

**THE COUNTY OF HEREFORDSHIRE DISTRICT COUNCIL
(YAZOR BROOK FLOOD ALLEVIATION SCHEME)
COMPULSORY PURCHASE ORDER 2010**

Public Inquiry August 2010

STATEMENT OF EVIDENCE OF MARC PINNELL

S226 (1) (a) Town and Country Planning Act 1990
S13 Local Government (Miscellaneous Provisions) Act 1976
Acquisition of Land Act 1981

Contents

1.	INTRODUCTION	3
2.	SCOPE OF EVIDENCE	5
3.	THE FLOOD ALLEVIATION WORKS	7
4.	OBJECTIONS TO APPLICATION	9
5.	GUIDANCE RELATING TO THE APPRAISAL OF FLOOD AND COASTAL DEFENCE PROJECTS	11
6.	FLOOD ALLEVIATION OPTION SELECTION PROCESS	13
7.	DESCRIPTION OF NEED (DEFINING)	16
8.	OPTIONS DEVELOPMENT & CONSULTATION (DEVELOPING)	19
9.	OPTIONS APPRAISAL (COMPARING)	24
10.	OPTION SELECTION	28
11.	FURTHER OPTIONS REVIEW	30
12.	DESIGN DEVELOPMENT	33
13.	RESPONSE TO OBJECTIONS	43
14.	SUMMARY AND CONCLUSIONS	44
15.	STATEMENT OF TRUTH	48

1. INTRODUCTION

1.1 My name is Marc Pinnell. I am a Divisional Director within JBA Consulting with responsibility for the Water South business. I have specialist knowledge of the investigation and assessment of hydrological and hydraulic systems and am familiar with the institutional and regulatory frameworks pertaining to the water environment. I have an Upper Second Class Bachelor of Science Degree in Oceanography and a Masters degree in Water Resource Engineering. I am a Chartered Member of the Institute of Water and Environmental Management (CIWEM) and a Member of the British Hydrological Society. I am a committee member of CIWEM's specialist interest group – the Rivers and Coastal Group.

1.2 I have over 15 years' professional experience of flood hydrology, hydraulics and flood risk management, for the past 10 years specialising in the investigation of a wide range of flood risk related land use, planning and risk management studies. I have produced technical publications including:

- Sustainable Development and Flood Risk - Reducing Uncertainty (Bristol City Re-Development Case Study), (2007)
- Setting Policy for Groundwater Flood Risk, (2006)
- Development and Flood Risk – Reducing Uncertainty, (2005)
- Modelling Flood Inundation of Urban Areas in the UK using 2D/1D Hydraulic Models, (2004)
- Sustainable Development and Flood Risk – Reducing Uncertainty (Bristol Broadmead Development Case Study), (2003)

1.3 Current and previous work includes: coordination, management, delivery and review of Flood Risk Assessments (FRAs) and Strategic Flood Risk Assessments (SFRAs and SFCAs); preparation of flood risk mitigation, management and design strategies; design and implementation of flood warning and forecasting systems; provision of flood risk advice to clients and design teams; selection, design and management installation of hydrometric measurement gauges; direction of hydraulic and hydrological analyses and input into numerous hydrological, water level and management studies. I

have knowledge of flood risk legislation and government guidance including PPS25, CIRIA 624 and Defra FCDPAG documentation. Additionally, I have completed hydrological and hydraulic elements of E.I.A. studies in support of wider engineering schemes. Schemes have included road transport links and bridge crossings.

- 1.4 Before joining JBA in 2009 I was director of the Flood Risk and Water Management group at Capita Symonds. Whilst in this role I was the Project Director for all work relating to the ESG regeneration project and flood alleviation scheme. This involvement spanned from 2006 to 2009.
- 1.5 I have knowledge of the proposed flood alleviation scheme, the ESG regeneration project, and the underlying requirement for flood risk management and mitigation.
- 1.6 My evidence is prepared to:
 - 1.6.1 Summarise the requirement for flood risk management to enable development within ESG in accordance with Government guidance relating to development and planning.
 - 1.6.2 Identify Government guidance relevant to and considered during the selection of a strategic flood management scheme that best supports the regeneration of ESG.
 - 1.6.3 Outline the processes adopted that led to the selection of the Yazor Brook Flood Alleviation Scheme (Yazor Brook FAS) to support ESG regeneration.
 - 1.6.4 Summarise objections made by the National Trust and others in relation to the selection of the Yazor Brook FAS.

2. SCOPE OF EVIDENCE

2.1 My evidence therefore sets out the background, processes, consultation and rationale behind the selection of the preferred flood alleviation option and its outline design. The scope and structure of my evidence is set out below:

- Section 3, Flood Alleviation Works: introduces the site and the proposed development. A more detailed account of the scheme is given in the evidence of Mr Andrew Burrows (Capita Symonds).
- Section 4, Objections to Application: Sets out the CPO objections that relate to this witness statement.
- Section 5, Guidance Relating to the Appraisal of Flood and Coastal Defence Project: notes the Government guidance that has informed the selection of the Yazor Brook FAS and acknowledges the recent update to this guidance.
- Section 6, Flood Alleviation Option Selection Process: introduces the principles and processes followed during the course of the options appraisal and outline design development.
- Section 7, Description of Need (Defining): sets out the preliminary investigations and studies that defined the requirement for a strategic flood risk management solution. A more detailed account of the need for a strategic flood risk management solution is given in the evidence of Mrs Ruth Goodall (Capita Symonds).
- Section 8, Options Development and Consultation (Developing): describes the steps undertaken to engage with key stakeholders including statutory consultees and landowners, leading to the identification and evolution of options for assessment.
- Section 9, Options Appraisal (Comparing): details the technical, economic, environmental and risk appraisal of options.
- Section 10, Option Selection: summarises the findings of the appraisal and selection of the Yazor Brook FAS.

- Section 11, Further Options Review: sets out the inclusion and appraisal of an additional option, based on upstream storage, and the root to its inclusion in the assessment.
- Section 12, Design Development: details the work undertaken to develop an outline design of the Yazor Brook FAS following selection of the preferred option.
- Section 13, Response to Objections: summarises how my evidence has addressed each of the relevant objections.
- Section 14, Conclusions and Summary: presents my conclusions in relation to the selection of the preferred flood alleviation option and its outline design.
- Section 15, Statement of Truth.

2.2 In addition to the studies directly related to and completed in support of the selection of the Yazor Brook FAS, reference should also be made to the evidence of:

- David Nicholson (Herefordshire District Council) – Planning policy context.
- Ruth Goodall (Capita Symonds) – Hydrological and hydraulic assessment, including flood risk assessment.
- Andrew Burrows (Capita Symonds) – Scheme design.
- Gerrard Williams (ESG Hereford Ltd) - A full account of consultation and stakeholder engagement undertaken by ESG Herefordshire. Consultation of direct relevance to the selection of the Yazor Brook FAS is however summarised within my evidence.

3. THE FLOOD ALLEVIATION WORKS

Introduction

- 3.1 The land and rights included within the Order are required to enable delivery of the Yazor Brook flood alleviation scheme (Yazor Brook FAS). The scheme comprises a culvert to divert Yazor Brook flood waters, which would otherwise flow through Hereford, directly to the River Wye, thereby relieving flooding downstream and specifically within the ESG area. The flood alleviation scheme is essential enabling infrastructure for the ESG regeneration project.

The site

- 3.2 The Order land which is required to deliver the scheme extends to approximately 11.22 hectares, and comprises the following principal land uses, referring to the plot numbers used in the Order:
- 3.3 Plot numbers 1, 2, 3: these plots are grouped on the periphery of Credenhill village and comprise a paddock and a stretch of the Yazor Brook (plot 1), a section of waterway bank (plot 2) and part of the access road and car park to the Credenhill Community Centre, which also includes a portacabin currently used as changing accommodation by local football teams (plot 3). As well as the Credenhill Community Centre, the Credenhill Playschool is also adjacent to but not within the site.
- 3.4 Plot numbers 4, 5, 6: these plots comprise land extending to the east and south of Magna Castra Farm and to the south of Credenhill Community Centre. Plots 4 and 6 are agricultural land used for grazing purposes as part of the dairy farm business which operates from Magna Castra Farm. Part of a public footpath known as Roman Road falls within the site (plot 5).
- 3.5 Plot numbers 7, 8, 9: these plots comprise agricultural land associated with Old Weir Farm, and include in addition the A438/King's Acre Road.

The proposed development

- 3.6 The general arrangement of the proposed development is set out on planning drawing CS029394-YBF-001 (CD5/2).

- 3.7 The development comprises the construction of an approximately 1.4 km long flood alleviation culvert. The development will begin adjacent to the Community Centre at Credenhill, a village to the west of Hereford. Here, an off-take will be constructed in the form of a side weir. Flood waters passing over this weir will flow within a 2m diameter culvert in a southerly direction towards to the River Wye. After crossing the A438/King's Acre Road, and on the approach to the River Wye, the velocity of flood flows will be reduced within an energy dissipation chamber. From here, flood waters will enter a short section of culvert before being discharged on to the Wye flood plain and then draining into the river. With the exception of the off-take and its associated compound, and the outfall, all principal elements of the scheme will be below ground.
- 3.8 The primary design objective is directed to minimising flooding caused by the 1 in 20 year event or 5% AEP (Annual Exceedance Probability), including an allowance for climate change, thereby reducing the extent of the functional floodplain downstream.
- 3.9 The design objective was informed by Planning Policy Statement 25: Development and Flood Risk (CD2/5) and the classifications of land, in respect of the probability of flooding, and of Flood Risk Vulnerability Classifications, therein.
- 3.10 Further detail on the design and operation of the scheme is set out within the proof of Mr Andrew Burrows.

4. OBJECTIONS TO APPLICATION

4.1 Objections to the Order relating to the areas covered by this witness statement were made by the National Trust, Credenhill Parish Council, Mrs Eileen M Hewer and Mr Price (CD1/4). The objections were:

National Trust

4.2 *In the absence of a full feasibility report there is insignificant information to confirm the Acquiring Authority's assessment of the preference of the Scheme over the alternatives considered. Moreover it is not possible to ascertain whether in their assessment of the alternatives the Acquiring Authority has followed the Economic Appraisal Flood and Coast Defence Project Appraisal Guidance (document FCDPAG3).*

4.3 *In the absence of this information it is not possible to confirm that this is the most viable option for the flood protection of the East Street Grid.*

4.4 *Section 4(1) National Trust Act 1907 states that the general purposes of the National Trust is to promote the permanent preservation for the benefit of the nation of lands and tenements (including buildings) of beauty or historic interest and as regards lands for the preservation (so far as practicable) of their natural aspect features and animal and plant life. It is not clear whether the Acquiring Authority has taken this into account in assessing whether, in accordance with paragraph 17 of Circular 06/2004, there is a compelling case for the Scheme. Nor is it clear whether this particular purpose has been taken into account when assessing and rejecting the alternative scheme designs.*

4.5 *The Scheme has not taken into consideration or properly mitigated against unacceptable impacts to National Trust property, including, but not limited to, the Dovecote and Old Weir Farm both of which are grade II listed.*

Mrs Eileen M Hewer

4.6 *The Statement of Reasons para 4.4 suggests six alternative options with only one of these being the diversion of the Yazor Brook. There is no evidence to suggest that they considered alternative routes for the diversion of the Yazor Brook. For this reason my client objects to the proposal and the compulsory purchase order.*

Mr F C Price

- 4.7 *Appropriate consideration has not been given to alternatives to the proposed Order.*

Credenhill Parish Council

- 4.8 *The Statement of Reasons paragraph 4.4 suggests six alternative options. Only one relates to the diversion of flood water, the remainder refer to flood storage area, or adaptive approaches. However, it appears they have not considered alternative routes to the proposed route for the flood diversion....*

5. GUIDANCE RELATING TO THE APPRAISAL OF FLOOD AND COASTAL DEFENCE PROJECTS

Flood and Coastal Defence Project Appraisal Guidance (FCDPAG, May 2001)

5.1 The Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) provides advice on best practice for the appraisal of flood and coastal defence projects. The series of guidance documents aims to provide best practice advice to practitioners involved in the preparation of strategies and schemes. Use of the guidance is intended to encourage a consistently high quality of decision-making supported by a rigorous appraisal of options so that the most appropriate scheme or strategy is proposed. The FCDPAG series is made up of six volumes:

- FCDPAG1 Overview (including general guidance)
- FCDPAG2 Strategic planning and appraisal
- FCDPAG3 Economic appraisal
- FCDPAG4 Approaches to risk
- FCDPAG5 Environmental appraisal
- FCDPAG6 Post project evaluation.

5.2 The series replaced the MAFF Project Appraisal Guidance Notes (PAGN) – 1993, and was current at the time that studies relating to the selection of the strategic scheme were undertaken.

Appraisal of flood and coastal erosion risk management – DEFRA Policy Statement (June 2009)

5.3 In June 2009 Defra published its Policy Statement on Appraisal. This Policy Statement replaces the previous policy guidance set out in the Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) Volumes 1-6 published between 1999 and 2001.

- 5.4 This Policy Statement sets out the principles that should guide decision making on the sustainable management of flood and coastal erosion risk in England. The operating authorities in England (the Environment Agency, local authorities, and internal drainage boards) are required to follow these principles when developing a case for investing taxpayers' money in flood and erosion risk management projects. The Policy Statement also sets out the risk-based context within which appraisal should take place.
- 5.5 More specific best practice guidance on how to undertake appraisals has been published in the Environment Agency, Flood and Coastal Erosion Risk Management Appraisal Guidance, March 2010 (FCERM-AG).

**Flood and Coastal Erosion Risk Management Appraisal Guidance
(FCERM-AG, March 2010)**

- 5.6 FCERM-AG reflects a change in approach from one focused on flood defences and coast protection to the management of risk. Other influences include the need to work better with natural processes and seek alternative sources of funding and partnerships for more efficient ways of working.
- 5.7 The new guidance has been issued as a living draft for review. The review period lasts until 31 December 2010.
- 5.8 My evidence details how FCDPAG, current guidance at the time of completing the assessment, has informed the selection of the scheme relating to the Order.

6. FLOOD ALLEVIATION OPTION SELECTION PROCESS

Yazor Brook FAS Selection Process

- 6.1 The principal driver for the Yazor Brook FAS is to support and realise the regeneration proposals of ESG Herefordshire. Consequently, the options appraisal process has been undertaken to select a scheme that meets the objectives of the regeneration of ESG.
- 6.2 Detailed flood risk studies undertaken by the Environment Agency showed the regeneration area of the ESG site to be at significant risk of frequent flooding. This included hydrological and hydraulic assessment and floodplain mapping of the Hereford Critical Ordinary Watercourses, the Yazor and Widemarsh / Eign Brooks. In order to realise the regeneration plans it is critical to reduce flood risk to an appropriate level.
- 6.3 Subsequent investigations undertook a preliminary review of options to mitigate flooding within the Edgar Street Grid development area. The review identified the technical (hydraulic) efficacy of possible flood mitigation measures that might be taken forward to enable flood risk within the development area to be significantly reduced.
- 6.4 Those studies concluded that, due to the nature and scale of flood risk, a strategic scheme would be needed to reduce flooding to a manageable level.
- 6.5 An appraisal of a range of options for a strategic flood alleviation scheme followed. That process investigated the feasibility of delivering flood mitigation, in consideration of cost, benefit, engineering constraints, environmental impact, programme and other risk factors that might impact successful delivery and as a consequence realisation of ESG regeneration.
- 6.6 During all stages of the selection of the strategic flood alleviation scheme, effort was made to follow the principals and processes of FCDPAG. Of note however, the proposals for the Yazor Brook FAS have not required an application for grant funding approval. The process has instead followed Advantage West Midlands' (AWM) own rigorous funding approval process. Key to obtaining AWM funding approval was the approval and endorsement of the options appraisal and scheme design by statutory consultees including the Environment Agency, Natural England and Herefordshire Council.

6.7 FCDPAG defines the project appraisal process as “the process of identifying and then evaluating options in order to select the one that most closely satisfies the defined project objectives. In the context of flood and coastal defence strategy and scheme appraisal these objectives include:

- reducing the risks to people and to the developed and natural environment from flooding and coastal erosion;
- identifying a solution that is technically sound and most fit for its purpose;
- being environmentally acceptable and sustainable; and
- ensuring best value for money from a national perspective.”

6.8 ESG Herefordshire Ltd must balance the needs and requirements of PPS25 with the aims and vision of the regeneration of Hereford and its Masterplan. Having established the requirement for flood alleviation the aims of the Options Appraisal were defined as:

- Identify flood mitigation options;
- Appraise the technical feasibility of options to significantly reduce flood risk within the ESG site;
- Assess the risks and constraints in delivering each of the options; and
- Consider costs, benefits, programme and risks, and then recommend the preferred option(s) for progression to detailed design and planning.

6.9 The appraisal process was undertaken therefore to assess the most suitable option for progression and to consider potential impacts to an appropriate level of detail, iterating the process where needed. The process also recognised that good decision-making is informed through consultation and the exchange of information with all interested parties, including other organisations or individuals who have an interest in the scheme and its impact.

6.10 The assessment of options has been guided therefore by FCDPAG. Subsequent sections of my evidence have been structured to reflect the 'strategic framework', as set out in FCDPAG, which consists of:

- Defining;
- Developing;
- Comparing; and
- Selecting options.

7. DESCRIPTION OF NEED (DEFINING)

Introduction

- 7.1 This section of my evidence summarises the need for the Yazor Brook FAS. I give particular regard to the definition of the scheme objectives as it pertains to option selection. In regard to the wider ESG regeneration project and the implications of flooding, reference should be made to evidence prepared by Dr David Nicholson and Mrs Ruth Goodall respectively.

Overview

- 7.2 A significant proportion of the ESG site falls within the Environment Agency Flood Zone 3B (Functional Floodplain), which is the most severe probability class considered in Planning Policy Statement 25: Development and Flood Risk (PPS25) (CD2/5). Flood Zone 3B is defined as areas within the predicted 5% AEP flood extent. PPS25 does not allow for any residential development within this flood zone, and it is necessary to significantly reduce the size of the functional floodplain within the ESG site to enable regeneration plans for the area to be realised.
- 7.3 The flood mitigation scheme must therefore overcome flooding caused by the 5% AEP river flood event and manage the 1% AEP river flood event within the ESG development area.
- 7.4 The context for the ESG regeneration proposals and Yazor Brook FAS are supported by a range of regional and local planning strategies and policies, details of which are included in the evidence of Dr David Nicholson and include the Regional Spatial Strategy (revised January 2008) (CD3/1), the Unitary Development Plan (2007) (CD4/1), the emerging Local Development Framework and a Supplementary Planning Document (November 2007) (CD4/3).
- 7.5 The Wye and Usk Catchment Flood Management Plan (CFMP), published March 2009 (CD6/2), promotes an approach to the management of flood risk in the City and its environs, based on existing or alternative actions. It specifically refers to the development of flood risk management schemes by Hereford City Council such as the 'Edgar Street Grid Project (ESG)'.

Yazor Brook FAS Timeline

- 7.6 In October 2006, on behalf of the Environment Agency, Capita Symonds Ltd began work on the flood risk mapping of the Yazor and Widemarsh Brooks, which flow through Hereford. This work was undertaken under the Environment Agency's 'Strategic Flood Risk Management' Framework (SFRM). The assessment studies identified extents, depths and probabilities of flooding from the Yazor and Widemarsh Brooks through the City and the then proposed ESG regeneration area. This work indicated that the ESG area was at risk of frequent and significant flooding. This work, on behalf of the Environment Agency, was completed in August 2007. The Environment Agency has maintained a strong involvement in the further studies.
- 7.7 The SFRM study identified that channel capacity is initially exceeded at two locations within ESG. Upstream of ESG, limitations in culvert capacity beneath the disused railway line result in flood water backing up into Widemarsh Common. Further upstream still, flood water flows exceed the channel capacity of Yazor Brook, with substantial flows entering directly into Widemarsh Brook, bypassing the bifurcation structure.
- 7.8 For larger flood events, flood water fills Widemarsh Common, resulting in overtopping of the disused railway line to the north of the Widemarsh Brook and overland flow into the ESG area. There is further widespread flooding through the ESG area principally centred around Merton Meadows car park and the old police training ground. Overland flooding from the ESG site rejoins the Widemarsh Brook downstream in the area of the city Hospital. There are no formal flood defence structures on either the Yazor or Widemarsh Brook operated or maintained by either the Environment Agency or Local Authority.
- 7.9 In January 2007, Capita Symonds was commissioned by ESG Herefordshire Ltd to undertake a preliminary review of options to mitigate flooding at the ESG development area to enable flood risk within the development to be maintained within acceptable limits. The 'Preliminary Options Review' (POR) was presented to the ESG board on the 31st May 2007. This was an investigation into the flood risk management approaches that may be applicable to the ESG regeneration proposals. The clear conclusion of this study was that flood risk within the ESG site could not be sufficiently mitigated

through the use of on-site measures such as channel works and culvert improvements. Consequently, a strategic approach to flood risk management was identified as essential, encompassing a strategic flood mitigation measure(s) upstream of Hereford and secondary measures within the ESG site.

- 7.10 Following the findings of the POR, ESG Herefordshire Ltd commissioned a more detailed assessment of the strategic flood mitigations options available with the aim of selecting a preferred option(s) to further progress. In July 2007 an 'Initial Options Appraisal Report' was released to key stakeholders to keep them informed and gain comment on the emerging conclusions.
- 7.11 The first issue of the 'Strategic Flood Mitigation Options Appraisal Report' was released to key stakeholders in January 2008. This report recommended the progression of the currently proposed scheme; a diversion of Yazor Brook flood flows to the River Wye upstream of Hereford.
- 7.12 A summary of the key reports relating to scheme selection is included in Appendix A.
- 7.13 Throughout the option selection and in progressing the eventual scheme to planning, considerable effort was invested in further developing hydraulic and hydrological modelling of the baseline condition and potential options. This involved extending the hydraulic model several kilometres upstream of Credenhill and detailed hydrological investigations. The Environment Agency was closely consulted, reviewing the final outputs. Further details of these assessments are contained in the Flood Risk Assessment that accompanies the planning submission and in the evidence of Ruth Goodall.
- 7.14 These studies confirmed that no single strategic flood mitigation scheme would be capable of completely eliminating the flood risk posed to the ESG area. The aim of the strategic scheme is therefore to reduce flooding to an acceptable and manageable level, so that remaining flood risk can be dealt with through further measures within the ESG site. Further details of the flood risk assessment and proposals for further on-site flood risk mitigation are presented in the evidence of Ruth Goodall.

8. OPTIONS DEVELOPMENT AND CONSULTATION (DEVELOPING)

Consultation Overview

- 8.1 At all stages ESG and their partners have sought to consult with all statutory bodies and interested parties including key stakeholders from:
- Herefordshire Council,
 - Environment Agency,
 - Advantage West Midlands,
 - Natural England,
 - National Trust,
 - Parish Councils,
 - Members of the public, and
 - Landowners.
- 8.2 Herefordshire Council's Statement of Community Involvement (SCI, March 2007) encourages those bringing forward significant development proposals to involve the community before a planning application is made. This is in addition to the early involvement of key consultees.
- 8.3 The Planning Statement including Statement of Community Involvement (July 2009) (CD5/3), prepared in respect of the Yazor Brook FAS and submitted with the Planning Application, also contains details therefore of the consultation and engagement undertaken in the course of the scheme's development.
- 8.4 Workshops, public meetings and engagement with key consultees, including Credenhill Parish Council, Environment Agency, Natural England and land owners are documented therein. The programme of meetings gave a valuable opportunity to explain to local communities the rationale for the FAS as part of the wider ESG Scheme, the basis of its selection and the technical basis of its design and operation.

8.5 Specific details of consultations and negotiations with land and property owners, notably the National Trust, relating to the Order are presented in the evidence of Mr Gerrard Williams, although reference is made where relevant within the remainder of my evidence.

8.6 In addition to extensive dialogue with individual stakeholders, ESG Herefordshire Ltd held a number of consultation events at key milestones in the scheme development process. These events are summarised below:

- 31 May 2007 – Presentation of Preliminary Options Review and strategy for flood risk management (Present: ESG Herefordshire, Herefordshire Council, Environment Agency and Advantage West Midlands. Unable to attend: Natural England).
- 2 and 3 June 2008 – Design Startup Workshops to explain options appraisal process and gain input into design process (Present: Landowners, ESG Herefordshire, Herefordshire Council, National Trust, Environment Agency and Advantage West Midlands. Unable to attend: Natural England).
- 14 July 2008 – Public consultation event on ESG flood risk management and strategic flood risk management options (public event).

Identification of Options

8.7 As discussed in section 7.9, the conclusion of the 'Preliminary Options Review' was that a strategic flood alleviation scheme was required to progress the ESG regeneration proposals. The POR identified flood mitigation measures considered to be broadly feasible in this regard.

8.8 At the consultation workshop held on the 31 May 2007 these findings were presented. Stakeholders were asked to comment on the findings and their support in undertaking a detailed option appraisal was requested. They were invited to propose other potential options for consideration also.

8.9 From the preliminary review and consultation five options (Options A – E) were agreed to be taken forward to a more detailed options appraisal. These options were:

- **Option A – Upstream Off-take into River Wye:** Off-take high flows on the Yazor Brook and divert them to the River Wye.
- **Option B – Offtake into Sugwas Quarry:** Diversion of flood flows on the Yazor Brook into Sugwas Quarry for flood storage.
- **Option C – Flood Storage at Livestock Market and Other Measures:** Construction of flood storage at the new site of the Livestock Market in conjunction with other smaller measures elsewhere.
- **Option D – Flood Storage at the Livestock Market and Adaptive Approach:** Deliver strategic flood mitigation in a staged approach to adapt to better catchment understanding and improved data collection. This option considered construction of flood storage at the new Livestock Market based on and assuming lower design flow estimates, together with adaptive measures.
- **Option E – Off-take into Canal:** Off-take of the Yazor Brook into the Herefordshire Canal upstream of the ESG site for storage and discharge into the River Lugg.

Options considered and discounted

8.10 A number of options were considered and discounted at an early stage as reported within the Options Appraisal Report. These included On-Site Flood Mitigation Measures, Increased Natural Upstream Flood Storage, Increasing the capacity of Yazor Brook downstream of its Bifurcation, and Do Nothing.

8.11 On-Site Flood Mitigation Measures - including channel re-alignment and flood storage, were discounted as a primary flood mitigation option because of the scale of flooding within the ESG Hereford.

8.12 Consideration of Increased Natural Upstream Flood Storage - recognised that changes to land management practices can positively influence runoff.

However, the opportunity was discounted as the effectiveness of these measures is difficult to quantify and would take many years to establish and many more to confidently evidence as effective. Such long-term measures did not meet the timescales or level of surety necessary to support the ESG regeneration proposals.

- 8.13 Increasing the capacity of Yazor Brook downstream of its Bifurcation - was not feasible as much of the brook is conveyed in culverts beneath existing development and over 1km of new culvert would be required through a heavily urbanised area of Hereford.
- 8.14 The 'Do Nothing' option - was not considered in any detail as the scheme justification dictated that an option to manage flood risk within ESG must be found in order to progress the regeneration of Hereford. However, baseline (current condition) modelling was performed to estimate the baseline damages in order to consider the benefit-cost of each option.

Evolution of Options

- 8.15 In July 2007 an 'Initial Options Appraisal Report' was released to key stakeholders for information and to gather feedback on the emerging conclusions. The report concluded that Options A and B were emerging as the most likely to be favourable schemes, but that a number of outstanding risks and uncertainties remained. Further information and analyses of both options was required. Further engagement with stakeholders and data collection were progressed as a consequence. This included the collection of further ecological surveys for both Options A and B to better understand the environmental risks with each of these options.
- 8.16 The first revision of the 'Strategic Flood Mitigation Options Appraisal Report' was released to key stakeholders in January 2008. This report recommended the progression of the currently proposed scheme; a flood diversion of the Yazor Brook to the River Wye upstream of Hereford.
- 8.17 It was on the basis of the January 2008 Strategic Flood Mitigation Options Appraisal Report that the preferred option (Option A, flood diversion to the Wye) was chosen with the support of statutory consultees. AWM gave approval to proceed with outline design of the FAS following their commissioning and receipt of a peer review. The peer review recommended

that Option A should be progressed as the preferred option. (A further assessment by AWM's consultants during October 2009 concluded that Option A is the most appropriate of the then six options considered (see section 11 of my evidence))

8.18 For completeness the following dates are also of note:

- Approval to submit the full planning application for the FAS was provided by the ESG Board on 11th May 2009.
- Following grant of planning permission for the scheme on 11th November 2009, AWM granted full funding approval on 12th November 2009.

9. OPTIONS APPRAISAL (COMPARING)

- 9.1 The appraisal of each option considered technical feasibility, economic assessment, environmental appraisal and risk. Quantitative and qualitative assessments were made of each of the options under consideration. This section of my evidence summarises the findings as detailed in the Strategic Flood Mitigation Options Appraisal Report, Final (December 2007).
- 9.2 Revision of the appraisal report (Yazor Brook Flood Alleviation Scheme Options Appraisal Report (July 2009)), as a consequence of discussions with the National, Trust is referred to in section 11 of my evidence.

Technical Feasibility

- 9.3 The hydraulic assessment used the hydrodynamic flood model developed for the Environment Agency SFRM of the Hereford Critical Ordinary Watercourses. The model developed is a linked 1-dimensional / 2-dimensional model using the ISIS and TUFLOW software.
- 9.4 The option scenarios were tested based on their effectiveness in reducing flood risk within the ESG site and the potential to exacerbate flooding elsewhere. Based on this analyses, Options A and B were shown to provide the best opportunity to deliver a significant degree of flood mitigation.
- 9.5 Option C was shown to be entirely dependent on the capacity of the flood storage pond that could be constructed at the site. Hydraulically the option was found to be feasible. However, on engineering grounds such storage capacity would be difficult to achieve requiring a large area of land, incompatible with the existing and proposed land uses at the new Livestock Market.
- 9.6 Hydraulically, Option D required the engineering refinement of Option C and assumes that lower design flow estimates could be justified.
- 9.7 Lastly, Option E was assessed as not being capable of diverting and storing the required flood waters (only a quarter of that required was possible) and so for strategic flood mitigation the option was found not to be viable.

Economic Assessment

- 9.8 The options costing exercise was based on industry standard rates and assumptions. The construction cost of each option included a combined cost of materials, plant and labour to give a single rate. The rates were estimated using Spon's Civil Engineering and Highway Works Price Book 2005 as a guide.
- 9.9 The calculation of flood damages (or scheme benefit) was undertaken using the 'Modelling and Decision Support Framework' (MDSF). MDSF provides an automated process of predicting economic damages through the calculation of flood extents and depths based on a digital terrain model (DTM), river centrelines and flood depth grids.
- 9.10 The estimated Average Annual Damage on the Yazor and Widemarsh Brook for the current or baseline situation was estimated to be £1,003,000 within Hereford and £323,000 within the ESG site. These damages were based on the current land use within the ESG site and not the proposed Masterplan which would further increase the potential scheme benefit.
- 9.11 It has been made clear within the Options Appraisal Report that the cost/benefit comparison undertaken is not a conventional cost/benefit analysis, in terms of FCDPAG, which uses discounted cost flows to reduce all items to their net present value. However, the comparison undertaken clearly showed that the benefits were similar for all options (except Option E) and hence the option selection was likely to be heavily influenced by relative costs of the options and the feasibility of implementing the options.
- 9.12 Due to the overriding requirement for strategic flood mitigation to facilitate delivery of ESG regeneration and the economic justification therein, the scheme's benefit/cost was not investigated further as part of the appraisal.

Environmental Appraisal

- 9.13 An initial review of the environmental impacts and consequences of the five options was completed during the options appraisal. An Environmental Impact Assessment (EIA) screening assessment methodology based on desk studies was adopted for this work to identify possible environmental issues, assess the likelihood of requiring a statutory EIA and the possible scope of such a study were it required.

- 9.14 Using available data, a broad assessment of environmental risks was possible. The environmental appraisal and discussions with the Planning Authority identified that several of the proposed options were likely to require an EIA. The options most likely to require EIA by the local authority were assessed to be Options A and B, although, Option C would be incorporated within an existing EIA for the livestock market development.
- 9.15 Ecological survey work was initiated during the course of the appraisal to support greater consideration of the environmental risks of Options A and B and to support any eventual EIA.
- 9.16 The options appraisal report concluded that, through the full investigation and assessment of an EIA and Appropriate Assessment where necessary, the environmental risks of all options would be manageable. However, significant environmental concerns regarding groundwater and landfill interaction were identified for Option B, the risks of which could not be quantified without an extended period of monitoring. This risk was judged to be un-manageable within the ESG development master programme.

Risk Appraisal

- 9.17 The assessment looked to identify as many of the risks and constraints relevant to each option as possible including:
- Hydraulic and Hydrological Suitably
 - Engineering Challenges and Constraints
 - Programme
 - Third Party and Other Risks
 - Planning Process
 - EA Consents
 - Land Purchase
 - Funding Arrangements
 - Maintenance

- Residual Flood Risk

9.18 The overall level of risk associated with delivering each option was summarised in the appraisal reports.

10. OPTION SELECTION

- 10.1 The appraisal process identified a range of strategic flood mitigation options to enable the development of ESG. The recommendations of the assessment were based on consideration of; the strategic reduction of flood risk within ESG; the ability of an option to benefit flooding which arises from events more extreme than the design event; environmental appraisal; cost, risk and ESG programme.
- 10.2 The assessment concluded that Option A was the most appropriate strategic flood mitigation option. The diversion of the flood flows from the Yazor Brook to the River Wye was judged to provide the best opportunity for strategic flood protection to the ESG area and present the lowest risk to the delivery of ESG regeneration.
- 10.3 The assessment discounted Options B to E from further consideration for the reasons stated below:
- 10.3.1 **Option B (Quarry)** – Due to unacceptable uncertainty in the quarry design water level, influence of the neighbouring landfill site and the potential for leachate mobilisation, environmental impact, slope stability and hydrogeology.
- 10.3.2 **Option C (Cattle Market Flood Storage)** – Due to the site being unable to deliver the required volume of flood storage and therefore flood mitigation.
- 10.3.3 **Option D (Adaptive Approach)** – Due to the difficulty in agreeing the approach with statutory bodies, the non-conformity with government guidance and the liabilities to ESG were insufficient mitigation to be demonstrated in the future.
- 10.3.4 **Option E (Offtake to Canal)** – Due to the option being unable to deliver the required level of strategic flood mitigation.
- 10.4 The conclusions of the options appraisal received no objections from statutory consultees either when first issued or during the course of the planning submission.

- 10.5 The Final Options Appraisal Report (December 2007) was externally reviewed by engineering consultants appointed to Advantage West Midlands (AWM), Waterman Group. Following this review AWM endorsed the selection of the preferred option.
- 10.6 Project appraisal guidance advocates an iterative approach to option selection and development. In the course of the assessment the viability of a strategic option based on flood storage in the upper catchment was promoted by the National Trust and their advisors. Although initially the National Trust's advisors considered that the use of natural upstream flood storage had been inappropriately discounted during the process, their stance evolved to advocate flood plain storage requiring engineered structures. This resulted in the appraisal of a further strategic flood mitigation option; Option F – Credenhill Flood Storage. The assessment of this option was included within the final appraisal report submitted in support of the planning application.
- 10.7 In section 11 of my evidence I describe the review of this further option, Option F, and the discussions held over an extended period that led to this option being included within the final appraisal.

11. FURTHER OPTIONS REVIEW

- 11.1 Following conclusion of the Options Appraisal Report, December 2007, which was issued to stakeholders January 2008, the identification and appraisal of options was kept under review.
- 11.2 Central to the ongoing review were discussions with the Environment Agency, Herefordshire Council, Advantage West Midland and the National Trust. The evidence of Mr Gerrard Williams details consultations with the National Trust since October 2007. Discussions with the National Trust began in early September 2007 and details of the emerging options appraisal (Initial Options Report, July 2007) were issued to Mr David Hughes, National Trust to provide an overview of the work to date.
- 11.3 At the request of the National Trust, ESG Herefordshire Ltd funded the appointment of Haycock Associates to act as their advisors, in early November 2007. A range of technical documents and technical data relating to the appraisal were issued to Haycock Associates during November and December 2007. A site meeting was also held with the National Trust and their advisors.
- 11.4 On 17th January 2008 Haycock Associates issued a report to ESG. The report suggested a number of design options for the lower portion of the scheme (i.e. downstream of the A438) and identified design constraints in this area.
- 11.5 A design start up workshop was held on 3rd June 2008, attended by the National Trust, Herefordshire Council and Environment Agency. The National Trust and their advisors provided useful feedback in relation to design opportunities in the lower portion of the scheme. Taking this and feedback from others onboard, further drawings and emerging design details were issued to the National Trust during September and October 2008.
- 11.6 Feedback from the National Trust on the draft design package issued was received by ESG Herefordshire Ltd on 23rd October 2008 by way of a letter. Included as an attachment was a short report of comments from Haycock Associates. The comments related principally to the offtake, jump chamber, culvert outfall and stepped cascade associated with the emerging design of the FAS. A comment within the wider text referred to Haycock Associates' feeling that "...using the area upstream of Station Road which forms a natural depression for floodplain attenuation would be a softer approach and more

natural hydrologically. We believe this would remove the need to create a diversion at all.”

- 11.7 Feedback on the draft design package was provided by both Natural England and the Environment Agency during October and November 2008.
- 11.8 Having had opportunity to further develop the design of the FAS and incorporate feedback, a meeting was held with the National Trust and their advisors on 9th December 2008. It was at this meeting that Haycock Associates raised for the first time their considerations of the opportunity for an upstream storage option.
- 11.9 Between December 2008 and March 2009 the design of the FAS progressed, informed by consultation. The opportunity for upstream storage was further discussed at a meeting between ESG Herefordshire Ltd and the National Trust and their advisors.
- 11.10 At the meeting and in subsequent correspondence, ESG Herefordshire Ltd undertook to examine in detail the catchment storage option as outlined by Haycock Associates.
- 11.11 An assessment of the potential for catchment storage to deliver strategic flood mitigation was undertaken throughout April 2009. The assessment included a number of review meetings with Herefordshire Council, Advantage West Midlands and the Environment Agency.
- 11.12 A report of the assessment was issued to the National Trust on 5th May 2009, Yazor Brook Flood Alleviation Scheme – Appraisal of Upstream Storage Options, April 2009. The findings of the assessment are summarised below.

Appraisal of Upstream Storage

- 11.13 The appraisal endorsed the selection of the upstream off-take over upstream storage for the following reasons:
- The inability of the storage option to provide the required level of strategic flood mitigation without impacting upon adjacent properties;
 - The option is likely to have significant environmental impact through the requirement for substantial engineering structures to hold water,

which would also fall within the Reservoir Act 1975. Included within this are impacts on Bishon Common SSSI; the lowland landscape, arising from the necessary bunding, up to 3.2m in high in places; the Grade I complex of listed buildings at Court Farm, and on Scheduled Ancient Monuments;

- Strong objections received from the Ministry of Defence (MOD) and the anticipated public opposition; and
- The inability of a storage option to deal effectively with successive flood events occurring in rapid succession or structural failure, both of which increase residual risk of flooding downstream.

11.14 In support of the planning application for the scheme, a second revision of the Options Appraisal report was produced. This was prepared as a public facing document and was therefore reworked to be more concise and less technical, whilst also including the assessment of upstream flood storage denoted as Option F. The findings and conclusions of the report were otherwise unchanged. The Yazor Brook Flood Alleviation Scheme Options Appraisal Report, July 2009, including consideration of Option F was submitted with the Planning Application for the FAS.

12. DESIGN DEVELOPMENT

Introduction

- 12.1 Following the options appraisal the design of the scheme has evolved through a rigorous design process capable of supporting the EIA and planning application.
- 12.2 The Options Appraisal Report (December 2007) outlined the design of a diversion and recognised that many design options and configurations existed. These needed further investigation. The Options Appraisal Report presented two offtake options, several generic open channel and culvert designs, two routes north of the A438 and two outfall options. At this stage these options were representative of scope for design choices and further development. The relative merit of each was not assessed.
- 12.3 The assessment of these options and scheme design in support of the planning application begun in May 2008. Design options, constraints and stakeholder feedback from the options appraisal process were considered. Nineteen design options were tabled by the design team, of these 7 were progressed for further design consideration
- 12.4 There is a narrow corridor between Credenhill and Old Weir Farm where the land's topography makes the diversion option practical. Therefore, the design options outlined below do not vary widely geographically.
- 12.5 The 7 initial design options were presented to external stakeholders and potentially affected landowners at the start-up workshops on the 2nd and 3rd of June 2008. In the course of further design development, these options evolved further such that the Environmental Statement submitted with the planning application outlined 10 component design options.
- 12.6 For ease the Environmental Statement (ES) divided the scheme into 3 sectors along its route. The rationale for the final design selection is summarised in the ES and illustrated in drawing CS-029394-GEN-003 of the ES.
- 12.7 The remainder of this section of my evidence is divided into three parts based on these sectors. These are:
- Offtake at Credenhill

- Route between offtake and A438
- Design south of A438

Off-take Design

- 12.8 The operation of the scheme is reliant upon the design and performance of the off-take structure on the Yazor Brook. The off-take structure takes from the Yazor Brook a proportion of flood floods and diverts this flow towards the River Wye. The flow rate diverted must be maximised during flood conditions but be minimised during normal flow conditions. Other design considerations were simplicity of operation, adaptability, access for maintenance and construction, health and safety, environmental impact, cost and landowner agreement.
- 12.9 Two options for the off-take were considered; upstream of Station Road and downstream of Station Road. Both options were similar in design, requiring a long lateral weir within the south bank of the Yazor Brook, over which flood flows would spill.
- 12.10 The option of an off-take upstream of Station Road proposes an off-take structure on the south bank of the Yazor Brook in the field belonging to Magna Castra farmland. A lateral weir would act as the off-take and be sited approximately 25m upstream of the bridge. A penstock structure would be required to limit flow downstream on the Yazor Brook and through the twin culverts beneath Station Road. Diverted flows would enter a buried culvert behind the lateral weir that would then pass beneath Station Road via the existing bridge opening associated with the disused railway and into the first field (south of Credenhill Community Centre).
- 12.11 The option for an off-take structure downstream of Station Road proposes a lateral weir recessed into the south bank of the Brook, under the Community Centre car park. The option includes the addition of an in-channel control flume downstream of the lateral weir to limit flow down the Yazor Brook. Diverted flood flow would then be culverted in a southerly direction between the playgroup building and Community Centre until reaching the first field.
- 12.12 At the workshops of the 2nd and 3rd June 2008 there was significant hostility to the upstream off-take option from the landowner. All other landowners were, in principle, open to either off-take design option.

12.13 The off-take structure downstream of Station Road was chosen over the upstream option because of:

- Risks associated with the impoundment of flood flows behind the railway line. The embankment structure was not designed for this purpose and its stability under such circumstances was questioned. The structure also has several small floodplain culverts which would need to be blocked to encourage storage.
- The impoundment would increase flooding directly upstream of Station Road, and was objected to by the landowner.
- A control structure (e.g. sluice) would be required on the bridge culvert to facilitate impoundment. This would have maintenance and residual flood risk issues.
- Vehicular access would be required. Access would need to be raised to allow access to structures during flood conditions. This would be costly and increase land take.
- A rising main is situated beneath the site. There would be additional costs and environmental risks associated with its relocation.
- The culvert would need to be buried to a depth of 3m under the existing bridge arch. This caused significant concerns over the safety of the excavation during construction and the structural stability of the bridge.
- The culvert would need to turn sharply on several occasions before reaching open ground.
- The visual impact of the option would be greater than the downstream off-take.

12.14 Further development of the off-take design was influenced by comments from the Parish Council, Mr and Mrs French and the Environment Agency. Particularly influential was the Environment Agency's suggestion for a downstream control structure to improve the efficiency and robustness of the off-take's operation. This was discussed at a meeting with the Environment Agency, and resulted in a detailed engineering and hydraulic assessment of

options for a downstream control structure. The assessment concluded that a flume constructed a short distance downstream of the off-take would benefit the efficiency and certainty of operation, whilst not negatively impacting on normal flows, fish passage or local flood risk.

- 12.15 At the suggestion of the EA's Fisheries team, a fish refuge on land opposite the off-take was incorporated into the design. Several arrangements were prepared with the selection of the final design being informed by the views of the land owners Mr and Mrs French who favoured a fish refuge with minimal land take located in the corner of their field.

Route between off-take and A438

- 12.16 The design requirements of the off-take set the invert levels of the diversion and it was concluded that a culverted diversion would be required for much or all of the route. An open section was assessed to be impractically deep, presenting little or no ecological gain and presenting issues in relation to maintenance, visual impact, land take, and health and safety. Landowners made it clear that they preferred a scheme that would not affect future agricultural land use.
- 12.17 The chosen route was therefore selected on the basis of minimising archaeological impact, length and depth of construction, existing field boundaries and residual flood risk from culvert failure.

Design south of A438

- 12.18 The Options Appraisal Report (December 2007), showed the use of the natural gorge feature down to the Wye, just east of Old Weir Farm. This landscape feature, referred to as the Dingle, was considered a natural choice for containing flood flows and dissipating energy on the steep descent to the Wye floodplain. However, further investigation and assessment revealed that the gorge was too small and unstable to accommodate the diversion of flood flows and the works required to engineer the channel were deemed to be too major and intrusive. This option was discussed at length at the design start-up workshop with stakeholders on the 3rd June 2008. At which point it was concluded that this option should be discounted from further consideration.

- 12.19 Also discussed and discounted following the design start-up workshop on the 3rd June 2008 was the option of routing the scheme between the gorge and Old Weir Farm. This option provided no clear advantages over a route to the east of the gorge but would increase the construction impacts on the farm and risk ground stability issues in close proximity to the gorge.
- 12.20 This left a route to the east of the gorge that would need to descend a 14 metre incline to the Wye floodplain. The design team therefore considered a variety of options to manage this descent:

Buried Options

12.20.1 To minimise visual impact a buried structure was considered. Two options were explored. The first being a rectangular culvert buried to a slope matching existing ground with all energy dissipated at the bottom of the descent. The second a pipe drop structure with energy dissipated at intermediate points as well as at the outlet. Pipe drop structures are typically limited to approximately 4-5m per drop with intermediate and terminal energy dissipation structures being approximately 6 x pipe diameter in length (USBR Design of Small Canal Structures). The buried pipe drop structure was not considered further due to the significant excavation required to construct the intermediate structures below ground as well as the likely difficulties in constructing these structures in the weak ground. The rectangular culvert/spillway was selected as the preferred buried option.

Above Ground Options

12.20.2 Three above ground options have been considered. A rectangular chute with baffle blocks to dissipate energy; a rectangular chute with small steps; and a rectangular chute with large steps. All of these options reduce the amount of energy dissipation required at the bottom of the descent by dissipating energy down the slope. The greatest amount of energy is dissipated with the large step option, followed by the baffle block and then the small step option. All three will require energy dissipation at the outlet/downstream extent but the dissipation required will be significantly less than the equivalent free flowing structure.

- 12.21 These energy dissipation options were sized hydraulically. A cascade (large-stepped) and buried rectangular culvert were designed in outline. These two options were presented in the Initial Design Package sent out on the 1st October 2008 to the National Trust, Environment Agency and Herefordshire Council.
- 12.22 The National Trust and Environment Agency provided feedback on the initial design package (23/10/2008 and 14/11/2008 respectively). The Environment Agency acknowledged that an open cascade would provide a more familiar design solution but may have a greater visual impact. The Environment Agency did not voice a clear design preference. The views of National Trust were clarified during a meeting on the 9th December 2008 between Capita Symonds and Haycock Associates. Haycock Associates stated that they were opposed to the cascade option on the grounds of landscape and visual impact. Consequently, largely based on National Trust feedback, the option for an open channel cascade was discounted in favour of a culverted spillway and buried energy dissipation chamber.
- 12.23 The Initial Design Package was also prepared to progress discussion on the options for the outfall into the Wye. The Initial Design Package presented an option for an open channel from either energy dissipation structure directly to the River Wye. The channel followed the east boundary of the field and presented a gabion basket stepped outfall structure into the Wye. The 'Design Commentary' report that accompanied the initial design package provided the following statement on the outfall design:

Only once a preferred energy dissipation option has been selected and its location and alignment agreed will it be possible to enter into design selection of the final component of the scheme, the outfall into the River Wye. Input from the National Trust on this element (as landowner) will be essential. The current designs are indicative only and represent a hard engineered solution as a starting point to further discussion. Conscious of the environmental and visual sensitivity of the location we expect significant design change.

Preferred thinking is for a wide spill into the lower field that naturally enters the River Wye along a wide frontage. Ideally only limited soft engineering would be required to reduce the risk of erosion. However

this option may not be fully compatible with an underground energy dissipation structure.

12.24 The initial design of the outfall into the Wye and the suggestion of a discharge onto the lower field was guided by earlier design input received from the National Trust through their advisors Haycock Associates. Following a site meeting with the National Trust and Haycock Associates on the 18th December 2007, ESG Herefordshire received a short report on the National Trust's design constraints and suggested design options. The technical report dated 17th January 2008 was produced by Haycock Associates. The report suggested a number of proposed design options for the lower portion of the scheme and identified key design constraints. The report concluded that it would be in the NT's best interests that:

1. It is agreed that the liability of maintenance and ownership do not lie with the Trust, and if possible, ownership of the flood alleviation scheme will fall with the local council.

2. Any diversion scheme does not increase the risk of flooding to residents in the eastern corner of the upper fields. Any open channel option would present a heightened flood risk to these residents.

3. The ditch in the upper fields outlined in option 1, should not be used as part of the diversion channel as it lies in very close proximity to properties near Sugwas Pool and will again heighten the flood risk to the Trust's neighbours.

4. Any diversion scheme avoids routing floodwaters through gorge. The gorge is a highly erodible feature and using it to route floodwaters will result in a massive increase in erosion rates, bank failure and possible complications with damage to the structural integrity of the foundations of the farm buildings at Old Weir Farm. Any erosion prevention measures will probably be undermined, prohibitively expensive or too aggressive to fit with the character of the Trust property.

5. Any development of the flood alleviation scheme should avoid routing flows through the drainage ditch in the lower fields. This has a high ecological score, and the landscape in this area is of a high

archaeological value, being in such close proximity to the Roman Road.

- 12.25 The report from Haycock Associates steered the design team away from further considering the drainage ditch in the lower field as an option for the outfall design. Furthermore, the report advocated a leet design and with this the possibility of a diffuse flow over the lower field. The suggestion for a diffused flow over the lower field was carried forward as an alternative to an engineered structure on the bank of the River Wye.
- 12.26 The suggestion for a diffused flow onto the Wye floodplain was further supported by statements received from the Environment Agency following their review of the Draft Design Package. The following was stated in a letter dated 14th November 2008 from Justin Burnett, Environment Agency:

For the outfall to the River Wye at the downstream limits of the scheme we would also prefer a "wide spill into the lower field that naturally enters the River Wye along a wide frontage". This would reduce the need to engineer a defined channel that may silt up and require de-silting following a flood. It should also retain the existing characteristics of the floodplain from both a visual and hydraulic perspective.

The indicative outfall into the River Wye is currently shown as a hard engineered structure. From a biodiversity perspective, we would wish to see a softer solution. Section 6 of the Design and Drawing Commentary suggests that it is intended to seek a softer engineering solution. Any hard engineering would need to be fully justified.

- 12.27 The case for wishing to avoid an engineered structure on the River Wye was to reduce the potential risks to the river's SSSI and SAC designation, visual impact, bank erosion and health and safety concerns.
- 12.28 The Capita Symonds design team met with Haycock Associates on the 9th December 2008 to run through the design and seek agreement on a number of technical matters. At the meeting, Haycock Associates explained that they see the merit in using the entire field alongside the Wye for dispersal and discharge into the Wye. However, they felt that the tenant farm was unlikely to agree to this proposal and that the open channel option was therefore the

most likely option to be acceptable. Haycock Associates explained their thoughts on how this channel and outfall might be designed and look to best meet the National Trust's requirements. Haycock Associates agreed to prepare sketched details of their design ideas for submission to the Capita Symonds design team.

12.29 Haycock Associates issued Capita Symonds with an outline design drawing for a submerged outfall on the 8th January 2009. This suggested design was further progressed by the Capita Symonds design team, including hydraulic modelling, engineering sizing, design risk assessment, 3D visualisations, and EIA input. This resulted in the April 2009 submission to the National Trust and Environment Agency of a further draft design package specifically concerned with the design of the energy dissipation structure and outfall.

12.30 Following the April 2009 draft design submission, several meetings and conversations were held with the Environment Agency concerning the design proposals. As a result of these discussions the EA issued a 'Summary Note' dated April 2009 that summarised their position. This note provided the following comments on the submerged outfall design:

For the outfall to the River Wye at the downstream limits of the scheme we also acknowledge that "wide spill" into the lower field could be an option which will naturally allow water to enter the River Wye along a wide frontage. This would reduce the need to engineer a defined channel and hard engineered outfall that will silt up and require de-silting following a flood. The "wide spill" option would also retain the existing characteristics of the natural floodplain from both a visual and hydraulic perspective.

Should the open channel and hard engineered outfall be the chosen option then we would advise the open channel is constructed to provide a natural feature. The submerged outfall indicated on Drawing Number CS029394-YBF-003/P3 is an option that is strongly discouraged, as its internal arrangement together with the screens will require a more robust maintenance regime for it to operate efficiently. It is probable that this structure would become totally blocked and fully laden with silt after a flood event and cause operation problems.

Therefore, we consider an open feature is used e.g. a cascade, which could be stone clad as per the proposals for the headwall on Drawing Number CS029394-YBF-025/P1. The cascade would also further reduce the energy of the floodwater from the scheme and the associated impacts of erosion of the bed of the River Wye.

- 12.31 The comments received from the Environment Agency were consistent with concerns raised by the design team. Consequently, the final decision was made that a diffuse flow outfall on to the Wye floodplain would be the preferable solution and taken forward to the planning application.

13. RESPONSE TO OBJECTIONS

National Trust

- 13.1 *In the absence of a full feasibility report there is insignificant information to confirm the Acquiring Authority's assessment of the preference of the Scheme over the alternatives considered. Moreover it is not possible to ascertain whether in their assessment of the alternatives the Acquiring Authority has followed the Economic Appraisal Flood and Coast Defence Project Appraisal Guidance (document FCDPAG3).*
- 13.2 Within my evidence I have referred to the range of technical and appraisal reports produced during the assessment of the Scheme over the alternatives considered. Within section 11 of my evidence I refer specifically to the assessment of a further option, informed through consultations with the National Trust. Section 9 of my evidence describes the economic assessment undertaken during the options appraisal study. The Options Appraisal Report acknowledged that this assessment was limited with respect to guidance within FCDPAG3. My evidence describes how the assessment was appropriate for the comparison of options, relevant to a development enabling scheme, and complimentary to the funding approval process of Advantage West Midlands.
- 13.3 *In the absence of this information it is not possible to confirm that this is the most viable option for the flood protection of the East Street Grid.*
- 13.4 My evidence describes the processes undertaken which have lead to the conclusion that the Scheme is the most viable option for the flood protection of the East Street Grid.
- 13.5 *Section 4(1) National Trust Act 1907 states that the general purposes of the National Trust is to promote the permanent preservation for the benefit of the nation of lands and tenements (including buildings) of beauty or historic interest and as regards lands for the preservation (so far as practicable) of their natural aspect features and animal and plant life. It is not clear whether the Acquiring Authority has taken this into account in assessing whether, in accordance with paragraph 17 of Circular 06/2004, there is a compelling case for the Scheme. Nor is it clear whether this particular purpose has been taken into account when assessing and rejecting the alternative scheme designs.*

13.6 Section 12 of my evidence describes how alternative scheme designs have been informed by, and assessed and rejected in consultation with the National Trust. Within section 9 of my evidence I explain how the environmental appraisal of impacts was included in the assessment process.

13.7 *The Scheme has not taken into consideration or properly mitigated against unacceptable impacts to National Trust property, including, but not limited to, the Dovecote and Old Weir Farm both of which are grade II listed.*

13.8 Section 12 of my evidence describes the selection of alternative scheme designs, minimising and mitigating impacts to National Trust property.

Mrs Eileen M Hewer

13.9 *The Statement of Reasons para 4.4 suggests six alternative options with only one of these being the diversion of the Yazor Brook. There is no evidence to suggest that they considered alternative routes for the diversion of the Yazor Brook. For this reason my client objects to the proposal and the compulsory purchase order.*

13.10 This is detailed in section 12 of my evidence.

Mr F C Price

13.11 *Appropriate consideration has not been given to alternatives to the proposed Order.*

13.12 My evidence presents the processes undertaken in the assessment of alternatives to the Yazor Brook FAS.

Credenhill Parish Council

13.13 *The Statement of Reasons paragraph 4.4 suggests six alternative options. Only one relates to the diversion of flood water, the remainder refer to flood storage area, or adaptive approaches. However, it appears they have not considered alternative routes to the proposed route for the flood diversion....*

13.14 This is detailed in section 12 of my evidence.

14. SUMMARY AND CONCLUSIONS

- 14.1 My evidence has summarised the requirement for a strategic flood mitigation scheme to support and realise the regeneration proposals of ESG Herefordshire. Detailed flood risk studies undertaken by the Environment Agency showed the regeneration area of the ESG site to be at significant risk of frequent flooding. A large proportion of the ESG site falls within PPS25 Flood Zone 3B (Functional Floodplain), and it is necessary to significantly reduce the size of the functional floodplain within the ESG site to enable regeneration plans for the area to be realised.
- 14.2 The Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) provides advice on best practice for the appraisal of flood and coastal defence projects. The series of guidance documents aims to provide best practice advice to practitioners involved in the preparation of flood defence strategies and schemes. The proposals for the Yazor Brook FAS have not required an application for (flood risk management) grant funding approval. Funding for the FAS has been approved by Advantage West Midlands (AWM). Key to obtaining AWM funding approval was the approval and endorsement of the options selection process and scheme design by statutory consultees including the Environment Agency, Natural England and Herefordshire Council. My evidence shows that during all stages of the selection of the strategic flood alleviation scheme, effort was made to follow the principles and processes of FCDPAG and that the options appraisal process has identified a scheme that meets the objectives of the regeneration of ESG.
- 14.3 My evidence describes the identification and evaluation of options. It explains the initial options considered and discounted; the detailed appraisal of initially five options (Options A – E); and the subsequent appraisal of a sixth option based on storage in the upper catchment (Option F). I describe the technical, economic, environmental and risk assessments that have been undertaken. These assessments are detailed within the 'Strategic Flood Mitigation Options Appraisal Report, Final (December 2007)' and 'Revision of the appraisal report (Yazor Brook Flood Alleviation Scheme Options Appraisal Report (July 2009))'.
- 14.4 The assessments completed justify the selection of Option A – Upstream Off-take into River Wye: Off-take high flows on the Yazor Brook and divert them to the River Wye, as the scheme for the strategic mitigation of flooding within ESG.

- 14.5 The processes undertaken recognised that good decision-making is informed through consultation. My evidence mentions the consultation and the exchange of information that has been undertaken, with all interested parties, including statutory consultees and other organisations, and identifies specifically the engagement with the National Trust.
- 14.6 I describe the further appraisal and iteration of the Yazor Brook FAS, informed by discussions with the National Trust and others. This includes the appraisal of alternative route alignments, the assessment of options for energy dissipation measures downstream of the A438 and the consideration of alternative mechanisms for the discharge of diverted floodwaters to the River Wye.
- 14.7 My evidence demonstrates how the assessments undertaken identified the route and outline design of the Yazor Brook FAS that were taken forward to planning application, and then through further refinement became the Scheme to which the Order relates.
- 14.8 I conclude from this evidence that:
- The process to identify a scheme which manages flooding to an acceptable level, enabling development within ESG, has been informed by Government guidance, FCDPAG;
 - The chosen scheme has considered economic, risk, environmental and technical issues, throughout, to evaluate the merits of one option over another;
 - This has led to logical and auditable decision making and the selection of the best option for the management of flooding within ESG;
 - The selection of the route alignment and outline design details, also considered the merits of alternative options, concluding with a scheme which when submitted for planning approval received no objections from Natural England, The Environment Agency and Herefordshire Council, and the scheme promoters, Advantage West Midlands;

- This demonstrates the support for the process undertaken and conclusions drawn within the assessments from statutory consultees.

15. STATEMENT OF TRUTH

- 15.1 I confirm that insofar as the facts stated in this proof are within my own knowledge, I have made clear which they are and I believe them to be true and that the opinions I have expressed represent my true and complete professional opinion.
- 15.2 This Report includes all facts which are regarded as being relevant to the opinion which I have expressed and I have drawn to the attention of the Inspector any matters which would affect the validity of that opinion.
- 15.3 I understand that my overriding duty is to help the inspector and the Secretary of state with matters within my expertise and this duty overrides any obligations to my client. I confirm that I have complied with this duty.

Marc Pinnell

JBA Consulting

14 July 2010

A handwritten signature in black ink, appearing to read 'M Pinnell', is written over a rectangular area of fine grey dot-matrix background.

APPENDICES

Appendix A - Document Register



Appendix A - Document Register

Document ID	Document Name	Document Date	Comment	Circulation
001	Initial Options Appraisal Report	July 2007	Interim findings and recommendations of the options appraisal process	16 th July 2007 - ESG Herefordshire Emailed to Mir D. Hughes 10.9.2007
002	Strategic Flood Mitigation Options Appraisal Report	December 2007	Final Options Appraisal Report	Members of the Infrastructure sub group including, ESG/AWM/Herefordshire Council and the Environment Agency. It was also offered to Natural England
003	The Weir – Flood Water Diversion Options from the Yazor Brook	17 Jan 2008	Report prepared by Haycock Associates on behalf of the National Trust to input into discussion on the feasibility of the FAS at the options appraisal stage	Passed to ESG on the 24.01.08
004	Meeting Minutes – Design Startup Work 3 rd June 2008	3 rd June 2008	Meeting minutes of the design startup workshop on the 3 rd June 2008, attended by key stakeholder and landowners	Passed to ESG on the 08.07.08.
005	Yazor Brook Flood Alleviation Scheme Options Appraisal Report	July 2009	Revisit and review of options appraisal included with Environmental Statement (Annex GEN.05)	Public document – Planning submission
006	Initial design package	1 st October 2008	Preliminary scheme drawings, accompanied by a drawing commentary note;	Environment Agency (FAO Mr M Davies) National Trust (FAO Mr D Hughes) Natural England (FAO Ms H Pankhurst) Herefordshire Council (FAO Mr R Pryce) EC Harris (FAO Mr S Russell)
007	Letter titled – Yazor Brook Flood Alleviation Scheme – Draft Design Package	Dated 7 th October 2008 Received 23 rd October 2008	Letter from David Hughes, National Trust, to Charles Pickles, ESG Herefordshire, responding to the Draft Design package. Included comments prepared by Haycock	Sent to Charles Pickles, ESG Herefordshire

				Associates.	
008	Letter Titled - DRAFT DESIGN PACKAGE FOR HEREFORD FLOOD ALLEVIATION SCHEME - 2KM CHANNEL DIVERSION OF THE YAZOR BROOK TO THE RIVER WYE, HEREFORDSHIRE	Dated 14/11/2008		Letter from Justin Burnett, Environment Agency, to Charles Pickles, ESG Herefordshire, responding to the Draft Design package.	Sent to Charles Pickles, ESG Herefordshire
009	Meeting Notes - 9th December 2008 & accompanying consultation log	Issued 15/12/2008		Design & hydrology workshop with National Trust Advisors	Passed to ESG on the 15.12.08 followed by a further meeting with NT on the 15.01.09.
010	Yazor Brook Flood Alleviation Scheme - Appraisal of Upstream Storage Options	April 2009		Standalone assessment of the option for flood storage upstream of Credenhill on the Yazor Brook	Passed to the NT on the 05.05.09. Copied to Defence Estates and HQ Hereford Garrison on the 21.05.09.
011	EA 'Summary Note' for the Progression of the Credenhill Flood Alleviation Scheme / flood storage option (April 2009)	April 2009		Note issued by the EA summarising their position on the draft design	Received by ESG on the 03.04.09 and copied to Capita Symonds
012	Draft Design Package & Issue Letter	28 th April 2009		The package included the following Design drawings - a full package of draft drawings for planning submission. Design commentary	Original package sent to Mr Charles Pickles, ESG Herefordshire on the 28 th April 2009 by Capita Symonds. Design package sent to Mr David Hughes, National Trust on the 28 th May 2009 by Mr Gerrard Williams, ESG Herefordshire.

**THE COUNTY OF HEREFORDSHIRE DISTRICT COUNCIL
(YAZOR BROOK FLOOD ALLEVIATION SCHEME)
COMPULSORY PURCHASE ORDER 2010**

Public Inquiry August 2010

SUMMARY STATEMENT OF EVIDENCE OF MARC PINNELL

S226 (1) (a) Town and Country Planning Act 1990
S13 Local Government (Miscellaneous Provisions) Act 1976
Acquisition of Land Act 1981

1. INTRODUCTION

1.1 My name is Marc Pinnell. I am a Divisional Director within JBA Consulting. I have specialist knowledge of the investigation and assessment of hydrological and hydraulic systems and am familiar with the institutional and regulatory frameworks pertaining to the water environment.

1.2 Before joining JBA in 2009 I was director of the Flood Risk and Water Management group at Capita Symonds. Whilst in this role I was the Project Director for all work relating to the ESG regeneration project and flood alleviation scheme. This involvement spanned from 2006 to 2009.

1.3 My evidence summarises the requirement for flood risk management to enable development within the ESG area; to identify Government guidance relevant to, and considered during, the selection of a strategic flood management scheme; to outline the processes adopted, and which led to the selection of the Yazor Brook Flood Alleviation Scheme (FAS); and to respond to the objections in relation to the selection of the FAS.

2. THE FLOOD ALLEVIATION WORKS

2.1 The land and rights included within the above Compulsory Purchase Order (CPO) are required to enable delivery of the FAS. The scheme is essential enabling infrastructure for the ESG regeneration project.

3. GUIDANCE RELATING TO THE APPRAISAL OF FLOOD AND COASTAL DEFENCE PROJECTS

3.1 Guidance relating to the appraisal of flood and coastal defence projects is included within Flood and Coastal Defence Project Appraisal Guidance (FCDPAG, May 2001). In June 2009 Defra published its Policy Statement on Appraisal. This Policy Statement replaces the previous policy guidance set out FCDPAG. My evidence details how FCDPAG, current guidance at the time of completing the assessment, has informed the selection of the FAS.

4. YAZOR BROOK FAS SELECTION PROCESS

4.1 The principals and processes of FCDPAG informed the appraisal of the FAS, and key to obtaining funding approval from Advantage West Midlands was the

approval and endorsement of the options appraisal and scheme design by statutory consultees.

- 4.2 An appraisal of a range of options for a strategic flood alleviation scheme was therefore undertaken. That process investigated the feasibility of delivering flood mitigation, in consideration of cost, benefit, engineering constraints, environmental impact, programme and other risk factors that might impact successful delivery, and as a consequence realisation of ESG regeneration.

5. DESCRIPTION OF NEED (DEFINING)

- 5.1 A significant proportion of the ESG site falls within the PPS25 Flood Zone 3B (Functional Floodplain), which is the most severe probability class considered in PPS25. The objective of the flood mitigation scheme is therefore to reduce flooding caused by the 5% and 1% AEP river flood events to a manageable level within the ESG development area.

6. OPTIONS DEVELOPMENT & CONSULTATION (DEVELOPING)

- 6.1 At all stages, ESG and their partners have sought to consult with all statutory bodies and interested parties. The Planning Statement including Statement of Community Involvement (July 2009), submitted with the Planning Application, contains details therefore of the consultation and engagement undertaken.
- 6.2 Specific details of consultations and negotiations with land and property owners, notably the National Trust, relating to the CPO are presented in the evidence of Mr Gerrard Williams, and reference is made where relevant within my evidence.

7. IDENTIFICATION OF OPTIONS

- 7.1 From the preliminary review and consultation, five options (Options A – E) were taken forward to a more detailed options appraisal. These options were:

- Option A - Upstream Off-take into River Wye;
- Option B - Off-take into Sugwas Quarry;
- Option C - Flood Storage at Livestock Market and Other Measures;

- Option D - Flood Storage at the Livestock Market and Adaptive Approach; and
- Option E - Off-take into Canal.

7.2 A number of other options were considered and discounted at an early stage as reported within the Options Appraisal Report.

8. **OPTIONS APPRAISAL (COMPARING)**

8.1 The appraisal of each option considered technical feasibility, economic assessment, environmental appraisal and risk. Quantitative and qualitative assessments were made of each of the options under consideration. My evidence summarises the findings as detailed in the Strategic Flood Mitigation Options Appraisal Report, Final (December 2007).

8.2 The options costing exercise was based on industry standard rates and assumptions. The calculation of flood damages (or scheme benefit) was undertaken using the 'Modelling and Decision Support Framework' (MDSF) and showed the relative merits of each option.

8.3 An initial review of the environmental impacts and consequences of the five options identified that several of the proposed options were likely to require an EIA. Ecological survey work was initiated during the course of the appraisal to support greater consideration of the environmental risks. The options appraisal report concluded that environmental risks would be manageable.

8.4 The assessment looked to identify as many of the risks and constraints relevant to each option as possible. The overall level of risk associated with delivering each option was summarised in the appraisal reports.

9. **OPTION SELECTION**

9.1 The recommendations of the assessment of options were based on consideration of; the strategic reduction of flood risk within the ESG area; the ability of an option to benefit flooding which arises from events more extreme than the design event; environmental appraisal; cost, risk and ESG programme. The assessment concluded that Option A was the most appropriate strategic flood mitigation option.

9.2 In the course of the assessment, the viability of a strategic option based on flood storage in the upper catchment was promoted by the National Trust and their advisors. This resulted in the appraisal of a further strategic flood mitigation option; Option F – Credenhill Flood Storage. The assessment of this option was included within the final appraisal report submitted in support of the planning application and a report of the assessment was issued to the National Trust on 5th May 2009. The findings supported the selection of Option A.

10. DESIGN DEVELOPMENT

10.1 The design process in support of the planning application began in May 2008. Design options, constraints and stakeholder feedback from the options appraisal process were considered. Nineteen design options were tabled by the design team, and of these 7 were progressed for further design consideration.

10.2 The 7 design options were presented to external stakeholders and landowners at the start-up workshops on the 2nd and 3rd of June 2008. These options evolved further, such that the Environmental Statement submitted with the planning application outlined 10 component design options. For ease the Environmental Statement divided the route of the scheme into 3 sectors.

10.2.1 Off-take at Credenhill

10.2.2 Route between off-take and A438

10.2.3 Design south of A438

10.3 Two main options for the off-take were considered by the design team; upstream of Station Road and downstream of Station Road.

10.4 The design requirements of the off-take set the invert levels of the diversion and it was concluded that a culverted diversion would be required for much or all of the routine. This met with the preferences of the affected landowners also. The chosen route was therefore selected on the basis of minimising archaeological impact, length and depth of construction, existing field boundaries and residual flood risk from culvert failure.

- 10.5 South of the A438 the use of the existing gorge down to the Wye, just east of Old Weir Farm, was considered but found to be too unstable and small to accommodate the diversion.
- 10.6 Also considered and discounted was the option of routing the scheme between the gorge and Old Weir Farm. This option provided no clear advantages over a route to the east of the gorge and it increased the construction impacts on the farm and risked ground stability issues in close proximity to the gorge.
- 10.7 This left a route to the east of the gorge that needed to descend a 14m incline to the Wye floodplain. The design team considered a number of buried and above ground options.
- 10.8 Favoured energy dissipation options were sized hydraulically and designed in outline. The two options were presented in the initial design package sent out on the 1st October 2008 to the NT, EA and Herefordshire Council.
- 10.9 The Initial Design Package was also prepared to progress discussion on the options for the outfall into the Wye.
- 10.10 The design of the outfall into the Wye was guided by consultation with the National Trust and the Environment Agency. Within my evidence I describe these discussions and design iterations. The final decision was made that a diffuse flow outfall on to the Wye floodplain would be the preferable solution and taken forward to the planning application.

11. **SUMMARY AND CONCLUSIONS**

- 11.1 A strategic flood mitigation scheme is required to support and realise the regeneration proposals of the ESG Area.
- 11.2 The options appraisal process has identified a scheme that meets the objectives of the regeneration of ESG and the review and approval processes therein.
- 11.3 The assessments justify the selection of Option A – Upstream Off-take into River Wye, as the scheme for the strategic mitigation of flooding within ESG, and the selection of its route, form and character.

12. **STATEMENT OF TRUTH**

- 12.1 I confirm that insofar as the facts stated in this proof are within my own knowledge, I have made clear which they are and I believe them to be true and that the opinions I have expressed represent my true and complete professional opinion.
- 12.2 This Report includes all facts which are regarded as being relevant to the opinion which I have expressed and I have drawn to the attention of the Inspector any matters which would affect the validity of that opinion.
- 12.3 I understand that my overriding duty is to help the inspector and the Secretary of state with matters within my expertise and this duty overrides any obligations to my client. I confirm that I have complied with this duty.

Marc Pinnell

JBA Consulting

14 July 2010