herbicide when the target plants are present as seedlings or young plants, and are actively growing, whilst non-target perennial grasses are present as large well-established plants, and are making little or no growth.

Fusilade 250 EW should be applied between 31 October and 31 December, though for optimum performace, spraying during November is recommended. Only one application may be made in any year. Apply by conventional hydraulic sprayer fitted with medium nozzles at a pressure of 2 to 4 bar. The sprayer may be mounted on a tractor or an all-terrain vehicle. Use 1.0 litres per hectare in November, increasing to 1.5 litres per hectare in December, or in November, if brome is well tillered or soil fertility is high. The herbicide should be applied in 200 to 500 litres of water per hectare, and *Agral* should always be added at a concentration of 0.1% (1 litre per 1,000 litres of diluted spray).

Black-grass and wild oats, if present, will also be controlled. Perennial grasses e.g. cock's foot, false oat-grass and Yorkshire fog may show some yellowing of the foliage after spraying and will be temporarily suppressed but will regrow in the following spring. However, repeated treatment every year is likely to weaken these valuable grasses and is not recommended. Instead, try to encourage development of a continuous perennial sward which will, in turn, discourage establishment of brome seedlings. In particular, avoid creating patches of bare ground during cultivations (try to plough to the same line each year) and take care to prevent spray and fertiliser drift onto the grass strip.

This off-label approval was granted to The Game Conservancy Trust following our research programme set up to solve this problem. See also Factsheet 1 "The selective control of barren brome in field boundaries with *Fusilade 250 EW*.

OTHER MANAGEMENT OPPORTUNITIES

BEETLE BANKS

Beetle Banks help nature to control pests by creating new habitats for predatory insects within larger fields. They are strips of cover designed to reproduce the most useful elements of field margins to be used in areas where perhaps hedgerows or similar cover has previously been removed. They are designed to provide all or most of the benefits of a hedge without compromising machinery efficiency or farming practice. These banks can also become valuable nesting sites for partridges and other farmland birds. For further details including appropriate seed mixtures and suppliers please contact The Game Conservancy Trust at Fordingbridge.

FIELD BOUNDARY MANAGEMENT ON SET-ASIDE - AN OPPORTUNITY

Why not take the opportunity given by set-aside, especially Rotational set-aside to work round some of your worst field boundaries (seriously infested with cleavers or barren brome) to bring them back into proper management?

Within six years, nearly every arable field could come into the set-aside scheme. As each field does so you could either follow our recommendations for brome control using *Fusilade 250 EW* in November or December or actually destroy the vegetation and start again. The following procedure could be followed.

1. At any appropriate time, spray out your weedy hedge-bottoms with a contact herbicide taking care not to damage the hedge itself.
2. Using the appropriate grass seed mixture (of the correct perennial grasses) sow a drill's width next to the hedge. Tussocky grasses such as cock's-foot should be part of this mix. Advice on appropriate seed mixtures (correct species and proportions) and suppliers is available.
3. During the summer **of the first year only,** cut this grass strip at least once to promote grasses to tiller and help control invasive annual weeds.
4. When the field comes back to arable cropping, plough out the grass strip but leave the outermost one to two metre wide area immediately next to the hedge-bottom.

In this way you can quickly and easily create a non-problematic but valuable grassy field boundary.

Where some useful species still exist, it may be better to encourage these to spread by appropriate management, rather than kill them and re-drill.

Supportive literature on game and wildlife habitat management is available on request from.

THE GAME CONSERVANCY TRUST,
FORDINGBRIDGE,
HAMPSHIRE,
SP6 1EF,
Telephone: (01425) 652381
Fax: (01425) 655848

Leaflets are available on the following topics:

- The free field margin advice service
- Conservation Headlands
- Beetle Banks
- Management of set-aside
- Brome Control in hedgerows

and a range of topics regarding game management.

Other Factsheets

Other factsheets available include:

1. "The selective control of barren brome in hedgerows with *FUSILADE 250 EW*".

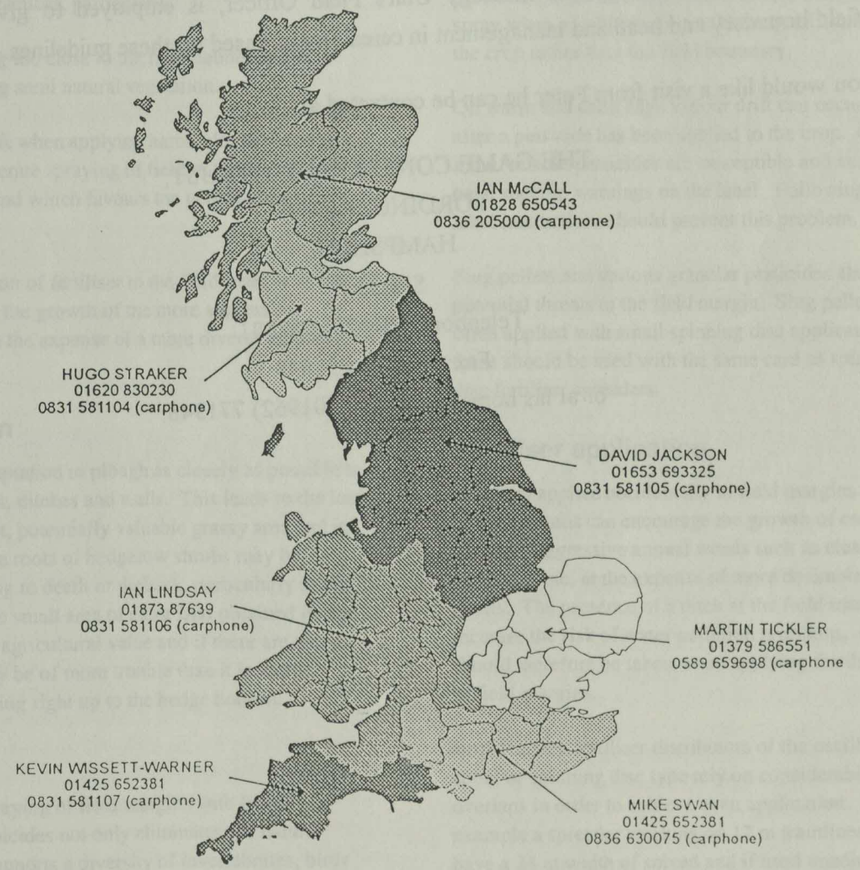
3. "Game Set-aside and Match - your guide to set-aside management for game".

COMPLETE GAME AND SHOOT MANAGEMENT ADVICE

Game Conservancy Ltd runs an advisory service, offering complete game and shoot management advice. For details of current rates, or to book a visit, please contact Liz Scott at:

GAME CONSERVANCY LTD,
FORDINGBRIDGE,
HAMPSHIRE,
SP6 1EF
Telephone: (01425) 652381
Fax: (01425) 655848

There is an advisor near you.



FREE FIELD MARGIN MANAGEMENT ADVICE

Peter Thompson, The Farmland Ecology Unit's Field Officer, is employed to give free advice on field boundary and headland management in cereal fields, based on these guidelines.

If you would like a visit from Peter he can be contacted at:

THE GAME CONSERVANCY TRUST,
FORDINGBRIDGE,
HAMPSHIRE,
SP6 1EF
Telephone: (01425) 652381
Fax: (01425) 655848
or at his home (evenings): (01962) 771348.

'Conservation through wise use'

3 Management of arable field margins. Leaflet from The Ministry of Agriculture Fisheries and Food.

MAFF

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FOOD, FARMING, LAND & LEISURE

Management of Arable Field Margins

Many field margins are badly infested with weeds such as barren brome and cleavers. These not only present problems for arable cropping but offer little value for wildlife. Careful modification of agricultural operations can help to reduce the problem and the adoption of options such as managed boundary strips and conservation headlands can have considerable benefit for wildlife.

Threats and How to Avoid Them

Field margin weed problems often arise as a result of agricultural practices, particularly:

- Ploughing too close to the field boundary and destroying semi natural vegetation.
- Spray drift when applying herbicides to the crop and deliberate spraying of field margins creating bare ground which favours the germination of weeds.
- Application of fertiliser to the field margin which promotes the growth of the more aggressive species at the expense of a more diverse natural flora.

Cultivation

There is a temptation to plough as closely as possible to hedge bottoms, ditches and walls. This leads to the loss of the adjacent, potentially valuable grassy area and in some cases the roots of hedgerow shrubs may be severed leading to death or dieback, particularly in dry summers. The small area of extra land obtained in this way is of low agricultural value and if there are weed problems, may be of more trouble than it is worth. Avoid ploughing right up to the hedge bottom.

Spraying

Deliberate spraying of field margins with broad spectrum herbicides not only eliminates the natural flora which supports a diversity of invertebrates, birds and small mammals, but creates bare ground which is quickly colonised by weeds worsening any weed problem. Accidental application of herbicides as a result of spray drift can have a similar effect. Avoid drift by not spraying on windy days. To give extra protection to particularly sensitive field margins try to spray when a light breeze would carry drift further into the crop rather than the field boundary.

On warm and calm days vapour drift can occur shortly after a pesticide has been applied to the crop. Only the more volatile pesticides are susceptible and usually have specific warnings on the label. Following the label instructions should prevent this problem.

Slug pellets and various granular pesticides also pose potential threats to the field margin. Slug pellets are often applied with small spinning disc applicators and these should be used with the same care as spinning disc fertiliser spreaders.

Fertiliser application

Fertiliser applied accidentally to field margins and hedge bottoms can encourage the growth of couch and the more aggressive annual weeds such as cleavers and barren brome, at the expense of more desirable or rare plants. The presence of a ditch at the field margin will increase the risk of water pollution problems. Care should therefore be taken when applying fertiliser near to field margins.

Broadcasting fertiliser distributors of the oscillating spout or spinning disc type rely on considerable overlaps in order to achieve even application. For example a spreader working on 12 m tramlines would have a 24 m width of spread and if used unadjusted on the headland would spread 6 m into the boundary. Approximately 15% of the fertiliser applied on the

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headland bout is therefore lost to the crop and if field sizes and application rates are known the total cost of wasted fertiliser can be calculated. The annual cost may be £200 for a farm of 100 ha. For larger farms the cost increases proportionally and avoiding this wastage not only provides considerable costs savings, but also benefits wildlife.

Overlaps can be prevented or reduced on most modern machines by:

- Buying a spreader with a tilting bed.
- Fitting a boundary disc.
- Fitting deflector plates.
- Fitting a headland spout on oscillating spout machines.

Pneumatic fertiliser distributors do not spread the fertiliser beyond the end of the booms and so do not apply fertiliser into the non cropping area as a general rule. However broadcasters account for approximately 90% of all fertiliser distributors in current use. Shutting off one disc on twin discs spreaders may protect the field margin but is likely to lead to uneven fertiliser application to the crop headland.

How Big is a Field Margin?

It is useful to know how much land area field margins take up. Obviously the smaller the field the greater the proportion which the margin represents and straight margins take up a smaller area than curved or convoluted ones. The table below shows the percentage of the field taken up assuming straight sided rectangular fields in which the length is 1.4 x the width.

	Field size (hectares)			
	2.5	5	10	20
Margin width				
2 metres	6.0%	4.3%	3.0%	2.1%
3 metres	9.1%	6.4%	4.5%	3.2%

This edge area will of course always be of lower productivity because of the effects of hedges, compaction and poaching.

Where boundary strips are being established relatively wide strips, 2-3 m, lead to greater land loss and require more seed but offer greater wildlife benefits and are suitable for mechanised management. Narrow strips 1-1.5 m are cheaper to establish but more vulnerable to damage and not wide enough to permit management with tractor mounted equipment when a growing crop is present.

Sterile Strips

Sterile strips are widely used to help prevent the ingress of weeds from the field margins. They also help the combine driver to steer clear of weedy field edges preventing contamination of the grain and headland with weed seeds. They are particularly useful in conjunction with conservation headlands because of the special problems of weed control.

A strip 1 m wide can be created and maintained by spraying or cultivation. One application a year of the residual herbicide propyzamide is adequate but where there are high proportions of more resistant weeds a follow-up treatment with glyphosate may be needed. Glyphosate may also be used alone but more than one application would be needed per season. Spray drift onto the field edge should be avoided and special sprayers are available to prevent this. Alternatively the strip can be cultivated two or three times a year during the growing season using a small rotary cultivator. This is more time consuming than herbicides but avoids spray drift or residue problems. Ensure that the edge of cultivation is in the same place each year to avoid damaging the perenniel strip and thereby encouraging weeds.

Perennial Boundary Strips

A boundary strip of perennial grasses and herbs will not invade the crop but will help in the management of problem weeds such as cleavers and barren brome. Before undertaking the establishment of a strip from new it will be worth taking a careful look at the extent of the weed problem and the damage to the natural vegetation. Where the field margins are only slightly damaged and weeds are present together with natural vegetation there is a good chance that with sympathetic management less aggressive grasses and herbs will slowly regain dominance by vegetative spread and the germination of seeds. This will take time and it may be five years or more before significant improvement takes place, however the cost of this approach is low. The only positive management required would be annual or two yearly mowing to prevent scrub developing. Regeneration will be hastened if cuttings can be removed although this may not be possible. Ensure that the edge of cultivation is in the same place each year to avoid damaging the perennial strip and thereby encouraging weeds.

Where the field margin is severely damaged and dominated by weed species with little or nothing remaining of the previous semi natural vegetation natural regeneration may take too long or would never happen. In these cases the best way to deal with the weed problem is firstly to eliminate the cause and then sow an appropriate grass/herb mix.

Choice of seed mixture

Choice of seed mixture may range from plain perennial ryegrass which will suppress weeds but have relatively little wildlife value through to a more elaborate mixture of native wild grasses and herbs. Factors to take into account when selecting a seed mix intending to have value for wildlife will include

- Contains species common in local semi natural grasslands.
- Does not contain species rare in the locality.
- Suited to the soil type, climate etc of the farm and the proposed programme of management.
- Includes long live perennials.
- Includes tussock forming grasses such as cocksfoot or Yorkshire fog to provide over wintering sites for predatory beetles and spiders.
- No highly competitive invasive or non- native species.
- Contains species which germinate readily.
- Provides at least some colourful and attractive flowers and is attractive to insects as a source of pollen and nectar.
- Cost.

Sowing the boundary strip

Just as with a crop, thorough seedbed preparation is important. If the field headland is being cultivated for a crop, then the same techniques and machinery can be used to prepare the seedbed for the boundary strip. After thorough mixing the seed can be shallowly drilled as soon as there is adequate moisture available, usually between late August and mid September. Early sowing at this time is likely to be more successful as later sowings run the risk of seedlings suffering frost damage and less vigorous species have more time to establish before rapid grass growth the following spring. Unless the seedbed is very wet, rolling lightly after sowing will help establishment.

Some field margins already have a reasonable grass flora but lack herbs. Over seeding with a herb only mixture would be an alternative to total re-seeding. Either slot seeding could be used or alternatively the sward can be mown very tightly and harrowed to expose some bare ground and break up dead material. The seed should then be broadcast onto the surface and lightly rolled in. Seed rates are generally low, around 2.5 kg/ha, and to get good results it would be necessary to mix the seed with an inert carrier such as fine sand or sawdust. Where wild flowers and grasses are to be sown together they should be mixed in the proportion (roughly) by weight of 85% grasses and 15% wild flowers.

Management

Annual weeds are often the greatest risk to a newly sown strip and will be especially competitive where soil nitrogen fertility is high. Most sown swards are, however, too complex to allow the successful use of selective herbicides so weed control by cutting will be necessary. Carefully timed mowings at the correct height will eliminate most annuals in the first season. Where possible, mowings should be removed but if this cannot be done a mower which deposits the clippings evenly across the sward is preferable to one which creates a central swath under which there may be extensive dieback.

If the margin is composed of grasses only then it will require periodic mowing every 2-3 years to suppress suckers or seedlings from the hedgerow shrubs. Where herbs have been included then one cut in the Autumn or Winter will help to keep the grasses from dominating the sward. When mowing is being carried out it is important not to destroy the tussocks and build-up of leaf litter used by over wintering insects. Equally it is important to avoid scalping the surface creating bare ground which weeds will be able to colonise.

The success of the boundary strip in suppressing weeds and providing a wildlife habitat will depend on

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continued careful application of fertiliser and pesticides to the crop, avoiding drift onto the boundary strip.

Beetle banks

In large fields where the centre is more than 200 m from the boundary, predatory insects may not be able to spread from their overwintering sites on the field margin into the centre of the crop in time to prevent the build up of pests. In these circumstances the creation of beetle banks may be beneficial.

A shallow ridge 1½ to 2 m wide is created by ploughing and this is sown with tussock forming grasses such as cocksfoot and Yorkshire fog. Management is by occasional topping, being careful not to destroy the grass tussocks in which insects overwinter.

Conservation Headlands

This approach has been developed by the Game Conservancy Trust, originally as a means of encouraging the breeding success of grey partridges on arable land by increasing the food supply to their chicks. By limiting the application of herbicides, insecticides and some fungicides which also have insecticidal properties on the outer most section of spray boom (usually 6 m) when spraying the field edge, the wild plants and insects which feed on them are encouraged. As well as benefiting partridges, conservation headlands are beneficial to other wildlife including less common arable weeds, ground dwelling invertebrates, butterflies and small mammals.

The following management prescriptions are adopted in an otherwise conventional crop on a headland adjacent to the field boundary.

- No insecticides to be used after 15th March (autumn BYDV sprays are acceptable).
- Weed control should be limited to grasses and the competitive broad-leaved species only and carried out using narrow spectrum herbicides.
- Use fungicides and plant growth regulators normally unless they contain active ingredients with insecticidal properties.
- Consider creating a boundary strip.

When selecting sites for conservation headlands avoid those with high populations of aggressive weeds, they would prove almost impossible to manage successfully. Conversely avoid fields which have traditionally had very low broad-leaved weed populations. Conservation headlands would not work well in these instances as the diverse flora on which other species depend would not develop properly.

Bear in mind that a small yield loss usually occurs compared with conventionally managed headlands, typically 5-10% and in wet summers grain from these areas may have a higher moisture content.

Conservation of rare weed species and communities

At sites where rare annual weed species or communities are known to occur an uncropped cultivated strip may be beneficial. Management will need to be specific to the requirements of the species targeted. Such fallow strips can also be created on sandy or chalk soils but site selection is important and specialist advice will be needed.

Further Advice

Further advice on management of field margins and other habitats on the farm is available from ADAS Conservation Consultants at your local ADAS office.

This leaflet was provided by:

Leaflet design by ADAS Ergonomics Team

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4. Leaflets from Linking the Environment and Farming.

(i) Information leaflet.

LEAF
LINKING ENVIRONMENT AND FARMING
Integrated Crop Management

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LEAF (Linking Environment And Farming) *DEVELOPS* and *PROMOTES* Integrated Crop Management (ICM) - common sense farm practices which are economically viable *and* environmentally responsible.

LEAF brings together a broad range of organisations, representing farmers, consumers and environmentalists to achieve a *BALANCED* and *REALISTIC* system of agriculture.

- LEAF ***ENCOURAGES*** farmers throughout the UK to take up ICM through practical guidelines on ICM and the LEAF Environmental Audit;
- LEAF ***PROMOTES*** ICM to a broad range of interest groups through the setting up of LEAF Demonstration Farms and arranges visits to these farms for those who want to know more about ICM. These groups include the media, politicians, opinion formers, concern groups and teachers. All these farms practise Integrated Crop Management and have been selected according to specific criteria.
- LEAF ***DEVELOPS*** technical information on ICM - **Practical Guide to Integrated Crop Management and the LEAF Environmental Audit.**

The LEAF Environmental Audit *is unique. It is designed as a farmer self-assessment checklist providing a practical way of recording current practices and identifying areas for improvement. It addresses eight main areas which include landscape features, wildlife and habitats, management of the soil, crop protection, conservation of energy, pollution control, organisation and planning and animal welfare.*

The LEAF Practical Guide to ICM *sets out 'preferred options' to meet the basic principals of ICM with reference to site, rotation, variety selection, cultivation techniques, soil erosion, implications to the environment, crop establishment, crop nutrition and crop protection.*

For many farmers, Integrated Crop Management is an extension of their current farming practices and beliefs. It is clear from the positive and encouraging support LEAF has received from farmers, research establishments and the agricultural industry, that ***LEAF could not have arrived at a better time.***

Integrated Crop Management offers a farming system which is ***environmentally responsible***, ***economically viable*** for the farmer and will raise ***confidence*** and ***understanding*** in the general public about food production. Farming is continuing to change and the logical progression is through Integrated Crop Management.

LEAF is one of a number of ICM projects operating throughout Europe. There are similar projects in Germany, France, Spain, Sweden and Luxembourg.

For further information on LEAF contact: Caroline Drummond, LEAF Project Co-ordinator, LEAF (Linking Environment And Farming), National Agricultural Centre, Stoneleigh, Warwickshire, CV8 2LZ.
Tel: 0203 696969 Fax: 0203 696900.

LEAF.....Linking Environment And Farming

LINKING ENVIRONMENT AND FARMING
Integrated Crop Management

'THE LEAF PRACTICAL GUIDE TO INTEGRATED CROP MANAGEMENT'

The **'LEAF Practical Guide to Integrated Crop Management'**, is an introduction to Integrated Crop Management (ICM) designed to assist farmers in meeting general ICM principles.

The Guide follows on from the **Guidelines for LEAF Farms** and the innovative **LEAF Environmental Audit**. Used together, these documents provide a comprehensive package for farmers to address the environmental and economic challenges of the current day.

Developed by the broad range of organisations on the LEAF Advisory Board and Executive Committee, the document is a user friendly, straightforward set of notes designed to be of practical help, not only to farmers but to anyone interested in integrated farming.

Building on best practices and the MAFF Codes of Good Agricultural Practice for the Protection of Soil, Water, and Air, the guide is generally applicable to all crops and addresses the following areas:

- *SITE*
- *CROP ROTATION*
- *VARIETY SELECTION*
- *CULTIVATION TECHNIQUES*
- *SOIL EROSION*
- *ADDITIONAL IMPLICATIONS FOR LANDSCAPE AND NATURE CONSERVATION*
- *CROP ESTABLISHMENT*
- *CROP NUTRITION - inorganic fertilisers*
- *CROP NUTRITION - organic manures*
- *CROP PROTECTION*

It lists general points and provides alternative approaches under the following options:

CHOOSE: Measures which meet the basic principles of ICM.
AVOID: Measures which do not conform to the basic principles of ICM and should not be adopted where there is a satisfactory alternative.

ICM is not a prescriptive policy. It is concerned with the development of a whole farm management strategy which recognises the site specific nature of farming systems. The Practical Guide to ICM will help farmers in achieving these goals.

ICM is a cropping strategy in which the farmer seeks to conserve and enhance the environment, while economically producing safe, wholesome food. Its long term aim is to optimise the needs of consumers, society, the environment and the farmer.

The Practical Guide to ICM is available from the LEAF office for £2.50 or FREE to members of the LEAF Association.

For further details please contact: Caroline Drummond, Project Co-ordinator, LEAF, NAC, Stoneleigh, Warwickshire CV8 2LZ, Tel: 01203 696969 Fax: 01203 696900.

The LEAF Practical Guide to Integrated Crop Management

LINKING ENVIRONMENT AND FARMING
Integrated Crop Management

The LEAF Environmental Audit

The ***LEAF Environmental Audit*** is a useful ***management tool*** to address the concerns of the consumer through good agronomic and environmental practices. It offers a unique way for farmers to assess their farming operations against the principles of ***Integrated Crop Management (ICM)*** - a whole farm policy which draws together the best of traditional methods with appropriate modern technology.

Used, together with the ***LEAF Practical Guide to Integrated Crop Management***, the documents present a complete package for farmers to work towards integrated farming practices.

The audit is a ***practical, non-prescriptive*** way for farmers to look objectively at their business, assess strengths and weaknesses and identify cost saving operations.

It shows how the integration of the environment with food production can be ***profitable*** as well as desirable.

What is an Environmental Audit?

'A management tool comprising a systematic, documented, periodic and objective evaluation of performance'

Why carry out an Environmental Audit?

- better environmental protection
- improved economic performance
- positive legislative verification
- acceptable public image
- enhanced environmental performance
- more accurate management
- reduced insurance costs
- greater market opportunities

The LEAF Approach

- *A whole farm policy statement*
  to set out the farms' aims and objectives
- *Self assessment sheets*
  to evaluate attention to detail on the whole farm
- *Setting targets*
  to continually maintain and enhance the farms' economic viability and environmental performance

The LEAF Environmental Audit addresses eight principal areas which include:

- landscape features
- wildlife and habitats
- soil management
- crop protection
- conservation of energy
- pollution control
- organisation and planning
- animal welfare

The LEAF Environmental Audit is available from LEAF for £20 (includes membership to LEAF for one year). If you would like further information on the audit, please contact Caroline Drummond, LEAF, The National Agricultural Centre, Stoneleigh, Warwickshire CV8 2LZ Tel: 0203 696969 Fax: 0203 696900

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LEAF.....Linking Environment And Farming

Integrated Arable Crop Production Alliance (IACPA)

Providing the information links for best farming practice

LIFE

I F S
Integrated Farming Systems

FOCUS ON FARMING PRACTICE

LEAF
LINKING ENVIRONMENT AND FARMING
Integrated Crop Management

FWAG

SCOTTISH NATURAL HERITAGE
TIBRE

RHÔNE-POULENC

THE ROLE OF IACPA

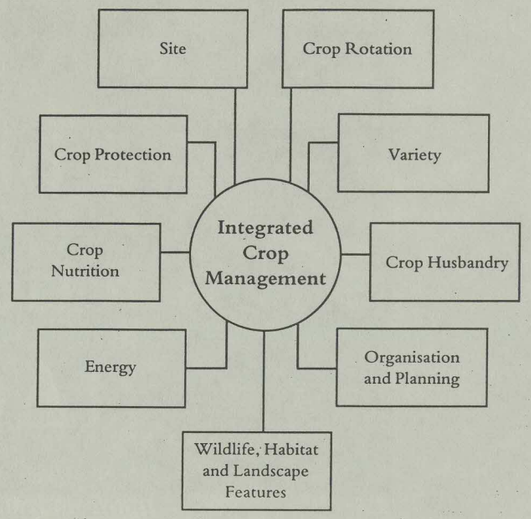
The Integrated Arable Crop Production Alliance brings together seven leading UK organisations involved in integrated crop management. The members are:

- **LIFE** - Less Intensive Farming and the Environment
- **LINK : IFS** - Integrated Farming Systems
- **FOFP** - Focus on Farming Practice
- **LEAF** - Linking Environment and Farming
- **FWAG** - Farming and Wildlife Advisory Group
- **TIBRE** - Targeted Inputs for a Better Rural Environment
- **RPMS** - Rhône-Poulenc Management Study

Each of the member organisations is actively involved in novel research monitoring or promotional and advisory work which contributes to our understanding of the integrated approach to crop management. By co-ordinating projects, exchanging literature and sharing research findings on a regular basis, IACPA avoids unnecessary duplication of work and ensures faster and effective dissemination of all the important results to enable farmers to adopt best practices to suit their business.

WHAT IS INTEGRATED CROP MANAGEMENT?

ICM is a whole farm policy aiming to provide the basis for efficient and profitable production which is economically viable and environmentally responsible. It integrates beneficial natural processes into modern farming practices utilising advanced technology and aims to minimise the environmental risks while conserving, enhancing and recreating that which is of environmental importance. This can be achieved by combining crop rotationswith the targeted use of crop protection chemicals and fertilisers, cultivation choice, variety selection and improved energy efficiency, together with a positive management plan for landscape and wildlife features.
ICM does not lay down prescriptions. It does, however, involve a set of principles and procedures which have to be applied, taking account of the specific circumstances of the farm and its surroundings.



THE ALLIANCE MEMBERS:

The organisations are all involved with projects aimed at supporting profitable and sustainable farming, with emphasis on both output of quality food and environmental benefits. The individual projects each contribute to the overall aim of providing the farmer with the information required to achieve ICM best practice. There are 3 broad categories where the strengths of the individual alliance members' projects are focused:

- **Research**
- **Commercial Farm Technology**
- **Demonstration / On-Farm Advice and Auditing**

RESEARCH

LIFE

Established in 1989, LIFE involves strategic and applied research to provide fundamental information underpinning the development of less-intensive arable production systems by exploiting the effects and interactions of crop husbandry practices, thus minimising waste. The aim is to develop a scientifically-based formulation of options to achieve reductions in inputs of fertiliser, agrochemicals and energy, whilst providing sufficient yield to maintain income and adequate crop protection consistent with human health and environmental safety. Dissemination of this knowledge (technology transfer) is addressed through practical demonstration of the technical and economic viability on commercial "Pilot Farms", and in study fields within farmer groups.

LIFE has active research collaboration with LINK:IFS, FOFP and Rhône-Poulenc Management Study, who collectively communicate research information to LEAF and FWAG for dissemination.

LINK : IFS

Established in 1992, the LINK:IFS initiative was set up to investigate whether integrated arable crop production is practical, economically viable and will deliver the environmental benefits that are needed. The project is seen as a development of integrated farming into different geographical and climatic locations in the UK, and covering a wide range of soil types. It concentrates on optimising inputs whilst maintaining profitability. Integrated arable crop production is compared, over a five course rotation, with conventional production methods. Initial results are encouraging and the successful components will be built into future practice as the integrated system continues to evolve.

LINK : IFS is jointly funded by MAFF, SOAEFD, HGCA, Zeneca and the BAA.

COMMERCIAL FARM TECHNOLOGY

FOFP

Focus on Farming Practice is a uniquely practical experiment in integrated farming. It recognises that for any new farming system to be widely accepted profitability is vital. Research is conducted on a field scale with fully-costed comparisons made between conventional, integrated and organic methods over an area of 430 acres. To address the needs of mixed farms, grass is included in the rotation. Besides evaluating the economic performance and practicalities of operating each farming system, an extensive environmental monitoring programme is underway. This is being carried out to identify the effects each approach has upon the soil, water, wildlife and the countryside.

The project is jointly funded by CWS Agriculture, Hydro Agri (UK) and Profarma.

RP MANAGEMENT STUDY

In 1988 Rhône-Poulenc, a research-based manufacturer of crop protection products, began a project to measure yield, food quality, effects on wild life, plants and the economics of organic and conventional arable farming systems. The commercial unit situated adjacent to their research station is typical of cereal farms in Essex. To gain the maximum value from the study, links were established with several independent organisations who could bring their expertise to the project.

In autumn 1994 an area with similar soil type was taken on a neighbouring farm to commence similar work involved with integrated crop management techniques.

Conservation work has been carried out for many years with advice from FWAG and auditing is underway using the LEAF process. An Annual Report is produced and now has a wide circulation.

TIBRE

TIBRE is an initiative led by Scottish Natural Heritage which is concerned with the sustainability of the more intensive kinds of arable and livestock farming. In arable systems TIBRE aims to harness new technology for the more efficient and less harmful use of pesticides, herbicides and fertilisers. Technology in agriculture and industry is often associated with environmental risks, but given the encouragement of farmers, industry and policy makers it must begin to solve environmental problems.

TIBRE is applicable to many types of farming. It does not pre-suppose an environmental commitment by the farmer and does not involve membership of a scheme. It can help to save costs. New technology and new products can add significantly to the methods of integrated crop management, increasing both its commercial viability and environmental benefits.

TIBRE has a vital part to play in creating conditions in the countryside where wildlife can co-exist with farming.

DEMONSTRATION / ON-FARM ADVICE AND AUDITING

LEAF

Funded by over 60 industry bodies and companies together with farmer members, LEAF promotes ICM, farm practices which combine care and concern for the environment with the responsible and economic use of the best of traditional and modern methods. LEAF looks to the Alliance members for information which will continually update its farmer members and its demonstration farms set up throughout the UK, run by volunteer farmers practising ICM. One of six similar initiatives in Europe, LEAF's philosophy is based in ICM to which the whole industry is becoming increasingly committed. To facilitate the uptake of ICM, LEAF has produced guidelines and The LEAF Environmental Audit, a self assessment approach to direct farmers towards ICM. This audit has been widely welcomed throughout the agricultural and food industries and is increasingly being used by farmers.

FWAG

FWAG promotes wildlife and landscape conservation within the context of a profitable farm business. Through its Environmentally Responsible Farming approach it works directly with farmers and land managers to encourage farming practices which minimise their impact on the environment. A UK-wide network of local FWAG groups, backed up by an advisory team, provides an effective means of taking sometimes complex messages to farmers in language they can understand. FWAG farm conservation advisers promote integrated farming through the whole-farm approach to conservation, which it pioneered and is the framework for its 'Landwise service' for farmers. FWAG visits over 5,000 farmers annually and communicates with thousands more through its telephone advice service and membership. It works with the Alliance to facilitate information transfer.

For further details contact the individual member organisations direct or the Alliance Co-ordinator, Dr. Clive Wall, on (tel) 0171 238 5562, (fax) 0172 963 8705
or e-mail: c.wall @ scd.maff.gov.uk

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