11.0 FLOOD RISK, HYDROLOGY AND DRAINAGE

Introduction

11.1 This chapter of the ES assesses the likely significant effects of the Development in terms of Flood Risk, Hydrology and Drainage.

11.2 The chapter describes: the assessment methodology; the baseline conditions currently existing 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. The Flood Risk Sequential and Exception Testing is provided at Appendix 11.1.

11.3 The effects of drilling and water injection are outside the scope of this chapter and are considered in Chapter 12 Produced Water Disposal.

Planning Policy Context

Legislation

Water Framework Directive[i]

11.4 The European Water Framework Directive (2000/60/EC) (WFD) 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)[ii] and the Groundwater Directive (80/68/EEC) (GWD)[iii].

11.5 The Environment Agency has used the various European Directives and Water Framework Directive (WFD) to inform River Basin Management Plans. The River Basin Management Plans (RBMPs) are specific to each river basin and the Site falls within the Humber RBMP[iv].

11.6 The Environment Agency summarises its focus in the following statement taken from its website:

> *"The Environment Agency implements this directive to plan and deliver a better water environment with a focus on ecology, and is geared to protection and enhancement of:*

- *surface freshwater (including lakes, streams and rivers);*
- *groundwaters;*
- *groundwater dependant ecosystems;*
- *estuaries; and*
- *coastal waters out to one mile from low-water."*

11.7 The Environment Agency's groundwater protection strategy of prevention and limitation is informed by the publication, Groundwater Protection: Principles and Practice (August 2013, Version 1.1) (GP3)[v].

Planning Policy

National Planning Policy

National Planning Policy Framework (March 2012)[vi]

11.8 The National Planning Policy Framework (NPPF) makes specific reference to flood risk and water supply in Section 10, in which Paragraphs 99 – 104 address the need to avoid inappropriate development in areas at risk from flooding. This section replaces 'Planning Policy Statement 25: Development and Flood Risk' (PPS25).[vii]

11.9 Paragraph 100 of the NPPF directs that:

> *"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere."*

11.10 The footnote to this paragraph refers to Technical Guidance[viii] which sets out how this paragraph should be implemented, using the Sequential Test and, if necessary, the Exception Test. The Technical Guidance was superseded by the Planning Practice Guidance in August 2013 and the Web-based Planning Practice Guidance to the National Planning Policy Framework published by the Department for Communities and Local Government in March 2014 has been taken into account in the preparation of this section of the report.

11.11 Paragraph 001 (Reference ID: 7-001-20140306) of the Planning Practice Guidance for Flood Risk and Coastal Change requires that all proposed development should be assessed in the following three-step sequence:

- *Assess Flood Risk,*
  In areas at risk of flooding or sites of 1 hectare or more, developers (should) undertake a site-specific flood risk assessment.
- *Avoid flood risk*
  A Sequential Test should be applied to specific development proposals with an Exception Test applied to steer development to areas with the lowest probability of flooding.
- *Manage and Mitigate flood risk.*
  Where development needs to be in locations where there is a risk of flooding as alternative sites are not available, local planning authorities and developers ensure development is appropriately flood resilient and resistant, safe for its users for the development's lifetime, and will not increase flood risk overall.

11.12 Paragraph 018 (Reference ID: 7-018-20140306) places emphasis on the need to ensure that:

> *'areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high flood risk areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible.'*

11.13 Paragraph 030 (Reference ID: 7-030-20140306) places emphasis on the need for a site-specific flood risk assessment to be carried out to establish:

> - *whether a proposed development is likely to be affected by current or future flooding from any source;*
> - *whether it will increase flood risk elsewhere;*
> - *whether the measures proposed to deal with these effects and risks are appropriate;*
> - *the evidence for the local planning authority to apply (if necessary) the Sequential Test, and;*
> - *whether the development will be safe and pass the Exception Test, if applicable.*

11.14 Paragraph 035 (reference ID:7-035-20140306) confirms that an Exception Test should only be applied as set out in Table 3 following the application of the Sequential Test, as set out in paragraph 102 of the NPPF.

11.15 Potential causes of flooding of the Site listed by the Technical Guidance include:

- The sea;
- Directly from rainfall onto the ground;
- Rising groundwater;
- Overwhelmed sewers and drainage systems; and
- And from reservoirs, canals, lakes and other artificial sources.

11.16 The potential of the Development to increase flood risk arises from:

- The addition of relatively impermeable hard surfaces; and
- The effect of the new development on surface water run-off from the area surrounding the Site.

11.17 To assess the vulnerability of an assessment area to flooding from watercourses or the sea, Paragraph 003 (Reference ID: 7-003-20140306) the Planning Practice Guidance separates areas into Flood Zones having different levels of risk, with reference to Table 1 of the PPG reproduced as Table 11.1 as follows:

Table 11.1 Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

11.18 The sequential test stipulated by the Planning Practice Guidance is intended to guide development towards sites within Flood Zone 1 first, and then Zone 2, before sites in Zone 3 can be considered. The appropriateness of any development within or near Flood Zones 2

and 3 is determined by using Table 3 of paragraph 035 of the PPG, reproduced as Table 11.2.

Table 11.2: Flood risk vulnerability and flood zone 'compatibility'

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.

× Development should not be permitted.

11.19 The Flood Risk vulnerability of different developments is categorised in Table 2, paragraph 066 of the PPG, where mineral workings are considered to be less vulnerable. This table is reproduced in part below as Table 11.3.

Table 11.3: Flood Risk Vulnerability Classification

Less Vulnerable

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill* and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

Local Planning Policy

North Yorkshire County Council Strategic Flood Risk Assessment

11.20 The Strategic Flood Risk Assessment (SFRA) is currently under development and a scoping report for its structure and content has been published by North Yorkshire County Council entitled 'Proposed Strategic Flood Risk Structure – Scoping Report and Methodology Final Draft'[ix].

North York Moor National Park Authority Core Strategy and Development Policies (2008) (Local Development Framework) (LDF)[x]

11.21 The North York Moors National Park Authority Core Strategy states that the impacts of climate change on the National Park will be mitigated by avoiding development in flood risk areas, facilitating flood protection and improve flood storage (Core Policy D – Climate Change). Development Policy 2 Flood Risk states that development will only be permitted where it will not lead to increased flood risk in other areas and where (if required) a Flood Risk Assessment has been carried out.

North York Moor National Park Authority Strategic Flood Risk Assessment (North East Yorkshire SFRA)[xi]

11.22 The North East Yorkshire SFRA (15 February 2012) provided an update to PPS25, however this was published prior to the publication of the NPPF and the associated Technical Guidance. It has not been updated since to include reference to the NPPF or the Technical Guidance. Nevertheless, it still provides useful information that remains relevant in considering flood risk and mitigation of that risk for areas within the North York Moor National Park.

Ryedale Local Plan, March 2002[xii]

11.23 The Ryedale Local Plan was adopted in March 2002. It is in the process of being replaced by the Local Development Framework (LDF). Most of the 2007 saved policies have been superseded by the policies in the adopted Ryedale Local Strategy (see below).

The Ryedale Plan – Local Plan Strategy Development Plan Document 5 September 2013. (Adopted Document)[xiii]

11.24 SP 17 Managing Air Quality, Land and Water Resources is the only policy in the adopted Ryedale Local Plan considered to be of relevance to this assessment. It recognises that:

"Flood Risk will be managed by:

- *Requiring the use of sustainable drainage systems and techniques, where technically feasible, to promote groundwater recharge and reduce flood risk. Development proposals will be expected to attenuate surface water run off to the rates recommended in the Strategic Flood Risk Assessment. In addition, major development proposals within areas highlighted as having critical drainage problems in the North East Yorkshire Strategic Flood Risk Assessment (or future updates)as Critical Drainage Areas may, if appropriate, be required to demonstrate that the development will not exacerbate existing problems by modelling impact on the wider drainage system.*
- *Ensuring new development does not prevent access to water courses for the maintenance of flood defences*
- *Undertaking a risk based, sequential approach to the allocation of land for new development and in the consideration of development proposals in order to guide new development to areas with the lowest probability of flooding, whilst taking account of the need to regenerate vacant and previously developed sites within the towns. In considering development proposals or the allocation of land, full account will be taken of the flood risk vulnerability of proposed uses and the national 'Exception Test' will be applied if required."*

"Water resources will be managed by:

- *Supporting the water efficient design of new development and requiring developers to demonstrate how development proposals will seek to minimise water consumption*

- *Ensuring applications for new development assess impacts on water quality and propose mitigation measures to reduce the risk of pollution and a deterioration of water quality*

- *Protecting surface water and groundwater from potentially polluting development and activity. Sources of groundwater supply within and adjacent to the District will be protected using the Source Protection Zones (SPZs) identified by the Environment Agency. Within SPZ1the following types of development will not be permitted unless adequate safeguards against possible contamination can be agreed:*
  - *Septic tanks, waste water treatment works, storage tanks containing hydrocarbons or any chemicals, or underground storage tanks;*
  - *Sustainable drainage systems with infiltration to ground*
  - *Oil Pipelines*
  - *Storm water overflows and below ground attenuation tanks*
  - *Activities which involve the disposal of liquid waste to land*
  - *Graveyards*
  - *Other specific types of development identified within the Environment Agency's Groundwater Protection Policy*
- *Within Source Protection Zones 2 and 3 a risk based approach will be applied to the consideration of development proposals with the exception of development involving deep soakaways, sewerage, trade and storm effluent to ground which will not be permitted unless it can be demonstrated that these are necessary, are the only option available and where adequate safeguards against possible contamination can be agreed.*
- *Within Source Protection Zones developers will be expected to provide full details of the proposed construction of new buildings and construction techniques, including foundation design as part of their proposals.*
- *Ensuring that necessary sewerage and water treatment infrastructure improvements are provided in tandem with new development and that scale, type, location and phasing of new development or land based activity can be accommodated without an unacceptable impact on water supply"*

Assessment Methodology

11.25 This assessment of flood risk, hydrology and drainage takes the form of a desk top study supported by site visits undertaken in November 2012, June 2013, and August 2013. The

Development follows the alignment covered by the earlier visits and no additional visit has been made in 2014.

11.26 The site visits covered the immediate area of the Site and took the form of a visual inspection, including viewing the existing installations on the Ebberston Moor South (EMS) Well Site from outside the security fencing that surrounds it. The initial inspection of the Vale of Pickering in November 2012 was carried out when the weather was wet and unsettled, immediately following a period of heavy rainfall that had caused extensive flooding.

11.27 An inspection of the EMS Well Site was carried out in June 2013 followed a period of drier weather which focused on the drainage and environmental protection measures existing at the Well Site. Furthermore a site visit in August 2013 focused on the pipeline route between EMS Well Site and the Knapton Generating Station (KGS).

11.28 Additional background information on the EMS Well Site has been gained from the work of designing the original site as part of planning permission NYM/2007/0901/FL, assisting with the preparation of the planning application submitted to NYMNPA, and supervision of the site construction in 2009.

11.29 The desk top study reviewed the information provided by:

- British Geological Survey (BGS) using a printed copies of the geological maps for the area, Sheets Nos 35/44 (Whitby and Scalby) and 54 (Scarborough)[xiv];
- BGS online web site, *www.bgs.ac.uk*;
- Chapter 15 of this Environmental Statement;
- Environment Agency website and interactive maps, *www.environment-agency.gov.uk*[xv]; and
- Records of previous site works, where these were available.

11.30 The pipeline route is effectively split into two distinct sections by the sharp change in topography associated with the change in geology just north of the A170 (see Figure 11.1). The two sections shall be referred to in this assessment as the North and South Areas to differentiate between the characteristics that are distinctive of each area of the pipeline route.

Flood Risk

11.31 The flood risk associated with the Site was assessed by reviewing the Environment Agency records for the area and the geological data published by the BGS.

11.32 In the North Area of the pipeline route, the elevation of pipeline route above sea level was compared with that for the springs issuing within the immediate area (within 1.5 km of the Site) to confirm the presence and level of groundwater. Site records taken when the EMS Well Site was first constructed in 2009 were also consulted to confirm whether groundwater was encountered during the construction of the well Site, or if any issues relating to flooding occurred.

11.33 In the South Area the presence of drainage ditches, dikes and watercourses such as the River Derwent, as well as data gathered during the site visits, was used to determine the extent of the flood risk within this area.

Hydrology

11.34 The hydrology of the area in terms of surface and ground water is determined by:

- the nature of the ground, such as composition and permeability; and
- its elevation in relation to surrounding areas.

11.35 The effect that the Development might have upon any groundwater will be influenced by:

- the ground conditions;
- the position of the Site in relation to any river basins or aquifers; and,
- the proximity of any water abstraction boreholes or springs.

11.36 The North Area is located upon permeable rocks with the potential for groundwater, aquifers and formation water and therefore the assessment in this area will focus on effects on groundwater and surface water.

11.37 In contrast the impermeable nature of the bedrock in the South Area rules out the presence of bedrock aquifers and assessment of the hydrology of the South Area will be limited to consideration of groundwater in the superficial drift deposits and surface waters.

11.38 The assessment has adopted the following description of groundwater, aquifers and formation water, in order to differentiate between the relatively shallow, potable water supplies and deeper reserves of water:

- 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
- Water Bearing Formation: A geological unit (or formation) which contains formation water.

11.39 The meaning of groundwater and aquifer are the same as that intended in by the WFD and GWDD, whilst the other terms are commonly used in the oil and gas industry.

11.40 The following information on aquifer designation is taken from the Environment Agency website and is reproduced in full, using designations consistent with the Water Framework Directive:

> *"The aquifer designation data is based on geological mapping provided by the British Geological Survey. It will be updated regularly to reflect their ongoing programme of improvements to these maps. We gratefully acknowledge this assistance.*
> *The maps are split into two different type of aquifer designation:*
>
> - *Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.*
> - *Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.*

The maps display the following aquifer designations:

Principal Aquifers
These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary Aquifers
These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:

Secondary A - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;

Secondary B - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

Secondary Undifferentiated - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."

Source Protection Zones (SPZs)

11.41 Groundwater in the aquifers in the North Area described in the previous paragraphs provides a source of water for drinking and streams flowing from the area. These sources need to be protected and the areas forming part of a protection area are designated by the Environment Agency as Source Protection Zones (SPZs), described as follows:

"These SPZs show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which we occasionally apply, to a groundwater source.

The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. When we {The EA} define a zone we find out how the groundwater behaves in that area, what constructions there are to get the water out into the public water supply, and the process for doing this. From this we can develop a model of the groundwater environment on which to define the zones.

The EA divide groundwater source catchments into three zones. The zones are divided as follows:

SPZ1 – Inner protection zone
Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.

SPZ2 – Outer protection zone
Defined by a 400 day travel time from a point below the water table to the source.... this zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction.

SPZ3 – Source catchment protection zone
Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management."

11.42 The source referred to in the above definitions is the abstraction point or point where the aquifer discharges, so any location within SPZ2 is located at least 250m from the nearest stream or public water abstraction borehole.

11.43 The vulnerability of the groundwater to contaminants will depend on the permeability of the ground, the distance the contaminant would have to flow before it reaches the water table, and whether that contaminant is carried into the water table by groundwater flow. The Environment Agency produces Vulnerability Zone (VZs) maps that indicate whether the Site is located in a VZ and importance of the vulnerable aquifer (see Figure 11.3).

Drinking Water Protected Areas (DrWPAs)

11.44 In addition to the designation of SPZs, the Environment Agency defines areas where water is abstracted for human consumption at a rate of at least $10m^3$/day or over 50 people are served by it. In some areas the raw water needs treatment to reach the required quality for human consumption.

Assessment of Effects

11.45 The assessment of effects will use the criteria described in Table 11.4, 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 11.4: Methodology for Determining the Magnitude of effect

Magnitude of Effect	Chapter 2 of ES
Major	Total loss or major/substantial alteration to key elements/features of the baseline (pre-Development) conditions such that the post Development character/composition/attributes will be fundamentally changed.
Moderate	Loss or alteration to one or more key elements/features of the baseline conditions such that post Development character/composition/attributes of the baseline will be materially changed.
Minor	A minor shift away from baseline conditions. Change arising from the loss/alteration will be discernable/detectable but not material. The underlying character/composition/attributes of the baseline condition will be similar to the pre- Development circumstances/situation
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.

11.46 The sensitivity of a receptor is based on the relative importance of the receptor using the scale in Table 11.5.

Table 11.5 Methodology for Determining Sensitivity

Sensitivity	Examples of receptor
High	The receptor/resource has little ability to absorb change without fundamentally altering its present character, or is of international or national importance.
Moderate	The receptor/resource has moderate capacity to absorb change without significantly altering its present character, or is of high importance.
Low	The receptor/resource is tolerant of change without detriment to its character, is of low or local importance.

11.47 The significance of an environmental effect is determined by the interaction of magnitude and sensitivity, whereby the effects can be beneficial or adverse. The Effect Significance Matrix is set out in Table 11.6.

Table 11.6: Effect Significance Matrix

Magnitude	**Sensitivity**		
	High	**Moderate**	**Low**
Major	Major Adverse/Beneficial	Major - Moderate Adverse/Beneficial	Moderate - Minor Adverse/Beneficial
Moderate	Major - Moderate Adverse/Beneficial	Moderate – Minor Adverse/Beneficial	Minor Adverse/Beneficial
Minor	Moderate - Minor Adverse/Beneficial	Minor Adverse/Beneficial	Minor - Negligible
Negligible	Negligible	Negligible	Negligible

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.

11.48 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.

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

Baseline Conditions

11.50 The Site is a linear site extending from the EMS Well Site in a southerly direction along the pipeline route to the KGS south of the River Derwent as shown on Figure 11.5.

Topography

11.51 The EMS Well Site is located at the northern extent of the Site on the crest of a relatively flat plateau at an elevation of approximately 223m AOD, near a north-facing scarp overlooking the head waters of Troutsdale Beck. South of the EMS Well Site the ground slopes down to the south with an approximate gradient of 1 in 100 towards a dry valley called Scamridge Slack.

11.52 The pipeline route on leaving the EMS Well Site in the North Area remains on almost level ground as it approaches Givendale Head Farm, after which the pipeline route turns to the south and west to cross a shallow valley before entering Dalby Forest at Givendale Rigg and turns south.

11.53 The pipeline route then runs on the west side of the crest of the ridge between Givendale Head Farm and Warren House, located on ground dropping steadily at an average gradient of about 1:100 along Givendale Rigg turning to the west around Warren House (487500E, 484650N) at approximately 185m AOD. West of the pipeline route, the ground drops away sharply into a dry wooded valley (Haw Dale) that opens to the southwest.

11.54 The ground level along the line of the pipeline then drops more steeply from Warren House towards the south at gradients up to 1:4 to the A170, which is located near the base of the 'cliff' at a height of approximately 60m AOD. The ground drops another 20m over the next 500m before reaching the flatter flood plain of the Vale of Pickering south of the A170 at an elevation of 30m AOD where the South Area of the pipeline route is located.

11.55 The topography then changes very slightly, varying between 20 and 25m AOD along thepipeline route to KGS.

Land Use

11.56 The EMS Well Site is located within arable land that extends to the west, towards Ebberston Lane. The southern boundary of the EMS Well Site is formed by a dilapidated dry stone wall separating the field in which the EMS Well Site is located from the public bridleway and cycle path. The boundary of the North York Moors National Park follows this stone wall. The land to the south of the bridleway and to the east and north of the EMS Well Site comprise conifer plantations.

11.57 The North Area of the pipeline route runs westwards parallel to the stone wall to cross Ebberston Lane before entering farmland and then onto tracks within part of Dalby Forest south of Givendale Head Farm.

11.58 The pipeline route remains in agricultural land which is predominantly arable for the remainder of the North Area and all of the South Area, crossing the line of the A170, the River Derwent and the York-Scarborough railway line to finish at KGS.

11.59 The character of the land changes dramatically along the line of the pipeline route from the raised hills of the Dalby Forest to the flat low lying Vale of Pickering, reflecting the geological change that sharply divides the Site into two separate areas. A geological fault that runs in an east-west direction about 50m north of the A170 defines the boundary between the Corallian sandstones and limestones of the northern part of the Area from the Lacustrine and glacial deposits that overlie the Kimmeridge Clays in the south (see Chapter 15 for more details).

11.60 The freely draining soils in the North Area are drier and effectively are at low flood risk, whilst the ground in the South Area is formed of lacustrine deposits, overlying relatively impermeable clays, and are prone to flooding.

Hydrology

North Area

11.61 The Site is located within the Derwent (Yorkshire) catchment/CAMS. The EMS Well Site and northern extent of the pipeline are located at the crest of a local divide that runs west-east, as shown in Figure 11.6. The water on either side of the divide flows into the River

Derwent, with the flow to the north issuing as a series of springs in Trout Beck at the head of Troutsdale and taking a longer pathway to the south.

11.62 The permeable ground indicates a high level of infiltration and minimal run-off so that the location of the EMS Well Site and northern extent of the pipeline on the catchment divide means that there is no potential for overland flow from an upstream catchment.

11.63 As the pipeline route follows Givendale Rigg, the catchment divides again into a series of sub-catchments, one for each valley running southwest. The pipeline route is located to the west of the Givendale Rigg divide along the ridge at the edge of the catchment of Haw Dale where Wetmoor Dike flows east to west, across the line of the pipeline route about 200m northwest of Givendale Head Farm, draining into the ground at the head of Haw Dale. Haw Dale is a dry valley in the upper sections with springs further down the valley at about 100m AOD. There are also springs in Haw Dale which are 500m west of the pipeline route and 70m lower than the elevation of the pipeline. Nevertheless the position of the pipeline on the ridge means that there is limited potential for receiving overland flow.

11.64 The catchment ridge along Givendale Rigg divides again and runs southwards either side of Warren House to the A170 providing the catchment for Weas Dale, a dry valley down to the 60m contour where a spring drains into the Dale. The pipeline follows the east ridge of Weas Dale crossing the dry valley just above the springs that supply the dike running south under the A170.

11.65 There are springs close to the geological fault on the boundary between the Corallian Sandstones and the Kimmeridge Clays. The pipeline follows the slope of the hill down to the A170 below the spring line. A groundwater SPZ is centred on a spring about 600m to the west of the pipeline route in Allerston but the pipeline route is outside both the inner and outer protection zones.

South Area

11.66 South of the A170 the ground is flatter and the edge of the catchment is defined by the rising ground near the A170. Deep drainage ditches called dikes run along field boundaries and roads generally southwards to larger dikes such as Friar Dike, which then combine to flow into the River Derwent or its tributaries.

11.67 The pipeline route runs from the A170 southwards and parallel to Friar Dike a 2m deep dike as shown on Figure 11.8.

11.68 The pipeline also crosses a minor dike east of Wilton Carr House. The pipeline then crosses a minor ditch running along the north side of Wilton Ings Lane before running parallel to a dike on the west side of the field, south of Wilton Ings Lane, that drains into Friar Dike on its westward flowing leg.

11.69 The pipeline crosses the line of Friar Dike, to reach Marishes Lane, after which the pipeline route reaches the immediate vicinity of the River Derwent.

11.70 South of the River Derwent banks and flood prevention bunds the Site extends through fields that have small dikes along their east-west boundaries, and each of these will have to be crossed by the pipeline.

11.71 The flatness of the area makes the Site in this area vulnerable to overland flow and flooding from static water.

Geology and Sensitivity of Water Receptors

North Area

11.72 The North Area of the pipeline route and EMS Well Site are located on permeable sandy soil overlying bedrock of Passage Beds, Lower Calcareous Grit and Middle Calcareous Grit forming part of the Corraline Oolite Formation which in turn is part of the general Corallian Group of sedimentary deposits which is underlain by a layer approximately 25m thick of Oxford Clay Formation as described further in Chapter 15. This rock forms an aquifer from which groundwater is abstracted for human consumption and is also a source for surface water flows as described in the previous section. The 1:50,000 scale plan issued by the British Geological Society (Sheet 54) (Solid and Drift Edition) 1992 shown in Figure 11.7.

11.73 The following descriptions of the different solid deposits and their aquifer potential are provided by the BGS UK Hydrogeology Viewer website[xvi] as shown on Figure 11.1.

> *"The Grits are permeable and water soaks into the ground relatively easily with a flow directly into the aquifer within the Corallian Group.*
>
> *This group is a moderately productive aquifer that is locally important, having yields of up to 15l/s, with flows through fractures and other discontinuities."*

11.74 The Environment Agency River Management Plan for the Humber River Basin confirms the significance of the bedrock groundwater in this area:

> *"The Corallian Limestone and Sherwood Sandstone are the two major aquifers in the catchment and they are able to support large groundwater abstractions. The Corallian Limestone outcrops on the hills surrounding the Vale of Pickering and, in places, gains significant quantities of water from the River Rye and River Derwent through swallow holes, it provides all of Scarborough's public water supply."*

11.75 The Site is located just within the groundwater SPZ Zone 2 defining the outer zone of protection for the Corallian primary aquifer shown on Figure 11.2. It is also shown in Figure 11.3 to be in a Groundwater Vulnerability Zone of low vulnerability, reflecting its position outside the SPZs.

11.76 Reference to the DrWPA plan shows the Site to be within the High Risk area. The Environment Agency website interactive plan describes the groundwater risk status as being 'at risk'.

11.77 The EMS Well Site is within SPZ2 and is located above an aquifer that is of local importance as a source of raw water for treatment and domestic consumption. The route of the pipeline runs through the SPZ2 Outer Zone of the Protection Area before exiting the Protection Zone near Ebberston Lane.

11.78 Sixteen licensed abstraction boreholes are recorded on the Environment Agency database with three being surface water abstraction and 13 groundwater abstraction boreholes. The nearest licensed groundwater abstraction to the Site is about 500m away at Givendale Head Farm.

South Area

11.79 In the area south of the A170, the underlying bedrocks are from the Kimmeridge Clay Formation which have been considered impermeable with no useful aquifer capacity even if they may have some groundwater. The Kimmeridge Clays are overlain by superficial deposits that vary according to their location. A narrow strip of Glacial deposits of silts and sands overlie the Kimmeridge Clay immediately south of the A 170 and the remainder of the pipeline route to the railway line is overlain by superficial Lacustrian deposits comprising silts sands and clays of variable permeability. The Envirocheck report (Appendix 15.1)

suggests the presence of running sands and quicksands in places. These water-bearing gravels and sands will present groundwater issues as there are some abstraction boreholes that are used to supply farms.

11.80 To the south of the railway line, the drift deposits are predominantly sands and gravels. Old borehole logs indicate bedded layers of sand, clay, and quicksand with Kimmeridge Clays encountered at depths of 33m. The quicksand probably results from loose water-bearing sands flowing into the borehole, with the water table about 9' (2.7m below ground level).

11.81 The impermeability of the Kimmeridge Formation means that all surface water flows to dikes and then drain from them into the River Derwent, with the upper soil layers getting saturated. The flatness of the area results in slow rates of drainage, so this area is prone to flooding, as noted during the survey in November 2012, when large areas of agricultural land were flooded.

Drainage

11.82 The EMS Well Site was constructed in 2009 by levelling the ground and then laying a bentonite membrane across the well Site, protected by sand layers and geotextiles from risk of puncture. This forms an effective impermeable membrane underlying the EMS Well Site that traps any fluids produced on the well Site, either from the construction or operation phases, or rainfall.

11.83 The bentonite membrane was continued through into the ditches forming the EMS Well Site boundaries and up over bunds to provide a sealed drilling site with capacity to contain any discharge from tanks on site and a nominal 50 barrels/day flow of oil from the wellhead in the event that control of the borehole was lost. Oil has not been discovered so the likelihood of that event occurring is non-existent.

11.84 The existing scheme of water management on the EMS Well Site is as follows:

- All surface water on the impermeable central part of the EMS Well Site drains into the perimeter ditch;
- Soil bunds outside the perimeter ditch prevent escape of water from the EMS Well Site;
- Flow in the perimeter ditch is under gravity to a sump located at the south east of the EMS Well Site;
- Water from the sump is pumped into two onsite storage tanks for use during the operations;

- Excess surface water not required for site operations will be removed by a licenced waste carrier; and
- There is no discharge of water from the EMS Well Site.

11.85 Where the pipeline route passes through the Dalby Forest and the higher agricultural fields north the A170, there will only be natural drainage associated infiltration into the groundwater and the surface water features described above.

11.86 In contrast the flat, poorly draining ground in the South Area will have land drains laid to drain into the dikes that run around the perimeter of the fields.

Flood Risk

North Area

11.87 Considering the external sources of flooding outlined in the Planning Practice Guidance[xvii], the following observations can be made for the North Area:

- there are no streams, rivers or other watercourses within the immediate vicinity of the EMS Well Site;
- there are no streams and other watercourses intersecting with the pipeline route;
- there are no reservoirs or other artificial sources of water within the area;
- rising groundwater has not been recorded as a risk in this area;
- there are no sewers within the locality; and,
- reference to the Environment Agency Flood Risk Map confirms that the EMS Well Site and pipeline north of the A170 are located within Flood Zone 1 (see Figure 11.5).

11.88 The Site in the North Area has no flood risk arising from water coming onto it from natural watercourses, artificial reservoirs or drainage and the risk of flooding from these sources can therefore be scoped out of this assessment.

11.89 The Development will not have any presence above ground, apart from within the EMS Well Site and KGS, so the risk of flooding of the areas through which the Development passes will not increase. Where the pipeline enters EMS Well Site and KGS, they are within the bunded areas associated with both of these locations and there will be no effect upon the flood risk for adjacent areas. The Development will not increase the flood risk for the surrounding area and can be scoped out of this assessment.

South Area

11.90 The pipeline route south of the A170 passes through two locations that are within Flood Risk Zone 3, where there is a 1 in 100 or greater annual probability of river flooding. One location is Friar Dike, as indicated on Figure 11.5, and the other is the land immediately adjacent to the River Derwent outside the flood bunds. The remainder of the pipeline route and KGS is located in Flood Risk Zone 1.

11.91 The fields in the South Area that are located within Flood Zone 1 are kept free of flooding by the network of drains and dikes that cross the area, so these watercourses must be maintained to avoid groundwater levels rising and causing floods. This is particularly important south of the railway, where the sands and gravels form a minor aquifer in the superficial deposits.

11.92 The Planning Practice Guidelines to the NPPF requires sequential and exception tests to be applied for developments within the two areas within Flood Zone 3, and it is clear that although the Site avoids most areas of flood risk, these two areas remain.

Likely Significant Effects

Construction

11.93 Information relating to the construction of the Development is provided in Chapter 5. This section provides an assessment of the effects resulting from the construction activities described in Chapter 5 without the inclusion of mitigation measures beyond those incorporated directly into the design of the Development.

Flood Risk during construction

11.94 The EMS Well Site has existed in its current state for at least six years, during which time no flood events have been reported as a result of the EMS Well Site being present. The construction works at the EMS Well Site will not directly produce any flood-related effects, as there will be no significant change in the area of impermeable surface at the EMS Well Site, no de-watering of excavations will be required, nor watercourses diverted.

11.95 The proposed use of the EMS Well Site as a construction compound will have a negligible effect on the structure of the Site or flood effects as the area of impermeable surface at the EMS Well Site will not significantly change.

11.96 The pipeline between the EMS Well Site and KGS will require removal and stockpiling of topsoil and excavated material from the pipeline trench; the installation of the pipeline and fibre optic cables; and then reinstatement of the subsoils into the trench and re-spreading the topsoil as described in Chapter 5.

11.97 The alignment of the pipeline along ridges in the North Area ensures that they will not be flooded by overland flows. Furthermore the construction process of the pipeline along the ridges also will not produce water to create a flood risk and the permeable strata into which the pipeline is being laid will allow natural drainage of any rainwater falling in the area. There will be negligible flood effects arising from this part of the construction.

11.98 The pipeline trench will cross the geological fault line near the A170, where the ground is expected to be saturated on the north side of the fault where springs are located as described above. Excavation through the Fault Zone creates the risk that water could flow from the north side of the fault down into the south area. This has the potential for a minor adverse effect.

11.99 The construction of the pipeline across the South Area from the A170 to the River Derwent and then to KGS will cross dikes and ditches creating a temporary minor adverse effect on the local drainage.

11.100 The summer flows in Friar Dike are low, although subject to swift increases during heavy rain. Interruptions to the flow of the Dike could result in localised flooding of the agricultural land and the pipeline trench, creating a minor adverse effect that will persist until the flow of water along the Dike is restored.

11.101 The pipeline under the River Derwent will be installed using directional drilling which will result in negligible effects on the river or its flood plain.

11.102 Connection of the pipeline into the existing infrastructure within KGS will not give rise to any flood effects as it is outside of the flood risk zone.

Drainage during construction

11.103 There will be negligible effect on drainage as a result of construction activities associated with construction of gas production facilities on the EMS Well Site especially as there will be no significant change to the area of impermeable surface on the Well Site.

11.104 During the installation of the pipeline and its connection with the gas production facilities on the EMS Well Site there will be a localised breach of the drainage ditch where it is crossed by the pipeline which will create a temporary or short term minor adverse effect on surface water drainage of low magnitude. This effect is reversible as the integrity of the ditch will be immediately restored after the pipeline has been constructed.

11.105 The porous nature of the ground along the pipeline route in the North Area will permit any rainwater water collected in the pipeline trench to soak away naturally into the ground resulting in negligible effects to drainage.

11.106 The pipeline trench excavated in Drift Deposits south of the A170 will retain any surface water discharged into it from overland flow or from rain water. This will need to be pumped out and discharged as appropriate into a water course in such a way as to avoid suspended silt entering the ditches or watercourses. The effect of such pumping is considered to be negligible.

11.107 Excavation of the pipeline trench between the A170 and KGS will encounter land drains, with potential to cause moderate adverse effect upon the land drainage.

11.108 Foul drainage from welfare facilities associated with the construction workers will be tankered off site by service companies and disposed of at an appropriate treatment plant. There will be negligible effect arising from foul drainage during the construction phase.

Hydrology during construction

11.109 The only sources of potential contamination during construction that will be large enough to cause significant adverse effects will be serious spillage or leaks of more than 50 litres from a fuel tanker, hydraulic oil drums or a large fuel storage tank as discussed in Chapter 15. The majority of these sources will be located on the EMS Well Site with machinery working within the rest of the Site only carrying limited amounts of fuel or other contaminants. The duration of the effect will depend upon factors such as the viscosity of the spilt fluid, and the rate of recharging the groundwater by rainfall.

11.110 Although the EMS Well Site is located on permeable ground close to an aquifer used for drinking water supply, the impermeable membrane and interceptors on the EMS Well Site will prevent any contaminants from leaving the Well Site and infiltrating into the ground water. This will result in negligible effects on the aquifer as a result of construction activities associated with gas production on the Well Site. However, the installation of the pipeline and its connection on the Well Site will cause a temporary localised breach in the

ditch surrounding the Well Site, which will give rise to a temporary increase in the risk of contaminants entering the ground with the associated possible minor effect on the aquifer.

11.111 In the unlikely event of a surface spillage while there is a short term temporary breach in the ditch surrounding the EMS Well Site, there is a potentially for contaminants to escape from the Well Site and soak into surrounding ground which will result in an adverse effect. In this scenario, without appropriate mitigation measures in place, any contaminants in the groundwater will be expected to show first in the springs at the base of the scarp slope north of the Well Site. Such an unlikely event will reduce surface and ground water quality and, depending upon the pollutant, potentially have adverse effects on the flora and fauna and Scarborough's water supply. Any contamination of the aquifer will be temporary, lasting until the contaminant is flushed out of the aquifer by groundwater flow. This will potentially give a temporary major/moderate adverse effect before mitigation.

11.112 In the same way, the pipeline trench will pass through an outer SPZ and relatively close to water abstraction boreholes at Givendale Head Farm and Warren House. The position of the pipeline on the ridges makes the aquifers in the underlying rocks vulnerable to contamination. However other than fuel and oil the construction activities are unlikely to require chemicals that will contaminate surface and ground water. In the unlikely event that there is a spillage or leak, as the ground and surface water are considered to be high sensitivity, this will potentially result in a temporary moderate adverse effect that will persist until the pollutant has been sufficiently diluted.

11.113 The initial drilling operations will utilise an existing borehole that is isolated from shallow groundwater aquifers by steel casings and there will be no effect on the aquifers from this operation. The water injection borehole will be drilled later and a new borehole will be constructed that penetrates the groundwater aquifers. The effects on groundwater of drilling the water injection borehole are assessed in Chapter 12.

11.114 South of the A170, any spillage of fuel and oil will soak into the ground but the relatively low permeability of the Lacustrian Deposits will inhibit the rapid dispersal of the spillage. In the unlikely event that there is a spillage or leak the low vulnerability of the groundwater in areas away from the River Derwent and south of the railway line will potentially result in a temporary minor adverse effect that will persist until the spillage is removed.

11.115 Groundwater issues associated with the pipeline route under the River Derwent will be avoided by drilling from outside the flood zone, thus avoiding the minor aquifer associated with the gravels in the proximity of the river, resulting in negligible effect.

11.116 South of the railway line, the pipeline passes through drift deposits that are a minor aquifer and have a high vulnerability, so that a spillage will potentially have a temporary moderate/major adverse effect that will persist until the pollutant had been removed or pumped out.

Operation

Flood Risk during Operation of the Facility

11.117 During operation of the Development, the construction compound, laydown area and other temporary construction phase installations will be removed and the Site will be in a static state. There will be no change from the existing situation in the overall flood risk to the EMS Well Site from the surrounding area, with negligible effects arising.

11.118 There will be negligible flood effects arising from the pipeline once the land has been reinstated or the KGS during operation.

Drainage

11.119 Rainwater will continue to be collected within the Well Site and discharged via the oil interceptors and soakaway into the ground resulting in negligible effects during the operational phase. There will also be negligible effects on drainage along the pipeline route once the land has been reinstated as the drainage regime will be returned to the existing situation. Furthermore there will be no changes to the drainage at KGS.

Hydrology

11.120 Negligible effects will arise from the Site once the land within the pipeline route has been reinstated.

Decommissioning

11.121 The decommissioning of the EMS Well Site as discussed in Chapter 5 will involve shutting down and removal of the equipment without removal of the bunding, bentonite membrane and other environmental protective measures. All pipelines and tanks will be drained and then dismantled down to their original components in order for them to be transported away from the Well Site. All fuels, oils and other contaminants will be removed from the Well Site resulting in an effect of low magnitude and minor beneficial significance on drainage and water quality.

11.122 This work will be carried out within the boundary of the EMS Well Site, protected by both the bunds around the tanks and the bentonite membrane, but care will still be required to prevent the risk of any contaminants entering the drainage system. The risk of contamination is still present and has a medium magnitude of effect that has moderate/minor adverse significance.

11.123 The pipeline will remain in place with the ends capped which will result in negligible effects along the pipeline route and at KGS.

Flood Risk

11.124 There will be negligible effects on the risk of flooding either into, or from, the EMS Well Site during decommissioning as long as the drainage system remains in operation. However, if the outflow into the interceptor is closed to avoid accidental discharge of contaminants when the pipework is drained, there will be a short term adverse effect on the internal flood risk of low magnitude and negligible significance, because the bunds around the Site will be sufficient to accommodate a 1:100 storm. The risk of flooding in the area around the site will be negligible.

11.125 There will be negligible effects on the risk of flooding along the pipeline route or KGS.

Drainage

11.126 Drainage from the Well Site will be closed during critical parts of the decommissioning phase, particularly when pipework is being drained and dismantled which will have a low magnitude effect upon the Site that will last for the duration of the closure. However, by preventing potential contamination events where practicable, there will be an effect of low magnitude on the local environment of short duration and minor beneficial significance.

11.127 There will be negligible effects on the drainage along the pipeline route or KGS.

Hydrology

11.128 There will be negligible effects arising from the decommissioning of the EMS Well Site as the drainage system is operational for the duration of the phase. The decommissioning of the pipework and other equipment at EMS Well Site has to be carried out before the site is reinstated, so the drainage will remain intact during decommissioning. There will also be negligible effects on the hydrology along the pipeline route or KGS.

Restoration

11.129 Restoration of the EMS Well Site will result in the removal of all construction materials and reinstatement of the land to its original contours, using the soil stored in the stockpiles and bunds around the Well Site. There will be negligible change to the pipeline route or KGS during this phase.

Flood Risk

11.130 There will be negligible effects on the flood risk of the area surrounding the EMS Well Site, either during the restoration or upon its completion and subsequent return of the land to the control of the land owner.

Drainage

11.131 Drainage within the locality of the EMS Well Site will remain unchanged although rainfall on the Well Site will be dispersed naturally over ground rather than concentrated into a single dispersal point at the soakaway. This will have a permanent effect of low magnitude and minor beneficial/negligible significance.

Hydrology

11.132 Removal of the compounds on the EMS Well Site after the plugging and abandoning of the boreholes will necessitate earthmoving equipment working on the exposed bedrock, so there is low risk of contamination from spilt fuel/hydraulic oil. In the unlikely event of this occurring there will be an effect of medium magnitude and moderate/minor adverse significance because of the relatively small quantities involved.

11.133 When completed, the restoration of the EMS Well Site to its original state will result in a permanent effect of medium magnitude and moderate beneficial significance as the ground will be restored to agriculture.

Mitigation Measures

11.134 This section provides a description of the mitigation measures to be incorporated into the Development to minimise the likely significant effects identified above during construction, operation, decommissioning and restoration.

Construction

11.135 Any potential effects of flood risk, hydrology and drainage during construction will be minimised by the implementation of the following mitigation measures through the Construction Environmental Management Plan (CEMP). Mitigation measures to be adopted during the construction phase will follow the Prevention of Pollution Guidelines (PPGs) published by the Environment Agency, with particular reference to PPG 6 'Working at Construction and Demolition Sites'[xviii]. These measures are described in greater detail in the following sections.

Flood Risk

11.136 At the EMS Well Site no mitigation measures beyond those incorporated into the design of the Well Site are required.

11.137 In terms of the construction of the pipeline, the risk of flooding will be minimised by:

- Overpumping water in ditches around the crossing points of the pipeline where bunding has been installed to create a dry working environment;
- Backfilling of the trench in advance of any potential flooding during the construction of the pipeline in close proximity to Friar Dike; and
- Directional drilling or a suitable installation technique will be used to construct the pipeline beneath the River Derwent to avoid effects on the river and its associated flood plain.

11.138 Where the pipeline route crosses the geological fault near the A170, the alignment of the pipeline will be routed to avoid crossing the valley floor of the Weas Dale at its lowest point to avoid the potential to act as a drain for the upper, saturated rock. This results in negligible effect upon the risk of flooding.

11.139 Trial pits and borehole records (See Chapter 15 for details) indicate that groundwater levels can be as low as 2.7m below ground level, and in order to avoid issues of groundwater rising into the excavated pipeline trench, the construction work would be better constructed during dryer times of the year. This will result in negligible effects.

11.140 Dikes and ditches in the South Area from the A170 to the River Derwent will be temporarily dammed upstream and downstream of the crossing point to allow localised dewatering with over-pumping of the water within the ditches and dikes around the drained section to

ensure that the flow rate and water quality in the ditches and dikes is maintained. This will result in negligible effects.

11.141 Damming up Friar Dike and provision for over-pumping of the water around the crossing points will ensure that all flows other than extreme flood conditions will be catered for. If an extreme flood event did occur the pipeline trench will potentially be vulnerable to flooding. However this will be avoided by temporarily backfilling the trench near the dike in the event of heavy rain likely to cause such a flood event. This will result in negligible effects.

11.142 No mitigation measures are required at KGS although any excavation would be better carried out when water tables are seasonally low, reducing any effects to negligible.

Drainage

11.143 When the EMS Well Site is developed the surface water management will be modified so that rainwater will be gathered in the ditches and either used on site or discharged through an oil interceptor and soakaway into the ground. The oil interceptor will be located at the south eastern corner of the EMS Well Site and 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 Site will enable isolation of the interceptor during drilling operations and the risk of contamination to the aquifer will be negligible. The location of the interceptor in this position moves the point of discharge to the outer edge of the SPZ Zone 2.

11.144 A land drainage scheme will be implemented prior to construction of the pipeline to divert water in the land drains as appropriate. In addition where practicable land drains which are damaged through the construction of the pipeline will be repaired to mitigate to the effect to negligible.

11.145 No mitigation is needed for the foul drainage associated with welfare facilities of construction workers during the construction phase.

Hydrology

11.146 The drilling process is closely controlled to minimise the effects of drilling through aquifers, with the drilling programme being scrutinised by the EA, the HSE, and DEFRA and controlled by a rigorous permitting system. The integrity of the borehole casings is tested to ensure isolation of the fluids within the borehole from the rock sequences through which the borehole passes. Fuller details of the mitigation measures implemented whilst drilling

through the groundwater aquifers are provided in Chapter 12, whilst mitigation measures for surface hydrology are considered in the following section.

11.147 In order to mitigate the risk of a pollutant entering the ground and thence the groundwater during construction within the EMS Well Site, along the pipeline route or in KGS, products to be used in construction activities will be carefully selected to avoid potential contaminants being used on the construction site. Particular focus during this phase will be on the location of remaining potential contaminants, their usage, and how they are stored. The following actions will be integrated into the CEMP:

- 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;
- Inspect all storage containers for all materials to ensure that they are fit for purpose, regularly inspected and maintained;
- No materials will be stored on uncovered ground;
- 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[xix];
- 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[xx];
- Any routine maintenance of machinery shall be carried out within the EMS 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;
- 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.

11.148 Given the silty sandy nature of the soil in the area south of the railway, in the unlikely event that any spillage of contaminants occurred, the contaminated soil could be excavated and soil washing techniques used to remove any contaminants. This will result in negligible effect.

11.149 All fluids used during testing will 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.

Operation

11.150 There will be regular monitoring of the pipeline to ensure that there are no leaks that could potentially affect ground or surface water. In addition 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.

Decommissioning

11.151 Closure of the drainage discharge pipe on the EMS Well Site during the decommissioning phase, combined with good working practices to be implemented through the CEMP will result in negligible effects on drainage or hydrology.

11.152 The risk of the site flooding because the drainage has been isolated will be countered by using tankers to take away the rainwater.

Restoration

11.153 Tight controls on all fuel and other liquids in line with those in the CEMP will form part of the site restoration management, with similar measures as for the construction phase to limit the volumes of fuel that could be spilt, and ensuring that any spillage is caught before it enters the ground.

Residual Effects

Construction

11.154 The presence of the impermeable membrane under the EMS Well Site combined with good working practices to be implemented through the CEMP will reduce the effects of the construction activities on flood risk, hydrology and drainage from minor adverse to negligible.

Operation

11.155 There will be negligible residual effects for the operational phase.

Decommissioning

11.156 Decommissioning will have an effect of minor beneficial significance, arising from the removal of possible contaminants from the Site combined with good working practices to be implemented through the CEMP.

Restoration

11.157 Restoration within both scenarios will produce a permanent effect of high magnitude and moderate beneficial significance resulting from the removal of all artificial surfacing and materials and the closing off of the boreholes combined with good working practices to be implemented through the CEMP.

Cumulative Effects

11.158 There is potential for cumulative effects to arise from the combination of the Development and Ebberston Moor EDS as described in Chapter 2. A planning application is currently being prepared for the York Potash Project with an anticipated submission date of September 2014.

EDS

11.159 The physical separation of the Ebberston Moor EDS and the Development is more definite than the distance between them, because a steep-sided valley forming the head of Troutsdale is located between the two sites. The valley floor is more than 100m lower than the surrounding plateau creating a cut-off between the two sites resulting in negligible cumulative effects arising from flood risk and drainage, with the influence of either site limited by the topography. The valley also creates a hydrological barrier, with the floor of the valley founded in the Oxford Clays so there is no hydraulic connection between the sites. It is therefore concluded that negligible cumulative effects on flood risk, drainage, or hydrology will arise from the concurrent operation of these two projects.

York Potash Project

11.160 The potash project is located to the north east of the North York Moors near Whitby and its physical separation will have no discernable cumulative effects when considered in conjunction with this Development.

Summary

11.161 The EMS Well Site and pipeline route north of the A170 are situated on permeable sandstones and is effectively free of the risk of flooding, being located in Flood Zone 1, which has a 1:1,000 annual chance of flooding. The permeability of the bedrock combined with the impermeability of the underlying Oxford Clay Formations means that there are no surface watercourses in the vicinity of the Site and any rainfall soaks into the ground below which is located a shallow aquifer from which groundwater issues as springs to the west and south.

11.162 The Site south of the A170 is located on Glacial and Lacustrine drift Deposits over impermeable rocks of the Kimmeridge Clay Formation. The pipeline route passes through Flood Risk Zone 3 areas associated with Friar Dike and River Derwent. Mitigation by using standard construction techniques will reduce any effects to negligible.

11.163 The Development will not significantly affect flood risk, hydrology and drainage during construction, operation or decommissioning and restoration provided the mitigation measures including best practice, the CEMP and minimisation of contaminants that could harm people and the environment are implemented.

11.164 Table 11.3 contains a summary of the likely significant effects of the Development.

Table 11.3: Table of Significance – Flood Risk, Hydrology and Drainage

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	D/NP	L	
Demolition and Construction											
Contamination of Aquifer during construction	Permanent/long term	Major/Moderate Adverse	Implement rigorous site management of the construction process using PPG6 as a datum						*	*	Negligible
Construction activities at EMS Well Site	Short term temporary	Minor Adverse / Negligible	Bases etc to be kept above lining membrane							*	Negligible
Spillages near KGS	Temporary	Minor Adverse	Rigorous site management						*	*	Negligible
Flood Risk near A170	Temporary	Minor Adverse	Re-route pipeline to avoid water table							*	Negligible
Drainage south of A170	Temporary	Minor Adverse	Install pre-emptive drainage works							*	Negligible
Flooding at Friar Dike	Temporary	Minor Adverse	Use bunds and over-pumping							*	Negligible
Completed Development (Operational Phase)											
Discharge of surface water from sites	Long term temporary	Negligible	3-phase oil interceptor with monitoring points						*	*	Negligible
Decommissioning											
Contaminated discharge	Permanent/long term	Moderate/Minor Adverse	Close off drainage whilst decommissioning						*	*	Negligible
Restoration											
Reinstatement of original environment	Permanent	Moderate Beneficial	None						*	*	Moderate 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; D = District; NP = National Park; L = Local

[i] European Parliament (2000) Directive 2000/60/EC: EU Water Framework Directive
[ii] European Parliament (2006) Groundwater Daughter Directive (2006/118/EC)
[iii] European Parliament (1980) Groundwater Directive (80/68/EEC)
[iv] Environment Agency (December 2009) Humber River Basin Management Plan
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