13.0 GEOLOGY AND HYDROGEOLOGY

13.1 Introduction

13.1.1 Soils and geology play an important role in determining the environmental character of an area. Major development schemes can have both direct and indirect effects on geology and groundwater. Existing soil conditions, particularly land contamination, can impose constraints on development and conversely new contaminants can be introduced into the soils and groundwater, both in the short-term, during construction, and in the long-term from the proposed use. This section of the ES assesses the effects of the proposed development upon the geology and hydrogeology (i.e. groundwater) in the area local to the site.

13.2 Methodology

13.2.1 The assessment has been undertaken as a desk-based study, the information for which has been derived from the sources summarised in Table 13.1.

Table 13.1 Sources of Geological and Hydrogeological Information

Data source	Information obtained
British Geological Survey, sheet 127 Grantham (solid and drift). 1:50 000 series. 1996.	Superficial and solid geology.
Environment Agency Groundwater Vulnerability Map, sheet 19 Lincolnshire. 1:100 000 series. 1995.	Groundwater and aquifer information.
Ordnance Survey Data – Digital mapping extracts	Topography.

13.2.2 The potential effects of the presence of contamination at the site have been identified and evaluated using the source-pathway-receptor risk assessment approach and from this, potential pollutant linkages have been identified. In terms of the layout of this section, potential contamination sources and sensitive receptors are considered in sub-section 13.3 Baseline Conditions. The potential for the creation of pathways between them, as well as consideration of the significance of the predicted effect, is considered in sub-section 13.4 Assessment of Effects.

13.2.3 The sensitive receptors that are identified as part of this assessment are considered in terms of their importance and their sensitivity to change within the context of the site. The criteria used to define this are presented in Table 13.2.

Table 13.2 Evaluation of Sensitive Receptors

Importance	
National	Nationally designated sites (e.g. Geological SSSI) A nationally important feature that is rare in the region.
Regional	A feature that falls short of national designation guidelines but provides a resource that is rare or relied upon at a regional level
Local	A regularly occurring feature that provides a resource that is relied upon at a local level
Sensitivity to Change	
High	Long-term integrity of the receptor may be compromised at a national or regional level
Medium	Integrity of the receptor may be compromised at a local level
Low	Integrity of the receptor is not at risk

13.2.4 Where pathways between potential sources of contamination and sensitive receptors have been identified, predicted effects have been documented. The prediction of these effects has considered the importance and sensitivity of the receptor and has also sought to determine whether the predicted effect is beneficial or adverse, direct or indirect and permanent or temporary.

13.2.5 The predicted effects have been evaluated in terms of their likely significance, which has informed the mitigation measures that are proposed in sub-section 13.5. The criteria used to determine the significance of the predicted effects are provided in Table 13.3. Where the significance of a predicted effect ideally relies on intrusive data and quantitative risk assessment, a worst-case scenario has been assumed in order to provide a robust assessment.

Table 13.3 Impact Significance

Significance	Criteria
Major Adverse	The effect would adversely affect the integrity of the receptor, and would be difficult to reverse and/or alleviate
Moderate Adverse	The effect would not permanently affect the integrity of the receptor but may result in noticeable damage that would require mitigation
Slight Adverse	No permanent or noticeable damage but requiring mitigation as a preventative measure
No Significant Effect	No significant adverse or beneficial effects would result
Beneficial	The effect would benefit the quality of the receptor but not such that its importance would be improved
Major Beneficial	The effect would improve the integrity of the receptor such that its overall importance would improve

13.3 Baseline Conditions

Sensitive Receptors

13.3.1 This sub-section considers the geological and groundwater receptors within the study area that may be sensitive to change and, in particular, exposure to contamination.

Geology

13.3.2 The geological survey sheet covering this part of Lincolnshire indicates that the study area is underlain by solid rocks of Jurassic strata comprising the Peterborough Member of the Oxford Clay formation overlying the Kellaway Beds. This is one of the thickest and most widespread of the Jurassic formations which outcrop in the district.

13.3.3 Superficial stratum is noted to comprise of river terrace deposits and, specifically, Sleaford Sand and Gravel.

Hydrogeology

13.3.4 The study area lies within an area classified as a Minor Aquifer (Subclass 2 – High Vulnerability), in accordance with Environment Agency's Policy and Practice for the Protection of Groundwater and is also noted to lie within an

Outer Protection Zone (Zone 2), as identified in the Environment Agency's Groundwater Source Protection Zone mapping system.

13.3.5 It is also understood that Anglian Water maintains a water abstraction borehole in some proximity to the site's eastern boundary.

13.3.6 The strata in the locality are moderately permeable and evidence would suggest they provide a productive groundwater resource capable of supporting abstractions for public supply and other uses, and as such are considered to be of Local importance with a medium sensitivity to change.

13.3.7 From the information available the site would appear to fall within an area where soil leachability has not been surveyed. As a precautionary measure, 'unclassified' soils are considered by default as being of "high leaching potential" in accordance with Environment Agency's Policy and Practice for Protection of Groundwater. High leachability soils are considered to have little or no ability to by-pass flow or attenuate pollutants and, as such, are highly sensitive to change.

13.3.8 There are no records available relating to the presence of shallow or perched groundwaters within the study area. It is likely, however, given the nature of the superficial geology and the proximity of the River Slea, that shallow groundwaters will be present beneath the site. Furthermore this groundwater is likely to be flowing at a shallow gradient towards the River Slea to the north of the site, and have a medium sensitivity to change.

Potential Contamination Sources

13.3.9 The historical records suggest that the site of the proposed REP has not previously sustained any use other than agriculture and, as such, the prospects of identifying any potential contaminants (with the potential exception of fertilisers/pesticides etc.) during the development process are very limited indeed.

13.3.10 The industrial processes involved in operating the proposed REP would not involve the use of any hazardous substances and, therefore, the risks associated with contamination of groundwater resources is restricted to minor

oil/fuel spills at surface level, and subsequent conveyancing via surface water runoff into soils with high permeability.

13.4 Assessment of Effects

13.4.1 This section considers the predicted effects that may occur should pathways between the identified receptors and sources of contamination be created. As a result of the baseline data collection, the following receptors have been identified in the vicinity of the site:

- solid geology;
- shallow groundwater;
- deep groundwater and abstraction.

Construction Effects

13.4.2 Owing to the receptors that have been identified as a result of the baseline data collection exercise, the potential effects on geology and groundwater during construction have been considered in terms of the creation of the following pathways:

- mobilisation of any existing pollutants (extremely limited potential);
- creation of groundwater pathways; and,
- potential contamination from spillage.

Mobilisation of Any Residual Pollutants

13.4.3 Any excavation of the ground may give rise to the mobilisation of potential contaminants within the soils, superficial and hard rock geology depending on the final depth of the excavation, foundation construction etc, which may result in moderate adverse effects Excavations may also give rise to the mobilisation of soil particles to ground and surface waters that may be polluted with contamination previously encapsulated below the study area, resulting in moderate adverse effects (although the likelihood of both the above is extremely limited).

13.4.4 Any contaminated excavated material extracted from foundation voids would be immediately removed from site. However, machinery tracks and wheels may pick up soil/geology residues which could be distributed across the site. These mechanisms may, in turn, give rise to cross-contamination and spread the potential contamination across a wider area resulting in slight adverse environmental effects.

13.4.5 Excavations and subsurface structures within a shallow groundwater area are likely to have an effect on the rainwater infiltration rate, flow direction and rate of groundwater beneath the study area. This may result in a slight adverse effect on the quality of shallow groundwater and any groundwater recharge of the surface watercourse system.

Creation of Groundwater Pathways

13.4.6 During the excavation processes and any piling for new foundations, pathways for potentially polluted shallow groundwater to flow into deeper groundwater may be created. The deep groundwater beneath the study area is designated as a Minor Aquifer and forms part of a Source Protection Zone for local public and industrial water supplies. The creation of preferential pathways for potential contamination into the deeper groundwater would constitute a major adverse environmental effect.

Potential Contamination from Spillage

13.4.7 The use of plant, equipment and machinery would require maintenance and refuelling. Accidental spillage of these substances, during storage or use, may lead to contamination of soils and groundwater either through open excavation, resulting in slight adverse effects.

Operational Effects

13.4.8 Given the extent of proposed hardstanding across the site, the sealed, below-ground foul sewer and surface water drainage systems and the stringent controls that would be in place to operate the proposed REP, it is considered highly unlikely that any contamination of geology or groundwater would occur during operations and, as a result, no significant effects are predicted.

13.5 Mitigation and Residual Effects

13.5.1 This section outlines the mitigation measures that are proposed to minimise the likelihood or effect of the potential effects on geology and groundwater both during and after construction, on the surrounding environment. With the adoption of these measures the magnitude of the predicted adverse effects can be reduced, so that no significant residual effects would remain.

Construction Mitigation

13.5.2 The potential effects on geology and groundwater have been predicted to occur predominantly during the construction phase and, specifically, in relation to the potential creation of pathways during piling operations, excavations for new foundations or the provision of services.

13.5.3 It is recommended that appropriate ground investigation is undertaken prior to construction in order to quantify any potential risks to groundwater as a result of potential contamination resulting from the site's previous use in agriculture. Investigations should be phased, targeted and efficient and based upon contemporary investigative methodologies.

13.5.4 Once any contamination and associated risk has been characterised, appropriate remediation measures would be designed, prior to site works commencing, to eliminate or mitigate environmental risks to acceptable and sustainable levels, resulting in no significant residual effects.

Mobilisation of Pollutants

13.5.5 The principal objective of any risk mitigation would be to sever any pollutant pathways and prevent or reduce the mobilisation of potential contamination within the ground and groundwater underlying the site.

13.5.6 All excavations would be carried out in accordance with current UK best practice so as to prevent the spread or mobilisation of any contaminated excavated material and cause surface water pollution. These practises would extend to the reuse or disposal of excavation residues as appropriate. If construction processes encounter suspected contaminated material, the

nature and extent of the contamination would need to be assessed by a specialist. Construction workers would be provided with appropriate personal protective equipment following a site-specific risk assessment, resulting in no significant residual effects.

13.5.7 All piling or deep excavations would be designed and carried out in accordance with current UK best practice guidelines with regard to the presence of a minor aquifer and Source Protection Zone underlying the site. The advice of the Environment Agency would be sought prior to the commencement of excavation works to ensure that no significant residual effects occur. Any contaminated material for off-site disposal would be classified in accordance with the Landfill Regulations 2002 to determine the appropriate disposal measures.

Operational Mitigation

13.5.8 The proposed REP would be operated and regulated under a PPC permit and would be subject to regular inspection and rigorous record keeping. As a result, no significant effects on geology or groundwaters are predicted during the operation of the plant and no specific mitigation measures are proposed as part of this assessment.

13.5.9 Generic measures to ensure effective site management, including procedures for dealing with accidental oil and fuel spillages during the use of plant, equipment and machinery would be included as part of the Environmental Management System for the site. Therefore no significant residual effects are predicted during the operation of the site.

13.6 Conclusions

13.6.1 This section has assessed the potential effects of the proposed development on the geology and groundwater local to the site. This has identified that the study area has not previously been developed and has been used solely for agricultural purposes. Accordingly, the potential for mobilising pollutants during the construction phase of the development is extremely limited

13.6.2 In the absence of any hazardous substances in the processes proposed at the REP, the risk of contamination of the local geology or groundwaters is considered to be negligible.

13.6.3 It has been predicted that any potential adverse environmental effects would occur predominantly during the construction phase and, specifically, in relation to excavation activities. Measures to mitigate these effects would be determined through appropriate ground investigation, together with the control of pathway creation through good site practice. No significant residual effects are predicted.

13.6.4 Although no significant effects are predicted during the operation of the proposed development, generic measures would be introduced to ensure effective site management including procedures for dealing with accidental oil and fuel spillage during the use of plant, equipment and machinery and these would be included as part of the Environmental Management System for the site.