

**E5516/1995/JULY**

**ENVIRONMENTAL REPORT TO ACCOMPANY  
PROPOSALS FOR THE RESTORATION OF THE  
RIVER COLE AT COLESHILL  
FINAL REPORT**

**WS Atkins Environment  
Woodcote Grove  
Ashley Road  
Epsom  
Surrey  
KT18 5BW**

**Tel: (01372) 726140  
Fax: (01372) 740055  
Tlx: 266701 (Atkins G)**

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## **SUMMARY**

### **S1 Introduction**

- S1.1 This report has been prepared to document the potential environmental impacts of proposals to restore a 2 km stretch of the River Cole at Coleshill, north east of Swindon.
- S1.2 A full environmental assessment is not legally required for the scheme, however this document has been produced as good practice.

### **S2 Project Description**

- S2.1 Three demonstration river restoration sites have been set up by the River Restoration Project in the UK and Denmark.
- S2.2 The site is located on the National Trust Buscott and Coleshill Estate on the Oxfordshire/Wiltshire border and consists of a 2 km reach of river with approximately 50 ha of floodplain.
- S2.3 The aim of the project is to restore, within the constraints of land use and flood defence, a selected reach of the river to its natural state in order to demonstrate the benefits of river restoration for integrated catchment management.

### **S3 Existing Environment**

- S3.1 Key features of the existing environment include:
- a grade II listed Mill on the River Cole;
  - the site lies within the area designated for the Great Western Community Forest;
  - land use is predominantly agriculture, with the landowner (the National Trust) leasing land to tenant farmers;

- the geology of the catchment is predominantly chalk with the river flowing over Oxford Clay at its downstream end;
- a former wetland meadow SSSI, de-notified as a result of habitat alterations resulting from an extensive flood defence scheme in the 1970's;
- the high landscape value of the valley and surrounding areas is reflected in the designation of the area as the North Vale Area of High Landscape Value and an Area of Local Landscape Importance;
- a long history of management, involving realignment and deepening has significantly altered the geomorphology of the watercourse, resulting in what is today a predominantly depositional environment;
- the Cole is designated as an EC Coarse Fishery, however populations and species diversity in the study reach are poor.

#### **S4 The Proposed Works**

S4.1 A number of options for river restoration were examined and a core scheme selected on the basis of cost and environmental benefit.

S4.2 Key elements of the scheme include:

- the re-creation of the former river channel along its original course to the west of the Mill Stream, upstream of Coleshill Bridge;
- the re-meandering of two lengths of the watercourse downstream of Coleshill Bridge;
- the creation of rifle areas; and
- the refurbishment of a number of structures including sluice gates and syphons.

## Potential Impacts

### Construction

S4.3 The main impacts likely to arise from the construction works include:

- the temporary removal of land adjacent to the river from production during the course of the works;
- an increase in turbidity in the watercourse with some sedimentation downstream. This will be minimised by constructing all new channels in the dry and minimising the amount of work carried out in the live watercourse;
- damage to marginal vegetation resulting from construction works and the movement of machinery. Surveys carried out have verified that no habitats or species of exceptional quality exist along the river banks. In addition, access and working areas will be restricted to prevent any unnecessary damage.
- there will be some temporary disruption to anglers during the course of the works, with restricted access to the watercourse;
- there may be some disturbance to the Mill House and adjacent properties resulting from the movement of construction traffic and the works themselves.

### End State Impacts

S4.4 The main end state impacts identified include:

- the loss of productive farmland as a result of the realignment of the river. The National Trust are renegotiating tenancy agreements with those tenants permanently affected;
- the recreation of a sinuous watercourse will restore a more natural planform to the river and create a more stable and diverse habitat, which will attract a greater diversity of species;

- the re-creation of a more natural flooding regime will restore the interaction between the river, its marginal vegetation and the floodplain, and will encourage deposition of silts over the floodplain during high flow events. However, under normal flows it is likely that the river will still retain a high sediment load;
- the creation of a more varied corridor habitat with wetland and reedbed areas will have significant conservation and wildlife benefits. In addition it is hoped that the restoration of historical river levels and flooding regimes will encourage the recovery of the fritillary meadow;
- the introduction of a more varied instream habitat, together with improved water quality should help ensure a healthy and more sustainable fishery;
- a 120 m section of the river between the two sections to be re-meandered will remain overwide, with low flow velocities. This will provide an impoverished habitat and will limit species diversity;
- raising the river bed and re-meandering the river will bring the river back into contact with the floodplain and make it a more important feature in the local landscape. Views up and downstream from Coleshill Bridge will be improved.

## **S5 Conclusions**

- S5.1 Overall the works will result in improved river and floodplain habitats on the river restoration site. The extent of these environmental benefits both on the site and within the wider catchment are unclear and will be assessed throughout the monitoring programme. It is hoped to continue restoration works on the site, including improvement works to the 120 m straight reach between the two re-meandered sections, as and when funds become available.



## **1 PREFACE**

- 1.1 Under the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988 (Statutory Instrument 1199), projects which require planning permission may also require the preparation of an environmental statement if the impacts are considered to be significant. In addition the Land Drainage Improvement Works (Assessment of Environmental Effects) Regulations 1988 (Statutory Instrument 1217) place an obligation on any drainage body proposing to carry out certain drainage improvement works to consider whether they are likely to have significant environmental effects and, therefore, require the preparation of an Environmental Statement (ES).
- 1.2 This project does not fall within the remit of either of these statutory instruments, however an environmental report has been produced as good practice to document the potential impacts of the scheme.

## **2 INTRODUCTION**

- 2.1 This report has been prepared to address the environmental implications of proposals to restore a 2 km stretch of the River Cole at Coleshill, north east of Swindon (Figure 1).
- 2.2 Three demonstration river restoration sites are being set up by the River Restoration Project in the UK and Denmark to examine the effects of the restoration of rivers and floodplains. Financial support has been provided by LIFE, an EC fund which provides grant aid for schemes for environmental benefit. The other two river restoration sites are the River Skerne in Darlington, Co. Durham and the River Brede in South Jutland, Denmark.
- 2.3 The River Restoration Project (RRP) is an independent non-profit making organisation. It was established to promote the restoration and enhancement of damaged rivers for conservation, recreation and amenity purposes, returning them as closely as possible to their original condition.
- 2.4 The RRP has a core group consisting of an executive and a National Rivers Authority technical group, comprised of officers with special interest and experience in river restoration. The core group is supported by a steering group whose members are drawn from a wide range of institutions and disciplines concerned with the riverine environment.
- 2.5 Member organisations of the group include the River Restoration Project Limited, National Rivers Authority, Darlington Borough Council, National Trust, Countryside Commission, English Nature and Northumbrian Water Limited.
- 2.6 The aim of the project is to restore, within the constraints of land use and flood defence, selected reaches of these rivers to their natural state which pre-dates intensive river management. It is hoped that the project will demonstrate the benefits of river restoration for integrated catchment management in terms of water quality, hydrology, flood defence, conservation and amenity, by monitoring and evaluating the physical, chemical and biological effects of restoration.

- 2.7 A monitoring programme is to be set up to study the impacts of the project. The first year of this monitoring programme has already been undertaken and was concerned with the establishment of baseline conditions. The following section details these baseline conditions.

### **3 THE EXISTING ENVIRONMENT**

#### **The Site**

- 3.1 The site is located on the National Trust Buscot and Coleshill Estate, on the Oxfordshire/Wiltshire border and consists of a 2 km reach of river with approximately 50 ha of floodplain (Figure 2). The Waterloo Ditch, a tributary of the Cole flows from Great Coxwell to Waterloo Copse joining the Cole to the north east of Tellards Copse. The 2 km reach of river which is the subject of this project stretches from 700 m upstream of the mill to the southern boundary of the National Trust land.
- 3.2 Upstream of Coleshill Bridge, the river has been diverted from its original historical course to flow down the mill channel. The former main channel of the river is visible to the west of the existing channel.
- 3.3 Drainage from adjacent agricultural land passes under the river, via a syphon to feed the channels to the west.
- 3.4 Approximately 200 m upstream of the mill, an offtake structure known as Seven Steps weir takes flow from the mill channel into a side channel along what was originally the course of river. Two structures discharge flow to the mill pool: the original timber sluice gates which are in poor condition and in need of repair, and a more recently constructed concrete cascade weir. Water still flows to the mill and the National Trust has plans to restore the mill wheel. Flows converge immediately upstream of Coleshill Bridge.
- 3.5 On the left bank of the river south west of Coleshill is Coleshill Football Club. The club has its pitch and pavilion located on the floodplain of the River Cole and both are subject to periodic flooding.
- 3.6 Coleshill Bridge carries the main road which passes through the village (B4019) over the river. The bridge is the main public point of access to the river.
- 3.7 The Mill is a Grade 2 listed structure. The National Trust hopes that eventually the mill can be restored for occasional operation.

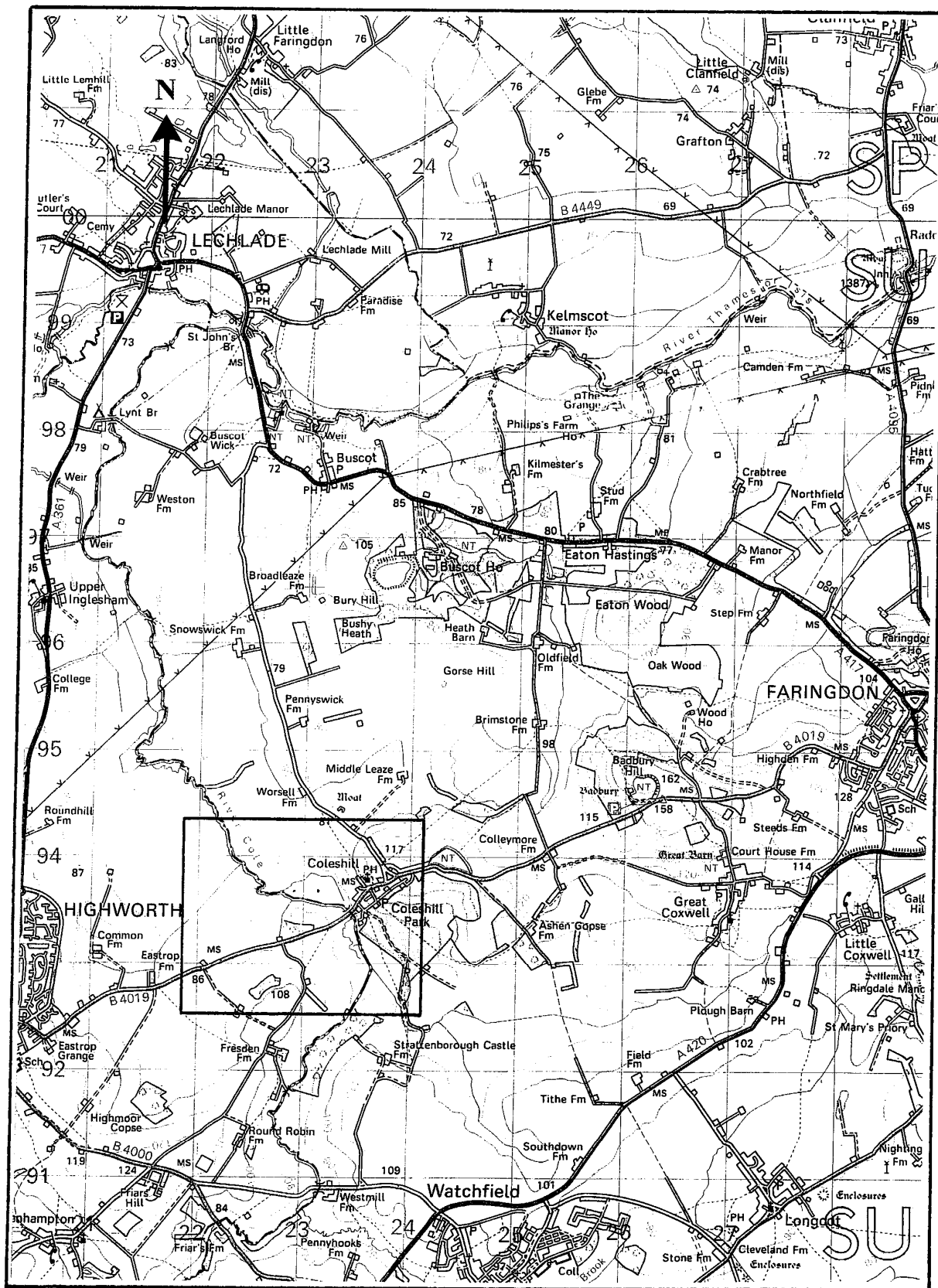
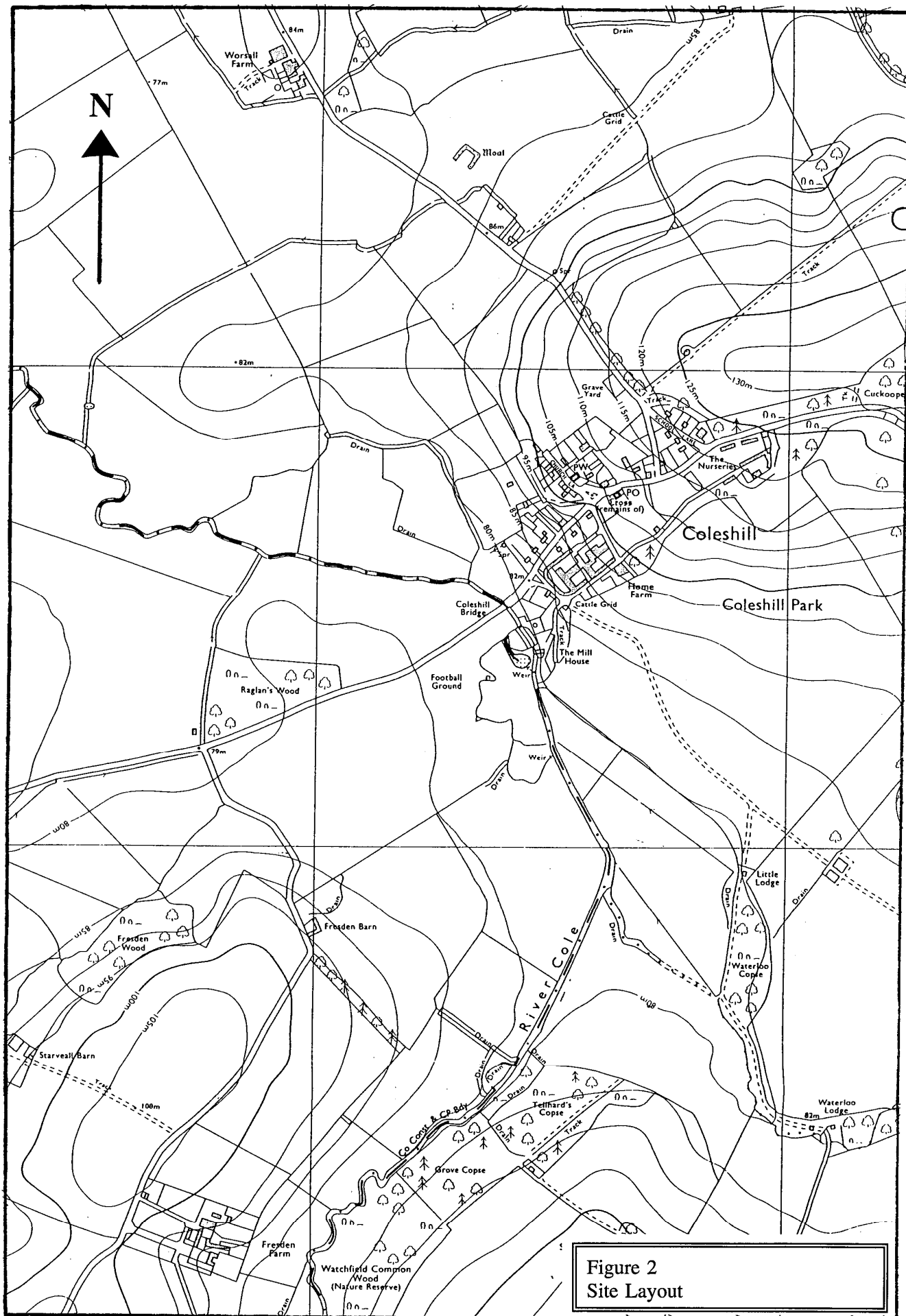


Figure 1  
Site Location

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- 3.8 Downstream of the bridge the river follows a relatively straight course in an overdeepened and overwide channel to the downstream end of the restoration area.
- 3.9 The river has been heavily managed in the past and the existing river course is almost entirely artificial. Most recently a land drainage scheme undertaken in the 1970's deepened the river by about a metre between Coleshill and the Thames, all but eliminating regular flooding downstream of Coleshill Bridge, and reducing its frequency upstream of the bridge.
- 3.10 The study is concerned with the restoration reach itself and an upstream control reach and a downstream impact reach, covering a total of approximately 6 km of watercourse.

### **Planning Context**

- 3.11 The River Cole forms the boundary between the Vale of the White Horse District in Oxfordshire and the Borough of Thamesdown in Wiltshire. Relevant planning policy designations have been extracted from the following Local Plans:
- Vale of White Horse Local Plan, Draft of Consultation, Vale of White Horse District Council, November 1993.
  - Thamesdown Local Plan 1991-1996, Consultation Draft, Thamesdown Borough Council, May 1991. This plan has been replaced by the 1994 Deposit Draft at the time of writing. The Deposit Draft is likely to be subject to further review at Inquiry in 1995.
- 3.12 Relevant planning policy designations include:

#### **The North Vale Area of High Landscape Value**

- 3.13 Coleshill and the eastern banks of the River Cole lie within the North Vale Area of High Landscape Value. The designation emphasises the quality and importance of the landscape of the Corallian Ridge and the need for special care when assessing the visual impact of development proposals. Vale of White Horse District Council seek to conserve and enhance the quality of the landscape within the AHLV.

#### Area of Local Landscape Importance

- 3.14 The countryside to the west of the River Cole is designated as an area of Local Landscape Importance by Thamesdown Borough Council. The river cuts through the Corallian ridge east of Highworth and the council consider that the quality of the landscape should be conserved and enhanced.

#### Coleshill Conservation Area

- 3.15 The River Cole forms the western Boundary of the Coleshill Conservation Area. The Council aims to preserve and enhance the special character and appearance of the village and would not permit development which could detract from the skyline, landscape or views into and out of the Conservation Area. Restoration proposals should enhance the visual impact both into and from within the Conservation Area.

#### Ancient Woodland

- 3.16 Flamborough Wood and Grove Copse have been identified as Ancient Woodlands by English Nature. The Vale of White Horse District Council would not normally permit the loss or significant alteration of these woodlands. These woods are not however shown on early maps eg 1761 and are therefore probably secondary woodland coppice plantations.

#### Great Western Community Forest

- 3.17 A Community Forest is being created in parts of Thamesdown Borough and the Vale of the White Horse, with the support of the Countryside Commission and the Local Authorities. The River Restoration site lies within the Great Western Community Forest (GWCF) area, the design and management of which were published in October 1994 (The Forest Plan). The GWCF is a partnership project with support from the Vale of White Horse District Council, Thamesdown Borough Council, the Countryside Commission, the Forestry Commission and other public, private and voluntary bodies. Work already carried out by the GWCF project team along the Cole corridor includes meadow restoration/creation, woodland planting, improved access and wetland creation.

### Sites of Special Scientific Interest

- 3.18 There are no SSSIs within or near to the study area, although a field on the right bank of the watercourse downstream, of Coleshill Bridge was previously a SSSI on account of its fritillary population. However following regrading of the river and the reduction of the population the site was de-notified.

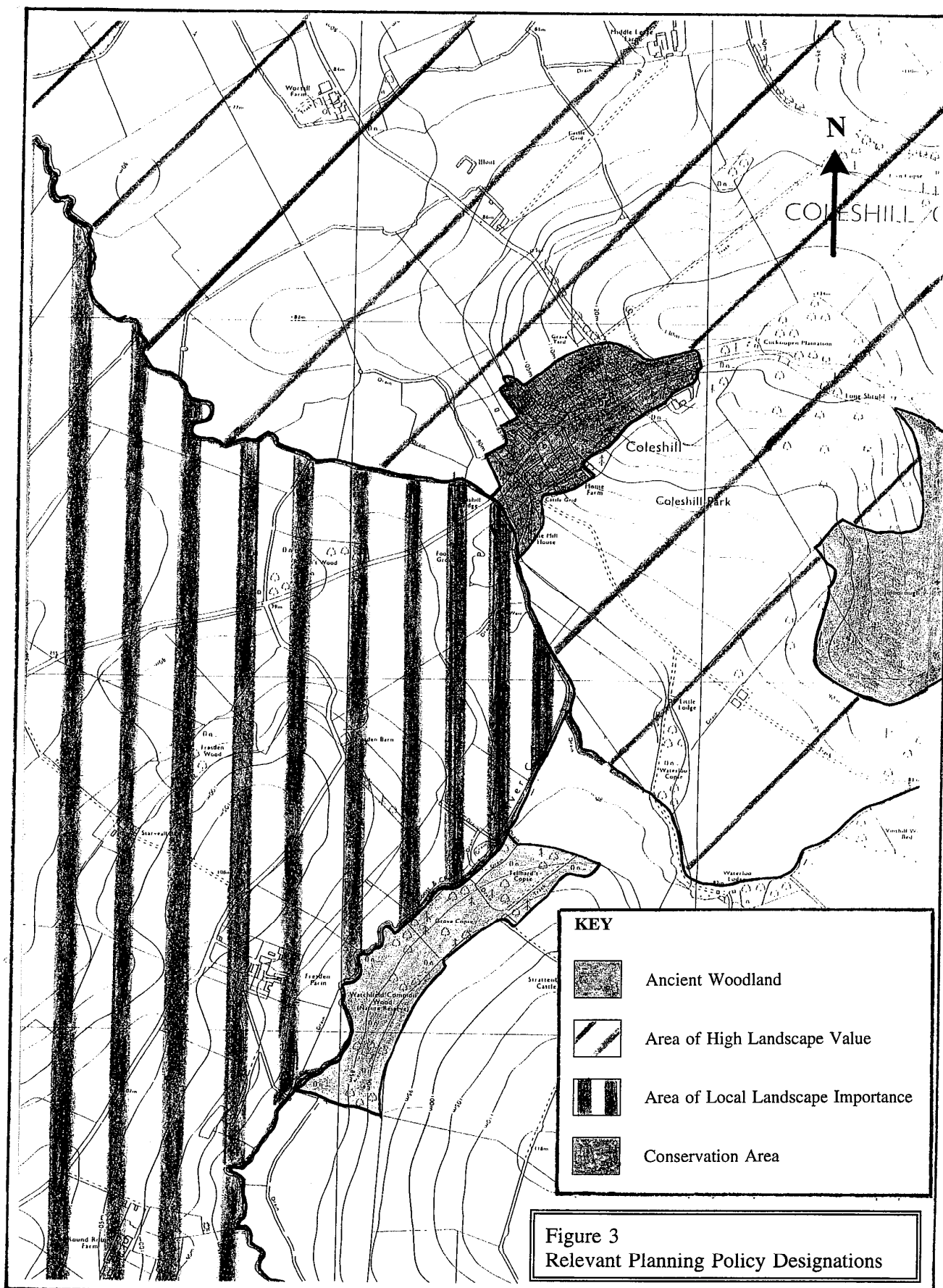
### General Planning Policies

- 3.19 The Vale of White Horse District Council recognises the importance of ponds and watercourses for wildlife habitats and would resist significant alteration of water features. Therefore the restoration proposals should provide for the retention, enhancement or protection of existing features of nature conservation value.
- 3.20 Thamesdown and Vale of White Horse councils encourage tree planting, particularly over large areas of land. Thamesdown Borough Council welcomes the Farm Woodland Scheme initiative which aims to enhance the rural landscape and create new wildlife habitats. Vale of White Horse District Council works with the Countryside Commission to grant-aid planting and management works, including hedgerow restoration.
- 3.21 Figure 3 summarises the planning policies relevant to the study area.
- 3.22 Both Thamesdown Borough Council and Vale of White Horse District Council have been consulted regarding the scheme. Vale of White Horse District Council were satisfied that the scheme is classed as permitted development under Part 15 of the Town and Country Planning Act 1988 General Development Order. However Thamesdown Borough Council requested that the scheme be submitted for planning approval. An application was made "without prejudice" and at the time of writing had received approval by committee.

### Land Use

- 3.23 The Cole catchment is dominated by agriculture with significant urban development in the headwaters draining Swindon.
- 3.24 Agricultural changes in the catchment have been dramatic since the 1950's. The dominant land use was originally pasture with flooding of the lowlands allowing





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two cuts of hay each year. Following World War II, the national drive for increased food production, resulted in extensive drainage of the lowlands to enable arable crops to be grown. Today, land use in this section of the catchment is a mixture of intensive arable farming for winter cereals (oil seed rape and flax), grassland and urban development.

- 3.25 Pre 1950 there was little urban development within the catchment, however between 1950 and 1980 there was a nearly continuous expansion of Swindon. Associated with this was culverting and straightening of the Cole and increased risk of pollution.
- 3.26 The reach of the Cole in this study area flows largely through agricultural land either used for pasture or arable.

### **Geology**

- 3.27 The valley of the River Cole is floored with alluvium. Extensive basins of alluvium exist in the upper reaches of the Cole catchment which demarcate former active floodplains. In the lower reaches of the River Cole including the restoration area, Thames gravels underlie alluvium, and locally outcrop in the river banks downstream of Coleshill Bridge (NGR SU234935).
- 3.28 The river rises from the chalk escarpment of the Berkshire Downs before flowing across a wide expanse of Kimmeridge Clay and passing between the Corallian Rag Hills, comprising Corallian Sandstone and Limestone, to the north east of Swindon. These hills are the only natural source areas for any form of gravel substrate for the river bed before the Thames Gravels. The downstream section of the river flows over lowland clay vales comprised of Oxford Clay, before joining the River Thames at Lechlade.

### **Soils**

- 3.29 The soils of the Cole catchment are dominated by clay based soils up onto the Downs. The main soils associations in the area are: Pelo-Stagnogley/Stagnogley (712 & 711 j/f), Brown Redzina (343h), Gleyic brown calcareous earths (512) and grey Redzinas (342a).

- 3.30 Clay vale landscapes of this type are not particularly susceptible to erosion, due to the low gradients associated with this landscape and the cohesiveness of the soil types.
- 3.31 The floodplain of the River Cole is floored with alluvium, which increases in proportion of sands and gravels downstream of the Coral Rag Hills in the Thames Vale, forming an extensive floodplain north west of the study area.

### **Topography and Drainage**

- 3.32 The River Cole drains a catchment area of 129 km<sup>2</sup>, draining the northern edge of the North Berkshire Downs in the Vale of the White Horse, before flowing northwards across clay lowlands to join the River Thames near Lechlade. The catchment has a flashy response to rainfall events, a feature exacerbated by urbanisation in the upstream reaches around Swindon. The river is a low energy system with sediment transport mainly confined to fine silts and clays. Low stream energy combined with the effects of artificial deepening and widening, has resulted in a mainly depositional environment, as the channel attempts to adjust and recover from the effects of dredging and overwidening.
- 3.33 The headwaters of the River Cole comprise a series of springs at the foot of the chalk escarpment, but the river is also fed by a number of springs along its course, notably at Highworth, Watchfield, and Coleshill.

### **Geomorphology**

#### **Historical Development**

- 3.34 The River Cole is a heavily managed and modified stream throughout its catchment.
- 3.35 Geomorphologically the most natural feature of the Cole is the channel planform, which in places is almost exactly the same as that recorded in maps as old as 1775. Floodplain deposits exposed in the reach downstream of Coleshill Bridge strongly suggest that the old course runs adjacent to the bluff line on the right bank of the river.



- 3.36 Studies of the history of the river have revealed the long history of management of the Cole and the recent and large scale changes in both channel and catchment. The River Cole has a history of modification in the restoration area. A mill is mentioned in the Domesday Book records of Coleshill (1086), indicating that the river has been impounded at this location for at least 900 years. The period 1930 - 1950 witnessed a change in floodplain from valuable water meadows to drainage of the land for agricultural purposes. In 1976 the channel downstream of Coleshill Bridge was regraded as part of the Lower Cole land drainage scheme. The scheme involved lowering the bed by at least a metre for 9.5 km, removing any gravel substrate and resulting in a loss of morphological diversity. In addition the alteration in the flood regime resulted in the destruction of the herb rich meadows either side of the channel.
- 3.37 This history of management has modified the Cole floodplain which was once an important store of water and fine sediments, so that all but the largest flood events are currently contained in bank.

#### Channel Sediment Transport

- 3.38 The Cole sediment transport system is dominated by fine silts and clays. This is clearly a reflection of both urbanisation and the dramatic change in agricultural practice within the catchment, which results in the production of large amounts of silt. Evidence of the influence of agricultural practices on sediment load is clearest in some of the rural tributaries of the Cole where silt deposition is similar to, and sometimes greater than that in streams draining the urban area.
- 3.39 Silt now covers much of the bed material and locally reaches depths of 1.0 m. There is, however, evidence that sand and gravel have been more extensive in the past and will still comprise the bed load. Gravels are thought to exist in the bed of the Cole, but as a thin layer above clay bedrock. Pools are cut into this bedrock and are floored by fine gravels, sands and silts. The supply of gravels to the downstream reach of the Cole is limited and riffles tend to be characterised by static concreted gravels.
- 3.40 The abundance of fine sediment, combined with the low stream power and slopes, means that the Cole is now providing an essentially depositional environment. This is leading to channel readjustment by deposition and associated colonisation by vegetation. This process will eventually lead to a new stable state for the river

although the environment of this new state will be very different from that of the more natural Cole.

- 3.41 Sediment has been identified as a key problem in relation to enhancement. Very fine sediment arising from urban and agricultural surfaces can smother instream features such as reinstated gravels causing problems for fish and invertebrates. A study has been commissioned to examine sediment problems on this watercourse and to make recommendations for mitigation.

#### The River Today

- 3.42 In its present state the channel is a series of backwaters interspersed with local control structures such as bridges and weirs. The channel has little gravel substrate remaining, mainly as a result of land drainage engineering works which removed the (presumably) armoured gravel bed.
- 3.43 Removal of gravel substrate during dredging has eradicated the pool riffle sequence, with the exception of a few isolated reaches. Largely because of the lack of replacement of coarse sediment new pool-riffle sequences have not developed. It is not possible to confirm whether an extensive pool-riffle sequence existed prior to management of the river occurred although it is likely that downstream of the Corallian Rag hills there was sufficient gravel to form a sequence. Upstream of the weir at Coleshill, the ponding effect has drowned out pool-riffle sequence. Similarly the fisheries enhancement weirs downstream of Coleshill Bridge have the effect of drowning out any riffles which may be developing locally.
- 3.44 The contemporary channel is managed and although analogues for planform may be derived from old maps, the correct width/depth ratio is difficult to establish. The channel was undoubtedly narrower and shallower than at present, with a floodplain which was more frequently inundated.
- 3.45 The hydrology and sediment supply and delivery from the Cole catchment has changed so that in all probability the sediment loads are now greater and flood peaks steeper than in the past. Despite this, the energy for erosion and wholesale bed mobilisation is not achieved, creating a depositional environment. A feature of the channel morphology throughout the river is the presence of marginal macrophyte covered berms. Some of these are associated with the inside of

meander bends where deposition is expected. Other features include berms along the margins of the channel in areas that have been widened or in the slack water areas found in deeper pools.

### **Hydrology**

- 3.46 The headwaters of the River Cole are in chalk, which sustains a modest baseflow throughout the year, however over 50% of the catchment is underlain by clay which promotes a rapid response to rainfall. The mean annual flood, based on the 18 year record from the gauging station at Inglesham is  $15.5 \text{ m}^3\text{s}^{-1}$ , rising to  $26.3 \text{ m}^3\text{s}^{-1}$  during the highest recorded flood in December 1979. Although no sewage effluent from Swindon itself enters the Cole, there are large amounts of urban runoff that have necessitated the gradual construction and continuous upgrading of 12 flood storage areas, in the urban areas of the catchment in order to regulate flashy flows.
- 3.47 Upstream channel changes have resulted in changes in the regime of the river over time, with possible higher flood peaks and reduced times to peak. Analysis of flow records shows that flood peaks are generally of short duration with the majority of floods occurring during the winter months.
- 3.48 The 1 in 2 year flood event currently floods the site, mainly upstream of Coleshill Bridge, with little flooding downstream. Figure 4 shows the predicted extent of this flood. Currently under this frequency event, floodwaters rise to the lower edge of the football pitch, making it unplayable. The 1 in 100 year flood event (Figure 5) is predicted to flood most of the site both up and downstream of Coleshill Bridge.
- 3.49 Up to 1950 the floodplain was only partially drained and large areas were operated as a water meadow system. Downstream of Coleshill Bridge, the floodplain was regularly inundated and land use was dominated by permanent pasture. Overall the hydrology of the catchment has been altered by urbanisation, large scale underdrainage and arterial drainage schemes, culminating in the 1974 Cole Stage 1 works which effectively eliminated inundation of the floodplain downstream of Coleshill Bridge.







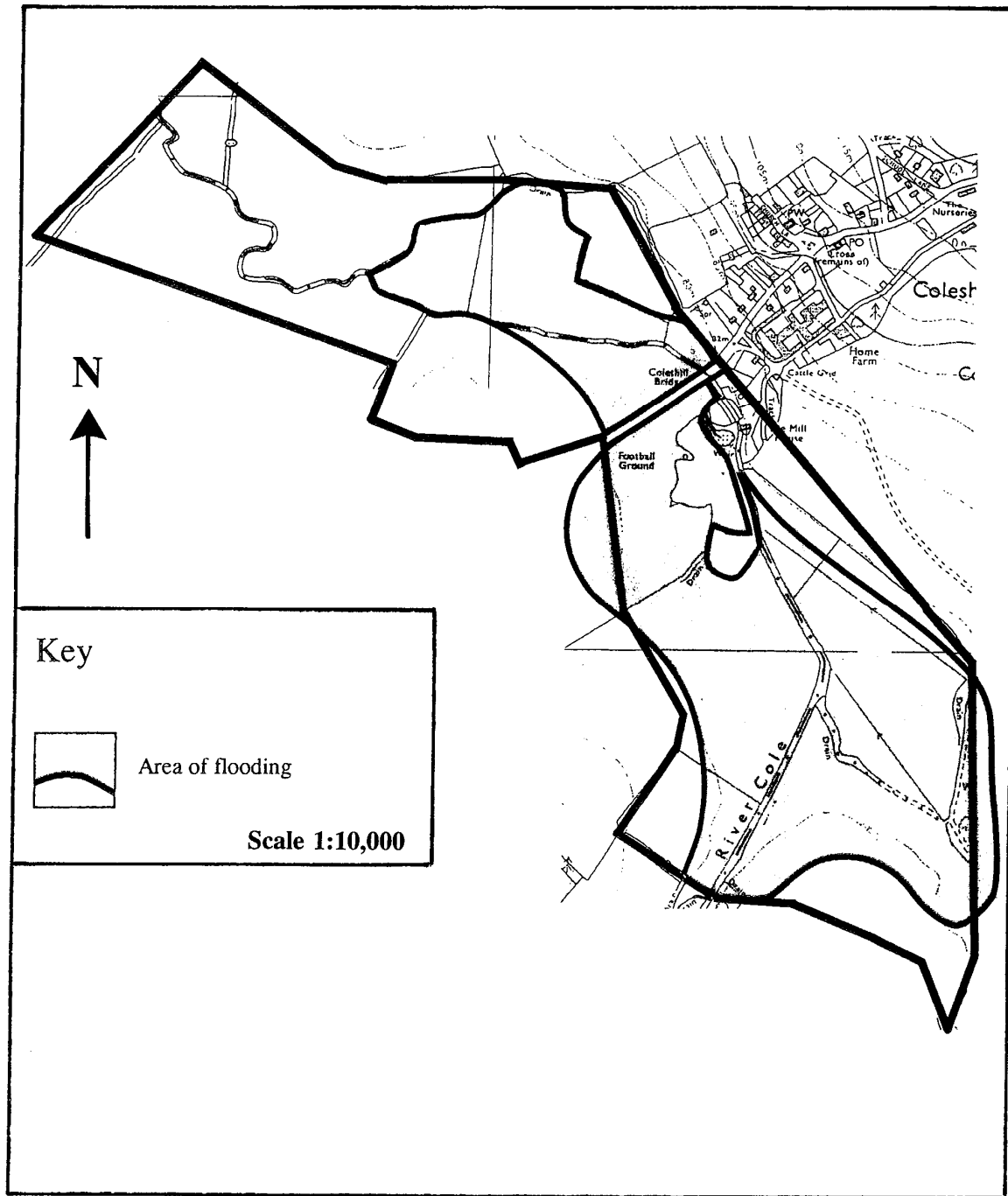


Figure 5  
Predicted Extent of 1 in 100 Year Flood  
Event Under Current Conditions





## Water Quality

- 3.50 The River Cole at Coleshill is fairly typical of many small rural rivers in lowland Britain. Table 1 shows average concentrations for selected determinands between 1990 and 1993.

**Table 1 - Values of Selected Water Quality Determinands  
sampled at Coleshill Bridge 1990 -1993**

Determinand	Mean	Range
pH	7.9	7.4 - 8.4
Suspended Solids (mg/l)	15.4	2.5 - 72.4
Biochemical Oxygen Demand (mg/l)	1.54	1.0 - 5.1
Dissolved oxygen (%)	92.1	69 - 118
Ammoniacal nitrogen (mg/l)	0.046	<0.05 - 1.46
Total oxidised nitrogen (mg/l)	6.32	2.1 -17.9
Chloride (mg/l)	43.3	19 - 83
Soluble reactive Phosphorus (mg/l)	0.55	<0.06 - 1.46
Alkalinity (as CaCO <sub>3</sub> ) (mg/l)	186	128 -242
Copper (dissolved) (µg/l)	0.14	<5 - 6
Zinc (µg/l)	9.4	<8 - 91

- 3.51 These results indicate that in general the water quality is good, well-saturated with oxygen and usually with a low BOD and only moderate levels of ammonia. The water has a high alkalinity, with a pH consistently above neutral.
- 3.52 Suspended sediment loads tends to be rather high and the range of values reflects the rather spaty nature of the catchment. Nutrient loadings also tend to be high with total oxidised nitrogen peaking well above the EC drinking water guidelines. Phosphate is also much higher than would be expected for an undisturbed

catchment. The high nitrate levels reflect the largely agricultural nature of the catchment and the phosphate levels reflect sewage discharges, possibly from the small sewage treatment works (STW) at Coleshill and possibly from the larger STW at Shrivenham further upstream. Levels of copper in the water are generally low, though levels of zinc are high at times, possibly reflecting the close proximity of Coleshill STW.

- 3.53 Biological monitoring of the site between 1990 and 1993 has also shown good water quality in terms of organic load. BMWP scores (a measure of the biological diversity of freshwater fauna) for the site ranges between 0.88 - 1.66. A value of 1.0 represents the fauna associated with rivers in good condition. ASPT values (a biological measure used to indicate the effect of pollution on macroinvertebrates) ranged from 0.92 - 1.05.
- 3.54 Monitoring of the nutrient budget is also being undertaken and regular sediment sampling is also being carried out.

### **Conservation**

#### **River Corridor Survey**

- 3.55 A river corridor survey of the Rive Cole was undertaken in 1994, with further data having been collected and analysed since then.
- 3.56 As a whole the River Cole in this area is moderately rich in wetland plant species. The ponded area upstream of the Mill supports the richest wetland reaches surveyed, including a diverse wetland herb community on the lower, cattle-poached banks. Despite the considerable depth of the channel in this section the aquatic plant community was also diverse. Both emergent and aquatic fauna of this area include species not recorded elsewhere including arrowhead (*Sagittaria sagittifolia*), narrow leaved water plantain (*Alisma lanceolatum*), skullcap (*Scutellaria galericulata*), tufted forget-me-not (*Myosotis laxa*) and marsh woundwort (*Stachys palustris*).
- 3.57 The other main areas of interest are the aquatic communities, dominated by stream water-crowfoot (*Ranunculus penicillatus*) and locally the marginals particularly flowering rush (*Butomus umbellatus*), both of which are associated with the shallows below Coleshill Mill and the road bridge.

- 3.58 Elsewhere on the site, particularly along the downstream reaches, the high steep banks and progressively increasing water depths significantly inhibit the development of marginal and aquatic flora.
- 3.59 No rare or nationally notable wetland species were recorded and the occurrence of local species was generally poor. In all, seven nationally uncommon species were recorded. However most of these species have a predominantly southern distribution. Only stream water crowfoot and narrow leaved water plantain could be considered both nationally and regionally uncommon and for both species there is some doubt about the accuracy with which the distribution has been recorded.
- 3.60 A species list for the river corridor survey is contained in Appendix 1.

#### Floodplain Survey

- 3.61 A Phase 1 survey of the flood plain adjacent to the Cole was also carried out in 1994 in accordance with the National Vegetation Classification (NVC) methodology.
- 3.62 Two broad habitat types emerged: arable land to the north of Coleshill Bridge and grassland to the south.
- 3.63 The area north of Coleshill Bridge is predominantly arable land, which in 1994 was largely down to rape. All fields on the western side of the river had broad (10 m) buffer strip areas between the arable crop and the rivers edge, supporting a variety of common ruderals.
- 3.64 Four NVC grassland types were recorded in the survey area. The grassland community of greatest species richness and conservation value was NVC type MG5 - Crested Dogs- tail - Common Knapweed Meadow and Pasture Community. Two fields held this community:
- the ex-SSSI fritillary field downstream of Coleshill Bridge. This had the best examples but still appears to be somewhat improved;
  - the football ground upstream of Coleshill Bridge, which supported a very species poor variety of this habitat.

- 3.65 This type of community is characterised by red fescue (*Festuca rubra*), crested dog's tail (*Cynosurus cristatus*), bird's-foot trefoil (*Lotus corniculatus*), ribwort plantain (*Plantago lanceolata*), Yorkshire fog (*Holcus lanatus*), cock's-foot (*Dactylis glomerata*), white clover (*Trifolium repens*), common knapweed (*Centaurea nigra*), creeping bent (*Agrostis stolonifera*), sweet vernal grass (*Anthoxanthum odoratum*) and red clover (*Trifolium pratense*). They are typically species rich pastures and can be quite variable in composition. They tend to occur on soils which are not high in nutrients, neither acid or alkali and freely drained. The pastures have usually not been sprayed with herbicide, and they receive little or no fertilizer. They are usually cut for hay and are ungrazed in summer but may be grazed in winter.
- 3.66 Of particular interest is the Coleshill fritillary meadow. This is a moderately species rich site, which has been partially improved, but still retains a number of old wet meadow species including snake's-head fritillary (*Fritillaria meleagris*), dropwort (*Filipendula vulgaris*), sweet vernal grass (*Anthoxanthum odoratum*), meadow sweet (*Filipendula ulmaria*), meadow vetchling (*Lathyrus pratensis*), ladies smock (*Cardamine pratensis*), knapweed (*Centaurea nigra*), and common vetch (*Vicia sativa*).
- 3.67 National Trust records suggest that there has been a significant increase in the fritillary population since 1989 (from 589 flower heads recorded in 1989 to 782 in 1994) with flowering heads covering a much greater area.
- 3.68 Most of the remaining grassland within the restoration area was improved (MR7 Rye Grass Ley) with little botanical interest. This included all the fields to the east of the river in Coleshill Park, upstream of the mill, and the two fields immediately west of the mill. These communities are typically species poor and are characteristic of the more nutrient rich and heavily improved soils which are usually well drained. They are either heavily grazed or are cut for hay or silage. The second largest area of grassland, the grazed field located to the west of the River Cole upstream of the mill was classified as MG6 Rye Grass - Crested Dog-tail Pasture. Once again this is often a relatively species poor community, but is often variable in composition depending on the precise type of grazing and soil. the pastures are typically heavily grazed for most of the year, and have often received fertilizer or slurry.

- 3.69 With the exception of the fritillary field, there were few floodplain areas of particular value. Species of particular note included: snake's-head fritillary, dropwort and meadow brome (*Bromus commutatus*) and smooth brome (*Bromus commutatus*). A full species list for the floodplain survey is contained within Appendix 2.

#### Invertebrate Ecology

- 3.70 Surveys of the river channel and surrounding floodplain identified 126 species of aquatic macroinvertebrates. Of these species, three were nationally notable and eleven are considered to have a localised distribution. Of the nationally notable species, only one, a whirligig beetle (*Gyrinus urinator*) was recorded in the main channel and seems to be present throughout the site. The other two nationally notable species, a diving beetle (*Hydroglyphus pusillus*) and a water scavenger beetle (*Helochaeres lividus*) were found only in the small temporary pools in the grazing meadow in the upstream section of the site. This emphasises the care which will need to be taken during construction works both along the river and on the floodplain.
- 3.71 Of the local species recorded during the studies, an alderfly (*Sialis nigripes*) is noteworthy. The exact distribution of this species is not clear, being only relatively recently recognised as a British species. A single record of this species was made in the downstream reaches of the restoration reach. Also of local interest is the white-legged damselfly (*Platycnemis pennipes*), which is present throughout much of the length of the main river.
- 3.72 Overall the river and its floodplain have a good diversity of species but none of exceptional rarity. The river itself has only one nationally notable species in the total of 115 species present. The value of off-river sites should also not be overlooked. Though the drain and the southern ditch were both species poor, they nevertheless had some species which were not found in the river itself.
- 3.73 A list of invertebrate species found on the site is contained within Appendix 3.
- 3.74 Monitoring of semi-terrestrial invertebrates is also being carried out, although no results are available at present.

## Birds

- 3.75 A survey was carried out in summer 1994 and a winter survey is ongoing in order to determine whether populations of breeding and overwintering birds change following restoration of the river.
- 3.76 Prior to the survey, a number of target species, which may benefit from river restoration were identified (see Table 2)

**Table 2 - Wetland Associated Bird Species which may benefit from River Restoration**

Species	Reason for Interest
Mute Swan	Recovering from decline in central Southern England and Midlands
Lapwing	National decline
Snipe	Decline on lowland grassland (candidate Red Data Book species)
Redshank	Decline on lowland grassland (candidate Red Data Book species)
Curlew	Uncommon breeding wader in Oxfordshire/Wiltshire
Shovler	Rare breeder in Oxfordshire/Wiltshire (on edge of UK range in the region)
Teal	Rare breeder in Oxfordshire/Wiltshire
Garganey	Nationally rare breeding species
Moorhen	Population decline where river engineering occurs
Coot	Common, but abundance probably reduced by severe river engineering
Water Rail	Uncommon wetland breeding species in Oxfordshire/Wiltshire
Barn Owl	National decline; often forages in river valleys
Kingfisher	Possible population declines due to river pollution and engineering
Yellow Wagtail	Wetland species perhaps affected by land drainage
Grey Wagtail	National decline (climate and possibly habitat degradation related)
Grasshopper Warbler	National decline; associated with wetland habitats
Sedge Warbler	Wetland species; climate related declines
Reed Warbler	Wetland species
Reed Bunting	National decline

- 3.77 During the summer survey a total of 58 species were recorded. Of the 19 target species identified as being of importance, only six were present in the restoration area. These were mute swan, lapwing, moorhen, kingfisher, yellow wagtail and reed bunting, all of which probably bred (with exception of the kingfisher) in the control reach. Lapwing were most numerous on the site in the right bank arable field downstream of Coleshill Bridge.
- 3.78 In addition three target species (curlew, redshank and sedge warbler) were seen in the area, but not on the restoration site.

### **Fisheries**

- 3.79 The River Cole is a designated EC Coarse Fishery for 20.3 km of its length from Acorn Bridge, west of Bourton to its confluence with the River Thames.
- 3.80 The River Cole appears to demonstrate the impact of flood defence engineering works on fish populations. Surveys shortly before and immediately after the land drainage works undertaken on the Cole in 1975/76 indicated a 90% reduction in the biomass of chub and a 95% reduction in the biomass of dace (TWA 1980).
- 3.81 Subsequent monitoring of fish populations on the Cole has been undertaken as part of the NRA's five year rolling programme. The most recent survey, undertaken in 1992 provides partial baseline data for the site with further surveys planned in spring 1995.
- 3.82 Species recorded on the Cole in 1992 include: bleak, bream, bullhead, chub, common carp, dace, eel, gudgeon, minnow, perch, pike and roach. Between October 1989 and January 1990 the river was restocked with 5500 coarse fish with species including: common carp, crucian carp, dace, chub, roach and bream.

### **Landscape**

- 3.83 A landscape assessment of the catchment has been undertaken to describe and classify the landscape of the restoration sections and to make recommendations for the management of individual areas.

3.84 A variety of landscape types exist within the study area:

- the village of Coleshill is an historic 17th century planned village, owned by the National Trust. The buildings are constructed mostly of Corallian Rag limestone with stone or slate pitched roofs. The gardens of residential properties are contained by neat clipped box or holly hedges with well maintained front lawns and planted beds. All saints church is prominent on the skyline in the centre of the village. The National Trust estate is surrounded by a high stone wall.
- To the south of the village, the river runs adjacent to Coleshill Park. The parkland is distinguished by gently undulating grassland with single specimen tree planting, varying in age from mature oak trees to young saplings. Young trees are protected from grazing by timber tree guards. The parkland is bounded on the higher ground by Flamborough Wood and Long Shrubbery. The parkland is currently being restored in accordance with a National Trust Restoration Plan.
- Farmland on the slopes of the clay vale is mixed, although generally arable with some unmanaged pasture fields. Field boundaries are characterised by hedgerows in varied stages of management resulting in an open and semi-enclosed character depending on their condition. Farmland within the floodplain is again generally arable with some pasture. Fields tend to be large scale with well maintained clipped hedges. Raglans wood is a dominant feature west of the river. To the south of Coleshill bridge, the alluvial pasture becomes more enclosed due to the presence of small fields and distinct hedgerows.
- Locally prominent limestone hill outcrops are found at Coleshill and above Fresden Barn. These represent part of the Corallian Hills and create a distinct character in this part of the valley. As the valley passes through the Corralian ridge it is dominated by Tellards Copse, Grove Copse and Watchfield Common Wood, believed to be secondary coppice woodland. Fresden Farm and Strattenborough Castle Farm are conspicuous either side of the valley.



### **Recreation**

- 3.85 Fishing rights along this reach of the River Cole are owned by the National Trust and leased to the local angling club: Highworth Angling Club. A public footpath crosses the site to the east of the River Cole.

### **Archaeology & Heritage**

- 3.86 The Mill House at Coleshill is a Grade II listed structure and as such any works, demolition, alteration or extension to the building, or within its curtilage which would materially affect its character will require "listed building consent" from the Vale of White Horse District Council.
- 3.87 Oxfordshire and Wiltshire County Councils have been consulted regarding the scheme and have confirmed that there is little of known archaeological interest in the area.

## **4 ALTERNATIVE SOLUTIONS AND THE PROPOSED WORKS**

- 4.1 A working group of environmental specialists was set up to establish baseline conditions for the site and to determine a number of options for the possible restoration of the Cole both up and downstream of the River Cole.

### **Do-nothing**

- 4.2 The do nothing option would involve no additional intervention in the current river regime and its surrounding floodplain. The current maintenance programme would however continue. This option would retain the existing status quo, with deposition over time serving to locally narrow the channel through the formation and vegetation of berms, creating a new riverine environment.

### **Restoration Options**

- 4.3 Initially two restoration options (Options 1 and 2 ) were identified for the reach upstream of the road bridge and two (Options 3 and 4) for the downstream section. These are detailed in Figures 6 and 7.

#### **Option 1 - Recreation of the Original Course Upstream of the Mill**

- 4.4 This option involved the diversion of the majority of flow, which currently passes down the mill channel, along the original course of the river, which would in parts need recreating. In other areas, an existing ditch would need enlarging. A sweetening flow would be maintained in the mill channel. The river would be designed to allow frequent inundation of the floodplain on the left bank of the river. This option would recreate the historical landscape of the area and preserve the existing habitat. It would however mean that the mill channel and weir structure would have significantly less flow than at present, resulting in loss of amenity and potential loss of habitat.

#### **Option 2 - Anastomosing Channel**

- 4.5 This would entail the creation of an anastomosing channel with one channel maintained deeper than the others to allow fish passage. The remaining channels would be smaller, shallower peripheral channels within a reed bed area acting as

a sediment trap. The sediment trapping system would require some maintenance in the long term.

- 4.6 It was felt that since the contemporary sediment system of the river has enhanced sediment loads from urbanisation, this type of channel would provide an imaginative way of dealing with the problem.
- 4.7 However the silt would have been trapped within the channel and subject to remobilisation under high flows and was not considered compatible with historic river forms. In addition it would involve considerable land take. Concerns were also raised that the channels would become a reed filled pond with little or no fisheries value.

#### Option 3 - Recreation of the Channel along its Original Route

- 4.8 The original course of the channel is thought to lie along the bluff to the north of the current course. This option would entail the recreation of the channel along this route, with sections of the current channel being retained as a series of separate seasonal linear ponds, with planted reed bed areas. A drop structure would be installed where the new channel meets the existing watercourse.
- 4.9 This scheme would create additional river habitat and give historical integrity to the project. However it would be very expensive and impractical in terms of land take. It would also result in the loss of habitat that currently exists along the Cole and would not be easily understood as a preferred option by members of the public.

#### Option 4 - Two Stage Channel

- 4.10 This alternative would involve raising the bed of the river downstream of Coleshill Bridge by approximately 1 m and the creation of a two stage channel with berms to be constructed around existing trees. The spoil excavated to create the berms would be placed in the channel and topped with compacted gravels in order to increase bed levels. However this would maintain the straight channel planform in this reach which would not be in keeping with the historical form of the river.

## The Vision

- 4.11 Following discussion and evaluation of the four alternatives, further refinements and recommendations were made as part of the appraisal process and an ideal solution or vision was arrived at, taking all interests, concerns and constraints into account. The elements of the vision plan are detailed in Figure 8 and described below.

### Upstream of Coleshill Bridge

- The original channel to the west of the mill leat would be recreated and would take the majority of flow. A sweetening flow would be retained in the mill stream passing through the old sluice structure which would be refurbished. The offtake structure for the new channel would be a side weir on the left bank of the existing channel;
- Land in the area immediately upstream of the confluence of Waterloo Ditch with the River Cole millstream would be lowered. Topsoil would be stripped and a reedbed area, fringed with alder and willow created. The area would drain via seepage to adjacent watercourses and ditches. It is anticipated that this reed bed area would serve to remove silt and nutrients, largely from non-point agricultural sources passing down the Waterloo Ditch. There would be an overspill of flood waters to the north of this area onto existing low spots;
- The mill stream would be diverted to run along the edge of the reedbed area. The redundant section of the old channel would be filled, but levels would be retained at a low enough level to permit the overspill of floodwaters across the meadow as indicated;
- Upstream of the reedbed area, a control structure is proposed on the Waterloo Ditch to divert the majority of flow towards this area, whilst allowing a sweetening flow along the existing ditches to the north;
- An Irish ford would be constructed to allow cattle to cross the main channel and pass over the mill stream via a bridge to reach the right bank, when flood levels are high.

- The crest of the seven steps weir will be raised and the weir itself refurbished, with the possibility of installing a footbridge over the structure in the future.
- A control structure would be constructed at the upstream end of the syphon.
- Dam boards would be installed over the weir at the mill wheel to the height of the old gate, thus allowing the majority of flow to pass through the existing old sluice gate which will be refurbished and raised as necessary. Dam boards would be placed across the cascade weir, which would retained as an emergency overspill;
- The level of an existing ford would be raised to a level appropriate with new water levels;
- Immediately upstream of the bridge a mock ha-ha would be constructed across the low ground in front of the flood culverts. There is scope to construct a stile over the fence should public access be considered appropriate;

#### Downstream of Coleshill Bridge

- The bank on the south side of the watercourse would be pulled back and gently graded towards the invert of the flood culverts passing beneath the road;
- A new meandering river channel proposed along the existing line of the River Cole. Where the new river channel crosses the old, the bed level of the watercourse would be raised by approximately 1 m by backfilling the channel with excavated material. Gravel would be placed in the new channel at suitable locations to form riffles. The new course of the river would be designed to accommodate some of the old willows along the bank. A seasonal ford would be constructed across the river;
- The first meander, immediately downstream of the bridge would be extended back along the ditch line to allow flood waters to pass along existing low level farm ditches on the right bank allowing more frequent flooding of the fields. Increased frequency of flooding is anticipated in an

attempt to return areas to a hay meadow of similar floristic value as that which existed prior to engineering works carried out approximately 25 years ago. This would be done by returning river levels and flooding regimes to those which existed previously;

- Lengths of the existing course would be retained, connected to the new channel at one end to create backwater habitats providing shelter for fish, birds, and insects during high flows. The mature willows and an ash tree on the left bank would be retained;
- The inside of the bend to the south west of the fritillary field would be drawn back and the artificially high ground level reduced to allow out of bank flows during high water levels;
- Selective lowering of the bank would be carried out to allow flood waters to re enter the channel.
- An existing ditch on the left bank of the river would be partially dammed to allow the formation of a wide reedbed and wetland area in the low spots either side of the ditch. This would create additional habitat and provide secondary treatment of the water to help remove sediment and nutrients from the system;
- Three riffle areas would be created downstream of the remeandered section. These would serve as a series of natural looking weirs lowering the bed to its pre-scheme level. In addition these areas would provide instream habitat diversity;
- An existing stone gabion weir at the downstream end of the site would be reinforced with cobbles and/or gravels;

#### **The Core Scheme - Proposed Works**

- 4.12 The various aspects incorporated into the vision plan would cost over £330,000, an amount far in excess of the project budget. Consequently key aspects of the vision, identified as being necessary for the project to succeed were incorporated into a core design (Figure 9). It is anticipated that the core scheme will be added to, as and when, funds become available, in order to achieve the vision.

4.13 The core scheme comprises:

Above Coleshill Bridge

- The original channel to the west of the mill leat would be recreated and would take the majority of flow. A sweetening flow would be retained in the mill stream passing through the old sluice structure which may be refurbished at a later date. The offtake structure for the new channel will be a side weir on the left bank of the existing channel constructed from concrete with timber boards. A flow of 2.625 cumecs is predicted under normal conditions for the watercourse upstream of the bifurcation, south of the mill. It is estimated that 0.625 cumecs (approximately 25%) will pass down the mill leat with 2 cumecs flowing down the new river channel;
- A 50 m section of the mill channel will be diverted and narrowed. The lower reaches of Waterloo Ditch will be extended to join the diverted mill leat;
- seven steps weir may be refurbished with the possibility of installing a footbridge over the structure in the future.
- an Irish ford will be constructed to allow cattle to cross the new channel and pass over the mill stream via a bridge to reach the right bank, when flood levels are high. The mill stream will pass beneath the bridge in a box culvert (2.1 x 3.0 m). The banks around the structure will be reinforced with rock filled gabions treated with hydraulic mulch seeding.
- a control structure will be constructed at the upstream end of the syphon.
- dam boards would be placed across the cascade weir, which would be retained as an emergency overspill.
- the level of the existing ford immediately upstream of the bridge will be raised to a level appropriate with new water levels;

#### Below Coleshill Bridge

- The bank on the south side of the watercourse will be pulled back and gently graded towards the invert of the flood culverts passing beneath the road;
- It is proposed to raise bed levels by 1 m using compacted excavated material and re-meander two sections of the watercourse downstream of the bridge. Gravels will be placed at suitable locations to form riffles. The first meander, immediately downstream of the bridge will be extended back along the ditch line to allow flood waters to pass along existing low level farm ditches on the right bank allowing more frequent flooding of the fields. Increased frequency of flooding is anticipated in an attempt to return areas of the site to hay meadow of similar floristic value as that which existed prior to engineering works carried out approximately 25 years ago. This is to be done by returning river levels and flooding regimes to those which existed previously. Remeandering the river will entail re-locating an existing gate and culvert on the right bank of the river;
- The second section to be meandered commences immediately upstream of the fritillary field and extends to the border of the National Trust owned land. The inside of the bend to the south west of the fritillary field is to be drawn back and the artificially high ground level reduced to allow out of bank flows during high water levels. A gravel riffle, which will also serve as a ford during low flows will be created immediately upstream of the first bend. Willow spiling will be used locally to reinforce sections where the new channel crosses infilled sections of the old channel;
- This proposal will result in a 340 m section of overdeep channel with deep sluggish water being maintained between the two re-meandered sections. The morphological diversity and instream habitat within this section will be poor;
- Three riffle areas will be created downstream of the re-meandered section. These would serve as a series of natural looking weirs lowering the bed to its pre-scheme level. In addition these area will provide instream habitat diversity;



- An existing stone gabion weir at the downstream end of the site is to be reinforced with cobbles and/or gravels;
- At the downstream end of the site the right bank, which is at present artificially high will be drawn back to allow the drainage of flood waters over a 20-30 length of river bank.
- The equestrian strip which currently runs along the left bank will be realigned to run adjacent to the new channel.

4.14 Figures showing the detailed works, structures and channel cross sections are contained in Appendices 4, 5 and 6.

4.15 Access to the site downstream of Coleshill Bridge will be from the B4109 via a farm gate on the right bank of the river. Upstream access will be via the track to the mill house along the right bank. Construction activity and the movement of vehicles will be confined to the working areas illustrated in Figures 10 and 11. The construction compound will be located on the upstream side of the B4019 along the north western perimeter of the field adjacent to the river. (Figures 10 and 11).

4.16 The works are scheduled to be carried out from July 1995 and expected to last three months. Planting will be carried out the following Spring (March 1996)

In addition to the main works, certain preliminary maintenance works will be carried out in advance of the main contract, funded by the NRA Flood Defence budget. These works will include:

- Clearance of willows from the channel where the bed level is to be raised;
- Reed and macrophyte clearance from the channel. Wherever possible the vegetation will be stored and used for planting following the works;
- Heavy pollarding of the mature willows along the existing watercourse. If this work is carried out pre-restoration there is less risk of damage by contractors machinery;



- At the road bridge two flood culverts on the left bank are obstructed by sheep netting and vegetation. It is proposed to construct a mock ha-ha (a trench with fencing at the bottom) to control stock and keep the area clear for flood discharge;
- Desilting of the mill leat upstream of the mill structure.

## **5 CONSULTATIONS**

- 5.1 All members of the River Restoration Project core and steering groups have been fully involved in the scheme design over the course of the project including NRA fisheries, conservation, landscape and geomorphology specialists. The National Trust, Countryside Commission and English Nature have also had full involvement.
- 5.2 Tenants, local farmers, landowners and tenants, along with the parish council have all been consulted regarding the proposed enhancement works.
- 5.3 Wiltshire and Oxfordshire County Councils were contacted regarding possible sites of archaeological interest in the area.
- 5.4 Vale of White Horse District Council and Thamesdown Borough Council have been consulted regarding the need for planning permission for the scheme and both have confirmed that the proposals are classed as permitted development under the 1988 Town and Country Planning Act.

## **6 POTENTIAL IMPACTS AND MEASURES FOR MITIGATION**

- 6.1 For ease of reference these have been divided into construction and end state impacts.

### **Construction Impacts**

#### **Land Use**

- 6.2 Land adjacent to the river will be temporarily out of production during the construction period July - October 1995, with reinstatement and planting likely to continue through to March 1996. Recovery of land could take several years.
- 6.3 The RRP will be responsible for temporary losses of land resulting from construction impacts.

#### **Geomorphology**

- 6.4 The construction works, particularly those close to, or within the channel will result in increased turbidity and sedimentation downstream. This impact is however likely to be short term and will have a minimal impact.
- 6.5 Care will be taken when working along the river banks to ensure bank stability is maintained. This may at times necessitate the use of small machinery.

#### **Hydrology**

- 6.6 Flows will be maintained within the watercourse at all times.

#### **Water Quality**

- 6.7 During the construction works, suspended sediment within the channel will increase and will result in increased turbidity. To minimise this, all new stretches of watercourse will be constructed in the dry as far as possible and the period of work in the live watercourse minimised.

- 6.8 The NRA Pollution Prevention Guideline on Works in, Near or Liable to Affect Watercourses (PPG 5) will be followed. In addition a silt screen will be installed at the downstream end of the works.
- 6.9 Construction machinery and materials will be kept in an enclosed compound, away from the river, in order to minimise the risk of accidental spillages.

#### Conservation

- 6.10 In channel works will cause damage to existing marginal vegetation. This was of particular concern within the fritillary field as it was feared the valuable site might be adversely affected by the construction works. However further survey work revealed that the 2-5 m strip along the river bank was slightly raised, possibly due to spoil dumping, and of a lower floristic value than the rest of the field.
- 6.11 Damage will be minimised through the use of small machinery and any trees protected with chestnut fencing. All working areas will be delineated and a planting scheme undertaken on completion of the works.
- 6.12 Works within the channel may result in some instream disturbance to macroinvertebrates and their habitat. Any impacts will however be short term and a full recovery is anticipated.

#### Birds

- 6.13 Works will be carried out towards the end of the bird breeding season. Disturbance to nesting and breeding birds will be minimal.

#### Fisheries

- 6.14 Instream disturbance resulting from in channel works are unlikely to impact the fishery, as fish will move away from any disturbance to quieter reaches.

### Archaeology

- 6.15 Oxfordshire and Wiltshire County Councils have been consulted and have confirmed that there are unlikely to be any areas of archaeological interest within the site. Should any finds be uncovered the relevant County Archaeologist will be notified, and appropriate procedures followed in accordance with Planning Policy Guidance Note 16 : Archaeology and Planning.

### Recreation:

- 6.16 The work are likely to be underway during the coarse fishing season (16 June - 14 March) and will therefore cause some disruption to local anglers. However, any impacts will be relatively short term and it is hoped that in the long term, the works will improve the overall status of the fishery in this reach of river.

### Human Impact

- 6.17 The site is relatively remote and therefore any disruption resulting from the works will be minimal. There may be some disturbance to the Mill House and adjacent properties resulting from the movement of construction traffic and a small increase in the volume of traffic passing along the B4019.

### Waste Disposal

- 6.18 Excavated material arising from land lowering and realignment of the river will be used to partially infill the old river channel and the remainder will be transported off site for disposal.

### End State Impacts

### Land Use

- 6.19 The recreation of the former course of the Cole upstream of Coleshill Bridge, and the landtake involved for the creation of ponds and reed planting will result in the loss of productive farmland. In addition some areas of remaining land are likely to be less productive due to changes in the management regime eg higher water table and the increased frequency of small flood events, resulting in crop and stock restrictions. Access to some land may be seasonally restricted.

- 6.20 The National Trust are re-negotiating tenancy agreements with those tenants whose land is permanently affected by the works and increased flooding of their land.
- 6.21 The National Trust is encouraging farmers to enter into Countryside Stewardship Schemes which aim to support and reintroduce traditional management methods or modern equivalents to sustain and extend meadows and pasture and the wildlife they support. Under the scheme payments are made to farmers for adopting certain land management practices and to create new access to the land. This scheme may serve to encourage farmers to adopt the new management techniques.

#### Geomorphology

- 6.22 The recreated sinuosity of certain reaches are in keeping with the original planform of the river. The cross sectional form of the remeandered reaches of the channel will also seek to model a natural river, with asymmetrical cross sections on meander bends and more symmetrical section on straighter reaches. This more natural morphology should help create a self maintaining system.
- 6.23 Low flow velocities in the unimproved reach will result in a depositional environment, similar to that of an impounded watercourse. The reach will be of little or no habitat value for fish and the diversity of invertebrate species may be limited. In addition deposition will encourage reed growth within the channel.
- 6.24 Bank protection is generally considered to be unnecessary given that a natural, stable system is being recreated. In addition the soil has a high clay content and is likely to be relatively stable. However it may be necessary to protect the areas of new channel where it crosses the old course of the river. Willow spiling will be used on the outside of bends. The banks on National Trust property and those in up and downstream reaches will be monitored for signs of instability. Should any erosion become apparent remedial action will be taken.
- 6.25 Under flood conditions the increased frequency of out of bank events will encourage the deposition of silt on the floodplain, however under normal conditions, the problem of fine silt load within the river system is likely to remain, even with localised reed bed treatment.



- 6.26 The creation of reedbeds around the mouths of agricultural ditches on the site will, however, serve to remove localised silt and nutrients arising from agricultural activities and urban runoff
- 6.27 Introducing gravels into the system will serve to increase habitat diversity. As the sediment supply system is limited there may be some erosion of the substrate. However overbank spilling onto the floodplain will limit the energy in the channel available for sediment transport and should remain relatively stable. However the river is a dynamic system and higher flows may result in the redistribution of gravels.

#### Hydrology

- 6.28 Following completion of the works there will be increased interaction between the river and the floodplain, resulting from an increased frequency of flooding of certain areas, under lower return periods.
- 6.29 At present there is very little interaction between the river, its marginal vegetation and the floodplain as a whole. The restoration works will restore a more natural flooding regime with increased flooding of the land under lower order events, during the winter and spring months. This is in accordance with historical flooding regimes will discourage siltation in the river channel whilst encouraging deposition on the floodplain. It is anticipated that floodwaters will normally only remain for fairly short periods with the underlying gravels ensuring rapid drainage. In exceptional circumstances however the meadow may be covered with flood water for up to three weeks in winter. Benefits will include reductions in dredging and maintenance costs.
- 6.30 The effect of splitting flows at the upstream end of the site will divert the majority of flow down the new channel. A sweetening flow will be maintained in the new channel, however it is likely that during lower flows, the majority of flow will pass down the mill stream and the new channel may experience low flows during drier summer months. A 6" diameter pipe is to be incorporated within the bifurcation structure in order to maintain a minimum flow at all times. The pipe will be situated below bed level to allow water to percolate up through gravels on the downstream side of the structure.

- 6.31 The reintroduction of a sluice at the mill wheel will increase water levels in the mill stream.

#### Water Quality

- 6.32 The restoration works will reinstate the interaction between the river its floodplain, and waterside plant margins and will help reduce siltation during flood events. Although current quality achievement on this section of the Cole is 1B, small localised sub-catchments are drained by farm ditches that feed to the river. This run off is typically silt laden with high nutrient concentrations. Reed beds systems at the lower end of farm ditches are planned to help trap silts and reduce non-point inputs of nitrate and phosphates, and other chemical and biological loads arising from these ditches. In addition the retention of silt on the floodplain which would otherwise pass directly to the river will provide a greater opportunity for degradation of associated organics away from the watercourse.
- 6.33 Lowered nutrient loadings and silt free river bed will also reduce algal growth and promote the development of more diverse aquatic vegetation capable of sustaining a more extensive and diverse river fauna.
- 6.34 The creation of fast flowing riffle areas, will help increase dissolved oxygen levels in the water.
- 6.35 Improvements in water quality at the local level are anticipated to be significant. However due to the scale of the proposed works no significant improvements in the overall quality of the river system are anticipated.

#### Conservation

- 6.36 The river currently suffers from a lack of corridor habitat such as wetland areas and reed beds. The creation of more varied habitats and the introduction of wetland species will have significant conservation and wildlife benefits.
- 6.37 The reintroduction of meanders will increase the length of natural river and its associated habitat. This will have conservation benefits.

- 6.38 It is hoped that the restoration of historical river levels and flooding regimes will encourage the recovery of the once flower rich fritillary meadow, a former SSSI, de-notified when channel improvement works resulted in the lowering of water levels and decreased frequency of flooding. It is hoped to recreate the meadow habitat in the adjacent meadow. Floral differences are likely to occur throughout the field dependant on field drainage. Species such as Marsh Marigold (*Caltha palustris*) and Yellow Flag (*Iris pseudocacorus*) are likely to develop along the ditch edges and fritillary, knapweed, adderstongue (*Ophioglossum vulgatum*) and yellow rattle (*Rhinanthus minor*) on the higher ground.
- 6.39 The introduction of reed beds will provide will provide an opportunity for invertebrates and other faunal communities associated with this habitat to establish. The planting of additional trees and shrubs will also increase habitat diversity.
- 6.40 The 250 m section of river between the two remeandered sections will not be modified. This reach will remain significantly over deep, with low instream velocities. The resulting habitat will be of limited value for fish, particularly species which require gravel beds for spawning.
- 6.41 An improved variety of good quality habitats will encourage the development of more numerous and diverse invertebrate species on and adjacent to then site.

#### Birds

- 6.42 It is hoped that a more natural river environment and increased areas of wetland will encourage more extensive use of the area by wetland and other target bird species.

#### Fisheries

- 6.43 Coarse fish populations on the River Cole are dominated by a limited number of species. The creation of a more natural regime will improve river habitat and create a number of benefits for the fishery:
- clean bed substrate and a variety of flow patterns will be established.

- off river habitats of a relatively quiet nature will be established to provide backwaters and sheltered areas for fish.
  - aquatic and marginal plant diversity, appropriate to the river
  - improved oxygenation of the water, backside vegetation providing shade, less silt in the river.
- 6.44 The introduction of a more varied in stream habitat together with improved water quality should help ensure a healthy and more sustainable fishery is created. Improvements in the quality of the coarse fishery will result in significant benefits to anglers. There are at least two angling clubs along the Cole each with between 100 and 200 members. Improvements in water quality and the creation of a sustainable fishery will eliminate the need for restocking.
- 6.45 Conversely the 120 m un-enhanced reach of over deep, slack water between the two remeandered reaches will provide an unattractive habitat and sustain few fish.

#### Landscape

- 6.46 Raising bed levels and remeandering the river will bring the river back into contact with the floodplain and make it a more important feature in the local landscape. Views up and downstream of Coleshill Bridge will be improved.
- 6.47 Tree and shrub planting will improve the landscape and public amenity value of the site.

#### Archaeology

- 6.48 No archaeological impacts are anticipated.

#### Recreation

- 6.49 There is currently limited public access to the River Cole in this area, with public footpaths passing close to but not along the river within the study area. One of the aims of the RRP is to introduce public access to the area. As a result of the scheme the National Trust are pursuing this aim in consultation with the Local Authorities and maintain a commitment to promote access in the medium to long

term as part of the Great Western Community Forest project. If these proposals come to fruition there will be significant benefits to river users from the improved river landscape and amenity interest resulting from the project.

- 6.50 The predicted increased frequency of flooding will result in the football pitch being unplayable approximately twice as often as it is under current flooding regimes. The RRP has agreed to compensate Coleshill Football Club for loss of facilities. In addition a site has been identified on National Trust land which will be levelled off as part of the construction works. This site will only be used if the current pitch becomes unplayable.

#### Maintenance

- 6.51 Future responsibility for the maintenance of all rivers, ditches and streams on the site will remain as it is at present. The NRA will be responsible for the maintenance of designated main rivers under its permissive powers to carry out such works for flood alleviation purposes. The landowners/tenants will be responsible for maintaining all other watercourses. It is intended that a management plan for the site will be developed.

## **7 MONITORING**

- 7.1 A monitoring programme is planned to provide information which can be used to assess the success of the project and to provide information on the value of the river restoration for integrated catchment management. It will include sampling, monitoring and photographic records all taken from specific fixed points. At present monitoring is only funded until the end of 1996. Funding for a further three to five years is being sought.
- 7.2 It is hoped that this wide ranging programme will ensure that lessons learnt from the Cole and other projects will benefit rivers across the country and Europe.

## **8 CONCLUSION**

- 8.1 The works will result in a more natural river environment, with improved habitat and species diversity across the study site.
- 8.2 The scale of the project means that the extent to which environmental benefits for example such as improved water quality will be realised within the restored area and in the wider catchment is uncertain. The pre and post project monitoring will help verify and quantify the benefits of the scheme.
- 8.3 It is hoped to continue and progress the enhancement works, with the aim of achieving the scheme vision, as and when additional funds become available.

## **9 SUPPORTING DOCUMENTATION**

River Restoration Project 1995 UK Monitoring Programme -Year 1 (1994) Interim Report, RRP.

River Cole Landscape Assessment, January 1995, WS Atkins Planning Consultants on behalf of the River Restoration Project.

River Cole Morphological Survey, August 1994, NRA

Planning Policy Guidance Note 16 : Archaeology and Planning.

Pollution Prevention Guidelines on Works in, Near or Liable to Affect Watercourses (PPG5).

Rich, T. River Cole Restoration Programme, Botanical Survey, 1994



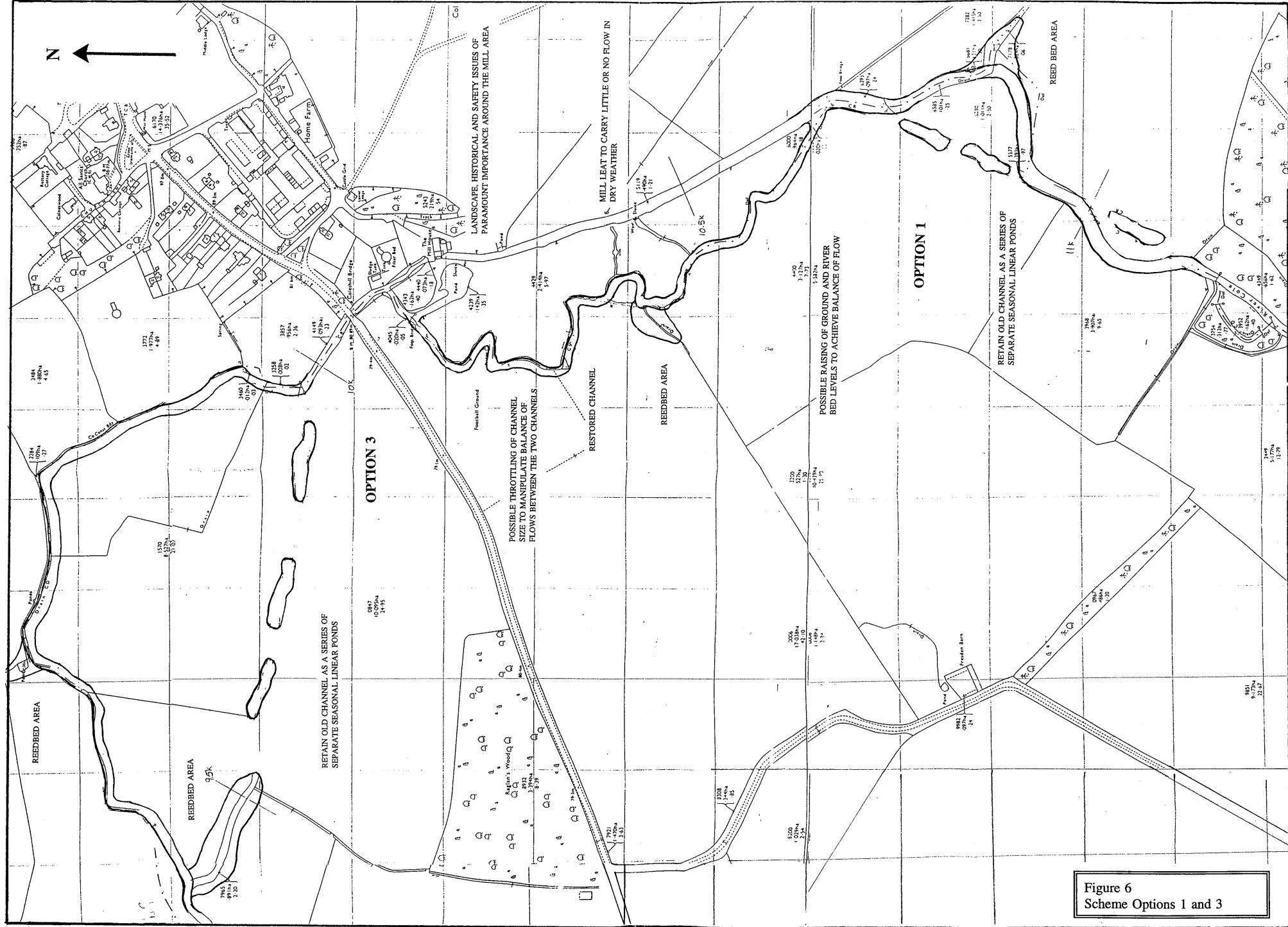
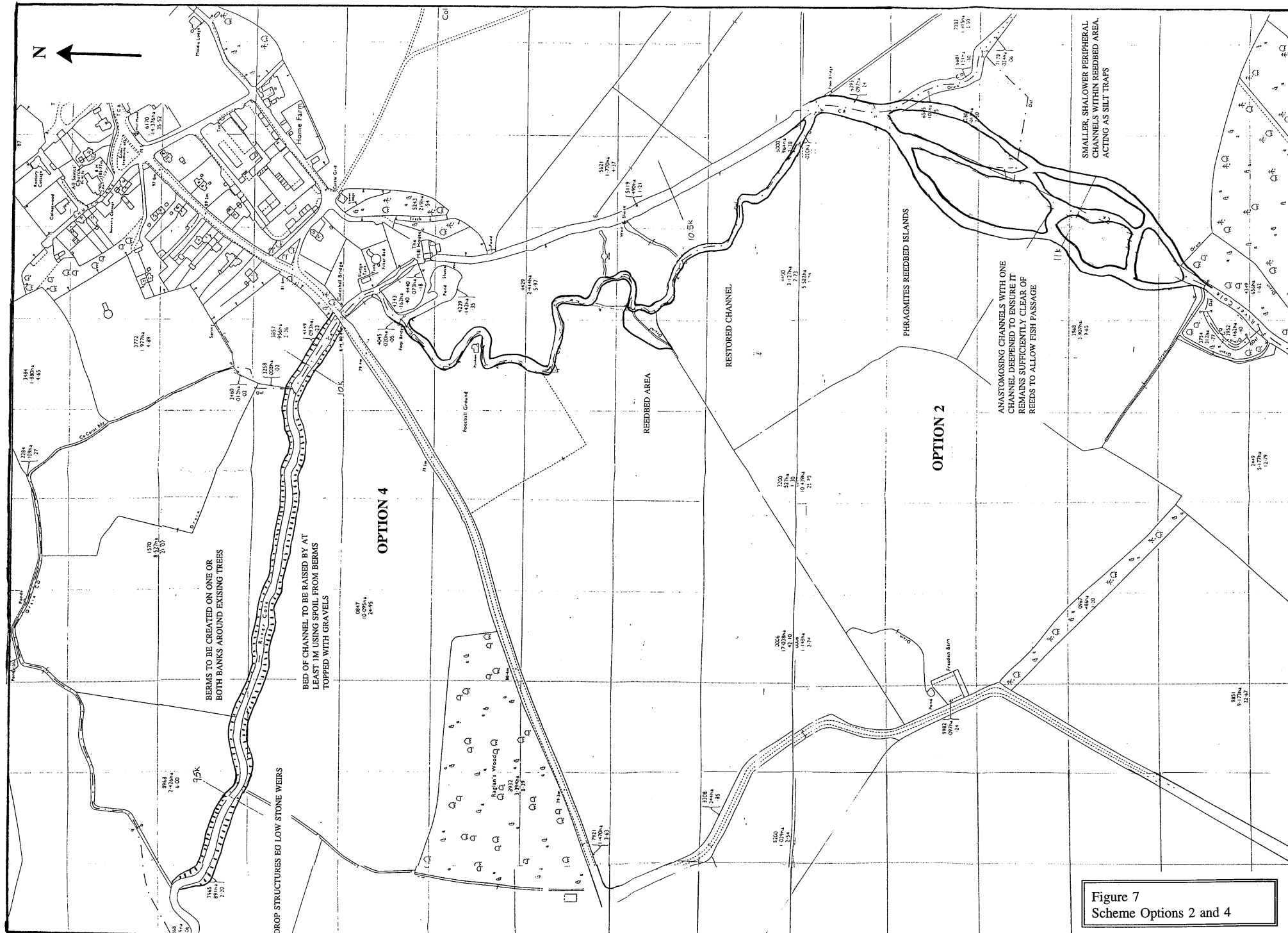


Figure 6  
Scheme Options 1 and 3







## **Appendix 1**

### **Species List : River Corridor Survey**



# Wetland Plant Species Recorded from the River Cole River Corridor Survey 1994

National Rarity Score			Downstream Control			Restoration Reach				Upstream Control		
Aquatics			1	2	3	4	5	6	7	8	9	
		<i>Callitriche</i> sp. (undet.)	Starwort Sp.	+	-	-	-	-	+	+	-	-
1		<i>Elodea canadensis</i>	Canadian Waterweed	-	-	-	-	-	+	-	-	-
1		<i>Elodea nuttallii</i>	Nuttall's Waterweed	-	-	-	+	+	+	-	-	-
1		<i>Lemna minor</i>	Common Duckweed	-	-	-	-	-	+	+	-	-
1		<i>Myriophyllum spicatum</i>	Spiked Water-milfoil	+	+	+	+	+	+	+	-	-
1		<i>Nuphar lutea</i>	Yellow Water-lily	-	+	+	+	+	+	+	+	+
2		<i>Potamogeton pectinatus</i>	Fennel Pondweed	-	-	-	+	+	+	-	-	-
2		<i>Ranunculus penicillatus</i>	Stream Water-crowfoot	-	-	+	+	+	+	-	-	-
2		<i>Sagittaria sagittifolia</i>	Arrowhead	-	-	-	-	-	+	+	-	-
1		<i>Sparganium emersum</i>	Unbranched Bur-reed	-	-	-	+	+	+	+	-	-
1		<i>Fontinalis antipyretica</i>	Willow Moss	-	-	+	+	+	-	-	-	-
Emergents												
1		<i>Agrostis stolonifera</i>	Creeping Bent	+	+	+	+	+	+	+	-	+
2		<i>Alisma lanceolatum</i>	Narrow-leaved Water-plantain	-	-	-	-	-	+	-	-	-
1		<i>Alisma plantago-aquatica</i>	Water-plantain	+	-	-	+	+	+	+	-	-
1		<i>Angelica sylvestris</i>	Wild Angelica	-	+	-	-	+	+	-	-	-
1		<i>Apium nodiflorum</i>	Fool's Water-cress	+	-	+	+	+	+	+	-	+
1		<i>Barbarea vulgaris</i>	Winter-cress	-	-	-	+	+	+	+	-	-
2		<i>Butomus umbellatus</i>	Flowering-rush	-	-	+	-	+	-	-	-	-
2		<i>Carex riparia</i>	Greater Pond-sedge	+	+	+	+	+	+	+	-	-
1		<i>Cirsium palustre</i>	Marsh Thistle	-	-	-	-	-	-	-	+	-
1		<i>Conium maculatum</i>	Hemlock	-	-	-	-	-	-	-	-	+
1		<i>Deschampsia caespitosa</i>	Tufted Hair-grass	+	-	-	-	-	-	-	+	-
1		<i>Epilobium hirsutum</i>	Great Willow-herb	+	+	+	+	+	+	+	+	+
1		<i>Eupatorium cannabinum</i>	Hemp-agrimony	-	+	+	+	-	+	+	-	+
1		<i>Filipendula ulmaria</i>	Meadowsweet	+	+	+	+	+	+	+	+	+
1		<i>Glyceria maxima</i>	Reed Sweet-grass	+	+	+	+	+	+	+	-	-
1		<i>Juncus inflexus</i>	Hard Rush	-	-	-	-	+	+	+	-	-
1		<i>Juncus effusus</i>	Soft-rush	-	-	-	-	+	+	+	-	-
1		<i>Lycopus europaeus</i>	Gipsywort	+	+	-	+	+	+	+	+	+
1		<i>Mentha aquatica</i>	Water Mint	-	-	-	-	+	+	+	-	-
1		<i>Myosotis laxa</i>	Tufted Forget-me-not	-	-	-	-	-	+	-	-	-
1		<i>Myosotis scorpioides</i>	Water Forget-me-not	+	-	-	+	+	+	+	+	+
2		<i>Myosoton aquaticum</i>	Water Chickweed	+	+	+	+	+	+	+	+	+
1		<i>Nasturtium officinale</i>	Water-cress	-	-	-	+	-	+	-	-	-
1		<i>Phalaris arundinacea</i>	Reed Canary-grass	+	+	+	+	+	+	-	+	+
1		<i>Phragmites australis</i>	Common Reed	+	-	-	-	-	-	-	-	-
1		<i>Polygonum amphibium</i>	Amphibious Bistort	+	+	+	-	-	+	+	-	-
1		<i>Polygonum hydropiper</i>	Water-pepper	+	-	-	+	+	+	+	+	+
1		<i>Polygonum persicaria</i>	Redshank	-	-	-	+	+	-	+	-	+
1		<i>Ranunculus sceleratus</i>	Celery-leaved Buttercup	+	-	-	+	-	+	-	-	-

National Rarity Score			Downstream Control			Restoration Reach				Upstream Control	
			1	2	3	4	5	6	7	8	9
1	<i>Rorippa palustris</i>	Marsh Yellow-cress	-	-	-	-	-	+	+	-	-
1	<i>Schoenoplectus lacustris</i>	Common Club-rush	+	+	+	+	+	+	+	-	+
1	<i>Scrophularia auriculata</i>	Water Figwort	-	-	+	+	+	+	+	-	+
1	<i>Scutellaria galericulata</i>	Skullcap	-	-	-	-	-	-	+	-	-
1	<i>Solanum dulcamara</i>	Bittersweet	+	+	+	+	+	+	+	+	-
1	<i>Sparganium erectum</i>	Branched Bur-reed	+	+	+	+	+	+	+	-	+
1	<i>Stachys palustris</i>	Marsh Woundwort	-	-	+	-	-	+	+	-	-
1	<i>Symphytum officinale</i>	Common Comfrey	+	+	+	+	+	+	-	+	+
1	<i>Typha latifolia</i>	Bulrush	-	-	-	-	-	-	+	-	-
1	<i>Veronica anagallis-aquatica</i>	Blue Water-speedwell	-	-	-	+	-	+	+	-	-
1	<i>Veronica beccabunga</i>	Brooklime	+	-	+	+	+	+	+	-	+
Trees and shrubs:											
1	<i>Alnus glutinosa</i>	Alder	+	-	-	+	-	-	-	-	-
1	<i>Salix alba</i>	White Willow	-	-	-	-	+	-	-	-	-
1	<i>Salix caprea</i>	Goat Willow	+	-	+	+	-	-	-	-	-
1	<i>Salix cinerea</i>	Grey Willow	+	+	+	+	-	-	-	+	+
1	<i>Salix fragilis</i>	Crack Willow	+	+	+	+	+	+	+	+	+
1	<i>Salix triandra</i>	Almond Willow	-	-	-	+	-	-	-	-	-
1	<i>Salix viminalis</i>	Osier	+	+	-	-	-	-	-	-	-
Number of plant species			28	20	25	36	34	43	35	14	20
Number of uncommon species			2	2	4	4	5	5	3	1	1
National conservation score			30	22	29	40	39	48	38	15	21
Species Rarity Index and conservation category			1.07 Mod	1.1 Mod	1.16 Mod	1.1 Mod	1.15 Mod	1.12 Mod	1.08 Mod	1.07 Mod	1.05 Mod



## **Appendix 2**

### **Species List : Floodplain Survey**



## Botanical Species Recorded from the River Cole Floodplain Survey 1994

The sites referred to are detailed within the full report.

### Site 1. Meadow

Description: An old flood meadow, grazed by cattle, with some poached areas. The sward is variable in height 5-30 cm, the thistles have been topped and the nettles sprayed. Has had N+P fertiliser this year. The meadow is somewhat improved and is generally species-poor.

Area recorded: A general meandering transect across the meadow including wet areas but excluding the river bank (Site 2) and the hedges on the north side (Sites 3 and 4).

Time spent recording: 20 minutes

<i>Agrostis capillaris</i> F	<i>Hordeum secalinum</i> O
<i>Agrostis stolonifera</i> O	<i>Lolium perenne</i> F
<i>Alopecurus pratensis</i> F	<i>Persicaria amphibia</i> R
<i>Bromus hordeaceus</i> O	<i>Phleum pratense</i> O
<i>Carex acutiformis</i> R	<i>Plantago major</i> O
<i>Cerastium fontanum</i> O	<i>Poa trivialis</i> F
<i>Cirsium arvense</i> O	<i>Ranunculus acris</i> O
<i>Cirsium vulgare</i> R	<i>Ranunculus repens</i> R
<i>Cynosurus cristatus</i> O	<i>Rumex acetosa</i> O
<i>Dactylis glomerata</i> F	<i>Rumex obtusifolius</i> R
<i>Deschampsia cespitosa</i> O	<i>Taraxacum officinale</i> R
<i>Holcus lanatus</i> LD	

### Site 2. River Cole by site 1.

Description: A river bank open to cattle with some poaching, with patches of swamp vegetation locally

Area recorded: River bank from the swamp edge to the top of the bank. The list is a bit of a mixture of meadow and swamp species.

Time spent recording: 20 minutes

<i>Agrostis stolonifera</i> A	<i>Juncus inflexus</i> R
<i>Angelica sylvestris</i> R	<i>Lamium album</i> R
<i>Apium nodiflorum</i> R	<i>Lathyrus pratensis</i> R
<i>Atriplex prostrata</i> R	<i>Lolium perenne</i> F
<i>Barbarea vulgaris</i> R	<i>Lycopus europaeus</i> R
<i>Bromus sterilis</i> R	<i>Mentha aquatica</i> R
<i>Capsella bursa-pastoris</i> R	<i>Myosotis scorpioides</i> O
<i>Cardamine flexuosa</i> R	<i>Persicaria amphibia</i> R
<i>Carduus crispus</i> R	<i>Persicaria hydropiper</i> R
<i>Carex riparia</i> LD	<i>Phalaris arundinacea</i> O
<i>Cirsium arvense</i> F	<i>Plantago major</i> R
<i>Cirsium vulgare</i> R	<i>Poa trivialis</i> F
<i>Conium maculatum</i> R	<i>Pulicaria dysenterica</i> R
<i>Dactylis glomerata</i> F	<i>Ranunculus repens</i> R
<i>Dipsacus fullonum</i> R	<i>Ranunculus sceleratus</i> R
<i>Elytrigia repens</i> R	<i>Rorippa palustris</i> R

*Prunus spinosa* O  
*Rosa arvensis* R  
*Rosa canina* R  
*Rubus ulmifolius* R  
*Rumex sanguineus* O  
*Sambucus nigra* R

*Symphytum uplandicum* R  
*Torilis japonica* O  
*Trifolium pratense* R  
*Tussilago farfara* R  
*Urtica dioica* LD

#### Site 8. Meadow by football pitch

Description: This meadow is probably improved and has been cut to 10 cm. Very few herbs are present. It is regularly flooded in winter.

Species recorded in cut grassland:

<i>Agrostis capillaris</i>	<i>Heracleum sphondylium</i>
<i>Arrhenatherum elatius</i>	<i>Holcus lanatus</i>
<i>Cirsium arvense</i>	<i>Hordeum secalinum</i>
<i>Dactylis glomerata</i>	<i>Urtica dioica</i>

There is a small old river course in the meadow south of the football pitch. It is silted up but at lower level than surrounding field. It has escaped being cut due to its lower level.

Area recorded: old river course only

Time spent recording: 4 minutes

*Agrostis stolonifera* F  
*Alopecurus pratensis* O  
*Anthriscus sylvestris* R  
*Arrhenatherum elatius* O  
*Cirsium arvense* R  
*Cirsium vulgare* R  
*Dactylis glomerata* F  
*Elytrigia repens* F  
*Galium aparine* O

*Heracleum sphondylium* R  
*Holcus lanatus* O  
*Hordeum secalinum* LD  
*Lolium perenne* O  
*Poa annua* R  
*Poa trivialis* LD  
*Stachys sylvatica* R  
*Urtica dioica* LD

#### Site 9. Football pitch

Description: The football pitch is regularly mown, and apparently flood in winter.

Area recorded: Penalty area at south end.

Time spent recording: 5 minutes whilst pitch was being cut

*Achillea millefolium* O  
*Agrostis capillaris* O  
*Centaurea nigra* O  
*Cynosurus cristatus* O  
*Dactylis glomerata* O  
*Hordeum secalinum* O  
*Leontodon autumnalis* O  
*Lolium perenne* D  
*Phleum pratense* O

*Plantago major* F  
*Poa annua* O  
*Potentilla reptans* O  
*Prunella vulgaris* R  
*Ranunculus repens* O  
*Taraxacum officinale* O  
*Trifolium pratense* O  
*Trifolium repens* A

Site 10. Meadow

This meadow had been cut and was not recorded in detail.

Alopecurus pratensis	Hordeum secalinum
Arrhenatherum elatius	Lolium perenne
Cirsium arvense	Ranunculus repens
Heracleum sphondylium	Urtica dioica
Holcus lanatus	

Site 11. Hedge/Old Channel

Description: This hedge was variable with areas at the north end dominated by trees (especially crack willows and poplars), patches of hawthorn and patches of nettles.

Area recorded: Recorded from west side, areas associated with hedge/old Channel only.

Time spent recording: 5 minutes

Canopy:	Herbs:
Crataegus monogyna D	Agrostis stolonifera O
Fraxinus excelsior R	Anthriscus sylvestris O
Populus X canescens R	Arrhenatherum elatius O
Rhamnus catharticus O	Bromus sterilis R
Rosa canina O	Bryonia dioica R
Salix alba R	Calystegia sepium R
Salix fragilis O	Carduus crispus R
Sambucus nigra R	Cirsium arvense O
Ulmus procera LD	Cirsium vulgare R
	Conium maculatum O
	Galium aparine F
	Glechoma hederacea R
	Heracleum sphondylium O
	Hordeum secalinum R
	Lapsana communis R
	Phleum pratense R
	Poa trivialis O
	Ranunculus repens R
	Rumex obtusifolius R
	Stachys sylvatica O
	Urtica dioica D

Site 12. Hedge by road by football pitch

Description: hedge dominated by hawthorn by road. The base of the hedge has been sprayed, with some spray on the hedge too. One new ash standard tree has been planted.

Area recorded: Hedge and one open patch of grassland by the bridge (recorded from south side, road verge excluded).

Time spent recording: 6 minutes

Canopy:	Herbs:
Acer campestre R	Anthriscus sylvestris O
Calystegia sepium R	Arrhenatherum elatius F
Crataegus monogyna D	Dactylis glomerata O
Fraxinus excelsior R	Galium aparine F
Prunus spinosa R	Heracleum sphondylium O
Rhamnus catharticus R	Holcus lanatus O
Rosa canina R	Lamium album R
Sambucus nigra R	Urtica dioica O
Ulmus procera LF	

Site 13. Hedge on north side of road

Description: an A-shaped hedge 1 m tall on a bank which drops away another metre from the road to the arable field. A few new oak standards have been planted.

Area recorded: Hedge and base only (recorded from north side, road verge excluded)

Time spent recording: 6 minutes

Canopy:

*Acer campestre* R  
*Crataegus monogyna* D  
*Fraxinus excelsior* F  
*Humulus lupulus* LD  
*Rhamnus catharticus* R  
*Rosa canina* R  
*Rubus caesius* R  
*Rubus ulmifolius* O  
*Sambucus nigra* R  
*Ulmus procera* LD

Herbs:

*Anthriscus sylvestris* O  
*Arrhenatherum elatius* O  
*Elytrigia repens* R  
*Galium aparine* F  
*Heracleum sphondylium* R  
*Stachys sylvatica* O  
*Urtica dioica* A

Site 14. Ley around margin of rape field

Description: The rape field had a 5 m wide strip of ley around an inner arable headland (Site 15). It was mown to 20 cm tall, and grades into headland and river bank.

Area recorded: Some grasses difficult to record frequency due to mowing.

Time spent recording: 15 minutes

*Achillea millefolium* R  
*Alopecurus pratensis* O  
*Anthriscus sylvestris* R  
*Arctium lappa* R  
*Arrhenatherum elatius* R  
*Cirsium arvense* R  
*Dactylis glomerata* O  
*Dipsacus fullonum* R  
*Equisetum arvense* R  
*Heracleum sphondylium* O  
*Lolium perenne* D  
*Matricaria discoidea* R

*Phleum pratense* F  
*Plantago major* LF  
*Poa annua* O  
*Poa trivialis* R  
*Ranunculus repens* O  
*Rumex crispus* O  
*Rumex obtusifolius* O  
*Taraxacum officinale* R  
*Tragopogon pratensis* R  
*Trifolium repens* A

Site 15. Headland

Description: Rape field itself is almost exclusively rape, with very few weeds.

Area recorded: 10 m wide strip around headland all way round field

Time spent recording: 30 minutes

*Aethusa cynapium* R  
*Alopecurus myosuroides* O  
*Alopecurus pratensis* R  
*Atriplex patula* F  
*Atriplex prostrata* R  
*Avena fatua* R  
*Capsella bursa-pastoris* O  
*Chenopodium album* A

*Lolium perenne* D  
*Myosotis arvensis* R  
*Papaver lecoqii* R  
*Persicaria lapathifolia* F  
*Persicaria maculosa* O  
*Plantago major* O  
*Poa annua* O  
*Polygonum aviculare* R

Chenopodium polyspermum D  
 Cirsium arvense R  
 Cirsium vulgare R  
 Conium maculatum R  
 Coronopus squamatus F  
 Equisetum arvense R  
 Fallopia convolvulus R  
 Galium aparine R  
 Geranium dissectum R  
 Lamium purpureum R

Ranunculus repens O  
 Senecio vulgaris O  
 Sinapis arvensis R  
 Sonchus asper F  
 Stellaria media F  
 Thlaspi arvense R  
 Tripleurospermum inodorum F  
 Urtica dioica R  
 Veronica persica O

#### Site 16. River bank adjacent to rape field

Description: The river bank is dominated by nettles. The banks are steep and steep (3 m drop)

Area recorded: River banks only to change of slope at top.

Time spent recording: 10 minutes

Achillea millefolium R  
 Agrostis capillaris O  
 Anthriscus sylvestris F  
 Arrhenatherum elatius F  
 Calystegia sepium F  
 Cirsium arvense O  
 Cirsium vulgare R  
 Conium maculatum O  
 Crataegus monogyna O  
 Dactylis glomerata O  
 Dipsacus fullonum R  
 Elytrigia repens R  
 Epilobium hirsutum O  
 Equisetum arvense R

Heracleum sphondylium O  
 Poa trivialis O  
 Rosa canina O  
 Rumex crispus R  
 Rumex obtusifolius O  
 Rumex sanguineus R  
 Salix caprea R  
 Salix cinerea O  
 Salix fragilis R  
 Solanum dulcamara R  
 Symphytum uplandicum O  
 Torilis japonica R  
 Urtica dioica D

#### Site 17. Hedge

Description: This hedge between two rape fields to 1 m tall, 50 cm wide, not laid, species-poor. There is a ditch on the north side (Site 18). The base has been sprayed.

Area recorded: Hedge only recorded, excluding field margin (Site 16), and recorded from south side.

Time spent recording: 10 minutes

##### Canopy:

Bryonia dioica O  
 Calystegia sepium R  
 Crataegus monogyna D  
 Hedera helix O  
 Quercus robur R (+ one standard)  
 Rosa canina O  
 Rubus ulmifolius O  
 Sambucus nigra O  
 Tamus communis R

##### Herbs:

Anthriscus sylvestris O  
 Arctium lappa R  
 Arctium minus subsp. minus R  
 Arrhenatherum elatius O  
 Bromus sterilis F  
 Chaerophyllum temulentum R  
 Cirsium arvense O  
 Elytrigia repens O  
 Equisetum arvense R  
 Galium aparine A  
 Geranium dissectum LA  
 Heracleum sphondylium O  
 Hordeum secalinum R

*Lapsana communis* F  
*Lolium perenne* O  
*Poa trivialis* F  
*Triticum aestivum* R  
*Urtica dioica* A  
*Vicia cracca* R

#### Site 18. Ditch

Description: This ditch was 2m deep, lined with nettles on north side, and had a hedge (Site 17) on the south side. Ditch had 10 cm water, which was not flowing.

Area recorded: Ditch and banks (not hedge), recorded from north side.

Time spent recording: 7 minutes

<i>Arrhenatherum elatius</i> F	<i>Lapsana communis</i> R
<i>Calystegia sepium</i> F	<i>Phalaris arundinacea</i> D
<i>Epilobium hirsutum</i> R	<i>Rumex sanguineus</i> R
<i>Equisetum arvense</i> R	<i>Solanum dulcamara</i> R
<i>Filipendula ulmaria</i> F	<i>Sonchus asper</i> R
<i>Geranium dissectum</i> R	<i>Symphytum uplandicum</i> O
<i>Heracleum sphondylium</i> R	<i>Urtica dioica</i> D

#### Site 19. Ley around margins of rape field

Description: An improved rye grass ley 4-5 m wide around a rape field outside the headland (Site 20).

Area recorded: Ley only.

Time spent recording: 15 minutes

<i>Capsella bursa-pastoris</i> O	<i>Polygonum aviculare</i> R
<i>Cirsium arvense</i> R	<i>Ranunculus repens</i> R
<i>Coronopus squamatus</i> R	<i>Rumex crispus</i> R
<i>Dactylis glomerata</i>	<i>Rumex obtusifolius</i> F
<i>Equisetum arvense</i> R	<i>Sonchus asper</i> R
<i>Geranium dissectum</i> R	<i>Taraxacum officinale</i> R
<i>Lolium perenne</i> D	<i>Trifolium pratense</i> R
<i>Phleum pratense</i> O	<i>Trifolium repens</i> A
<i>Plantago major</i> R	<i>Tripleurospermum inodorum</i> R
<i>Poa annua</i> R	

#### Site 20. Headland around rape field

Description: A weedy headland around a rape crop. Often quite grassy, open variable in composition. No weeds in rape crop.

Area recorded: Headland only.

Time spent recording: 20 minutes

<i>Alopecurus myosuroides</i> O	<i>Papaver lecoqii</i> R
<i>Arctium seedling</i> R	<i>Persicaria lapathifolia</i> O
<i>Atriplex patula</i> O	<i>Persicaria maculosa</i> O
<i>Atriplex prostrata</i> R	<i>Polygonum aviculare</i> O
<i>Capsella bursa-pastoris</i> O	<i>Rumex crispus</i> R
<i>Carduus crispus</i> O	<i>Senecio vulgaris</i> O
<i>Chenopodium album</i> F	<i>Silene alba</i> R
<i>Chenopodium polyspermum</i> LA	<i>Sinapis arvensis</i> O



*Coronopus squamatus* F  
*Fallopia convolvulus* R  
*Fumaria officinalis* R  
*Geranium dissectum* O  
*Lamium purpureum* R  
*Lolium perenne* D  
*Myosotis arvensis* R

*Sisymbrium officinale* R  
*Sonchus asper* F  
*Stellaria media* F  
*Thlaspi arvense* O  
*Trifolium repens* R  
*Tripleurospermum inodorum* O  
*Triticum aestivum* R

#### Site 21. River bank by rape field

Description: Steep sinuous banks of river dominated by nettles with a 4-5 m drop to river.

Area recorded: River banks to change of slope at top.

Time spent recording: 20 minutes

*Agrostis capillaris* R  
*Anthriscus sylvestris* O  
*Arctium lappa* O  
*Arctium minus* subsp *minus* R  
*Arrhenatherum elatius* A  
*Bryonia dioica* O  
*Calystegia sepium* F  
*Carduus crispus* R  
*Carex riparia* O  
*Cirsium arvense* O  
*Conium maculatum* O  
*Crataegus monogyna* O  
*Dactylis glomerata* O  
*Dactylis glomerata* O  
*Dipsacus fullonum* R  
*Elytrigia repens* O  
*Equisetum arvense* O  
*Filipendula ulmaria* O

*Galium aparine* F  
*Heracleum sphondylium* O  
*Lapsana communis* R  
*Lapsana communis* R  
*Phalaris arundinacea* F  
*Phleum pratense* O  
*Phleum pratense* R  
*Poa trivialis* O  
*Rosa canina* R  
*Rubus ulmifolius* R  
*Rumex crispus* F  
*Salix fragilis* O  
*Scrophularia auriculata* O  
*Solanum dulcamara* O  
*Sonchus asper* R  
*Symphytum uplandicum* O  
*Urtica dioica* D

#### Site 22. Ditch

Description: This ditch was by arable land and was not grazed. It was dominated by tall nettles with occasional hawthorn trees.

Area recorded: Ditch and banks only.

Time spent recording: 7 minutes

*Anthriscus sylvestris* R  
*Arrhenatherum elatius* A  
*Ballota nigra* R  
*Calystegia sepium* A  
*Carduus crispus* R  
*Cirsium arvense* O  
*Elytrigia repens* O  
*Epilobium hirsutum* R  
*Equisetum arvense* R  
*Filipendula ulmaria* F  
*Galium aparine* F  
*Heracleum sphondylium* R  
*Lapsana communis* R

*Lathyrus pratensis* R  
*Persicaria amphibia* R  
*Phalaris arundinacea* R  
*Poa trivialis* R  
*Prunus spinosa* R  
*Rosa canina* R  
*Rumex sanguineus* R  
*Sparganium erectum* O  
*Stachys sylvatica* R  
*Symphytum uplandicum* R  
*Urtica dioica* D  
*Vicia cracca* R

Site 23. Three improved fields

Description: Improved pastures outside inner study areas, cut and now grazed. Fields separated by hawthorn hedges to 1 m, cut, with a ditch on the north west side.

Main species in grassland:

*Dactylis glomerata*  
*Lolium perenne*  
*Holcus lanatus*  
*Ranunculus acris*  
*Taraxacum officinale*

Site 24. Species-rich Meadow

Description: A grazed grassland with variable sward height grazed by horses. Quite species-rich and not improved. Some large thistle patches present.

Area recorded: Grassland only recorded, not river banks.

Time spent recording: 15 minutes

<i>Achillea millefolium</i> R	<i>Plantago lanceolata</i> R
<i>Agrostis capillaris</i> F	<i>Plantago major</i> O
<i>Bellis perennis</i> O	<i>Poa annua</i> O
<i>Bromus commutatus</i> O	<i>Poa trivialis</i> O
<i>Centaurea nigra</i> R	<i>Poa trivialis</i> O
<i>Cirsium arvense</i> LD	<i>Potentilla reptans</i> R
<i>Cirsium vulgare</i> R	<i>Prunella vulgaris</i> O
<i>Cynosurus cristatus</i> O	<i>Ranunculus acris</i> O
<i>Dactylis glomerata</i> F	<i>Ranunculus bulbosus</i> O
<i>Deschampsia cespitosa</i> O	<i>Ranunculus repens</i> O
<i>Galium verum</i> R	<i>Rumex acetosa</i> R
<i>Holcus lanatus</i> O	<i>Rumex acetosa</i> R
<i>Hordeum secalinum</i> F	<i>Taraxacum officinale</i> R
<i>Leontodon autumnalis</i> R	<i>Trifolium fragiferum</i> R
<i>Leucanthemum vulgare</i> R	<i>Trifolium pratense</i> O
<i>Lolium perenne</i> O	<i>Trifolium repens</i> O
<i>Lotus corniculatus</i> O	<i>Trisetum flavescens</i> R
<i>Phleum pratense</i> O	

Site 25. Watchfield Common Wood

This woodland is outside the inner study area so was only briefly noted. It was chestnut and poplar plantation over nettles with a little ash. On the river floodplain the canopy was mainly ash over nettles.

Site 26. Grove Copse

This woodland is outside the inner study area so was only briefly noted. It was dense spruce plantation over nettles..

Site 27. Tellhard's Copse

This woodland is outside the inner study area so was only briefly noted. The wood was variable with a poplar plantation on floodplain to 25 m tall:

*Populus x canadensis* D  
*Urtica dioica* D  
*Sambucus nigra* D  
*Galium aparine* A  
*Alliaria petiolata* A  
*Heracleum sphondylium* O  
*Equisetum telmateia* R  
*Phragmites communis* R

On the slope to the west over old ridge and furrow, indicating that the woodland is unlikely to be ancient, and the same may apply to the other woods. It was an ash wood over nettles under planted with spruce and chestnut. In ground layer were patches with *Allium ursinum*, *Ribes rubrum*, *Filipendula ulmaria* and *Poa trivialis*.

Site 28. Ditch on north side of Tellhard's Copse

Description: Dense nettles on ditch on north side of poplar plantation, with more open patches nearer river with reeds.

Area recorded: Ditch outside fence only. Recorded from north side.

Time spent recording: 3 minutes

<i>Alopecurus pratensis</i> R	<i>Heracleum sphondylium</i> R
<i>Arrhenatherum elatius</i> R	<i>Lycopus europaeus</i> R
<i>Calystegia sepium</i> A	<i>Phragmites communis</i> D
<i>Carduus crispus</i> R	<i>Salix fragilis</i> R
<i>Cirsium arvense</i> R	<i>Solanum dulcamara</i> R
<i>Festuca gigantea</i> R	<i>Stachys sylvatica</i> R
<i>Filipendula ulmaria</i> O	<i>Urtica dioica</i> D
<i>Galium aparine</i> F	

Site 29. Meadow

Description: An improved cut meadow, now cattle grazed, 10 cm tall, very few herbs present.

<i>Cirsium arvense</i>	<i>Plantago lanceolata</i>
<i>Dactylis glomerata</i>	<i>Ranunculus acris</i>
<i>Deschampsia cespitosa</i>	<i>Ranunculus repens</i>
<i>Festuca rubra</i>	<i>Rumex acetosa</i>
<i>Filipendula vulgaris</i> (1 plant seen)	<i>Taraxacum officinale</i>
<i>Heracleum sphondylium</i>	
<i>Holcus lanatus</i>	
<i>Lolium perenne</i>	

Site 30. River Cole banks

Description: Banks of the river with reed sweet grass, fenced from the cattle in the adjacent meadow.

Area recorded: River banks to fence.

Time spent recording: 10 minutes

Trees:

*Crataegus monogyna*

*Fraxinus excelsior*

*Salix fragilis*

Herbs:

*Alliaria petiolata* R

*Alopecurus pratensis* F

*Anthriscus sylvestris* F

*Arctium lappa* R

*Arrhenatherum elatius* F

*Calystegia sepium* F

*Carduus crispus* O

*Cirsium arvense* F

*Cirsium vulgare* R

*Conium maculatum* F

*Dactylis glomerata* O

*Dipsacus fullonum* R

*Epilobium hirsutum* F

*Filipendula ulmaria* O

*Galium aparine* F

*Glyceria maxima* LA

*Heracleum sphondylium* R

*Hordeum secalinum* R

*Humulus lupulus* R

*Lapsana communis* R

*Myosotis scorpioides* R

*Persicaria amphibia* R

*Phalaris arundinacea* F

*Poa trivialis* F

*Ranunculus repens* R

*Rumex obtusifolius* F

*Stachys palustris* R

*Symphytum uplandicum* F

*Urtica dioica* A

*Vicia cracca* R

Site 31. Wet hollow in meadow under crack willow

Description: A wet hollow lined with pollarded crack willow along an old river backwater. Trampled and poached under the trees, with open vegetation, shaded.

Also present was a cow stuck in a tree, which we later rescued with the fire brigade.

Area recorded: Wet hollow under willow pollards.

Time spent recording: 10 minutes

*Agrostis stolonifera* F

*Apium nodiflorum* R

*Atriplex prostrata* R

*Callitriche stagnalis* A

*Cardamine flexuosa* R

*Cardamine pratensis* R

*Dipsacus fullonum* R

*Glyceria maxima* R

*Myosotis scorpioides* O

*Persicaria maculosa* R

*Plantago major* R

*Poa trivialis* F

*Ranunculus sceleratus* F

*Rorippa nasturtium-aquaticum* aggregate O

*Rorippa palustris* F

*Rumex obtusifolius* R

*Stellaria media* R

*Veronica beccabunga* O

*Veronica catenata* A

Site 32. Ditch between meadows 29 and 33

Description: A ditch 2 m wide and 0.5 m deep, patchy swamp vegetation along its length, fenced.

Area recorded: Areas of ditch inside fences, viewed from north side

Time spent recording: 15 minutes

Angelica sylvestris O  
Arrhenatherum elatius F  
Calystegia sepium F  
Carex acutiformis R  
Carex riparia LD  
Cirsium arvense F  
Cirsium vulgare R  
Conium maculatum R  
Crataegus monogyna F  
Dactylis glomerata O  
Dipsacus fullonum R  
Elytrigia repens R  
Eupatorium cannabinum R  
Filipendula ulmaria A  
Galium aparine  
Geranium dissectum R

Glyceria maxima VLD  
Heracleum sphondylium R  
Lapsana communis R  
Lycopus europaeus R  
Myosotis scorpioides R  
Phalaris arundinacea O  
Potentilla reptans R  
Rosa canina O  
Rumex hydrolapathum O  
Rumex sanguineus R  
Senecio erucifolius R  
Solanum dulcamara O  
Sparganium erectum O  
Stachys palustris R  
Symphytum uplandicum O  
Urtica dioica LD  
Vicia cracca R

Site 33. Meadow

A meadow mown to 10 cm tall so not recorded in detail, very dull.

Cirsium arvense  
Dactylis glomerata  
Deschampsia cespitosa  
Festuca rubra  
Heracleum sphondylium  
Holcus lanatus  
Lolium perenne

Phleum pratense  
Plantago major  
Quercus seedling  
Taraxacum officinale  
Trifolium repens

Site 34. River Cole bank

Description: Bank of the River Cole fenced from meadow, to 1 m tall.

Area recorded: Banks to fence edge.

Time spent recording: 7 minutes

Achillea millefolium R  
Alopecurus pratensis R  
Angelica sylvestris R  
Anthriscus sylvestris R  
Arrhenatherum elatius F  
Atriplex patula R  
Bromus sterilis O  
Calystegia sepium O  
Carex riparia R  
Cirsium arvense F  
Conium maculatum R  
Dactylis glomerata LF  
Dipsacus fullonum R  
Elytrigia repens R  
Epilobium hirsutum O  
Eupatorium cannabinum R

Juncus effusus R  
Juncus inflexus R  
Lapsana communis R  
Lathyrus pratensis R  
Lolium perenne F  
Lycopus europaeus R  
Mentha aquatica R  
Persicaria maculosa R  
Poa trivialis F  
Ranunculus sceleratus R  
Rumex obtusifolius R  
Rumex sanguineus O  
Salix fragilis O  
Scrophularia auriculata R  
Sonchus asper O  
Tripleurospermum inodorum R

Filipendula ulmaria F  
Galium aparine F  
Geranium dissectum R  
Glyceria maxima LD  
Heracleum sphondylium O  
Holcus lanatus LF

Urtica dioica A  
Vicia cracca R

Site 35. Ditch between meadows 33 and 36

Description: A ditch with vegetation 2 m tall from water. The water was 1 m wide, and slow flowing. Fenced on both sides.

Area recorded: Areas inside fence, recorded from north side.

Time spent recording: 20 minutes

Shrubs:

Crataegus monogyna O  
Prunus spinosa R  
Salix caprea R

Herbs:

Achillea millefolium R  
Angelica sylvestris R  
Anthriscus sylvestris O  
Apium nodiflorum R  
Arrhenatherum elatius F  
Calystegia sepium R  
Carex acutiformis LD  
Carex riparia R  
Cirsium arvense O  
Cirsium vulgare R  
Conium maculatum O  
Dactylis glomerata R  
Deschampsia cespitosa R  
Dipsacus fullonum R  
Elytrigia repens R  
Epilobium hirsutum D  
Equisetum palustre F  
Eupatorium cannabinum O  
Filipendula ulmaria F  
Galium aparine F

Glyceria fluitans R  
Heracleum sphondylium R  
Iris pseudacorus R  
Juncus inflexus O  
Lapsana communis R  
Lathyrus pratensis O  
Lysimachia nummularium R  
Myosotis scorpioides R  
Persicaria amphibia O  
Plantago lanceolata R  
Rorippa microphylla R  
Rubus idaeus O  
Rubus ulmifolius R  
Scrophularia auriculata R  
Solanum dulcamara R  
Sparganium erectum R  
Symphytum uplandicum F  
Torilis japonica R  
Urtica dioica LD  
Veronica anagallis-aquatica R

Site 36. Meadow

Description: Improved pasture, mown, species-poor, uniform, on slope above river. There is some ridge and furrow near the Lodge.

General grassland:

Agrostis capillaris  
Agrostis stolonifera  
Conium maculatum  
Dactylis glomerata  
Lolium perenne  
Phleum pratense  
Poa trivialis  
Ranunculus repens  
Rumex obtusifolius  
Taraxacum officinale  
Trifolium repens

Edges:

Anthriscus sylvestris  
Deschampsia cespitosa  
Heracleum sphondylium  
Rumex sanguineus

Scattered trees:  
*Crataegus monogyna*  
*Fagus sylvatica*  
*Fraxinus excelsior*  
*Populus nigra* agg.  
*Quercus cerris*  
*Quercus robur*

Bank in field near river:  
*Bellis perennis*  
*Cynosurus cristatus*  
*Hordeum secalinum*  
*Lotus corniculatus*  
*Ranunculus acris*  
*Trifolium pratense*

Site 37. River Cole bank by field

Description: A patchy bank-side vegetation with scrub and grassland with nettles. Bank steep.

Area recorded: Areas outside fence to river.

Time spent recording: 12 minutes

*Acer pseudoplatanus* R  
*Anthriscus sylvestris* O  
*Arrhenatherum elatius* O  
*Cirsium arvense* R  
*Conium maculatum* O  
*Crataegus monogyna* F  
*Dactylis glomerata* O  
*Epilobium hirsutum* O  
*Equisetum arvense* R  
*Euonymus europaeus* R  
*Filipendula ulmaria* O  
*Glyceria maxima* O  
*Hedera helix* R  
*Heracleum sphondylium* R  
*Lolium perenne* O

*Myosotis scorpioides* R  
*Poa trivialis* O  
*Populus tremula* F  
*Prunus spinosa* R  
*Quercus robur* R  
*Rosa canina* F  
*Rosa canina* O  
*Rubus ulmifolius* O  
*Rumex sanguineus* O  
*Salix fragilis* R  
*Solanum dulcamara* R  
*Symphytum uplandicum* O  
*Ulmus procera* F  
*Urtica dioica* F

Site 38. Meadow

Description: An improved meadow, cut, with planted hybrid limes trees by road.

*Agrostis capillaris*  
*Capsella bursa-pastoris*  
*Elytrigia repens*  
*Hordeum secalinum*  
*Lolium perenne*  
*Plantago major*  
*Rumex obtusifolius*  
*Taraxacum officinale*

Site 39. River Cole Bank

Description: Crack willow woodland along River Bank to 20 m tall.  
Area recorded: Area outside fence to water edge.  
Time spent recording: 3 minutes

Canopy:

*Hedera helix*  
*Prunus spinosa*  
*Rhamnus catharticus*  
*Salix alba*  
*Salix fragilis*  
*Sambucus nigra*  
*Ulmus procera*

Herbs:

*Agrostis stolonifera*  
*Anthriscus sylvestris*  
*Carduus crispus*  
*Cirsium arvense*  
*Cirsium vulgare*  
*Dactylis glomerata*  
*Elytrigia repens*  
*Galium aparine*  
*Rumex obtusifolius*  
*Urtica dioica*

Site 40. Ditch edge of arable field

Description: A narrow ditch along the edge of a rape field.  
Area recorded: Ditch only (c. 1 m wide)  
Time spent recording: 3 minutes

*Angelica sylvestris* R  
*Bromus commutatus* R  
*Bromus sterilis* D  
*Carduus crispus* R  
*Cirsium vulgare* R

*Conium maculatum* R  
*Epilobium hirsutum* O  
*Filipendula ulmaria* R  
*Heracleum sphondylium* R  
*Ranunculus repens* R  
*Rumex obtusifolius* O  
*Sonchus arvensis* R  
*Stachys sylvatica* R  
*Urtica dioica* D

Site 41. Weeds in Rape field

Description: A rape field planted up to the river bank edge with a very narrow path. Edges of field had sprayed grass.  
Area recorded: Edge of rape field along by river, with occasional excursions into meadow and around east side.  
Time spent recording: 10 minutes

*Arctium lappa* R  
*Atriplex patula* R  
*Bromus hordeaceus* O  
*Bromus racemosus* R  
*Bromus sterilis* F  
*Capsella bursa-pastoris* R  
*Carduus crispus* R  
*Chenopodium album* R  
*Chenopodium polyspermum* F  
*Cirsium arvense* R  
*Conium maculatum* R  
*Coronopus squamatus* R  
*Dipsacus fullonum* R  
*Elytrigia repens* R  
*Equisetum arvense* R

*Fallopia convolvulus* R  
*Galium aparine* O  
*Geranium dissectum* R  
*Lapsana communis* R  
*Lapsana communis* R  
*Matricaria discoidea* R  
*Persicaria lapathifolia* O  
*Plantago major* R  
*Poa trivialis* O  
*Rumex obtusifolius* R  
*Senecio vulgaris* R  
*Sinapis arvensis* R  
*Sonchus asper* O  
*Stellaria media* R  
*Tripleurospermum inodorum* R  
*Urtica dioica* F



Site 42. River bank by field 41

Description: A patchy river bank with scrub and nettles.

Area recorded: Difficult to see bank and recorded from top of bank.

The middle section was done very briefly due to bee swarm!

Time spent recording: 10 minutes

Shrubs:

Acer campestre R  
Crataegus monogyna F  
Fraxinus excelsior R  
Juglans regia R  
Prunus spinosa LD  
Rhamnus catharticus R  
Rosa canina R  
Salix fragilis F  
Sambucus nigra O

Herbs:

Alopecurus pratensis R  
Arctium lappa R  
Arrhenatherum elatius F  
Bromus racemosus R  
Calystegia sepium O  
Conium maculatum O  
Elytrigia repens O  
Galium aparine F  
Geranium dissectum R  
Heracleum sphondylium O  
Phalaris arundinacea R  
Rubus ulmifolius R  
Symphytum uplandicum O  
Urtica dioica D

Site 43. Field boundary between fields 41 and 44 (east side of Fritillary meadow)

Description: Vegetation along a fence line dominated by nettles.

Area recorded: Fence line. Difficult to define limits of area, the fields and their weeds not included.

Time spent recording: 5 minutes

Anthriscus sylvestris O  
Arrhenatherum elatius F  
Avena fatua R  
Bromus hordeaceus R  
Bromus sterilis R  
Cirsium arvense R  
Elytrigia repens O  
Festuca pratensis R  
Filipendula ulmaria R  
Galium aparine D  
Galium verum R

Heracleum sphondylium F  
Holcus lanatus R  
Persicaria lapathifolia R  
Rumex obtusifolius R  
Sambucus nigra R  
Urtica dioica D  
Vicia cracca R

Site 44. Fritillary meadow

Description: A relatively species-rich meadow reported to have fritillaries (none seen). Meadow uncut and ungrazed, to 1 m tall but much grass lodged. More rank on north side.

Area recorded: Meadow only

Time spent recording: 25 minutes

Grasses:

Agrostis gigantea F  
Agrostis stolonifera O  
Alopecurus pratensis F  
Anthoxanthum odoratum O  
Arrhenatherum elatius A  
Bromus hordeaceus R

Herbs:

Achillea millefolium R  
Anthriscus sylvestris F  
Centaurea nigra F  
Cerastium fontanum O  
Cirsium arvense O  
Filipendula ulmaria F

Bromus sterilis R  
 Cynosurus cristatus O  
 Dactylis glomerata F  
 Deschampsia cespitosa R  
 Elytrigia repens R  
 Holcus lanatus F  
 Hordeum secalinum F  
 Phleum pratense O  
 Trisetum flavescens F

Filipendula vulgaris R  
 Galium verum F  
 Heracleum sphondylium O  
 Hypochaeris radicata R  
 Lathyrus pratensis O  
 Leucanthemum vulgare R  
 Lotus corniculatus R  
 Plantago lanceolata O  
 Ranunculus acris O  
 Rumex acetosa O  
 Taraxacum officinale R  
 Tragopogon pratensis R  
 Trifolium pratense O  
 Vicia cracca R

Site 45. Hedge behind Fritillary field

Description: A hedge behind fritillary meadow with a ditch on the edge of the field with a broad band of nettles

Area recorded: Hedge and nettle band.

Time spent recording: 8 minutes

Crataegus monogyna D  
 Glyceria maxima O  
 Urtica dioica D  
 Rumex obtusifolius R  
 Sambucus nigra O  
 Arctium minus R  
 Arrhenatherum elatius O  
 Salix cinerea R  
 Salix fragilis R  
 Heracleum sphondylium R  
 Rubus ulmifolius R

Prunus ?domestica R  
 Prunus spinosa O  
 Cornus sanguinea R  
 Arctium lappa R  
 Carduus crispus R  
 Cirsium arvense R  
 Phalaris arundinacea R  
 Calystegia sepium R  
 Rosa canina R

Site 46. River Cole by Fritillary meadow

Description: The river bank had a broad band of nettles and some hawthorn.

Area recorded: River bank to change of slope, difficult to see bank properly.

Time spent recording: 6 minutes

Canopy:

Crataegus monogyna LD  
 Humulus lupulus O  
 Salix fragilis O  
 Sambucus nigra O

Herbs:

Anthriscus sylvestris O  
 Arctium lappa R  
 Arrhenatherum elatius O  
 Calystegia sepium R  
 Carduus crispus R  
 Conium maculatum R  
 Dipsacus fullonum R  
 Epilobium hirsutum R  
 Galium aparine O  
 Glyceria maxima O  
 Heracleum sphondylium O  
 Lapsana communis R  
 Rubus fruticosus R  
 Rubus ulmifolius R  
 Rumex sanguineus R  
 Scrophularia auriculata R  
 Symphytum uplandicum R  
 Urtica dioica D

Site 47. River Cole bank of Rape field

Description: The River Cole bank on the edge of a rape field.

Area recorded: Access not possible, so recorded from west side across river.

Achillea millefolium  
Alnus glutinosa  
Anthriscus sylvestris  
Arctium lappa  
Arrhenatherum elatius  
Ballota nigra  
Calystegia sepium  
Carduus crispus  
Conium maculatum  
Crataegus monogyna  
Crataegus monogyna  
Dipsacus fullonum  
Elytrigia repens

Epilobium hirsutum  
Filipendula ulmaria  
Galium aparine  
Heracleum sphondylium  
Lapsana communis  
Phalaris arundinacea  
Rhamnus catharticus  
Rubus fruticosus  
Salix cinerea  
Salix viminalis  
Sambucus nigra  
Symphytum uplandicum  
Urtica dioica



## **Appendix 3**

### **Species List : Invertebrates**



# Macroinvertebrate Species Recorded From Coleshill : Summer 1994

KEY S1 to S9 =main channel standard survey sites (1-9)  
 B1 to B6 =main channel bug hunt sites (1-6); BW = weir and mill pond;  
 BS = southern ditch; BD = drain; BP = temporary pools; BB = bypass cahnnel

	S1	S2	S3	S4	S5	S6	S7	S8	S9	BI	B2	B3	B4	B5	B6	BW	BS	BD	BP	BB
<b>GASTROPODA</b>																				
<b>Neritidae</b>																				
<i>Theodoxus fluviatilis</i>	+	+	+	+	+	+	+	+	+	+	-	-	+	+	-	-	-	-	-	-
<b>Valvatidae</b>																				
<i>Valvata cristata</i>	-	+	+	+	+	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-
<i>Valvata piscinalis</i>	+	+	+	+	+	+	+	+	+	-	-	+	-	-	+	+	-	-	-	-
<b>Hydrobiidae</b>																				
<i>Potamopyrgus jenkinsi</i>	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	-	-
<b>Bithyniidae</b>																				
<i>Bithynia leachi</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	-	-	-	-	-
<i>Bithynia tentaculata</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	-	-
<b>Physidae</b>																				
<i>Physa acuta</i>	+	+	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>Physa fontinalis</i>	+	-	+	+	-	+	-	+	+	-	+	+	-	-	-	-	-	-	-	-
<b>Lymnaeidae</b>																				
<i>Lymnaea auricularia</i>	+	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>Lymnaea palustris</i>	+	-	-	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-
<i>Lymnaea peregra</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	+	-	+	-	+	-	-
<i>Lymnaea stagnalis</i>	+	+	-	+	+	-	+	+	+	-	+	+	-	-	+	-	-	-	-	-
<i>Lymnaea truncatula</i>	-	+	+	-	-	+	+	+	+	-	-	-	-	-	-	-	+	-	-	-
<b>Planorbidae</b>																				
<i>Planorbis carinatus</i>	-	+	+	+	+	-	+	-	-	-	-	+	+	-	-	+	-	-	-	-
<i>Anisus vortex</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	-	-
<i>Bathymphalus contortus</i>	+	+	+	+	+	+	+	+	-	-	+	+	-	-	-	-	-	-	-	-
<i>Gyraulus albus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	-	-	-
<i>Armiger crista</i>	+	+	+	+	+	+	+	+	-	-	-	+	+	-	-	-	-	-	-	-
<b>Ancylidae</b>																				
<i>Ancylus fluviatilis</i>	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+	-	-	-	-	-
<b>Acroloxidae</b>																				
<i>Acroloxus lacustris</i>	+	+	+	+	+	+	+	+	+	-	+	+	-	-	+	+	-	-	-	-
<b>BIVALVIA</b>																				
<b>Unionidae</b>																				
<i>Unio tumidus</i>	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Anodonta anatina</i>	+	+	-	-	+	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-
<b>Sphaeriidae</b>																				
<i>Sphaerium corneum</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	-	-	-	-
<i>Sphaerium rivicola</i>	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-

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	S1	S2	S3	S4	S5	S6	S7	S8	S9	BI	B2	B3	B4	B5	B6	BW	BS	BD	BP	BB
<b>OLIGOCHAETA</b>	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
<b>HIRUDINEA</b>																				
<b>Piscicolidae</b>																				
<i>Piscicola geometra</i>	+	+	-	-	+	+	+	+	+	-	-	+	-	-	-	-	-	-	-	-
<b>Glossiphoniidae</b>																				
<i>Theromyzon tessulatum</i>	-	-	-	-	-	-	-	+	-	-	-	+	+	-	-	-	-	-	-	-
<i>Hemiclepsis marginata</i>	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Glossiphonia complanata</i>	+	+	+	+	+	+	+	+	+	-	-	+	+	+	-	+	-	-	-	-
<i>Glossiphonia heteroclita</i>	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>Helobdella stagnalis</i>	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<b>Erpobdellidae</b>																				
<i>Erpobdella octoculata</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-	-	-
<i>Erpobdella octoculata cocoon</i>	-	-	+	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>Erpobdella testacea</i>	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>Trocheta subviridis</i>	+	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-
<b>MALACOSTRACA</b>																				
<b>Asellidae</b>																				
<i>Asellus aquaticus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-	-
<i>Asellus meridianus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<b>Crangonyctidae</b>																				
<i>Crangonyx pseudogracilis</i>	+	-	+	+	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-
<b>Gammaridae</b>																				
<i>Gammarus pulex</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	-	+
<b>EPHEMEROPTERA</b>																				
<b>Baetidae</b>																				
<i>Baetis fuscatus</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Baetis rhodani</i>	+	+	+	-	+	+	+	+	+	+	-	-	+	+	+	+	-	-	-	+
<i>Baetis scambus</i>	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>Baetis vernus</i>	+	-	-	-	+	-	+	+	+	-	-	-	-	-	-	-	-	-	-	+
<i>Centroptilum luteolum</i>	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cloeon dipterum</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Leptophlebiidae</b>																				
<i>Habrophlebia fusca</i>	+	+	-	+	+	+	+	+	+	-	-	-	+	+	+	-	-	-	-	-
<b>Ephemeridae</b>																				
<i>Ephemera vulgata</i>	+	-	-	-	+	+	+	+	+	-	-	-	+	+	+	-	-	-	-	-
<b>Ephemerellidae</b>																				
<i>Ephemerella ignita</i>	+	+	+	+	+	+	+	+	+	+	-	-	-	-	+	+	-	-	-	+



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[illegible]

S1 S2 S3 S4 S5 S6 S7 S8 S9 BI B2 B3 B4 B5 B6 BW BS BD BP BB

## Haliplidae

<b>Haliplidae</b>																			
<i>Haliplus flavicollis</i>	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Haliplus fluviatilis</i>	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
<i>Haliplus lineatocollis</i>	-	+	+	+	+	-	+	-	+	-	-	+	-	-	-	+	-	-	-
<i>Haliplus ruficollis</i> gp female	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
<i>Haliplus wehnckei</i>	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
<b>Dytiscidae</b>																			
<i>Laccophilus minutus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Hyphydrus ovatus</i>	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>Hydroglyphus pusillus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Hydroporus planus</i>	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Hydroporus tessellatus</i>	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-
<i>Nebrioporus depressus</i> (elegans)	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	-	+
<i>Stictotarsus duodecimpustulatus</i>	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Platambus maculatus</i>	+	+	+	-	+	+	+	+	+	+	-	-	+	+	+	+	+	-	-
<i>Agabus bipustulatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Agabus nebulosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Ilybius fuliginosus</i>	-	-	-	-	-	-	+	-	+	-	-	-	-	-	+	-	-	-	+
<i>Ilybius quadriguttatus</i>	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-
<i>Dytiscid larva</i>	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-
<b>Gyrinidae</b>																			
<i>Gyrinus urinator</i>	-	-	-	-	-	-	-	-	+	+	-	+	-	+	+	+	-	-	-
<i>Gyrinid larva</i>	-	+	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-
<b>Hydrophilidae</b>																			
<i>Hydrophilid larva</i>	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Anacaena globulus</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>Anacaena limbata</i>	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>Laccobius minutus</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>Laccobius bipunctatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Helochaeres lividus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Helophorus aequalis</i>	+	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+
<i>Helophorus grandis</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+
<i>Helophorus brevipalpis</i>	+	+	-	-	-	-	+	+	+	-	-	+	+	-	-	-	-	-	+
<i>Helophorus granularis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Helophorus minutus</i>	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+
<i>Helophorus obscurus</i>	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
<b>Hydraenidae</b>																			
<i>Ochthebius dilatatus</i>	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>Hydraena riparia</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
<b>Dryopidae</b>																			
<i>Dryopid larva</i>	-	+	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-

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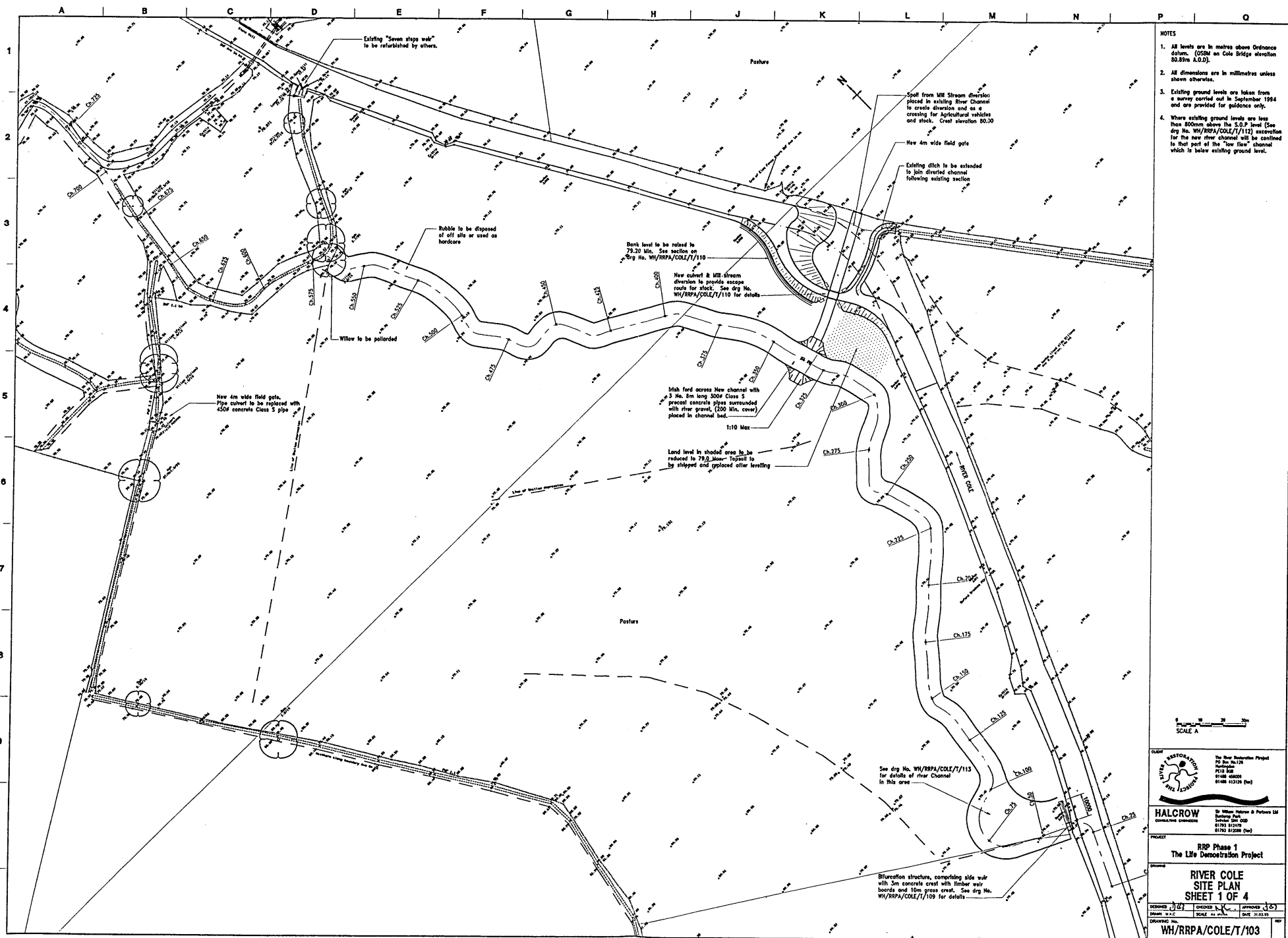
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	S1	S2	S3	S4	S5	S6	S7	S8	S9	BI	B2	B3	B4	B5	B6	BW	BS	BD	BP	BB
TRICHOPTERA (continued)																				
Goeridae																				
<i>Goeridae pupae</i>	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Goera pilosa</i>	-	-	-	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Sericostomatidae																				
<i>Sericostoma personatum</i>	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molannidae																				
<i>Molanna angustata</i>	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-
Leptoceridae																				
<i>Athripsodes aterrimus</i>	+	-	-	-	+	+	-	-	+	-	-	+	-	+	-	+	-	-	-	-
<i>Athripsodes cinereus</i>	+	+	+	-	+	+	+	+	+	+	-	-	+	+	+	+	-	-	-	-
<i>Ceraclea albimacula</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Ceraclea annulicornis</i>	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Ceraclea dissimilis</i>	+	+	+	+	+	-	+	+	+	+	+	-	-	-	+	-	-	-	-	-
<i>Mystacides azurea</i>	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-
<i>Mystacides longicornis</i>	+	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Mystacides nigra</i>	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
DIPTERA																				
Chironomidae																				
<i>Chironomidae</i>	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
Tipulidae																				
<i>Tipulidae</i>	+	+	+	+	+	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-
Simuliidae																				
<i>Simuliidae</i>	+	+	-	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
SPECIES TOTALS																				
	S1	S2	S3	S4	S5	S6	S7	S8	S9	BI	B2	B3	B4	B5	B6	BW	BS	BD	BP	BB
GASTROPODA																				
<i>GASTROPODA</i>	17	17	16	19	12	15	15	15	14	4	11	16	9	6	8	9	1	3	0	0
BIVALVIA																				
<i>BIVALVIA</i>	2	2	2	2	2	1	2	3	3	0	2	2	1	1	1	1	0	0	0	0
HIRUDINEA																				
<i>HIRUDINEA</i>	5	3	3	2	4	3	4	6	4	1	2	4	3	2	0	1	3	1	0	0
MALACOSTRCA																				
<i>MALACOSTRCA</i>	3	2	3	3	3	2	2	3	2	1	3	2	2	2	2	2	1	3	0	1
EPHEMEROPTERA																				
<i>EPHEMEROPTERA</i>	7	6	3	4	7	5	8	8	7	3	2	1	4	4	5	3	0	0	0	3
PLECOPTERA																				
<i>PLECOPTERA</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
ODONATA																				
<i>ODONATA</i>	3	2	3	3	2	2	3	3	3	1	3	2	2	3	3	2	0	0	0	1
HETEROPTERA																				
<i>HETEROPTERA</i>	4	2	2	5	2	1	0	3	4	3	3	4	3	2	4	3	1	1	2	0
COLEOPTERA																				
<i>COLEOPTERA</i>	11	6	8	6	6	5	12	7	16	2	4	7	7	6	7	3	0	2	14	2
MEGALOPTERA																				
<i>MEGALOPTERA</i>	1	1	0	1	1	1	2	1	1	0	0	1	1	1	0	0	0	0	0	0
TRICHOPTERA																				
<i>TRICHOPTERA</i>	13	11	5	6	17	17	13	14	14	7	5	3	5	6	6	4	2	5	0	2
TOTAL																				
<i>TOTAL</i>	66	52	45	51	56	52	61	63	68	22	35	42	37	33	36	28	8	16	16	9

## **Appendix 4**

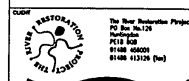
### **Detailed Works**



NOTES

1. All levels are in metres above Ordnance datum. (OSDM on Cole Bridge elevation 80.89m A.O.D).
2. All dimensions are in millimetres unless shown otherwise.
3. Existing ground levels are taken from a survey carried out in September 1994 and are provided for guidance only.
4. Where existing ground levels are less than 800mm above the S.O.P. (See drg No. WH/BRPA/COLE/T/112) excavation for the river channel will be confined to that part of the "low flow" channel which is below existing ground level.

0 10 20 30  
SCALE A



**HALCROW**  
CONSULTING ENGINEERS

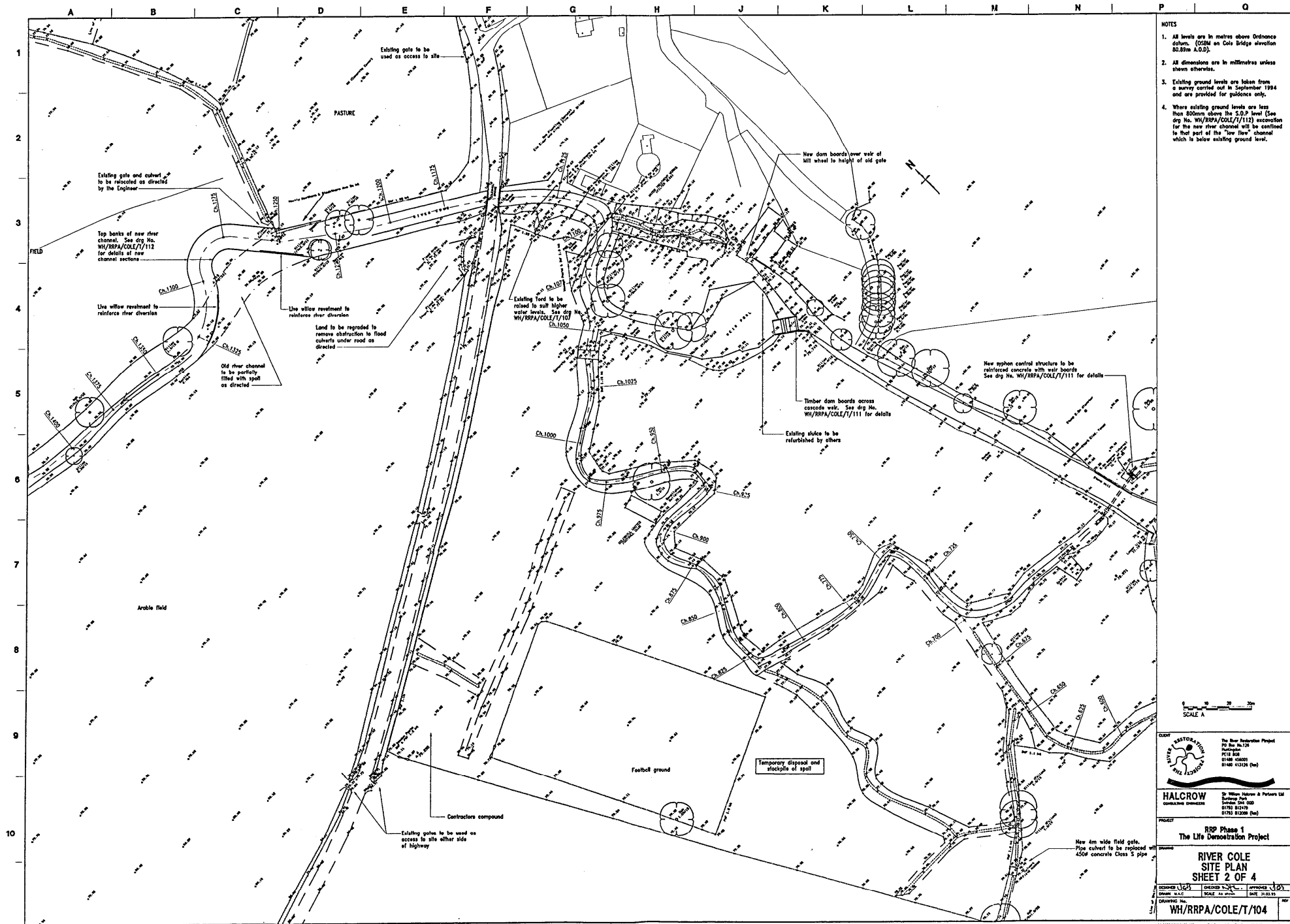
Dr William Halcrow & Partners  
Riverside Park  
Swinford S94 0GD  
01793 512479  
01793 512088 (Fax)

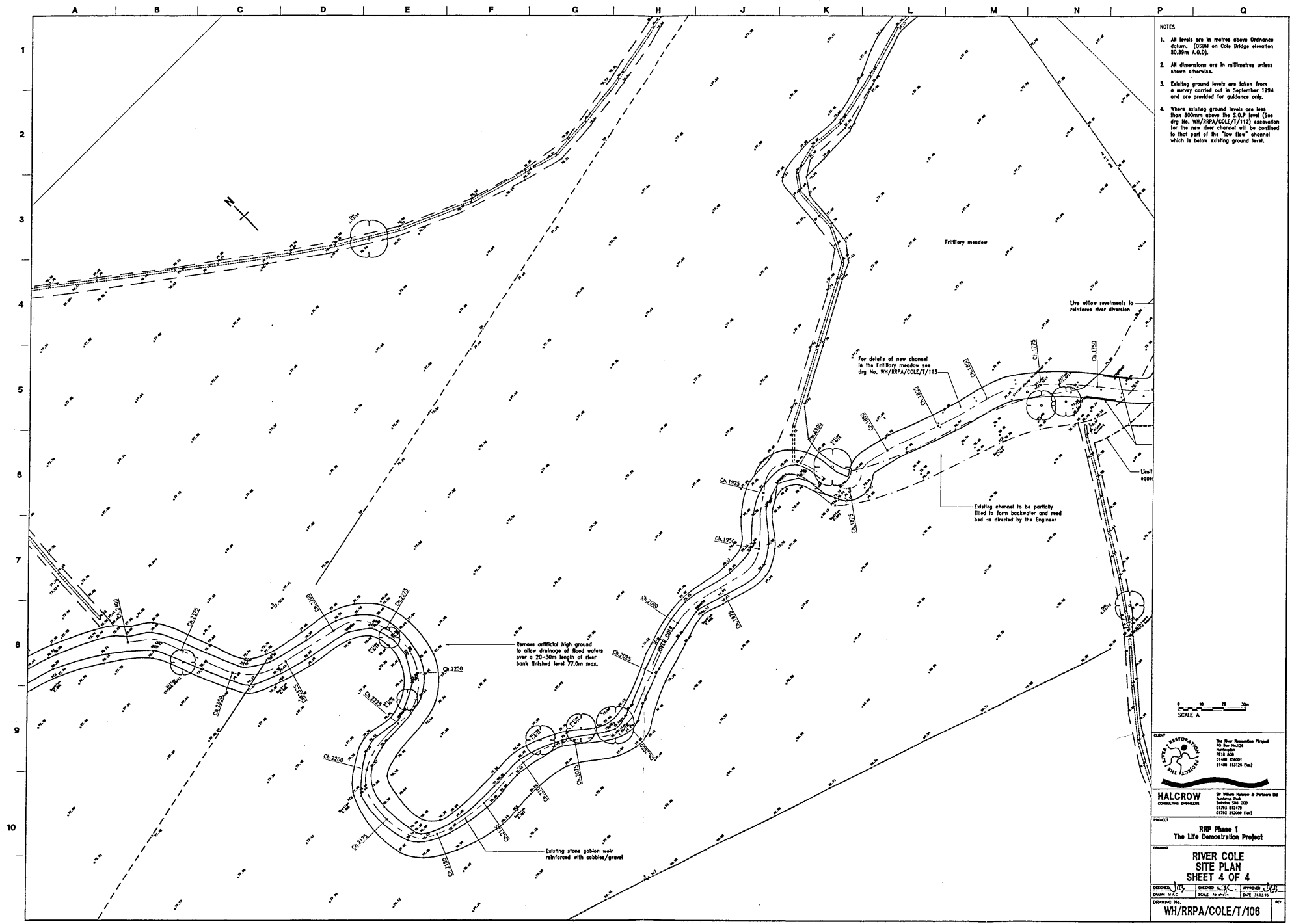
## RRP Phase 1 The LNE Demonstration Project

RIVER COLE  
SITE PLAN  
SHEET 1 OF 4

DESIGNED <i>JW</i>	CHECKED <i>NC</i>	APPROVED <i>J</i>
DRAWN W.A.C.	SCALE As shown	DATE 31.03.91

DRAWING No.  
WH/RRPA/COLE/T/103





- NOTES
1. All levels are in metres above Ordnance datum. (OSDM on Cole Bridge elevation 80.89m A.O.D.)
  2. All dimensions are in millimetres unless shown otherwise.
  3. Existing ground levels are taken from a survey carried out in September 1994 and are provided for guidance only.
  4. Where existing ground levels are less than 800mm above the S.O.P. level (See drg No. WH/RRPA/COLE/T/112) excavation for the new river channel will be continued to that part of the "low flow" channel which is below existing ground level.

0 10 20 30m  
SCALE A

**HALCROW**  
CONSULTANTS

**RIVER COLE SITE PLAN SHEET 4 OF 4**

**RHP Phase 1**  
**The Life Demonstration Project**

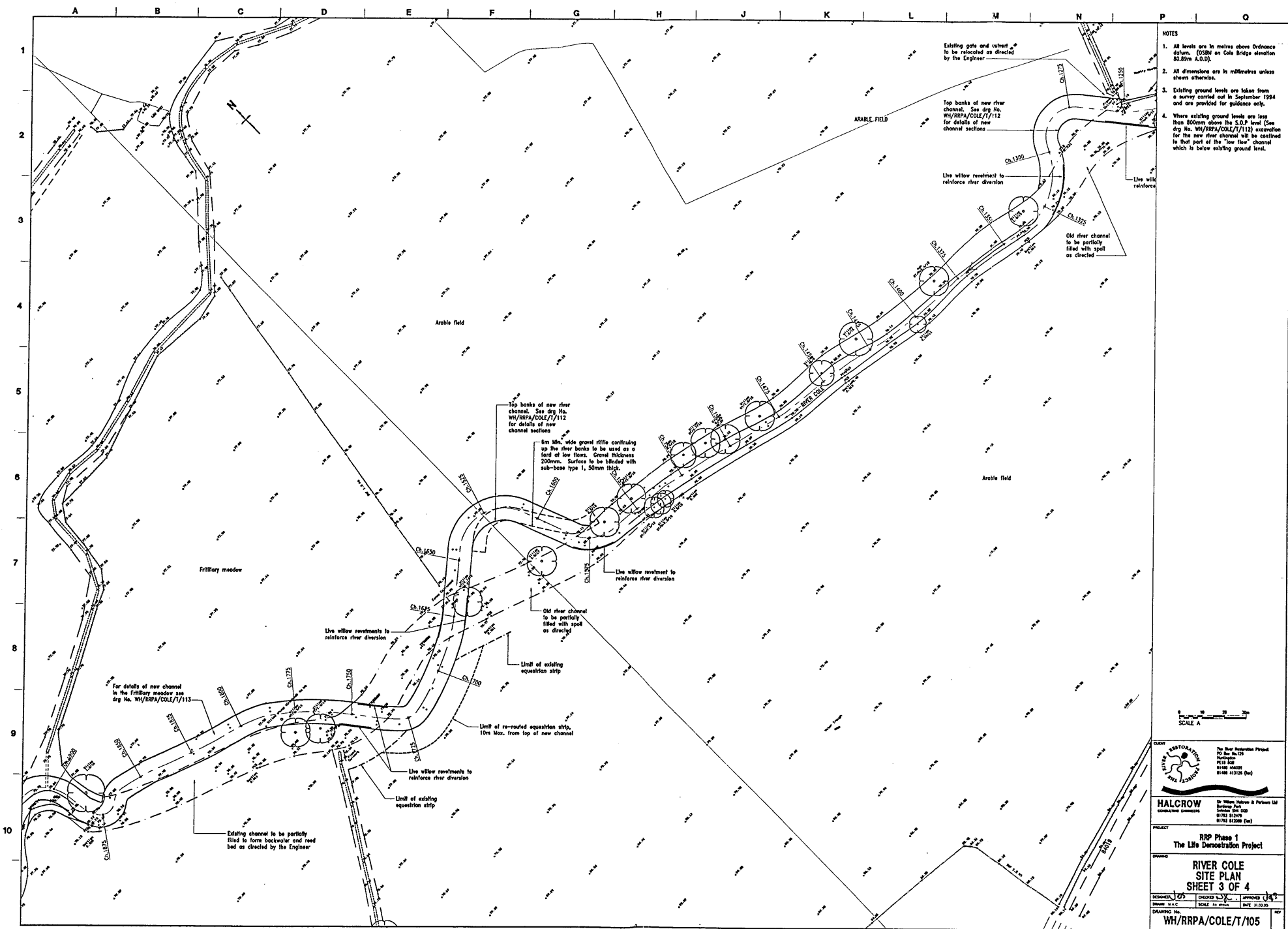
**WH/RRPA/COLE/T/106**

Dr William Johnson & Partners Ltd  
Burlington Park  
Glasgow G3 7LN  
01469 688000  
01469 613726 (fax)

Dr William Johnson & Partners Ltd  
Burlington Park  
Glasgow G3 7LN  
01469 688000  
01469 613726 (fax)

DATE: 20.03.99





**NOTE**

1. All levels are in metres above Ordnance datum. (OSDN on Cole Bridge elevation 80.89m A.O.D.)
2. All dimensions are in millimetres unless shown otherwise.
3. Existing ground levels are taken from a survey carried out in September 1994 and are provided for guidance only.
4. Where existing ground levels are less than 800mm above the S.O.P. level (see drg No. WH/RRPA/COLE/T/112) extension for the new river channel will be confined to that part of the 'low flow' channel which is below existing ground level.

SCALE



**HALCROW**  
CONSULTING ENGINEERS

PROJECT

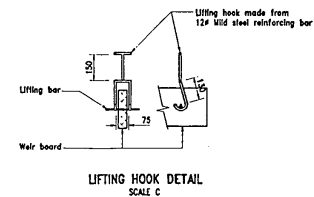
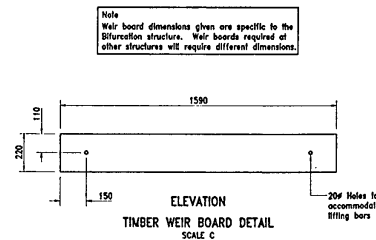
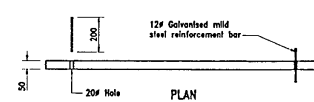
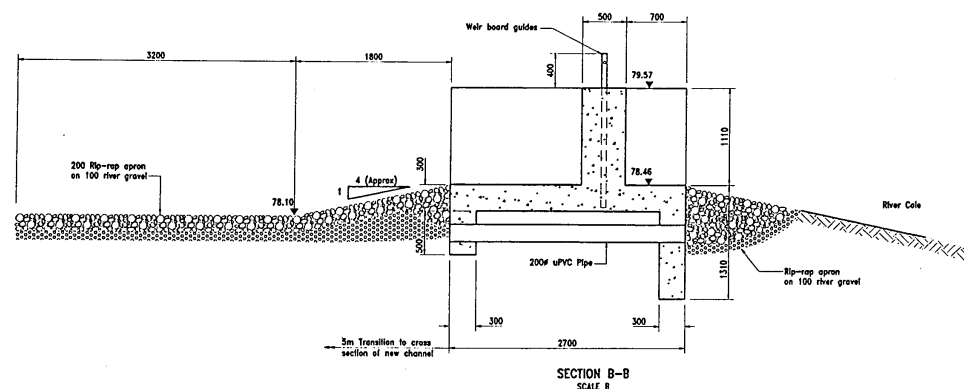
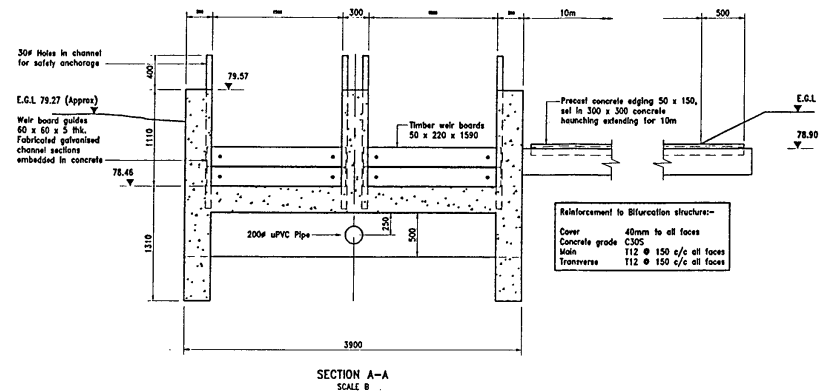
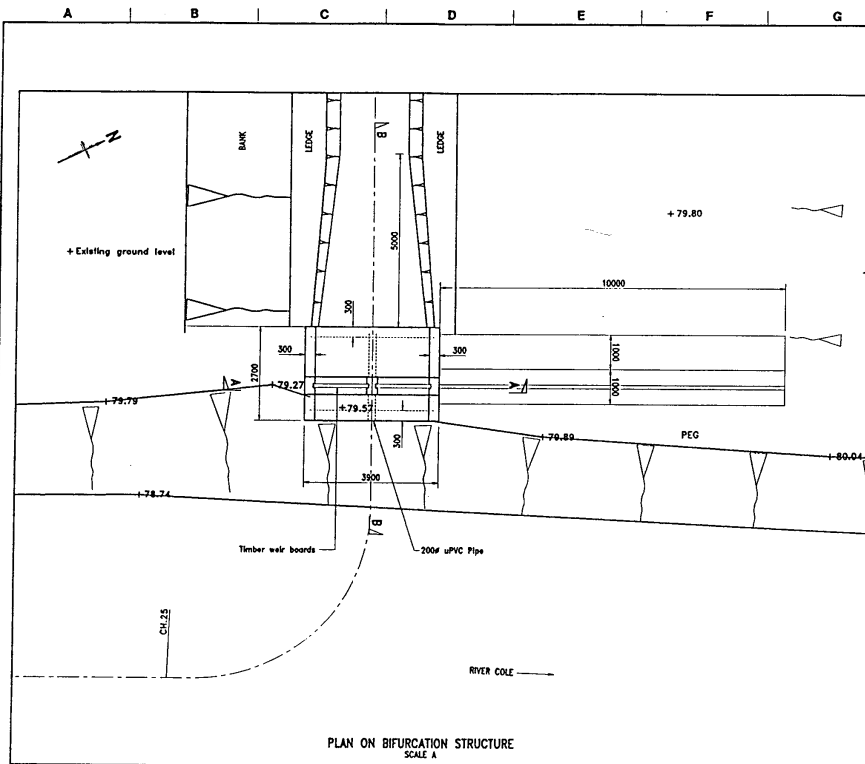
RRP Phase 1  
The Life Demonstration Project

RIVER COLE  
SITE PLAN  
SHEET 3 OF 4

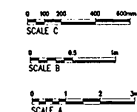
SHEET 3 OF 4		
DESIGNED <i>Jos</i>	CHECKED <i>WJ</i>	APPROVED
DRAWN M.A.C.	SCALE As shown	DATE 31.03.05
DRAWING No.		
WH/RRPA/COLE/T/105		

## **Appendix 5**

### **Details of Structures**



- NOTES
1. All dimensions are in millimetres unless shown otherwise.
  2. All levels are in metres above Ordnance datum (OSM on Cole Bridge elevation 80.81m AOD).
  3. This drawing is to be read in conjunction with Dwg No. WH/RRPA/COLE/T/113.



CLIENT: The River Restoration Project  
PC No. 04/175  
Hatchfield  
P118 408  
01400 45000  
01400 45100  
01400 45124 (tel)

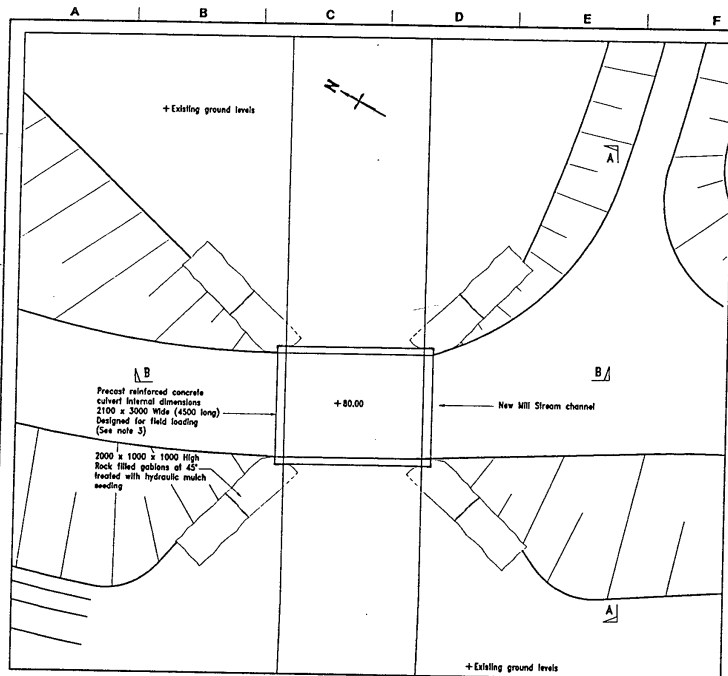
HALCROW  
CONSULTING ENGINEERS

PROJECT: RRP Phase 1  
The Life Demonstration Project

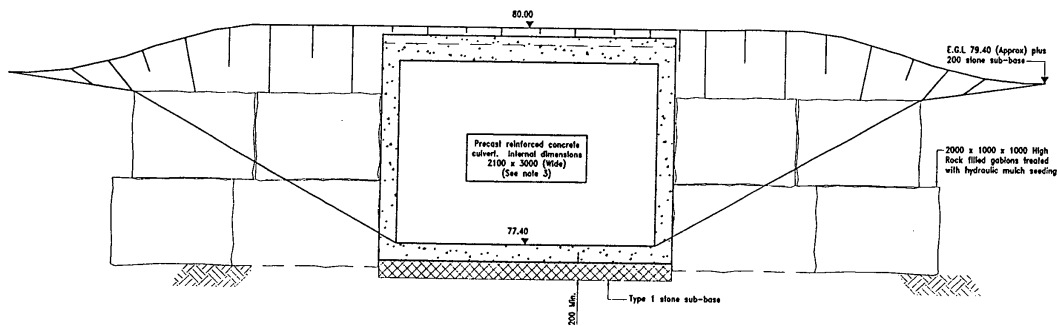
DRAWING: RIVER COLE  
STRUCTURES & DETAILS  
SHEET 1 OF 3

DESIGNED: JCA  
CHECKED: JCA  
APPROVED: JCA  
DATE: 01/01/05

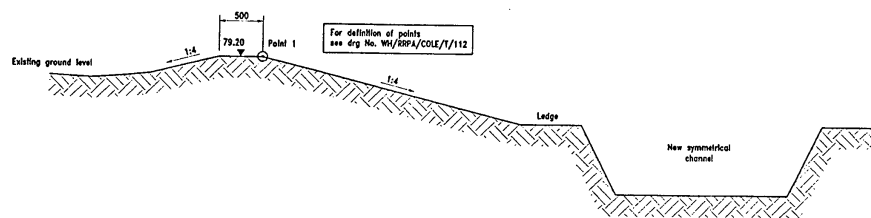
DRAWING NO.: WH/RRPA/COLE/T/109



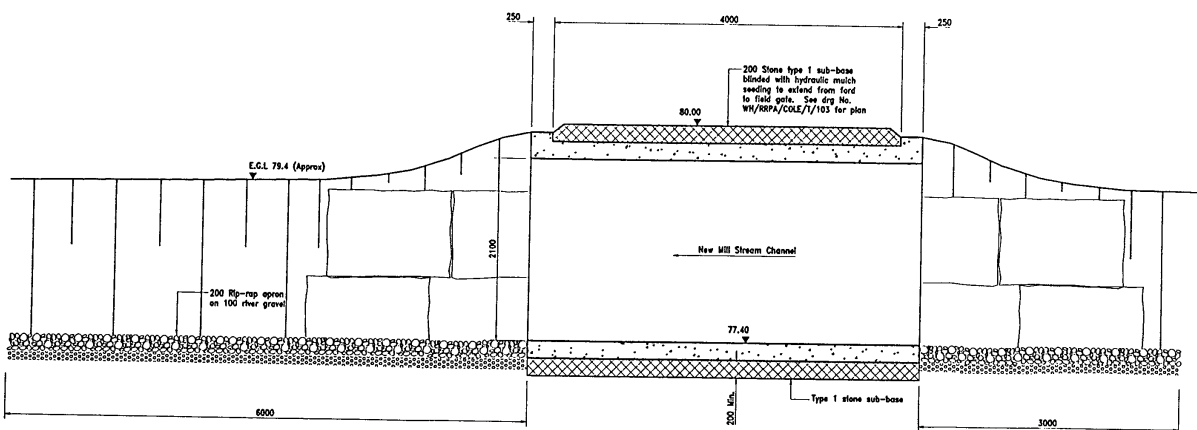
PLAN ON PRECAST CULVERT  
SCALE A



SECTION A-A  
SCALE B



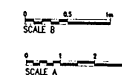
SECTION THROUGH BANK DOWNSTREAM OF NEW CULVERT  
(See drg No. WH/RRPA/COLE/T/103 for Plan)  
SCALE B



SECTION B-B  
SCALE B

# NOTES

1. All dimensions are in millimetres unless shown otherwise.
2. All levels are in metres above Ordnance datum (OSM) on Cole Bridge elevation 80.8m AOD.
3. Field loading two wheels 1m apart, each of 60kN including impact allowance. Contact pressure is 0.4N/mm<sup>2</sup>.

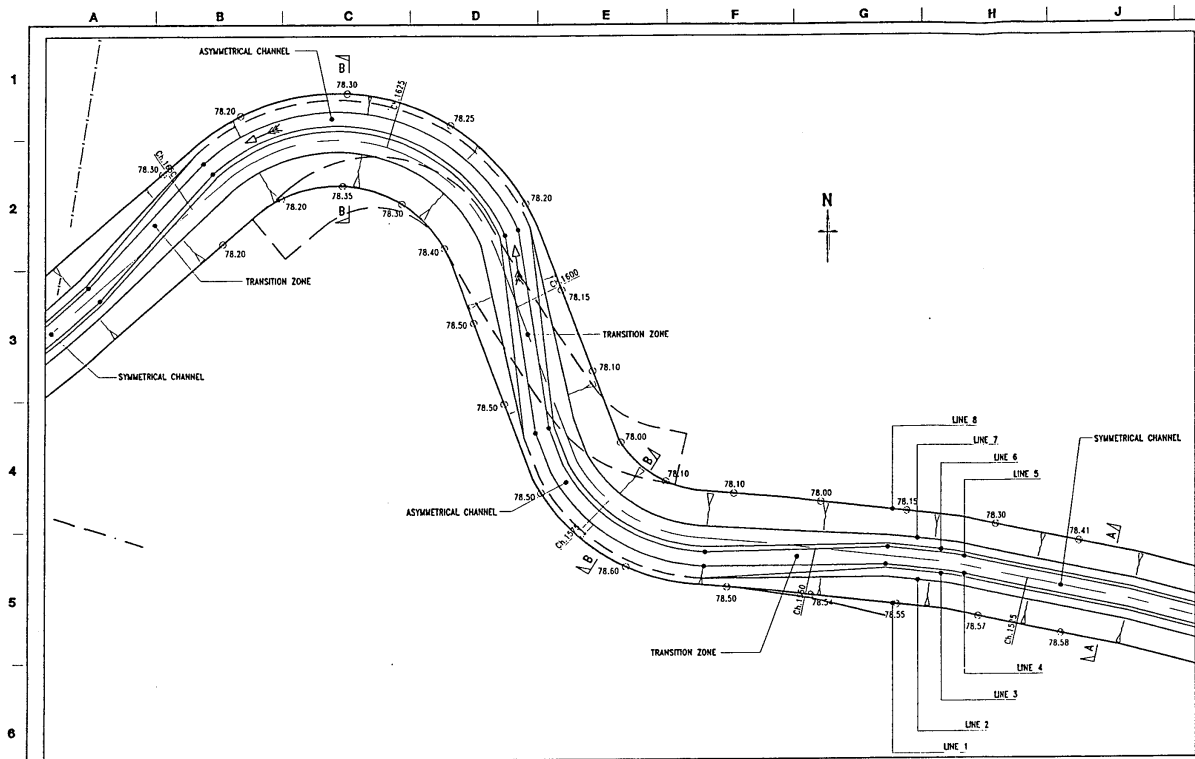


		The River Restoration Project PO Box 10128 Hordle PC18 802 01480 620001 01480 621126 (fax)
<b>HALCROW</b> CONSULTING ENGINEERS		Dr William Hordle & Partners Ltd Building Dept Southern SH 100 01793 812179 01793 812008 (fax)
PROJECT <b>RIP Phase 1</b> <b>The Life Demonstration Project</b>		
DRAWING <b>RIVER COLE</b> <b>STRUCTURES &amp; DETAILS</b> <b>SHEET 2 OF 3</b>		
DESIGNED <b>WJS</b> DRAWN <b>WJS</b>	CHECKED <b>WJS</b> SCALE <b>AS SHOWN</b>	APPROVED <b>WJS</b> DATE <b>09.04.01</b>
DRAWING NO. <b>WH/RRPA/COLE/T/110</b>		

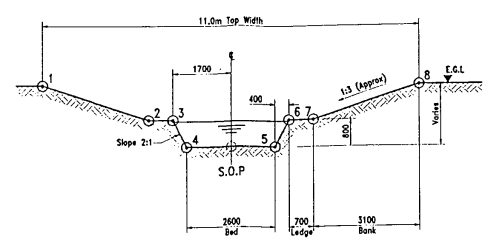


## **Appendix 6**

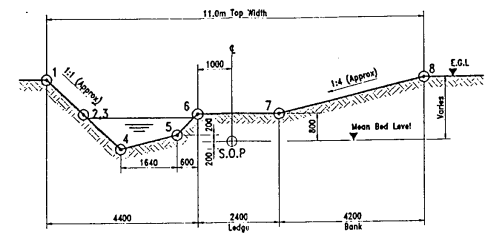
### **Channel Cross Sections**



PLAN ON NEW TYPICAL DOWNSTREAM REACH OF RIVER  
UPSTREAM REACH SIMILAR  
SCALE A

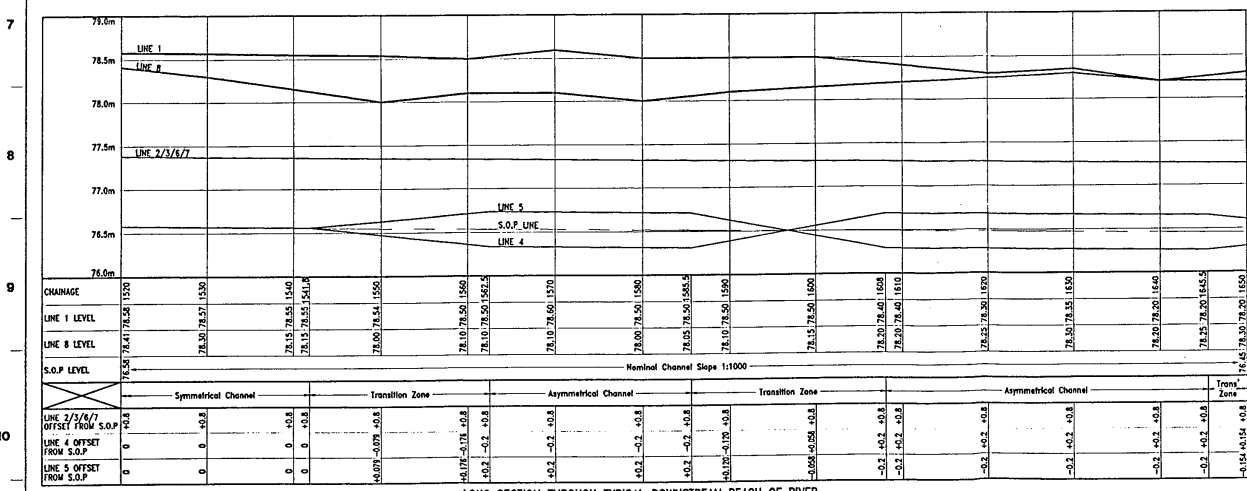


TYPICAL SYMMETRICAL CHANNEL SECTION A-A (STRAIGHT)  
SCALE C

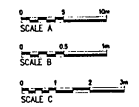


TYPICAL ASYMMETRICAL CHANNEL SECTION B-B (APEX OF BEND)  
SCALE C

- NOTES
1. ALL DIMENSIONS IN MILLIMETRES UNLESS SHOWN OTHERWISE.
  2. ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE SURVEY DATUM (NEWLYN)



LONG SECTION THROUGH TYPICAL DOWNSTREAM REACH OF RIVER  
SCALE A HORIZONTALLY : SCALE B VERTICALLY



THE RIVER RESTORATION PROJECT  
PO Box 40128  
Birmingham  
B15 9JL  
0121 450001  
0121 451158 (fax)

**HALCROW**  
CONSULTING ENGINEERS

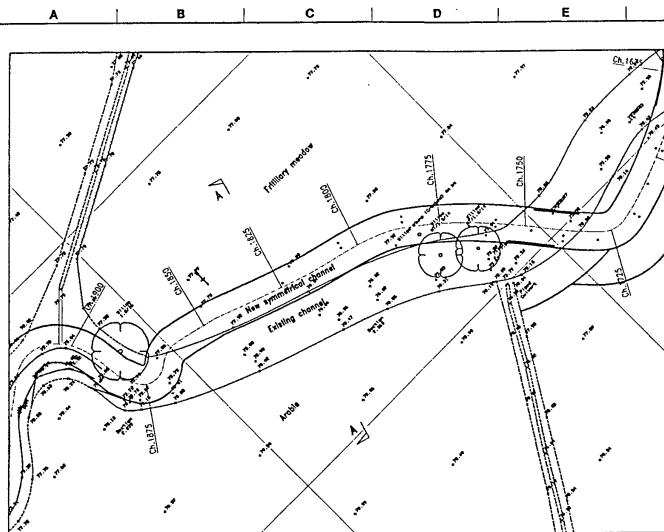
St. Wilfrid, Holmes & Partners Ltd  
Birmingham City Centre  
0121 633 1578  
0121 633 1508 (fax)

PROJECT: RRP Phase 1  
The Life Demonstration Project

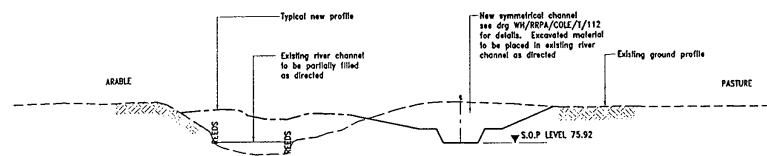
WORK: RIVER COLE  
TYPICAL CHANNEL SECTIONS

DESIGNED BY: [Signature] CHECKED BY: [Signature] APPROVED BY: [Signature]  
SCALE: As shown DATE: 21.03.15

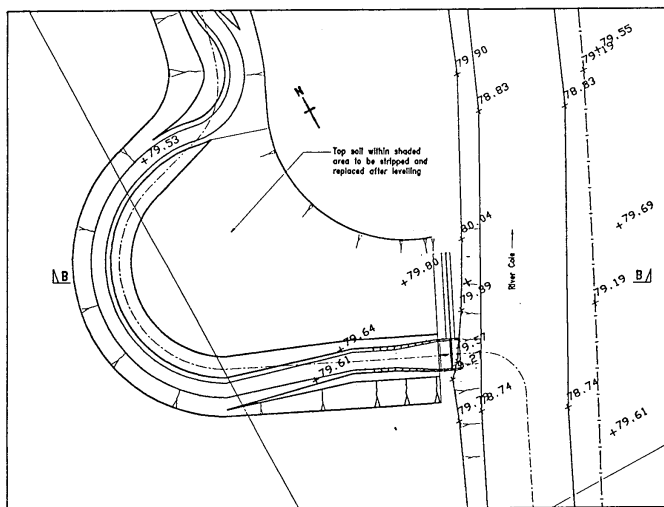
Calculation No: WH/RRPA/COLE/T/112



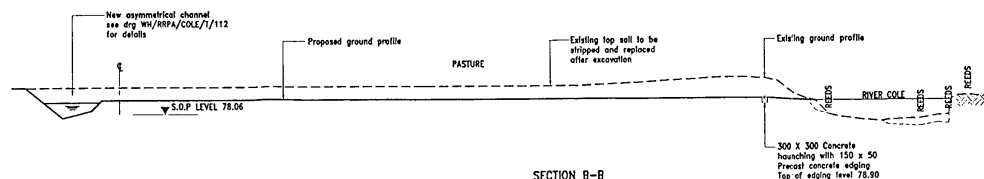
PLAN ON FRITHLY MEADOW  
SCALE A



SECTION A-A  
SCALE B

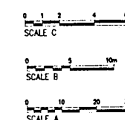


PLAN ON RIVER DETAIL AT BIFURCATION STRUCTURE  
SCALE B



SECTION B-B  
SCALE B

- NOTES
1. All ground levels shown on plans are taken from a survey carried out in September 1994 and are provided for guidance only.
  2. All levels are in metres above Ordnance datum. (OSBM on Cole Bridge elevation 80.8m A.O.D.).

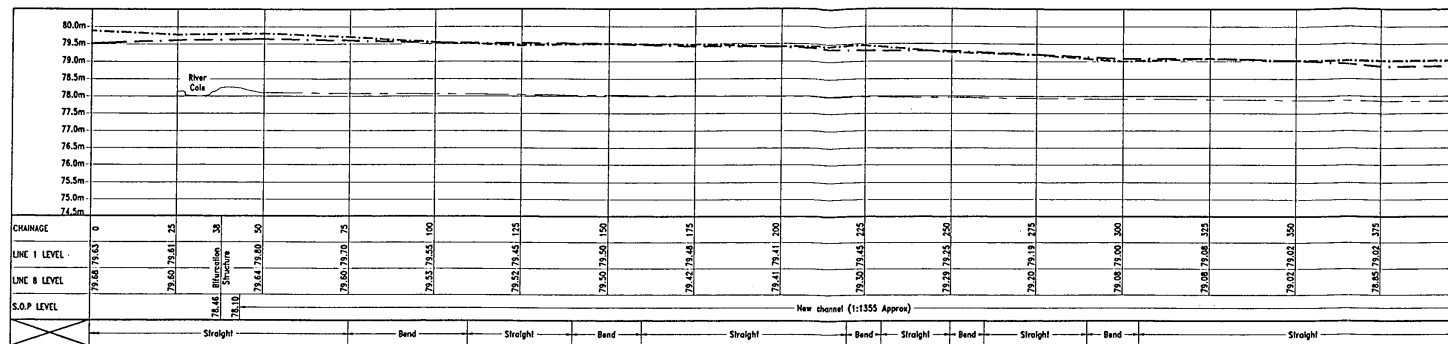


<p>The River Restoration Project PO Box 10178 Barnstaple Devon PL1 1BX 01409 650001 01409 651124 (fax)</p>	
<p><b>HALCROW</b> CONSULTING ENGINEERS</p>	
<p>Dr. Wilson, Halcrow &amp; Partners Ltd Barnstaple Devon PL1 1BX 01409 651124 (fax)</p>	
<p>PROJECT <b>RRP Phase 1 The Life Demonstration Project</b></p>	
<p>DRAWING <b>RIVER COLE RIVER DETAILS</b></p>	
<p>DESIGNED: [Signature] DRAWN: [Signature]</p>	<p>CHECKED: [Signature] DATE: 18.04.95</p>
<p>WH/RRPA/COLE/T/113</p>	

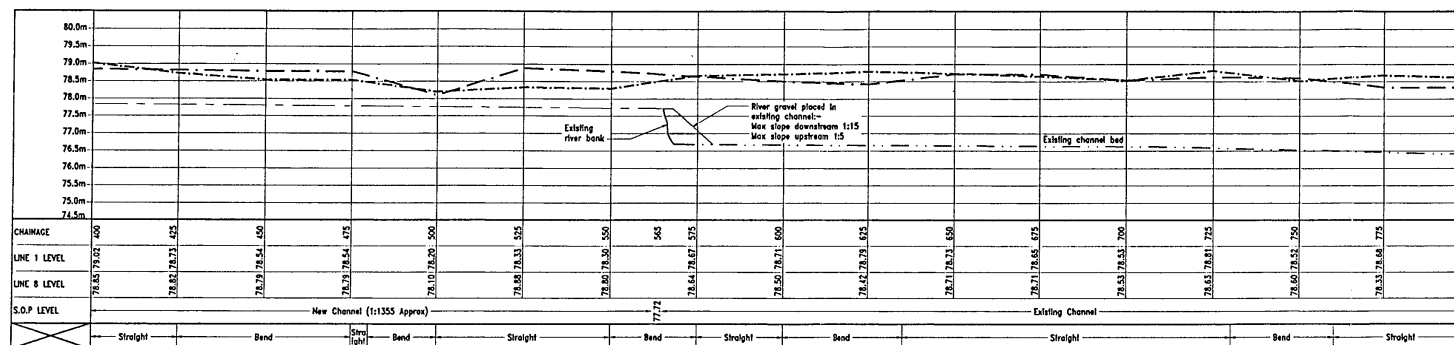


Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains. The *Agrobacterium* strains were grown in YEA medium at 28 °C for 24 h. The cell concentration was adjusted to 1.0 × 10<sup>8</sup> cells/ml. The cells were then mixed with the plant tissue and the transformation efficiency was determined. The results are shown as the mean ± SD of three independent experiments. The transformation efficiency was significantly different from the control (p < 0.05).

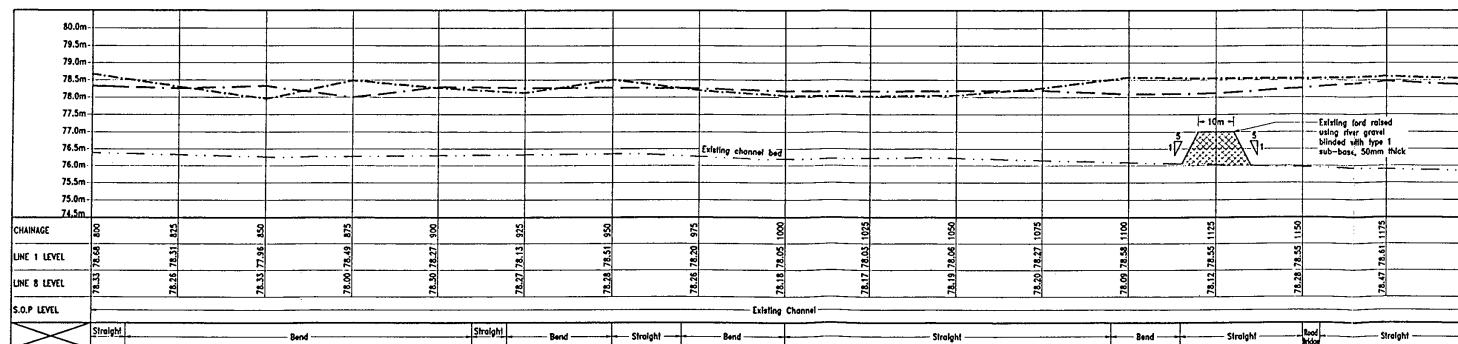
## Channel Long Sections



LONG SECTION CH.0 - CH.400  
SCALE A HORIZONTALLY : SCALE B VERTICALLY



LONG SECTION CH.400 - CH.800  
SCALE A HORIZONTALLY : SCALE B VERTICALLY



LONG SECTION CH.800 - CH.1200  
SCALE A HORIZONTALLY : SCALE B VERTICALLY

# NOTES

1. All levels are in metres above Ordinance datum (OSBM) on Cole Bridge elevation 80.85m AOD.
2. For definition of Line 1 & Line 8 see drg No. WH/RRPA/COLE/T/112.

**KEY**

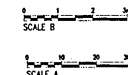
Line 1 (left hand bank) ————

Line 8 (right hand bank) ————

S.O.P. Level ————

Existing channel bed ————

For definition of Lines and levels see typical channel sections on drg No. WH/RRPA/COLE/T/112.



**HALCROW**  
CONSULTANTS

**RRP Phase 1**  
**The Life Demonstration Project**

**RIVER COLE**  
**LONG SECTIONS**  
**SHEET 1 OF 2**

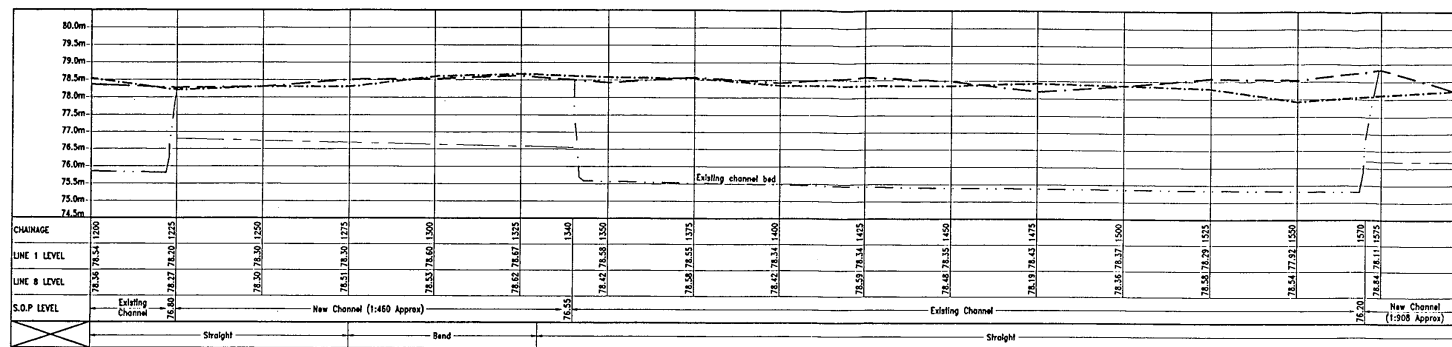
DESIGNED: [Signature] CHECKED: [Signature] APPROVED: [Signature]

DATE: 11/12/12 SCALE: AS SHOWN DATE: 11/12/12

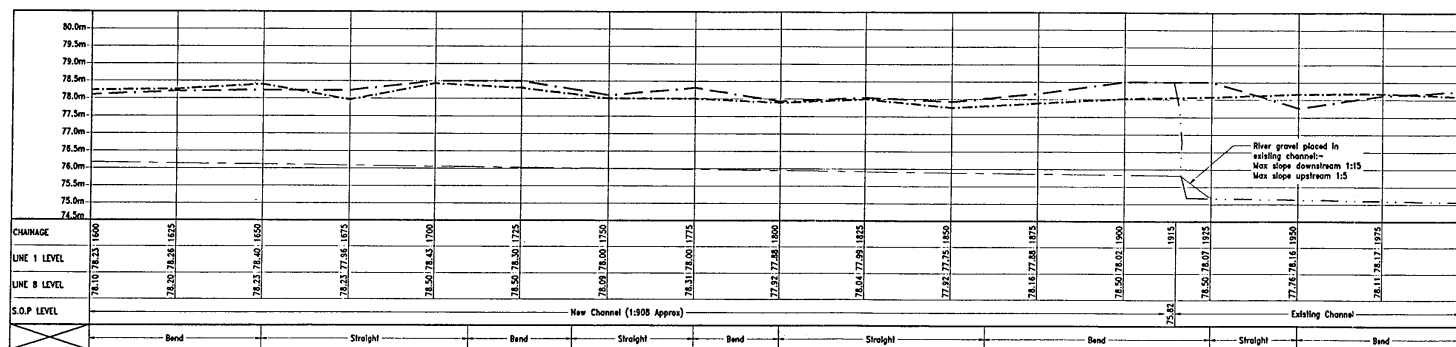
DRAWING NO: WH/RRPA/COLE/T/107

# NOTES

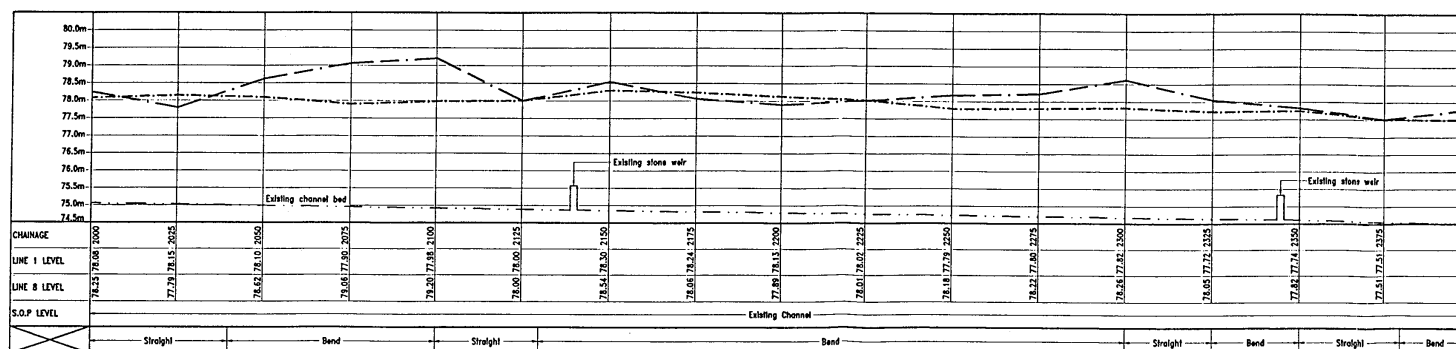
1. All levels are in metres above Ordnance datum (OSBM on Cole Bridge elevation 80.85m AOD).
2. For definition of Line 1 & Line 8 see drg No. WH/RRPA/COLE/T/112.



LONG SECTION CH.1200 - CH.1600  
SCALE A HORIZONTALLY : SCALE B VERTICALLY

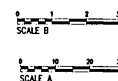


LONG SECTION CH.1600 - CH.2000  
SCALE A HORIZONTALLY : SCALE B VERTICALLY



LONG SECTION CH.2000 - CH.2400  
SCALE A HORIZONTALLY : SCALE B VERTICALLY

KEY  
Line 1 (Left hand bank) ---  
Line 8 (Right hand bank) ---  
S.O.P. Level ---  
Existing channel bed ---  
For definition of Lines and levels see typical channel sections on drg No. WH/RRPA/COLE/T/112.



**HALCROW**  
CONSULTANTS  
Dr William Palmer & Partners Ltd  
Building Dept  
1000  
01753 811719  
01753 811720 (fax)

PROJECT  
RIP Phase 1  
The Life Demonstration Project

DESIGNED BY  
RIVER COLE  
LONG SECTIONS  
SHEET 2 OF 2

CHECKED BY  
WH/RRPA/COLE/T/108