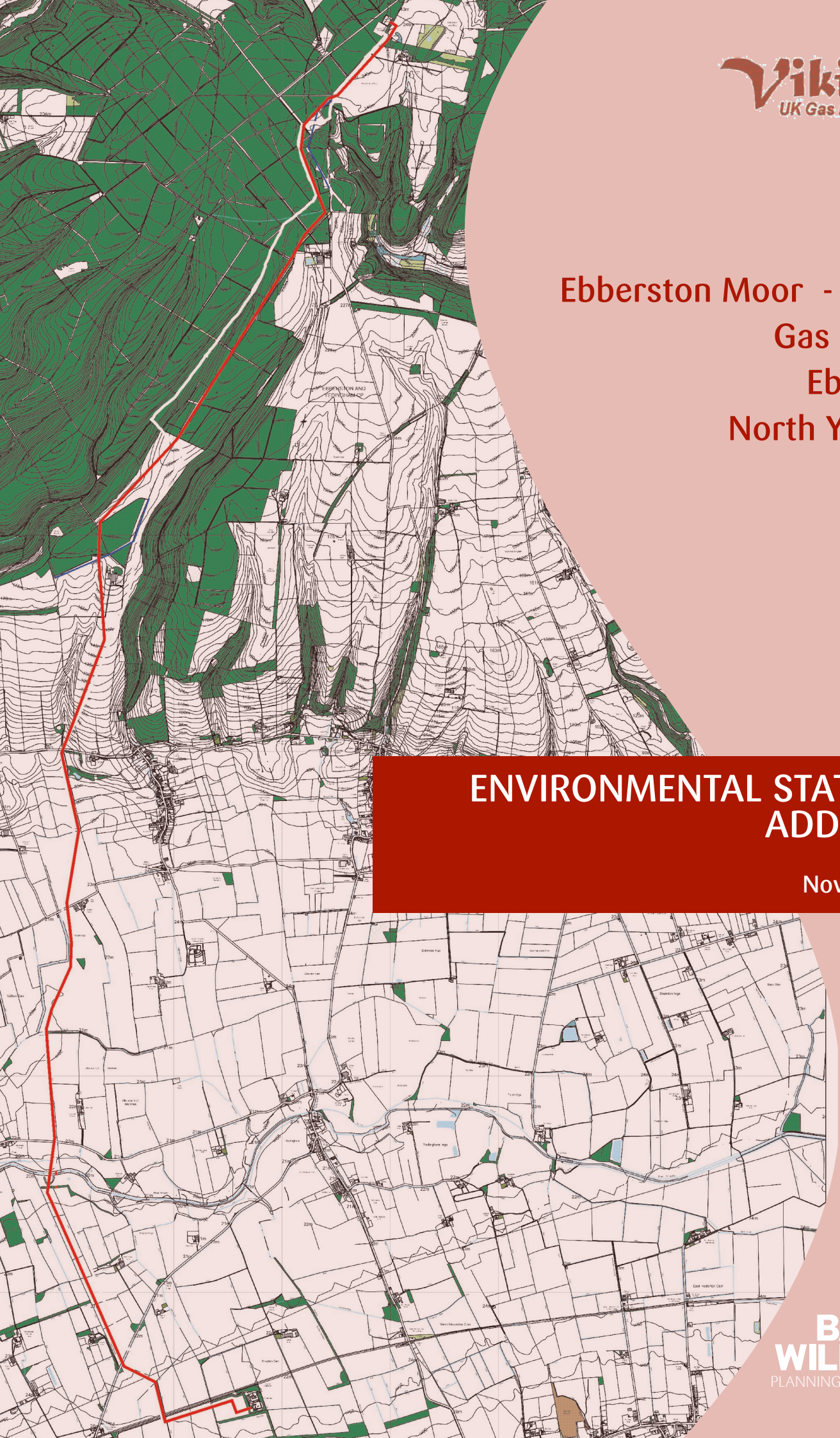

Viking UK Gas Ltd

Ebberston Moor - Knapton Gas Pipeline, Ebberston, North Yorkshire

ENVIRONMENTAL STATEMENT ADDENDUM

November 2013

BARTON WILLMORE
PLANNING/DESIGN/DELIVERY

Ebberston Moor 'A' Well Site to Knapton Pipeline, North Yorkshire

Environmental Statement Addendum

Issue/Revision	Draft	Final
Date	November 2013	November 2013
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Reference	19819/A5/Pipeline ES Addendum 2013	

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Date: November 2013

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A. PREAMBLE

1.1 In August 2013 Viking UK Gas Limited (hereafter referred to as the "Applicant") submitted a planning application (Ref. NYM/2013/0593/EIA) to North York Moors National Park Authority (NYMNPA) and North Yorkshire County Council (NYCC) seeking full planning permission for the exploitation of conventional hydrocarbon resources only, for the production of energy, including: gas production from the existing Ebberston Moor 'A' Well Site; and construction of a 15.3 km long 8" diameter steel underground pipeline from Ebberston Moor 'A' Well Site to Knapton Generating Station (KGS) for the purpose of delivering natural gas and condensate from Ebberston Moor 'A' Well Site to KGS where it will be used as fuel-gas to generate power. These activities are collectively referred to hereafter as the "Proposed Development".

1.2 An Environmental Statement (ES) was prepared to accompany the planning application in accordance with the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (SI 1824) (the "EIA Regulations").

1.3 A number of consultation responses were received following submission of the planning application from various departments within NYMNPA, Yorkshire Water Services, Yorkshire Wildlife Trust, Health and Safety Executive, Allerston and Wilton Parish Council, Ryedale Environmental Health Officer, North Yorkshire Police, Scarborough Fire Station, English Heritage and Moorland Energy Limited.

1.4 At the time of the submission in August 2013, it was made clear in the ES that a separate planning application would be submitted to the NYMNPA at a later date for the injection of produced water into the Sherwood Sandstone. Since that time, the Applicant and its advisers have made considerable progress in agreeing the technical process of water injection with the Environment Agency. Consequently, it is now possible to submit additional information about injection of the produced water into the Sherwood Sandstone within the Planning Application instead of it forming the subject of a separate planning application as discussed originally.

1.5 This document updates the ES to account for the changes to the Proposed Development and the inclusion of additional information as outlined above.

Methodology

1.6 The ES has been updated, where necessary, with respect to the following issues:

- Description of produced water disposal; and
- Assessment of the likely significant effects of the produced water disposal on the environment.

1.7 The following terminology is used throughout the addendum:

- The planning application submitted in August 2013: the "Original Application";
- The proposals assessed by the ES in 2013: the "Proposed Development";
- The site proposed to be developed: the "Assessment Site";
- The ES submitted alongside the planning application in August 2013: the "ES";
- The updated proposals: the "Proposed Development As Amended"; and
- This document, which updates the ES: the "ES Addendum".

1.8 Text added to chapters is indicated by **bold underlining**. Deleted text is identified by strikethrough text as follows: ~~deleted~~. This chapter is entirely new so normal text is used.

Structure of the ES Addendum

1.9 The structure of the ES Addendum and chapter authors is set out in **Table A.1**. The ES Addendum is designed to be read alongside the ES. Chapter numbers correspond to those used in the ES with a new chapter provided to assess the effects of injection of the produced water into the Sherwood Sandstone deep underground. The new chapter is complementary and supplementary to Chapter 12 which provides an assessment of the effects on surface water and groundwater located close to the ground surface.

1.10 Updated chapters and figures from ES Volume 1 and appendices from ES Volume 2 are all contained in the main volume of the ES Addendum. Figures and appendices follow the relevant chapter in the document. Updated references are provided, where required, at the end of the chapters. A Non-Technical Summary Addendum has been submitted as a standalone document and updates Volume 3 Non-Technical Summary of the ES.

Table A.1 Revised ES Structure

ES Chapter	Author	ES Addendum Chapter
N/A	Barton Willmore	Chapter A. Preamble
Chapter 1 Introduction	Barton Willmore	Chapter 1A Introduction
Chapter 2 EIA Methodology	Barton Willmore	Chapter 2A EIA Methodology
Chapter 3 Assessment Site	Barton Willmore	Chapter not updated
Chapter 4 Proposed Development	Barton Willmore	Chapter 4A Proposed Development
Chapter 5 Alternatives and Design Evolution	Barton Willmore	Chapter not updated
Chapter 6 Construction	Barton Willmore	Chapter not updated

ES Chapter	Author	ES Addendum Chapter
Programme		
Chapter 7 Ecology	Barton Willmore	Chapter 7A Ecology
Chapter 8 Landscape & Views	Barton Willmore	Chapter not updated
Chapter 9 Air Quality	URS	Chapter not updated
Chapter 10 Noise	ACIA Engineering Acoustics	Chapter not updated
Chapter 11 Transport	R Elliott Associates Ltd	Chapter not updated
Chapter 12 Flood Risk, Hydrology and Drainage	R Elliott Associates Ltd	Chapter not updated
Chapter 13 Archaeology and Cultural Heritage	Archaeological Project Services	Chapter not updated
Chapter 14 Economics	Barton Willmore	Chapter not updated
Chapter 15 Ground Conditions and Contamination	URS	Chapter not updated
Chapter 16 Summary of Mitigation and Monitoring	Barton Willmore	Chapter 16A Summary of Mitigation and Monitoring
Chapter 17 Statement of Significance	Barton Willmore	Chapter 17A Statement of Significance
N/A	Envireau Water	Chapter 18A Produced Water Disposal

Availability of the ES Addendum

1.11 Additional copies of the ES Addendum are available for viewing by the public during normal office hours in the planning department of NYMNPA. Comments on ES Addendum should be sent to the address below:

North Yorkshire County Council
County Hall
Northallerton
North Yorkshire
DL7 8AH

Tel: 08450 349494
Email: planning.control@northyorks.gov.uk

North York Moors National Park Authority
The Old Vicarage
Bondgate
Helmsley
York
YO62 5BP

Tel: 01439 772700

Email: planning@northyorkmoors.org.uk

1.12 Additional paper copies of the ES Addendum can be purchased at a cost of £75. The Non-Technical Summary can be obtained free of charge. Copies of the ES Addendum and NTS can be obtained on CD for £20. All documents are available from:

Paul Foster
Barton Willmore LLP
St Andrews House
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Tel: 01223 345555

1A.0 INTRODUCTION

1.1 Viking UK Gas Limited (hereafter referred to as the "Applicant") is seeking full planning permission for the exploitation of conventional hydrocarbon resources only, for the production of energy, including: gas production from the existing Ebberston Moor 'A' Well Site; and construction of a 15.3 km long 8" diameter steel underground pipeline from Ebberston Moor 'A' Wellsite to Knapton Generating Station (KGS) for the purpose of delivering natural gas and condensate from Ebberston Moor 'A' Wellsite to KGS where it will be used as fuel-gas to generate power. These activities are collectively referred to hereafter as the "Proposed Development".

1.2 The area within which the Proposed Development will be located is referred to in this Environmental Statement (ES) as the "Assessment Site". The Assessment Site, situated within the administrative areas of North Yorkshire County Council (NYCC) and the North York Moors National Park Authority (NYMNPA), is shown on **Figure 1.1**. The minerals planning authorities (the decision makers) are NYCC and NYMNPA.

Background to the Proposed Development

1.3 The Ebberston Moor gas field (originally called Lockton) was discovered in 1966 and produced gas between May 1971 and 1974. Since the 1970s, further discoveries of gas have been made in the area. Interpretation of seismic data acquired by the Applicant for the fields shows that large areas of gas remain un-tapped, while further studies have improved the understanding of the reservoir's behaviour. New seismic data, acquired by the Applicant in 2012, confirms the extension of the Ebberston Moor gas field eastwards. Additional information about the history of the Ebberston Moor gas field is contained within the Planning Statement.

1.4 Knapton Generating Station (KGS) opened in May 1995. It is located in close proximity to the village of East Knapton and approximately 10 km to the east of Malton. KGS processes gas from the local gas fields including the Vale of Pickering and is used to generate energy that can provide power for the equivalent of up to 40,000 homes when run at capacity.

1.5 Whilst, inevitably, there is still a degree of uncertainty about the scale of recoverable gas reserves, the Applicant wishes to pursue a phased approach to the development of the Ebberston Moor gas field. This phased approach will help to:

- Ensure a clearer understanding of the production performance and recovery from the gas

field;

- Minimise economic risk and mitigate any adverse effects on the local environment; and
- Establish early production.

1.6 Ebberston Moor 'A' Well Site was first approved in 2006 and reprofiled in 2008. A further permission was granted to retain the existing well site in 2011. Temporary planning permission was granted by the NYMNPA on 18 June 2013 to enable the Applicant to drill a sidetrack from the existing well (Ebberston Moor – 1) within Ebberston Moor 'A' Well Site and the drilling of up two additional appraisal boreholes.

1.7 The sidetrack from the existing well will be drilled prior to construction commencing for the Ebberston Moor Early Development Scheme (Ebberston Moor EDS) or this Proposed Development. **The second borehole will be used for injecting the produced water into the Triassic Sherwood Sandstone rock layer beneath the well site**. ~~In addition separate planning permission will be sought to use the existing well cellar to drill a borehole for water disposal use, if required at a later date. The use of the borehole through the existing cellar will not be assessed further as part of this ES.~~

1.8 The initial phase of development or Ebberston Moor EDS forms a separate planning application (ref: NYM/2013/0477/EIA) and involves the exploitation of conventional hydrocarbon resources only, for an operational period of up to five years, including: gas production from Ebberston Moor – 1 Well at the existing Ebberston Moor 'A' Well Site; piping the produced gas to the adjoining Lockton Compound where the gas would be conditioned; injecting the conditioned gas via an existing Above Ground Installation (AGI) connection to a Northern Gas Network (NGN) pipeline that runs between Pickering and Whitby; and creation of two new access points off Ebberston Common Lane. If planning permission is granted in 2013, it is assumed that construction of the Ebberston Moor EDS will commence in January 2014, with gas production commencing after July 2014. The operational life of the Ebberston Moor EDS is anticipated to be up to five years. The aim of the Ebberston Moor EDS is to enable medium term production performance of the Ebberston Moor gas reservoir to be assessed, with the aim of proving reservoir volumes sufficient to support investment in future field development.

1.9 This planning application seeks permission for the second phase of the Ebberston Moor gas field development which is anticipated to be carried out after the Ebberston Moor EDS (or instead of the Ebberston Moor EDS if planning permission for the Ebberston Moor is not granted) on condition that reservoir volumes are assessed to be sufficient to support investment in future development of Ebberston Moor gas field. The Proposed Development aims to carry out the following activities:

- Gas production at Ebberston Moor 'A' Well Site; and
- Construction of one 8" diameter steel underground pipeline from the existing Ebberston Moor 'A' Well Site to deliver gas and associated liquids to the KGS at East Knapton where the natural gas will be used as fuel-gas to generate power

Environmental Impact Assessment

1.10 The Proposed Development falls within Schedule 2,2, (e) and Schedule 2, 10, (k) Section of the Town and Country Planning (Environmental Impact Assessment) (England) Regulations 2011 (SI 1824) (the "EIA Regulations") (Ref. 1.1) as it involves a surface industrial installation for the extraction of natural gas where the area of the development exceeds 0.5 hectares and a pipeline for the transport of gas.

1.11 A screening opinion was sought from NYCC and NYMNPA in November 2011 in accordance with the EIA Regulations and Section B of the Planning Practice Guidance of Onshore Oil and Gas (DCLG, July 2013) (Ref. 1.2). The screening opinion adopted by NYCC and NYMNPA regarded the proposal submitted in 2011 to be a Schedule 1 Development under the EIA Regulations (Ref. 1.1) as discussed in **Appendix 1.1**. However modifications to the design of the Proposed Development since the adoption of the screening opinion means that the Proposed Development now falls within Schedule 2 of the EIA Regulations instead of Schedule 1. Even with the modifications since 2011, the Proposed Development is still considered to have the potential to have significant environmental effects and therefore the Applicant has submitted an ES in support of the planning application. The modifications are discussed in more detail in Chapter 2 of this ES.

1.12 EIA is the process of collection, publication and consideration of environmental information in the determination of a planning application. Consequently information on the likely significant effects of the Proposed Development has been gathered and is presented in this document, the ES. The ES will inform decision-makers (in this case NYCC and NYMNPA) of the likely significant environmental effects of the Proposed Development during construction, operation, decommissioning and restoration. It also identifies mitigation measures to prevent, reduce and offset any significant adverse effects on the environment.

Planning Policy

1.13 The EIA Regulations (Ref. 1.1) do not require assessment of planning policy or guidance; however, where appropriate, national and development plan document policies of relevance have been considered within the technical chapters of this ES.

ES Structure

1.5 The EIA Regulations (Reg. 2 (1)) identify a requirement for an applicant to include within an ES:

> ***"...such of the information referred to in Part 1 of Schedule 4 as is reasonably required to assess the environmental effects of the development and which the applicant can, having regard in particular to current knowledge and methods of assessment, reasonably be required to compile."***

1.6 An outline of this information in respect of the Proposed Development and where it can be found in the ES is presented in **Table 1.1**.

Table 1.1: Location of Information within the ES Required by Part 1 and Part 2 of the EIA Regulations

Specified Information		Location within ES
1	Description of the development, including in particular –	
(a)	a description of the physical characteristics of the whole development and the land-use requirements during the construction and operational phases.	Chapter 4 (The Proposed Development), Chapter 6 (Construction Programme)
(b)	a description of the main characteristics of the production processes, for instance, nature and quantity of materials used.	Chapter 4 (The Proposed Development), Chapter 6 (Construction Programme)
(c)	an estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed development.	All technical chapters (7-15)
2	An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for its choice, taking into account the environmental effects.	Chapter 5 (Alternatives and Design Evolution)
3	A description of the aspects of the environment likely to be significantly affected by the development, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and inter-relationship between the above factors.	All technical chapters (7-15)
4	A description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development, resulting from:	
(a)	the existence of the development;	All technical chapters (7-15) and summarised in chapter 17 (Statement of Significance)

Specified Information		Location within ES
(b)	the use of natural resources;	Chapter 12 (Flood Risk, Hydrology and Drainage)
(c)	the emission of pollutants, the creation of nuisances and the elimination of waste; and	Chapter 9 (Air Quality), Chapter 10 (Noise), Chapter 12 (Flood Risk, Hydrology and Drainage).
d)	the description by the Applicant of the forecasting methods used to assess the effects on the environment.	Chapter 2 (EIA Methodology) and all technical chapters (7 – 15) where appropriate
5	A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.	All technical chapters (7 - 15)
6	A non-technical summary of the information provided under paragraphs 1 to 5 of this Part.	Non Technical Summary (provided as a separate document)
7	An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the applicant in compiling the required information.	Chapter 2 (EIA Methodology) and in technical chapters where appropriate

1.7 The ES comprises three separate volumes, namely:

- The ES Main Text: The full text of the ES which comprises a total of 17 chapters, illustrated throughout by tables and figures;
- The ES Technical Appendices: A complete set of the technical documents undertaken as part of, or in support of, the ES. The technical appendices are provided in a separate volume to limit the size of the ES main text; and
- The Non-Technical Summary (NTS): The NTS provides a concise and straightforward summary of the Proposed Development, its likely significant environmental effects and the measures proposed to mitigate or to avoid these effects.

EIA Team

1.8 The ES has been coordinated by Barton Willmore LLP and presents the results of technical studies carried out in conjunction with a number of specialist consultants appointed by the Applicant. The EIA team is listed in **Table 1.2** along with their respective disciplines and contributions to the ES.

Table 1.2: EIA Team

Organisation	Expertise/EIA Input
Viking Gas UK Ltd	Description of the Proposed Development; and Description of the Alternatives.
Barton Willmore LLP	Town Planning; EIA Coordination; Landscape and Views; and Economic Assessment.
URS Scott Wilson	Ecology and Nature Conservation; Air Quality; and

Organisation	Expertise/EIA Input
	Ground Conditions and Contamination
Archaeological Project Services	Archaeology and Cultural Heritage
Acia Engineering Acoustics	Noise
R Elliott Associates	Transport; and Flood Risk, Hydrology and Drainage
Envireau Water	Produced Water Disposal

Other Documents

1.9 A number of other documents have been submitted to NYCC and NYMNPA as part of, or accompanying, the planning application, including:

- Planning and Sustainability Statement;
- Statement of Community Involvement;
- Design and Access Statement;
- Outline Safety Report; and
- Validation Checklist.

ES Availability and Comments

1.10 Paper copies of the ES and the Technical Appendices can be purchased at a cost of £100 and £300 respectively. The Non-Technical Summary can be obtained free of charge. Copies of the ES, Technical Appendices and NTS can be obtained on CD for £20. All documents are available from:

Paul Foster
Barton Willmore
Elizabeth House
1 High Street
Chesterton
Cambridge, CB4 1WB.

Tel: 01223 345555

1.11 Additional copies of this ES are also available for viewing by the public during normal office hours in the planning departments of NYCC and NYMNPA. Comments on the planning application should be forwarded to Alan Goforth at NYCC and Mark Hill at NYMNPA at the addresses below:

North Yorkshire County Council
County Hall
Northallerton
North Yorkshire, DL7 8AH
Tel: 08450 349494

Email: planning.control@northyorks.gov.uk

North York Moors National Park Authority
The Old Vicarage
Bondgate
Helmsley
York, YO62 5BP

Tel: 01439 772700
Email: planning@northyorkmoors.org.uk

2A.0 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

Introduction

2.1 This chapter explains the EIA methodology. In particular, it details the process of identifying and assessing the likely significant environmental effects of the Proposed Development.

General Approach

2.2 The ES has been prepared in accordance with the EIA Regulations (Ref. 2.1) which implement European Council Directive 2011/92/EU (codified Directive on EIA) (Ref. 2.2). Reference has also been made to currently available good practice guidance on EIA including:

- Environmental Impact Assessment – A Guide to Procedures, Department of the Environment, Transport and Regions (DETR) 2000 (Ref. 2.3);
- Environmental Impact Assessment, DETR Circular 02/99 (Ref. 2.4);
- Guidelines for Environmental Impact Assessment, Institute of Environmental Management and Assessment (IEMA) 2004 (Ref. 2.5);
- Amended Circular on Environmental Impact Assessment – A Consultation Paper, Department for Communities and Local Government (DCLG) (June 2006) (Ref. 2.6);
- Environmental Impact Assessment: A Guide to Good Practice and Procedures, A Consultation Paper, DCLG (June 2006) (Ref. 2.7); and
- Office for the Official Publications of the European Communities (1999) Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions, Luxemburg (Ref. 2.8).

Scoping

2.3 Scoping involves focusing the content of the ES on those issues of greatest potential significance. It is an important tool for identifying the likely significant effects of a proposed development through its design, construction, operation and decommissioning and restoration phases and ensures that appropriate mitigation options are considered, where necessary.

2.4 A request for an EIA Scoping Opinion (**Appendix 2.1**) was submitted to NYCC on 6th February 2012 and the NYMNPA on 21st March 2012 (**Appendix 2.1**) in accordance with Regulation 13 of the EIA Regulations and Planning Policy Guidance of Onshore Oil and Gas

(DCLG, July 2013) (Ref. 2.9). The scoping requests considered that the following environmental issues should be addressed in detail in the ES:

- Ecology;
- Landscape and Views;
- Air Quality;
- Noise and Vibration;
- Transport;
- Flood Risk, Hydrology and Drainage;
- Archaeology and Cultural Heritage;
- Socio Economics; and
- Ground Conditions and Contamination.

2.5 NYCC adopted a Scoping Opinion (attached at **Appendix 2.1**) on 2nd July 2012; and NYMNPA adopted a Scoping Opinion on 13th April 2012, both of which generally agreed with the scope set out above (**Appendix 2.1**). A table setting out the issues raised in the Scoping Opinions and how these have been addressed within the ES is provided in **Appendix 2.2**.

2.6 Since the adoption of the Scoping Opinions, there have been design modifications to the Proposed Development. Modifications include:

- Producing gas from Ebberston Moor 'A' Well Site rather than from several well sites in the Ebberston Moor and Lockton areas;
- Construction of one pipeline to transport gas and condensate between Ebberston Moor 'A' Well Site and KGS rather than two pipelines to transport the gas and condensate separately;
- Use of gas at KGS to produce energy rather than conditioning the gas at the KGS and then feeding the conditioned gas into the National Transmission System (NTS) pipeline;
- Existing facilities will be used at the KGS for using the gas rather than introducing new facilities to condition the gas prior to feeding it into the NTS; and
- No Above Ground Installation (AGI) will be constructed as part of this planning application to allow connection into the existing NTS pipeline.

2.7 These modifications have not affected the scope of the ES in terms of the environmental issues to be assessed.

Consultation Process

Consultees

2.8 The following organisations were approached as part of the EIA process to identify baseline information and to enable the Proposed Development to be refined in relation to environmental issues raised, where appropriate:

- NYCC (various departments);
- NYMNPA (various departments);
- English Heritage;
- Ryedale District Council (RDC) Environmental Health Officers;
- Environment Agency;
- Natural England;
- Yorkshire Wildlife Trust; and
- Yorkshire Water.

Public Exhibition

2.9 The Applicant carried out public exhibitions on 18th July in Allerston Village Hall and 19th July in the Church Room, Rillington. The exhibitions described the nature and purpose of the Proposed Development. Leaflets advertising the exhibition were posted prior to the public exhibition to local households and businesses, posters were place on notices boards and other prominent places in the local area and an advertisement was placed in the local media. The issues raised at the public exhibitions and responses, together with the design evolution, are discussed in the Statement of Community Involvement submitted in support of the planning application. Involvement with the local community will continue throughout the planning process.

Assessment Methodology

2.10 The EIA Regulations (Ref. 2.1) stipulate that an ES should, where possible, identify, describe and assess the likely significant effects of a development on the environment. Therefore, this ES identifies and assesses the likely significant effects of the Proposed Development in relation to construction, operation, and decommissioning and restoration phases. Environmental effects have been evaluated with reference to definitive standards and legislation where available. Where it has not been possible to quantify effects, qualitative assessments have been carried out, based on available knowledge and professional

judgement. Where uncertainty exists, this has been noted in the relevant assessment chapter.

Determining Significance

2.11 Guidance on significance has been mainly of a generic nature (e.g. DETR Circular 02/99 (Ref. 2.4) and DCLG draft Amended EIA Circular (Ref. 2.6)), and practitioners have been obliged to develop definitions for specific topics and projects. It is broadly accepted, however, that significance reflects the relationship between two factors:

- The sensitivity, importance or value of the affected resource or receptor; and
- The magnitude or severity of an effect (i.e. the actual change taking place to the environment).

2.12 The sensitivity, importance or value of the resource or receptor is normally derived from:

- Legislative controls;
- Designated status within the land use planning system;
- The number of individual receptors such as residents;
- An empirical assessment on the basis of characteristics such as rarity or condition; and
- Ability of the receptor to absorb change.

2.13 The magnitude of an effect is often quantifiable in terms of, for example, extent of land take or predicted change in noise levels.

2.14 Determination of significance also includes consideration of:

- Extent and magnitude of the effect;
- Type of effect (beneficial or adverse);
- Duration of effect (whether short, medium or long term; permanent or temporary);
- Nature of effect (whether direct or indirect, reversible or irreversible);
- Whether the effect occurs in isolation, is cumulative or interactive;
- Performance against environmental quality standards or other relevant pollution control thresholds; and
- Compatibility with environmental policies.

2.15 Significant effects occur where valuable or sensitive resources, or numerous receptors, are subject to effects of considerable magnitude. Effects are unlikely to be significant where low

value or non-sensitive resources, or a small number of receptors, are subject to minor effects. Allocation of significant effects in intermediate situations will be a matter for professional judgement in each topic area.

2.16 Where an effect is considered to be significant, this significance will generally be classified as major, moderate or minor (with these descriptions again being based on precedent or current guidance). Within this ES, the significance matrix in **Table 2.1** has been used to define the level of significance of effects. In some cases analogous matrices for the various specialist topics are used, and where these use different assessment criteria this is clearly stated within the relevant chapter.

Table 2.1: Significance Matrix

Sensitivity /Value of Receptor	Magnitude of Effect		
	High	**Medium**	**Low**
High (England, UK, International)	Major	Major/Moderate	Moderate
Medium (County, Regional)	Major/Moderate	Moderate	Moderate/Minor
Low (Local, Borough)	Moderate	Moderate/Minor	Minor

2.17 The three levels of significance defined by the generic matrix are:

- Major – an effect which in isolation could have a material influence on the decision making process;
- Moderate – an effect which on its own could have moderate influence on decision making, particularly when combined with other similar effects; or
- Minor – an effect which on its own is likely to have a minor influence only on decision making but when combined with other effects could have a more material influence.

2.18 Effects are also described as:

- Adverse – detrimental or negative effects to an environmental resource or receptor; or
- Beneficial – advantageous or positive effect to an environmental resource or receptor.

2.19 Where an effect is considered to be not significant or have no influence, irrespective of other effects, this is classified as "negligible".

2.20 Each of the technical chapters or accompanying technical appendices provides the criteria, including sources and justifications, for quantifying the different levels of effect. Where possible, this has been based upon quantitative and accepted criteria, together with the use

of value judgements and expert interpretations to establish to what extent an effect is likely to be environmentally significant.

2.21 In the context of the Proposed Development, short to medium term temporary effects are considered to be those associated with construction, and long term or permanent effects are those associated with the operation or decommission/restoration of the Proposed Development.

2.22 Local effects are those on receptors in and around the Assessment Site, while effects upon receptors in Ryedale District and the North York Moors National Park are considered to be at a District or National Park Authority level. Effects on North Yorkshire and the North East region are considered to be at a County and Regional level respectively, whilst effects on England are considered to be at an England level and national effects are considered to be at a UK level. No effects have been identified at an international level.

Cumulative and Interactive Effects

Cumulative Effects

2.23 A requirement of the EIA Regulations is to assess cumulative effects as part of the EIA. Cumulative effects are generally considered to arise from the combination of effects from the Proposed Development and from other proposed or permitted schemes in the vicinity, acting together to generate elevated levels of effects. Circular 02/99 (Ref. 2.4) identifies that:

> ***"in judging whether the effects of a development are likely to be significant, local planning authorities should always have regard to the possible cumulative effects with any existing or approved development..."***

2.24 The schemes that have been covered as part of the cumulative effects assessment are set out in **Table 2.2** and shown on **Figure 2.1**.

Table 2.2: Cumulative Schemes

Scheme	Description
Ryedale Gas Project (NY/2010/0159/ENV)	The Ryedale Gas Project includes five principal elements: • Gas production from the existing Ebberston South Well Site: • The construction of two underground pipelines from the existing Ebberston Well Site to a new Gas Processing Facility; • A new access road between the A170 and the proposed Gas Processing Facility; • A Gas Processing Facility at Hurrell Lane, Thornton-le-Dale; and • An Above Ground Installation (AGI) connection into the existing National Transmission System (NTS) pipeline to the south of the

Scheme	Description
	Gas Processing Facility on land off New Ings Lane.
Ebberston Moor Early Development Scheme (EDS) (NYM/2013/0477/EIA)	Ebberston Moor EDS planning application was submitted in July 2013 and therefore planning permission has not been granted at the time of submitting the planning application for this Proposed Development (i.e. Ebberston Moor 'A' Well Site to Knapton Gas Pipeline). The project comprises the exploitation of conventional hydrocarbon resources only, for an operational period of up to five years, including: • Gas production from one wellhead at the existing Ebberston Moor 'A' Well Site; • Piping the produced gas to the adjoining Lockton Compound where the gas would be conditioned; • Injecting the conditioned gas via an existing Above Ground Installation (AGI) connection to a Northern Gas Network (NGN) pipeline that runs between Pickering and Whitby; and • Creation of two new access points off Ebberston Common Lane. If the Ebberston Moor EDS is granted planning permission and is operational prior to this Proposed Development (Ebberston Moor 'A' Well Site to Knapton Gas Pipeline) then the scheme will be in operation during the construction of the pipeline and will be considered as a cumulative development. Once the pipeline is operational the Ebberston Moor EDS facilities on the well site will remain and be connected to the pipeline as part of this Proposed Development while the gas conditioning facilities on the Lockton Compound and the flare will be decommissioned and restored to their existing condition and will be assessed in conjunction with this Proposed Development as cumulative effects. If the Ebberston Moor EDS is not granted planning permission or is not operational prior to construction of this Proposed Development, then the Ebberston Moor EDS will not be considered as a cumulative development and is not assessed during this scenario (see Chapter 3 and 4 for more details on the different development scenarios).

2.25 Each of the technical assessments take into account the likely significant cumulative effects of the Proposed Development with the Ryedale Gas Project in accordance with the significance matrix set out in **Table 2.2**. The level of detail of assessment has been dependent on the information available for each scheme and has generally been undertaken in a qualitative manner. Where no cumulative effects are predicted, this has also been stated.

Interactive Effects

2.26 Interactive effects are also considered in the ES. Interactive effects arise where effects from one environmental element bring about changes in another environmental element. These effects are also reviewed in each of the technical chapters of this ES. Examples of the main potential types of interactive effects are as follows:

- Effects of traffic on noise;
- Effects of traffic on air quality;
- Effects of water discharges on ecology; and
- Effects of landscaping on ecology.

Structure of Technical Chapters

2.27 Through the EIA process, the likely significant environmental effects of the Proposed Development will be assessed. Each key environmental topic has been assigned a separate chapter (in no particular order) in the ES (Chapters 7 - 15), and within each of these chapters the information that will inform the EIA process has been set out in the following way:

- **Introduction** – a brief summary of what is considered in the chapter;
- **Planning Policy Context** – a review of relevant National and Development Plan Document (DPD) policies related to the technical issues;
- **Assessment Methodology** – an outline of the methods used to undertake the technical studies with reference to legislation, published standards, guidelines, best practice and any relevant significance criteria;
- **Baseline Conditions** – a description of the environmental conditions against which the likely significant environmental effects of the Proposed Development have been assessed;
- **Likely Significant Effects** – identification and assessment of the likely significant environmental effects of the Proposed Development during construction, operation and decommissioning and restoration;
- **Mitigation Measures** – development of measures to avoid, offset or reduce the significant adverse effects of a project. These measures can relate to any of the phases of the project: design, construction, operation, decommissioning and restoration. Where any significant adverse environmental effects have been identified, a commitment is made by the Applicant to implement mitigation measures;
- **Residual Effects** – identification of the remaining effects of the Proposed Development, assuming implementation of available mitigation measures, and includes an assessment of the significance of those effects in accordance with the criteria set out in paragraphs 2.19 – 2.20; and
- **Summary** – a summary of the key finding of the ES chapter.

Assumptions and Limitations

2.28 The principal assumptions that have been made and any limitations that have been identified, in preparing this ES are set out below. Assumptions relevant to specific topics have been made in the appropriate chapter:

- All of the principal existing land uses adjoining the Assessment Site remain;
- Information received by third parties is complete and up to date;
- The design, construction, operation, decommission and restoration phases of the Proposed Development will satisfy minimum environmental standards, consistent with contemporary legislation, practice and knowledge;
- It is expected that construction will commence in 2015 (subject to gaining planning permission) and is scheduled for completion in 2016;
- Significant environmental effects have been assessed using the design of the Proposed Development;
- Conditions will be attached to the planning permission that will control any disturbance during construction works;
- Necessary off-site services infrastructure will be provided by statutory undertakers;
- The planning permission, when granted, will contain conditions that will be sufficient to limit the development to that which has been assessed in the EIA;
- The sidetrack from the existing borehole permitted under NYM/2013/0068/FL will be drilled prior to construction of the Proposed Development;~~. Any future drilling other than that included within this existing planning permission will be assessed as part of a separate planning application and therefore is not covered in this ES;~~
- **The second borehole permitted under NYM/2013/0068/FL will be drilled from the existing well cellar for water disposal use; and** ~~Separate planning permission will be sought to use the existing well cellar to drill a borehole for water disposal use, if required at a later date; and~~
- Any future **drilling or** development of the Ebberston Moor 'A' Well Site or Lockton Compound after operation of the Proposed Development will be determined through a separate planning application ~~and will not be assessed within this ES~~. **Future proposals would be subject to EIA if required. The ES and ES Addendum assesses all likely significant effects of the Proposed Development on the environment and do not consider any potential future proposals.**

4A.0 THE PROPOSED DEVELOPMENT

Introduction

4.1 The Proposed Development, as the second phase of the development of the Ebberston Moor gas field as described in Chapter 1, aims to carry out the following activities as shown on **Figure 4.1** and **Figure 4.2**:

- Gas production from the Ebberston Moor 'A' Well Site; and
- Construction of an 8" (200 mm) diameter steel underground pipeline from the existing Ebberston Moor 'A' Well Site to deliver natural gas and condensate to the KGS at East Knapton where it will be used to produce energy.

4.2 The proposed construction sequence and programme of works are outlined in Chapter 6. The current project schedule for the Proposed Development anticipates planning and field development approval in 2013, construction commencing in 2015 and transfer of gas via the pipeline between Ebberston Moor 'A' Well Site and KGS commencing in 2016. The gas production associated with the Proposed Development is expected to be up to 15 years duration.

4.3 If, as the Applicant anticipates, the initial phase of development of the Ebberston Moor gas field (Ebberston Moor EDS) is constructed and operational prior to this Proposed Development (in 2014), the structures and equipment on the Ebberston Moor 'A' Well Site will already be in place as shown in **Figure 3.2** and therefore only the pipeline and its connections to the well site and KGS will need to be constructed as part of this Proposed Development. The flare and Lockton Compound will have been decommissioned and restored as part of the Ebberston Moor EDS project and will only be considered in terms of cumulative effects as part of this ES as discussed in Chapter 2.

4.4 However, if the Ebberston Moor EDS is not granted planning permission, and is not operational prior to construction of this Proposed Development, all the structures and equipment for this Proposed Development required at the well site as well as the pipeline will be constructed. This will occur once the 'sidetrack' to Ebberston Moor – 1 well has been drilled under planning permission NYM/2013/0068/FL. The construction activities associated with gas production at the well site and constructing the pipeline are discussed further in Chapter 6.

Description of the Proposed Development

Ebberston Moor 'A' Well Site

4.5 The Ebberston Moor 'A' Well Site lies within the Parish of Allerston at the edge of the Dalby Forest approximately 6.5 km to the north of Ebberston.

4.6 The existing well site will be developed to allow for gas production as shown in **Figure 4.1**. It is anticipated that the volume of gas to be produced will be up to 15 million standard cubic feet per day (mmscf/d). In order to facilitate the construction and development of the Proposed Development, the following facilities listed below will be required:

- Construction compound;
- Lay down area for pipes;
- Workforce facilities – messing catering and offices;
- Security cabin;
- Parking spaces;
- Potable water tank; and
- 1 MW natural gas fuelled electric generator.

4.7 The main equipment at Ebberston Moor 'A' Well Site will include:

- Gas well;
- Water disposal well;
- Site office;
- Fire water tank (50 cubic metres);
- Pipeline pig trap area;
- Water separator building;
- Gas fired heater;
- Water storage tank; and
- 1 MW natural gas fuelled electric generator.

4.8 All storage tanks, loading and unloading areas will be sited on an impermeable and curbed surface with suitable drains, catchment and hydrocarbon separation equipment. A specially designed interceptor will be provided to clean rain and surface water within the site drains before leaving the well site through the soakaway.

4.9 Electrical distribution, control, shutdown systems, telecommunications, instrument air and

wellhead hydraulic control panel will be housed within the site office (normally unmanned).

4.10 The gas, produced water and condensate will flow from the well head on the Ebberston Moor – 1 well through a flow line, into the three phase separator. The inlet separator will operate at the pipeline pressure with the rate of flow limited by the energy generating capacity at KGS. The three-phase wellhead separator will then separate the gas and condensate from the produced water, before transfer of the gas and condensate along the pipeline to the KGS. The wellhead pressure will provide the driving force for the liquid and gas flow. Pig launchers will allow the pipeline to be inspected and/maintained but will not be used during normal operation.

4.11 Methanol will be stored in the well site storage tank and will be injected by pump immediately downstream of the wellhead and upstream of the choke valve to reduce hydrate formation. In addition a corrosion inhibitor will be injected at the wellhead.

4.12 The Proposed Development will be monitored by a System Control and Data Acquisition (SCADA) system and safety systems will be remotely operated via a telephone or satellite link to KGS. The operation of the Proposed Development will be carried out by the KGS management team as it will be remotely operated with operators available at KGS to respond to alarms and to carry out routine inspection and maintenance.

Produced Water Disposal

4.13 Any water produced during the production of gas will be disposed of via a water disposal well within the well site. Planning permission **(NYM/2013/0068/FL)** has already been granted for two gas appraisal wells and it is intended that one of the wells will be used for **injecting the produced water into the Triassic Sherwood Sandstone rock layer beneath the well site. The produced water injection will be achieved by low pressure injection from the surface with the hydrostatic pressure of the water column assisting the water injection process. Injection is anticipated to be at a rate of 1900 m^3 throughout the operational phase of the Proposed Development. This will take place via a well, constructed for the purpose into the Sherwood Sandstone formation. The well will be cased and grouted to the injection zone and injection will take place in either an open hole or through a perforated section, depending on the stability of the borehole wall.** ~~water disposal. Therefore separate planning permission will be sought to use the existing well cellar to drill a borehole for water disposal use, if required at a later date. The use of the borehole through the existing cellar will not be assessed further as part of this ES.~~

Heights of Buildings and Structures at Ebberston Moor 'A' Well Site

4.14 **Table 4.1** provides the approximate heights of the tallest structures on the well site.

Table 4.1: Approximate Heights of Structures/Buildings

Structure/Buildings	Height (m)
Inlet separator	1.8m
Gas fired heater	1.8m
Water storage tank	4.8m
Site Office (to apex)	3.5m

Pipeline from Ebberston Moor 'A' Well Site to KGS

4.15 The length of the pipeline route is 15.3 km. Therefore, the Proposed Development lies outside the remit of the National Infrastructure Directorate of the Planning Inspectorate which deals with nationally significant infrastructure projects including cross-country pipelines (that is, 16 km or more in length) (Schedule 21 of the Planning Act 2008) (Ref. 4.1).

4.16 One underground 8" diameter pipeline will be constructed from Ebberston Moor 'A' Well Site to KGS to transport gas and hydrocarbon condensate. The pipeline will be accompanied by a fibre optic cable within the construction working width. The construction working width will be 30m across as shown on **Figure 4.2**. A typical cross-section for the pipeline is shown on **Figure 4.3**.

4.17 Once construction has been completed, a 10m easement will be maintained during the operational lifetime of the proposed pipeline for maintenance purposes.

KGS

4.18 The gas and condensate will be separated after arriving at KGS using existing facilities at the KGS. The gas will be used as fuel-gas to generate power while the condensate will be collected and then transported off site by tanker for appropriate disposal.

Access

4.19 Access to Ebberston Moor 'A' Well Site is from the A170 via Ebberston Lane and Ebberston Common Lane. No unauthorised vehicles associated with the Proposed Development will use the Dalby Forest Drive. Ebberston Common Lane and Ebberston Lane are unclassified roads

with passing places. Approximately 100m north of Givendale Head Farm, Ebberston Common Lane becomes an unimproved public highway (gravel track). There is already an established access using this route to Ebberston Moor 'A' Well Site and the adjacent Northern Gas Networks (NGN) Lockton Compound.

4.20 Access to the pipeline route is from the local road network including: A170; B1415 Penniston Lane; Allerston Lane; Marishes Lane and B1258 Malton Road where the pipeline route crosses these roads.

Parking

4.21 Eighteen car parking spaces are already provided at Ebberston Moor 'A' Well Site which will be retained and used during the Proposed Development. There will be no car parking spaces available along the pipeline route.

Landscaping

4.22 The landscape strategy for the Proposed Development has been designed with particular consideration to the topography, landscape and ecological constraints and opportunities identified on the Assessment Site. Landscaping works will involve some ground modelling works associated with careful felling of woodland. Elsewhere within the Assessment Site, works will include soil preparation, tree and vegetation planting and seeding once the pipeline has been constructed. The existing screening along the frontage with the Ebberston Common Lane will be retained and enhanced where possible.

Sustainable Drainage Measures

4.23 Sustainable Drainage Systems (SuDS) will be used to reduce flood risk, improve water quality, assist groundwater recharge whilst also providing amenity and wildlife benefits.

4.24 The existing drainage system at Ebberston Moor 'A' Well Site and Lockton Compound will be upgraded to ensure that the Assessment Site is capable of safely containing, separating and disposing of both rainwater and any fluid spills from the tanks and piping. A closed drain system will recover and store any liquids drained from the process equipment, which will be disposed of in an approved manner. Surface water site drains will be sent to a receiving interceptor and then routed to a clean water discharge point. See Chapter 12 for more details.

4.25 Along the northern extent of the pipeline route between the well site and the A170 drainage will be reliant on the natural drainage of the land with the majority of surface water infiltrating into the ground. In contrast south of the A170 where the ground is impermeable, existing field drains will be modified to ensure that drainage of the fields remains unaffected by the presence of the pipeline. There will be no modifications to the drainage at KGS.

Utilities

4.26 The Proposed Development will connect into the existing telephone network in close proximity to Ebberston Moor 'A' Well Site, with new infrastructure installed beneath roads, and verges wherever possible. Electric power will be generated on the well site by a 1 MW natural gas fuelled engine driven generator. Use of natural gas as fuel instead of diesel for power generation reduces the carbon footprint of the Proposed Development. Natural gas will also be used on the well site to fuel a heater to keep the gas from forming hydrates in the plant inlet.

Lighting

4.27 The facility will not be lit at night except in emergencies or for urgent maintenance and therefore has not been described or discussed further in this ES.

Waste Management

4.28 The Proposed Development will provide an appropriate plan and facilities for the efficient collection, storage and transport of waste to an approved and licensed waste company for recycling or disposal. Adequate space for refuse for storage and collection will be provided within the Proposed Development as required by NYCC, NYMNPA and RDC.

16A.0 SUMMARY OF MITIGATION AND MONITORING

Introduction

16.1 This chapter of the ES presents a summary of the mitigation and monitoring measures identified by the specialist environmental studies in the ES. Full details can be found in the respective ES chapters.

16.2 Schedule 4, part 1 of the EIA Regulations (Ref. 16.1) require an ES to include:

> ***"...a description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment."***

16.3 The mitigation and enhancement measures included in this ES fall into one of four categories:

1) Measures to be incorporated into the detailed design;
2) Measures to be applied during construction; and
3) Measures to be applied during operation of the Proposed Development; and
4) Measures to be applied during decommissioning and restoration.

16.4 **Table 16.1** outlines a topic by topic summary of the key issues addressed by the ES and the mitigation measures identified. The mitigation measures are separated into the above categories.

Implementation of Mitigation Measures

16.5 The Applicants anticipate that, where appropriate, NYMNPA and/or NYCC will attach conditions on the planning permission to ensure commitment to these mitigation measures.

Review Procedure

16.6 The construction programme is expected to take place during 2015 and 2016, subject to gaining planning permission. It is recognised that environmental standards and legislation that currently apply to the Proposed Development may change during this period. In light of this, the Applicants intend to undertake regular reviews of the Proposed Development, to ensure that best practice is being followed. The review process will be iterative and ongoing,

so that new information is identified at an early stage and incorporated into the Proposed Development.

16.7 Construction techniques will be incorporated into the works which, where practicable, will be updated when new techniques are devised. This will also apply to monitoring of the works, ensuring that effective mitigation measures are used to minimise disturbance to surrounding receptors.

16.8 The Applicants have committed to preparing a Construction Environmental Management Plan (CEMP) which will clearly set out the methods of managing environmental issues during the construction works. The CEMP will be implemented prior to works commencing on the Assessment Site and will be updated regularly, thus ensuring it reflects and incorporates current legislation as outlined within this ES.

Table 16.1: Summary of Mitigation and Monitoring Measures

Topic	Effect	Measures
1) Measures incorporated into the Detailed Design		
Landscape and Views	Effects on landscape and views	• The height of equipment and structures has been minimized where practicable i.e. tanks positioned horizontally rather than vertically. • Landscape features such as woodlands, tree belts and hedgerows will be retained along the pipeline route. • New planting will reinforce and enhance the existing landscape framework and compensate for limited areas of vegetation loss. • Planting to be included within the overall landscape strategy is to include predominately native and locally endemic species with reference to the Supplementary Planning Document Design Guide (Ref. 16.2). • A recessive colour/material pallet for permanent built elements or structures will be established as part of the Proposed Development. Dark colours (dark green, brown, or dark grey) are generally more acceptable as they complement the natural environment throughout the seasons and the different characteristics of daylight during the year. Consideration will also be given to the general colour of the backdrop against which the building will be seen.
Air Quality	Emissions to air from natural gas refining	• The gas facility will include isolation valves to enable the isolation of relatively small, discrete sections of plant to minimise quantities of gas requiring venting.
Noise	Effects of noise on sensitive receptors	• At the equipment procurement stage the design team will confirm that all plant operating together can achieve the proposed noise limit of 60dB $L_{Aeq,5min}$ at any point on the Assessment Site boundary.
Flood risk, hydrology and drainage	Effect on flood risk and contamination of ground and surface water	• The drainage regime on the well site will be modified to ensure rainwater will be gathered in the ditches surrounding the well site and either used on site or discharged through an oil interceptor and soakaway into the ground. • All tanks will be bunded to provide 110% of the capacity of the largest tank.
Ground Conditions and Contamination	Effects from oil, hydrocarbon and process waste contamination	• The provision of securely bunded areas with interceptors in areas where oil, fuel and process wastes are stored, handled or transferred.
Produced Water Disposal	**Effects from injecting produced water into the Sherwood Sandstone**	• **The borehole to be used for the injection of produced water into the Sherwood Sandstone will be designed in compliance with The Offshore Installations and Well (Design and Construction) to ensure that the borehole is designed and planned to the highest standards.**
2) Measures to be applied during Construction		
Ecology	Effects from pollution events close to water	• Pollution control measures will be implemented during the construction phase to minimise the risk of a pollution event in the working area close to the River Derwent and the ditches in

Topic	Effect	Measures
	courses	accordance with national guidelines and legislation.
	Effects on habitats	• Dust emissions arising from the topsoil stripping during construction will be controlled through standard dust suppression measures set out in the CEMP to minimise dust deposition. • Topsoil and subsoil will be stored separately to ensure retention of the natural seed bank and to promote re-instatement of the natural habitat. • All habitats will be reinstated post construction, with any affected sections of ditch re-graded to reflect the 'natural' profile and hedgerows replanted with native species of stock originating and grown in Britain in accordance with the canopy species present in undisturbed sections of each hedgerow.
	Effects on breeding birds	• The following measures will be incorporated into the CEMP: - Vegetation clearance (including tree felling and topsoil stripping) will be undertaken outside the breeding bird season where possible (typically March to September inclusive). - If vegetation clearance is unable to be undertaken outside the breeding bird season, all areas of vegetation should be checked by an ecologist prior to clearance. In the event that active nest sites are found, an appropriate buffer zone (c. 5m) should be established around the nest and works suspended in this zone until the nest has become unoccupied and any young have fledged. - Liaison will be undertaken with the Forestry Commission during the 2013 goshawk survey season to establish whether any additional goshawk nest sites within 400m of the Assessment Site have been identified. - In the event that active goshawk nest sites are identified prior to the commencement of construction, the following measures are likely to be required: - Maintenance of a 400m disturbance-free zone between February and July inclusive; and - All tree felling works will be undertaken outside the breeding bird season where practicable (which will be extended to include February due to early nesting habits of goshawk).
	Effects on bats	• Lighting (both permanent and temporary columns) will be directed and focused downwards with appropriate lantern designs to reduce light spillage onto habitats outside construction areas. • In the event that any of the identified trees or tree groups with bat roost potential will be impacted (either directly or indirectly) by the Proposed Development, further surveys will be undertaken to determine whether bats are present prior to felling. This will comprise dusk emergence/ dawn re-entry surveys at an appropriate time of year in accordance with standard survey methodologies. • Should bats be identified as roosting in any trees to be felled or otherwise pruned as a result

Topic	Effect	Measures
		of the construction of the Proposed Development, a licence may be necessary to enable works to proceed. Where necessary, licence applications including detailed mitigation and roost compensation provisions would be made to Natural England prior to any works to the trees commencing, to ensure compliance with the Habitats Regulation. • Mitigation is likely to require the provision of alternative roost sites (e.g. bat roost boxes), which must be installed prior to tree felling.
	Effects on reptiles	• Areas of deadwood piles and loose heaps of soil/pine needles suitable for reptile hibernation will be cleared outside the winter period to avoid the reptile hibernation season (i.e. between November and February to avoid the bird breeding season) where practicable. • If woodland is cleared during the winter months habitats potentially suitable for reptiles will be fenced with temporary reptile exclusion fencing as the forestry felling progresses, to prevent further migration of reptiles into working area upon emergence from hibernation. The tree stumps will be left in situ until March to avoid disturbing reptiles that may be hibernating below ground in and amongst tree roots. Stumps will be grubbed out from March onwards under an ecological watching brief. The felled areas will then be subject to capture and translocation exercise using artificial refuges. • The potential presence of reptiles will be highlighted to site personnel as part of the site induction package. • Any reptiles encountered incidentally during the construction works will be immediately moved to a place of safety if they are unable to escape unaided, and the advice of an ecologists sought.
	Effects on water voles	• Prior to construction, all of the identified ditches with water vole potential will be re-surveyed for water vole. • Those ditches that do not have any evidence of water vole occupation will not be subject to any further constraints during the construction phase. • Where water vole occupation is confirmed at any ditch/river crossing, exclusion of water voles using the 'displacement technique' will be undertaken. This involves the removal of suitable bankside cover by directional strimming to encourage the passive movement of water voles away from affected areas followed by a destructive search.
Landscape and Views	Effects on landscape and views	• The following measures will be incorporated into the CEMP: - Retention of existing hedgerows and woodland between the boundary of the well site and Ebberston Common Lane to keep an established screen between activity within the well site and adjacent sensitive receptors, all trees to be retained will be protected in accordance with BS5837:2012 - Trees in Relation to Construction; - Restoration of the agricultural landscape, through which the pipeline route passes once the pipeline has been completed to equivalent quality to that prior to construction; - Establishment of the landscape proposals at an early stage of the construction phase where possible -i.e. reinstate hedgerows and field boundaries immediately following

Topic	Effect	Measures
		construction; - Location of contractor's compound, pipeline laying and material stockpiles away from nearby sensitive receptors i.e. mature trees; - Control of the security lighting of construction compound and machinery to minimise upward and outward light pollution. In addition, ensure that the minimum area only is lit, for the minimum period of time; - Limit movements of material between stockpiles so that these do not shift over time thereby adding to the sense of fragmentation and instability of the landscape; - Minimisation of the duration of construction activities which require cranes, scaffolding, and use of designated routes within and around the Assessment Site; and - Agreeing appropriate working hours as proposed (07:00 to 18:00 Monday to Friday and 07:00 to 13:00 on Saturdays) with NYMNPA and NYCC to ensure that adverse visual effects of construction experienced by the closest residential receptors are minimised at times when they could reasonably expect a cessation of construction activity, for example evenings, weekends and bank holidays.
Air Quality	Effects from release of construction dust	• Construction dust will be controlled through the application of a series of measures incorporated into the CEMP including (where appropriate): - Regular inspection and, where necessary, wet suppression of material/soil stockpiles (including wind shielding, storage away from site boundaries, and restricted height of stockpiles); - Appropriate orientation of material stockpiles to minimise wind dispersion; - Provision of wheel washing and wet suppression during loading of wagons/vehicles; - Covering vehicles carrying dry spoil and other wastes; - Shielding of dust-generating construction activities; - Provision of suitable site hoarding; - Restricting vehicle speeds on access roads and other unsurfaced areas of the Assessment Site; and - Inspection of unsurfaced haulage routes, and wet suppression as necessary, during prolonged dry periods.
Noise and Vibration	Effects from construction noise	• Good practice as recommended in BS 5228-1:2009 (Ref. 16.3) will be implemented. Measures include maintaining good relations with people living and working in the vicinity of site operations by keeping people informed of progress. • Quiet working methods will be adopted and implemented through the CEMP including: - The use of most suitable plant; - Reasonable hours of working for noisy operations; - Noise will be controlled at source; - On-site noise levels will be monitored regularly; - Avoidance of unnecessary revving of engines; - Switch of equipment when it is not required;

Topic	Effect	Measures
		- Minimise the drop height of materials; - Starting up plant and vehicles sequentially rather than all together; and - Audible reversing alarms should be of types that have a minimum noise effect on persons outside the site. • The local authority may consider it appropriate to lay down or agree work programmes and periods of use of certain equipment. • Noise from construction will be controlled primarily by the restriction of working hours. In this case, 07.00 to 18.00 Monday to Friday and 07.00 to 13.00 Saturday.
Traffic and Transportation	Effects from traffic along Ebberston Lane and Ebberston Common Lane	• Route cards will be issued to all drivers to ensure that they use the designated access route to the Assessment Site. • All vehicle speeds along Ebberston Lane and Ebberston Common Lane will be restricted to 30 mph. • Large loads being moved along any minor road will be escorted by an escort vehicle to avoid conflict with oncoming traffic. • Road traffic signs, temporary traffic lights and a speed restriction will be put in place between Wilton and Allerston to reduce the potential for delays during construction. • Access to the Assessment Site along Malton Lane/Wilton Ings Lane will be normally limited to private cars and light goods vehicles and a temporary 30mph speed restriction will be applied. • Access by essential HGVs to the Assessment Site from Malton Lane/Wilton Ings Lane will be permitted only from the east and Penniston Lane and will be escorted. • Traffic management including signage and traffic lights will be required between the road junction at Penniston Lane and the Assessment Site to avoid conflict between vehicles passing in different directions. • Access to the Assessment Site from Marishes Lane will only be from the east, off the B1258 and speed restricted to 30mph. • Traffic management will be in force between the B1258 and the Assessment Site to ensure that the risk of two vehicles meeting is minimised. • Access along Allerston Lane will be prohibited for HGVs because articulated lorries will not be able to avoid over-running the verges when turning into or out of Malton Lane.
Flood Risk, Hydrology and Drainage	Effects on surface and groundwater	• The CEMP will include the following measures in compliance with the Environment Agency Prevention Pollution Guidelines especially PPG 6 (Ref. 16.4): - The construction compound will be located within the limits of the well site, which has an impermeable membrane passing under the well site and into the perimeter ditches; - The ditch lining that is currently exposed will be protected to ensure that it retains its water retaining qualities; - During the adaptation of the existing perimeter ditch at the well site, the ditches will be temporarily blocked to the side of the working area to prevent accidental discharge of water or contaminants into the partly construction system or the ground;

Topic	Effect	Measures
		- All fuel tanks brought onto site for construction machinery will be kept locked when not being used, and sat within a containment tray in the bunded section of the well site where practicable and shall be double-skinned in accordance with PPG2 (Ref. 16.4); - The fuel store will be located in appropriate areas away from water-courses and where it is not at risk of site vehicles colliding with it; - Machinery shall be re-fuelled in the site compound where practicable where the existing site construction will provide protection to the aquifer complying with the procedures stipulated in PPG7 (Ref. 16.4); - Any routine maintenance of machinery shall be carried out within the Ebberston Moor 'A' Well Site to contain spillages of oil, fuel or hydraulic oil; - All cement and grout shall be stored within a contained area and all washing out of cement mixers or concrete delivery lorries must be carried out so that the discharge flows into a lined settlement pond. All tools will also be washed in a suitable area where the discharge cannot flow into the ground as specified in PPG6 (Ref. 16.4); - Avoid storage of large volumes of potential contaminants such as fuel and waste water that will have a much more significant effect than smaller volumes; and - All static machinery located outside the bunded containment area of the well site during construction shall have drip trays placed under them. • All pipework shall be pressure-tested prior to being commissioned. • All fluids used during testing shall be drained into a prepared sump/tank with a capacity 110% of the pipeline capacity and all waste fluids arising from the testing or construction works will be taken off site by road tanker and disposed of at a suitably licensed facility.
Archaeology and Cultural Heritage	Effects on unknown archaeology beyond the existing made ground	• In those areas where the Proposed Development crosses or closely approaches cultural heritage resources of low sensitivity, or is further away from cultural heritage features of medium-high sensitivity, a programme of archaeological monitoring and recording will be carried out of the initial construction work within the Proposed Development working corridor across these areas. • In those areas where the Proposed Development crosses or closely approaches cultural heritage resources of medium sensitivity, or of uncertain significance, a programme of archaeological trial trench evaluation will be undertaken area prior to the commencement of development. Subject to the results of the trenching, a programme of archaeological monitoring and recording will be carried out of the initial construction work within the Proposed Development working corridor across these areas. • At a few locations in the northern part of the Proposed Development, the pipeline route will cross prehistoric linear features which are protected as Scheduled Monuments. At these locations it is proposed that directional drilling or a suitable alternative installation technique is used to carry the pipeline beneath the Scheduled Monuments. • Any archaeological recording of potential remains should meet the specific requirements of the Archaeological Curators.

Topic	Effect	Measures
Ground Conditions and Contamination	Oil and Hydrocarbon contamination	• To mitigate the risk of pollutants entering the controlled waters, handling and storage of fuels and oils will adhere to Environment Agency guidance: PPG1, PPG2, PPG5, PPG6, PPG8, PPG18 and PPG21 (Ref. 16.4). Measures to be implemented through the CEMP will comprise: - Fuels will be handled on securely bunded areas; - Oils and hydrocarbons will be stored in designated locations with specific measures to prevent leakage and release of their contents, including locating the storage area away from the surface water drainage system and watercourses on an impermeable base, with an impermeable bund that has no outflow and is of adequate capacity to contain at least 115% of the contents; - Machinery will be refuelled using a transfer hose and valves. Trigger guns will also be protected from vandalism and kept locked when not in use; - Plant and machinery will have drip trays beneath oil tanks/engines/gearboxes/hydraulics where appropriate that will be checked and emptied regularly via a licensed waste disposal operator; - Any potential contaminated soils will be kept separate from natural soils in the vicinity of the roads and railway during the roads and railway crossings by temporary placement of soils on geotextile fabric, chemical testing to confirm if soils are contaminated and disposal to a suitable licensed waste facility if necessary. Dust suppression measures will also need to be incorporated when working in or near to these materials; and - An emergency spillage action plan will be produced, which site staff will have read and understood. On-site provisions will be made to contain a serious spill or leak through the use of spill kits, booms, bunding and absorbent material. Site staff will be trained in the use of emergency spill response equipment.
	Loss of ground support due to dissolution, sliding caused by adverse bedrock structure, collapse and running sands.	• Appropriate geotechnical investigation will be undertaken in key areas of the Proposed Development and construction activities especially where the pipeline route crosses beneath roads, the railway and the river or where the pipeline route could be subject to landslides or running sands. The ground conditions encountered will need to be logged and geotechnical testing of the soils will need to be undertaken: - Appropriate stability analyses should be undertaken to confirm if there is a risk; and - If required, temporary excavation support and temporary dewatering could be designed to prevent collapse of the excavation while it is open.
Produced Water Disposal	**Effects from injecting produced water into the Sherwood Sandstone**	• **The borehole to be used for the injection of produced water into the Sherwood Sandstone will be constructed in compliance with The Offshore Installations and Well (Design and Construction) to ensure that the borehole is constructed properly.**
3) Measures to be applied during Operation		
Landscape and Views	Effects on landscape and views	• A landscape maintenance programme will be adopted to ensure the long-term survival of existing and proposed features in order to enhance their biodiversity and amenity value. The

Topic	Effect	Measures
		details of the landscape maintenance programme will be agreed with the North York Moors National Park Authority.
Noise and Vibration	Effects of noise on nearby sensitive receptors	• The noise limit to ensure that there is no audible noise above background at the nearest noise-sensitive receptor to the well site, Ebberston Common Farm, is 60dB $L_{Aeq,5min}$ at any point on the Assessment Site boundary.
Traffic and Transportation	Effects from traffic along Ebberston Lane and Ebberston Common Lane	• Route cards will be issued to all drivers to ensure that they use the designated access route to the Assessment Site. • All vehicle speeds along Ebberston Lane and Ebberston Common Lane will be restricted to 30 mph.
Flood Risk, Hydrology and Drainage	Effects on flood risk	• Rainwater on the well site will be gathered in ditches and either used on site or discharged through an oil interceptor into the soakaway.
	Effects on quality of surface and ground water	• The oil interceptor will provide control on all discharge and a monitoring point will permit sampling to check the discharge. • Valves fitted to the outflow pipe from the Assessment Site will enable isolation of the interceptor. • Rainwater collecting within the new tank bunds and other bunded areas will be taken off site in tankers to be processed at an off-site facility.
Ground Conditions and Contamination	Oil, hydrocarbon and process waste contamination	• To mitigate the risk of pollutants entering the controlled waters, handling and storage of fuels and oils will adhere to Environment Agency guidance: PPG1, PPG2, PPG5, PPG6, PPG8, PPG18 and PPG21 (Ref. 16.4). Measures will comprise: - Oils and hydrocarbons will be stored in designated locations with specific measures to prevent leakage and release of their contents, including locating the storage area away from the surface water drainage system and watercourses on an impermeable base, with an impermeable bund that has no outflow and is of adequate capacity to contain at least 115% of the contents; - An emergency spillage action plan will be produced, which site staff will have read and understood. On-site provisions will be made to contain a serious spill or leak through the use of spill kits, booms, bunding and absorbent material. Site staff will be trained in the use of emergency spill response equipment.
Produced Water Disposal	**Effects from injecting produced water into the Sherwood Sandstone**	• **The borehole to be used for the injection of produced water into the Sherwood Sandstone will be operated in compliance with The Offshore Installations and Well (Design and Construction) to ensure that the borehole is operated properly.** • **Injection pressures will be generally low and will be controlled so that they do not exceed the strength and fracturing pressure of the formation.**
4) Measures to be applied during Demolition and Restoration		
Ecology	Effects on habitats resulting	• Dust emissions arising from the topsoil stripping during decommissioning and restoration

Topic	Effect	Measures
	from dust emissions	regardless of whether future planning permission is secured for the well site will be controlled through standard dust suppression measures set out in the CEMP to minimise dust deposition.
Landscape and Views	Effects on landscape and views	• The following measures will be incorporated into the CEMP: - Retention of existing hedgerows and woodland between the boundary of the well site and Ebberston Common Lane to keep an established screen between activity within the well site and adjacent sensitive receptors, all trees to be retained will be protected in accordance with BS5837:2012 - Trees in Relation to Construction; - Location of contractor's compound, pipeline laying and material stockpiles away from nearby sensitive receptors i.e. mature trees; - Control of the security lighting of construction compound and machinery to minimise upward and outward light pollution. In addition, ensure that the minimum area only is lit, for the minimum period of time; - Limit movements of material between stockpiles so that these do not shift over time thereby adding to the sense of fragmentation and instability of the landscape; - Minimisation of the duration of activities which require cranes, scaffolding, and use of designated routes within and around the Assessment Site; and - Agreeing appropriate working hours as proposed (07:00 to 18:00 Monday to Friday and 07:00 to 13:00 on Saturdays) with NYMNPA and NYCC to ensure that adverse visual effects of construction experienced by the closest residential receptors are minimised at times when they could reasonably expect a cessation of construction activity, for example evenings, weekends and bank holidays.
Air Quality	Effects from release of dust	• Dust produced during decommissioning and restoration regardless of whether future planning permission is secured for the well site will be controlled through the application of a series of measures incorporated into the CEMP including (where appropriate): - Regular inspection and, where necessary, wet suppression of material/soil stockpiles (including wind shielding, storage away from site boundaries, and restricted height of stockpiles); - Appropriate orientation of material stockpiles to minimise wind dispersion; - Provision of wheel washing and wet suppression during loading of wagons/vehicles; - Covering vehicles carrying dry spoil and other wastes; - Shielding of dust-generating construction activities; - Provision of suitable site hoarding; - Restricting vehicle speeds on access roads and other unsurfaced areas of the Assessment Site; and - Inspection of unsurfaced haulage routes, and wet suppression as necessary, during prolonged dry periods.
Noise and Vibration	Effects from noise	• Good practice as recommended in BS 5228-1:2009 (Ref. 16.3) will be implemented regardless

Topic	Effect	Measures
		of whether future planning permission is secured for the well site. Measures include: - Maintaining good relations with people living and working in the vicinity of site operations by keeping people informed of progress. • Quiet working methods will be adopted and implemented through the CEMP regardless of whether future planning permission is secured for the well site including: - The use of most suitable plant; - Reasonable hours of working for noisy operations; - Noise will be controlled at source; - On-site noise levels will be monitored regularly; - Avoidance of unnecessary revving of engines; - Switch of equipment when it is not required; - Minimise the drop height of materials; - Starting up plant and vehicles sequentially rather than all together; and - Audible reversing alarms should be of types that have a minimum noise effect on persons outside the site. • The local authority may consider it appropriate to lay down or agree work programmes and periods of use of certain equipment regardless of whether future planning permission is secured for the well site. • Noise from construction will be controlled primarily by the restriction of working hours regardless of whether future planning permission is secured for the well site. In this case, 07.00 to 18.00 Monday to Friday and 07.00 to 13.00 Saturday.
Traffic and Transportation	Effects from traffic along Ebberston Lane and Ebberston Common Lane	• Route cards will be issued to all drivers to ensure that they use the designated access route to the Assessment Site. • All vehicle speeds along Ebberston Lane and Ebberston Common Lane will be restricted to 30 mph. • Large loads being moved up Ebberston Lane and Ebberston Common Lane will be escorted by an escort vehicle to avoid conflict with oncoming traffic. • Surface materials arising from the decommissioning and restoration of the well site will be dispersed on forestry roads where appropriate to reduce the effects of raised volumes of traffic travelling along Ebberston Common Lane.
Flood Risk, Hydrology and Drainage	Effects on surface and groundwater	• The CEMP will include the following measures in compliance with the Environment Agency Prevention Pollution Guidelines especially PPG 6 (Ref. 16.4): - The construction compound will be located within the limits of the well site, which has an impermeable membrane passing under the well site and into the perimeter ditches; - The ditch lining that is currently exposed will be protected to ensure that it retains its water retaining qualities; - During the adaptation of the existing perimeter ditch at the well site, the ditches will be temporarily blocked to the side of the working area to prevent accidental discharge of water or contaminants into the partly construction system or the ground;

Topic	Effect	Measures
		- All fuel tanks brought onto site for construction machinery will be kept locked when not being used, and sat within a containment tray in the bunded section of the well site where practicable and shall be double-skinned in accordance with PPG2 (Ref. 16.4); - The fuel store will be located in appropriate areas away from water-courses and where it is not at risk of site vehicles colliding with it; - Machinery shall be re-fuelled in the site compound where practicable where the existing site construction will provide protection to the aquifer complying with the procedures stipulated in PPG7 (Ref. 16.4); - Any routine maintenance of machinery shall be carried out within the Ebberston Moor 'A' Well Site to contain spillages of oil, fuel or hydraulic oil; - All cement and grout shall be stored within a contained area and all washing out of cement mixers or concrete delivery lorries must be carried out so that the discharge flows into a lined settlement pond. All tools will also be washed in a suitable area where the discharge cannot flow into the ground as specified in PPG6 (Ref. 16.4); - Avoid storage of large volumes of potential contaminants such as fuel and waste water that will have a much more significant effect than smaller volumes; and - All static machinery located outside the bunded containment area of the well site during construction shall have drip trays placed under them. • All pipework shall be pressure-tested prior to being commissioned. • All fluids used during testing shall be drained into a prepared sump/tank with a capacity 110% of the pipeline capacity and all waste fluids arising from the testing or construction works will be taken off site by road tanker and disposed of at a suitably licensed facility.
Ground Conditions and Contamination	Oil, hydrocarbon and process waste contamination	• To mitigate the risk of pollutants entering the controlled waters, regardless of whether future planning permission is secured for the well site, handling and storage of fuels and oils will adhere to Environment Agency guidance: PPG1, PPG2, PPG5, PPG6, PPG8, PPG18 and PPG21 (Ref. 16.4). Measures to be implemented through the CEMP will comprise: - Oils and hydrocarbons will be stored in designated locations with specific measures to prevent leakage and release of their contents, including locating the storage area away from the surface water drainage system and watercourses on an impermeable base, with an impermeable bund that has no outflow and is of adequate capacity to contain at least 115% of the contents; - Machinery will be refuelled using a transfer hose and valves. Trigger guns will also be protected from vandalism and kept locked when not in use; - Plant and machinery will have drip trays beneath oil tanks/engines/gearboxes/hydraulics where appropriate that will be checked and emptied regularly via a licensed waste disposal operator; and - An emergency spillage action plan will be produced, which site staff will have read and understood. On-site provisions will be made to contain a serious spill or leak through the use of spill kits, booms, bunding and absorbent material. Site staff will be trained in the use of emergency spill response equipment.

17A.0 STATEMENT OF SIGNIFICANCE

Residual Effects

17.1 The residual effects of the Proposed Development following implementation of the measures outlined in the preceding technical chapters and in Chapter 16 have been assessed. Although each technical chapter contains detailed consideration of residual effects, **Table 17.1** summarises the main residual effects of the Proposed Development. The significance criteria are set out in Chapter 2 (EIA Methodology) and within relevant technical chapters where a different approach is followed.

17.2 The preparation of the ES was undertaken in parallel with the design process. Consequently, many measures to mitigate likely significant adverse environmental effects have been incorporated into the Proposed Development design in order to avoid, reduce or offset such effects. With respect to management of the demolition and construction process, the Construction Environmental Management Plan (CEMP) will set out the methods of managing environmental issues for all involved with the construction works to eliminate, reduce or offset adverse environmental effects. These will address relevant environmental issues, such as: noise; air quality and dust; hours of work; site drainage and protection from or minimisation of surface/ground-water pollution and protection of environmental and amenity resources. It is anticipated that the mitigation measures identified will be secured by planning obligations or conditions, to ensure that the scheme proposed by the Applicant is delivered.

17.3 In summary, the Proposed Development comprises the exploitation of conventional hydrocarbon resources only, for the production of energy, including: gas production from the existing Ebberston Moor 'A' Well Site; and construction of a 15.3 km long 8" steel diameter underground pipeline from Ebberston Moor 'A' Well Site to Knapton Generating Station (KGS) for the purpose of delivering natural gas and condensate from Ebberston Moor Ebberston Moor 'A' Well Site to KGS where it will be used as fuel-gas to generate power.

17.4 The Proposed Development will result in the following beneficial effects:

- The recording of previously unknown cultural heritage remains where found during construction of the Proposed Development;
- Supplying a significant area of North Yorkshire with locally produced energy;
- The creation of up to 50 construction, and 10 demolition and restoration jobs, for people with skills that are readily available in the local labour market;

- Introduction of indirect economic vitality to the local area through local procurement of supplies and services during construction;
- Securing the present employment of the Applicant's employees who will be in charge of operating the facility;
- Providing additional and new business to local businesses engaged in transport, engineering, maintenance and supply; and
- Improvement of the UK's ability to manage fluctuations (daily, weekly and seasonally) which occur in gas supply and demand and thus enabling indirect reductions in costs for householders and commercial and industrial companies.

17.5 The ES has also identified a number of adverse effects which will mainly occur during construction and demolition and restoration phases which include the following:

- Loss of breeding bird habitat;
- Changes to a limited number of views associated with construction activities from residential properties, roads and public rights of way;
- Local changes to landscape features, character and the National Park as a result of construction activities;
- Temporary disruption to users of the surrounding road network;
- Potential for mobilisation of contaminants resulting in the deterioration of surface and ground water quality;
- Potential for dust emissions resulting from the clearance of on-site structures and groundworks; and
- Potential for noise and vibration disturbance to the nearby residents.

17.6 However, the implementation of the mitigation measures outlined within the CEMP during construction such as the use of site hoarding, dust and noise suppression measures and temporary drainage will result in many adverse effects being minimised or avoided.

17.7 There will also be adverse residual effects during operation of the Proposed Development resulting from the following:

- Changes to a limited number of views from residential properties, roads and public rights of way;
- Local changes to the National Park;
- Visual and landscape effects on Ebberston Low Moor Round Barrow and Givendale Head Pit alignment Scheduled Monuments and their setting; and
- Increased traffic movement affecting the setting of Ebberston Low Moor Round Barrow Scheduled Monument.

17.8 Once decommissioning and restoration has been completed after up to 15 years of operational activities in scenario 1 (future planning permission is secured for the well site) many of the effects on the environment will generally be neutral or slightly beneficial. There will be more beneficial effects in scenario 2 (no future planning permission is secured for the well site) as the well site will be decommissioned and restored to its original state of forestry. The pipeline between Ebberston Moor 'A' Well Site and KGS will be left in situ with the ends capped to avoid further disturbance of the ground. There will also be no decommissioning or restoration at KGS.

Table 17.1: Significance Table

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / NP	L	
Ecology	Construction	Displacement/ disturbance to birds in the North York Moors SPA/ SSSI	Short term temporary	*							Negligible
		Changes in water quality resulting in effects on Troutsdale & Rosekirk Dale Fens SSSI	Short term temporary		*						Negligible
		Loss of habitat including forestry plantation	Short term temporary							*	Negligible
		Damage to habitat as a result of dust deposition	Short term temporary							*	Negligible
		Loss of breeding bird habitat	Short term temporary							*	Minor Adverse
		Noise/ visual disturbance to breeding goshawk	Short term temporary							*	Negligible
		Noise/ visual disturbance to breeding nightjar	Short term temporary							*	Negligible
		Loss of habitat used by foraging/ commuting bats	Short term temporary							*	Negligible
		Lighting disturbance to foraging/ commuting bats at Ebberston Moor 'A ' Well Site	Short term temporary							*	Negligible
		Loss/ damage to habitat supporting reptiles	Short term temporary							*	Negligible
		Loss/ damage to habitat supporting water voles	Short term temporary					*			Negligble
		Loss of habitat supporting brown hare	Short term temporary							*	Negligible
	Operation	Changes in water quality resulting in effects on Troutsdale & Rosekirk Dale Fens SSSI	Long term temporary		*						Negligible

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / N P	L	
		Noise/ visual disturbance to birds in the North York Moors SPA/ SSSI	Long term temporary	*							Negligible
		Changes in air quality resulting in effects on habitats	Long term temporary							*	Negligible
		Changes in water quality resulting in effects on habitats	Long term temporary							*	Negligible
		Noise/ visual disturbance to breeding goshawk	Long term temporary							*	Negligible
		Noise/ visual disturbance to breeding nightjar	Long term temporary							*	Negligible
		Lighting disturbance to foraging/ commuting bats at Ebberston Moor 'A' Well Site	Long term temporary							*	Negligible
	Decommissioning and Restoration	Changes in air quality resulting in effects on Troutsdale & Rosekirk Dale Fens SSSI	Short term temporary		*						Negligible
		Noise/ visual disturbance to birds in the North York Moors SPA/ SSSI	Short term temporary	*							Negligible
		Noise/ visual disturbance to breeding goshawk	Short term temporary							*	Negligible
		Noise/ visual disturbance to breeding nightjar	Short term temporary							*	Negligible
		Increased habitat availability for foraging/ commuting bats	Short term temporary							*	Minor Beneficial
Landscape and Views	Construction with no Ebberston Moor EDS in place prior to construction	Landscape Features	Short term temporary							*	Moderate Adverse
		Landscape Character	Short term temporary					*	*	*	Moderate Adverse
		National Park	Short term temporary				*	*	*	*	Moderate Adverse
		Visual Effects – Residential Properties	Short term							*	Minor Adverse

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / N P	L	
			temporary								
		Visual Effects - Roads	Short term temporary							*	Moderate Adverse
		Visual Effects - PROW	Short term temporary						*	*	Moderate Adverse
	Construction with Ebberston Moor EDS in place prior to construction	Landscape Features	Short term temporary							*	Minor Adverse
		Landscape Character	Short term temporary					*	*	*	Minor Adverse
		National Park	Short term temporary				*	*	*	*	Moderate Adverse
		Visual Effects – Residential Properties	Short term temporary							*	Negligible to Minor Adverse
		Visual Effects - Roads	Short term temporary							*	Minor Adverse
		Visual Effects - PROW	Short term temporary						*	*	Moderate Adverse
	Construction of pipeline	Landscape Features	Short term temporary							*	Moderate Adverse
		Landscape Character	Short term temporary					*	*	*	Moderate Adverse
		National Park	Short term temporary				*	*	*	*	Moderate Adverse
		Visual Effects – Residential Properties	Short term temporary							*	Negligible to Major Adverse
		Visual Effects - Roads	Short term temporary							*	Negligible to Major Adverse
		Visual Effects - PROW	Short term temporary						*	*	Negligible to Major Adverse
	Operation	Landscape Features	Long term temporary							*	Minor Adverse

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / N P	L	
		Landscape Character	Long term temporary					*	*	*	Minor Adverse
		National Park	Long term temporary				*	*	*	*	Minor Adverse
		Visual Effects – Residential Properties	Long term temporary							*	Negligible to Minor Adverse
		Visual Effects - Roads	Long term temporary							*	Negligible to Minor Adverse
		Visual Effects - PROW	Long term temporary						*	*	Negligible to Minor Adverse
	Decommissioning and Restoration (Scenario 1)	Landscape Features	Permanent							*	Minor Adverse
		Landscape Character	Permanent					*	*	*	Minor Adverse
		National Park	Permanent				*	*	*	*	Minor Adverse
		Visual Effects – Residential Properties	Permanent							*	Negligible to Minor Adverse
		Visual Effects - Roads	Permanent							*	Negligible
		Visual Effects - PROW	Permanent						*	*	Minor Adverse
	Decommissioning and Restoration (Scenario 2)	Landscape Features	Temporary							*	Minor Beneficial
		Landscape Character	Temporary					*	*	*	Minor Beneficial
		National Park	Temporary				*	*	*	*	Minor Beneficial
		Visual Effects – Residential Properties	Temporary							*	Minor Beneficial
		Visual Effects - Roads	Temporary							*	Minor Beneficial
		Visual Effects - PROW	Temporary						*	*	Minor Beneficial
Air Quality	Construction	Increase in fugitive dust emissions during construction	Short term temporary							*	Negligible
		Construction traffic emissions	Short term temporary							*	Negligible
	Operation	Operational traffic emissions	Long term temporary							*	Negligible
		Operational plant emissions	Long term							*	Negligible

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / N P	L	
			temporary								
	Decommissioning and Restoration	Increase in fugitive dust emissions during decommissioning and restoration	Short term temporary							*	Negligible
		Decommissioning and restoration traffic emissions	Short term temporary							*	Negligible
Noise and Vibration	Construction	Noise nuisance at local noise-sensitive properties local to Ebberston Moor 'A' Well Site	Short term temporary							*	None
		Noise nuisance at noise-sensitive properties within 500m of pipeline route.	Short term temporary							*	None
		Increased road traffic noise at local noise-sensitive properties	Short term temporary							*	None
	Operation	Noise nuisance and loss of amenity at local noise-sensitive properties local to Ebberston Moor 'A' Well Site	Long term temporary							*	Negligible
		Increased road traffic noise at local noise-sensitive properties	Short term temporary							*	Negligible
		Increased noise for passers-by	Short term temporary							*	Negligible
		Noise nuisance and loss of amenity at noise-sensitive properties within 500m of pipeline route.	Long term temporary							*	None
	Decommissioning and Restoration	Noise nuisance at local noise-sensitive properties	Short term temporary							*	None
Transport and Access	Construction	Construction activities	Short term temporary							*	Minor Adverse / Negligible
	Operation	Operational staff	Long term temporary								Negligible
	Decommissioning and	Traffic along Ebberston Lane and Ebberston Common Lane	Short term temporary								Minor Adverse / Negligible

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / N P	L	
	Restoration	Traffic on minor roads south of A170	None								None
Flood Risk, Hydrology and Drainage	Construction	Contamination of Aquifer during construction	Permanent/ long term						*	*	Negligible
		Construction activities	Short term temporary							*	Negligible
	Operation	Discharge of surface water from sites	Long term temporary						*	*	Minor Adverse / Negligible
	Decommissioning and Restoration	Contaminated discharge	Permanent /long term						*	*	Negligible
		Reinstatement of original environment	Permanent						*	*	Moderate Beneficial
Archaeology and Cultural Heritage	Construction	Damage / destruction buried archaeological remains or deposits within Assessment Site: site of post-medieval farm and adjacent earthworks; continuation of prehistoric Allerston West Dyke; alignment of prehistoric ditch near Warren House; and Roman pottery cluster north of A170 road.	Permanent						*		Moderate Beneficial
		Damage / destruction of buried archaeological remains or deposits within Assessment Site: vicinity of Scheduled Monument prehistoric pit alignment near northern end of route and vicinity of Scheduled Monument prehistoric barrow near Warren House	Permanent		*						Moderate Beneficial
		Damage / destruction of buried archaeological remains or deposits within Assessment Site: concentration of Roman pottery south of River Derwent and Iron Age-Roman and medieval ditches near KGS.	Permanent						*		Moderate Beneficial
		Damage / destruction of buried	Permanent		*						Moderate

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / N P	L	
		archaeological remains or deposits on Givendale Head pit alignment Scheduled Monument.									Beneficial
		Visual and landscape effects on Scheduled Monument: Givendale Head pit alignment	Short term temporary		*						Minor Adverse
		Visual and landscape effects on Scheduled Monument: Ebberston Low Moor Round Barrow	Short term temporary		*						Minor Adverse
		Visual and landscape effects on Scheduled Monument: Warren House Round Barrow	Short term temporary		*						Minor Beneficial
		Landscape effect on setting of Scheduled Monument: Ebberston Low Moor earthworks	Short Term temporary		*						Negligible Adverse
	Operation	Visual and landscape effects on Scheduled Monument: Warren House Round Barrow	Long term temporary		*						Minor Beneficial
		Visual and landscape effects on Scheduled Monument: Givendale Head pit alignment	Long term temporary		*						Minor Adverse
		Visual and landscape effects on Scheduled Monument: Warren House Round Barrow	Long term temporary		*						Minor Beneficial
		Visual and landscape effects on Scheduled Monument: Givendale Head pit alignment	Long term temporary		*						Minor Adverse
		Visual and landscape effects on Scheduled Monument: Ebberston Low Moor Round Barrow	Long term temporary		*						Minor Adverse
		Increased traffic movement affecting setting of Scheduled Monument: Ebberston Low Moor Round Barrow	Long term temporary		*						Minor Adverse
		Increased traffic movement affecting	Long term		*						Minor Adverse

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / N P	L	
		setting of Scheduled Monument: Ebberston Low Moor Round Barrow	temporary								
		Increased traffic movement affecting setting of Scheduled Monument: Ebberston Low Moor Round Barrow	Long term temporary		*						Minor Adverse
		Landscape effects on setting of Scheduled Monument: Ebberston Low Moor earthworks	Long term temporary		*						Negligible Adverse
	Decommissioning and Restoration	Visual and landscape effects on Scheduled Monument: Ebberston Low Moor Round Barrow	Short term temporary		*						Moderate Beneficial
		Increased traffic movement of Scheduled Monument: Ebberston Low Moor Round Barrow	Short term temporary		*						Moderate Beneficial
		Landscape effects on setting of Scheduled Monument: Ebberston Low Moor earthworks	Short term temporary		*						Moderate Beneficial
Socio Economics	Construction	Effects on Employment	Short term temporary					*	*	*	Minor Beneficial
	Operation	Effects on Employment	Long term temporary					*	*	*	Minor Beneficial
		Effects on Gas Supply	Long term temporary		*						Major Beneficial
	Demolition and Restoration	Effects on Employment	Short term temporary					*	*	*	Minor Beneficial
Ground Conditions and Contamination	Construction	Hydrocarbon contamination	Short term temporary							*	Negligible
		Ground collapse during construction	Short term temporary							*	Negligible
		Landslides	Short term temporary							*	Minor Adverse
		Collapse of pipeline trench due to running sands	Short term temporary							*	Negligible

Topic	Stage of Development	Residual Effects	Duration of Effect	Geographical Importance							Significance of Residual Effect
				I	UK	E	R	C	D / NP	L	
	Operation	Hydrocarbon contamination	Temporary							*	Negligible
		Process waste contamination	Temporary							*	Negligible
	Decommissioning and Restoration	Hydrocarbon contamination	Short term temporary							*	Negligible
Produced Water Disposal	**Construction**	**Contamination of aquifer**	**Permanent/ Long Term**						*	*	**Negligible**
	Operation	**Contamination of aquifer**	**Permanent/ Long Term**						*	*	**Negligible**
	Decommissioning	**None**									**N/A**
	Restoration	**Reinstatement of original environment**	**Permanent**						*	*	**Negligible Beneficial**

*** Geographical Level of Importance**

I = International; UK = United Kingdom; E = England; R = Regional; C = County; D = District; NP = National Park; L = Local

18A.0 PRODUCED WATER DISPOSAL

Introduction

18.1 This chapter of the ES assesses the likely significant effects of the Proposed Development in terms of the disposal of produced water and should be read in conjunction with Chapter 12 Flood Risk, Hydrology and Drainage of the Original ES which assesses the effects on the surface water environment. The description of the process of injecting water into the Sherwood Sandstone formation is provided in Chapter 4A Proposed Development.

18.2 This chapter describes: the approach to disposal; the technical assessment; the baseline conditions relating to the disposal; the likely significant environmental effects; the mitigation measures required to prevent, reduce or offset any significant adverse effects; and the likely residual effects after these measures have been employed. This chapter has been prepared by Envireau Water.

Planning Policy Context

Relevant Legislation and UK Regulation

18.3 The European Water Framework Directive (2000/60/EC) (WFD) (Ref. 18.1) came into force in December 2000 and became part of UK law in December 2003. Groundwater issues are addressed by the Groundwater Daughter Directive (2006/118/EC) (GWDD) (Ref. 18.2) and the preceding Groundwater Directive (80/68/EEC) (GWD) (Ref. 18.3).

18.4 Disposal of water into the natural environment is controlled by the Environment Agency under the Environmental Permitting Regulations 2010 (Ref. 18.4). In order to be able to discharge water to groundwater a permit is required ("a groundwater permit") under these regulations.

18.5 The Environment Agency's groundwater protection strategy of prevention and limitation is informed by the publication, Groundwater Protection: Principles and Practice (Nov 2012, Version 1) (GP3) (Ref. 18.5).

18.6 The Applicant and its advisers have had a number of constructive discussions with the Environment Agency at both local (area) and national levels about the proposed disposal of produced water to the Sherwood Sandstone formation. The proposal to discharge water will be the subject of a formal application to the Environment Agency under the Environmental Permitting Regulations 2010 (Ref. 18.4).

18.7 A detailed review of the regulatory context of this application has been undertaken by the Applicant. The review demonstrates that under European and English law and regulation that the proposed discharge can be permitted if:

- The receiving water is permanently unsuitable and has no resource value;
- That the discharge lies within the policy described by the Environment Agency in GP3 (Ref. 18.5);
- That the discharge represents best available technology (BAT) and best practicable environmental option (BPEO);
- That the discharge meets the requirements of the Water Framework Directive (Ref. 18.1) and Groundwater Daughter Directive (Ref. 18.2).

National Planning Policy

18.8 The NPPF (Ref. 18.6) was published in March 2012 and sets out the new approach to streamlining the Planning System and encouraging growth. All previous Planning Policy Guidance (PPGs) and Planning Policy Statements (PPSs) listed in Annex 3 of the NPPF are replaced by the NPPF.

18.9 Fundamental principles underpinning the NPPF are the need to deliver sustainable development and build a strong, competitive economy nationwide. In terms of produced water disposal the following sections of the NPPF are considered of relevance to this assessment.

18.10 11. Conserving and enhancing the natural environment states in paragraph 109 that:

> ***"The planning system should contribute to and enhance the natural and local environment by:***
>
> - ***protecting and enhancing valued landscapes, geological conservation interests and soils;***
> - ***recognising the wider benefits of ecosystem services;***
> - ***minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological***

networks that are more resilient to current and future pressures;

- ***preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and***
- ***remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."***

18.11 In addition paragraph 143 states that:

"In preparing Local Plans, local planning authorities should:

- ***set out environmental criteria, in line with the policies in this Framework, against which planning applications will be assessed so as to ensure that permitted operations do not have unacceptable adverse impacts on the natural and historic environment or human health, including from noise, dust, visual intrusion, traffic, tip- and quarry-slope stability, differential settlement of quarry backfill, mining subsidence, increased flood risk, impacts on the flow and quantity of surface and groundwater and migration of contamination from the site; and take into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality;"***

Local Planning Policy

NYMNPA Local Development Framework

18.12 Mineral planning within the National Park comes under the jurisdiction of the North York Moors National Park Authority (NYMNPA). The Local Development Framework consists of a number of different documents to guide future development whilst ensuring that the National Park's special qualities are conserved and enhanced. The Core Strategy and Development Policies document, adopted in November 2008 (Ref. 18.7), is key to the NYMNPA Local Development Framework. It sets out a spatial vision for the future of the National Park and provides Core Policies guiding a strategic framework for the scale and location of all types of new development and detailed development policies against which individual proposals such as waste and minerals will be assessed.

18.13 Development Policy 1 Environmental Protection states that

"To conserve and enhance the special qualities of the North York Moors National Park, development will only be permitted where:

1. ***It will not have unacceptable adverse impact on surface and ground water, soil, air quality and agricultural land.***
2. ***It will not generate unacceptable levels of noise, vibration, activity or light pollution.***
3. ***There will be no adverse effects arising from sources of pollution which would impact on the health, safety and amenity of the public users of the development.***
4. ***Land stability can be achieved without causing unacceptable environmental or landscape impact. "***

Assessment Methodology

Desk Top Study

18.14 This assessment of the risk associated with the disposal of produced waters takes the form of a desk top study supported by water sampling and analysis undertaken in the summer of 2013. The assessment has covered the following key areas:

- A detailed overview of the relevant legislation and UK regulation governing disposal of produced water from onshore oil and gas production, within the context of the proposal to dispose of produced water from gas production at Ebberston Moor 'A' Well Site to the Sherwood Sandstone formation;
- A detailed, technical appraisal of the geology beneath the Ebberston Moor gas field and the quality of the relevant water bearing formations;
- A comprehensive risk assessment for the proposed method of disposal, conducted in accordance with the approach set out in DEFRA's Green Leaves III (Ref. 18.8). Green Leaves III is the latest edition of the Government's Guidelines for Environmental Risk Assessment and Management, providing generic guidelines for the assessment and management of environmental risks. The guidelines supersede earlier versions published in 1995 by the Department of the Environment, and in 2000 by the Department of the Environment, Transport and the Regions and the Environment Agency. Revision III brings the guidelines in England and Wales in line with current thinking in the field of environmental risk management;
- A robust justification for the proposed method of disposal, based on the principles of Best Practicable Environmental Option (BPEO) and Best Available Technology (BAT).

Technical Assessment

18.15 The desk top study reviewed the information provided by:

- Environment Agency;
- British Geological Survey;
- Geological Society;
- The Applicant's geological and geophysics (G&G) team; and
- Peer reviewed journals and other publications.

18.16 A full Bibliography of all reference materials used to inform the baseline study is presented in **Appendix 18A.1**. A dull description of the produced water injection proposals is contained within Chapter 4A Proposed Development.

18.17 The detailed technical assessment examined the following:

- The geographical, hydrological, geological and hydrogeological setting;
- Examination of water dependent features and protected water rights within a 70 km radius of the proposed injection site (Ebberston Moor 'A' Well Site);
- Examination of the quality of the formation water within the Permian Kirkham Abbey Formation (KAF) reservoir and the Sherwood Sandstone formation, both by analysis of samples and with reference to published information;
- Examination of proposed additives;
- Comparison of injection and formation waters with sea water; and
- Review of the injection method, rates and volumes.

18.18 The technical assessment has been drawn together into a conceptual model which is illustrated in **Figure 18.1**. In summary the conceptual model comprises:

- Four hydrogeological units – namely:
  - The geology above the Oxford Clay (Layer 1);
  - The geology from the base of the Mercia Mudstone to the Oxford Clay (Layer 2);
  - The Triassic Sherwood Sandstone formation (Layer 3); and
  - The Zechstein (Permian) / Carboniferous (Layer 4);
- The lateral variation in geology, is controlled by dip and east west faulting;
- Natural recharge to the Sherwood Sandstone formation is limited to the outcrop and subcrop areas in Vale of York / Mowbray. Recharge to the geology above the Oxford Clay is limited to the outcrop on the North York Moors;

- Hydraulic properties of the layers have been defined by literature search, but broadly:
  - Layer 1 can be taken as having useful hydraulic conductivity and storage;
  - Layer 2 is poorly permeable (very low hydraulic conductivity) and has limited useful storage;
  - Layer 3 has useful hydraulic conductivity and storage; and
  - Layer 4 has limited hydraulic conductivity and storage, and poorly permeable clay and mudstone horizons effectively hydraulically separate the Permian (Layer 4) from the overlying Triassic water bearing formation;
- Differences in water quality between the water bearing formations has been defined by literature search and confirmed in the case of Layer 3 & 4, from water sampling and analysis.
- The change in salinity of the formation water in the Sherwood Sandstone is illustrated by an arbitrary line on **Figure 18.2**. This line denotes a change from what can be described as groundwater to formation water. This line has been located based on the literature search and can be conceptualised as an isochlor (a line of equal salinity [or more accurately chloride concentration]); and
- To the west of the above line the Sherwood Sandstone can be considered to form an aquifer, where the groundwater has a resource value. The Ebberston Moor 'A' Well Site is some 40 km to the east of this aquifer, where the formation water has no resource value.

18.19 When combined, the various aspects of the conceptual model produce a system with no transfer of water vertically between the permeable Layers 1 and 3, either upward or downward. This is achieved by the low permeability and thickness of Layer 2 and low vertical hydraulic conductivity of Layer 4. The effectiveness of the hydraulic separation is demonstrated by the marked difference in water quality between Layers 1 and 3, where the sandstone is located at great depth; in excess of 1km below ground level.

18.20 The quality of the sandstone water at depth demonstrates that circulation of recharge into the Sherwood Sandstone formation is limited to near the outcrop/subcrop areas, with very little deep circulation occurring. Evidence published in the literature (Bottrell 2006) indicates that the sodium chloride (NaCl) in the sandstone formation water is mineral rather than sea water based. This demonstrates that the salinity is due to the long residence time of the water in the rock and the dissolution of salt based minerals. This further demonstrates that the significant down dip distance of the Ebberston Moor 'A' Well Site (~40 km) effectively separates it from the aquifer zone.

18.21 This assessment has adopted the following descriptions of groundwater, aquifers and formation water, in order to differentiate between the relatively shallow, potable water supplies and the deep system with no resource value:

- **Groundwater:** That water which occurs in the strata above the Triassic Mercia Mudstone and can be reasonably attributed to relatively geologically recent recharge and which would reasonably be considered to be wholesome (potable) unless it has been contaminated (altered) by anthropogenic activity;
- **Aquifer:** The strata that contains groundwater as described above;
- **Produced Water:** The water (brine) produced from the gas production formation in association with the extraction and separation of gas or the development of the well;
- **Formation Water:** The water (brine) within the deep geological horizons which can be considered as connate, or sourced from geologically old recharge and has no resource value; and
- **Water Bearing Formation:** A geological unit (or formation) which contains formation water.

18.22 The meaning of groundwater and aquifer are the same as that intended in the Water Framework Directive (Ref 18.1) and Groundwater Daughter Directive (Ref 18.2), whilst the other terms are commonly used in the oil and gas industry.

Assessment of Effects

18.23 The assessment of effects will use the criteria stated in Chapter 2, including the matrix detailed in **Table 2.1**, reproduced below as **Table 18.1**, which defines the level of significance of effects. Where an effect is considered to be significant, this significance will generally be classified as major, moderate or minor (with these descriptions again being based on precedent or current guidance).

Table 18.1: Significance Matrix

Sensitivity /Value of Receptor	Magnitude of Effect		
	High	**Medium**	**Low**
High (England, UK, International)	Major	Major/Moderate	Moderate
Medium (County, Regional)	Major/Moderate	Moderate	Moderate/Minor
Low (Local, Borough)	Moderate	Moderate/Minor	Minor

18.24 The three levels of significance defined by the generic matrix are:

- Major – an effect which in isolation could have a material influence on the decision making process;
- Moderate – an effect which on its own could have moderate influence on decision making, particularly when combined with other similar effects; or
- Minor – an effect which on its own is likely to have a minor influence only on decision making but when combined with other effects could have a more material influence.

18.25 Effects are also described as:

- Adverse – detrimental or negative effects to an environmental resource or receptor; or
- Beneficial – advantageous or positive effect to an environmental resource or receptor.

18.26 Where an effect is considered to be not significant or have no influence, irrespective of other effects, this is classified as "negligible".

18.27 Where an effect is not relevant for any reason then "NA" (not applicable) is used.

Limitations and Assumptions

18.28 This assessment is based on a desk study, supported by analysis of data on water quality in the KAF at Knapton and the Sherwood Sandstone formation at Ebberston Moor.

18.29 Appropriate geological and hydrogeological techniques have been used to extrapolate data to the Ebberston Moor 'A' Well Site and where necessary the extrapolations have been checked against published data for reasonableness.

18.30 The underlying assumptions therefore, are that the water quality identified from the samples which have been analysed are representative of the water quality at the Ebberston Moor 'A' Well Site and that the hydrogeological properties of the underlying geology is consistent with published information on those properties elsewhere in the region.

Baseline Conditions

Produced water quality

18.31 The Applicant is currently producing gas from wells targeting the KAF in the Vale of Pickering. The water produced from the wells is considered by Envireau Water to be representative of the produced water that would be obtained from producing wells targeting the KAF at Ebberston Moor gas field. This is based on the fact that the geological setting and

the depth of the geological units is similar in both cases.

18.32 A sample of injection water has been collected from the Vale of Pickering and was analysed in the RPS Mountainheath laboratory for a basic chemistry suite and EU defined hazardous and non-hazardous substances. The results are provided in **Appendix 18A.2**, whilst **Table 18.2** presents the principal components of the water.

Table 18.2: Major Cations, Anions and General Chemistry of Produced Water

Component	Result	Units
pH	5.6	pH units
ammonia	46.9	mg/l NH_3
chloride	170000	mg/l
fluoride	< 100.0	mg/l
nitrite	< 1000.0	mg/l
nitrate	< 1000.0	mg/l
phosphate	< 100.0	mg/l
sulphate	1050	mg/l
aluminium	63.0	µg/l
copper	< 2.0	µg/l
zinc	11.0	µg/l
potassium	5300	mg/l
magnesium	620	mg/l
calcium	6700	mg/l
iron	0.32	mg/l
manganese	220	µg/l
mercury	< 0.10	µg/l
sodium	84000	mg/l
conductivity	208000	µS/cm
total dissolved solids	Not Determined	mg/l
density	1212	g/l

18.33 The sodium, chloride and conductivity results are indicative of deep formation water and confirm that the production water is highly saline. Salt (sodium chloride) concentrations are greater than would be found in seawater (Hem 1985) (Ref. 18.8).

18.34 **Table 18.3** gives a summary of the main hydrocarbon analyses and shows that the production water contains in the region of 7.4mg/l of hydrocarbons, which is consistent with the fact that the production water is from a hydrocarbon (gas) reservoir.

Table 18.3: Diesel & Petrol Range Organics plus Mineral Oils

Component	Result	Units
aliphatic C5-C6:	280	µg/l
aliphatic C6-C8:	1200	µg/l
aliphatic C8-C10:	610	µg/l

Component	Result	Units
aliphatic C10-C12:	820	µg/l
aliphatic C12-C16:	550	µg/l
aliphatic C16-C21:	75	µg/l
aliphatic C21-C35:	73	µg/l
aromatic C5-C7:	1600	µg/l
aromatic C7-C8:	1100	µg/l
aromatic C8-C10:	940	µg/l
aromatic C10-C12:	120	µg/l
aromatic C12-C16:	72	µg/l
aromatic C16-C21:	5.9	µg/l
aromatic C21-C35:	< 1.0	µg/l
aliphatic C5-C35:	3600	µg/l
aromatic C5-C35:	3800	µg/l
TPH ali/aro:	7400	µg/l

Sherwood Sandstone formation water quality

18.35 Samples were collected from the Ebberston Moor EMB well site on 21 August 2013 at depths of 1131m and 1141m below ground level. Full results are provided in **Appendix 18A.3** and **Table 18.4** provides a summary of the key components. These results are consistent with a detailed literature review of Sherwood Sandstone formation water chemistry and on that basis are considered representative.

Table 12.4: Major Cations, Anions and General Chemistry of Sherwood Sandstone Formation Water

Component	Result		Units
	232206 1131mbgl	232207 1141mbgl	
pH	6.7	6.3	pH units
ammonia	13	13	mg/l NH3
chloride	108000	101000	mg/l
fluoride	<100	<100	mg/l
nitrite	<3000	<3000	mg/l
nitrate	<100	<100	mg/l
phosphate	<100	<100	mg/l
sulphate	12600	11600	mg/l
aluminium	79	200	µg/l
copper	220	390	µg/l
zinc	340	350	µg/l
potassium	5700	6900	mg/l
magnesium	440	310	mg/l
calcium	2100	2100	mg/l
iron	8.9	17.0	mg/l
manganese	620	600	µg/l

Component	Result		Units
	232206 1131mbgl	232207 1141mbgl	
mercury	1.99	.25	µg/l
sodium	65000	61000	mg/l
conductivity	260000	250000	µS/cm
total dissolved solids	190000	180000	mg/l
density	1100	1100	g/l

18.36 **Table 18.5** gives a summary of the main hydrocarbon analyses and shows that the formation water in the Sherwood Sandstone formation contains in the region of 0.5 – 1.2mg/l of naturally occurring hydrocarbons, which is consistent with the fact that the Sherwood Sandstone formation is a hydrocarbon reservoir on a regional scale.

Table 12.5: Diesel & Petrol Range Organics plus Mineral Oils in the Sherwood Sandstone

Component	Result		Units
	232206 1131mbgl	232207 1141mbgl	
aliphatic C8-C10:	<0.1	<0.1	µg/l
aliphatic C10-C12:	72.0	29.0	µg/l
aliphatic C12-C16:	550	160	µg/l
aliphatic C16-C21:	200	110	µg/l
aliphatic C21-C35:	200	110	µg/l
aromatic C8-C10:	<0.1	<0.1	µg/l
aromatic C10-C12:	7.4	1.3	µg/l
aromatic C12-C16:	77.0	14.0	µg/l
aromatic C16-C21:	35.0	8.3	µg/l
aromatic C21-C35:	79.0	30.0	µg/l
aliphatic C8-C35:	1022	409	µg/l
aromatic C8-C35:	198.4	53.6	µg/l
TPH ali/aro:	1220.4	462.6	µg/l

Sea Water Quality

18.37 In order to provide a context of the salinity of the produced water from the Sherwood Sandstone formation, a comparison has been made to the salinity of the North Sea.

18.38 The Royal Belgian Institute of Natural Sciences provides monitoring data on the salinity of the North Sea. Data collected from their website (www.naturalsciences.be) (Ref. 18.9) shows that the salinity (total dissolved solids) is in the order of 34,000 to 35,000 mg/l.

Comparison of Water Types

18.39 **Table 18.6** gives a summary of the main constituents of the two different waters with a comparison of the North Sea salinity. The results show that the KAF water is approximately two times more saline than the Sherwood Sandstone formation water, owing to a higher concentration of sodium chloride. However, this is within the context of both waters having total dissolved solids concentration (TDS) in excess of 180,000mg/l. Both waters show significant amounts of naturally occurring hydrocarbons, with the produced water showing more, as would be expected. The produced water and Sherwood Sandstone formation water are 10 and 5 times more saline than the North Sea, respectively.

Table 18.6: Comparison of Produced, Formation and Sea Waters

Component	Result			Units
	KAF Produced Water	Sherwood Sandstone Formation Water	North Sea	
Conductivity	208000	255000		µS/cm
TDS	349	180	34 - 35	g/l
Density	1212	1100		g/l
Chloride	170	104.5		g/l
Sulphate	1.05	12.1		g/l
Sodium	84	63		g/l
Calcium	6.7	2.1		g/l
Potassium	5.3	6.3		g/l
aliphatic C8-C35:	3600	715		µg/l
aromatic C8-C35:	3800	126		µg/l
TPH ali/aro:	7400	841		µg/l

Likely Significant Effects

18.40 The proposed disposal route for produced water is injection into the Sherwood Sandstone formation, below the Ebberston Moor 'A' Well Site. This section provides an assessment of the effects resulting from the injection activities without the inclusion of mitigation measures beyond those incorporated directly into the design of the Proposed Development.

Construction

18.41 Construction of the injection well is controlled by The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 (Ref. 18.11) and the environmental impacts via a notice to the Environment Agency under section 199 of the Water Resources Act 1991 (Ref. 18.12).

18.42 While the construction of any well or borehole poses a theoretical risk to shallow aquifers, the construction method and final completion is designed and operated to minimise any significant effects. Standard practice and regulatory requirements mean that shallow aquifers are cased, grouted and sealed before a well is progressed into underlying geological units which may contain poor or saline water. Therefore the only plausible risk of contamination of water supplies will relate to inadequate construction of the injection well.

18.43 The effect of any issues arising during construction would be limited to the immediate environs of the well and of a low magnitude. Thus the overall effect would be minor adverse.

Operation

18.44 Injection of produced water will be via a borehole, constructed for the purpose into the Sherwood Sandstone formation. Planning permission was granted by NYMNPA in 2013 for two appraisal boreholes and one of these will be used for injection purposes. The borehole will be cased and grouted to the injection zone and injection will take place in either an open hole or through a perforated section, depending on the stability of the borehole wall.

18.45 Injection will be achieved by low pressure injection from surface; the hydrostatic pressure of the water column will assist the water injection with only limited additional pressure added from pumping.

18.46 The moderate hydraulic conductivity of the Sherwood Sandstone formation means that no high pressure injection is anticipated, since the "injectivity" of the well should be sufficient to provide the required injection flow rates. During the life of the injection well, accumulation of fines may lead to a higher pressure being required to maintain injection flow rates although the injection pressure will always be below the material strength of the Sherwood Sandstone formation and therefore far below the pressure required to fracture the rock.

18.47 The proposed rates and volumes of injection for the Proposed Development and the (preceding) EDS scheme are presented in **Table 18.7** below.

Table 18.7: Proposed Injection Rates & Volumes for the Proposed Development

Duration (years)	Total Injection Volume (m^3)	Average Daily Injection (m^3/day)
5.00	3.47 million	1900

18.48 Assuming that the total volumes above are injected into a formation with a porosity of 10%; and the water forms a spherical bubble, the radius of the bubble for the total volume would

be in the order of 200m (400m diameter). If it is assumed that the porosity is 1%, then the radius increases to 435m (870m diameter).

18.49 The act of injection will result in displacement of the formation water, with a theoretical zone of influence of less than 900m. The effects of the displacement will be controlled by the elastic storage of the formation. Assuming this to be 1 x 10^{-5} m^3/m^3 then head effects would be expected to propagate up to 4400m from the injection point. Given the fact that the Assessment Site is 40 km from the outcrop; where the Sherwood Sandstone contains useful groundwater, then no effect will be seen in the outcrop area.

18.50 The conceptual model has been used as the basis of a risk assessment for the proposed disposal of produced waters to the Sherwood Sandstone at Ebberston Moor in accordance with the DEFRA Green Leaves III (GL III) (Ref. 18.8) methodology. The risk assessment has covered:

- Hazard Identification;
- Source – Pathway – Receptor linkage analysis;
- Consequence – Likelihood – Risk analysis; and
- Mitigation analysis.

18.51 The analysis shows that while the consequence of contamination would be high, the likelihood and therefore the risk of occurrence is very low. The likelihood of occurrence is low because:

- Approximately 750m of low permeability formations provide a vertical separation between the point of injection and the nearest groundwater supplies; and
- The lateral distance between the point of injection and the Sherwood Sandstone outcrop area is in excess of 40 km and injection displacement of formation water is less than 400m, with pressure effects limited to less than 3.9 km.

18.52 Owing to the natural geology at Ebberston Moor, disposal of produced water will not present any discernible impact on the quality of groundwater, the Sherwood Sandstone formation water, any potential receptors; or beneficial users which may be abstractors for domestic or industrial / agricultural uses; or the natural environment where groundwater feeds springs, wetlands and base flow to rivers.

18.53 During operation of the injection system, there will be no change from the baseline situation in the overall risk to the groundwater system. The only plausible risk of contamination of water supplies would therefore relate to inadequate construction of the injection well. As

such, the effect of any issues arising during operation would be limited to the immediate environs of the well and of a low magnitude. Thus the overall effect would be minor adverse.

Decommissioning

18.54 The decommissioning of the injection system will involve shutting down the injection well and removal of the equipment. All pipelines and ancillary equipment will be drained and then dismantled down to their original components in order for them to be transported away from the well site. Any residual water in the pipelines will be collected and stored, for safe disposal at a suitable facility.

18.55 The injection well will be decommissioned before the impermeable base to the well site is removed. Therefore any saline water that is spilt will be captured and recovered by the water management system on the well site.

Contaminant Risk during Decommissioning of the System

18.56 During decommissioning of the injection system, there will be no change from the baseline situation in the overall risk to the groundwater system. As such, there is no significant effect.

Restoration

18.57 Restoration will result in cutting the well casing at 2m below ground level; sealing the top of the well with a steel plate and placement of a 1.5m x 1.5m x 300mm concrete block over the plate. The land will be reinstated to its original level, using the soil stored in the stockpiles and bunds around the well site.

Contaminant Risk during Restoration

18.58 During restoration of the injection system, there will be no change from the baseline situation in the overall risk to the groundwater system.

18.59 Completion of the restoration phase will result in the appropriate sealing of the injection well and removal of potential contaminants from the well site so that there will be a long term negligible beneficial significance.

Mitigation Measures

18.60 This section provides a description of the mitigation measures to be incorporated into the Proposed Development to minimise the possible minor adverse effects, identified above.

18.61 The Significance Analysis above has identified that the only plausible risks of contamination of water supplies is during the construction and operational phases which would relate to inadequate construction of the injection well.

18.62 In accordance with best practice, a number of mitigation measures will be taken to minimise the risks associated with the disposal of produced waters to the Sherwood Sandstone formation. These will be based on The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 (Ref. 18.11) to ensure that the well is designed, modified, constructed, commissioned, operated and abandoned, such that there is no unplanned escape of fluids from the well and that the risks to the health and safety of person from it or anything in it, or in strata to which it is connected, are as low as is reasonably practicable. This will be confirmed in writing by an independent competent person before the design of the well is commenced, to ensure that the well is designed and constructed properly and is maintained adequately. These regulations ensure that the well is designed and planned to the highest standards. In addition, injection pressures will be generally low and will always be controlled to ensure they do not exceed the strength and fracturing pressure of the formation.

Residual Effects

18.63 Based on the application of these mitigation methods, the residual risk associated with the proposed injection of produced water to the Sherwood Sandstone formation through all phases of the Proposed Development is negligible.

Cumulative Effects

18.64 The injection system into the Sherwood Sandstone formation is a self-contained activity. There are no other similar schemes in the region and therefore there are no cumulative effects to consider.

Summary

18.65 The water to be produced during the production of gas is from the gas reservoir within the Permian Kirkham Abby Formation (KAF). The produced water is highly saline with salt concentrations greater than would be found in seawater. The produced water will be injected into the Sherwood Sandstone formation which is located above the KAF. The produced water originating from the KAF will typically have twice the salinity than the Sherwood Sandstone formation water. In addition both waters show significant amounts of naturally occurring hydrocarbons related to the presence of natural gas. The water found in the KAF and Sherwood Sandstone beneath the well site is not used for drinking water or any other uses and is separated from drinking water and other usable water supplies vertically by impermeable rock and horizontally by a considerable distance.

18.66 The injection system into the Sherwood Sandstone formation involves the movement of water from one very saline water bearing formation to another. In both cases the formation water has no resource value. The geological units involved are at great depth; are distant from any groundwater with resource value; and lie below a great thickness of clay rich, low permeability geological units.

18.67 Based on the nature of the natural geology and the application of appropriate mitigation methods, the residual risk associated with the proposed injection of produced water through all phases of the Proposed Development is negligible.

18.68 The injection system into the Sherwood Sandstone formation is a self-contained activity. There are no other similar schemes in the region and therefore there are no cumulative effects to consider.

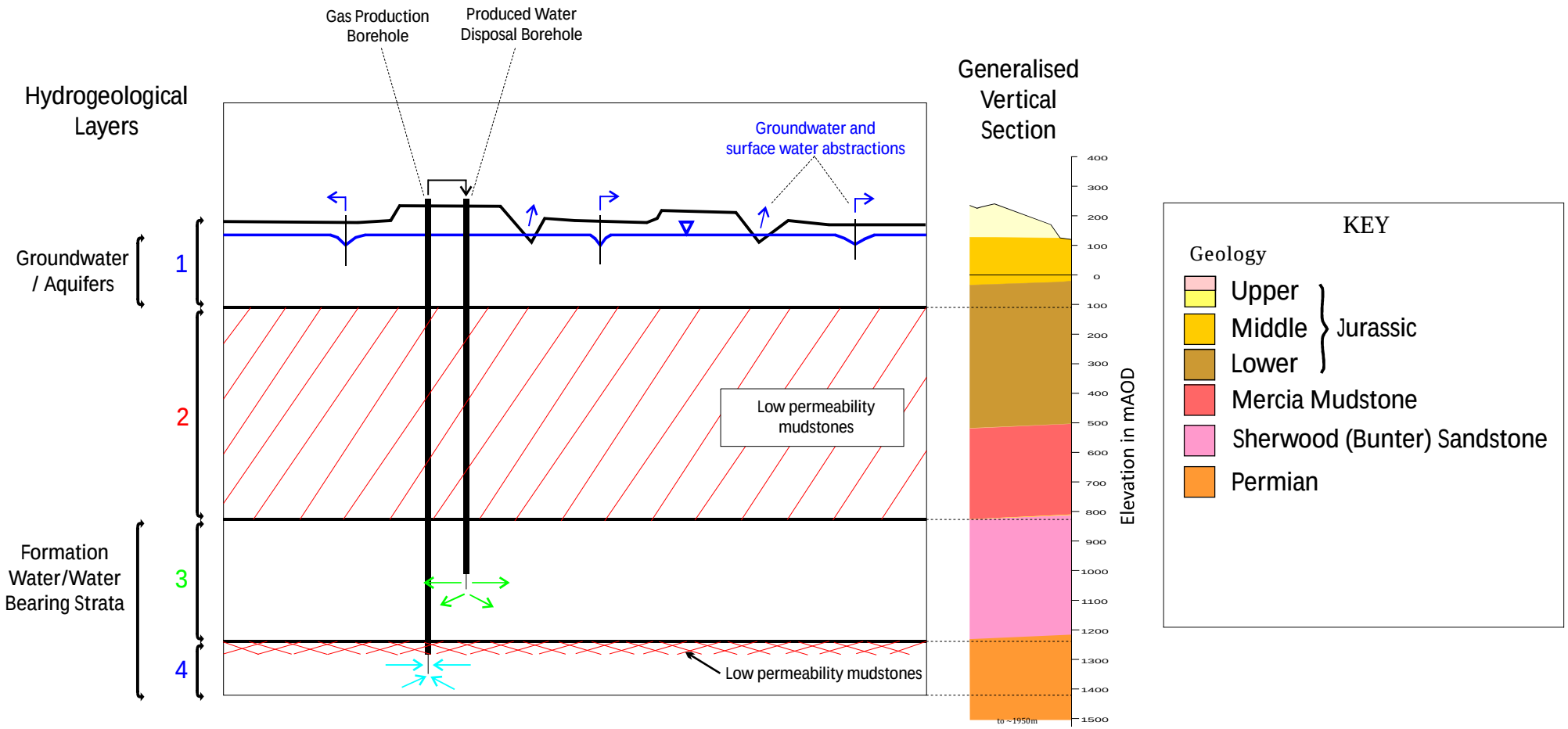
18.69 The injection system has been discussed at length with the Environment Agency at both local and national levels. The permit application and determination process will run in parallel with the planning process.

18.70 **Table 18.7** contains a summary of the likely significant effects of the injection system.

Table 18.7: Table of Significance – Produced Water Disposal

Potential Effects	Nature of Effects (Permanent/ Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse/ Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)
				I	UK	E	R	C	NP	L	
Construction											
Contamination of Aquifer	Permanent/Long Term	Major/Moderate Adverse	Well cased into injection horizon						*	*	Negligible
Contamination of Aquifer during construction	Permanent/long term	Major/Moderate Adverse	Implement rigorous site management of the construction process using The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996						*	*	Negligible
Operation											
Contamination of Aquifer	Permanent/Long Term	Major/Moderate Adverse	Geology of site naturally controls risk						*	*	Negligible
Decommissioning											
None	N/A	N/A	N/A								N/A
Restoration											
Reinstatement of original environment	Permanent	Moderate Beneficial	None						*	*	Negligible Beneficial
Cumulative Effects											
None	N/A	N/A	N/A								N/A

***Geographical Level of Importance**
I = International; UK = United Kingdom; E = England; R = Regional; C = County; NP = National Park; L = Local



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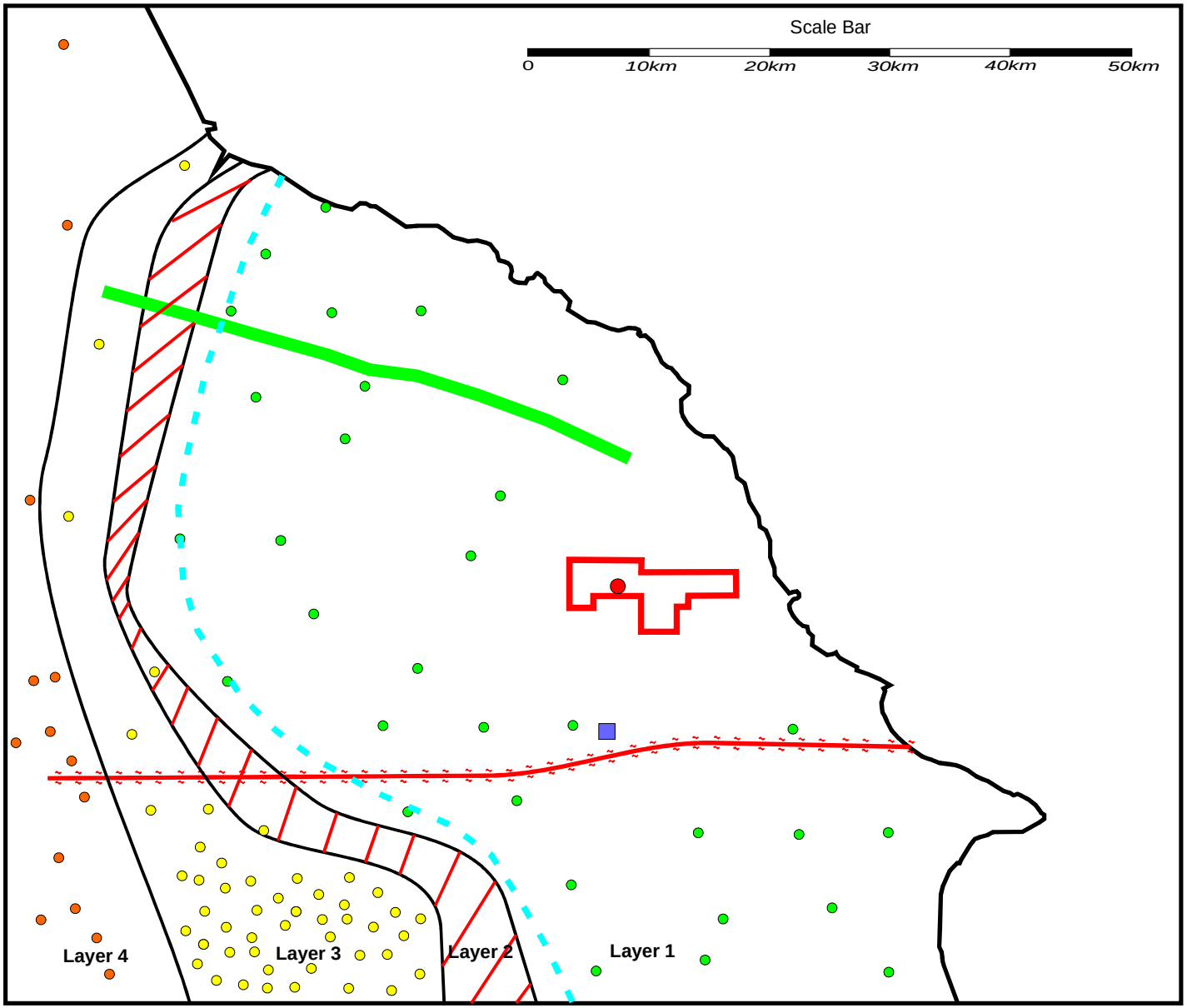
Ref: P:\Viking Planning Support (1631) \Figure A Date: 17/11/13	
Figure 18.1	Conceptual Model - Cross Section



KEY

Ebberston Moor A well site (NGR SE 89901 89679)

Petroleum Licence Pl077 (Ebberston Moor Field)

Knapton Generating Station

Fault Zone

Cleveland Dyke

Schematic Groundwater Abstractions
Density denotes concentrations of abstractors
Colour denotes source layer

Layer 1 Layer 3 Layer 4

Schematic Isochlor
Line denotes a conjectured line of equal salinity separating groundwater from formation water in Layer 3

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Ref: P:\Viking Planning Support (1631) \Figure B Date: 17/11/13	
Figure 18.2	Conceptual Model - Plan

REFERENCES

The additional references are set out below; the remainder of the references are as previously set out within the ES.

CHAPTER 18: PRODUCED WATER DISPOSAL

18.1 European Water Framework Directive - DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Communities.

18.2 Groundwater Daughter Directive - DIRECTIVE 2006/118/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 December 2006 on the protection of groundwater against pollution and deterioration. Official Journal of the European Union.

18.3 Groundwater Directive - Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances. Official Journal of the European Communities.

18.4 Environmental Permitting (England and Wales) Regulations2010

18.5 Environment Agency (November 2012) Groundwater Protection: Principles and Practice (GP3), Version 1,

18.6 Department of Communities and Local Government (March 2012) National Planning Policy Framework

18.7 North York Moors National Park Authority Development Framework (2008). Core Strategy and Development Policies (Adopted Nov 2008)

18.8 Defra and the Collaborative Centre of Excellence in Understanding and Managing Natural and Environmental Risks, Cranfield University (November 2011) Green Leaves III - Guidelines for Environmental Risk Assessment and Management: Green Leaves III. Revised Departmental Guidance Prepared by Defra and the Collaborative Centre of Excellence in Understanding and Managing Natural and Environmental Risks, Cranfield University

18.9 Hem (1985) Study and Interpretation of the Chemical Characteristics of Natural Water. USGS Water Supply Paper 2254

18.10 Royal Belgium Institute of Natural Sciences website: www.naturalsciences.be

18.11 The Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996

18.12 Water Resources Act 1991

APPENDIX 18A.1

REFERENCE DOCUMENTS FOR DESCRIBING BASELINE CONDITIONS

APPENDIX 18A.1: REFERENCE DOCUMENTS FOR DESCRIBING BASELINE CONDITIONS

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E027 - Durham

E032 - Barnard Castle

E033 - Stockton

E034 - Guisborough

E035 - Whitby & Scalby (includes part of E044)

E041 - Richmond

E042 - Northallerton

E043 - Egton

E051 - Masham

E052 - Thirsk

E053 - Pickering

E054 - Scarborough

E055 - Flamborough and Bridlington (includes part of E065)

E062 - Harrogate

E063 - York

E064 - Great Driffield

E070 - Leeds

E071 - Selby

E072 - Beverley

E073 - Hornsea

E078 - Wakefield

E079 - Goole

E080 - Kingston upon Hull

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APPENDIX 18A.2

KAF WATER QUALITY

APPENDIX 18A.3

SHERWOOD SANDSTONE WATER QUALITY

APPENDIX 18A.4

GLOSSARY OF TERMS

Glossary of Technical Terms

Hydrogeological unit	A geological unit or group of units that behave in a similar hydrogeological manner
Dip	Slope of geological units
Outcrop	Where geological units occur at the surface (or at shallow depths)
Sub-crop	Where geological units occur below other materials, often superficial deposits
Hydraulic conductivity	The ability of a geological unit to transmit water
Storage	The volume of water that can be released from a unit volume of rock under a unit fall in head (water level)
Elastic storage	Storage due to the elastic nature of a rock mass
Salinity	Synonymous with Total Dissolved Solids (TDS), within the context of this report
Isochlor	A line of equal salinity, within the context of this report
Injectivity	The ability of a geological unit to accept a fluid via well injection
Porosity	Proportion by volume of the pore space volume of a volume of rock or soil
Zone of influence	Area around a well or borehole where the water head or pressure is materially affected by the act of abstraction or injection