

17.0 GEOLOGY

Introduction

- 17.1 This Chapter has been prepared by URS and addresses the impact of the Proposed Development on the existing geology (including overlying soils) and ground conditions. Consideration has been given to impacts during the construction, operational and decommissioning phases of the proposed project. For the purposes of this Chapter the Proposed Development comprises the proposed Ebberston Wellsite, the proposed Hurrell Lane Gas Processing Facility and the Pipeline Route.
- 17.2 The Chapter describes the methods used to identify the baseline ground conditions at the Site and in the surrounding area. Potential impacts are identified, the need for mitigation measures has been addressed and consideration is given to residual impacts.
- 17.3 Direct Consultation with external parties undertaken as part of the Environmental Impact Assessment (EIA) process, includes the commissioning of a Landmark Envirocheck® Report to appraise baseline conditions. In addition, a variety of data sources were consulted such as geological maps and historic Ordnance Survey data. All data sources are referenced in the following Sections.

Planning Policy context

- 17.4 Planning policy and legislation in relation to the Proposed Development in the context of the Geology and Ground Conditions is summarised below.

National Planning policy

- 17.5 Voids in the ground e.g. caves or mines and unstable ground such as running sands or landslide areas could pose a risk to pipeline projects. The Draft National Policy statement for Gas Supply Infrastructure and Gas and Oil Pipelines (Ref 17.1) states that:

“Applicants should assess the stability of the ground conditions associated with the pipeline route”.

- 17.6 Construction activities have the potential to cause pollution through waste management activities resulting in contamination of the land, groundwater or surface water

(Ref.17.2). Under the Environmental Protection Act 1990 the Environment Agency (EA) is responsible for prevention of pollution of the environment, harm to human health and detriment to local amenity. The EA has produced guidance for the managing the environmental impact of construction activities, which is also considered pertinent to the Proposed Development.

Regional Planning policy

- 17.7 Regional planning policy is covered by the Regional Spatial Strategy for Yorkshire and the Humber (Ref.17.3), and in relation to Geology and ground conditions, in particular the following policies are relevant:
- 17.8 **Policy ENV4 - Minerals** states that “Plans, strategies, investment decisions and programmes should safeguard mineral deposits in the region including aggregates, silica, sand, coal, clay, brick earth, chalk and potash, from sterilisation by other types of development”.
- 17.9 **Policy ENV8 - Biodiversity** states “The Region will safeguard and enhance biodiversity and geological heritage”. The geological heritage includes geological and geomorphological features and processes.

Local Planning Policy

- 17.10 The local planning policy (Ref. 17.4) is undergoing review at the current time. The Local Development Framework (LDF) is due to be adopted at the end of 2010. The Ryedale Local Plan contains a number of policies, which have been saved until they are replaced by the LDF. Those policies of particular relevance to the project in terms of geology relate to Geological Sites of Special Scientific Interest (SSSI's) and to Regionally Important Geological/Geomorphological Sites (RIGS). RIGS are geological or geomorphological sites (excluding SSSI's) that are considered worthy of protection for their educational, scientific, historical or aesthetic/landscape importance. Their status is similar to that of Sites of Importance for Nature Conservation.
- 17.11 **Policy ENV10 – Sites of Special Scientific Interest** states that “Proposals for development within or likely to affect a designated or proposed Site of Special Scientific Interest will be subject to special scrutiny. Where such a development may have a detrimental effect, either directly or indirectly, on the SSSI, and all damage could not be prevented through the use of conditions or planning obligations, the development will not be permitted unless the development would clearly outweigh the national

importance of the site and the national network of such sites and it can be demonstrated that no suitable alternative site is available for the development”.

- 17.12 **Policy ENV13 – Regionally Important Geological/Geomorphological Sites (RIGS)** states “The District Council will aim to avoid detrimental effects of development proposals on Regionally Important Geological/Geomorphological Sites (RIGS) by use of planning conditions and/or Section 106 Agreements including, in appropriate situations a requirement for the creation of new exposures”.

Assessment Methodology and Significance Criteria

Assessment Methodology

- 17.13 The assessment of ground conditions has involved the collation and review of available information pertaining to the current condition of the soils on the site. This information has been used to characterise the baseline conditions for the site. The information has been reviewed in the context of the proposed development to evaluate the short, medium and long term, direct and indirect impacts.

- 17.14 The following data were reviewed as part of the assessment:

- Landmark Envirocheck® Report;
- www.magic.gov.uk - interactive online geographic information on land classification;
- The Ryedale Local Plan;
- British Geological Survey (BGS) solid and drift geology maps – 1 mile to six inch Sheets 92 NE, 92 SW and 92 NW.(Refs. 17.5, 17.6 and 17.7 respectively); and
- Ordnance Survey Map OL27 1:25,000 North York Moors Eastern Area.

Significance Criteria

- 17.15 A qualitative assessment of potential impacts has been carried out using the significance criteria described in Chapter 2 of the ES and summarised in **Table 17.1**.

Table 17.1 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

17.16 Definitions of pre mitigation and residual impact significance take into account the large body of technical guidance that has been produced in the UK for the assessment of ground conditions by the Government, i.e. Department of Environment, Food and Rural Affairs (DEFRA) and its predecessor Departments and agencies such as the EA. The following documents are considered to be central:

- Department for Transport, Local Government and the Regions (2002); Development on land affected by contamination – Consultation paper on draft planning technical advice;
- Part 2A of the Environmental Protection Act, DEFRA Circular 01/2006;
- EA Remedial Targets Methodology, 2006; and
- Contaminated Land Research (CLR) Reports 7 - 13.

17.17 In summary, the guidance provides for staged and risk-based data interpretation. This commences with the application of generic risk assessment criteria (which are conservative in nature) and may proceed to the development (i.e. calculation) of site-specific criteria. The former are set to ensure that, if they are not exceeded, it is unlikely that relevant receptors will be exposed to significant levels of risk. In cases where they are exceeded, it is appropriate to undertake further assessment, which may include additional data collection and site-specific risk assessment, to determine the need for further action.

17.18 Contaminated Land Research (CLR) Reports 7-13 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.

17.19 An assessment of the significance of the Proposed Development on the geology and ground conditions is made by comparing the existing geology and ground conditions to the condition of these media post development. The definition of low, medium and high magnitude of effect is subjective for impacts to both ground conditions and geology. However, comment is made in the context of the guidance and legislation described above:

- **High:** In the case of ground conditions, a major impact would be defined as an

identified significant impact for a specific receptor e.g. Potential loss of human life / serious injury or illness, to construction worker;

- **Medium:** In the case of ground conditions, a moderate impact would be defined as one that could result in the land meeting the definition of Contaminated Land under Part 2A of the Environmental Protection Act, 1990 (Ref. 17.9); and
- **Low:** In the case of ground conditions, a minor impact would be defined as disruption to construction, demolition or operation of the facility.

Baseline conditions

Geology

17.20 The geology of the pipeline route comprises The Corallian Group as indicated on the six inches to 1 miles geology maps. Generalised geology plans for the Site are shown on **Figures 17.1 to 17.7** and summarised in **Table 17.2** below.

Table 17.2 Geological strata / Geotechnical Hazards

Group	Formation	Key members	Description	Natural Geotechnical Hazards Associated with Strata
	Glacial Till		Clay and silty clay, commonly pebbly and sandy.	
	Lacustrine Clay		Clay of lacustrine origin (Lacustrine Clay)	Potential for Shrinking and swelling clay, running sands and compressible ground.
	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	Calcareous sandstone, with beds of sandy and oolitic limestones.	Ground dissolution

		Hambleton Oolite Member	Thin sandy or muddy ooidal limestone.	Ground dissolution
		Passage Beds Member	Calcareous sandstones and shell detritus limestones.	Potential for Shrinking and swelling clay.
	Lower Calcareous Grit		Fine grained calcareous sandstone up to 25m in thickness.	
	Oxford Clay Formation		Silicate-mudstone, green grey, generally smooth to slightly silty, with sporadic beds of argillaceous limestone nodules.	Potential for Shrinking and swelling clay.

17.21 Hand augers excavated during the walkover indicated that area north of the A170 the soils appear to be shallow with weathered rock occurring at depths of 0.3 to 0.5m depth. South of the A170 by the Hurrell Lane Gas Processing Facility, the geological map indicates that drift deposits of Glacial Till and Lacustrine Deposits overlie the solid geology.

Running sands

17.22 Running sand is typical of loosely packed sand deposits, where the pressure of water flowing through the sand reduces the contact between grains of sand causing liquefaction. This may occur naturally where springs are present at the base of sand outcrops or during construction where excavations in sand go below the water table.

17.23 The Lacustrine Deposits are also shown to present a low running sand hazard. The rest of the deposits are classified as 'No Hazard'. The area of pipeline is likely to be excavated through Lacustrine Deposits is from the base of Blue Bank through to and including the Hurrell Lane Gas Processing Facility.

Landslides

17.24 The Envirocheck Report indicates that there is a Low to No Hazard potential from natural landslides along the pipeline route. Noting that this does not include the

potential for artificially induced landslides caused as a result of construction which are detailed later in this Chapter.

RIGS

- 17.25 A review of Thornton Dale Ward profile indicates there are no Regionally Important Geological/Geomorphological Sites (RIGS) within the Ward and, hence, in the vicinity of the pipeline.

SSSI

- 17.26 A review of Thornton Dale Ward profile indicates that there are no Geological Sites of Special Scientific Interest (SSSI) within the Ward and, hence, in the vicinity of the pipelines.

Mineral reserves

- 17.27 There are dozens of historic quarries located in the vicinity of the Proposed Development, which are indicated on the ordnance survey maps, geological maps and the Envirocheck 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. They are probably associated with the winning of local building stone for the houses of the area.
- 17.28 Given the wide occurrence of the Corraline Oolite Formation locally it is unlikely that the Proposed Development would result in sterilisation of the potential mineral reserve for building stone.
- 17.29 The historic quarries are considered to have a negligible contamination potential on the soils of the pipeline route, the Ebberston Wellsite and the Hurrell Lane Gas Processing Facility.

Contamination Potential

- 17.30 The Envirocheck Report lists one operational landfill (Caulklads Quarry at 941m distance) and one historic landfill (Thornton Dale Railway cutting at 361m distance) within 1km of the pipeline route. Givendale Head Farm (391m distance) is listed as a waste management facility. The contamination potential from these three sites is considered to be negligible on the soils of the pipeline route, the Ebberston Wellsite and

the Hurrell Lane Gas Processing Facility.

- 17.31 The walkover identified that the pipeline route would pass under a disused railway embankment before it reaches the Hurrell Lane Gas Processing Facility and given the proposed auger boring method, it is likely to have no impact on the embankment.

Likely Significant Effects

Construction Phase Impacts

- 17.32 The construction of the pipeline, the development at the existing Ebberston Wellsite and the Hurrell Lane Gas Processing Facility would involve the following main construction activities:

- Establishment of working areas and site compounds, including fencing the working areas;
- Removal of topsoil;
- Stringing out the pipeline adjacent to the trench location;
- Welding of the pipe;
- Excavation of the pipe trench;
- Lowering of the pipe and backfilling of the trench;
- Testing / cleaning the pipe; and
- Reinstatement of soils and land drainage.

- 17.33 Likely significant effects from the construction phase include:

- Release of oils and fuels (hydrocarbons) from plant and machinery into the ground;
- Initiation of slope instability caused by excavation of trench for pipeline; and
- Collapse of the pipeline trench due to the presence of running sands in the excavation.

Hydrocarbon contamination

- 17.34 Point source hydrocarbon pollution resulting from fuel and oil spills from heavy machinery during the construction phase has the potential to enter the ground and ultimately groundwater.

- 17.35 The escape of hydrocarbons can result in a reduction in quality of local soils which may have agricultural value. Hydrocarbons can also 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 humans and animals through the food chain.
- 17.36 The effect of the hydrocarbon contamination will largely be dependant on the amount lost to ground. Therefore, it is considered that hydrocarbon spill have the potential to cause a **long term, high, adverse** impact to **local** receptors. Consequently, it is assessed as having a **Moderate** significance.

Instigation of landslides

- 17.37 The excavation to install the pipeline would cut across slopes at the head of Weas Dale and to the east of Thornton High Fields. At these locations excavation of the pipe trench would temporally remove supporting soils / rock. This has the potential for the soils located up slope from the trench to slide into the trench (i.e. shallow translational failures). This could cause injury to construction personnel and result in damage to agricultural land
- 17.38 It is considered that there may be a higher risk of failure at Thornton High fields where Kimmeridge Clay is present. Published strength values (angle of effective shearing resistance) of weathered Kimmeridge Clay (Ref. 17.8) are between 14° to 23° and given the overall slope angle appears to be approximately 18° in this location, stability of an excavated trench in the slope may be marginal.
- 17.39 The trench for the pipeline is likely to be open for a period of few weeks, consequently the effect is likely to be **short term**, of **high, adverse** magnitude. Therefore the significance of the effect is assessed as **Moderate**.

Running sands

- 17.40 The Envirocheck Report indicated that running sands could be present in the soils from Blue bank to the Hurrell Lane Gas Processing Facility. If these are present in any excavations they are likely to only have an effect if groundwater is also elevated and would result in localised collapse of the trench, resulting in disruption to the project.
- 17.41 Consequently the effects are considered to be **short term, low adverse** magnitude to

local receptors. Therefore the significance of the effect is assessed as **Minor**.

Operational Phase Impacts

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

- Hydrocarbon contamination from minor oil spills from vehicles / machinery and or stored fuel on the Ebberston Wellsite and Hurrell Lane Gas Facility; and
- Leaks of natural gas condensate from the pipeline.
- These are discussed in more detail below.
- Hydrocarbon contamination

17.43 There are the potential minor spills of oils and hydrocarbons at both the Ebberston Wellsite and the Hurrell Lane Gas Processing Facility, from vehicles or fuel storage areas. These are likely to be localised point source pollution which has the potential to enter the ground and ultimately groundwater. Hydrocarbon pollution from these sources could affect human health through the linkage described in section 17.36.

17.44 It is considered that the potential affects could be **long term, high** and **adverse** to local receptors. Consequently, it is assessed as having a **Moderate** significance.

Decommissioning Phase Impacts

17.45 Decommissioning activities associated with the end of the developments lifespan include the removal of site infrastructure at the Ebberston Wellsite and the Hurrell Lane Gas Processing Facility.

17.46 The main effect is considered to be from hydrocarbon contamination from minor oil spills from vehicles / machinery and or stored fuel on the Ebberston Wellsite and Hurrell Lane Gas Processing Facility, as well as potential pollution from natural gas condensate.

17.47 The contamination is likely to be point source and could affect soils in which crops are grown, resulting in a potential risk to human health.

17.48 It is considered that the potential affects could be **long term, high** and **adverse** to local receptors. Consequently, it is assessed as having a **Moderate** significance.

Mitigation Measures

17.49 General mitigation measures can be employed which would reduce the potential effects of the proposed development are summarise in the **Table 17.3** below.

Table 17.3 Mitigation Measures

Phase	Likely significant effect	Mitigation Measures
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. Spill kits and trained personnel on site.
	Landslides	Appropriate geotechnical investigation prior to development and design of temporary excavation support if required.
Operation	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. Spill kits and trained personnel on site.
Decommissioning	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. Spill kits and trained personnel on site.

Hydrocarbon contamination – Construction, operational and decommissioning

17.50 The effects and mitigation measures for potential contamination of soils and groundwaters from hydrocarbon contamination are similar for all three phase of the proposed development and summarised below.

17.51 To minimise the risk of pollutants entering controlled waters, handling and storage of fuels and oils will adhere to EA guidance: PPG1, PPG2, PPG5, PPG6, PPG08 and PPG21 (see Chapter 12 for summary and document references). 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 would also be protected from vandalism and kept locked when not in use;
- When not operational, plant and machinery would have drip trays beneath oil tanks/engines/gearboxes/hydraulics that would 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.

Railway embankment – contamination

17.52 To mitigate against potential contamination from soils in the embankment procedures should be produced to ensure that potentially contaminated soils are kept separate from natural soils in the vicinity of the embankment this would probably include temporary placement of soils on geotextile fabric, chemical testing to confirm if they are contaminated and disposal to a suitable licensed waste facility if necessary (i.e. they could not be re-used on site in bunds etc.)

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

Running sands / landslides

17.54 The risk of collapse of the pipeline trench from running sands and the potential initiation of a landslide from excavation of the pipeline trench across the slope can be mitigated using the same measures which are summarised below.

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

- Appropriate stability analyses should be undertaken to confirm if there is a risk; and
- If required, temporary excavation support could be designed to prevent collapse of the trench / landslides while the trench is open.

Residual Effects

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

Hydrocarbon contamination – Construction, operational and decommissioning

17.57 With the mitigation measures identified above, potential impacts associated with the release of oil and fuel during construction works are likely to be **negligible** and, therefore, of **Minor significance**.

17.58 Implementation of the above measures does not, however, exclude the possibility of an accidental spillage of oils and fuels, the impact of which is dependent upon the volume lost to ground. Although an emergency spillage plan will be designed and implemented through the construction programme to minimise the impact of such an event, accidental spillages still have the potential to result in a **high, adverse impact**, which could be of **moderate significant**.

Running sands / landslides

17.59 The potential for landslide to occur as a result of the excavation of the trench, or the potential for running sands to cause collapse of the proposed trench would be controlled through design following on from an appropriate geotechnical investigation and ground modelling. Therefore, the residual effects for both of the hazards are

considered to be **negligible** and of **Minor significance** level.

Cumulative and Interactive Effects

17.60 The response from North Yorkshire County Council and the Environment Agency do not list any potential cumulative or interactive effects that need to be considered with respect to the review of Geology.

Summary

17.61 The impact of the Proposed Development on the geology and ground conditions has been assessed through the identification of baseline environmental quality and the potential sources, magnitudes and significance of any impacts. The assessment has been based on professional judgement, data and reviews of relevant literature, policies and legislation.

17.62 No significant soil and geology impacts on are expected to occur throughout the construction and operational phases, provided that standard mitigation measures are applied as discussed above. **Table 17.4** summarises the potential effects the mitigation measures and the residual impacts.

Table 17.4 Summary of Mitigation Measures and Effects

Potential Effect	Significance	Mitigation Measures	Residual effect
Construction			
Hydrocarbon contamination	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.	Minor Negligible
Landslides	Moderate Adverse	Appropriate geotechnical investigation prior to development and design of temporary excavation support if required.	Minor Negligible
Collapse of pipeline trench	Minor Adverse	Appropriate geotechnical investigation prior to development and design of	Minor Negligible

from - Running Sands		temporary excavation support, if required.	
Operation			
Hydrocarbon contamination	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.	Minor Negligible
Demolition			
Hydrocarbon contamination	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.	Minor Negligible

References

- 17.1 Department of Energy & Climate Change (2009) *Draft National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4)*, The Stationary Office, London.
- 17.2 Environment Agency (2003) *Pollution Prevention Guidelines 6: Working at Construction or Demolition Sites*, Environment Agency.
- 17.3 Government Office for Yorkshire and the Humber (2008) *The Yorkshire and Humber Plan – Regional Spatial Strategy to 2026*, The Stationary Office, London.
- 17.4 Ryedale District Council (2002) *The Ryedale Local Plan*, Ryedale District Council.
- 17.5 British Geological Survey (1876) *Geological Map Yorkshire (North Riding) Sheet 92 NE*, Scale 1 inch to 6 miles, Ordnance Survey, Southampton.
- 17.6 British Geological Survey (1876) *Geological Map Yorkshire (North Riding) Sheet 92 SW*, Scale 1 inch to 6 miles, Ordnance Survey, Southampton.
- 17.7 British Geological Survey (1876) *Geological Map Yorkshire (North Riding) Sheet 92 NW*, Scale 1 inch to 6 miles, Ordnance Survey, Southampton.
- 17.8 Cripps, J.C. & Taylor R.K.(1981) *The Engineering Properties of Mudrocks*, Quarterly Journal of Engineering Geology Vol.14, pp. 325-346, Geological Society, London.