



**ENVIRONMENT
AGENCY**

EATHORPE FLOOD ALLEVIATION SCHEME

PRE-FEASIBILITY STUDY

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CONTENTS

	Page
Summary	1
1. Introduction	1
2. Background	2
3. Problem	3
4. Design Aspects	3
4.1. Modelled design water levels and flows	3
4.2. Economic Analysis	4
4.3. Thresholds	4
4.4. Other Information	5
4.5. Information available for use in study	5
4.6. Geological considerations	5
5. Environmental and Planning Considerations	5
6. Scheme Options	6
6.1. Do nothing	7
6.2. Do minimum	7
6.3. Improved maintenance	7
6.4. Lowering of weirs/Increasing capacity of bridges	7
6.5. Flood relief channel	8
6.6. Channel Improvements	8
6.7. Construction of permanent raised defences	9
6.7.a. Construction of permanent raised defences - Flood embankment and wall	9
6.7.b. Construction of permanent raised defences - Extended Flood embankment and wall	9
6.7.c. Construction of permanent raised defences - Flood embankment and wall with exclusion of the Mill Channel	9
6.8. Improved Flood Warning Service	10
6.9. Provide Upstream Storage	10
6.10. Land Use Change	11
6.11. Flood Proofing Properties	11
7. Scheme costs	11
8. Economic analysis	12
9. Choice of scheme	14
10. Priority score and risk	15
11. Sensitivity of option to impact of climate change	15

12. Risks	15
13. Conclusion	16
14. Recommendations	16
15. References	17

FIGURES

Figure 1.	Location Plan
Figure 2.	Map of Eathorpe and Indicative Floodplain
Figure 3.	Option 6.7a Earth Embankment and Wall
Figure 4.	Option 6.7b Extended Earth Embankment and wall
Figure 5.	Option 6.7c Earth Embankment and wall with exclusion of the Mill Channel

APPENDICES

Appendix A.	Information received from Eathorpe Parish Council
Appendix B.	Environmental Impact Assessment
Appendix C.	Summaries of costs
Appendix D.	DEFRA Decision Rule Table
Appendix E.	Derivation of priority score
Appendix F.	Risk Register

SUMMARY

Eathorpe is a village situated on the left bank of the River Leam, approximately 5km north-east of Leamington Spa in Warwickshire. This report gives details of the pre-feasibility study which has been undertaken to determine whether a scheme is likely to be justified at Eathorpe and whether it is worth investing in more detailed studies. Flooding caused by high river levels in the River Leam has affected the village on a number of occasions, being worst hit during the Easter 1998 floods when 11 houses were affected. The Easter 1998 event is estimated to be a flood with an annual probability of between 2% and 1% (i.e. between 50 and 100 year event). Other floods of note are those of September 1992 and July 1968.

Options considered within this study to alleviate flood risk include, as standard, the Do Nothing and Do Minimum options, together with improved maintenance, flood relief channel, channel improvements, provision of upstream storage, improvements to flood warning and construction of permanent raised defences.

Initial economic analysis at this pre-feasibility stage has indicated that the option that should be selected for Eathorpe, following Defra guidelines, is 'Do Minimum'. However initial indications are that raised defence options could be viable having an incremental benefit cost ratios greater than 1. This scheme should be progressed to feasibility although the current priority score would preclude construction for at least 3 years from now.

1. INTRODUCTION

Eathorpe (SP390692) is a village situated on the left bank of the River Leam, approximately 5km north east of Leamington Spa in the area of Warwick District Council. A location plan indicating the study area is shown in Figure 1. A map of the village is shown in Figure 2.

This pre-feasibility study was undertaken to investigate the flooding problem at Eathorpe resulting from high water levels in the length of the River Leam designated Main River and to consider potential options to alleviate property flooding at this location.

The River Leam is designated Main River on maps held by Department for Environment, Food and Rural Affairs (Defra) from its confluence with the River Avon (SP301657) to the road bridge on Grandborough - Woolscott Road (SP495672).

In Eathorpe only the flood relief channel and channel downstream of Wappenbury Access Bridge is classified as Main River. This legal designation gives the Agency permissive powers to carry out maintenance and improvement works. Permissive powers mean that the Agency can carry out works, under provisions contained within the Water Resources Act 1991, though does not have a duty to do so. Riparian landowners have certain rights and responsibilities in relation to the watercourse flowing through or adjacent to their property.

In order to carry out flood alleviation works using public money it has to be shown that the work is technically feasible, environmentally acceptable, sustainable and that the economic benefits to the country outweigh the costs of the scheme. There are a number of steps the Agency is required to undertake, to ensure these criteria are met, before a scheme can be constructed and these are outlined in more detail.

Pre-feasibility is the first step in the process and a desktop study is undertaken using readily available data. If, following the pre-feasibility study, there is found to be a potentially viable option,

a full feasibility study is carried out which investigates the scheme in more detail. Should the viability criteria be met in this more detailed feasibility study, the selected option is again assessed using a priority score and entered onto a prioritised Works programme. Works are then designed for construction, the necessary approvals gained and then, subject to having passed these stages and public money being available, constructed. At any stage up to construction a scheme may not meet the necessary criteria and, therefore, may not proceed. Consultation is undertaken with affected residents and interested parties at each stage.

In order to ensure that the chosen option is environmentally acceptable and sustainable an environmental impact assessment is carried out. This ensures that any options that cause adverse environmental effects are either discounted, or if appropriate, adequate mitigation measures identified and constraints imposed to offset the negative effects.

This pre-feasibility study has focused on direct actions that would alleviate the problem of flooding at Eathorpe, there is no strategy covering this area and the study has been carried out in isolation.

2. BACKGROUND

The River Leam rises on the border hills between Warwickshire and Northamptonshire, flowing in a westerly direction to its outfall into the River Avon at the western edge of Royal Leamington Spa. The river drains a low-lying and largely rural catchment and flows through Eathorpe from a northerly direction, past the industrial unit of Tech-speed Motorsport and to the west of the main village houses.

The River Leam splits into two channels upstream of Eathorpe village at SP3901869470, one of which flows into the flood relief channel and the other into the old channel leading to two weirs and a disused mill channel. The two weirs are of a fixed height in order to continuously feed the mill leat. The remainder of flow is taken over the weirs into a weir pool and then at an acute angle under the Wappenbury access road bridge which is of brick construction with three flow arches. The relief channel runs from a fixed weir set above the level of the two downstream weirs. Ordinarily this channel has no flow, containing still residual water. During high flows the control weir is overflowed and the channel becomes operational, taking excess water from the river system away from the old channel and discharging through the three arches of the Wappenbury Access bridge. Some thirty metres away from this bridge the road also traverses the mill channel via a small brick culvert. An island is formed between the brick lined mill channel and the main river channel. The mill channel and main channel then converge approximately 100m downstream of the road bridge. The old channel from SP3901869470 until its confluence with the main channel at SP3906369198 is not designated as Main River and is, therefore, classed as an ordinary watercourse. The Operating Authority with permissive powers in respect of this watercourse is Warwick District Council.

Eathorpe is covered by the Agency's flood warning scheme (Area A6, River Leam Marton to Leamington). Routine tree and bush work is carried out by the Agency every 8 to 10 years on this section of the River Leam where it can be justified to reduce flood risk. The responsibility for maintenance, however, lies ultimately with the riparian owner/s. Future maintenance work will be programmed for this location. This work is to include cutting back the vegetation in the flood relief channel, clearing the material accumulated on the crest of the weir and selected de-silting of the channel downstream of the road bridge.

Flooding has affected the village on a number of occasions, including July 1968, September 1992

and Easter 1998. A Public Meeting was held with Eathorpe Parish Council and the residents of Eathorpe on 24 January 2001. Reportedly, flooding occurs due to a number of causes:

- High water levels in the River Leam. Properties in the main village road are affected.
- It was reported that a blocked pipe caused flooding to Penns Lane and Row Lane in the village.
- Increased surface water run-off caused by the road bypass built some 30 years ago, along with new developments, have contributed to the flooding problems.
- Flooding is exacerbated by the inability of the drains and ditches to handle the excess volume of water.

The Agency does not have permissive powers to improve surface water drainage or sewer systems, and any improvements to the design, maintenance and operation of these systems should be considered by the appropriate body, i.e. the local authority/Severn Trent Water plc. Clearing of highway ditches normally falls on the Highways Authority. A blocked ditch not associated with highways is usually the responsibility of the riparian owner.

For these reasons, only alleviation from flooding to properties as a result of high water levels in the River Leam will be considered further in this study

3. THE PROBLEM

In Easter 1998 (estimated to be somewhere between a 50 and 100 year flood event), 11 houses in the village were reported as being affected by flooding, as shown on map provided by the Parish Council in Appendix A. The indicative flood-plain outline shown on the website, www.environment-agency.gov.uk, shows the extent of the 1998 flood, taken from existing information held by the Agency.

Using modelled design water levels, it is estimated that 21 properties in Eathorpe are at risk of flooding from the River Leam at the 100 year event (1% probability of occurring in any one year). Tech-Speed Motorsport, an industrial unit located on the island between the main channel and the mill channel is at risk before the two year flood. The onset of flooding for the remainder of the properties in the village commences at between the 25 and 50 year flood.

4. DESIGN ASPECTS

4.1 MODELLED DESIGN WATER LEVELS & FLOWS

Models have their limitations but are currently the best available means of assessing flows for different frequencies of flood event (design water flows) and their corresponding level (design water levels) at a location.

In 1997 Jeremy Benn Associates Ltd (JBA) were commissioned by the Environment Agency, Midlands Region to undertake a hydrological and hydraulic modelling study of the Rivers Leam and Itchen with the aim of producing floodplain maps. Two types of hydraulic model were constructed for the study, both 1 dimensional. A steady state backwater model using HEC- RAS and a hydrodynamic model using ISIS were constructed.

The aim of the HEC-RAS model was to provide information to help appraise the significance of bridge afflux through using the bridge modelling routines contained in the HEC-RAS program. Channel detail (like the channel bifurcation's upstream and downstream of the village bridge at Eathorpe) were therefore not considered. The ISIS model was constructed to include all of the channel bifurcations and loops to determine their dynamic reaction during flood. Bridge structures found to be insignificant in the HEC-RAS model were excluded from the ISIS model. The output of the design water surface profiles for the 5, 10, 50 and 100 year ISIS simulated events were used in this study to assess onset return period of flooding of properties and heights of defence required. The model report concedes that the Leam river is complex with hydrological discontinuity between Eathorpe and Leamington gauging stations however reasonably good agreement has been obtained between model predictions and observed peak water levels and flow/level hydrographs. The report stresses the importance of continued operation of the gauging station at Eathorpe and at Leamington and to include another gauging station on the River Itchen. Since the model report by JBA was issued a new gauging station on the River Itchen at the nearby village of Southam has been built and is currently operational.

4.2 ECONOMIC ANALYSIS

Costs have been based upon SPONS 2003. Maintenance costs over the life of the scheme have been based upon recent values being used by the Area Operations Team in other projects and have been reduced to present value using a 3.5% discount rate in accordance with the Defra guidance of 17 March 2003*.

Total scheme costs have been increased by 60% to take account of Optimism Bias in line with Defra guidance of 14 March 2003 "Revisions to Economic Appraisal Procedures arising from the New HM Treasury 'Green Book'".

Economic benefits have been assessed using a simplified method of calculation, based on the Middlesex University Flood Hazard Research Centre's 'The Benefits of Flood and Coastal Defence: Techniques and Data for 2003' known as 'the Multi-Coloured Manual (MCM). The simplified benefits have been updated by the Retail Price Index, excluding mortgages (RPIX), and supplied by the Agency's National Capital Programme Management Service (NCPMS). Benefits are calculated over a 100 year asset life and have been reduced to present value using a discount rate of 3.5% in accordance with the Defra guidance of 17 March 2003.

Design water levels for the Do Nothing scenario are not available. It has been assumed that the modelled design water levels reflect the current ('do minimum') situation as routine maintenance is carried out on this stretch of watercourse. Do Nothing damages have been calculated, following guidelines given by NCPMS, by assuming that flooding occurs 'one return period' earlier than estimated in the current ('do minimum') case.

Options have been appraised in accordance with Flood and Coastal Defence Project Appraisal Guidance 3 (PAG3) published by the Ministry of Agriculture, Fisheries and Food (now Defra).

4.3 THRESHOLDS

A site-specific topographic survey was undertaken for the Agency in February 2002 by Total Surveys Limited. Threshold levels of properties were taken along with road levels and cross sections across the River Leam through the village. There is a discrepancy between the road levels

* It is necessary to discount all of the costs and the benefits of a scheme, from the time when they arise in the future, to their present value in order to test the economic efficiency of different options on a comparable basis.

in this topographic survey and existing contour maps produced for the Agency in 1995/96. In places the discrepancy is up to 0.5m. These levels affect where the raised defences would be tied in to high ground. However, this has little impact on the outcome of this study.

4.4 OTHER INFORMATION

The effects of future climate change have not been considered at this stage as per current Defra guidance, which states that, with the degree of uncertainty involved, there is no current justification for the general adoption of either reduced or increased allowances.

There are four Grade II listed buildings within the study area. The Local Planning Authority would need to be consulted on the design of the preferred option if a scheme were to progress.

The peak water level measured at Eathorpe Gauging station at Easter 1998 read 59.94m AOD (the modelled 100 year level at the Gauging station is 60.35m AOD). The river level rose 2.2m over a 12 hour period leading up to this, at a rate approximately equivalent to 180mm per hour. Peak flow measured 116 cumecs (cubic metres per second). Peak water levels in Easter 1998 at Tech-speed Motorsport and The Gables were 60.56m and 60.43m respectively.

Peak flood flow in September 1992 measured 51.7 cumecs and in July 1968 100 cumecs.

The mill channel road bridge has flow area of approximately 3m² and the Wappenbury Access bridge has a flow area of approximately 37m². The modelled 100 year flow at the mill channel bridge is approaching 19.13 cumecs and at the three arch bridge is 60.84 cumecs.

4.5 INFORMATION AVAILABLE FOR USE IN FURTHER STUDY:

- 1995 Aerial Contour Survey of River Leam floodplain
- Topographic survey carried out by Total Survey Ltd for the Agency in Feb 2002
- Warwick District Council Local Plan 1995
- Historical flood levels
- Map of flooded properties in 1998 provided by Eathorpe Parish Council
- 1: 10 000 Geological map of area showing deposits.
- Spreadsheet showing onset return period for properties and associated benefits

4.6 GEOLOGICAL CONSIDERATIONS

The British Geological Survey, Tile SP36NE indicates that the study area is of underlying Mercia mudstone covered with river terrace gravels throughout the village. In the vicinity of the river alluvium deposits of unknown depth cover the area. A geo technical survey would be required to determine their depths and extents. These strata may affect the type of defence required to alleviate flooding. At this pre-feasibility stage it has been assumed that the preferred defence option will not suffer significant seepage due to the rapidity of the flood event.

5. ENVIRONMENTAL AND PLANNING CONSIDERATIONS

A report, which considers the environmental issues in respect of the options considered has been written by the Environmental Impact Assessment Team at Lower Severn Area Office, and is included in Appendix B. The report concludes that this project is to be progressed according to EIA Level: 2 – Environmental Impact Assessment of the project not formally requiring the production of an Environmental Statement by the EIA Regulations, but which warrant a similar level of assessment due to their nature, scale or location.

The environmental constraints and opportunities relating to the options considered are outlined below:

Table 1: Constraints/Opportunities

Criteria	Details	Potential Impact on Criteria (High or Low)			
		Negative	None	Positive	No Info. available
Constraints					
Natural Environment (List all issues on or near proposed site)					
Designated Sites (List as appropriate)	Warwickshire Wildlife Trust Nature Reserve		✓		
Non-designated sites of Wildlife Value	River Leam Woodland Island	High High/Low			
Rare Flora and Fauna (Protected Species)	Rare Flora Otter habitat Badger sets				✓ ✓ ✓
Loss of flood-plain / wetland	Reduced flood-water storage Impeded flow route		✓		
Visual					
Built Environment					
Recreation & Navigation	Sailing Angling Walking	Low	✓ ✓		
Human Impact	Road closures Disturbance (noise, dust, gardens &c)	High High			
Archaeology and Historic Buildings	Scheduled Ancient Monument County Archaeological Site Listed Building	✓ Low			✓
Other	Preserve historic defences		✓		
Opportunities					
Habitat Creation	Improved riparian habitats			✓	
Re-creation of flood- plain / wetland	Creation of scrapes/wetland area			High	
Other					

6. OPTIONS

In order to give best value, the Agency seeks to reduce the risk of flooding for as many people as possible for the amount of public money spent to provide a flood defence scheme. This study has been undertaken to look at providing a scheme to benefit the community as a whole. The land use descriptions used in table 2, Appendix 1 of PAG 3 indicate that Eathorpe falls in band B. The corresponding indicative standard of flood protection is defined as being between 25 (4%) and 100 (1%) years.

Modelled design water levels suggests that 21 properties in Eathorpe are at risk at the 100 year flood. As onset return period of flooding for 17 of these properties is between 50 and 100 year, only 100 year standard of protection has been considered in this study. Protecting to the 50 year return period would only reduce risk of flooding for 4 of the 21 properties and has not therefore been considered. Options to protect Techspeed Motorsport, which is at risk of flooding by the 2 year flood, have not been considered in isolation, as it is not the Agency's remit to provide protection to individual properties.

OPTION 6.1 - DO NOTHING

The Do Nothing option provides a necessary common baseline against which all options can be assessed and different investments in different parts of the country can be compared. Where there is no flood defence scheme in existence, as is the case in Eathorpe, then Do Nothing means that no action is taken to intervene with natural processes. It reverts to situation where the Agency doesn't exist, flood warning and all maintenance carried out by the Agency, including routine tree and bush work, blockage removal and localised silt removal, would cease. This may result in an increased risk of flooding in the village.

OPTION 6.2 - DO MINIMUM

The Do Minimum option means that no new defences will be constructed at Eathorpe but the Agency may continue to carry out maintenance of the watercourse under its permissive powers. This maintenance includes tree and bush works, localised de-silting and blockage removal where considered to have a significant impact on flood risk. The flood warning system that exists would be continued, but not extended or developed. The consequence of this option would be a continuation of the existing situation.

OPTION 6.3 – INCREASED FREQUENCY OF MAINTENANCE

Increasing the frequency of maintenance carried out by the Agency may increase channel conveyance and decrease the frictional effects on water in this watercourse. However, it is unlikely that works would improve either the velocity of flow or channel capacity sufficiently to reduce flood risk to properties. This option has not therefore been considered any further in this study though this should not discourage landowners from carrying out works under their riparian responsibilities.

OPTION 6.4 – LOWERING OF WEIRS/INCREASING CAPACITY OF BRIDGES

An investigation of the modelled design water levels upstream and downstream of the study area has indicated that the existence of the weirs and bridges has no significant impact on the design water levels within the study area.

This option has the potential to provide significant environmental improvements. Provided the scheme is designed in a sympathetic manner the ecological value of the upstream river could be improved because lower weir levels could allow the river to revert to a more natural state. Marginal and in-channel vegetation would also adapt to a more natural equilibrium. At present the weirs are a significant barrier to fish movement. The sympathetic lowering or removal of the weirs would allow fish to migrate upstream, providing considerable environmental benefits. It may be possible that the weirs have some archaeological significance and/or there are features associated with the mill pond that have overriding ecological importance, but generally weir removal and lowering must be viewed as a positive ecological step.

The lowering of the weirs may detrimentally affect the water level in the mill channel. However it is considered that lowering the weirs and/or increasing the capacity of the bridges would not significantly reduce flood risk in the village. This option has therefore not been considered further.

OPTION 6.5 – FLOOD RELIEF CHANNEL

A flood relief channel, to take the excess flow in a 100 year event which could not be contained in the existing channel, could be built on the land adjacent to the existing watercourse. The bed level of the channel could be formed so that it would only convey flows during times of flood. During normal summer and winter flows it could appear as a dry grassed depression.

Detailed modelling would be required to assess the precise size and gradient of flood relief channel which would be required to reduce flood risk from the 100 year flood. The location at which water would be taken from and returned to the existing watercourse would also need to be investigated. This modelling has not been undertaken in this study. At a rough estimate, the cost of a channel to take excess flow in a 100 year event is in excess of £1,000,000. This cost was based on a channel of sufficient length to just bypass the study area and could be increased if a larger channel were required. There are potentially considerable environmental gains associated with option, including additional wetland creation and other habitat improvements. As part of this option, tiered wetland scrapes could be created within the grass meadow downstream of the bridge alongside the grass meadow. There would be scope to produce several ponds of varying depths throughout the grass meadow. Such scrapes and shallow ponds would have the potential to create a bio-diverse and species rich meadow. The precise number and location of scrape would need to be determined at the design stage.

Substantial works would be required to the highway to install a culvert beneath the road of sufficient flow area to take the 100 year flood. The cost estimate has not included for this and the cost of this is likely to make this a prohibitively expensive option.

OPTION 6.6 – CHANNEL IMPROVEMENTS

At present, water overflows the bank at less than a 2 year flood. The existing average channel capacity is only 30% of that required to carry the 5 year flood and 10% of that required to carry the 100 year flood. Works would have to be extensive to alleviate flooding to the 100 year event. Modelling would be needed to assess the magnitude of channel improvements which would be required to carry the 100 year flow in-bank, and the length of the channel over which such improvements would need to be made. This is highly likely to extend beyond the study area. This modelling has not been undertaken in this study.

A rough assessment of the volume of material which, would need to be excavated in the study area has been made. Excavation and removal of material is likely to have an initial cost in excess of £1,000,000. It is likely that silt will re-accumulate and further work would be need to be undertaken a number of times in the future. This will further increase the cost of this option.

The adverse ecological impacts of such an option are likely to be high. In order to provide a sufficient volume to convey flood flows, the majority of natural in-channel and bank side features are likely to be removed. It may however be possible to provide increased capacity by re-profiling the river banks, improving the channel features by providing meanders, etc. and creating a two stage channel to carry flood flows. Creating a two stage channel is likely to have a temporary detrimental effect, but it may be possible to create a self cleansing channel that retains and improves it's ecological features over the long term.

It is unlikely that through such channel improvements the velocity could be increased sufficiently for the existing bridges to take the 100 year flow and the capacity of the bridges would also need to be increased. This would add significantly to the cost. As the cost of this option is likely to far outweigh the benefits available, this option has not been considered further.

OPTION 6.7 – CONSTRUCTION OF PERMANENT RAISED DEFENCES

It is suggested that Figures 3-5 be looked at in conjunction with the sub-option descriptions given below.

OPTION 6.7A - CONSTRUCTION OF PERMANENT RAISED DEFENCES – REAR OF MAIN VILLAGE ROAD (SEE FIG.3)

Earth embankments/walls could be constructed, with appropriate land drainage consents and planning permissions, to provide a physical barrier against surface flooding from the river. The impact on properties elsewhere in terms of increased water levels of constructing any defence, would need to be investigated at an early stage in the process of providing a scheme.

This option would involve undertaking works in/adjacent to private gardens, which may cause disruption as well as potentially causing negative environmental impacts.

Works would involve constructing a permanent physical barrier along the rear of properties in the main village road merging in to the higher ground at both ends. Height of defence would be dependent on ground levels, but has been estimated to be between 0.15m and 1.44m, excluding any settlement allowance, which may be required. Due to the configuration of gardens and dwellings, it is not viable to extend an earth defence through all the critical locations in the village and, therefore, any defence would require some form of wall to be constructed. The proposed defence comprises of four elements: an earth embankment with clay core, a length of brick clad concrete wall, a steel floodgate across the road and some highway modifications to raise the road at two locations. Any existing outfalls not flapped would require a flap to be installed. Surface water drainage would also need to be addressed either via a new outfall or a diversion. An appointed floodgate operator would need to be nominated from within the community and signs would need to be erected in conjunction with the highways authority to warn traffic that the Wappenbury road is temporarily closed. Due to it's location on the island, protection of 'Tech Speed Motorsport' is not considered.

OPTION 6.7B - CONSTRUCTION OF PERMANENT RAISED DEFENCES – REAR OF MAIN VILLAGE ROAD AND TECH- SPEED (SEE FIG.4)

As for Option 6.7a, plus defence of 'Tech Speed Motorsport'. A floodgate would need to be provided to allow access to Tech Speed. Providing a ring bank defence around the premises may impact on the height of the defence required in Option 6.7a, due to a permanent change to the mill channel hydraulics caused by a raised bank or wall constricting any out of bank flows through this section.

Due to space restrictions the defence would need to incorporate part of the existing building on both left bank and right bank of the mill channel. This may have legal and maintenance impacts, which would need to be addressed.

OPTION 6.7C - CONSTRUCTION OF PERMANENT RAISED DEFENCES – PLUS EXCLUSION OF THE MILL CHANNEL FROM THE RIVER SYSTEM (SEE FIG.5)

As for option 6.7b plus installation of water controlling structures on the mill channel. Installation of such structures on the upstream and downstream extents of the mill channel would prevent floodwater from entering the mill channel during flood conditions up to the designed return period of 1 in 100 years. These structures would be located at the entrance to the culvert on the upstream

side of the mill channel road bridge and at the footbridge in the garden on the downstream side. It would be necessary to strengthen or rebuild the walls on which the structures would be built at these locations. The structures would include penstocks that could be used to temporarily seal off the mill channel during flood conditions. The nominated floodgate operator would be required to close both the penstocks as well as the floodgates when authorised by the Agency, Warwick District Council or an Emergency Service such as the Police. The closed penstocks then combine with the raised embankments, floodgates and walls to form a defence to protect to a 100 year return period.

Alternatively the mill channel could be removed altogether from the river system. The channel could be in-filled downstream of the second weir to where it rejoins the main river at The Cottage. This would effectively remove the 'mill island' altogether and any raised defences could also protect 'Tech Speed Motorsport'. Future traditional operation of the mill would, however, be lost as long as the properties remained defended. As the mill leat is classified as an ordinary watercourse it would be necessary to include Warwick District Council in consultation if progressing this option.

Consultations should also include Warwickshire County Council Highways if works are to be carried out on the road bridge.

OPTION 6.8 – IMPROVED FLOOD WARNING SERVICE

Flood warning will not reduce frequency of flooding but will, if acted upon, reduce the impact. At present this location is within the Agency's Flood Warning Area A6 Marton to Leamington. The gauge for this warning area is at Eathorpe. A new gauge has been installed at Kites Hardwick (upstream) so, in time, improvements may be possible from records of events from this gauge. A gauge has also been constructed on the River Itchen, just downstream of Southam, so the contribution of this tributary of the Leam can now be studied in more detail.

In Eathorpe only 11 of the properties at risk at the 100 year event are currently on the *Automatic Voice Messaging* (AVM) system to receive flood warnings. The model indicates that a further 10 properties are at risk of flooding in a 1 in 100 year event. It is recommended that householders of these additional properties take up the agency's invitation to join the flood warning scheme and have details entered onto the AVM. In the future (currently one year away), the AVM will be replaced by the Multi Media system which will enhance the methods of warning dissemination and aid the improvement of the information given out by the Agency. Flood awareness in the village could be raised with the help of the Parish Council. The Agency would be pleased to provide advice and information to facilitate this.

OPTION 6.9 - PROVIDE UPSTREAM STORAGE

Upstream storage works on the principle of flow attenuation. Once the flow in the river increases beyond its capacity, flooding occurs. Upstream storage restricts the flow to the stretch of river being protected by means of a retaining structure. This results in flow building up behind the retaining structure and flooding open land upstream. Once the flood declines, this excess stored volume of water is allowed to flow gradually back into the river.

In order to protect properties in Eathorpe against a 100 year (1%) flood, it has been estimated that in excess of 9,500,000m³ of water would need to be stored upstream.

This would require a Class 'A' reservoir to be constructed and it would need a spillway to permit flows in excess of the Probable Maximum Flood (PMF) or 10,000 year (0.01% chance) flood to

pass over. Depending on the existing upstream habitats the environmental impacts of creating an upstream storage area could be either a significant benefit or cause a significant negative impact. The cost of this option is likely to be prohibitively expensive and has not been considered further in this study. As such, the existence of a suitable location upstream has not been investigated.

OPTION 6.10 – LAND USE CHANGE

It is possible that changes in land use upstream of Eathorpe have resulted in increased flood flows through the village although this is still the subject of considerable R&D work to prove either way. Development, as well as changes in agricultural practice, may have increased surface run off, soil erosion and consequent silting of the river. It may be an option to implement a project focusing on land use changes, with the aim of reducing runoff and improving infiltration upstream of the village. Other benefits may include reduced siltation, improved soil structure and water quality and increased agricultural productivity.

As this option is still an unproven method it couldn't be justified at all in providing flood alleviation to Eathorpe therefore it has not been considered further. However, the Agency could seek changes to Land Use allocation in Local Plans as precautionary principals can apply.

OPTION 6.11 – FLOOD PROOFING PROPERTIES

The Agency has no general mandate to flood-proof individual properties nor to supply grants to householders in order for them to do so. Should a viable scheme not be possible at Eathorpe, residents may be interested in learning more about methods of self-help to reduce the impact of flooding. This they can implement regardless of the Agency's actions. Floodwater can enter properties by a number of routes including walls, doors, windows, air bricks and vent covers, and there are various removable household flood products available, namely door boards and air brick covers, which could be considered for individual property protection. These products are unlikely to make properties fully waterproof. They will however give vital time to move light furniture, valuables, memorabilia and perishable items out of reach of floodwater and to evacuate the property safely if necessary, so reducing the impact of flooding. The responsibility in respect of household products lies with the individual property owner/tenant. Reduction of risk would be dependent on sufficient warning, which at present is given by the Agency on a best endeavours basis and installation and maintenance being carried out in accordance with the manufacturer's instructions. It is important to note that before making any decision in relation to the use of a temporary barrier, the person or body taking the action should check with the local Environment Agency office and local authority that they have obtained all necessary statutory permissions and consents to erect the protection at the chosen location. In particular, they should ensure that the protection of their property does not significantly increase the risk of flooding to other properties.

7. COSTS

Initial economic analysis has been undertaken in respect of Option 6.2 (Do Minimum) and Option 6.7. Option 6.7 considers the possibility of constructing raised defences to provide a physical barrier against flooding. Three sub options were described, for which the estimated construction costs and maintenance costs over a 100 year design life of the scheme are summarised in Table 2. The derivation of the costs of this is shown in detail in Appendix C.

Where there is considered to be available space, embankments have been costed rather than walls. Actual space available will need to be checked at detailed design stage. Where walls may be more appropriate these have been included in the cost of the options.

Where outfalls have been costed in respect of surface water drainage from behind the protected areas, no allowance has been made in the costs for pumping this drainage. No allowance has been made for inadequate ground conditions. These costs would need to be added if considered appropriate following further investigation. The level of compensation that would be required has not been addressed in detail and only a minimal allowance has been made for this within the costs. At this pre-feasibility stage it has been assumed that the above factors will not contribute major costs to the scheme and will not detriment the present robust benefit/cost ratio.

The control structures have been costed in option 6.7c rather than the infilling of the mill channel, the amenity value of the mill channel would, therefore not be lost.

Table 2 – Costs

Option	Scheme Cost £k	Present Value Maintenance cost £k	Total Scheme Cost £k
Option 6.2 – Do Minimum	-	42	42
Option 6.7a – Raised defence not including Tech-Speed	328	155	483
Option 6.7b – Raised defence including Tech-Speed	486	163	649
Option 6.7c – Raised defence with exclusion of the Mill Channel	470	163	633

8. ECONOMIC ANALYSIS

The benefits of a flood alleviation scheme are calculated as the difference between the expected value of flood damage costs with the option being evaluated compared with the flood damage and losses incurred in the “Do Nothing” situation (known as “damages avoided”). Damages relate to losses to the nation and not to losses to an individual, and are calculated as a function of the probability of a flood occurring and the loss that such an event would incur. The greatest proportion of benefits generally comes from the more frequent return periods. Intangible damages such as stress, effects on health and loss of memorabilia cannot be readily assessed and have to date been excluded from methods of benefit calculation.

The Multi-Coloured Manual, on which simplified method of calculation is based, gives standard values for flood damage to be expected for different types of property, which are unrelated to market value or cost of property and are calculated as a function of the depth, duration and velocity of flooding. It is worth noting that flood damages begin to be calculated when water levels are approximately 300mm below threshold level, due to damage to the building fabric, even though internal property flooding may not occur.

The return periods of flooding and the corresponding numbers of properties affected, which have been used in the assessment of economic benefit, are shown in Table 3.

Table 3: Onset return period of flooding over threshold and estimated number of properties affected

Return period of flooding over threshold	Estimated number of properties which commence flooding	Total number of properties flooded at return period
2 year	1	1 *
5 year	0	1
10 year	0	1
25 year	3	4 *
50 year	3	7
100 year	14	21

* Estimated number because no design water levels available

The benefits for each option undergoing economic analysis are shown in Table 4.

The vast majority of the benefits arise from protecting Tech Speed Motorsport. At this stage only standardised figures have been used for benefit assessment. A site specific assessment for this industrial unit should be undertaken at the feasibility stage.

Do nothing damages have been estimated at £876k. This may be greater than the damages that would actually be incurred.

The benefits for the Do Minimum option have been calculated by subtracting the Do Minimum damages from the Do Nothing damages. Damage estimates for both options do not include any damages, which may be incurred in floods greater than the 100 year flood.

Damage avoided due to the operation of a flood warning system has not been calculated specifically in the Do Minimum benefits.

Table 4 – Derivation of Benefit-Cost Ratios

Option	Scheme Benefits £k	Scheme Costs £k	Benefit-Cost Ratio
Option 6.2 – Do Minimum	204	42	4.9
Option 6.7a – 100yr Raised defence not including Tech-Speed	265	483	0.6
Option 6.7b – 100yr Raised defence including Tech-Speed	981	649	1.5
Option 6.7c -100yr Raised defence with exclusion of the Mill Channel	981	633	1.6

9. CHOICE OF SCHEME

Options 6.2, 6.7b and 6.7c have potential benefit-cost ratios of greater than 1. As part of Defra's project appraisal guidelines, a set decision tree is followed in order to compare economical options for a flood alleviation scheme. This decision tree has been expressed in tabular form and is shown in Appendix D. As part of the comparative assessment, incremental benefit-cost ratios need to be calculated. An incremental benefit-cost ratio is the ratio of the increase in costs compared to the increase in benefits from one option to another with a higher standard of protection. Incremental benefit-cost ratios compared to the Do Minimum option are shown in Table 5.

Table 5 – Derivation of Incremental Benefit-Cost Ratios

Option	Total Benefits £k	Total Costs £k	B-C Ratio	Incremental B-C Ratio – comparing option with Do Minimum
Option 6.2 – Do Minimum	204	42	4.9	-
Option 6.7a - 100 year Raised defence	265	483	0.6	0.14
Option 6.7b - 100 year Raised defence not including Tech Speed	981	649	1.5	1.28
Option 6.7c - 100 year Raised defence with exclusion of the Mill Channel	981	633	1.6	1.32

The Defra rules have been followed, within the limits discussed above and with the aid of figures taken from table 5.

- *Is the benefit-cost ratio > 1* → *Yes*
- *Consider option with highest benefit-cost ratio* → *Option 2 – Do minimum*
- *Standard below indicative standard?* → *Yes (standard 25-100 years)*
- *Does the next highest option have an incremental benefit-cost ratio robustly > 1* → *Only 100 year protection considered. Robustness generally is considered to be greater than 1.5:1. No option robustly greater than 1.*
- *Recommended option following DEFRA guidelines* → *Option 6.2 – Do minimum*

The option that should be selected, following DEFRA guidelines is Option 6.2 - the do minimum option. Pre-feasibility however, is undertaken to determine if there is a potentially viable scheme using simplified benefit calculations and approximate costs regardless of grant earning funding. A scheme which has a Benefit/Cost ratio of greater than 1 may still be considered under FDMM and FSOD as a large project (non grant eligible). If less than £500,000 it can be approved by PAB and not referred to DEFRA. Options 6.7b and 6.7c have incremental benefit cost ratios greater than 1 and should therefore progress to the next stage of feasibility where costs and benefits can be considered in more detail.

10. PRIORITY SCORE AND RISK

Even if shown to be technically feasible, economically justifiable and environmentally acceptable, a flood alleviation scheme is not automatically guaranteed to be constructed. To ensure that National funds are distributed fairly and according to a common system, the Agency follows the DEFRA Flood Management Division's 'Scheme Prioritisation System March 2002'. It is this that forms the basis upon which subsequent priority scores and risks are based.

At this pre feasibility stage, the priority score for the option with the highest incremental benefit cost ratio (Option 6.7c) is 4.6. Derivation of this priority score is shown in Appendix E.

Schemes for construction using grant aided funds must meet a priority score threshold set by DEFRA which ensures the equitable distribution of funds for any year. For schemes to be constructed in 2004/05 this threshold has been set at 20, and current indications are that the threshold will drop to 15 in year 2005/06, though this is subject to change. A scheme could not attract funding for construction at Eathorpe until its priority score exceeds the DEFRA threshold. Feasibility and design are usually carried out immediately prior to construction. Based on the priority score assigned at this pre-feasibility stage, it is unlikely that this scheme will progress to detailed design before 2005/06 at the earliest. At the feasibility stage, the priority score may however change from 4.6, once the scheme has been looked at in greater detail.

It should be noted that an increase of 10.4 priority points would be required to reach the 2005/6 threshold of 15 points. This is equivalent to an increase in economic score portion to 12.5, requiring an increase in the benefit cost ratio to 6.75.

11. SENSITIVITY OF OPTION TO IMPACT OF CLIMATE CHANGE

Sensitivity analysis has been undertaken in this study to assess the impact of climate change on the standard of protection offered by the selected options, using 100 year + 20% flow, in line with current guidelines, and extrapolated corresponding water level. This analysis suggests that the 100 year flood in 50 years time would overflow the defence.

12. RISKS

In options 6.7b and 6.7c there are flood defence structures namely floodgates and penstocks, which need to be shut correctly in order to provide the designed standard of protection during flood conditions. If not operated correctly the defence would fail. If flood warnings are not received and acted upon people and property would be at risk.

The risk of flooding cannot be eliminated entirely - risk would still exist from events more extreme than that designed for by the scheme. The existence of a physical barrier to floodwaters may lead residents to perceive that there is a degree of security beyond that which has been designed. In the event of a flood exceeding the design of the defence, residents may be caught unaware and suffer accordingly. Frequent educational publicity campaigns and flood warning may mitigate against this.

The construction of flood defence works is dependent on agreement with the landowners and operating authorities and granting of any consents and planning permission required.

Effects of future climate change may reduce the standard of protection offered.

Tech-Speed damages may be worth less than actual standardised values used such that the economic viability may then be increased or decreased.

If option 6.7b were to progress it would be necessary to use existing buildings as part of the defence, this has potential legal and maintenance impacts which could prevent this option from being viable.

The costs only include a minimal amount in respect of compensation payable and if economic compensation cannot be agreed at reasonable levels the viability of any scheme may be in doubt.

At this stage it is only possible to make certain cost assumptions and further costs may be incurred, as discussed in section 7.

Risks that must be considered at the next stage of feasibility are shown on the Risk Register, included in Appendix F.

13. CONCLUSION

Initial economic analysis has indicated that the option that should be selected for Eathorpe, following Defra guidelines, is Option 6.2, Do Minimum. However, the aim of pre-feasibility is to indicate whether there is a potentially viable scheme, using simplified benefit calculations and approximate costs. Initial indications are that raised defences could be viable with options 6.7b and 6.7c having incremental benefit cost ratios greater than 1.

14. RECOMMENDATIONS

Recommendations are as follows:

- 1) The project should proceed to feasibility
 - a) The following investigations should be undertaken at the feasibility stage, and costs and benefits be refined according to the outcome:
 - i) Site specific damages assessment should be carried out for Tech-Speed
 - ii) Further topographic survey work should be carried out
 - iii) The impact on properties elsewhere, in terms of increased water levels, of constructing any defence.
 - b) The following should be considered further and costs and benefits be refined according to the outcome:
 - i) Modelling of the 100 year flow + 20% and corresponding level to look at the impact of climate change on standard of protection.
 - ii) Pumping of surface water drainage from behind protected areas
 - iii) The level of compensation that would be required

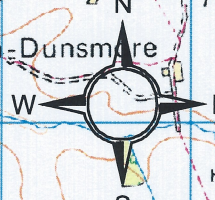
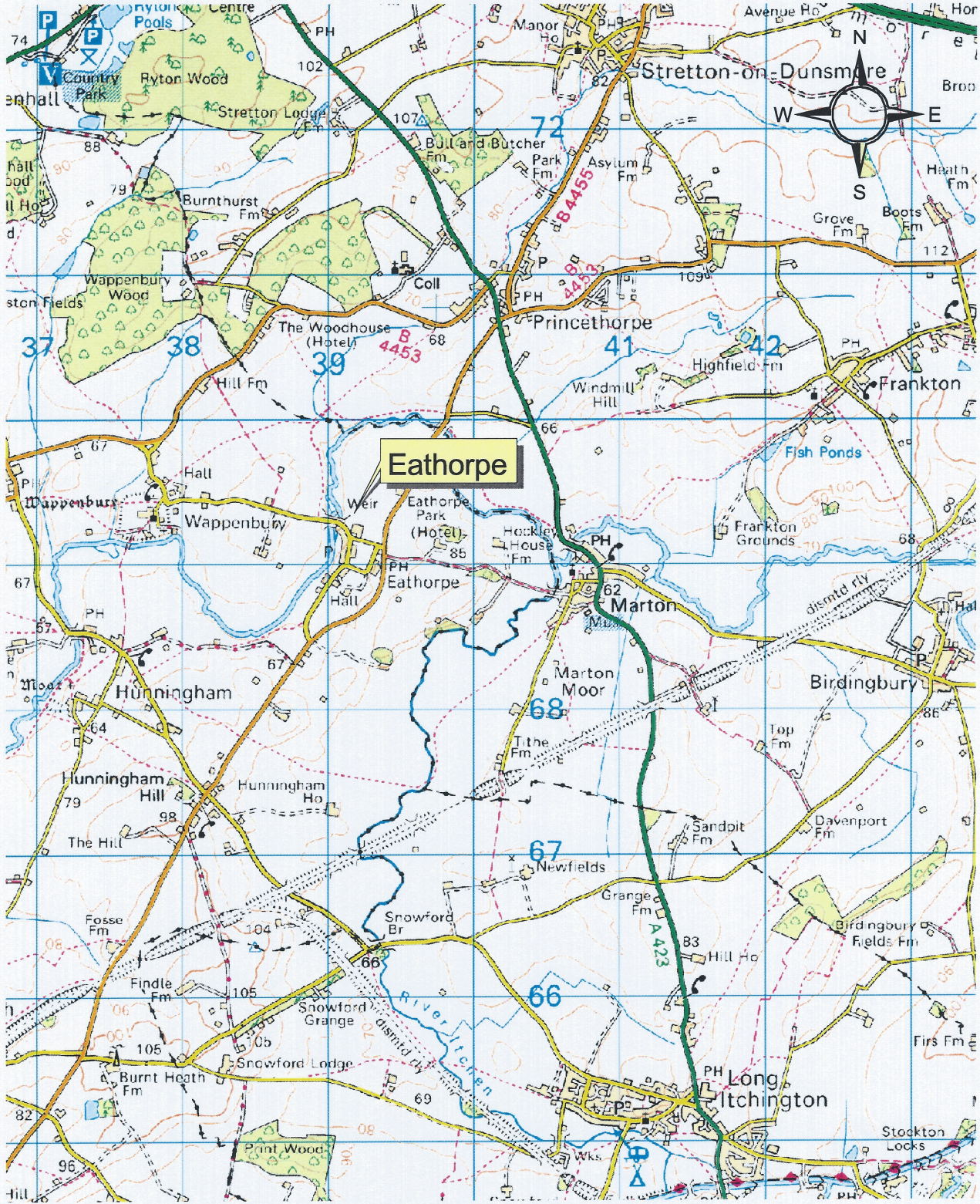
- iv) The space required to construct a defence and whether walls are more appropriate than embankments.
 - v) Do Nothing damages.
 - vi) Consultation should include Warwick District Council in connection with any works to the mill channel and the Highways Authority in connection to works impacting on the highway
- c) An Environmental Impact Assessment (EIA) should be carried out to at least a Level 2 standard acceptable to the EIA Agency Management System.
- 2) The Agency should continue to undertake general improvements to the Flood Warning Service and Eathorpe Parish Council could consider a scheme to raise flood awareness in the village.
 - 3) The number of properties taking up the invitation to join the Agency AVM should increase to include all those at risk of flood damage from the 100 year level. This could be achieved by the Agency seeking to improve the awareness of the AVM system by the Eathorpe residents.
 - 4) The Agency would require consultation with the Parish Council and residents of Eathorpe at the feasibility stage of the study in connection with the principal of using a nominated operator from within the village to operate the floodgates and penstocks during flood conditions.
 - 5) The Agency should consider a catchment wide land use study in the catchment area, which could be included in a future Agency R&D programme.

15. REFERENCES

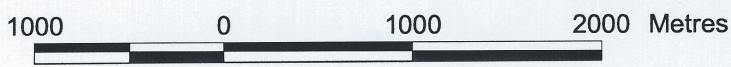
- 1. Jeremy Benn Associates Ltd (JBA) Hydrological and Hydraulic modelling study of the River Leam 1997
- 2. Map indicating extent of Easter 98 flood provided by Eathorpe Parish Council dated 19 Oct 2001
- 3. Total Survey Ltd Topographic Survey carried out in Feb 2002

Figures -

- Figure 1. Location Plan**
- Figure 2. Map of Eathorpe and Indicative Floodplain**
- Figure 3. Option 6.7a Earth Embankment and Wall**
- Figure 4. Option 6.7b Extended Earth Embankment and wall**
- Figure 5. Option 6.7c Earth Embankment and wall with exclusion of the Mill Channel.**



Eathorpe



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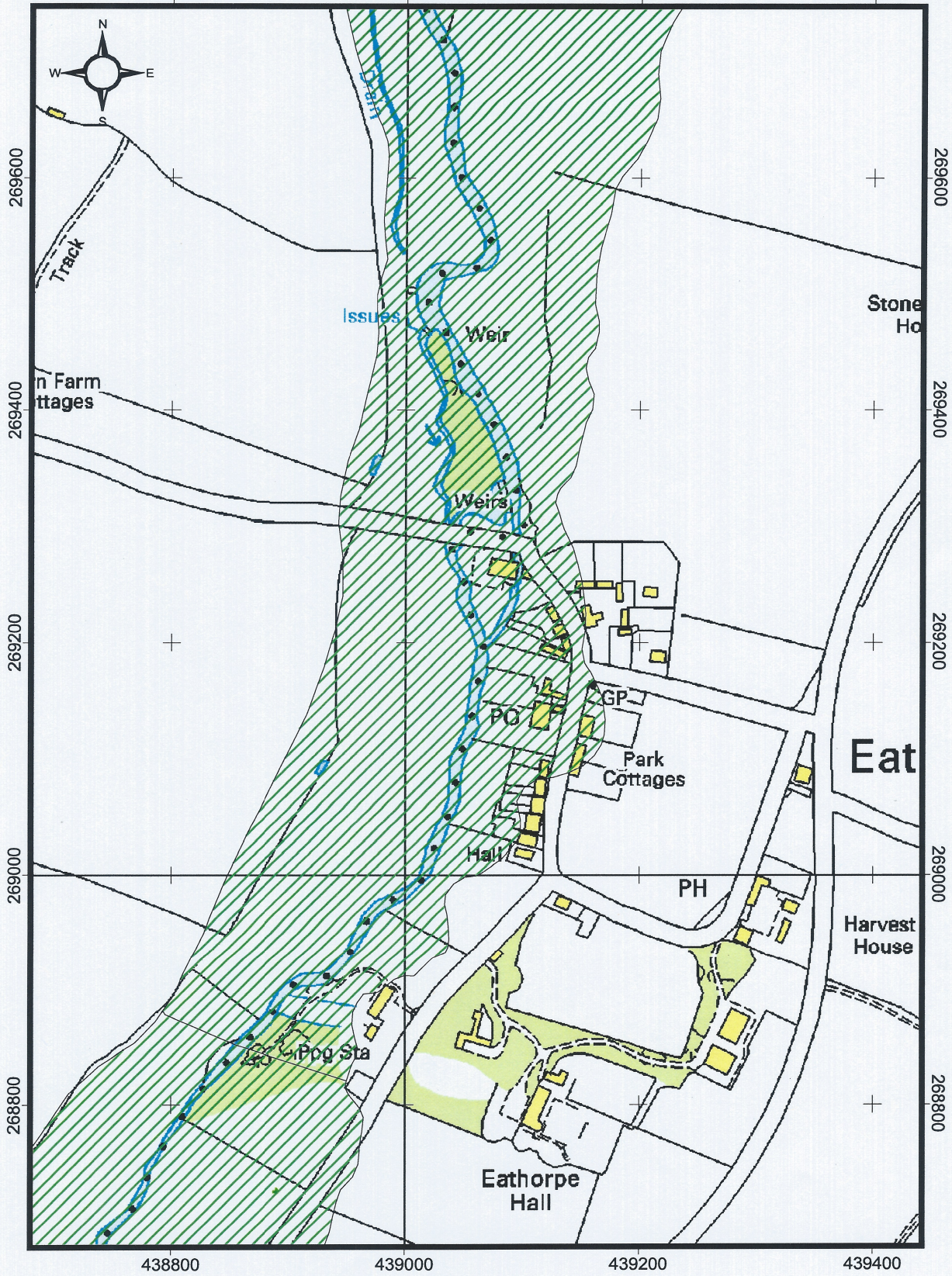


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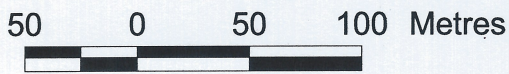
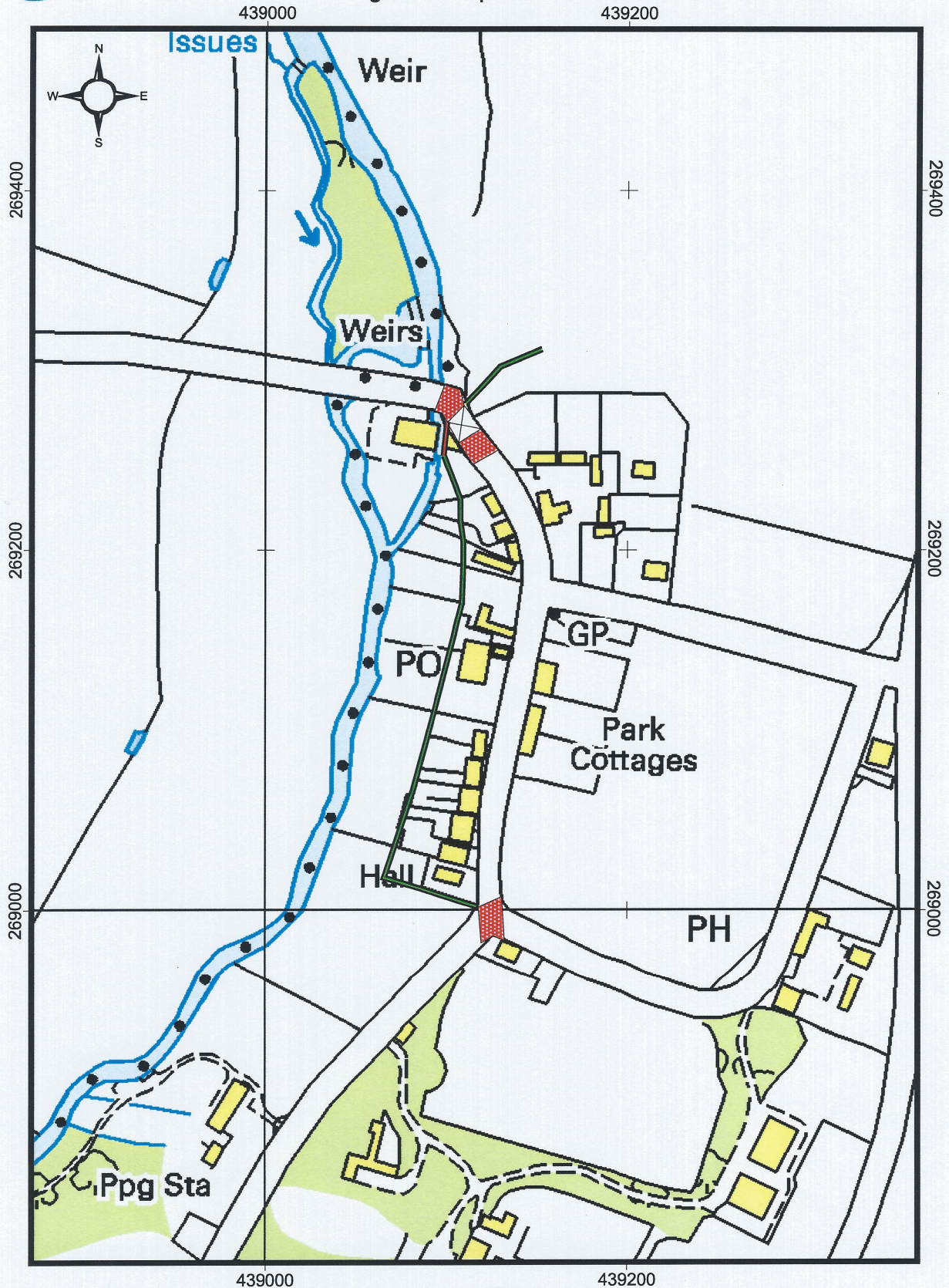
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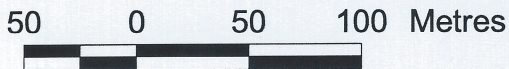
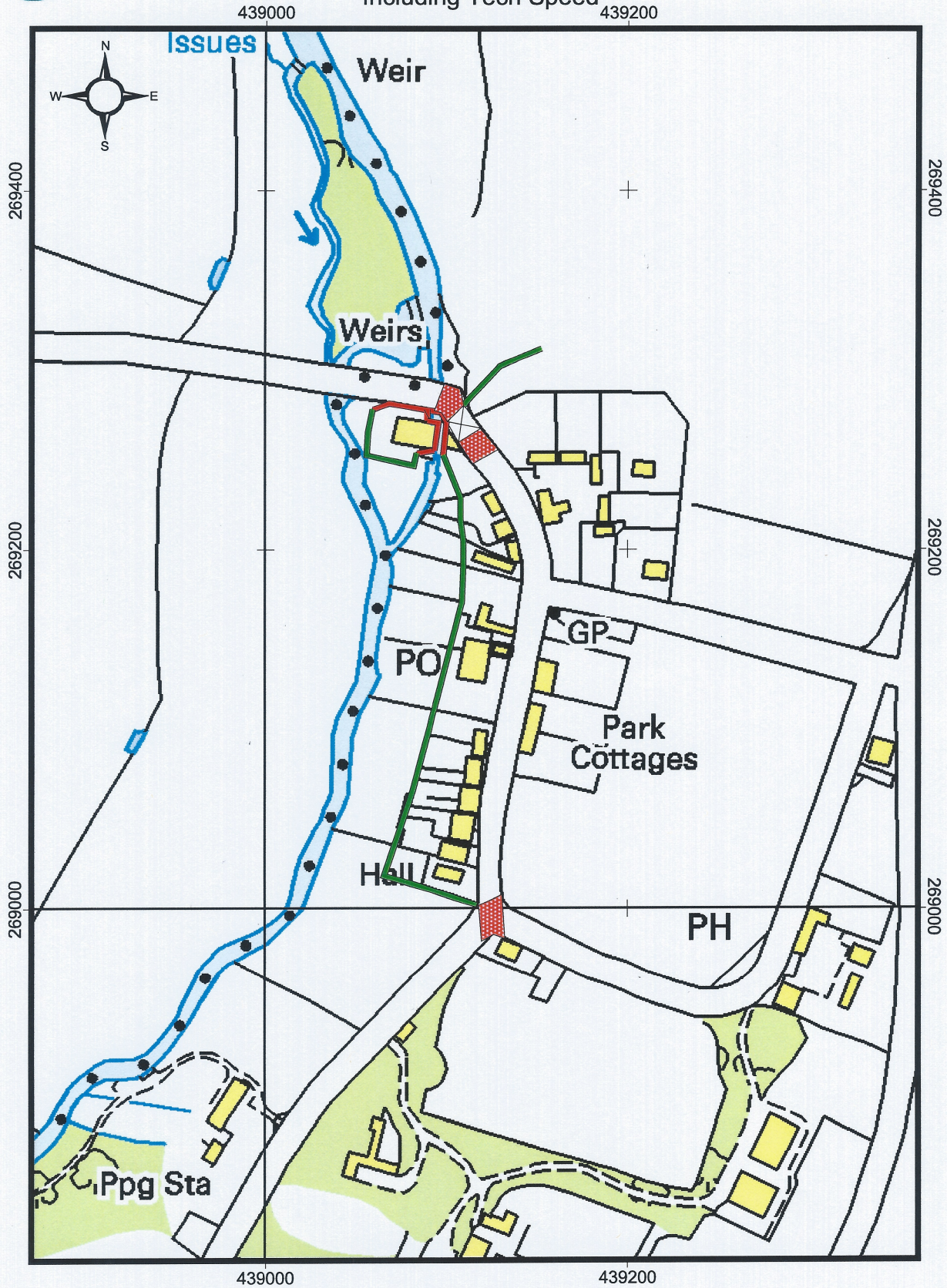






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- Flood Defence Wall
- Raised Earth Defence
- Area of Road to be Raised
- Flood Gate

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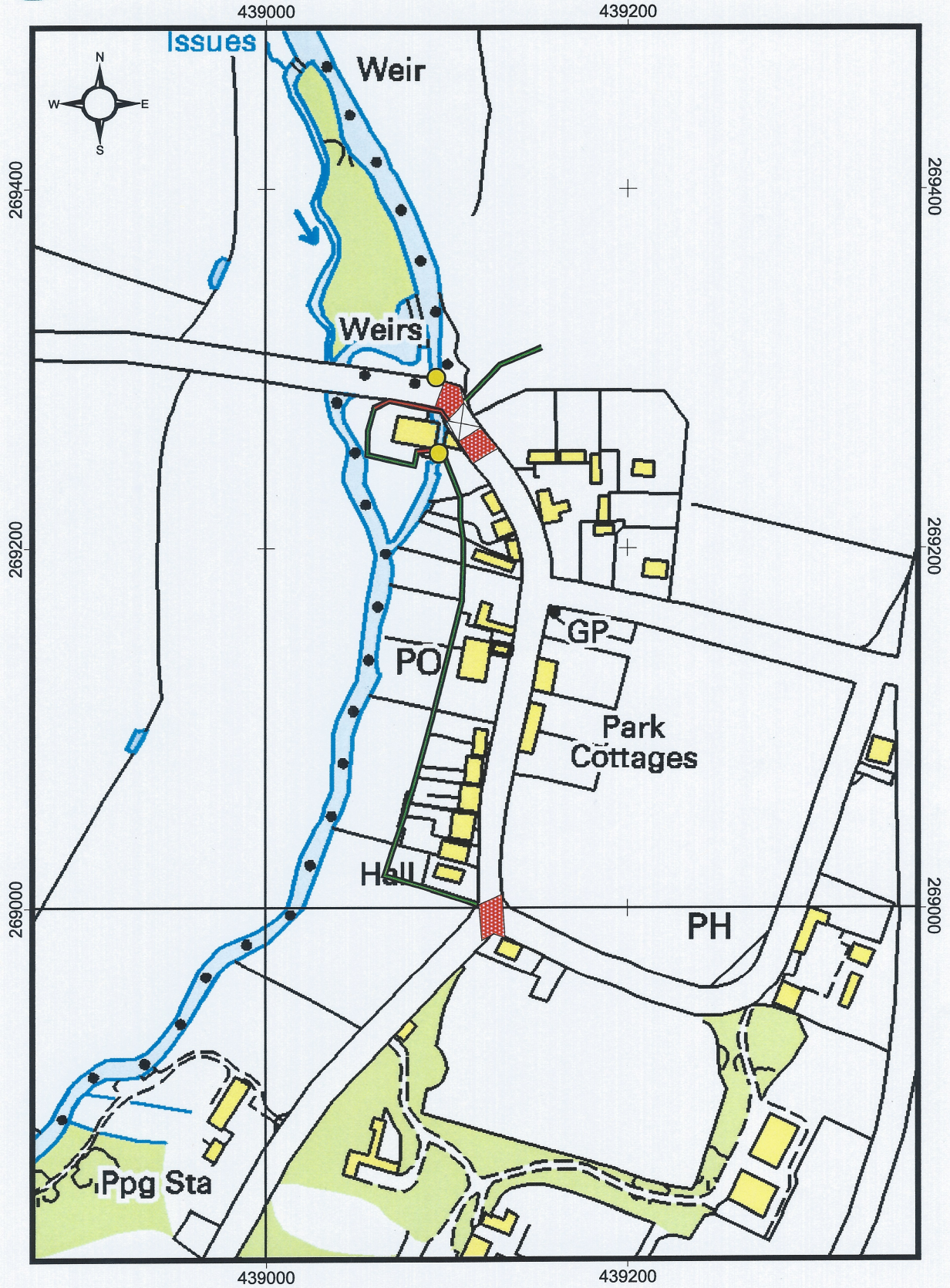
-  Area of Road to be Raised
-  Raised Earth Defence
-  Flood Defence Wall
-  Flood Gate

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

**ENVIRONMENT
AGENCY**

Eathorpe Flood Alleviation Scheme Pre-Feasibility Study
Figure 5 - Option 6c: Extended Embankment, Wall and
Control Structures to Mill Channel



50 0 50 100 Metres



-  Mill Channel Structure
-  Flood Defence Wall
-  Raised Earth Defence
-  Area of Road to be Raised
-  Flood Gate

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Appendix A – Information received from
Eathorpe Parish Council

55/805/515/100.

22 OCT 2001
Amount
Officer
CHQ No.
Midlands P...

Thyme Cottage
Eathorpe
Leamington Spa
CV33 9DE

19th October 2001

Your Ref: WJF/syw

Ref: FLOODING AT EATHORPE

Dear Mr Portsmouth

Please find enclosed a copy of a map of the village as requested showing the buildings that were flooded and the extent of the flood water into the village.

We hope that this will help the surveyor when he arrives to assist him to do his feasibility study of the area in question.

We would appreciate it if you could kindly keep us informed of all developments so we can pass on this new information to the residents of the village.

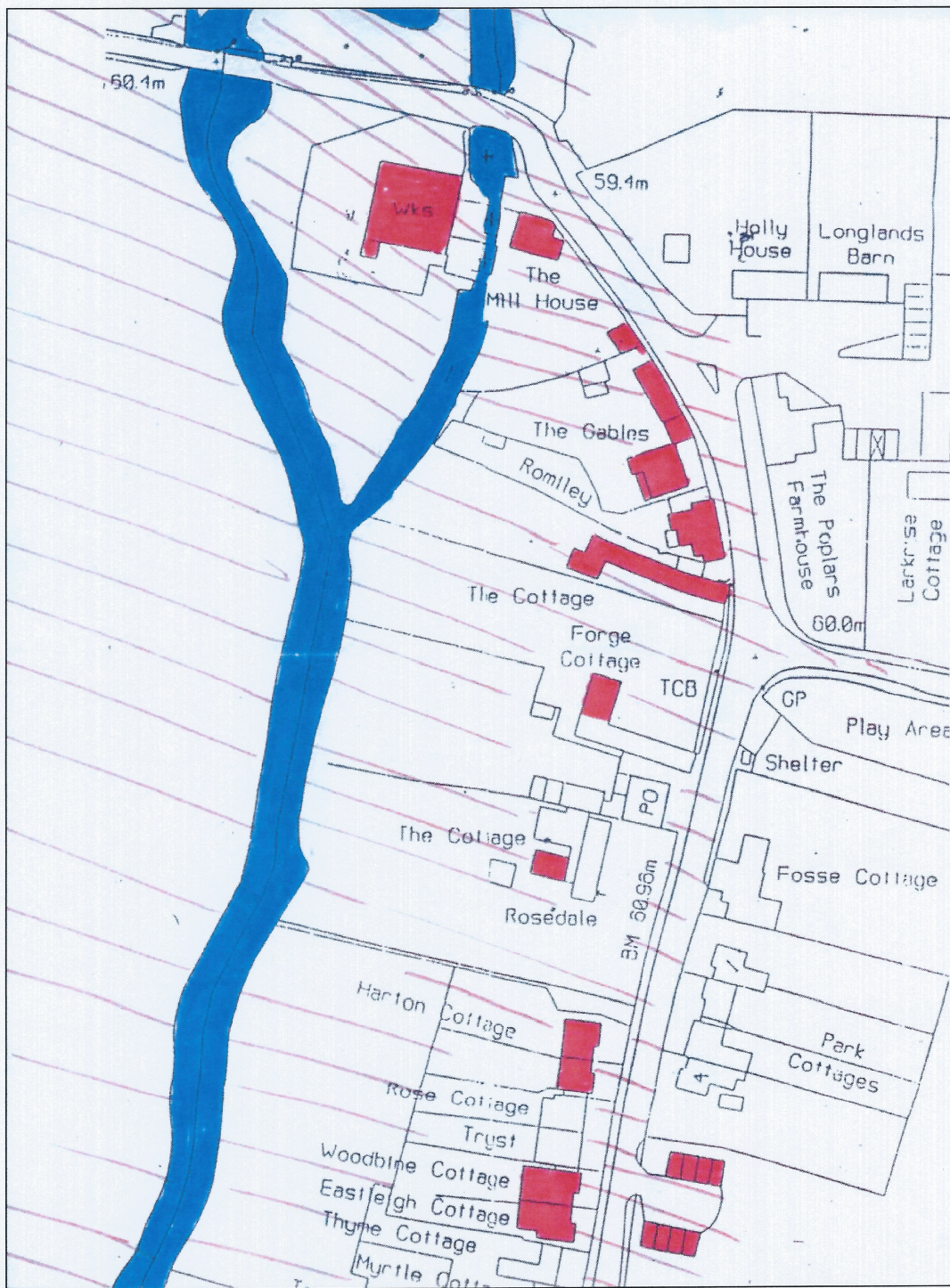
Thanking you for your help and co operation.

Yours sincerely






Carl Goddard
PARISH COUNCILLOR

Appendix A – Flooding Information Provided By Parish Council



Legend

-  = RIVER LEAM
-  = BUILDINGS FLOODED
-  = EXTENT OF FLOOD WATER



Appendix B – Environmental Impact
Assessment

Eathorpe Flood Alleviation Pre-feasibility Study
SCREENING AND SCOPING FILE NOTE

PART A:

1.0 Background Information

Eathorpe is a small village situated on the left bank of the River Leam, approximately 5km north east of Leamington Spa in the area of Warwick District Council, SP390692.

Eathorpe is covered by the Agency's flood warning scheme. Routine tree and bush work is carried out by the Agency every 8 to 10 years on this section of the River Leam and some dredging was carried out at this location in the mid 1980s.

Flooding has affected the village on a number of occasions to a more or lesser extent, being worst hit during the Easter 1998 floods. Other events of note are those of September 1992 (51.7 cumecs) and July 1968. Flooding occurs more frequently at Mill House and to an industrial unit 'Tech Speed'. Many more properties however were affected in the exceptional floods of Easter 1998, estimated to be flooding with an annual probability of between 2 and 1% (i.e. a return period between 50 and 100 years).

2.0 Alternative Options

Brief outline of the possible solution

The main options are for:

1. Do Nothing

The Do Nothing option means that no new defences will be constructed at Eathorpe. Flood Warning and all maintenance carried out by the Agency, including routine tree and bush work, blockage removal and dredging, would cease. This may result in an increased risk of flooding in the village. This option is included as a baseline against which alternative options can be assessed.

2. Do Minimum

The Do Minimum option means that no new defences will be constructed at Eathorpe but Flood Warning provision and maintenance would continue at the current level. The consequence of this option would be a continuation of the existing situation.

3. *Increased Frequency of Maintenance*

Increasing the frequency of maintenance carried out by the Agency may increase channel conveyance and decrease the frictional effects on water in this watercourse. However, it is unlikely that works would improve either the velocity of flow or channel capacity sufficiently to reduce flood risk to properties. This option would not include any de-silting or dredging. It would be necessary to provide technical justification (including appropriate modelling) before additional maintenance works are implemented. There is a potential to cause significant negative environmental impacts in association with the works.

4. *Lowering of Weirs/Increasing Capacity of Bridges*

An investigation of the modelled design water levels upstream and downstream of the study area has indicated that the existence of the weirs and bridges has no significant impact on the design water levels within the study area.

This option has the potential to provide significant environmental improvements. Provided the scheme is designed in a sympathetic manner the ecological value of the upstream river could be improved because the lower levels could allow the river to revert to a more natural state. Marginal and in-channel vegetation would also adapt to a more natural equilibrium. At present the weirs are a significant barrier to fish movement. The sympathetic lowering or removal of the weirs could allow fish to migrate upstream, providing considerable environmental benefits.

It may be possible that the weirs have some archaeological significance and/or there are features associated with the mill pond that have overriding ecological importance, but generally weir removal and lowering must be viewed as a positive ecological step.

5. (a). *Flood Relief Channel*

The existing flood relief channel could be diverted and extended south through the grass meadow, discharging opposite the Severn Trent Pumping Station site located on the east bank. Substantial works would be required to the highway to install a culvert beneath the road of sufficient flow area to convey up to a Q_{100} flow. The bed level of the proposed channel could be formed so that it would only convey flows during times of flood, if necessary. The present levels of the two weirs upstream of the bridge govern normal flows and water levels at the bridge location and therefore the channel bed level would need to be in line with these.

There are potentially considerable environmental gains associated with option, including additional wetland creation and other habitat improvements.

(b). *Relief Channel with Meadow Scrapes*

As Option 3 except that tiered wetland scrapes would be created within the grass meadow downstream of the bridge alongside the relief channel. There would be scope to produce several small ponds of varying depths through the grass meadow. Such scrapes and shallow ponds would have the potential to create a diverse and species rich meadow. The precise number and location would need to be determined at the design stage. Some of these ponds would act as flood attenuation areas, storing floodwaters until river levels drop after a fluvial flood event.

6. Channel Improvements

There is scope to undertake substantial desilting works within the channel. These would take the form of deepening and widening the channel along the length downstream of the bridge and also upstream adjacent to the weirs. Dredging or desilting of parts of the channel is seen by some members of the community to be a low cost solution in reducing the villages flooding problems. Any works would need to be extensive in order to alleviate flooding to the village in an extreme event. With the passage of time silt will continue to be deposited in the river and the benefits of the works will reduce. Works would be undertaken to both the mill leat, relief channel and designated Main river through the village. Small scale or marginal desilting works would have little or no effect on reducing the effect of large floods. It is unlikely that through such channel improvements the velocity could be increased sufficiently for the existing bridges to take the 100 year flow and the capacity of the bridges would also need to be increased. Channel improvements would not constitute more frequent maintenance as described under Option 3 above.

The adverse ecological impacts of such an option are likely to be high. In order to provide a sufficient volume to convey flood flows, the majority of natural in-channel and bank side features are likely to be removed. It may however be possible to provide increased capacity by re-profiling the river banks, improving the channel features by providing meanders, etc. and creating a two stage channel to carry flood flows. Creating a two stage channel is likely to have a temporary detrimental effect, but it may be possible to create a self cleansing channel that retains and improves it's ecological features over the long term.

7. (a). Construction of Permanent Raised Defences- Rear of main village road

Works would involve constructing a permanent physical barrier along the rear of properties, merging in to the higher ground at both extremes. Due to the configuration of gardens and dwellings, it is not viable to extend an earth defence through all the critical locations in the village and therefore any defence would require some form of wall to be constructed. The proposed defence line comprises four elements: an earth embankment with clay core, a length of brick clad concrete wall, a steel floodgate across the road and some highway modifications. Any existing outfalls not flapped would require modifications. Surface water drainage would also need to be addressed either via a new outfall or a diversion. Due to the commercial property Tech Speed Motorsport being located on an island, any formal defence to protect this property under this option is not considered. Instead local, de-mountable or temporary defences should be a considered as part of the scheme. This option is likely to cause considerable disturbance to properties and private gardens, as well as potentially causing negative environmental impacts.

(b) Construction of permanent raised defences – Rear of main village road and Tech-Speed

Exactly as Option 7a with the exception of the Tech Speed Motorsport being included within any defence. Providing a ring bank defence around the premises will be expensive and may impact on the height of the defence required in Option 7a, due to a permanent change to the mill leat channel hydraulics caused by a raised bank or wall constricting any out of bank flows through this section.

(c) Construction of permanent raised defences – plus exclusion of the mill channel from the river system

As for option 7b plus installation of water controlling structures on the mill channel. Installation of such structures on the upstream and downstream extents of the mill channel would prevent floodwater from entering the mill channel during flood conditions up to the designed return period of 1 in 100

years. The channel could be in-filled downstream of the second weir to where it rejoins the main river at The Cottage. This would effectively remove the 'mill island' altogether and any raised defences could also protect 'Tech Speed Motorsport'. Future traditional operation of the mill would, however, be lost as long as the properties remained defended. According to Agency records, this length is not classified as statutory Main river and therefore deemed to be ordinary watercourse.

8. *Improved Flood Warning*

11 of the properties at risk at the 100 year event are currently on the *Automatic Voice Messaging* (AVM) system to receive flood warnings. Those on the At Risk database are invited annually to receive warnings via the AVM. This option will have a negligible impact on the environment.

9. *Provide Upstream Storage*

In order to protect Eathorpe against a 1 in 100 year event the volume of water that would need to be stored would be very large considering the size of the catchment upstream. As such it would incur high cost and it would be extremely difficult to find a suitable location. This option has therefore not been considered further at this stage. It is however an option which could be considered further in any future strategy for the Avon catchment.

Depending on the existing upstream habitats the environmental impacts of creating an upstream storage area could be either a significant benefit or cause a significant negative impact.

10. *Land Use Change*

It is possible that changes in land use upstream of Eathorpe have had a detrimental impact on flood flows through the village. Increased runoff as a result of development may have increased the rate that storm flows enter the river. Changes in agricultural practices may also have resulted in considerable increase in surface water runoff. Changes in agriculture can also contribute to an increase in soil erosion and cause subsequent siltation of river. It may be possible to implement a land use change project to encourage the upstream landowners to farm in such a way that reduces the rate of surface water runoff and optimises infiltration. This type of solution has the benefits of reducing flooding, reducing siltation of water courses, improving soil structure and water quality, improving agricultural productivity, improving the environmental potential of the land in the long term.

11. *Flood Proofing Properties*

Floodwater can enter properties by a number of routes including walls, doors, windows, air bricks and vent covers, and there are various removable household flood products available, e.g. door boards and air brick covers, which could be considered for individual property protection.

There may also be the potential for householders to permanently flood proof individual properties, by waterproofing walls, raising doorways, etc. This option is likely to have a minimal adverse impact on the surrounding environment and may provide an adequate permanent solution if the properties can be permanently flood proofed to the 1 in 100 year level. The added benefit of this solution is that it does not involve reducing the flood plain in any way, and as such future development within the flood plain can be resisted.

3.0 Level of EIA and Consenting Regime of Alternative Preferred Options

A provisional determination has been made of the level of EIA required and the likely consenting regime to be followed for each of the options currently being considered. Relevant details are summarised below.

Level of EIA required and consenting regime:	Date table completed:											
	Options											
	1	2	3	4	5	6	7a	7b,c	8	9	10	11
	Do Nothing	Do Minimum	Increased Frequency of maintenance	Lowering of Weirs/increasing capacity of Bridges	Flood Relief Channel	Channel Improvements	Flood Wall & Embankment	Extended Wall & Embankment	Improved Flood Warning	Provide Upstream Storage	Land Use Change	Flood Proofing Properties
Level of EIA Required:	N/A	4	3(2)	2(1)	2(1)	2(1)	2(1)	2(1)	NA	2(1)	2	3(2)
Do the proposals benefit from permitted development rights (GPDO 1995)?*	N/A	Yes	Yes	No	No	Yes	No	No	NA	No	No	No
Are the proposals likely to require planning permission (TCPA 1990)?	N/A	No	No	Yes	Yes	No	Yes	Yes	NA	Yes	No	Yes
Are proposals likely to fall under Town and Country Planning EIA Regulations 1999 (SI 293)?	N/A	No	No	Yes	Yes	Yes	Yes	Yes	NA	Yes	No	No
Are proposals likely to fall under the Land Drainage EIA Regulations 1999 (SI 1783)?	N/A	No	No	Yes	No	Yes	No	No	NA	No	No	No
Are proposals likely to fall under other EIA Regulations (specify)?	N/A	No	No	No	No	No	No	No	NA	No	Yes [#]	No
Are proposals likely to require consents under other legislation (specify)?	N/A	No	LDC	LDC	LDC	LDC	LDC	LDC	NA	LDC	LDC	LDC

[#] Environmental Impact Assessment (for uncultivated land) Regulations 2002

This project is to be progressed according to EIA Level: 2 - Environmental Impact Assessment of the project not formally requiring the production of an Environmental Statement by the EIA Regulations, but which warrant a similar level of assessment due to their nature, scale or location

The decision as to the appropriate level of environmental impact assessment is based on three fundamental criteria, namely:

- i. Does the project require planning permission, does the Agency benefit from permitted development rights or does the Agency's powers to carry out the works derive from elsewhere (Land drainage enforcement action)?
- ii. Does the project require a Statutory EIA under the Regulations (SI 99/1783 or SI 99/293)?
- iii. Will the project be likely to give rise to 'significant' environmental effects?

A final Screening Decision (statutory) will need to be made at the end of Feasibility for the preferred option (see Part B, below).

Further outputs from the EIA process:

- Scoping Report
- Environmental Report (Level 2)
- Environmental Action Plan

* The Agency ceases to have permitted development rights under General Permitted Development Order (1995) (SI 418) if, in accordance with The Conservation (Natural Habitats &c.) Regulations 1994 (SI 2716) if works or operations in or adjacent to a designated or proposed Special Protection Area (SPA) or Special Area for Conservation (SAC) are considered to effect the integrity of the site, and in accordance with The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 (SI 293) if the development falls under Schedules 1 or 2 and requires a statutory EIA.

4.0 Key Environmental Issues

Key environmental issues, raised as a result of a desk study and consultation with internal functional specialists on the environmental constraints and opportunities relating to the above proposal, are outlined below. These issues should be included/taken into account in the final Pre-feasibility Report. See Constraints map at the back of this report. A summary of the issues is included in the Table below:

Constraints/Opportunities

Criteria	Details	Predicted Impact on Criteria (High or Low)			
		Negative	None	Positive	No Info. available
Constraints					
Natural Environment (List all issues on or near proposed site)					
Designated Sites (List as appropriate)	Warwickshire Wildlife Trust Nature Reserve		✓		
Non-designated sites of Wildlife Value	River Leam Woodland Island	High High/ Low			
Rare Flora and Fauna (Protected Species)	Rare Flora Otter habitat Badger setts				✓ ✓ ✓
Loss of flood-plain / wetland	Reduced flood-water storage Impeded flow route		✓		
Visual					
Built Environment					
Recreation & Navigation	Sailing Angling Walking	Low	✓ ✓		
Human Impact	Road closures Disturbance (noise, dust, gardens &c)	High High			
Archaeology and Historic Buildings	Scheduled Ancient Monument County Archaeological Site Listed Building	✓ Low			✓
Other	Preserve historic defences		✓		
Opportunities					
Habitat Creation	Improved riparian habitats Removal of Weirs – recreation of natural channel			✓ High	
Re-creation of flood-plain / wetland	Creation of scrapes/wetland area – Nature Reserve			High	
Other	Incorporation of Fish pass into schemes			High	

4.1 Human beings

The village of Eathorpe is very small, predominantly residential dwellings on the east bank of the River Leam. The area is largely agricultural, comprising predominantly pasture and some arable. A small industrial unit adjacent to the bridge is the main employer in the village and is subject to frequent flooding.

Any flood alleviation works that are carried out to protect properties and business in the village would greatly improve the quality of life of local residents and would reduce the frequency of damage to properties caused by flooding.

One or more of the options would result in significant disturbance to private gardens and/or properties. A development Control 'stand-off zone' of up to 8m applies to formal flood defences. This is likely to have considerable detrimental impacts in many of the gardens in Eathorpe, particularly where trees, hedges, sheds, conservatories, etc. form part of the structure of the garden.

Recreation

The only recreational activity that is likely to be affected by the proposals is walking. One or more public footpaths may have to be temporarily closed or diverted for the duration of the works. Due to the network of footpaths in the area it is likely that a suitable diversion route will be available if necessary.

Other recreational activities are unlikely to be affected by the proposals, although further investigations may be necessary as and when details proposals are available.

4.2 Flora and fauna

The only designated wildlife site that exists in the study area is the Warwickshire Wildlife Trust Nature Reserve adjacent to the Severn Trent Water pumping station. The Reserve is water dependant and as such it must be shown that any flood alleviation works do not have an detrimental effect on the hydrology of the nature reserve.

Although there are no other formally designated sites within the study area, there are several areas of ecological interest that need to be taken into account when investigation the various options.

- The River Leam is a valuable wildlife corridor within the heavily managed surrounding land. Any damage to the wildlife corridor associated with the flood alleviation works must be adequately mitigated for.
- The River Leam has extensive in-channel vegetation and is a valued wildlife feature. Prior to any works being carried out provision must be made to ensure that there is no long term negative impact on the in-channel and bank side vegetation and that adequate mitigation works are carried out.
- The island upstream of the road bridge is wooded and of ecological value. Prior to any works being carried out that could affect this habitat an appropriate species/habitat survey should be carried out and any damage to the site associated with the works must be adequately mitigated for. If it is found that this site is of particular interest, the entire area should be designated a landscape protection zone and no works should be permitted within the area.

Although there are no known protected species in the area, it is essential that protected species surveys are carried out in the study area as part of the environmental impact assessment. If it is found that protected species are present in the area, the scheme should be designed to minimise disturbance to any protected species. Where disturbance is unavoidable, adequate mitigation must be carried out and incorporated into the design of the scheme.

There are various opportunities to create and improve wildlife habitats within the study area if one or more of the options were implemented:

- Creation of a bypass channel – possibility of creating a permanently wet area at the downstream end of the bypass channel to act as a fish refuge.
- Sympathetic bypass channel design incorporating meanders and 2 stage channel could provide a valuable wildlife corridor past the village.
- The creation of scrapes/washland on the west bank of the river could provide an extensive area of wetland habitat.
- The banks of the existing river channel could be re-profiled on the right bank to provide a 2 stage channel and create a more diverse bankside habitat.
- At present the weirs in the village act as a barrier to fish movement. Provision could be made to incorporate a fish pass into the weir or mill channel to allow fish to migrate upstream.

Other mitigation and enhancement measures may be appropriate to the site, which have not been highlighted at this stage.

It may be possible to obtain additional non-flood defence funding for options which offer significant environmental benefits, for example the removal of weirs, or the creation of a nature reserve in conjunction with the bypass channel option

4.3 Air and climate

No issues relating to air and climate have been identified at this stage.

4.4 Landscape and visual amenity

The area around Eathorpe is of High Landscape value. Many of the properties in the villages have historical value. Any works within the area must not impact negatively on the aesthetics of the area.

4.5 Water

The River Leam is of Grade B (Good) Chemical General Quality Assessment (GQA) and Grade B (Good) Biological GQA (although there was a drop in quality at the last survey).

There is an Environment Agency gauging station at the downstream end of the study area. The proposals should not detrimentally affect the gauging station, including its ability to continue making accurate flow recording.

There is also a Severn Trent Water pumping station within the study area that supplies water to Draycott Reservoir. Works must not have a detrimental impact on the pumping station site.

4.6 Land use

Land use in the area is predominantly agricultural, with pockets of wildlife habitat. Further investigation will need to be carried out on Land Use if the scheme progresses beyond Pre-feasibility Stage.

4.7 Cultural heritage, archaeology and material assets

There are no Scheduled Ancient Monuments in the study area.

Although there are no SAMs within the study area, there may be other areas of archaeological interest and therefore advice should be sought from the County Archaeologist on the need for further archaeological investigations if the project is likely to proceed beyond Pre-feasibility Stage.

There are several Listed Structures with in the Study Area. These buildings must be taken into account when considering the options and locations of structures. The local Planning Authority should be consulted if the project progresses beyond Pre-feasibility.

Listed Buildings in Eathorpe

<i>Eathorpe Hall</i>	<i>Grade II Listed.</i>	<i>SP 39108 68793</i>
<i>Gardeners Cottage</i>	<i>Grade II Listed</i>	<i>SP 39126 68823</i>
<i>Myrtle Cottage</i>	<i>Grade II Listed</i>	<i>SP 39112 69041</i>
<i>Thyme Cottage</i>	<i>Grade II Listed</i>	<i>SP 39114 69050</i>

4.8 Traffic and transport

Any works affecting the road that crosses the river are likely to have a significant impact on local traffic. This is the only crossing point for the River Leam for some distance up and downstream of Eathorpe, although the work is generally likely to be only used by local traffic. The option of constructing a bypass culvert under the road is likely to result in temporary road closure, as is the option for carrying out works to the bridge itself. Disturbance as a result of the bypass culvert works could be minimised by thrust boring under the road, or creating a temporary bypass route through the field, if appropriate.

The construction of the flood gates and road raising on the main road are likely to temporarily restrict traffic flows during the works. A nominated person(s) will need to be on hand at all times to ensure that the flood gates are closed when necessary.

At this stage it is not anticipated that there will be any permanent detrimental impact to traffic and transport as a result of any of the proposals, other than for periods when the flood gates result in the temporary road closure during flooding. The Highways Authority will need to be informed of the proposals and be aware of the consequences of having a formal flood defence across the road.

4.9 Soil, geology and hydro-geology

Further investigations will need to be carried out in relation to Soil, hydrology and hydro-geology if the progresses beyond Pre-feasibility.

4.10 Use of natural resources

No issues relating to natural resources have been identified at this stage, although the general principle for any works should involve the use of recycled and sustainable resources wherever possible.

4.11 Others, including cumulative impacts

Other impacts, including cumulative impacts may arise as a result of the proposals. These will be identified and assessed if the scheme progresses beyond Pre-feasibility.

5.0 Continuing Consultation

Limited informal internal consultation has already taken place to determine the key environmental issues relating to each option. Further internal consultation is ongoing to determine if there are any other known environmental constraints that have not yet been highlighted. If the scheme continues beyond Pre-feasibility, further consultation will be required with all internal Environment Agency departments.

6.0 Conclusion

The Pre-feasibility Study has indicated that the most cost effective options are the Do Minimum and option 7 (b & c) – Raised Defences. Initial investigations indicate that there are likely to be significant environmental impacts associated with these options, which will need to be addressed at the Feasibility Stage.

Whilst Options 7 (b & c) appear to be the most cost effective Options 4 and 5 have the potential for providing significant environmental improvements if carried out in an appropriate manner. Whilst the Pre-feasibility Study has indicated that these options will be too costly, their potential environmental benefits and possible flood alleviation benefits justify further consideration when the study proceeds to Feasibility Stage.

Appendix C – Summaries of Cost

SPREADSHEET TO OBTAIN SCHEME TOTAL COSTS BASED ON PERCENTAGE COSTS

Scheme title:	Eathorpe Option A 100 year
scheme code:	
1) Construction costs	£120,500
2) Tender costs	£145,800
3) Estimate of construction time in weeks	
4) Design risk percentage	60 %
Total scheme costs less maintenance =	£328,300
Total scheme costs plus maintenance =	£483,500

Construction	
Bank costs =	£79,500
Bank/Wall costs =	£8,400
Road raising/bridge costs =	£11,000
floodgates =	£15,000
Road costs =	
Outfall costs =	£6,600
Channel Costs =	
Services costs =	
Other costs =	
Total	£120,500
Maintenance costs =	£97,000
Maintenance costs + 60%	£155,200

COSTS BY EXTERNAL CONSULTANT

Costs for Design, Contract Documentation and Contract Administration

Element	Cost of element	Cumulative cost	% increase	comments
Construction	£120,500	£120,500		
Preliminaries	£12,050	£132,550	10%	of measured work
Additions	£13,255	£145,805	10%	of measured work & prelimins
TENDER TOTAL		£145,800		
SI	£7,290	£153,095	5%	of tender total
CDM regs sup	£1,531	£154,626	1%	of tender total & SI
Design	£15,310	£169,935	10%	of tender total & SI
Supervision	£7,655	£177,590	5%	of tender total & SI
Project management	£5,741	£183,331	25%	of design and supervision
Conservation	£7,290	£190,621	5%	of tender total
Compensation & land	£14,580	£205,201	10%	of tender total
Design risks	£123,121	£328,322	60%	of everything
SCHEME TOTAL (B) =		£328,300		

SPREADSHEET TO OBTAIN SCHEME TOTAL COSTS BASED ON PERCENTAGE COSTS

Scheme title:	Eathorpe Option B 100 year
scheme code:	
1) Construction costs	£178,100
2) Tender costs	£215,500
3) Estimate of construction time in weeks	
4) Design risk percentage	60 %
Total scheme costs less maintenance =	£485,300
Total scheme costs plus maintenance =	£648,700

Construction	
Bank costs =	£103,500
Bank/Wall costs =	£27,000
Road raising/bridge costs =	£11,000
floodgates =	£30,000
Road costs =	
Outfall costs =	£6,600
Channel Costs =	
Services costs =	
Other costs =	
Total	£178,100
Maintenance costs =	£102,100
Maintenance costs + 60%	£163,400

COSTS BY EXTERNAL CONSULTANT

Costs for Design, Contract Documentation and Contract Administration

Element	Cost of element	Cumulative cost	% increase	comments
Construction	£178,100	£178,100		
Preliminaries	£17,810	£195,910	10%	of measured work
Additions	£19,591	£215,501	10%	of measured work & prelimins
TENDER TOTAL		£215,500		
SI	£10,775	£226,276	5%	of tender total
CDM regs sup	£2,263	£228,539	1%	of tender total & SI
Design	£22,628	£251,166	10%	of tender total & SI
Supervision	£11,314	£262,480	5%	of tender total & SI
Project management	£8,485	£270,966	25%	of design and supervision
Conservation	£10,775	£281,741	5%	of tender total
Compensation & land	£21,550	£303,291	10%	of tender total
Design risks	£181,974	£485,265	60%	of everything
SCHEME TOTAL (B) =		£485,300		

SPREADSHEET TO OBTAIN SCHEME TOTAL COSTS BASED ON PERCENTAGE COSTS

Scheme title:	Eathorpe Option C 100 year
scheme code:	
1) Construction costs	£172,400
2) Tender costs	£208,600
3) Estimate of construction time in weeks	
4) Design risk percentage	60%
Total scheme costs less maintenance =	£469,700
Total scheme costs plus maintenance =	£632,700

Construction	
Bank costs =	£86,200
Bank/Wall costs =	£18,600
Road raising/bridge costs =	£11,000
floodgates =	£30,000
Road costs =	
Outfall costs =	£6,600
Channel Costs =	
Services costs =	
Other costs (penstock) =	£20,000
Total	£172,400
Maintenance costs =	£101,900
Maintenance costs + 60%	£163,000

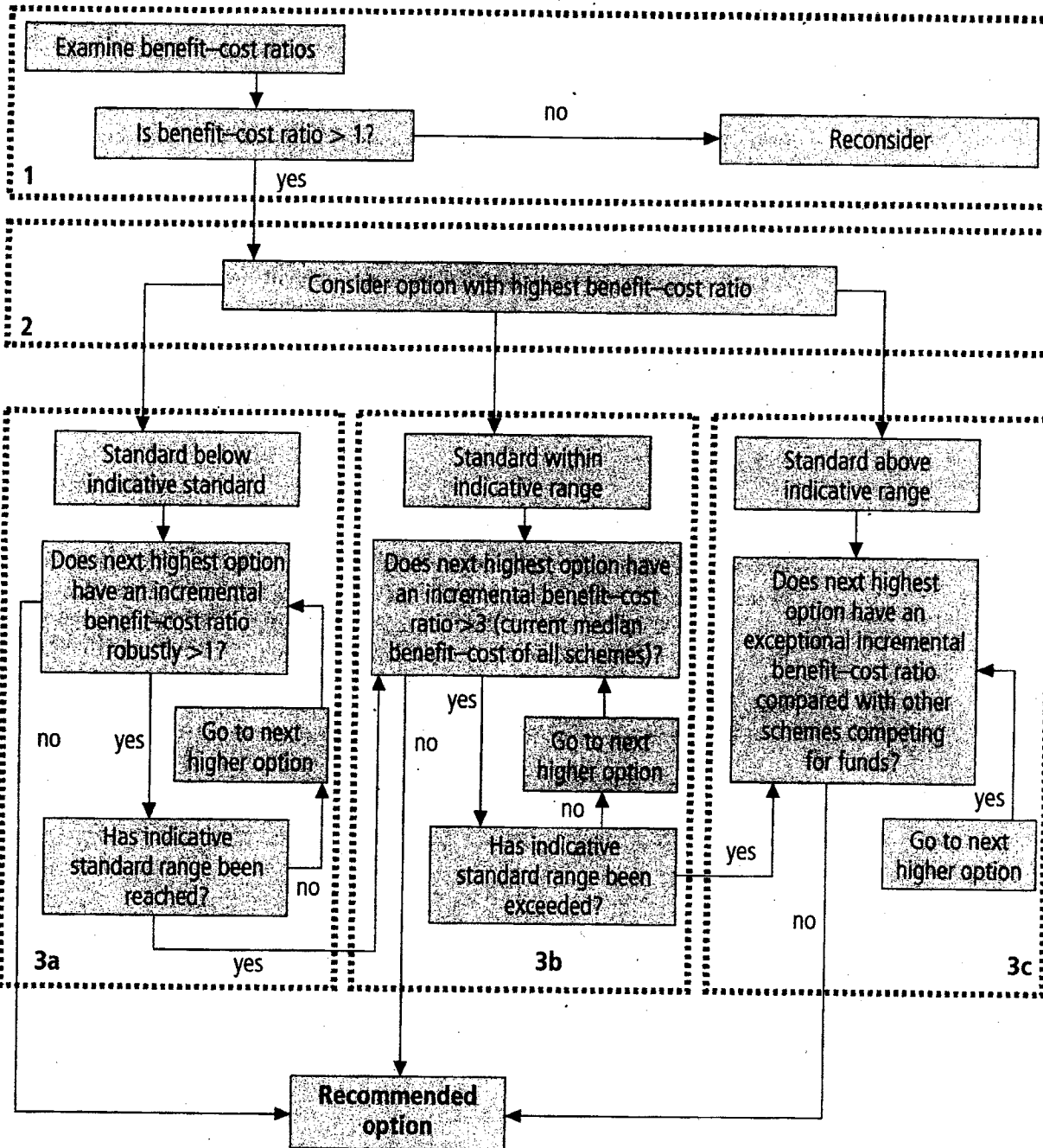
COSTS BY EXTERNAL CONSULTANT

Costs for Design, Contract Documentation and Contract Administration

Element	Cost of element	Cumulative cost	% increase	comments
Construction	£172,400	£172,400		
Preliminaries	£17,240	£189,640	10%	of measured work
Additions	£18,964	£208,604	10%	of measured work & prelimins
TENDER TOTAL		£208,600		
SI	£10,430	£219,034	5%	of tender total
CDM regs sup	£2,190	£221,224	1%	of tender total & SI
Design	£21,903	£243,128	10%	of tender total & SI
Supervision	£10,952	£254,079	5%	of tender total & SI
Project management	£8,214	£262,293	25%	of design and supervision
Conservation	£10,430	£272,723	5%	of tender total
Compensation & land	£20,860	£293,583	10%	of tender total
Design risks	£176,150	£469,733	60%	of everything
SCHEME TOTAL (B) =		£469,700		

Appendix D – Defra Decision Rule Table

Figure 6.1 The decision process



Part 5.4 defines the Incremental benefit-cost ratio.

Appendix E – Derivation of Priority Score

PRIORITY SCORE CALCULATION FLOWCHART –

ECONOMIC SCORE

	Benefits (£'000s)	Costs (£'000s)	Economic Score
Divide	981	633	2.1
	by		multiply by 2 and subtract 1 =

Economic score = (benefits / costs * 2) - 1

(Max is 20)

PEOPLE SCORE

No of residences	Cost (£'000s)	Base People Score	Risk factor	Affluence factor:	Add:	People Score
21	633	2.5	very high = 2 high = 1	1 to 300 301 to 1500 1501 to 6664 6665 to 8114 8115 to 8414	+2 +1 no adjustment -1 -2	1.5
	multiplied by 75, divided by	=		plus	-1	=

(Max is 8)

People score = (number of residences protected * 75 / cost) + risk factor + vulnerability factor

(Max. is 12)

ENVIRONMENTAL SCORE

BAP (Ha)	SSSI (Ha)	Other (Ha)	Cost (£'000s)	Heritage I or II* = 2 II or other = 1	Environmental Score
()	()	()	()	()	()
multiplied by 2)	plus	multiplied by 1.5)	plus	plus	=
(())		()			1

Environmental score = (((BAP area created * 2) + (SSSI area protected * 1.5) + other designated area protected) * 2.5 / cost) + heritage factor

(Max is 12)

TOTAL SCORE

Economic + People + Environmental =	4.60
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(Max is 44)

Studies should be scored as for the works to which they relate; studies not related to works (eg coastal process studies for SMPs) score 20.

Please note there is an Internet Score Calculator at <http://www.defra.gov.uk/enviro/fcd/policy/grantaidd.htm>

Appendix F – Risk Register

PROMPT LIST FOR RISK IDENTIFICATION

To aid the process of risk identification, the following prompt list may be used. The list is not exhaustive and the words have been chosen to encourage the users to **think laterally** about the risks that may be appropriate to an individual project.

Once risks have been identified, they should be transferred to the Risk Register for assessment and control evaluation.

It should be noted that this is not a checklist.

Prompts originating from general engineering and project management issues are in normal font. Prompts originating from property/land acquisition and compensation issues are *highlighted in italics*.

Prompts originating from environmental issues are *highlighted in bold italics*.

<i>Accredited EIA staff</i>	<i>Compensation</i>	<i>Ecology</i>
Access / <i>Boundaries</i>	Competence	Eng. Construction Contract
Accidents	Confined Spaces	Emergency
Accuracy of estimate	Consultants / <i>relationships</i>	<i>English Nature</i>
<i>Added value</i>	<i>Consultants (Int/Ext)</i>	<i>Entry conditions</i>
Adjacent property	Consents	<i>Environmental Action Plan</i>
Approval	<i>Contract names</i>	<i>Environmental Incident</i>
Affordability	Contamination	<i>Environmental Report</i>
Archaeological	Contingency level	Errors
Assumptions	Contract : <i>EIA Input</i>	European Union
Availability	Contributions	<i>Exhibition</i>
Bankruptcy	Cost Control	Explosion
<i>Baseline surveys</i>	Customer requirements	Financial
Brief	<i>Delay</i>	Fire
Budget	<i>Damage to buildings</i>	Fitness for
<i>Budget Management</i>	<i>Damaged relationships</i>	Ground site conditions
Buried services	<i>Data : certainty of</i>	<i>Habitats Directive</i>
Cashflow	Delivery periods	Handover
<i>ChaMPs</i>	<i>Design (Environmental)</i>	Health
Change Control	<i>Designations</i>	Hydrological
Changes	Difficult Landowners	<i>Impact prediction</i>
Claims	<i>Disturbance</i>	<i>Information Notices</i>
Commissioning	Dual use of site	Instructions
<i>Communication Plan</i>	Durability	<i>Issue Report</i>
Compatibility	<i>Dust</i>	Land/Comp. Purchase Order

<i>Landowners</i>	Programme	Tenderers
Legal challenge	Project management	Terrorism
<i>Legal right (fishing)</i>	Project team	<i>Third parties</i>
Legislation	<i>Protected bodies</i>	<i>Time of year</i>
<i>Lorry movements</i>	<i>Protected species</i>	Timescales
<i>MAFF biodiversity targets</i>	Public perception	<i>Trade loss</i>
Maintainability	Public relations	<i>Training (Environmental)</i>
Margin B/C Ratio	Quality <i>assurance</i>	Uncertainty
Market changes	Re-appraisal	User requirements
Measurement	<i>Receptors</i>	Value for money
<i>Mitigation (Costs)</i>	Records	Vandalism
<i>Mitigation (Environmental)</i>	Regulations	Variations
Modelling	<i>Reinstatement</i>	Vires
<i>Monitoring</i>	Reliability	<i>Watching Brief</i>
<i>National EIA Handbook</i>	<i>Residual impacts</i>	Weather
<i>National Review Group</i>	Resources	<i>Wildlife & Countryside Act</i>
Need	Reviewers	<i>Working areas</i>
New technology	Safety	
<i>Noise</i>	<i>Scoping Guidelines/Report</i>	
Non-completion	<i>Section 28 Consent (EN)</i>	
<i>Notice serving powers</i>	Services	
Objections	<i>Site compounds</i>	
Objectives	<i>Site information</i>	
Obstructions	<i>Social impacts</i>	
<i>Occupiers</i>	Specialist Advice	
Operability	Specification	
Operation During Construction	<i>Specification (Environmental)</i>	
<i>Partners : community group</i>	Staff changes	
<i>Perception v Reality</i>	<i>Stakeholder ownership</i>	
Performance	Standard Details	
<i>Permanent rights</i>	<i>Statement (Environmental)</i>	
Planning	Statutory consultees	
Pollution	Storm	
<i>Process Manual (EIA)</i>	Strategy	