15.0 GROUND CONDITIONS AND CONTAMINATION

Introduction

15.1 This chapter assesses the likely significant effects of the Development on the existing geology (including overlying soils) and other ground conditions such as ground instability and contamination. This chapter is supported by information contained in Appendix 15.1.

15.2 The chapter describes: the assessment methodology; the baseline conditions at the Site and surroundings; 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.

Planning Policy Context

15.3 This section presents the national legislation, national planning policy, regional planning policy and local planning policy that is relevant to the geology and ground conditions assessment relating to the Development.

National Planning Policy

National Planning Policy Framework (NPPF), March 2012 [i].

15.4 The National Planning Policy Framework was published by the Government in March 2012, with the purpose of providing simple and clear guidance to the Local Planning Authorities to help achieve sustainable development when considering planning applications affecting protected habitats, sites and species. Circular 06/2005 [ii], which provides further guidance on the statutory obligations for Biodiversity and Geological Conservation and their impact within the planning system has been retained for information.

15.5 With regard to geodiversity, the NPPF includes the following:

> *"The planning system should contribute to and enhance the natural and local environment by:*
> - *Protecting and enhancing valued landscapes, geological conservation interests and soils;"* (paragraph 109)
>
> *"Distinctions should be made between the hierarchy of international, national and locally designated sites* (citing Circular 06/2005) *so that protection is commensurate with their status and gives appropriate*

weight to their importance and the contribution that they make to wider ecological networks." (paragraph 113)

Planning Practice Guidance (PPG) (March 2014)

15.6 Guidance on dealing with land impacted by contamination is provided in the PPG (ID 33), which explains why local planning authorities should be concerned about contaminated land and how planning contributes to dealing with the risk of contaminated land. The guidance also considers: when contamination is likely to be present; how Local Plans consider contaminated land; and how concerns of land contamination are relevant to neighbourhood planning.

15.7 Guidance on dealing with land stability is provided in the PPG (ID 44) to ensure that development is appropriately suited to its location, and that there are no unacceptable risks caused by unstable land or subsidence. The guidance also considers: what is the role of local plans in planning for land instability in their areas; where can planning authorities obtain information on land stability issues; what measures can planning authorities take to mitigate the risk of subsidence; what steps should the developers take if they suspect land stability is an issue for an individual application; what should a land stability risk assessment report contain; what role does the Coal Authority play in the planning system to prevent land instability.

15.8 Guidance on dealing with mineral extraction and in particular hydrocarbon extraction is provided in the PPG (ID 27) in plan making and the application process. The guidance also considers: the phases of hydrocarbon extractions; when is planning permission required for the extraction of hydrocarbons; whether a single planning application covers more than one phase of extraction; how should mineral planning authorities plan for hydrocarbon extraction; what are mineral planning authorities expected to include in their local plans on hydrocarbons; can mineral planning authorities include site-specific locations in their local plans; should mineral planning authorities be safeguarding areas for the extraction of hydrocarbons; what is the role of planning in obtaining permissions for drilling wells; who are the key regulators for hydrocarbon extraction; what other bodies may be involved in the process of consenting hydrocarbon extraction; what hydrocarbon issues can mineral planning authorities leave to other regulatory regimes; what role do statutory and non-statutory consultees have at the pre-application stage; should planning performance agreements be used for hydrocarbon extraction; what information should be included on a location plan for oil and gas extraction; what issues should mineral planning authorities include on their local list for exploration of hydrocarbons; what constitutes an application for an exploratory well;

can vertical and horizontal drilling, including hydraulic fracturing, be included in one application for exploratory drilling; when is an Environmental Impact Assessment required for hydrocarbon extraction; should mineral planning authorities take account of the environmental effects of the production phase of hydrocarbon extraction at the exploration phase.

National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4), July 2011[iii].

15.9 The National Policy Statement (NPS) for Gas Supply Infrastructure and Gas & Oil Pipelines was published in July 2011. Paragraph 1.2.1 states that the NPS, together with the 'Overarching Policy Statement for Energy' (EN-1), provides the basis for decisions by the IPC [now the Secretary of State for Energy and Climate Change] on applications for gas supply and infrastructure and gas and oil pipelines that are nationally significant infrastructure projects. Paragraph 1.2.3 goes on to say that the NPS is likely to be a material consideration in decision making on relevant applications that fall under the Town and Country Planning Act 2011 [iv]. Whether and to what extent the NPS is a material consideration will be judged on a case by case basis.

15.10 The NPS states that pipelines may be installed in a variety of geological conditions and therefore it is important to understand the soil types and the nature of the underlying strata. This is because underground cavities in the ground such as caves or mines and unstable ground conditions such as running sands or landslide areas could pose risks to pipeline projects. Impacts could include sterilisation of mineral resources or loss of soil quality. The National Policy further states that:

> *"Applicants should assess the stability of the ground conditions associated with the pipeline route and incorporate the findings of that assessment in the ES…"*
>
> *"…When considering any application where the pipeline goes under a designated area of geological or geomorphological interest, the applicant should submit details of alternative routes, which either bypass the designated area or reduce the length of pipeline through the designated area to the minimum possible, and the reasons why they were discounted."*

15.11 Construction activities also have the potential to cause pollution due to waste management activities resulting in contamination of the land, groundwater or surface water. Under the Environmental Protection Act 1990 [v], the Environment Agency is responsible for prevention of pollution of the environment, harm to human health and detriment to local amenity. The

Environment Agency has produced guidance for the management of environmental impact of construction activities [vi] which is also considered pertinent to the Development.

Local Planning Policy

North Yorkshire Minerals and Waste Plan 1991

15.12 Contains policies which need to be taken into consideration while drawing up a planning application for minerals development and which must bear in mind when deciding such applications.

The following policies are related to the ground condition:

- Policy 3/7 - Mineral sterilisation;
- Policy 4/3 - Areas of outstanding natural beauty;
- Policy 4/5 - Other areas of landscape quality;
- Policy 7/5 - Production wells;
- Policy 7/6 - Development scheme;
- Policy 7/8 - Gathering stations;
- Policy 7/9 - Transport;
- Policy 7/10 - Restoration;
- Policy 7/11 - Retention of features;
- Policy 7/12 - Pipelines;

North York Moors National Park Authority Core Strategy and Development Policies (2008) [vii]

15.13 The North York Moors National Park Authority has published planning advice in respect of developments potentially affecting geological receptors. This document includes a number of references in terms of geological conservation, ground stability and avoidance of adverse impact on soil. These policies provide the framework for more specific actions required for the determination of planning applications and are summarised as follows:

- Core Policy C – Natural Environment, Biodiversity and Geodiversity. The policy recognises the importance of Regionally Important Geological / Geomorphological Sites (RIGS), which are identified as worthy of protection for their educational, scientific, historical or landscape importance. The policy takes forward the following spatial objectives in terms of management of the natural environment:

  "Conserve and enhance the natural environment and biological and geological diversity of the Park". The policy expresses that all developments, projects and activities will be expected to: *"...Maintain*

> *and where appropriate enhance recognised geodiversity assets"* and *"Maintain and where appropriate enhance other sites, features, species or networks of ecological of geological interest and provide for appropriate management of these"*.

- Development Policy 1 – Environmental Protection. The policy refers specifically to issues of ground instability and especially to peripheral areas comprising of steep slopes and cliffs affected by landslip, historical mine workings, coastal erosion or compression of soft upland peat. It states that ground stability can be a material consideration in determining a planning application. It also states that detailed information is not available on where unstable land exists in the National Park, but in some cases the authority may request the applicant to demonstrate that land is stable or that any instability can be overcome. These objectives are listed in Items 1 and 4:

> "*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 an unacceptable adverse impact on surface and ground water, soil, air quality and agricultural land*.", and *"[4] Land stability can be achieved without causing unacceptable environmental or landscape impact."*

The Ryedale Local Plan Saved Policies (adopted 22 March 2002) [viii]

15.14 The Ryedale Local Plan is in the process of being replaced by the Local Development Framework (LDF). In the meantime the Ryedale Local Plan contains a number of key policies, which have been retained since 27 September 2007 under instruction from the Secretary of State until they are replaced by the LDF.[ix]

The Ryedale Plan – Local Plan Strategy September 2013) [x]

15.15 The Ryedale Local Plan Strategy was adopted in September 2013 and superseded the 2002 Ryedale Local Plan. The new Local Plan details the proposed delivery of housing, employment and retail development in the county for the next 15 years. The Local Plan will also ensure the protection of key Ryedale assets such as environmental and historic assets. There is one policy relevant to ground conditions and contamination, which is summarised below:

- Policy SP17 (Managing Air Quality, Land and Water Resources).The relevant section of this policy states that:

> *"Land resources will be protected and improved by…supporting new uses for land which is contaminated or degraded where an appropriate scheme of remediation and restoration is agreed and in place…"*

Assessment Methodology and Significance Criteria

Assessment Methodology and Sources of Information

15.16 The assessment of ground conditions has involved collation and review of available information pertaining to the current condition of soil and bedrock within the Site extending from the EMS Well Site to Knapton Generating Station (KGS). This information provides the basis for characterisation of the baseline conditions at the Site. The information has been reviewed in context of the Development and used to evaluate direct and indirect effects posed in the short, medium, and long-term.

15.17 The following data was reviewed as part of the assessment:

- Landmark Envirocheck® and GroundSure Reports (see Appendix 15.1);
- DEFRA Magic – interactive online geographic information on land classification [xi];
- North York Moors National Park Authority – Local Development Framework – Proposals Map;
- British Geological Survey (BGS) [xii] solid and drift geology maps [xiii];
- The Geological Memoir of the country between Whitby and Scarborough [xiv];
- Current Ordnance Survey Mapping [xv]; and
- British Geological Survey (BGS) GeoRecords and boreholes browser [xvi].

Significance Criteria

15.18 A qualitative assessment of potential effects has been carried out using the significance criteria described in Chapter 2 of the ES and summarised in Table 15.1. The assessment, where possible identifies, describes and assesses the likely significant effects of the Development on the environment.

15.19 The process of EIA sets out to determine the significance of an effect to a receptor, which may include land, water or persons. Determination of the significance is based on a relationship between sensitivity (importance or value of affected receptor) and magnitude or severity of an effect (actual change taking place).

15.20 The determination of significance also includes considerations of the type of effect (beneficial or adverse); the extent and magnitude of the effect; the duration of the effect (short, medium, long-term, temporary or permanent); and, the nature of the effect (direct, indirect, reversible or irreversible).

15.21 The definitions of pre-mitigation and residual significance of effects specific to ground conditions and contamination take into account the large body of technical literature and guidance that has been produced in the UK for the assessment of ground conditions by the Government (Department of Environment, Food and Rural Affairs – DEFRA), and predecessor Departments and agencies such as the Environment Agency. The following documents are considered to be relevant to the assessment:

- DTLR Development on land affected by contamination – Consultation paper on draft planning technical advice[xvii];
- Part 2A of the Environment Protection Act, DEFRA Circular 01/2006 [xviii];
- Environment Agency Remedial Targets Methodology[xix]; and
- Contaminated Land Research (CLR) Reports 7 to 13 [xx] [xxi] [xxii] [xxiii] [xxiv] [xxv].

15.22 The guidance provides for staged and risk-based data interpretation. The preliminary assessment is undertaken according to the criteria set out for a generic risk assessment. Based on the outcome of the initial review it may be required to proceed through to a more onerous development of site specific criteria, determined by calculation. The former are set as a boundary limit, which when not exceeded, minimise the likelihood that relevant receptors will be exposed to significant levels of risk. But when these limits are exceeded, it becomes appropriate to undertake further assessment, which may include for additional data collection and site-specific risk assessment to determine the need for further action.

15.23 The CLA reports (No's 7 to 13) set out the process required to calculate specific soil guideline values (SGV), including the Contaminated Land Exposure Assessment (CLEA) model, in order to safeguard human health.

Table 15.1: Assessment Significance Matrix

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

15.24 The assessment of the significance of the Development on the geology and ground conditions is made by comparing the existing geology and ground conditions to the likely conditions during construction, operation and decommissioning and restoration. The definition of low, medium and high magnitude of effect is subjective for effects to both ground conditions and geology. However, comment is made in the context of the guidance and legislation described above as follows:

- High: In terms of ground conditions, a major effect would be defined as a potential significant effect identified for a specific receptor i.e. Construction Worker - Potential loss of human life / serious injury or illness;
- Medium: In terms of ground conditions, a moderate effect would be defined as a consequence that could result in land contamination as defined under Part 2A of the Environmental Protection Act, 1990; and
- Low: In the case of ground conditions, a minor effect would be defined as disruption to construction, demolition or operation of the facility.

15.25 Based on the sensitivity of the receptor and magnitude of the effect, three levels of significance are defined as:

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

15.26 Where an effect is considered to be not significant or have no influence, irrespective of other effects, then it is classified as 'negligible'.

15.27 Where appropriate, the effects may also be described as:

- Adverse: presenting detrimental or negative effects to an environmental resource or receptor; or
- Beneficial: of beneficial or positive effect to an environmental resource or receptor.

Limitations and Assumptions

15.28 The conclusions and recommendations contained in this chapter are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by URS has not been independently verified by URS, unless otherwise stated in the chapter.

15.29 The methodology adopted and the sources of information used by URS are outlined in this chapter. The work described in this chapter was undertaken between June 2014 and July 2014 and is based on the conditions encountered and the information available during the said period of time. The scope of this assessment and the services are accordingly factually limited by these circumstances.

15.30 Where assessments of works or costs identified in this chapter are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

15.31 The field investigations have been restricted to a level of detail required to meet the stated objectives of the services. The results of any measurements taken may vary spatially or with time and further confirmatory measurements should be made after any significant delay in issuing this chapter.

15.32 This chapter does not classify soils in terms of soil associations as reported in the Soil Survey of England and Wales. As such, no reference has been made to specific soil properties, classifications or other soil characteristics relating to the soil associations affected by the Development.

Baseline Conditions

Site Inspection

15.33 The Site comprises the EMS Well Site and a pipeline corridor extending from the EMS Well Site situated on Ebberston Low Moor to KGS. The reader should refer to chapter 3 for further information on the site. The landscape of the pipeline route is described in chapter 7. The geomorphology of the site is shown on Figures 15.1 to 15.9.

EMS Well Site

15.34 The existing EMS Well Site is located approximately 6km to the north of the A170 Pickering to Scarborough Road. The EMS Well Site is separated from open farmland by a substantial hedgerow which aligns the Tabular Hills Walk. Land to the south and south-east is primarily open farmland used for arable farming. Land to the north, west and south-west is forested. Access to the EMS Well Site is gained from a track off the metalled access road leading from the A170, to Givendale Head and High Scamridge Farms and into Dalby Forest.

15.35 The existing EMS Well Site lies on Land at an elevation of approximately 220mAOD. Land to the North falls away sharply, although the perception of this is masked by the plantation of trees in this part of Dalby Forest. Land immediately to the south of the well extends for some 200m before dropping away to form a series of narrow valleys which extend down towards the A170.

15.36 There are no large settlements within 3km of the existing Well Site, although several large working farms lie in close proximity, including Givendale Head Farm and High Scamridge Farm, approximately 900m to the north-west.

Pipeline corridor from EMS Well Site to KGS

15.37 The northern part of the Site to the north of the A170 is situated in the southern part of the North York Moors National Park known as the Tabular Hills. To the south of the A170 the land generally comprises of flat crop fields broken by the River Derwent and its associated flood plain.

KGS

15.38 The Knapton Generating Station is located near Malton in North Yorkshire. KGS is located south of the railway line. KGS is separated from open farmland by a substantial hedgerow. Land to the south, east and west is primarily open farmland used for arable farming.

Geology

15.39 The geology of the EMS Well Site and pipeline route comprises strata of Upper Jurassic age including the Corallian Group Kimmeridge Clay Formation, as indicated on the 1:50,000 scale geological maps and within the Geological Memoir. The generalised geology and geomorphology for the Site and immediate surrounding area is shown on Figures 15.1 to 15.9 and summarised in Table 15.2.

Table 15.2: Summary of Geological Strata and Related Potential Geological Hazards

Group	Formation	Key Members	Description	Associated Natural Geotechnical Hazards
Superficial deposits	Alluvium		Clay and silt of fluvial origin.	Potential for shrinking and swelling clay, running sands and compressible ground.
Superficial deposits	Glacial Till		Clay and silty clay, locally pebbly and sandy.	Potential for perched groundwater, running sands, boulders.
Superficial deposits	Lacustrine Clay		Clay of lacustrine origin.	Potential for shrinking and swelling clay, running sands and compressible ground.
Ancholme Group	Kimmeridge Clay Formation		Mudstones, thin siltstones and cementstone beds. Locally sands and silts.	Potential for shrinking and swelling clay.
Corallian Group	Coralline Oolite Formation	Middle Calcareous Grit Member (MCG)	Calcareous fine sandstone, with beds of sandy and oolitic limestone. Attains maximum thickness of between 12-15m in Tabular Hills.	Ground Dissolution Voids
		Hambleton Oolite Member (HaO)	Thin bedded sandy or muddy ooidal limestone. Attains maximum thickness of between 20-35m in Tabular Hills.	Ground Dissolution Voids
		Passage Beds (PaB)	Mudstones, thin siltstones and cementstone beds. Locally sands and silts.	Potential for shrinking and swelling clay.
	Lower Calcareous		Fine grained calcareous sandstone up to 50m in	Potential for shrinking and swelling clay.

Group	Formation	Key Members	Description	Associated Natural Geotechnical Hazards
	Grit Formation (LCG)		thickness.	Potential for Landslides Potential for Running Sands (weathering)

15.40 Site examination comprising of; shallow hand excavation; inspection of forest and farm excavations, abandoned quarries and exposures; and reference to archival borehole data, indicates that the soil cover in the area north of the A170 tends to be shallow with weathered rock occurring typically at depths of 0.11 to 0.8m (locally 1.3m depth). Areas of Made Ground and disturbed ground were not identified within the Envirocheck report and GroundSure report data (Appendix 15.1).

15.41 The gas reserves of the Ebberston Moor gas field have originated from Carboniferous (Westphalian) Coal Measures strata and became trapped in overlying fractured Permian limestone, dolostone and basal sandstone strata particularly the porous Permian Kirkham Abbey Formation (KAF). The gas reservoir is located approximately 1200 and 1500m below ground level and is overlain by younger strata of Triassic and Jurassic age comprising significant thicknesses of mudstones, sandstones and limestone units. Above the mudstones, sandstones and limestone units are the younger Corralian Group bedrock strata of Upper Jurassic age which are encountered at outcrop and shallow subcrop in and around the Site. It is therefore highly unlikely for any continuity to exist between the surface bedrock and deeper reservoir rock and therefore there should not be any issues in relation to the Development. Therefore it is the Corralian Group bedrock strata which are significant to the infrastructure development at ground surface and considered further in relation to the Development.

15.42 The Envirocheck and GroundSure reports (Appendix 15.1) indicate that the lower Calcareous Grit is shown to present moderate potential for shrinking or swelling clay; and for landslides.

15.43 South of the A170 between Wilton in the west and Alleston Cliff in the east, the geological map indicates that superficial deposits of Glacial Till and Lacustrine Deposits overlie the solid geology. No Head Deposits are indicated on the 1:50000 Provisional Series Geological map covering the area. BGS Archival boreholes generally indicate the solid geology occurring typically at variable depths of between 13.3m and 24.4m below ground level.

15.44 The course of the River Derwent is situated in an east-west alignment immediately to the south of Marishes Lane where the pipeline route crosses west of Crake Hall. The geological map indicates that alluvial deposits associated with the river extend over a distance of

approximately 250m. Archival BGS reference boreholes consulted indicate that the alluvium comprises of alternating clay and sand beds (also described as quicksand) and groundwater strikes are recorded, the depths of alluvium recorded extend to between 8.8m and 9.1m below ground level.

Running Sand

15.45 Running sand is typically loosely packed sand deposits, where the pressure of water flowing through the sand reduces the contact between the grains of sand causing liquefaction. This occurs naturally where springs are present at the base of sand outcrops or during construction where excavations in sand extend below the water table, particularly in areas where surface water flow regimes are present.

15.46 The Envirocheck and GroundSure reports (Appendix 15.1) indicate that the Lacustrine Deposits and Alluvium are shown to present a low running sand hazard. All other deposits including at or immediately adjacent to the Site are classified as 'No Hazard'. The area of pipeline likely to be excavated through Lacustrine Deposits is from approximately 300m south of the A170 road, extending to the edge of the railway line located immediately to the north of KGS. Alluvium will be encountered extending over a zone of approximately 250m adjacent to the River Derwent.

Landslides

15.47 The Envirocheck and GroundSure reports (Appendix 15.1) indicate that there is 'No Hazard' potential at the Well Site and 'Very Low to Moderate' potential from natural landslides along the pipeline route. It should be noted that the 1:50000 Provisional Series Geological map covering the area does not show landslip because it was not distinguished in the original survey. However, landslip areas are known to be common on and below of the steeper slopes in the district. It should be also noted that this does not include the potential for artificially induced landslides or ground slips caused as a result of construction, which is covered later in this Chapter.

15.48 Locally 20 to 30 degree steep slopes were observed around south of Givendale Head Farm during the walkover and east of Warren House Farm. A valley is present south of Givendale Head Farm and East of Warren House Farm. Following a period of intense rainfall, saturated slopes have a low to moderate potential for mass movement processes. A small landslip back scar was observed along the pipeline corridor in the valley slope located south east to Givendale Farm. The failure was probably triggered by the collapse of the disused badger

set. The occurrence of natural landslides is considered to be negligible except for the area south of Givendale Head Farm and east and south of Warren House Farm.

Ground Dissolution

15.49 The dissolution of calcareous rocks occurs due to the inflow of aggressive carbonated surface water and throughflow of groundwater. Over significant periods of elapsed time, dissolution of the calcareous rock may occur particularly along discontinuities and voids may develop at discontinuity intersections. The unsupported voids may develop into a network of caves or remain as discrete features but nonetheless pose issues in terms of ground collapse.

15.50 The members of the Coralline Oolite Formation are classified as 'Very Low Hazard to No Hazard', and therefore should not pose a ground dissolution issue in relation to Well Site or pipeline route.

Shrinkage and Swelling of Clay

15.51 The Envirocheck and GroundSure reports (Appendix 15.1) indicate that there is a moderate hazard with regard to Shrinkage and Swelling Clay within the Oxford Clay encountered north of the Site and the Lacustrine Deposits from immediately north of the A170 to 2km south of the A170. There is a negligible risk of Oxford Clay being encountered in any sufficient thickness to adversely affect the Site.

15.52 Such movements of soil against the pipe can induce stresses in the pipe wall. This should be addressed by specific geotechnical ground investigations.

Compressible deposits

15.53 The Envirocheck and GroundSure reports (Appendix 15.1) indicate that there is a negligible to moderate hazard with regard to compressible deposits south of the A170 up to immediately north of KGS. The net load imposed by the pipe is considered to be very low. Consequently the negative effect of compressible soil is considered to be negligible and is not considered further.

RIGS

15.54 A review of the DEFRA 'Magic' interactive mapping site, Envirocheck and GroundSure Data and NYMNPA LDF Proposals Map indicates that there are currently no RIGS within a 1km distance of the Site.

SSSI

15.55 A review of DEFRA 'Magic' interactive mapping site, Envirocheck and GroundSure Data and NYMNPA Local Development Framework Proposals Map indicates that there are currently no Sites of Special Scientific Interest (SSSI) relating to geological or geomorphological features within a 1 km of the Site. The closest SSSI to the Site is the Troutsdale and Rosekirk Dale Fens SSSI located approximately 350m to the North at the nearest point to the Site (to the north of EMS Well Site) and is a statutory designated Nature Conservation Site due to its rare spring and flush fen habitat.

Mineral Reserve

15.56 There are many small historic quarries located in the area surrounding the Site, which are indicated on the Ordnance Survey maps, geological maps, and the Envirocheck and GroundSure reports. These are typically located to the north of the A170 where the Corraline Oolite Formation is close to the surface and would have been easily excavated. These small quarries were likely associated with the winning of local building stone for construction of the houses and farm buildings of the area.

15.57 There are two historic quarries located in the area surrounding the Site, which are indicated on the Ordnance Survey maps, geological maps, and the Envirocheck and GroundSure reports (see Appendix 15.1). A quarry associated with Ebberston Common Farm (referenced Ebberston Moor House) is located approximately 400m north of the pipeline corridor. The second old quarry is located along the pipeline corridor around 350m south east of Givendale Head Farm. The sites are located over the Coralline Oolite Formation which lies close to the ground surface and will have been easily excavated. It is likely that the operations were probably associated with the winning of local building stone for construction of the houses and farm buildings of the area.

15.58 Given the wide occurrence of the Corraline Oolite Formation it is unlikely that the Development will result in sterilisation of the potential mineral reserves of building stone.

15.59 The historical quarries were very small operations and are considered to have a negligible contamination potential on the soils of the Site.

Contamination Potential

15.60 The Envirocheck and GroundSure Reports (Appendix 15.1) do not have records of any operational or historical landfill site within 1 km of the EMS Well Site or pipeline route. Givendale Head Farm (>300m from the pipeline corridor) is listed as a waste management facility. The contamination potential from this facility is considered to be negligible on the soils of the Well Site or pipeline route.

15.61 The walkover identified that the pipeline route will pass under a number of roads including the A170, the River Derwent and an active railway before it reaches KGS and given the proposed auger boring, directional drilling or suitable alternative installation techniques, it is likely to have no impact on the roads, river or the railway.

Likely Significant Effects

Construction

15.62 This section considers the effects of the construction phase without considering any further mitigation measures beyond those incorporated directly into the design of the Development. Further information on the construction phase of the Development is presented in Chapter 5., The main construction activities will involve:

- Construction of a temporary construction compound including site cabins within the west of the EMS Well Site which will contain offices and welfare facilities for management and construction workers.
- Ground modelling works including topsoil stripping and stockpiling for later use;
- Foundation excavation and construction; installation of below and above ground services, the fibre optic cable and pipeline; construction of structures including separator and storage tanks; and construction of services and facilities at the EMS Well Site.
- Erection of temporary fences along the boundaries of the pipeline working corridor.
- Gates and stiles will be incorporated into the fence wherever access by public rights of way and farm tracks are required;
- Installation of temporary surface water management measures for construction;
- Re-entry of an existing borehole at the EMS Well Site for natural gas production and water re-injection;

- Construction of a new combined water production and water disposal well at the EMS Well Site (further information is provided in Appendix 5.2);
- Stringing out the pipeline adjacent to the trench location;
- Welding of the pipe;
- Excavation of the pipe trench;
- Lowering the pipe and backfilling of the trench;
- Testing and cleaning of the pipe;
- Reinstatement of soils and land drainage;
- Auger boring, directional drilling or alternative suitable installation techniques at crossings such as at the SAM, River Derwent, the railway or roads; and
- Construction of the Pig and pipeline receiver module at KGS.

15.63 Likely significant effects from the construction phase include:

- Release of oil and fuel (hydrocarbons) from plant and machinery into the ground;
- Initiation of ground instability due to fragmentation, overbrake and ground collapse in temporary excavations;
- Initiation of slope instability caused by excavation of the trench for the pipeline;
- Collapse of temporary excavations at pipeline crossings and the pipeline trench due to the presence of running sands and high groundwater levels in the excavation.
- Damage of soil structure during their removal, storage and replacement as the pipeline is constructed, resulting in temporary reduction in soil quality for agricultural purposes; and
- Contamination of the Sandstone aquifer via a water disposal well (this item is covered in Chapter 12).

Hydrocarbon contamination

15.64 Point source hydrocarbon pollution resulting from fuel and spent oil spills from machinery during the construction phase for either scenario has the potential to enter the ground and ultimately the groundwater.

15.65 The escape of hydrocarbons can result in a reduction in quality of local soils which have agricultural and forestry value. Hydrocarbons can bind to soils and have the potential to stay in the ground for a relatively long period of time. Some compounds could be taken up by plants (including vegetables), which may eventually reach animals and humans through the food chain.

15.66 The effect of the hydrocarbon contamination will depend on the quantities lost to the ground. Therefore it is considered that hydrocarbon spills have the potential to cause long-term, high adverse effect to local receptors. Consequently it is assessed as having a moderate adverse significance.

Ground Instability

15.67 The pipeline is generally flat, however, at several locations the pipeline will:

- Cross the ancient ditch with slopes of 10 – 20 degrees, South East of Givendale Head Farm.
- Run Parallel to slightly steeper slopes of 10 – 20 degrees, South East of Givendale Head Farm.
- Cut across the valley with slopes of up to 20 to 30 degrees South of Givendale Head Farm.
- Run adjacent to slopes of 20 to 30 degrees (see Figure 4 and Figure 5) East of Warren House Farm and 14 to 16 degrees south of Warren House Farm (see Figure 5).

Geotechnical investigation is required in the valley south of Givendale Head Farm and south of Warren House Farm to determine ground conditions and to assess the stability of the slopes.

Minimum offset of the pipeline from the crest of the slope, east of Warren House Farm, is required to prevent future slope instability. Minimum offset to be determined following ground investigation.

15.68 At these locations shallow temporary excavations of the pipe trench through soil into rock will temporarily remove support for the soil / rock. This has a minor potential for soil located upslope of the trench to slide into the trench (i.e. shallow translational failures) and could develop into rotational failure into the excavation if the bedrock structural geometry is unfavourable. This would have the potential to cause injury to construction personnel and result in damage to adjacent plant, adjacent infrastructure and adjacent agricultural land. Excavation of trenches near the crest of steep slopes will result in a preferential pathway for water infiltration and increase the likelihood of future ground instability.

15.69 The excavation for foundations, upgrade of the wells and installation of connecting pipework at the EMS Well Site will be formed in an area of level ground where rock head is anticipated to be present at a shallow depth. At this location the rock mass condition, dip orientation and

dip of the bedrock strata is uncertain. Shallow temporary excavations into rock will temporarily remove support for the soil / rock which may develop potential for rotational failure into the excavation if the bedrock structural geometry is unfavourable. This could cause injury to construction personnel and result in damage to adjacent plant and infrastructure, but is unlikely to result in damage to the adjacent access road or agricultural land.

15.70 The excavations are likely to be open for periods of a few days to a few weeks. Consequently the effect is likely to be short-term and of high adverse magnitude. Therefore the effects are assessed to be of moderate adverse significance.

Landslide Activation

15.71 The excavation for the pipeline installation cuts across slopes at the head and sides of Weas Dale extending down to the A170. At this location shallow temporary excavations of the pipe trench through soil into rock will temporarily remove support for the soil / rock. This has the potential for soils located upslope from the trench to slide into the trench (i.e. shallow translational failures), and development of potential conditions for rotational failure into the excavation if the bedrock structural geometry is unfavourable. This could cause injury to construction personnel and result in damage to adjacent plant, infrastructure and agricultural land. There is negligible risk of landslides within the rest of the Site.

15.72 The excavations are likely to be open for periods of up to a few weeks. Consequently the effect is likely to be short-term and of high adverse magnitude. Therefore the effects are assessed to be of moderate adverse significance.

Running sands

15.73 The Envirocheck and GroundSure reports (Appendix 15.1) indicate that the presence of running sands could be present in the soils from approximately 300m to the south of the A170 up to the area delineated by the railway line immediately to the north of KGS. If these are present in any excavations they are only likely to have an effect if groundwater is also elevated particularly in the flood plain surrounding the River Derwent and will result in localised collapse of the trench, resulting in disruption to construction activities. Water entry from surface runoff and rainwater may cause localised occurrence of running sand and lead to loss of support to the excavations. Also the presence of elevated or perched groundwater will potentially result in localised collapse. The effects are assessed to be of minor adverse significance.

Ground Dissolution

15.74 The Envirocheck and GroundSure reports (Appendix 15.1) indicate that the members of the Coralline Oolite Formation which are present in the area of the Site to the north of the A170 have a very low likelihood of ground dissolution features. Weathering will potentially result in minor dissolution along shallow discontinuities affecting the shear strength along these features. This will potentially produce minor and immediate settlement of the backfilled pipe trench and minor block fall into the excavations where orientations of the discontinuities dip into the excavation.

15.75 Consequently the effects of both running sands and ground dissolution are considered to be short-term and of low adverse magnitude to local receptors. Therefore the significance of the effect is assessed as minor adverse.

Damage to soil structure

15.76 The excavation of the pipe trench, will involve; stripping of top soil and sub soil, temporary storage of top soil and sub soil in separate rows, and replacement of soil. Typically, where this is undertaken, soil structure is often weakened and can be damaged by soil movement and storage. However, the soil will return to a stable and more natural structural condition, over a relatively short period of time which can be hastened by appropriate handling and maintaining an effective cropping and soil management regime.

15.77 The pipe is likely to be laid in short sections, so the disturbance will be over a relatively very small area, over a short time period (days). For the areas where the pipeline is located on agricultural land the restoration of the soil structure is likely to be much quicker as normal agricultural actions (ploughing, cropping, etc.) are likely to help restore the soil structure. Consequently the damage to soil structure is considered to be negligible and is not considered further.

Operation

15.78 The operational phase effects are considered to be as follows:

- Hydrocarbon contamination from minor oil spill from vehicles / machinery and or stored fuel at the EMS Well Site and KGS;
- Leaks of natural gas condensate from the pipeline; and

- Minor spills of waste material during storage and transfer at EMS Well Site prior to transfer of natural gas by pipeline to KGS, and during transfer away from the Site by road to appropriate treatment facility.

15.79 There is the potential for minor spills of oil and hydrocarbons at both the EMS Well Site and KGS, from vehicles and fuel storage areas. These are likely to be localised point source pollution which has the potential to enter the ground and ultimately the groundwater. Hydrocarbon pollution from these sources could affect human health through contact by site workers and the linkage described in sections 15.64 to 15.66.

15.80 There are the potential minor spills of process waste material including during processing, transfer and storage at the Site. The pollution from these sources could affect human health through contact by site workers and similar linkage described for hydrocarbons in sections 15.64 to 15.66.

15.81 The contamination is likely to be point source and could affect the groundwater by infiltration and soil in which crops are grown, resulting in a potential risk to human health.

15.82 It is considered that the potential affects could be long-term, of high adverse magnitude to local receptors. Consequently it is assessed as having a moderate adverse significance.

Decommissioning and Restoration

15.83 Decommissioning and restoration activities associated with the end of the Development lifespan include the plugging of the wells, removal of the well heads and removal of site infrastructure and restoration of the EMS Well Site.

15.84 At the EMS Well Site, all wells will be plugged, hydrodrostatically tested, and abandoned with an agreed programme or method approved by the Health and Safety Executive (HSE). The wellheads will be removed and the well casing cut off not less than 1.83m below the finished ground level, a metal plate welded on top, and a concrete slab placed on top of the plate. All plant, equipment, pipes, cables, buildings, security fencing, and surface installations, will be dismantled and removed from the Well Site. Concrete installations will be broken up and removed.

15.85 All access roads will be removed. The tarmac wearing and base course will be broken up and removed from the EMS Well Site. The remaining sub base will be broken up and excavated to the depth of the original excavated subsoil depth.

15.86 The pipeline between EMS Well Site and KGS will be left in situ, filled with an inert gas at lower pressure and the ends capped. The corrosion control system will be maintained.

15.87 The main effect is considered to be from hydrocarbon contamination from minor oil spills from vehicles and machinery and stored fuel, as well as potential minor pollution from residual natural gas condensate.

15.88 The contamination is likely to be point source and could affect soil, particularly around the EMS Well Site, which it is planned to restore to woodland.

15.89 It is considered that the potential effects could be long-term, medium adverse magnitude to local receptors. Consequently it is assessed as having a minor-moderate adverse significance.

Mitigation Measures

15.90 The general mitigation measures that can be employed to reduce the potential effects of the Development are summarised in Table 15.3. The construction and decommissioning and restoration mitigation measures will be implemented through the Construction Environmental Management Plan (CEMP).

Table 15.3: Mitigation Measures

Phase	Likely significant effect	Mitigation Measure
Construction	Oil and Hydrocarbon contamination	Installation of drip trays beneath oil tanks / engines / gearboxes / hydraulics where appropriate. Handling of fuel on securely bunded areas. An emergency spillage action plan will be produced for the Site, with reference to Environment Agency Guidance. Spill kits and trained personnel on site.
	Ground Instability	Appropriate geotechnical investigation and design prior to construction and design of temporary excavation support if required.
	Landslide	Appropriate geotechnical investigation prior to construction and design of temporary excavation support if required.
	Collapse of pipeline trench due to running sands and high groundwater levels	Appropriate geotechnical investigation prior to construction and design of temporary excavation support and groundwater control measures if required or consideration of other construction methodology such as

Phase	Likely significant effect	Mitigation Measure
		trenchless technique.
Operation	Oil, Hydrocarbon and Process Waste contamination	Installation of drip trays beneath oil tanks / engines / gearboxes / hydraulics where appropriate. Handling of fuel on securely bunded areas. Storage and transfer of process waste bunded area installed with interceptors to prevent ground infiltration with petrol interceptors to treat waste process water before discharge to soakaways. An emergency spillage action plan will be produced for the Site. Spill kits and trained personnel on site.
Decommissioning and Restoration	Oil, Hydrocarbon and Process Waste contamination	Installation of drip trays beneath oil tanks / engines / gearboxes / hydraulics where appropriate. Handling of fuel on securely bunded areas. Transfer of process waste securely bunded area installed with interceptors to prevent ground infiltration. An emergency spillage action plan will be produced for the Site. Spill kits and trained personnel on site. The pipeline between EMS Well Site and KGS will be left in situ with the ends capped to avoid further disturbance of the ground.

Hydrocarbon contamination – Construction, operation and decommissioning

15.91 The effects and mitigation measures for potential contamination of soil and groundwaters from hydrocarbon contamination are similar and for all three phases of the Development and summarised below.

15.92 To mitigate the risk of pollutants entering controlled waters, handling and storage of fuels and oils will adhere to Environment Agency guidance: PPG1 [xxvi], PPG2 [xxvii], PPG5 [xxviii], PPG6, PPG8 [xxix] PPG18 [xxx] and PPG21 [xxxi]. Various measures are recommended in the above guidance to protect soils and controlled waters from the release of oils and hydrocarbons, which would otherwise have an adverse impact. These measures 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 110% of the contents;
- Machinery would 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 that will be checked and emptied regularly via a licensed waste disposal operator; and

- The contractor shall provide an Environmental Management Plan and Waste Management Plan prior to commencing construction. As part of these plans 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.

Roads and Railway crossing – contamination

15.93 Appropriate geotechnical investigation of key areas of the pipeline route that will be subject to crossing beneath roads, the railway and the river. The ground conditions encountered will be logged and geotechnical and chemical testing of the soils will need to be undertaken to enable design of most appropriate control measures.

15.94 To mitigate against potential contamination from soils during the roads and railway crossing, appropriate procedures will be designed to ensure that any potentially contaminated soils are kept separate from natural soils in the vicinity of the roads and railway. This will likely include 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.

15.95 Dust suppression measures will also need to be incorporated when working in or near to these materials.

Landslides and Running sands

15.96 The risk of collapse of the excavations from running sands and potential initiation of a localised landslide during construction and where the pipeline trench is excavated across the slope will be mitigated using the measures summarised below.

15.97 Appropriate geotechnical investigation will be undertaken of key areas of the Development and pipeline route that could be subject to landslides or running sands. The ground conditions encountered will need to be logged and geotechnical testing of the soils and rocks would need to be undertaken:

- Appropriate stability analyses will 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 (see chapter 11 for further information).

Residual Effects

15.98 The residual effects of the Development, after the above mitigation measures have been incorporated are discussed below for each of the potential effects.

Hydrocarbon Process Waste contamination– Construction, operational and decommissioning

15.99 With the mitigation measures identified above, potential effects associated with the release of oil and fuel during construction works are likely to be negligible.

Loss of Ground Support due to running sands and landslides

15.100 The potential for ground collapse to occur as a result of the excavations during construction, and decommissioning and restoration, or the potential for running sands or landslides to cause collapse of the pipeline trench during construction will be controlled through design following on from an appropriate geotechnical investigation and ground modelling. Therefore, the residual effects for the running sand hazard is considered to be negligible and landslide hazard is considered to be minor adverse because of the unknown extent of landsliding within the area concerned.

Cumulative Effects

Construction

15.101 The cumulative effects of the Development has been assessed in relation with other proposed or permitted schemes in the area, which in combination may generate compounded elevated levels of effect above those discussed for the Development alone. The schemes included in the cumulative assessment comprise the Third Energy's Ebberston Early Development Scheme (EDS) and the York Potash Scheme (further information is provided in Chapter 2).

15.102 There is potential for cumulative effects with the EDS Scheme in relation hydrocarbon contamination. In the unlikely result of a simultaneous accidental spillage at both sites, it is likely that it could be of high magnitude and have a cumulative moderate adverse effect. However, with appropriate management procedures in place the chances of an accidental spillage occurring at both sites simultaneously are very low, and so the overall cumulative effect is considered to be negligible.

15.103 The potash mine site will be constructed at a site approximately 5 km south of Whitby, North Yorkshire. Although no detailed impact assessment of the York Potash Project has been published to date, based on the available construction information the potash mine site is c. 17 km north of the Development. It is reasonable to assume that there will be negligible cumulative effects should the construction phases of the Development and the potash mine progress at the same time. It is reasonable to assume also that given the distance between the York Potash Project and the Development negligible cumulative effect will occur also during the operational and decommissioning phases of the Development.

15.104 There is minimal potential for damage when construction crosses existing high pressure pipelines, HV electricity or other third party services associated with the above mentioned schemes. During construction these features will be clearly identified by the owner of the service and hand excavated within the last metre on both sides. The work to enable the pipeline to cross the services will be undertaken in line with the requirements of the asset owners. Therefore cumulative effects from such events are considered unlikely.

15.105 In the unlikely event of such an incident the likely contamination is likely to be of minor to no significance to the groundwater and soil in which crops are grown.

15.106 It is considered that the all the potential affects could be short-term, of minor adverse magnitude causing disruption to construction and local receptors. Consequently it is assessed as having a negligible significance. Any accidental spillage that may occur will be dealt with in accordance with the emergency spillage action plan to be produced for the site.

Completed Development

15.107 No additional items to the ones described from sections 15.101 to 15.107.

Summary

15.108 The effect of the Development on the geology/soil and ground conditions has been assessed through the identification of baseline environmental quality and the potential sources, magnitudes and significance of any effects. The assessment has been based on professional judgement, data and reviews of relevant literature, policies and legislation.

15.109 No significant geology/soil impacts are expected to occur throughout the construction, operational and decommissioning and restoration phases in their various stages within the various scenarios considered, providing that standard mitigation measures are applied as discussed in this chapter. Any accidental spillage that may occur will be dealt with in accordance with the emergency spillage action plan to be produced for the Site.

15.110 Table 15.4 contains a summary of the likely significant effects of the Development, the mitigation measures and the residual impacts.

Table 15.4: Table of Significance – Ground Conditions and Contamination

Potential Effect	Nature of Effect (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	D / NP	L	
Construction											
Hydrocarbon contamination	Short term temporary	Moderate Adverse	Installation of drip trays beneath oil tanks/engines/gearboxes/hydraulics where appropriate. Handling of fuel on securely bunded areas. An emergency spillage action plan will be produced for the site. Spill kits and trained personnel on site.							*	Negligible
Ground instability during construction	Short term temporary	Moderate Adverse	Appropriate geotechnical investigation prior to development and design of temporary excavation support and temporary dewatering control if required.							*	Negligible
Landslides	Short term temporary	Moderate Adverse	Appropriate geotechnical investigation prior to development and design of temporary excavation support if required.							*	Minor Adverse
Collapse of pipeline trench due to running sands and high groundwater levels	Short term temporary	Minor Adverse	Appropriate geotechnical investigation prior to development and design of temporary excavation support and dewatering control if required or consideration of other construction methodology such as trenchless technique.							*	Negligible
Operation											
Hydrocarbon contamination	Short term temporary	Moderate Adverse	Installation of drip trays beneath oil tanks/engines/gearboxes/hydraulics where appropriate. Handling of fuel on securely bunded areas. An emergency spillage action plan will be produced for the site. Spill kits and trained personnel on site.							*	Negligible
Process waste contamination	Short term Temporary	Moderate Adverse	Handling of waste on securely bunded and lined areas with petrol interceptors for treatment of waste water							*	Negligible

			prior to discharge. An emergency spillage action plan will be produced for the site. Spill kits and trained personnel on site.								

Potential Effect	Nature of Effect (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	D/NP	L	
Decommissioning and Restoration											
Hydrocarbon contamination	Short term temporary	Moderate/Minor Adverse	Installation of drip trays beneath oil tanks/engines/gearboxes/hydraulics where appropriate. Handling of fuel on securely bunded areas. An emergency spillage action plan will be produced for the site. Spill kits and trained personnel on site.							*	Negligible
Process waste contamination	Temporary	Moderate Adverse	Handling of waste on securely bunded and lined areas prior to removal from site. An emergency spillage action plan will be produced for the site. Spill kits and trained personnel on site.							*	Negligible
Cumulative Effects											
Damage to existing buried services and pipelines	Short Term Temporary	Minor Adverse	Features to be clearly identified by the owner of the service. Hand excavation within the last metre on both sides. The work to enable the pipeline to cross the services will be undertaken in line with the requirements of the asset owners.							*	Negligible

*** Geographical Level of Importance**

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

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