



Rampion Offshore Wind Farm



ES Section 22 – Ground Conditions

RSK Environmental Ltd

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22 GROUND CONDITIONS

22.1 Introduction

22.1.1 This section of the Environmental Statement (ES) provides a description of the physical environment (soils, superficial geology, solid geology and hydrogeological regime) within a 2km area of search surrounding the proposed onshore works (landfall, onshore cable and onshore substation) relating to the Rampion Offshore Wind Farm (the Project). It also provides an assessment of the predicted physical impacts of the proposed onshore works during the construction, operational and decommissioning phases. Where necessary, mitigation measures are identified to eliminate or minimise potential impacts.

22.2 Legislation and Policy Context

Key Legislation

- 22.2.1 The principal legislation designed to protect the physical environment, including land quality, waste management and water resources, and which may be relevant to construction, operation and decommissioning of the onshore elements of the proposed development.
- 22.2.2 **Environmental Protection Act 1990 (EPA)** Part IIA: A wide-ranging Act incorporating numerous issues, but primarily making provision for the improved control of pollution. Part IIA deals with the identification and remediation of contaminated land.
- 22.2.3 **Contaminated Land Regulations (2006) (SI2006/1380) replaced 2012:** Extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.
- 22.2.4 **Environment Act 1995:** Includes the establishment of the Environment Agency (EA) and Scottish Environmental Protection Agency (SEPA) improving control of contaminated land, abandoned mines, control of pollution and the conservation of natural resources and the environment.
- 22.2.5 **The Control of Pollution (Oil Storage) (England) Regulations 2001:** Legislation to prevent pollution of controlled waters due to the use or storage of oil.
- 22.2.6 **Control of Substances Hazardous to Health Regulation 2002 as amended:** These regulations require employers to control exposure to hazardous substances to prevent ill health. They require protection of employees and others who may be exposed.
- 22.2.7 **Water Resources Act 1991:** Amended by the Water Act 2003 (see below).

- 22.2.8 **Land Drainage Act 199:** An Act relating to the responsibilities and functions of internal drainage boards, and of local authorities in relation to land drainage.
- 22.2.9 **Groundwater Directive (1980) (80/68/EEC) and 2006 Groundwater Daughter Directive (2006/118/EEC) of the Water Framework Directive:** Main European legislation in place that is protective of groundwater. The 1980 regulation is due to be repealed in December 2013
- 22.2.10 **Groundwater Regulations 1998:** Relate to the prevention, reduction and elimination of pollution of water.
- 22.2.11 **European Community Water Framework Directive 2000 (WFD):** The directive establishes an integrated approach to the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater.
- 22.2.12 **Water Act 2003:** The act provides amendments to the Water Resources Act, 1991 and strengthens the EA's powers for the sustainable management of water resources, including powers relating to abstraction licensing.
- 22.2.13 **Water Resources (Abstraction and Impounding) Regulations 2006:** These regulations specify procedural requirements in respect of the licensing of abstraction and impounding of water.
- 22.2.14 **Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991 as amended:** Local authorities are required to establish and maintain a register of carriers of controlled waste.
- 22.2.15 **European Community Landfill Directive (1999/31/EC):** Legislation to ensure that the amount of waste being landfilled is reduced, with an emphasis on minimisation, reuse, re-cycling or recovery options. The Directive has provisions covering location of landfills, and technical and engineering requirements for aspects such as water control and leachate management, protection of soil and water and methane emissions control.
- 22.2.16 **European Community Hazardous Waste Directive 91/689/EC:** The directive aims to provide a precise and uniform European-wide definition of hazardous waste and to ensure the correct management and regulation of such waste.
- 22.2.17 **Landfill (England and Wales) Regulations 2002:** Regulations to ensure that the technical and regulatory requirements of the Landfill Directive are implemented.
- 22.2.18 **Clean Neighbourhoods and Environment Act 2005:** This act covers a wide range of provisions, including the transportation, collection, disposal and management of waste.
- 22.2.19 **Hazardous Waste Regulations 2005:** These require that notification be provided to the EA prior to any hazardous waste being produced at a site.

- 22.2.20 **Environmental Permitting Regulations 2007:** These regulations combine Pollution Prevention and Control (PPC) and Waste Management Licensing (WML) regulations. The EP Regulations contain references to the Environmental Protection Act of 1990, which remains in force.
- 22.2.21 **Site Waste Management Plans Regulations 2008:** Apply to any construction site with an estimated cost greater than £300,000. Construction cannot begin without a Site Waste Management Plan.
- 22.2.22 **Priority Substances Directive (2008/105/EC):** A 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health.

Policy Guidance

- 22.2.23 Relevant adopted and emerging planning policies that are relevant to the proposed development are addressed in Section 4 (Planning Policy Context).
- 22.2.24 The following guidance is also available and of relevance to the proposed development:
- Statutory guidance on the Duty of Care regarding waste is given in the Department for Environment Food and Rural Affairs (DEFRA) publication Waste Management: The Duty of Care – A Code of Practice, 1996.
 - EA guidance on the assessment of risks from potentially contaminated land (CLR) is provided in CLR11 – Model Procedures for the Management of Land Contamination, 2004.

22.3 Assessment Methodology

Establishment of Baseline Environment

- 22.3.1 A desk-based assessment of environmental data to November 2011 has been undertaken to develop an understanding of the physical environment and setting of the onshore components of the Project. The study area in which the assessment has been undertaken has been defined by the alignment of the proposed landfall, onshore cable route and substation site with a 1km buffer on either side, i.e. a 2km area of search starting from the landfall at the coast in the south, to the proposed substation site in the north (hereon referred to as the onshore route).
- 22.3.2 Baseline data was obtained from the following sources:
- British Geological Survey (BGS) – geology mapping (superficial and solid), landslip data, and mineral prospecting data;

- Environment Agency (EA) – Groundwater vulnerability maps, groundwater source protection zones, licensed groundwater abstractions, landfills (historic and present), and pollution incidents;
- Local authorities (Mid Sussex District Council (MSDC), Adur District Council (ADC) and Worthing Borough Council (WBC) – pollution incidents, landfills, sensitive land use, location of made ground and potentially contaminative sites; and
- West Sussex County Council (WSCC) – minerals planning and strategic waste site planning.

22.3.3 Reference should also be made to Section 22 (Surface Water Hydrology and Flood Risk) which assesses factors such as flood risk, drainage design and water resource management.

Scoping

22.3.4 As part of the scoping phase of the Environmental Impact assessment (EIA), a Scoping Report (E.ON/RSK, 2010) was prepared to set out the proposed approach to EIA in respect of the proposed development, including the identification of assessment methodologies for each of the EIA topic areas to be assessed. The Scoping Report was submitted to the Infrastructure Planning Commission (IPC) in September 2010. A Scoping Opinion (IPC, October 2010) was received from the IPC in October 2010 incorporating comments from a wide range of consultees. A copy of the Scoping Report and Scoping Opinion including consultee comments are included in Appendix 5.1 and 5.2.

22.3.5 The information and advice received during the scoping process with regard to ground conditions is summarised in Table 22.1.

Table 22.1: Relevant Scoping Responses

Date	Consultee	Summary of issues	Where addressed
11/11/2010	Worthing Borough Council	The Adur recreation ground has a historic waste activity. The availability of suitable data to allow a robust environmental assessment. Insurance and license requirements for intrusive investigations on council land	Table 22.9 Section 22.4 Section 22.5 Paragraph 22.6.23
01/11/2010	Worthing Borough Council	Much of the WBC land is contaminated (1950s waste disposal) and they are considering future investigation – intrusive works will need special precautions and planning. Propagation of contamination along cable routes	Table 22.9 Section 22.4 Section 22.5 Paragraph 22.6.23

- 22.3.6 WBC identified that part of the cable route would pass through an area which they describe as being a 1950s 'rubbish tip', but which was subsequently reinstated and is now used as recreational land. The land is owned by WBC.
- 22.3.7 A meeting was held with WBC during November 2011. The availability of environmental data was discussed and copies of reports on site investigations and risk assessments for areas of former waste disposal were provided to RSK and subsequently reviewed. Details of the reports are presented in 22.4.46-22.4.47.
- 22.3.8 The scope of the assessment was modified accordingly to take account of the above consultee responses and the opinions of the IPC, the findings of which were reported in draft form in the Draft ES.

Formal Pre-application Consultation

- 22.3.9 As detailed in Section 5 (EIA Methodology), an extensive programme of engagement has been undertaken with regard to the Project, details of which are provided in the Consultation Report (which accompanies the Development Consent Order (DCO) application) Document 5.1. This included publication of the Draft ES as part of the Section 42 and Section 48 consultation in June 2012.
- 22.3.10 Following a review of consultee feedback on the Draft ES, and discussions with consultees, including a meeting with WBC during November 2012 to discuss initial contaminated site investigation baseline/scope, the following modification has been made to the Project and overall assessment scope:
- Additional information added on Regionally Important Geological Sites (RIGS), also referred to as West Sussex Local Geological Sites (WS LGS).
- 22.3.11 Full details of the consultation process and associated responses are documented in Document 5.1 (Consultation Report).

Identification and Assessment of Impacts and Mitigation Measures

- 22.3.12 Potential impacts have been identified from data gathered during the desk study. This data has been assessed with the knowledge and experience of the impacts from similar construction projects, leading to the development of appropriate mitigation measures.
- 22.3.13 An assessment has been made of the significance of the potential effects on both the environment and the physical components of the Project, taking into account the importance and sensitivity of the receptor, the magnitude of impact, the duration or persistence of the impact and the likelihood of the impact occurring. Criteria adopted in the assessment are presented in
- 22.3.14
- 22.3.15 Table 22.2 and Table 22.3.

Table 22.2: Importance/Sensitivity

Receptor Sensitivity	Examples
High	Areas of existing mineral extraction and areas designated in Local Authority Plans as preferred areas for mineral extraction Areas of contaminated land Areas of known high risk of landslips or where landslips have occurred Principal aquifers Little or no soil cover (attenuation capacity) Soils at high risk of damage or erosion during construction Areas of known/confirmed contaminated ground (e.g. landfill) and groundwater
Medium	Soils with moderate risk of damage during construction Secondary (A, B or undifferentiated) aquifers Areas with intermediate groundwater vulnerability
Low	Soils with low risk of damage during construction Unproductive strata Areas with low groundwater vulnerability

Table 22.3: Magnitude of Impact

Magnitude	Description
Large	Irreversible or long-term change well outside the range of natural variation where recovery could be protracted (>10 years) to a large area or an area remote from the development. Potential health hazard.
Medium	A change outside the bounds of natural variation to a large area or an area remote from the development, which will recover over a medium period of time (5-10 years).
Small	A slight change (within the bounds of natural variation) to an area in close proximity to the development, which will recover over a short period of time (1-5 yrs).
Negligible	No impact detectable

(Note: Impacts can be adverse or beneficial)

22.3.16 The categories that have been adopted to classify the overall significance of effects are identified in Table 22.4.

22.3.17 An assessment has also been made of the significance of residual impacts, i.e. those remaining after mitigation.

Table 22.4: Significance of Effects

	Sensitivity		
Magnitude	High	Medium	Low
Large	Major	Major/ Moderate	Moderate
Medium	Major/Moderate	Moderate	Minor
Small	Moderate	Minor	Minor
Negligible	Minor	Negligible	Negligible

Uncertainty and Technical Difficulties Encountered

- 22.3.18 This assessment has not included a walkover of the onshore cable route or substation site, as many of the features are below ground and much of the relevant data is available either through general release publications or from information requests to local authorities or government agencies. Data from the EA is subject to their standard commercial conditions for use (2009), which generally states that the recipient of the information is responsible for the consequences of using the supplied data and that the EA do not promise that the information will always be accurate, complete or up to date. The information supplied by WBC included no limitations or notes on report accuracy although each report contained specific limitations and restrictions. In addition, the CLR11 model procedures require a tiered approach to contaminated land, which sees the initial phase of any assessment incorporating a desk-based search for environmental information, which allows an assessment of the potential environmental impacts that the study site may present. In addition there has been no intrusive investigation undertaken specific to the proposed development.

22.4 Environmental Baseline

Topography

- 22.4.1 The landward section of the onshore cable route (see Figure 2b.1) starts at the English Channel coast, approximately 2km to the east of the centre of Worthing. From here the route heads in a north-westerly direction across the coastal plain for approximately 3km crossing the A27 and to the base of the hills of the South Downs. The Downs comprise part of the lithostratigraphic unit known as the Chalk.
- 22.4.2 The route ascends and crosses the undulating topography of the Downs (elevations varying between 50m and 150m Above Ordnance Datum (AOD)) in a north-easterly direction before turning east for approximately 6km and then descending to cross the River Adur. From the River Adur, the route continues to the northeast for another 2km ascending Beeding Hill to 150m AOD. At this point the route heads in a northeasterly direction for 2.4km, skirting the western flanks of Truleigh Hill, then descending steeply down the northern edge of the Downs, marked by a prominent escarpment, to Edburton road at 50m AOD.
- 22.4.3 The route then continues over gently undulating agricultural land (varying between 10m and 50m AOD) north-northeast for approximately 2.0km then north for another 3.7km, crossing the A281 and past the town of Henfield, which is to the west of the route. The route passes to the west of Heatonthorn Farm before continuing north before approaching the proposed substation site, up a slight incline from the south.

Soils

22.4.4 Soil types identified along the onshore cable route are summarised in Table 22.5 and presented in Figure 22.1.

Table 22.5: Summary of Soil Characteristics

Route Sections (km from southern end of route)	Soil Type	Fertility	Drainage	Habitat	Land Cover
0.0 to 2.9 and 9.5 to 10.2	Loamy and clayey soils of coastal flats with naturally high groundwater level	Lime rich - moderate	Naturally wet	Wet brackish coastal flood meadows	Arable, some grassland
2.9 to 3.2	Slightly acid but base rich loamy soils	High	Freely draining	Base rich pastures and deciduous woodland	Arable and grassland
3.2 to 3.8, 5.1 to 5.5, 6.6 to 8.0, 8.9 to 9.4 and 15.1 to 16.2	Lime rich loamy soils	Lime rich - moderate	Freely draining	Herb rich chalk and limestone pastures and lime rich deciduous woodlands	Arable with grassland at higher altitude
3.8 to 4.9, 8.0 to 8.9, 16.9 to 17.8 and 19.1 to 21.1	Slightly acid loamy soils	Low	Freely draining	Neutral and acid pastures, deciduous woodlands and acid communities in the uplands	Arable and grassland
4.9 to 5.1, 5.6 to 6.5 and 10.2 to 15.1	Lime rich loamy soils over chalk or limestone	Lime rich	Freely draining	Herb-rich Downland and limestone pastures; limestone pavements in the uplands and lime-rich woodlands	Arable and grassland
16.2 to 16.9, 17.9 to 19.1 and 21.1 to end	Basic loams and clays	Moderate	Impeded drainage	Seasonally wet pastures and woodland	Grassland and arable, some woodland

22.4.5 In summary, the southernmost part of the onshore cable route between the coast and the A27 and the area of the River Adur are underlain by clayey soils that are naturally wet owing to the high groundwater levels. As the route crosses the South Downs between 2.9km and 14.2km, the soils are recorded as freely draining and generally lime rich. From 14.2km along the proposed route, a mixture of freely draining slightly acid soils and basic loams with impeded drainage are reported.

- 22.4.6 The soils reflect the nature of the underlying superficial or solid geology, being created through weathering of the underlying parent material. The sensitivity of soils to contamination will vary depending on the location; generally soils over the Downs are thin and transmissive, resulting in a high sensitivity designation, but soils over the Weald Clay, are likely to have a moderate sensitivity as they can attenuate the migration of contaminants.

Geology

- 22.4.7 The geological environment beneath the onshore cable route is recorded on the following publicly available BGS mapping:

- Sheet 318/333, Brighton and Worthing (1:50,000 series), Solid and Drift Edition, plus the BGS memoir to sheet 318/333 - Geology of the Country Around Brighton and Worthing' (1988).

- 22.4.8 1:10,000 geological mapping data has been obtained from the BGS and this has been used to determine the nature of solid geology beneath the onshore cable route. Geological data can be seen on Figure 25.3, which is in Section 25 - Archaeology and Cultural Heritage of this ES. Additional information regarding the Chalk aquifer was also obtained from the following publications:

- British Geological Survey and Natural Environment Research Council, National groundwater Survey - The Chalk Aquifer of the South Downs (1999); and
- British Geological Survey and Environment Agency, The Physical Properties of Major Aquifers in England and Wales. Technical Report WD/97/34, R&D publication 8 (1997).

- 22.4.9 A summary of the geological setting is presented below.

Superficial Deposits

- 22.4.10 Superficial deposits are shown to be present beneath approximately one third of the onshore cable route. Where present, these deposits comprise Alluvium, Head, Clay with Flints and River Terrace Deposits and are described as:

- Alluvium - comprising silts and clays, mapped on the fringes of the River Adur and other minor streams. Marine and estuarine alluvium is also shown to be present beneath the first 1.4km at the southern end of the onshore cable route.
- Head deposits - formed by solifluction and reflecting the parent material from which they are derived. Typically comprising brown silty loam with variable content of flint and sandstone fragments. These deposits are mapped sporadically along the length of the onshore cable route, generally filling dry river channels. The largest area of Head mapped in the area of the onshore cable route is located directly to the south of the South Downs, underlying the route for a distance of approximately 1.6km. Elsewhere along the route the

Head deposits are generally mapped as narrow bands with widths up to 0.4km.

- Clay with Flints – comprising clay or sandy clay with flint nodules, sandstone blocks and pebbles, mapped in localised areas on the Chalk down-lands and underlying the cable route for approximately 0.6km in total.
- River Terrace Deposits - mapped towards the northern end of the onshore cable route for approximately 1.1km south of Cutlers Brook (northeast of Henfield) and for approximately 0.1km to the south of the upstream crossing of the River Adur.

22.4.11 BGS borehole records (TQ10SE177 and TQ10SE88) relating to sites near to the onshore cable route indicate ground conditions at approximately 0.4km to 0.6km from the landfall with up to 5.3m of landfill material (comprising ash, glass clinker, brick, metal, plastic, wood, clay and concrete) recorded. The fill is underlain by marine alluvium comprising soft to firm silty clay with shell fragments over stiff mottled clay of the Woolwich and Reading Beds and Chalk at approximately 22m bgl.

Solid Geology

22.4.12 The solid geology beneath the onshore cable route is represented either at outcrop or beneath overlying superficial deposits (sub crop) rocks of the Cretaceous period.

22.4.13 The landward section of the onshore cable route, between the shoreline and the A259 – Brighton Road (0.2km) is underlain by Chalk, which is considered to be of high sensitivity. Beyond this, to approximately 3.2km of the onshore route are rocks of the Lambeth Group (formerly the Woolwich and Reading Beds), which are considered to be of medium sensitivity. Rocks of the Chalk Group, which form the South Downs are considered to have a high sensitivity and are found beneath the southern half of the route (to approximately 15.5km). The Chalk has a high degree of protection owing to its importance as a source of potable water and importance in maintaining baseflow in surface waters.

22.4.14 A prominent feature of the Downs landscape is dry valleys on the dip slope, and combs along the steep scarp. Most of the larger dry valleys have a general north–south alignment and several of these features are either crossed or approached by the proposed route as it crosses the Downs. The dry valleys vary from shallow depressions to deep incisions up to 100m below the adjacent interfluvies but they do not generally intersect the present groundwater table.

22.4.15 Solution features, such as swallow holes, are not generally well developed on the South Downs although some are present. These features are rarely mapped, being discovered either through collapse at the surface or during excavations during development.

- 22.4.16 Continuing north, the route is underlain by older rocks from the Cretaceous, such as the Upper Greensand and the Gault, which are considered to be receptors of medium sensitivity and which can be found along the northern slopes of the South Downs. The Weald Clay is a receptor of low sensitivity and it dominates the geology beneath the northern part of the proposed route. The Weald Clay gives rise to the reduced permeability of the overlying soils and the gentle sloping morphology of the area.
- 22.4.17 Details of the solid strata found beneath the onshore cable route are summarised in Table 22.6 below, in succession from south to north along the entire route.

Table 22.6: Geological Description of Solid Formations

Formation (order south - north)	Description of lithology	Route Description
Lambeth Group	Silty Clay with sandy intercalations	This formation overlies the chalk at the southernmost (coastal) end of the cable route only, for approximately 3.0km.
Upper and Middle Chalk (White Chalk)	Thickly bedded white chalk	The Chalk is present along the majority of the southern half of the route, namely the large outcrop of the South Downs. These strata dip to the south. The route then crosses this series of outcropping scarp bands from the base of the South Downs until the route is level due east of the village of Small Dole
Lower Chalk	Off-white marly chalk with marl bands	
Upper Greensand	Calcareous siltstone	
Gault	Mudstone	
Folkestone Beds	Fine to medium sand	
Lower Greensand	Fine silty sand and silt	
Weald Clay	Silty mudstone	Crossed by the route in the area of and to the south of the village of Woodmancote.
Lower Greensand	Fine silty sand and silt	The route then passes over a succession of Lower Greensand and Folkestone Beds (with Gault also shown nearby to the east) which are shown overlying the Weald
Folkestone Beds	Fine to medium sand	
Lower Greensand	Fine silty sand and silt	
Weald Clay	Silty mudstone	Once the route passes to the east of the town of Henfield, Weald Clay is shown to underlie the remainder of the route. Occasional thin beds of sand, sandstone and limestone are marked as crossing the cable route in an east-west direction. The Sayers Common Fault is shown to run through the Weald Clay, crossing the route directly to the west of the village of Sayers Common

- 22.4.18 An east to west trending fault within the Weald Clay (the Sayers Common Fault) is crossed by the onshore cable route at approximately 24.0km. The magnitude of fault displacement and any recent activity is not known.

Geological Structure

- 22.4.19 In general the strata crossed by the onshore cable route form the southern limb of the Wealden anticline whose axis runs east to west. Beneath the northern part of the route strata are repeated as a result of a series of anticlinal and synclinal sub-ordinate folds to the main limb.

Regionally Important Geological Sites

- 22.4.20 Four WS LGS, formerly known as RIGS have been identified within the area of search. Details of the sites have been obtained from the Biodiversity Data Officer and these include;

- Shoreham Cement Works (Beeding Quarry);
- Horton Clay Pit (Small Dole);
- Golding Barn Quarry (Upper Beeding); and
- Beeding Small Quarry (Upper Beeding).

- 22.4.21 Shoreham Cement Works and Beeding Small Quarry have recently been re-assessed by a local geologist for the Sussex Wildlife Trust and the revised citation has been used for this assessment. Horton Clay Pit and Golding Barn Quarry were not visited as part of the Sussex Wildlife Trust re-assessment and so the original citation for these sites has been used here. The following summarises the content of the citation for each site and provides the date for the assessment:

- Shoreham Cement Works (Beeding Quarry) – LGS I.D. - TQ20/101.

The site designation is for scientific and educational purposes on the basis of the exposed sequence of lower Lewes Chalk to upper Seaford Chalk (both being approximately 50m thick). The citation notes that the quarry continues to be used for recycling of construction material and that if plans were presented to infill the site, that some of the exposures should be preserved. The site was last surveyed on 22/09/2010.

- Horton Clay Pit (Small Dole) – LGS I.D. - TQ21/01.

The site designation for Horton Clay Pit is for a site of special scientific interest (SSSI). The reasons documented for the designation are that the quarry shows “the thickest and the stratigraphically most important Lower Gault Formation sequence in the country. It is also a very important site for fossil collecting and it is the type locality of the Horton Wood Clay of *regularis* Subzone age which is a local and unusual development of the upper part of

the Folkestone Formation.” At the time of the assessment (which was not dated), the site was being used for landfilling, with a small corner preserved as the SSSI. The assessment states that landfilling is expected to continue at the site, however, It is indicated that if any restoration of the site is to occur, then the exposed corner (SSSI) should be preserved.

- Golding Barn Quarry (Upper Beeding) – LGS I.D. - TQ21/58.

The site designation is as an Area of Outstanding Natural Beauty (AONB). The reasons given for the designation are for educational purposes as the quarry exposes sections of the “Lower/Middle Chalk boundary (Cenomanian/Turonian boundary) and a zone fossil boundary. It also exhibits a facies difference compared with other nearby sites (Newtimber, Steyning, Washington), and is therefore, of great importance for palaeoenvironmental studies”. At the time of the assessment, which is not dated the site was an active quarry. It is stated that when the site is no longer worked that consideration should be given to preserve certain faces.

- Beeding Small Quarry (Upper Beeding). – LGS I.D. - TQ21/68.

The site designation is for scientific and educational purposes due to the presence of exposed rock face 50m long by 20m high. The site was noted to be disused and to form part of a SSSI, designated for its calcareous grassland habitat. The site was last surveyed on 24/06/2010.

22.4.22 The full citation for each site is included within Appendix 22.2. The sites identified have been classified on the basis of their educational importance to observe exposed rock sequences (lithologies) or to collect specific fossil types.

Landslides

22.4.23 BGS data indicates one unconfirmed and undated occurrence of a reported landslide (BGS reference – landslide 2149) at Upper Beeding Quarry. It is likely that the landslide was induced by the quarry activities and not due to the natural morphology of the area. Beeding Small Quarry (Upper Beeding) is registered as an LGS, it is considered likely that this is also the location of the BGS reported landslide although this is not confirmed.

22.4.24 Surface erosion along the Chalk is unlikely under present-day conditions because rapid infiltration and percolation through the unsaturated zone means that the infiltration capacity is rarely if ever exceeded, and runoff seldom occurs. The thin soil covering over the Chalk and the rather subdued topography (particularly on the dip slope side – the southern edge of the Downs) therefore contributes to a relatively stable environment where surface failures are uncommon. Soils and rocks along the onshore cable route are considered to have a low sensitivity to the potential occurrence of landslides.

Mineral Extraction

- 22.4.25 Within the West Sussex area through which the onshore cable route passes, there are several minerals of economic interest to the mineral extractive industry, including sand (Lower Greensand – Folkstone beds), sandstone (Lower Greensand – Sandgate and Hythe beds), fullers earth (Lower Greensand), clay (Hastings beds, Gault Clay and Weald Clay) and Chalk.
- 22.4.26 The West Sussex Minerals Local Plan does not indicate any proposed mineral working within 1km of the onshore cable route and there are no known prospecting sites for minerals according to this plan and available BGS information.
- 22.4.27 The sites that have been identified in the Local Plan have a low sensitivity to the onshore cable route.

Ground Conditions

- 22.4.28 Details of current and historic ground conditions have been established from desk based review of information presented by the EA (see Appendix 22.1), the BGS and the local authorities (Mid Sussex District Council (MSDC) and Worthing Borough Council (WBC)) through which the onshore cable route passes.

Historic Land Use

- 22.4.29 Historic mapping dating from 1879 was reviewed to identify any potential contaminating historical land uses in the vicinity of the onshore cable route. Two brick fields are shown approximately 0.2km from the landward start of the onshore cable route – these sites are presently occupied by industrial and commercial warehouse units. Approximately 1km inland from the coast, the route is shown to cross a railway line which remains in place today. The land surrounding the cable route is predominantly open agricultural land, with some minor roads and field boundaries present, but no other major developments are identified.

Current Land Use – Potentially Contaminated Sites

- 22.4.30 Current land uses and identification of potentially contaminated sites have been established through a review of contemporary mapping, EA and MSDC data. This information is presented below and depicted in Figure 22.2 above. Sites used for waste management purposes also have the potential to impact the environment and these sites are discussed separately (see paragraphs 22.4.48 to 22.4.55)
- 22.4.31 Ordnance Survey (OS) mapping shows residential and commercial development adjacent to the first 3.1km of the onshore cable route, near to the south coast. At approximately 1.0km the route passes a sewage works and several commercial and industrial works, which are located approximately 0.1km to the southwest of the route.

22.4.32 After crossing the railway line, at 1.3km to 2.0km the route passes an industrial estate situated approximately 0.2km to the west. The route then passes residential properties before crossing the A27. Beyond the A27, the route continues past a business park and superstore before passing a disused quarry at approximately 3.5km. The proposed route then crosses open countryside of the South Downs. The River Adur is crossed at approximately 10.0km and a disused cement works and quarry are located approximately 0.1km to the west at 11.0km and at approximately 13.0km another quarry is identified approximately 0.8km to the west.

22.4.33 The remainder of the route then passes through predominantly open countryside with occasional roads, nearby farms and small villages. A series of small sites comprising made ground, nurseries, mills and unidentified use are present approximately 1.0km east of the onshore cable route, between 18.0km and 22.0km.

22.4.34 At 23.0km a works and tank (at Firsland Park Estate) are approximately 0.3km east of the route; the tank is of unknown size and content. The route is close to works (at Winterpick Business Park) at 23.5km. At 25.5km a tank of unknown contents is approximately 0.05km west of the route. The existing Bolney Substation is located to the east of the proposed substation site and this is identified by WSCC as a potentially contaminating site. There are no further significant potentially contaminative land uses identified within 1.0km of the onshore cable route.

Pollution Incidents

22.4.35 The EA has identified a total of 236 pollution incidents within 1km of the onshore cable route. Of these a total of 23 pollution incidents related to impacts to either land or water and with a classification of minor or above are reported within 0.5km of the onshore cable route. A summary of these pollution incidents and the approximate distance from the cable route is presented in

22.4.36

22.4.37

22.4.38 Table 22.7 below. The incidents relate to spillages or discharges of oil/ fuel, sewage wastes, dyes and inks, and fly tipping of hazardous materials such as asbestos. MSDC also identified records of EA closed pollution incidents within the consultation corridor, one of which is less than 0.5km from the onshore cable route and is therefore presented in

22.4.39

22.4.40

22.4.41 Table 22.7 below.

22.4.42 Pollution incidents that have been identified within the area of search and which match the above criteria are presented on Figure 22.3.

22.4.43 MSDC is not aware of any known contamination issues within the search area, and it has also identified that there are no register entries under Part IIA of the Environmental Protection Act 1990 within the area.

Table 22.7: Summary of EA Pollution Incidents

EA report item number	Impact to land (L) or water (W)	Impacting material	Cause/Premise	Distance from cable (km)
384	W	Oils and fuel	Unknown	0.18
327	W	Mixed/waste oils	Unknown	0.08
560	L+W	Insulating cable oils	Vandalism/electricity supply and distribution	0.3
420	L	Sewage sludge	Sewage treatment works	0.08
360	W	Mixed/waste oils	Fly-tipping	0.26
449	W	Diesel	Unknown	0.26
451	W	Unidentified oil	Unknown	0.13
331	W	Dyes and inks	Unknown	0.18
417	L	Diesel	Private dwelling	0.14
439	W	Unidentified oil	Unknown	0.31
452	W	Unidentified oil	Unknown	0.33
436	L	Diesel	Transport/road	0.33
485	L+W	Unidentified oil	Unknown	0.30
462	L+W	Oils and fuel	Fly tipping	0.66
458	L+W	Gas and fuel oils	Vandalism	0.1
459	L+W	Oils and fuel	Accidental spillage	0.0
471	L+W	Oils and fuel	Accidental spillage	0.0
534	W	Petrol	Pipeline/transport	0.09
434	L	Diesel	Spillage / supermarket	0.27
441	W	Diesel	Unknown	0.23
494	L	Asbestos	Fly-tipping	0.41
438	W	Unidentified oil	Unknown	0.17
536	L	Petrol	Unknown	0.30
482	L+W	Silage liquors	Agriculture	0.42
483	L+W	Slurry	Agriculture	0.42
560	L+W	Insulating cable oil	Vandalism	0.29

Discharge Consents

22.4.44 The EA has identified 271 licensed discharge consents within the area of search. Full details are presented in Appendix 22.1.

Made Ground

22.4.45 BGS mapping identifies made ground beneath the southern end of the route for approximately 1.4km. This corresponds with several historic landfills recorded by the EA and WBC. These areas of land were also associated with the brick fields identified on the historic mapping.

22.4.46 In addition, WBC has also identified areas of made ground, the most significant of which have been named and are presented on Figure 22.4 – the nature of the ground in many of these sites is not fully known.

22.4.47 Made ground deposits also include landfill sites, which may be identified by the EA or local authority if deposition occurred prior to records being kept or if deposits were illegal. No data will be available as to the nature or potential risk from these areas. Details of known landfills and waste disposal sites are presented below.

Landfill/Waste Disposal Sites

22.4.48 Information on waste management sites close to the onshore cable route have been obtained from the EA, MSDC and WBC. The location of historic landfills and sites with a valid wastes management permit are presented on Figure 22.4.

22.4.49 A total of two current landfills (Horton Landfill and Small Dole Landfill) and 16 historic landfills have been identified within the area of search, the details of which are contained in Table 22.8 below.

Table 22.8: Landfill Sites within the Area of Search

RSK Ref	Site Name	Description
1	Brooklands	Route passes through this site. Waste accepted: Inert, industrial, commercial and household, 1950-1962.
2	Meadow Road	Route passes through this site. Waste accepted: Inert, industrial, commercial, household and leachate, 1953-1970.
3	Decoy Farm	Waste accepted: Inert, commercial and household, 1970-1977.
4	Hundred Steadies	Waste accepted: Inert, 1987-1988.
5	Room Bottom Valley	Waste accepted: Inert and industrial, 1960-1964.
6	Oreham Piggeries	Waste accepted: Inert, 1984-1985.
7	Church Lane Chalvington	Waste accepted: unknown, 1960-1993.
8	Golding Farm Chalk Pit	Waste accepted: Inert, 1979-1985.
9	Disused	Waste accepted: Inert, industrial, commercial and household, 1974-

RSK Ref	Site Name	Description
	Brickworks	1987. Leachate control measures in place
10	Halewick Lane	Waste accepted: Inert, industrial, commercial, household and leachate, 1956-1990. Leachate and gas control measures in place
11	Small Dole south of Mackley	Waste accepted: Inert, 1950-1979.
12	Hill Barn	Waste accepted: unknown, dates unknown
13	Beech Green	Waste accepted: unknown, dates unknown
14	Horton Landfill	Co disposal licence, current
15	Roma Farm	Waste accepted: Inert and industrial, 1986-1987.
16	Coomes Road Steyning	Waste accepted: Inert, commercial and household, 1955-1960.
17	Small Dole and SD Hale	Waste accepted: Inert, commercial and household, current.
18	Holmebush Farm	Waste accepted: inert, dates unknown

22.4.50 In addition to the listed landfill sites there are a total of 11 current waste management licences registered within the area of search. The location of these sites are presented on Figure 22.4.

22.4.51 The West Sussex Waste Local Plan (Revised Deposit Draft – 2004) identifies the former Shoreham Cement Works at Beeding, which is west of the onshore cable route, as a RIGS and a suitable site for a major built facility for the collection, sorting, recovery, transfer and treatment of waste material. However, it is understood that this site no longer forms part of these plans.

22.4.52 Seven landfill sites are within 0.5km of the onshore cable route and three landfill sites are to be crossed by the route; the latter are all located within the first 2.0km of the cable length and were operational from the 1950s through to the late 1970s – a period when the collection of waste disposal records was not required. These three sites accepted a mixture of inert, commercial, industrial and household waste, which at the time precluded very little material. The following reports relating to the Brooklands site have been obtained from WBC and have been reviewed to obtain a better understanding of the baseline conditions in this area:

- Technical Study Related to Development Proposals (November 1988). Wallace Evens and Partners;
- Contamination Analysis (April 2011). Southern Testing;
- Silt Survey and Analysis (2011). PHB Consulting;
- Report on Methane Monitoring at Brooklands and Dominion Way, Worthing (1990). Author unknown;

- Site Investigation Report for Land North of Brooklands (1985). Author unknown;
- East Worthing Water Treatment Works, Access Road Landscape Works (1996). Terence O'Rourke plc;
- An assessment of the environmental issues associated with the proposed Dale Road development area (October 1997). M.J. Carter Associates; and
- Ground Investigation into Landfill Cover Layer Thickness and Integrity at Brooklands Golf Course (July 2005). Owen Williams Consultants.

22.4.53 Other reports have been produced for the Brooklands Landfill, as they are referenced within the reports reviewed above, although these reports were not made available. The reports reviewed show the composition of the shallow soils within the southern part of the Brooklands Landfill to be extremely variable. A thin layer of topsoil (approximately 0.1m thick) generally covers the area, although in some parts made ground is identified within the topsoil and made ground is also identified directly beneath the topsoil in other areas. Landfill capping material comprising either clay or sandy clay is identified in some areas although this is not extensive. There is no indication from the reports or the borehole logs available that a liner is present at the base of the landfill material. Since landfilling activities occurred between the 1950s and 1970s it is likely that dilution and dispersion of any potential contaminants was considered an acceptable approach and as such no liner was installed. Elevated concentrations of some hydrocarbons and metals are recorded within some of the soil samples collected for analysis.

22.4.54 Groundwater was generally not encountered during the investigations for which the reports have been reviewed. However, the 2005 Owen Williams report refers to a previous (undated) report, which detected elevated mercury, boron and ammoniacal nitrogen concentrations in groundwater samples.

22.4.55 Elevated gas concentrations (methane and carbon dioxide) have been identified (1997) in the ground immediately south of the northern part of the Brooklands site and within the Brooklands site (1985), indicating the presence of landfill gas. The 1985 survey also noted elevated temperatures (50°C), suggesting degradation of the waste material was occurring. An assessment of the gas generation potential in 1985 also identified the potential for high gas yields from the landfilled waste, which was attributed to the high proportion of sewage sludge. A ground gas survey in 1990 identified production of methane and carbon dioxide within the landfill, but little evidence of gas migration outside the landfill boundary, with the exception of an area to the west of the Decoy Farm Landfill, where elevated methane concentrations were recorded. The assumed lack of migration may be due to the reliability of test methods and the absence of a competent capping layer across much of the landfilled waste allowing gas migration into the atmosphere.

Hydrogeology

- 22.4.56 The geological succession represented in the South Downs and the surrounding area includes several significant hydrogeological units: the Tunbridge Wells Sand, the Ashdown Formation, and the Lower Greensand Group and the Chalk. Although each is usually considered for practical purposes to be a separate, distinct aquifer, the cover above the Hercynian basement actually represents a single hydraulic continuum with a regional flow system extending from the crest of the Weald to the coastal outlets.
- 22.4.57 The majority of the southern part of the onshore cable route is underlain by the Chalk Group (White Chalk Formation and the Lower Chalk) deposits, which are classified by the EA as a Principal aquifer as these rocks have high intergranular and fracture permeability, and can provide a high level of water storage and high yields. These aquifers can support water supply and river base flow on a strategic scale and are both regionally and locally important aquifers. Upper and Lower Greensand rocks are also classified as Principal aquifers.
- 22.4.58 The Woolwich and Reading Beds, which overlay the Chalk and are found close to the shoreline along the first part of the onshore cable route, are classified by the EA as Secondary (A) aquifers. The Weald Clay, which dominates the ground conditions beneath the route from approximately 16km is generally considered to be an Unproductive aquifer, which does not yield appreciable volumes of groundwater.
- 22.4.59 Superficial deposits of alluvium are also reported to overly the bedrock along the southern part of the cable route; these deposits are classified by the EA as Secondary (A) aquifers and are capable of supporting water supplies at a local rather than strategic scale, and in some cases they can form an important source of base flow to rivers such as the River Adur and its tributaries.
- 22.4.60 The alluvium and Head deposits on which the onshore cable route crosses have been classified by the EA as Secondary aquifers (undifferentiated). The proposed route crosses a series of River Terrace Deposits approximately 19.5km to 21km from the landfall and these deposits are classified as Secondary (A) aquifers, which may provide locally important groundwater abstractions and baseflow to tributaries of the River Adur, alluvial deposits of which are shown to be connected to the River Terrace Deposits.
- 22.4.61 Groundwater flow through the unsaturated zone of the Chalk is complex, comprising both a slow piston flow through the matrix and a more rapid bypass flow through the fractures. Within the saturated zone, groundwater flow within the Chalk is primarily through solution features such as fractures and fissures (karsts in extreme situations) and can be rapid. These solution features are often found along river corridors or dry river valleys and they can allow groundwater flow rates along the valley features that are several orders of magnitude higher than areas of high ground (interfluves).

22.4.62 A dominant feature of the area is the presence of a spring-line at the top of the Upper Greensand, which has a lower permeability than the overlying Chalk. Consequently, groundwater leaves the ground at this geological boundary along a spring line, which is often found close to the base of scarp slopes in the area.

Groundwater Source Protection Zones and Groundwater Abstractions

22.4.63 A total of 27 groundwater abstractions are recorded by the EA within the area of search. The data includes 20 groundwater abstraction licenses for a single point (i.e. borehole or well), six groundwater abstractions with protected rights and a line abstraction, which covers the removal of surface water from the Chess Stream at Swains Farm, Woodmancote.

22.4.64 The nature of the abstractions (i.e. limitations on the pumping rate and duration) and their exact locations are not recorded. However, their location has been estimated and they are placed within the centre of the grid square identified by the EA ($\pm$ 500m). In addition, MSDC has identified six water wells, which may be unlicensed groundwater abstractions (i.e. they abstract less than 20m³ per day), but they may be registered with the local authority because of their use as a domestic supply. The location of the licensed abstractions and the water wells are presented in Figure 22.5.

22.4.65 Several groundwater abstractions presented on Figure 22.5 relate to sources of locally important potable water supply, and as such the EA has modelled source protection zones (SPZ) that are designed to be protective of groundwater and soil conditions within the total catchment of the source. Figure 22.6 shows the location of the SPZs that have been identified by the EA in relation to the onshore cable route.

22.4.66 The SPZs have been 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 50m.
- SPZ2 (Outer protection zone) - defined by a 400-day travel time from a point below the water table. This zone has a minimum radius of 250m or 500m 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.

22.4.67 The onshore cable route crosses two SPZ1s at locations of approximately 2.3km to 2.6km (Sompting) and approximately 4.0km to 5.2km (north of Sompting) along the route length. The route also crosses three SPZ2s at approximately 2.6km to 3.3km, 5.2km to 6km and approximately 10.1km to 10.5km. Two SPZ3 zones are also crossed by the onshore cable route at approximately 3.3km to

3.6km and approximately 12.2km to 13km. Remaining areas of the proposed cable are not understood to lie above a SPZ.

- 22.4.68 SPZ data includes the protection zones for an abstraction within Shoreham-by-Sea, but the data obtained from the EA does not include the coordinates for this abstraction so it is unclear as to the status of this abstraction.

Groundwater Vulnerability

- 22.4.69 The EA soil classification and aquifer classification is used to determine the potential vulnerability of groundwater to surface derived contamination. There are three soil vulnerability classes (high, intermediate and low) based on physical and chemical properties, which affect the downward migration of water and there are three aquifer classes (Principal, Secondary and Unproductive), which are generally based on the aquifers ability to transmit water. These classifications have been used to determine the potential groundwater vulnerability along the length of the onshore cable route, which is discussed below.
- 22.4.70 The first 1.7km of the proposed route are characterised by soils of a high leaching potential over a Secondary aquifer (Head and Alluvium). From 1.7km to 14.5km, the soil leaching potential is high and the aquifer is classified as a Principal aquifer (i.e. the most vulnerable classification possible). This designation relates to the Chalk, which is a very transmissive rock, with high storage capacity and often used for potable water supply. Chalk landscapes are characterised by very thin soil cover. Along parts of the onshore cable route there are Head deposits within buried river channels; these areas are given an intermediate leaching potential for a Principal aquifer, reflecting the potentially greater attenuating capacity of the superficial deposits.
- 22.4.71 The Greensand and Folkstone Beds, which are found between 14.5km to 14.7km, 15.9km to 16.2km and 18km to 19.8km are also classified as Principal aquifers with soils of intermediate leaching potential.
- 22.4.72 All other sections of the onshore cable route traverse soils with either a low leaching potential over a Secondary aquifer or unproductive rocks (i.e. negligible permeability).
- 22.4.73 Impact to the groundwater within the Chalk is very difficult to reverse (due to rapid travel times and dual porosity matrix) and impacts on abstractions or groundwater fed river systems can take many years to return to normal.

22.5 Predicted Impacts

- 22.5.1 The impacts discussed in this section are those have the potential to occur in the absence of mitigation measures. A suite of mitigation techniques will be implemented during the works to ensure protection of valuable soils resources and continued operational viability of affected land holdings; these are described in Section 22.6 below.

Rochdale Envelope Principles

- 22.5.2 In line with the use of the “Rochdale Envelope” (see Section 5 – EIA Methodology), the assessment in this section has been based on a development scenario, which is considered to be the worst case in terms of impacts to the physical environment (soils, superficial geology, solid geology and hydrogeological regime). Rochdale Envelope principles relating to impacts on the physical environment relate primarily to the area of temporary and permanent land take.
- 22.5.3 For the onshore cable route, the working width will generally be no wider than 30m and will run for a total length of 26.4km. Although the actual working width will generally be no wider than 30m, a general working width of 40m has been defined for the order limits of the cable corridor (the Development Area) to allow 10m for micro-siting tolerance. As such, 40m working width has been taken to represent the worst case scenario for the assessment below.
- 22.5.4 The substation site covers an area of approximately 23.3 hectares. Approximately 7.01 hectares will be required for the permanent footprint of the substation, with the remainder required for site establishment, lay down areas and landscaping. For the assessment undertaken below, permanent land take of 7.01 hectares has been adopted as the worst case scenario.

Construction

Soils

- 22.5.5 The soil cover across much of the South Downs is very thin and often very poor, with large amounts of chalk and flint fragments. Excavation of this material should be relatively straightforward, although the weathered surface of the underlying solid geology may be relatively shallow. Soils over the South Downs are very free draining; therefore stockpiling and open trenches are unlikely to result in increased run-off, although where their removal exposes bedrock in areas close to groundwater abstractions it is possible to increase suspended solids loading to these abstractions, which would be regarded as a medium magnitude impact at the abstraction.
- 22.5.6 The attenuation capacity of Chalk based soils for contaminant release is negligible. The underlying aquifer has a high sensitivity to the effect of chemical contamination and the magnitude of impact can be large, for even a moderate release of contamination to the soil.
- 22.5.7 Soils reflect the nature of the underlying rocks and therefore should be replaced close to the area of excavation. This is particularly important for areas running through agricultural land or where geological boundaries are identified, e.g. free draining soils associated with the Folkstone Beds are juxtaposed against the slowly permeable soils of areas overlying the Weald clay. Placement of soils at

inappropriate locations along the route may lead to impacts of small to medium magnitude being noticed – depending on the use of the land, etc.

- 22.5.8 Excavations are not anticipated to be very deep (maximum depth of 1.65m to the base of the trench) and the displacement of materials is unlikely to be significant as the volume of the cables placed into the trenches is minimal.
- 22.5.9 Temporary haul roads will be constructed along the cable route to allow for the safe passage of construction personnel and machinery alongside the cable trench. This may require some degree of imported aggregates, hence in the absence of mitigation measures, there is a potential risk of importing leachable contaminants or asbestos which may impact underlying soils, groundwater or human health.

Geology

- 22.5.10 Much of the onshore cable route traverses areas where superficial deposits are absent and where overlying soils are either very thin or absent altogether. Trenching may therefore need to progress through the weathered zone of the underlying rock, which may be highly variable along the route. Even excavating through the Chalk, which is relatively heterogeneous, may require modifications to excavating techniques if hard bands are encountered. The need to excavate through rock or weathered rock may potentially increase the construction time and require additional equipment to be brought to site.
- 22.5.11 Superficial deposits (Head) found in dry valleys can often overlay bedrock with increased frequency of dissolution features. Excavations through these areas have the potential to uncover underground voids, which may be aerially limited in extent but which can cause damage to human health and/or equipment, and can allow contaminants to enter the ground far more rapidly than if soil cover was intact. The impact of removing Head deposits is anticipated to be small to medium magnitude. Where directional drilling is anticipated in natural deposits, i.e. beneath the River Adur (and its tributaries), the superficial deposits are generally Alluvium or Head. The Alluvium is likely to be relatively unproblematic to drill through and yield water, but the Head could be more variable and if it contains chalk or flint deposits in significant volumes, the drilling could prove more difficult.
- 22.5.12 A geological fault (Sayers Common Fault) is aligned east to west with down throw to the north. It is not known if this fault remains active, but the BGS do not report earthquakes along the fault plane within the area of the onshore cable route. It is unlikely that the fault would represent a risk for the duration of construction for the onshore cable route.
- 22.5.13 The BGS data and knowledge of the local geology suggests that landslides are unlikely along the course of the onshore cable route, particularly as the proposed excavations are very shallow. The onshore cable route is therefore unlikely to cause a detectable impact on soils and rocks that may manifest to cause a landslide.

- 22.5.14 The West Sussex Mineral Plan does not identify additional sites for mineral extraction or increases in the size of existing quarries along the alignment of the onshore cable route. The onshore cable route will therefore not sterilise mineral extraction sites currently being considered.
- 22.5.15 The RIGS sites that have been identified are between approximately 100m and 1,000m from the onshore cable route. These sites are designated for their importance in providing exposed rock faces that can provide useful educational material, including fossils. The infilling of these sites, through waste disposal or other restoration methods may cover the rock faces, which are the basis for their designations. The onshore cable route will not result in the infilling of these sites and the potential subsequent covering of the rock faces. The onshore cable route will also be sufficiently far from each site so as not to induce instability of the quarry face (particularly Shoreham Cement Works), which would result in a change in appearance at the rock face. Excavations along the route are comparatively shallow and therefore overburden stockpiles are considered unlikely to influence the stability of the rock faces. Mitigation measures for the RIGS sites are not considered necessary as the proposed cable route will not result in the quarry faces being covered.

Hydrogeology

- 22.5.16 The Chalk aquifer is classified by the EA as a Principal aquifer due to its regional importance in supplying potable water in the area. The Chalk is a dual porosity aquifer, which means contamination can move rapidly through an interconnected fracture network, while at the same time reside in the small pore spaces for a very long time. Consequently, in the absence of mitigation measures impacts to the Chalk have the possibility of being of large magnitude, which could also include a potential health hazard for potable water abstractions.
- 22.5.17 The onshore cable route passes through the SPZ1 for five abstractions (at three locations), a SPZ2 for one abstraction and the total catchment (SPZ3) for multiple catchments (note that if the route passes through a SPZ1, it must also pass through the SPZ2 and SPZ3 for the same abstraction but these additional, less hazardous passages are not considered), see Figure 22.6. Any impact on groundwater within the Chalk and specifically within a SPZ will be considered to be of large magnitude.
- 22.5.18 The EA data shows the onshore cable route passes within 1km of up to 16 licensed groundwater abstractions (some of which have no designated SPZ) and five wells that are identified by MSDC (see Figure 22.5). In the absence of mitigation measures impacts on these abstractions could include:

- Increased turbidity in pumped water during construction period, particularly for abstractions that are close to the onshore cable route and where groundwater levels and pump intakes are close to the ground surface, or where well developed fracture systems allow bypass flow through the unsaturated zone to the groundwater table. Areas of shallow and well draining soil cover will exacerbate this or where trenching cuts into weather bedrock; and
- Fuels, oils or chemicals used during construction could enter the groundwater impacting the abstraction.

22.5.19 The first part of the onshore cable route passes over made ground over Alluvium, which is likely to have shallow groundwater that could fill excavations through seepages, or if under pressure, it could enter rapidly causing instability problems (impacts on hydrogeology in this area are likely to be small to medium magnitude). The volume of this water could be significant and if it is close to contamination associated with the old landfills in the area, it could contain leachate and therefore be difficult to dispose and hazardous to work with. Contaminated water entering excavations could present a large potential impact owing to the potential health hazard for Project workers and also the general public, but also an impact of small to medium magnitude on the Project programme.

22.5.20 Much of the onshore cable route crosses freely draining soils, which offer little or no attenuating capacity to the underlying rock from chemical spills at ground level (see Figure 22.1). The location of these free draining soils generally coincides with an increased vulnerability of groundwater and an associated increase in the magnitude of potential impact.

22.5.21 The cable route passes over several large dry valley features, which are filled with Head deposits (see Figure 25.3). These features can have higher permeability along the same orientation as the valley feature (due to dissolution processes), which can manifest themselves as large voids or fissures, which can collapse.

22.5.22 The migration of groundwater within the Chalk is strongly influenced by the underlying Greensand deposits, which have a lower permeability and therefore spring lines form at the boundary of these two units at outcrop. Many of these springs have a high local value and the spring line can often indicate the presence of subsurface voids even in the absence of flowing water.

22.5.23 Within the interfluvies (land between river channels), groundwater is anticipated to be encountered at some depth; in areas this may be around 50m. Groundwater entry into the excavations in these areas is therefore unlikely to occur from the excavation sides. Runoff and surface water flow is also likely to be low over the Chalk as infiltration rates are high and soil cover is thin. However, groundwater levels will be closer to the ground surface nearer to the rivers (e.g. River Adur) and on ground north of the Downs, therefore dewatering may be required. Dewatering rates from the alluvium are likely to be more predictable

than dewatering rates from the Chalk, which is highly dependent on the presence of solution features or fractures, for example. Changes in water ingress rates into excavations will have an impact of small to large magnitude on the Project owing to the highly variable rates of water flow through Chalk (variations can be six orders of magnitude).

- 22.5.24 Conversely, shallow perched groundwater may be encountered within the Weald Clay. This part of the onshore cable route tends to be topographically lower with lower infiltration rates, greater amount of surface ponding and increased likelihood of shallow perched groundwater bodies being encountered. Perched water bodies are unlikely to be aerially extensive and therefore unlikely to yield significant volumes of water, unless they are hydraulically connected to a surface water feature. The magnitude of impact in the Weald Clay is therefore less, either negligible or small.
- 22.5.25 The cable trenches and site activities are linear and therefore have the potential to allow surface water or shallow groundwater to migrate considerable distances along the course of the route. Chemically different water may therefore be allowed to mix along the cable route, or surface water may flow towards river crossings and associated earthworks. This is likely to be more significant along the route where lower permeable soils are encountered, due to their lower infiltration rates, along either the first 2km or the last 15km.

Contaminated Land

- 22.5.26 Due to the shallow nature of the construction requirements for the proposed cable, it is not considered necessary to take account of potential pollutant sources that are at a significant distance from the construction site. Of the potential pollutant sources identified, only those within 0.2km of the onshore cable route have been considered. These include the following:
- Potential impact from contamination (asbestos, metals, hydrocarbons, etc) within soils or groundwater, ground gas (methane, carbon monoxide, carbon dioxide or oxygen deficiency), soil vapours (volatile organic compounds or semi-volatile organic compounds) generation from the historic landfills reported to be located on or nearby to the onshore cable route, e.g. Brooklands Landfill, Meadow Road Landfill and Decoy Farm Landfill, etc;
 - Vessels containing potentially contaminated material along the cable route, e.g. tanks (see Figure 22.2);

- Wastes management facilities near to the cable route, including potential redevelopment of Decoy Farm site, e.g. waste crushing and recycling operations and disposal of sewage sludge around areas close to sewage treatment facilities (see Figure 22.4 and Table 22.8);
- Potential impact from works buildings located near to the cable route on the outskirts of Worthing (see Figure 22.2);
- Potential impact from the former cement works, quarries, mills and works located on or near to the cable route (see Figure 22.2);
- Potential pollution from the existing Bolney Substation currently located close to the proposed substation site; and
- Potential impact from pollution incidents to soil and water reported in the vicinity of the proposed route, e.g. sewage sludge, oils and fuel, dyes and inks, etc (see Figure 22.3 and Table 22.7).

22.5.27 In the absence of mitigation measures the potential impact of contamination from the existing landfills is large, owing to the potential health hazard associated with some of the potential contaminants that have been identified, including landfill gas. Gas monitoring data from within the landfilled waste is incomplete and little recent data is available. However, data from the investigations listed earlier in this section show areas with very high methane (within the explosive range of 5%-15%) and carbon dioxide concentration, and also correspondingly low concentrations of oxygen. The absence of an extensive impermeable capping layer (particularly over the Brooklands Landfill) has limited the lateral spread of landfill gas and may also limit the ability for the landfill to 'store' large quantities of gas. Construction of the onshore cable route through the landfilled waste is therefore unlikely to increase the risk to surrounding areas although there may be a negligible increase in gas release to the atmosphere.

22.5.28 The greatest risk is with the workers undertaking construction on the cable route and so safe systems of work will be implemented and rigorously monitored. The working methods will take into account the following issues:

- Presence of landfill gasses (methane – explosive and lighter than air, carbon dioxide –asphyxiant and heavier than air) within excavations and in areas where hot equipment may be used; and
- Odour nuisance during excavation works, particularly to residents and locals down-wind of the excavation.

22.5.29 Exposure of contaminated soils will have a potential to create a large magnitude impact due to the potential health hazard, but this is largely dependant on the characteristics of the soils that are planned to be excavated, stored and re-used.

22.5.30 The presence or otherwise of a containment liner at the base of the landfills cannot be confirmed with the information that has been made available.

However based upon the limited borehole logs available and the age of the landfills it is considered unlikely that an engineered basal liner is in place and therefore any leachate that is generated though infiltrating water may already migrate away from the waste mass. Undoubtedly the construction of shallow trenches and infilling with material that potentially has a higher hydraulic conductivity may result in the rapid migration of leachate to areas outside the waste mass. The magnitude of impact to groundwater from leachate is considered to be medium to large, depending on the volume and the chemical composition of the leachate. There is also a potential large magnitude impact to human health if the leachate is released into an area with public access.

- 22.5.31 An impact of medium magnitude on groundwater resources is likely due to the superficial deposits and the lower sensitivity of the aquifer beneath the area of landfilling, although no groundwater data from within or beneath the landfill areas has been made available as many of the intrusive investigations for which reports have been reviewed, did not encounter groundwater. It is unlikely that the cable route excavations will be deep enough to encounter groundwater within the landfill waste although it is accepted that perched horizons of water may be found.
- 22.5.32 Directional drilling operations planned for crossing the railway line at 1km may create preferential pathways for the migration of contaminated water from shallow identified made ground into the underlying groundwater (if not already present). This operation may also provide preferential pathways for the migration of ground gas and soil vapours from the area of generation, to remote areas although this is considered to be less likely. The method of drilling may also require the drill rig to be lowered into a pit, which would require contaminated soils to be excavated with workforce and equipment placed into a potentially hazardous working environment. Due to the human health risk, the magnitude of impact is considered large, although the impact to the surrounding sub-surface geology is likely to be small to medium, due to the anticipated poor construction of the landfill sites.
- 22.5.33 Any fuels, oils or chemicals brought to site and used on site have the potential to contaminate soils and groundwater on the site where they are used. Vehicles traversing the onshore cable route also have the capacity to spread contamination over a long distance. The magnitude of impact caused by any spill of chemicals or fuels will depend on the quantity released and also the type of chemical released. Therefore, the magnitude of impact is likely to vary from small to large.
- 22.5.34 The stockpiling, disposal or re-use of contaminated material could present a large effect to local residents, site operators and controlled waters (e.g. surface water and groundwater) so appropriate mitigation measures will be implemented once a risk assessment has been undertaken to consider the material re-use.
- 22.5.35 An intrusive investigation of the selected substation site will also be undertaken to confirm the ground conditions in respect of soil and groundwater quality. The

EA has identified potential impact to soils and groundwater in the area of the Bolney Substation (see EA report reference 560, Table 22.7) through plant defects and vandalism, leading to the release of oils from insulating cables and hydraulic systems. The investigation data will provide the baseline quality for the site prior to the commencement of construction work.

Operation

Soils

- 22.5.36 Maintenance activities that bring fuel, oils or other chemicals to site have the potential to impact soil quality during the operation of the Project although it is unlikely that these volumes will be large and therefore a magnitude of small to negligible is considered appropriate. Routine maintenance operations are unlikely to represent a significant risk.
- 22.5.37 The use of any vehicles and powered equipment has the potential to impact the underlying soils.

Geology

- 22.5.38 It is unlikely that maintenance works during the operation of the onshore cable route will result in an impact on the underlying geology, unless major works were planned that would require operations similar to those undertaken during the construction phase, e.g. excavation. A negligible to small impact is predicted in this instance.
- 22.5.39 The use of any vehicles and powered equipment has the potential to impact the underlying geology.

Hydrogeology

- 22.5.40 The release of chemicals and oils to groundwater is likely to affect water quality, particularly if this release occurs over the Chalk or close to a surface water feature. The Chalk aquifer is regionally important for potable water and it can allow rapid movement of contaminants with little or no attenuating capacity once they are in the water. The use of any vehicles and powered equipment has the potential to impact groundwater resources. Effects from the introduction of chemicals or fuels to groundwater are large.

Contaminated Land

- 22.5.41 Aggressive ground conditions, through which the cable would be laid, could be present even if clean fill material is placed around the cables; aggressive leachate can migrate from areas of waste, along normal or preferential pathways and accumulate along the proposed cable trench. Some leachates can increase degradation rates of plastics, which may be used to coat or cover the outside of the cables placed along the proposed route.

22.5.42 There is a potential contamination risk from the existing Bolney Substation, which has been identified by the EA as being associated with two contamination events, relating to the release of oils to land and groundwater. It is possible that any contamination could migrate to the proposed substation site.

22.5.43 There is also a potential for solids or liquids to enter the ground during the operation of the substation, which may have the potential to contaminate groundwater or present a risk to human health. These materials may be brought to the site for purposes of regular maintenance, or they may be stored on site within site equipment or apparatus. It is possible, although unlikely that these materials could be released to ground as a result of material failure or an accident but if this occurs, mitigation may be necessary.

Decommissioning

22.5.44 At decommissioning it is anticipated that the onshore cables will be left buried in situ, unless removed to be replaced by new cables to be run along the same route ducting as part of future developments or wind farm repowering. It is likely that ducting will remain in place; however, the cables may be pulled out of the ducts via the jointing bays. If the cables are removed, residual impacts on the physical environment would be of smaller scale than impacts described in this section for construction as works would only occur at specific locations.

22.5.45 No decision has been made regarding the final decommissioning policy for the substation, as it is recognised that industry best practice, rules and legislation change over time. The onshore substation may continue to be used as a substation site after the Project has been decommissioned. It is quite possible that the substation will be upgraded for use by future offshore renewable developments. The decommissioning methodology cannot be finalised until immediately prior to decommissioning; the substation will be decommissioned inline with relevant policy at that time.

22.6 Mitigation Measures

22.6.1 The mitigation measures presented in this section are summarised in Table 22.9.

During Construction

Soils

22.6.2 Where the risk of increasing suspended solid loading in groundwater is identified, as a result of soil excavation (particularly where fractured bedrock is encountered within excavations), nearby groundwater abstraction licence holders will be notified of the potential effect on supply and appropriate mitigation measures will be agreed.

22.6.3 Natural excavated soils will be stockpiled adjacent to the excavation in an appropriate manner so that their physical properties are not detrimentally

affected. Excavated soils will then be used to backfill the excavation from where they came. Soils will be placed and compacted within the excavations and the soils landscaped to blend into the surrounding land. Where cut and fill balance is not achieved within an area of the onshore cable route, soils will be spread over the 30m wide working area and the volumes displaced are not expected to significantly alter the topography. Soils will not be transferred to areas of significant geological or agricultural difference, so that impacts on land use is prevented. Soils management will be dealt with in a Soils Management Plan that will be produced prior to the commencement of the Project.

- 22.6.4 The need for suitable cover material to surface temporary construction areas and haul roads, will be minimised by using existing metalled roads and hard surfaced areas as far as possible. Where feasible, recycled aggregates will be used in preference to primary materials, where they meet the relevant specifications. Any such materials will be tested, including for leachability, to demonstrate that they are suitable for use and will not present an unacceptable risk to human health or to the contamination of soil or groundwater. Imported material will be re-used along the cable route as the scheme progresses and geotextile separator layers may be used in areas where a defined layer between imported material and natural material may not be clear at the time of recovering the material. Any stone and hardcore used may be offered to landowners or to other construction sites in the area for re-use, subject to the provisions of the relevant planning and waste management licensing legislation. If materials are not reused they will be taken to a licensed waste disposal site.

Geology

- 22.6.5 A review of geological information will be undertaken by the Project engineers to confirm trenching methodologies throughout the onshore cable route. Site-specific information will be reviewed where this is available, e.g. borehole logs and site investigation reports. Pre-construction activities will include geotechnical and ground stability surveys.
- 22.6.6 Additional care will be taken during excavations in areas where the likelihood of dissolution features being present is high, i.e. Head filled dry valleys on Chalk. An initial walkover survey will be undertaken to identify potential sinks with precautionary excavation adopted when working in these areas. Where dissolution features are encountered, they will be backfilled using a methodology that has been agreed with the relevant authorities prior to the commencement of the Project.
- 22.6.7 Directional drilling is likely to encounter different geological material during each bore and the variation may be significant. It is possible to encounter Alluvium, Head, Chalk and clay with flints in a single bore. Appropriate drilling heads will be used to ensure drilling rates are maintained and a supply of spare tools will be retained on site to cover failures and to minimise down-time. The re-use of bored material will depend on the nature of the soils and the rock. Where it is possible to displace bored material close to the Horizontal Directional Drilling (HDD) area,

this will be done in preference to moving the soils to a different part of the route, with a similar geology for restoration purposes. Soils from HDD trenches will be stored close to the excavation and replaced to retain geotechnical properties.

- 22.6.8 If the Sayers Common Fault is identified it may be possible to discern the slip plane at a single location, if so appropriate construction methods will be adopted to accommodate any future movement at the location. However, it is more likely that due to the shallow excavations that are planned, the fault will not be identified. Additional bedding material may be placed around the cables in this area to allow some movement of the cable in the event that displacement across the fault occurs.
- 22.6.9 No mitigation measures are considered necessary for the proximity of RIGS sites as the closest is approximately 100m from the onshore cable route. The shallow excavations and low temporary soil stores will not impact the designated sites, which rely on the exposure of geological strata.
- 22.6.10 Geological resources are not being sterilized due to the project being undertaken, so mitigation measures in relation to this are not required.
- 22.6.11 There is a remote likelihood of landslides along the cable route and mitigation measures are not considered necessary. The design of works on the steep slopes of Tottington Mount will be preceded by analysis and testing prior to confirmation of final design. However, in areas where springs are known to be present, care will be taken so that these features are not covered as this may induce material instability. Any observation of such instability will be immediately reported and appropriate mitigation measures will be instigated. Surface drainage will be designed so that impacts to surface soils and temporarily stored soils is minimized, this is especially important in areas of clay cover, where soil infiltration can be impeded.

Hydrogeology

- 22.6.12 The Chalk aquifer is classified by the EA as a Principal Aquifer due to its regional importance in supplying potable water in the area. Impact to the groundwater within the Chalk is very difficult to reverse (due to rapid travel times and dual porosity matrix) and impacts on abstractions or groundwater fed river systems can take many years to return to normal.
- 22.6.13 Where the onshore cable route passes through a SPZ1 or SPZ2, the licence holder will be contacted to discuss the nature of the proposed works and the proposed pollution mitigation that is proposed for the Project. The licence holders' input will be requested to ensure that all parties are content with the provisions in place prior to the work commencing. The EA and MSDC may also be included in these discussions.
- 22.6.14 There is a risk of impacting groundwater abstractions from increased turbidity in certain geological conditions, i.e. where the unsaturated zone thickness is

relatively small, where solution features are developed leading to very short travel times to abstractions and where abstractions are undertaken close to the groundwater surface. Prior to the commencement of the site works, licence holders for abstractions within the Chalk, whose abstraction is less than 0.5km from the onshore cable route, and where there is no superficial cover, will be contacted to discuss specific monitoring and mitigation measures – these measures can only be determined on a case by case basis.

- 22.6.15 Any fuels, oils or chemicals brought to the construction site for the cable route have the potential to contaminate soils and groundwater beneath the area where they are intended for use; vehicles accessing the site also have the capacity to spread contamination over a long distance. Mitigation for a worst case assessment is proposed to ensure protection of the sensitive groundwater regime, particularly found overlying the Chalk geology (Principal aquifer).
- 22.6.16 All fuel and chemical storage will comply with the relevant storage regulations and only trained personnel will be permitted to re-fuel vehicles and equipment and use chemicals that may cause an impact to groundwater. All chemicals will be stored in a locked area, clearly signed and illuminated if access during the hours of darkness is required.
- 22.6.17 Drip trays will be used during refuelling and also to position small equipment during operation (e.g. generators). Refuelling will be undertaken in designated areas away from excavations, springs, sink holes and watercourses or drainage channels. Spill kits will be available in every piece of equipment where fuel is used and spill kits will be present at the re-fuelling operation so that immediate attention to spills can be given. All refuelling will be manually operated to ensure that the operation cannot be undertaken unattended. All spills will be reported and any impacted soils removed – a Project specific protocol will be produced to cover the refuelling and spill response requirements for all staff. Environmental sensitivity to chemicals will form part of the site induction and training programme and specific training will be given to designated persons undertaking refuelling operations.
- 22.6.18 All vehicles entering the construction site will be inspected to ensure they contain the appropriate spill response equipment and where this is lacking, appropriate supplies will be provided for the duration of time on site. Vehicle checks will be conducted to ensure fuel storage and engine condition is satisfactory and that no fuel or chemical release will occur during site operations; drip trays will be used where necessary. A speed limit will be imposed on site to minimise the risk of accident between mobile plant and the speed limit will also reduce the potential damage and likelihood of fuel release in the unlikely event of an accident; spill kits will be available in all mobile plant.
- 22.6.19 Where excavations are required it is likely that dewatering will be undertaken, especially at locations close to surface water features. Shallow excavations on the South Downs are unlikely to yield appreciable volumes of water. Where this is possible, additional pumping capacity and discharge availability may be required

and this will be in place to cover this likelihood. Excavations within contaminated soils (landfill) and Alluvium may require additional engineering input to prevent instability. Safe access and egress is to be incorporated into excavation design, which will also consider the flow of water into the void. Appropriate licenses will be obtained for all de-watering operations that require discharge to either drainage systems, land or surface water channels, chemical test data and COSHH assessment will be undertaken to characterize this water and to assist in obtaining appropriate permits. Actions appropriate to achieve the consent limits will be incorporated, including such requirements as limits on silt loading, chemical and temperature conditions and scouring of banks on surface channels.

- 22.6.20 The control of groundwater and its discharge into surface water courses will need to be tightly controlled as chalk streams (e.g. River Adur) have very little (if any) suspended solids during normal flow conditions and their chemistry and physical flow regime are typically very stable throughout the year.
- 22.6.21 When constructing the proposed cable trench across the boundary of the Chalk and the Upper Greensand it is possible that springs will be present, or may appear as a result of the excavation. Where new springs are discovered as a result of excavation, the water will be controlled to prevent contact with material that may deteriorate its quality and channelled to a nearby surface water feature, without increased sediment loading. The EA will be contacted and made aware of the situation and appraised of the proposed treatment method.
- 22.6.22 Where necessary clay barriers will be installed at regular intervals along the trench route. These barriers will form a low permeable barrier to retard the migration of chemically different water along the cable route.

Contaminated Land

- 22.6.23 Site specific data will be obtained, through the completion of a targeted intrusive investigation along the onshore cable route within the boundary of the landfill sites. An assessment of the soils within the made ground at the Brooklands Landfill will therefore be made prior to commencement of the works. This assessment will be discussed and approved by the local authority. Soil, groundwater and gas samples will be collected during the investigation and for a period of monitoring following completion of the works. The data collected from the investigation will be used to assess the nature of the ground and the potential risk to the environment and the workers during the proposed works. The assessment will enable a safe system of work to be planned for the cable route construction, but it will also allow an assessment of the suitability for soil re-use to be made.
- 22.6.24 The risk assessment will be conducted to identify the most suitable use for the excavated material and if it is to be stored on the construction site until it can be re-used, or removed to landfill. The data will determine the most suitable method for material storage. Soil quality data will be collected as much of the data available is 10-20 years old and the chemical composition of the soils may have

changed considerably since then, potentially leading to a different risk outcome. Irrespective of the potential risk outcome, access by the general public to the working area will be prevented at all times by security fencing so direct contact risks are unlikely to be significant.

22.6.25 All proposed excavations upon areas that are found to contain contaminated soils, groundwater or elevated levels of landfill gasses (methane and carbon dioxide) will be discussed and approved by the local authority, and where appropriate the EA, prior to commencing. Once reliable site specific data is available, safe systems of working can be produced to ensure the safety of construction site workers, the general public and the wider environment are protected. The nature of the mitigation measures that will be employed during the site works are solely dependant on the outcome of the site investigation and subsequent risk assessment, but the following measures may be implemented:

- The use of binding material where necessary to reduce odour generation and prevent direct contact risks for the workforce;
- Air monitoring for asbestos fibres (if these asbestos material is identified) during the investigation and the adoption of appropriate mitigation measures to limit the generation of fibres;
- Rigorous equipment and personnel decontamination when moving out of the work area;
- Groundwater and surface water management utilising either licensed discharge to foul sewer or tanker removal from site to a suitably licensed facility – temporary storage of water on site may be necessary prior to removal from site;
- Like-for-like replacement of cover material to control the rate of infiltration into areas of known waste disposal and where other underground barriers are identified (e.g. basal lining systems in landfills), these will also be replaced by appropriate materials (e.g. clay, synthetic liners or other techniques); and
- Production of a site conceptual model to identify where the existing contamination is and how it will be affected by directional drilling, including pathways for gas and water migration. The conceptual model will influence the design of the directional drilling and required mitigation and this will be submitted along with the details of directional drilling for approval by the local authority and the EA (when undertaken on contaminated land).

22.6.26 Site investigation data will be collected from locations identified for directional drilling operations. Soil, groundwater and ground gas data from these locations will be used to produce safe systems of work specific to the drilling operations. The data will supplement the conceptual model of the drill site to help identify the potential risks that are likely to materialise during the works. Mitigation measures will be produced once the site investigation data has been reviewed in

conjunction with the proposed operations, and this will address potential risks to workers, the general public, groundwater and the potential for gas migration outside the area of landfilled waste. Measures will include the placement of bentonite seals to inhibit the migration of leachate or contaminated water along the bore channel.

- 22.6.27 In order to mitigate the risks of the trenches becoming a preferential pathway for leachate in the area of the landfills, clay barriers will also be installed at regular intervals along the trench route. These barriers will be keyed into the surrounding geology/waste and will form a low permeable barrier to retard the migration of any leachate that may be present.
- 22.6.28 Where trenching is undertaken in areas where landfill capping materials are present, these will be replaced on a like for like basis to retain the present infiltration and hydraulic behavior of the shallow soils. Elsewhere, suitable cover material will be replaced over the cable route to break the linkage between the landfilled waste and future site users. The nature of this cover layer will be discussed and agreed with the local authority and where appropriate the EA, prior to implementation. Similarly, although it is suspected that no containment system is in place, should landfill lining material be discovered during the site investigation then this again will be replaced in a way that retains the lining integrity and which is agreed by the local authority and the EA.
- 22.6.29 All vehicles accessing the construction site will have spill kits on board and all personnel working on the Project will undertake spill response training as part of their induction. All vehicles stored overnight will be kept in a locked compound to prevent tampering and mobile equipment will be housed on a drip tray (or similar) when operating. Refueling will be undertaken by trained personnel and only within designated areas; a spill kit will be present in the refueling area. All chemicals and fuel will be stored in areas clearly demarked and with access restrictions to prevent unauthorised access.
- 22.6.30 A Site Waste Management Plan (SWMP) will be produced to allow the tracking of contaminated soils, showing their point of origin, characterization and proposed method to deal with them. The plan will be produced prior to the commencement of works, but it will be continually updated and shall incorporate information obtained from site data, which will support the rationale for the methods of re-use or disposal. The plan will incorporate details of contingencies that can be initiated in the event of unexpected occurrences.

During Operation

- 22.6.31 During the operation phase, mitigation measures that are protective of the ground and groundwater include the management of chemicals and fuels that may be used as a result of ongoing maintenance. These management procedures are no different to those incorporated into the construction phase, including the refueling of equipment and the storage of chemicals or fuel. It will also be a requirement of maintenance teams to be trained in the use of spill response

equipment and to have access to the spill response procedure in the event of an incident occurring.

- 22.6.32 In the unlikely event that either solids or liquids, which have the potential to contaminate groundwater or impact human health, are released to the ground, this material will be removed as soon as is practicable and the relevant authorities will be notified. If it is considered necessary, a ground investigation in the area of the released material will be conducted to assess the potential environmental risk and evaluate the need to undertake additional remediation works. If remediation is required this will be undertaken to prevent ongoing risks to groundwater and human health. Where necessary, all contaminated material and waste material will be removed from site using a licensed contractor with disposal or treatment occurring at an appropriately licensed facility. Reports for any investigation and verification work will be produced by a third party.

22.7 Residual Impacts

- 22.7.1 The significance of residual effects (i.e. those impacts predicted to remain after mitigation measures have been implemented) is presented in Table 22.9.

22.8 Cumulative Impacts

- 22.8.1 The proposed alignment of the diverted Teville Stream runs parallel to the cable route and therefore soils along this alignment may be impacted during both projects.
- 22.8.2 The Teville Stream restoration is due to commence within the 2012/2013 financial year, which is therefore likely to result in its completion prior to construction on the cable route. The mitigation measures relating to the proximity of the cable route to a surface water feature are addressed in Section 23 – Surface Water, Hydrology and Flood Risk. The only mitigation measure considered appropriate to minimising the excavation of soils along the cable route would be to undertake ground works for each scheme concurrently.
- 22.8.3 The following planned developments are noted in the vicinity of the proposed substation:
- Modifications to the existing National Grid Bolney substation (associated with Rampion connection).
 - Modifications to the existing National Grid Bolney substation (not associated with Rampion).
- 22.8.4 Recent discussions between National Grid and E.ON have indicated that the works associated with the Rampion connection would fall outside NGET's permitted development rights and therefore planning consent would be required. E.ON intends to apply for planning permission from Mid Sussex District Council for these works.

- 22.8.5 It is understood that National Grid will undertake the works not associated with Rampion as Permitted Development with pre-application consultation with the LPA expected in 2013.
- 22.8.6 The National Grid Bolney substation modifications will be located in close vicinity to the works required as part of the Rampion project. The Bolney modifications will be located on land immediately adjacent to the existing National Grid operational land at Bolney.

22.9 References

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Table 22.9: Summary of Impacts, Mitigation Measures and Significance of Effects

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Construction Phase					
Soils/Hydrogeology	Removal of soils to expose weathered or bedrock geology will decrease infiltration times and may also increase suspended solids loading if fracturing and fissures are present and the excavation is close to a point of groundwater abstraction	If the following criteria apply, specific monitoring and mitigation measures will be agreed with abstraction license holders where appropriate: Abstraction <0.5km from cable route in Chalk and <0.2km from cable route in all other geology Superficial deposits are absent from the surface geology	High	Small - negligible	Minor - Moderate
Soils	Risk of changing the local topography through excess (bulking) or insufficient (removed contamination) soils	All soils are to be placed into excavations in an engineered manner and surface conditions are to be returned to the same as prior to excavation. Photographs of 'before' and 'after' will be taken along the route to demonstrate compliance. Where excess material is generated, this will be spread within the working width of the route such that changes in ground level will be negligible.	Low	Negligible	Negligible
Soils	Risk of changing the soil characteristics and recharge if soils from a different geological area are used to backfill excavations	All soils that are to be re-used will be stored so that the physical and biological content is not impacted. Storage time will be reduced to as short a time as possible. All natural soils excavated are to be placed adjacent to the excavation and used to backfill once completed. Soils will only be used to backfill trenches in areas where the host geology is the same, i.e. soils excavated from areas underlain by Chalk will not be used to backfill excavations in the Weald Clay. A Soils Management Plan (SMP) (part of the CEMP) will be prepared in advance of construction.	Low - Medium	Small - Medium	Minor - Moderate

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Soils / hydrogeology	Potential impact to soil and groundwater due to potential contaminants in imported aggregates for haul road construction	Requirement for imported material will be minimised by using existing metalled roads and hard surfaced areas as far as possible. Any imported materials will be tested, including for leachability, to demonstrate that they do not present a risk of contaminating soil or groundwater. Separator layers may be placed between imported soils and in-situ soils if it is deemed appropriate to facilitate the recovery and further re-use of imported soils. Any excess road material will be offered for re-use locally if it cannot be incorporated into the project permanently; final option of off-site disposal is also available.	Medium - High	Small - Large	Major - Minor
Soils / Geology	Risk of landslide, or trench collapse either within soils or underlying weathered/solid geology	Mitigation measures are not considered necessary but a constant review of ground conditions as the trenching progresses will be undertaken to confirm the appropriateness of the construction methods. Shoring methods or benching excavation sides can be considered where appropriate. Pre-construction activities will include geotechnical and ground stability surveys, this data will be used to confirm appropriate construction methods along the route.	Low	Small	Negligible
Geology / Hydrogeology	Excavations within Chalk (or overlying soils) may uncover solution features, which may collapse or require filling – particularly high risk over dry valleys, etc. Risk from surface equipment falling into hole, or reducing pathway length to groundwater from surface contaminants (negative impact on Project).	Engineering solutions to be developed for these areas, including backfilling. Prior to commencement of Project, agree methodology to treat solution features if they are encountered.	High	Small - Medium	Moderate – Major/ Moderate

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Geology	Risk of differential settlement / movement of cable over differing geological material (particularly Head deposits) (negative impact on Project).	Additional bedding material may be required in areas crossing geological features to allow some deformation if there is ground movement. In addition, it may be possible to incorporate some 'slack' in the cable at these locations to retain integrity in the event of movement across the geological feature.	Low	Negligible	Negligible
Geology	Variability in geology may impact directional drilling during a single bore, i.e. Alluvium, Head with clay and flints (negative impact on Project).	Appropriate cutting heads to be available to ensure drilling rates are not reduced.	Low	Negligible - Small	Minor - Negligible
Geology	Sayers Common Fault is crossed near to the northern end of the onshore cable route. If the fault is active, there is a risk of movement along its plane with potential increased longitudinal tension and potentially exposure at ground level (negative impact on Project).	If the location of the fault can be identified as a single line, ground preparation may be required if the geotechnical properties of the soils are different to the surrounding soils. 'Slack' may also be incorporated into cables in areas where this is possible. It is possible that the fault will not be identified, particularly as excavations are shallow.	Low - High	Negligible	Minor - Negligible
Geology	Sterilisation of minerals for future extraction	Local mineral plan shows no prospecting sites within 1.0km of the onshore cable route	High	Negligible	Minor
Geology	Damage to work area and cable in the event of landslide.	Although likelihood is remote, extra vigilance is required during work. Springs or surface water will not be covered and soil movement will be reported to the engineer immediately. Surface water run-off will be controlled, especially in areas where drainage is impeded by low permeable soils.	Low - Medium	Negligible	Negligible
Geology	Detrimental impact on geological quality at RIGS sites	None anticipated.	Low	Negligible	Negligible

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Hydrogeology	Potential impact to groundwater quality and groundwater abstractions from chemical contamination. Increased sensitivity in Chalk and where unsaturated zone is thin (fluvial environment)	Spill kits in all site vehicles and spill training given to all site staff as part of induction. Emergency response to be established and appropriate site person to be delegated to inform EA as required – clear line of responsibility to be established. Spill kits will be present at all refuelling and also available in all vehicles.	High	Medium - Large	Major – Major/ Moderate
Hydrogeology	Potential impact to groundwater resources – onshore cable route passes through SPZ1 and SPZ2	All license holders for abstractions where the onshore cable route passes through the SPZ1 or SPZ2 will be contacted to discuss operating and mitigating procedures for the construction phase. These procedures will incorporate chemical handling, spill response, training requirements, response to incidents and details of notification hierarchy	High	Large	Major – Major/ Moderate
Hydrogeology /Contaminated Land	Shallow contaminated groundwater from landfills may impact water quality for discharge. Water quality may also be hazardous to construction phase workers	Chemical test data will be obtained to assess COSHH requirements and this data will be used to apply for discharge consents. Any other requirements for consented discharges will be discussed at the time of application.	Medium - High	Small - Large	Major - Minor
Hydrogeology	Risk of intercepting or causing breakout of shallow groundwater along spring line at the boundary of the Chalk and Upper Greensand	New springs will be protected from contamination and diverted to a nearby surface channel where appropriate. The EA will be contacted to discuss appropriate options.	High	Small	Moderate
Hydrogeology	Risk of instability in excavations and water disposal during dewatering.	Pre-construction activities will include geotechnical and ground stability surveys. Slopes will be designed appropriately and water inundation considered in highly transmissive soils.	Low - high	Small - Large	Major - Minor

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Hydrogeology	Risk of inundation from groundwater in excavations where highly variable transmissivity is likely	Sufficient spare pumping capacity will be available in dewatering systems for locations where a poor understanding of the soil transmissivities is present, or where these rates are potentially very variable.	Low - High	Small - Large	Major - Minor
Contaminated Land	Potential impact from contamination in soils (asbestos, metals, hydrocarbons, etc) or groundwater, ground gas (methane, carbon monoxide, carbon dioxide or oxygen deficiency), soil vapours (volatile organic compounds or semi-volatile organic compounds) generated within historic landfills (e.g. Brooklands Landfill Meadow Road Landfill)	Obtain site specific data for soil, groundwater and gas characterisation. Much of the available data is 20-years old and a risk assessment will require more recent data to be available. An intrusive contamination investigation will be conducted before works through this kind of material is undertaken.	High	Large	Major
Contaminated Land	Vessels of unknown integrity containing materials of an unknown nature, may have contaminated soils and groundwater beneath or around the area and these may slow down the Project or increase costs for disposal.	Obtain site specific data. If unavailable undertake tiered approach to investigation, with potential investigation and sample collection as required. If contaminated material is present, then clean area to allow onshore cable route to proceed.	Low - Moderate	Small - Medium	Minor - Moderate
Contaminated Land	Potential for contaminated soils and groundwater to be present along cable route when passing close to or through present or historic industrial sites, e.g. former wastes management sites, electricity sub-stations and quarries, etc.	Obtain site specific data. If unavailable undertake tiered approach to investigation, with potential investigation and sample collection as required. If contaminated material is present, then clean area to allow onshore cable route to proceed.	Low - Moderate	Small - Medium	Minor - Moderate

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Contaminated Land	Potential for contaminated soils and groundwater to be present along cable route when passing close to or through pollution incidents, e.g. sewage sludge, oils, fuels, etc.	Produce a project specific procedure to follow if unexpected contamination is unearthed. Obtain site specific data. If unavailable undertake tired approach to investigation, with potential investigation and sample collection as required. If contaminated material is present, then clean area to allow onshore cable route to proceed. Produce a SWMP with details of soils to be excavated and outline procedures to follow if unexpected materials are encountered.	Low - Moderate	Small - Medium	Minor - Moderate
Contaminated Land	Potential impact from excavated soils, particularly on landfill sites, required for trenching and positioning directional drilling rig.	Obtain site specific data on chemical composition and design appropriate mitigation, protecting human health (workers and general public) and controlled waters. Seek data and permission to investigate (if necessary) from local authority, then submit proposed working methods to local authority and EA for approval.	Low - High	Small - Large	Major - Minor
Contaminated Land	Potential damage to integrity of capping system on existing landfills – increased infiltration and long term leachate generation may occur, as well as increased potential to release gas into atmosphere.	Replace material 'like-for-like' and obtain approval from local authority for proposed reinstatement.	Low	Negligible - Medium	Minor - Negligible
Contaminated Land	Potential risk of creating contaminated land from the accidental release of chemicals or fuels (etc) used during the construction works.	Adopt appropriate storage techniques in accordance with guidance and best practice. Instigate training for certain operations (e.g. refuelling) and ensure that spill kits are available for immediate use. Follow procedures in the SWMP where appropriate. All vehicles to be stored overnight in a locked compound	Low - High	Negligible - Large	Major - Negligible

Aspect	Impact	Proposed Mitigation Measures	Sensitivity	Magnitude	Residual Effect
Operational Phase					
Contamination	Potential risk to ground and groundwater from fuels or chemical brought to site.	As per the construction phase, including management of the refuelling of equipment and the storage of chemicals or fuel. Maintenance teams to be trained in the use of spill response equipment and to have access to the spill response procedure in the event of an incident occurring.	Low - High	Negligible - Large	Major - Negligible