

## **Ground Conditions Desk Top Study**

Ford Car Compound, Dagenham

For Novera Energy Ltd



**GROUND CONDITIONS DESK TOP STUDY  
of the site located  
at  
FORD CAR COMPOUND, DAGENHAM, LONDON**

**On behalf of  
NOVERA ENERGY LTD**

<b>REFERENCE: REPORT/E06577/UA/FORD//MAY05/DTS/V2</b>					
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**Environmental Consultancy**

# CONTENTS

	Page
0.0 EXECUTIVE SUMMARY	5
1.0 INTRODUCTION	7
1.1 Instruction	
1.2 Proposed Use	
1.3 Conditions	
2.0 SITE AREA AND STATUS	8
2.1 Site Location	
2.2 Site Inspection	
2.3 Site Boundaries and Adjoining Site Uses	
3.0 HISTORICAL REVIEW	9
3.1 Basis	
3.2 Historical Ordnance Survey Review	
3.3 Detail Recorded on Historical Ordnance Survey Maps	
4.0 GROUND CONDITIONS	12
4.1 Geology	
4.2 Hydrogeology	
4.3 Hydrology	
4.4 Radon	
5.0 REVIEW OF PUBLICLY AVAILABLE INFORMATION	14
5.1 Environmental Data Search	
5.2 Planning	
5.3 Environmental Health Office	
5.4 Building Control	
6.0 GEOTECHNICAL OVERVIEW	16
7.0 GROUND CONTAMINATION ASSESSMENT	18
7.1 General	
7.2 Potential Risk Sources	
7.3 Risk Pathways	
7.4 Environmental Receptors	
7.5 Discussion of Environmental Risk	
7.6 Ground Contamination Risk Summary	
8.0 CONCLUSIONS	23
8.1 Summary	
8.2 Site Investigation	
8.3 Redevelopment Considerations	

## SKETCHES

SK01 SITE LOCATION PLAN  
SK02 SITE LAYOUT PLAN

## APPENDICES

A REPORT CONDITIONS  
B SITE PHOTOGRAPHS  
C OS MAP EXTRACTS  
D LANDMARK ENVIROCHECK REPORT

0.0 EXECUTIVE SUMMARY

<b>Current Site Status</b>	The subject site is located within the Ford Plant, Dagenham, London and centred on National Grid Reference 550670, 181270. The site is currently owned and used as a car holding compound by Ford Motoring Company.
<b>Site History</b>	<p>The earliest available extract (1867) shows the site as part of the "Hornchurch Marshes". The eastern limits of the site are shown as part of a gravel pit/refuse heap which is shown to be covering the entire site by 1920s. The site becomes part of the Ford Car Compound by 1970s, however no building structures are indicated on site.</p> <p>The eastern neighbouring area of the site is shown as gravel pit/refuse heap since the 1890s. In addition further to the east of the site a number of works are located since the 1890s. A large area to the west of the site is occupied Ford factory in the 1930s expands significantly by 1970s. Fairview Industrial Park is established to the east of the site by 1990s.</p>
<b>Geology</b>	Made Ground underlain by Alluvium and River Terrace Deposits overlying London Clay which in turn overlies the Lambeth Group and Thanet Sand with White Chalk at depth.
<b>Hydrogeology</b>	The River Terrace Deposits (gravels) underlying the site is classified as a Minor Aquifer with high leaching potential. This aquifer is expected to be tidal with exchange of water with the River Thames. The Chalk at depth is designated a Major Aquifer with the London Clay, depending upon its thickness at this location, acting as a potential barrier between the Minor Aquifer and the Chalk. There are no EA licensed groundwater abstractions within 1km of the site.
<b>Hydrology</b>	The nearest surface watercourse to the site is the tidal River Thames. The site is situated on a coastal indicative flood zone. The nearest EA licensed surface water abstraction is located approximately 900m northwest of the site from the River Beam.
<b>Potential Contamination</b>	The site is indicated to have been part of the Hornchurch Marshes and was landfilled until the 1960s. The nature of the fill is not known, consequently a wide range of possible contaminants in the absence further details may be present within the fill. In addition landgas may be generated from the fill material beneath the site. The current use of the site (temporary storage of new cars) is not considered to be a significant contamination source. The local area including land in the immediate proximity of the site has also been part of the land filling activities historically. In addition a number of past and present industrial activities including chemical works, locks, automotive manufacturing and a timber yard were located in the vicinity of the site.
<b>Risk Assessment</b>	Overall risk, with respect to ground contamination, is rated as <b>Moderate to High</b> due to the likely presence of the significant amount of landfilling undertaken on site historically. It is recognised that the surrounding area may also be contaminated as a result of both historical and current contaminant sources.
<b>Geotechnical Considerations</b>	It is considered likely that piled foundations extending in the Thanet Beds will generally be required for the structures at the site. However, for more lightly loaded structures, vibrated concrete columns or short piles extending into the River Terrace

	<p>Gravels may be suitable whilst raft foundations could also be considered depending upon the tolerance of the structures to total and differential settlements. It is anticipated that floor slabs will also need to be piled. The use of piled foundations, particularly extending below the London Clay and Lambeth Group, will require discussion and agreement with the Environment Agency.</p> <p>Measures to reduce settlements for infrastructure and services are likely to be required. These could include dynamic compaction, the use of geogrids beneath roads and hardstanding, the use of flexibly jointed services or the piling of major services.</p>
<b>Recommendations</b>	<p>Prior to acquisition of the leasehold or freehold and subject to an appropriate acceptance of risk, it is recommended that a site investigation should be undertaken to characterise geotechnical and soil/groundwater/landgas chemical conditions. Prior to redevelopment further investigation and remedial/mitigation measures are likely to be required to reduce risks to the environment, human health and building infrastructure.</p>
<p><i>This sheet is intended to provide a summary only of the initial indicative assessment study of the site in relation to ground contamination. It does not provide a definitive engineering analysis for the purposes of costing or construction, and is subject to the limitation of the agreed brief. A site investigation is recommended.</i></p>	

## **1.0 INTRODUCTION**

### **1.1 Instruction**

White Young Green Environmental (WYGE) was appointed by John Howson of Novera Energy Ltd to undertake a Ground Conditions Desktop Review of the site located within the Ford Motor Company Plant, Dagenham, London. The owner and occupier of the site is understood to be Ford Motor Company.

No reports or additional details were provided by the client.

### **1.2 Proposed Use**

The site is intended to be redeveloped as a Sustainable Energy Facility (a gasification plant) by Novera Energy Ltd. The site is currently owned and occupied by Ford Motor Company and Novera Energy Ltd propose to acquire either the freehold or leasehold of this plot prior to redevelopment. Consequently for the purposes of this assessment, a managed commercial/industrial scenario is being considered. The report is to be used as part of a potential planning application and a Pollution Prevention Control (PPC) application.

### **1.3 Conditions**

This report is prepared in line with the agreed brief detailed within our accepted proposal of 22<sup>nd</sup> April 2005 (Ref. CG18April05Prop) and its terms and conditions, and is also subject to the report conditions shown in Appendix A. WYGE take no responsibility for the use of this information by third party for uses other than that described in this report.

## **2.0 SITE AREA AND STATUS**

### **2.1 Site Location**

The subject site is located at the Ford Plant, Dagenham, London and centred on National Grid Reference 550670, 181270 as shown in SK01. The site only occupies the south eastern part of the car compound currently occupied and used by Ford. The site is approximately rectangular in shape and covers an area of approximately 1Ha as indicated by the client. Site access is gained through the remaining parts of the car compound and the northern and western site boundaries are not well defined. The site location and boundaries are detailed in SK01 and SK02.

### **2.2 Site Inspection**

A site walkover was undertaken by WYGE on 13<sup>th</sup> April 2005. The inspection was carried out with the accompaniment of Ben Diggins of Ford. During the inspection, access was gained to the entire site. Photographs were taken during the inspection and are provided in Appendix B.

The exact site boundaries for the northern and western parts of this site have not been physically delineated as the site consists part of a larger car compound area (Photo 1). However the eastern and the southern site boundaries are delineated clearly as the area fenced off (Photos 2 & 4). A pond is also located in the south eastern part of the site (photo 8). The site is currently being used by Ford for temporary storage of vehicles that have been sold and waiting to be shipped. Ben Diggins indicated that all cars stored within the site are new and that no repairs are performed on site and that the site is used for parking only.

The land cover on site consists entirely of hardstanding. However the tarmac appeared to be in poor condition with cracks and some vegetation outcropping (Photos 5 & 6). The hardstanding surface appeared uneven and some areas were noted to be recently patched (Photo 7). No stains were observed at the surface during the site walkover.

It is understood that the pond located within the car compound is used to collect surface water runoff from the area and appears as untreated (Photo 8).

The site is located at an approximate elevation of 6m AOD and gently slopes to the River Thames towards the south. The river banks were not visible from the site but are likely to be engineered.

### **2.3 Site Boundaries and Adjoining Site Uses**

The northern and western site boundaries are not physically demarcated as the car compound is located within a larger area than the site occupies.

The eastern boundary of the site is occupied by commercial premises as part of the Fairview Industrial Park. The area to the east of the site is occupied by Flogas, which incorporates as a gas filling station and storage of gas cylinders. To the north of Flogas the area is used by a scaffolding company.

Immediately to the south of the site the banks of the River Thames and the mud that is associated with the tides are located.

### **3.0 HISTORICAL REVIEW**

#### **3.1 Basis**

Historical land use of the property and land immediately surrounding the site has the potential to result in ground contamination. Extracts of historical Ordnance Survey (OS) maps were reviewed for the period between 1867 and 1999 to establish the recorded sequence of site development. The OS map extracts are included as drawings in Appendix C.

#### **3.2 Historical Ordnance Survey Summary Review**

The earliest available extract (1867) shows the site as part of the "Hornchurch Marshes". The eastern limits of the site are shown as part of a gravel pit/refuse heap which is shown to be covering the entire site by 1920s. The site becomes part of the Ford Car Compound by 1970s, however no building structures are indicated on site.

The eastern neighbouring area of the site is shown as gravel pit/refuse heap since the 1890s. In addition further to the east of the site a number of works are located since the 1890s. A large area to the west of the site is occupied Ford factory in the 1930s expands significantly by 1970s. Fairview Industrial Park is established to the east of the site by 1990s.

#### **3.3 Detail Recorded on Historical Ordnance Survey Maps**

##### **1867 & 1872**

These earliest historical Ordnance Survey Maps, as provided by the Envirocheck report, show the site and the surroundings as open land as part of the "Hornchurch Marshes" that occupy a large area. No developments appear to be within 1km of the site.

##### **1897**

This extract shows the eastern limits of the site to have become part of a gravel pit associated with a cement works 120m to the east of the site. Beyond this, to the east a "chemical works" is located.

##### **1898**

This extract shows the addition of a further "chemical works" approximately 450 to the northeast of the site and two other "chemical works" approximately to the 800m southeast of the site. A "lock" and a "candle manufactory" are also shown constructed approximately 700m west of the site.

##### **1910**

No significant changes are shown within this extract.

### **1920 & 1921**

This extract shows the boundary elevation of the parcel of land at which the site is located to have changed. The site is indicated to be a part of a dockside loading area (named Rainham Shoot) with travelling cranes running along the river and into the site. It is likely although not proven that cargo was stored on site prior to a following transfer by river. A tank associated with this use is illustrated 150m west of the site. A "sewage works" is shown to be built approximately 550m to the east of the site. "Rainham Caves" are shown to be located approximately 100m to the southeast of the site. Another large gravel pit is shown 300m west northwest of the site.

### **1938 & 1939**

No significant changes are shown on site with the exception of a footpath/access road located within the western boundaries of the site. The "travelling crane" to the south of the site is now shown to be removed. A number of "tanks" are shown to be located approximately 20m to the southeast of the site. Structural changes area also shown within the Cement Works to the southeast of the site and the adjacent "chemical works" is removed from the extract. A large factory is shown located approximately 700m to the west of the site.

### **1951**

No significant changes are shown in this extract within the site or the immediate surroundings of the site. However, significant variations in ground levels are indicated across the wide area. Further industrial developments are shown 350m to the northeast of the site and 700m southeast of the site.

### **1961**

Further industrial developments within the "Frog Island" located approximately 300m southeast of the site. The large factory, from west of the site and now noted as a Motor Car Manufacturing has increased in size and has numerous tanks and rail links associated with it.

### **1967**

Further industrial developments are shown to the east of the "Rainham Creek" approximately 500m to the northeast of the site. In addition infilling with refuse is illustrated approximately 650m northwest of the site.

### **1976**

The site is now labelled as a "Car Compound" as part of the motor works to the west. A "Timber Yard" is shown approximately 100m east of the site.

### **1990 & 1992**

No significant changes are shown within the site in this extract. "Fairview Industrial Park" consisting of a number of warehouses is located beyond the eastern and north eastern boundaries of the site.

**1999**

The layout of the site and surrounding area are not shown in detail but appear to be as the present day layout.

## 4.0 GROUND CONDITIONS

### 4.1 Geology

Reference to the British Geological Survey (BGS) Map (Sheet 257, Romford, Scale 1:50,000) indicates that the general geological sequence consists of the drift deposits, Alluvium over River Terrace Deposits (gravels) which overlie the solid geology comprising London Clay overlying the Lambeth Group (formally the Woolwich and Reading Beds) over Thanet Sand which in turn overlies the White Chalk, (formally known as the Upper and Middle Chalk), at depth.

Due to the land filling activities that have taken place in the past a thick layer of Made Ground is anticipated beneath the site.

### 4.2 Hydrogeology

The River Terrace Deposits underlying the site is classified as a Minor Aquifer with soils of unclassified leaching potential, therefore a high leaching potential is assumed (NRA sheet 40). The deeper Chalk stratum is classified as a Major Aquifer by the Environment Agency. Depending upon its thickness at this location, the London Clay deposits may act as an aquiclude or aquitard, impeding potential vertical groundwater migration from the Minor Aquifer to the underlying Chalk.

Shallow groundwater (the Minor Aquifer in the River Terrace Deposits) on site is likely to be tidally influenced through exchange of water with the River Thames. Net groundwater flow is anticipated to be towards the south into the River Thames. Laterally and vertically discontinuous perched water is likely to be present within the fill materials above the Alluvium.

The Landmark Envirocheck report suggests that there are currently no EA licensed groundwater abstractions within 1km of the site.

### 4.3 Hydrology

The nearest surface watercourse to the site is the River Thames which is tidal and therefore does not have an EA River Quality classification. However, the latest EA GQA classification given for Ingrebourne River, located approximately 330m to the east of the site, in 2000 is Grade F (bad). The flow rate for Ingrebourne River is given as less than  $0.62\text{m}^3\text{s}^{-1}$ .

Data presented in the Landmark Envirocheck Report indicates the site to be situated on a coastal indicative flood zone, although this designation does not take into account any local flood defence measures which may be in place.

The Landmark Envirocheck report suggests that the nearest EA licensed surface water abstraction is located approximately 900m northwest of the site from the River Beam and used for cooling in industrial/commercial processes of the Ford Motor Co Ltd at Dagenham.

### 4.4 Radon

National Radiological Protection Board data presented within the Landmark Envirocheck Report indicates that the percentage of houses exceeding the Action

Levels for Radon is likely to be 1%. This rating reflects a low risk and as such, it is thought unlikely that the local authority would request any special radon protection measures.

## 5.0 REVIEW OF PUBLICLY AVAILABLE INFORMATION

The outcome of enquiries made to the relevant authorities is given below. These correspondences have been supplemented by searching an environmental database, Envirocheck, provided by Landmark (Appendix C). This information should only be regarded as preliminary and indicative and subject to formal confirmation where appropriate.

### 5.1 Environmental Data Search

A search of environmental databases was completed to identify any known sources of contamination in the surrounding area. The results of this search are summarised below and the full report included in Appendix D.

- There are currently 2no. **air pollution controls** within 1km of the site. The closest is approximately 700m south east of the site.
- There is 1no. **discharge consent** on site, pertaining to discharge of Final/Treated Effluent to land/soakaway. There are 4no. discharge consents within 500m of the site of which one is indicated to been revoked. These discharges indicated to be to sewer feed channels, River Thames and Rainham Creek.
- Currently 2no. **integrated pollution prevention and controls** exist between 500m to 1km of the site
- There have been 2no. **pollution incidents to controlled waters** within 500m, which were categorised as Category 3 – Minor Incidents relating to an unknown – miscellaneous pollutant or storm sewage. The closest incident took place approximately 176m to the northwest of the site. There have been 41no. pollution incidents to controlled waters between 500m – 1km of the site, 3no. of which were Category 2 incidents, relating to 2no. chemical spillages and 1no. discharge of unknown sewage.
- There are 4no. entries onto the **Substantiated Pollution Incident Register** for Category 2 incidents in respect to water pollution, incidents relate to storm sewage, fuels and lubricating oils and are located beyond 500m of the site.
- The Envirocheck report indicates that there are currently no **registered radioactive consents** within 2km of the site.
- Envirocheck report indicates that there are 3no. **licensed waste management facility** within 500m of the site. The closest being 274m south east of the site, operating as a composting centre under the IPPC regime. In addition there are 2no. licensed waste management facilities within 1km of the site as a household, commercial and industrial waste transfer stations and a metal recycling site.
- The Envirocheck report indicates that there are 5no. **local authority registered landfills** within 700m of the site. One of which is registered as being located on the subject site. No further details are given.
- There are 3no. EA **registered landfill sites** within 1km of the site, the closest of which is located 280m northwest of the site although it is now inactive. The

authorised waste material include: Coal fired boiler ash & riddlings, industrial non-hazardous inert non-flammable waste. The licence for this landfill was held by Ford Motor Company Ltd.

- There is 1no. **registered waste transfer sites** 561m east of the site which is currently inactive due to license lapse/cancelled/defunct/not applicable or surrendered.
- There are 2no. **registered waste transfer or disposal sites** both located approximately 544m east of the site. These sites are operated by Attgo Granules Ltd and P Craven t/a Grove Road Tyres and are licensed to receive electric cable and wire and tyres respectively.
- There is 1no. **control of major accident hazard sites (COMAH)** which is the Flogas UK Ltd adjacent to the subject site. In addition the Envirocheck reports 1no. **planning hazardous substance consents** for the Flogas UK Ltd site for flammable substances relating to Liquefied petroleum gas.
- There are moderate to high risk of **compressible ground subsidence hazards** both onsite and in the surrounding locale.

**5.2 Planning Department of London Borough of Havering, (Peter Fletcher, Tel: 01708 434343)**

Peter Fletcher of the planning department of London Borough of Havering indicated that there are no planning applications pertaining to the subject site. In addition as there are currently no buildings on site it was indicated that there were also no building control notices pertaining to the site.

**5.3 Environmental Health Department of London Borough of Havering, (Peter Haden, Tel: 01708 434343)**

Peter Haden of London Borough of Havering indicated that the site was part of the "Hornchurch Marshes", which was used as part of a landfill to a depth of at least 10m. Although the environmental health department does not hold ground investigation information on the subject site, a number of reports were available relating to the adjacent Fairview Industrial Park.

Mr Haden indicated that the tipping finished in 1960s but due to the long practice of tipping the nature of waste was not known and could potentially include waste from the nearby former chemical works. The adjacent Fairview Industrial Park was indicated to be built in 1980s and no protection against landgas was used. Mr Haden confirmed that any future development on site would require methane and carbon dioxide preventative measures.

## 6.0 GEOTECHNICAL OVERVIEW

Available published geological information indicates that the natural geology beneath the site comprises superficial deposits of Alluvium over Flood Plain Gravels which in turn overlie the London Clay Formation over the Lambeth Group, over the Thanet Sand, over the White Chalk. Due to historic landfilling activities in the area, it can be expected that the natural geology will be overlain by a substantial thickness of Made Ground, potentially in the order of 10m in thickness.

The site lies adjacent to the River Thames and therefore, it is anticipated that both the Alluvium and the River Terrace Gravels will be several metres in thickness whilst the London Clay may be relatively thin.

It is understood that the proposed development comprises a gasification plant and that the process equipment will impose substantial loads on the ground. It should be noted, however, that details of likely structural loadings were unavailable at the time of compiling this report.

### 6.1 Foundations

Due to the potential thickness of the Made Ground and underlying Alluvium, it is anticipated piled foundations are likely to be required for the proposed buildings. The installation of short piles or vibrated concrete columns, bearing upon the Flood Plain Gravels may be an appropriate solution, for relatively lightly loaded structures. However, the combined thickness of the Made Ground and the Alluvium may negate the use of vibrated concrete columns whilst it is likely that environmental considerations will render vibrated stone columns unsuitable.

Raft foundations could potentially be considered as an alternative for lightly loaded structures although their suitability will be dependent upon the tolerance of structures to total and differential settlements, both of which can be expected to be substantial.

For more heavily loaded structures, or if the Flood Plain Gravels are of insufficient thickness to form an appropriate bearing stratum, it may be necessary for piled foundations to extend to greater depth. Currently, it is likely that the London Clay Formation and/or clay horizons within the Lambeth Group, form an aquitard. Such a feature will reduce the potential for impact of the Major Aquifer formed by the White Chalk by any contaminants within the landfill. If piled foundations are required to penetrate these clay horizons, into the permeable Thanet Beds or White Chalk, consideration will need to be given to the potential for piled foundations to create pathways for the downward migration of any contaminants from strata above. If such a foundation solution is proposed, extensive consultations with the Environment Agency are likely to be required and it may be necessary to consider solutions such as piling through bentonite or permanent sleeving of the piles.

Consideration may also need to be given to the potential the upward migration of landgas into buildings at pile locations which may require that piles are appropriately sealed to mitigate against landgas migration, should landgas prove to be a consideration at the site.

## **6.2 Ground Settlements**

Due to the presence of a substantial thickness of Made Ground and Alluvium, it is anticipated that ground settlements for structures bearing on to these near surface strata, will be unacceptable for the proposed structure and it is anticipated that floor slabs will require piled foundations.

For the remainder of the site, settlements associated with the Made Ground and Alluvium are also likely to be unacceptable. Appropriate methods to reduce settlements for infrastructure and services are likely to be required. Such methods may include one or a combination of dynamic compaction, the use of geogrids beneath roads and hardstanding, the use of flexibly jointed services and the piling of major services. Vibrated stone columns are unlikely to be appropriate for use as this site since they can be pathways both for the downward migration of contaminants of the upward migration of landgas.

If dynamic compaction is used at the site, consideration will need to be given to the potential for the technique to result in the lateral and vertical migration of any leachate and/or landgas.

## **6.3 Temporary Works**

It is likely that temporary excavations through the Made Ground, for example for the laying of drainage, will require shoring in order to maintain their stability during temporary works.

## **6.4 Drainage**

Whilst it is understood that a surface water feature which may be a soakway is currently present on site, it is considered that it is highly unlikely that soakaways will be suitable for use as a part of the new development. Soakaways have the potential to create a pathway for potentially contaminated Made Ground to reach groundwater and strata beneath and hence are generally unacceptable to the Environment Agency on such a development.

## **6.5 River Wall**

It is noted that the site is bounded by a river wall. It is likely that restrictions will apply regarding development close to the wall and that licences will be required from the Environment Agency to work within the vicinity of the wall.

## 7.0 GROUND CONTAMINATION RISK ASSESSMENT

### 7.1 General

The Environment Act 1995 (Section 57) makes provision for a risk-based framework for the identification, assessment and management of contaminated land within the UK. The provisions of the Act came into effect in April 2000 and are aimed at ensuring that actions taken with respect to contaminated land are directed by a technically well-founded assessment of risk, in terms of pollutant linkages.

Ground contamination can occur through several causes, particularly from the historical use of the site, and is often linked to the processes of waste disposal, underground storage, open storage, process pipework, leaks, tanks, site filling and for various other processes. The contamination can either be from on-site pollution sources or as the result of migration from pollution sources off-site, which may lead to long-term liabilities under recent legislation for any site owner.

This section of the report provides a qualitative assessment of environmental risks associated with the site. The qualitative risk assessment is achieved by the classification of the significance of the potential harm and the probability of a pollutant linkage (source-pathway-receptor scenario). The harm and probability of linkage via identified pathways are then compared to indicate the potential environmental risk for a pollutant linkage. The assessment has been developed with cognisance of:

- the nature, level and extent of identified contamination (this may include for duration and frequency),
- potential contamination receptors, and
- regard to the current site status

The risk assessment will also take cognisance of the potential sensitivity of the receptor and the significance of the contaminant source (i.e. the expected volume and concentration of the contaminant source).

The following discussion of pollutant linkages and derivation of environmental risks is summarised on the Risk Assessment Summary Table (Section 7.6).

### 7.2 Potential Risk Sources

Based on the review of publicly available information and a site visit, the potential environmental risk sources have been identified as described below.

#### Onsite current use/ historical use.

As discussed in section 3.3, the site is indicated to have been part of the Hornchurch Marshes and was landfilled until the 1960s. The nature of the fill is not known, although it is believed that it may have been sourced from the adjacent chemical works (see below). Consequently a wide range of possible contaminants may be present within the fill. The potential contaminants that may be present include a wide range of metal compounds, especially heavy metals, ash, hydrocarbons, especially Polycyclic Aromatic Hydrocarbon (PAH), Total Petroleum Hydrocarbons (TPH) including aromatic and aliphatics, phenolics, volatile and semi-volatile solvent

compounds such as trichloroethylene (TCE), Polychlorinated Biphenyls (PCBs), effluent treatment chemicals such as hydrochloric acid and asbestos. In addition landgas generated from the fill material beneath the site and also from natural alluvial deposits is a risk source.

The site is currently used as a car holding compound for newly produced cars. In the absence of any works being performed on the vehicles and the reduced likelihood of oil leaks or spills from new cars, the current use of the site is not considered to be significantly contaminative.

#### Offsite current use/ historical use

The local area including land in the immediate proximity of the site has also been part of the land filling activities historically. In addition a number of past and present industrial activities including chemical works, docks, automotive manufacturing and a timber yard were located in the vicinity of the site. Consequently offsite contamination sources are also anticipated in the vicinity of the site. The potential contaminants involved would also include metal compounds, ash, PAHs, aromatic and aliphatic TPHs, phenolics, PCBs and volatile and semi-volatile organic compounds. In addition leachate and land gas that may be generated from the fill material within the adjacent land may also be considered a risk source.

### **7.3 Risk Pathways**

The key environmental pathways and exposure routes by which the potentially toxic substances can reach environmental receptors are considered to be:

#### Indirect

- Vertical leaching of contaminants to the Minor Aquifer
- Lateral and vertical migration of groundwater
- Migration of contaminants along service ducts, drainage runs including the pond on site and via surface runoff
- Surface run-off
- Lateral migration of leachate to the River Thames

#### Direct

- Dermatological contact with contaminated soil
- Ingestion of contaminated soil.
- Ingestion of contaminated waters.
- Inhalation of dusts, vapours and landgas.

### **7.4 Environmental Receptors**

The environmental receptors at, beneath or surrounding the site include:

- Shallow groundwater within the River Terrace Deposits (Minor Aquifer)
- Deep groundwater within the Chalk.
- The River Thames
- Site occupants / public
- Future site occupants / construction workers
- Off site human receptors
- Landscaping – future (current site layout currently does not consist of extensive landscaping)

- Future building materials (current site layout currently does not consist of buildings)

## 7.5 Discussion of Environmental Risk

The risks of pollution to the identified receptors have been assessed as described below and a summary is presented in Section 7.6.

### Groundwater:

The ground conditions beneath the site are anticipated to include significant depths of fill materials of unknown source and quality. The shallow groundwater on site (the Minor Aquifer) is likely to be tidally influenced and the associated rise and fall of the water table is likely to have encouraged the downward transfer of leachate from the fill material into the Aquifer. In addition the hardstanding on site is considered to be in poor condition and that it is anticipated that infiltration of surface water through the fill to the Minor Aquifer will be likely. However, the Minor Aquifer is unlikely to be an important resource due to its saline influence and there is no record of it being abstracted within 1km of the site. Despite this though, the risk to the shallow Minor Aquifer from the site's historical use is considered to be of **Moderate to High** order.

The presence of the London Clay beneath the Minor Aquifer may reduce the risk to the deep chalk aquifer consequently the risk to the Major Chalk Aquifer is rated as **Low to Moderate**. However, if the thickness of the London Clay is proved by intrusive investigation to be thin or absent at this location, or is penetrated by piling for the development, the risk to the Chalk and the Major Aquifer will increase to **Moderate to High**.

### Surface Water:

Given the close proximity of the nearest surface water body to the site, Thames River and its tidal nature it is likely that the potential contaminants may be transported to this receptor. Consequently the potential risk to local surface water bodies from expected ground conditions is rated as **Moderate to High**.

### Current / Future Site Users:

The past use of the site potentially increases risks from any contamination beneath the site to current site occupiers. The ground cover on site consists of hardstanding which is considered to be in poor condition. Although the hardstanding may be considered to be of sufficient integrity to impede some of the direct pathways such as ingestion, it is not considered to be adequate to hinder other pathways such as inhalation of vapours and landgas, which may be significant. There is also the risk of dermal contact if any historic wastes penetrate the existing surface covering. However as the site is currently used as a car compound the time spent on site by site users are considered to be minimal. Consequently the potential risk to current site occupiers is therefore considered to be **Moderate**.

The site is proposed for redevelopment as a gasification plant by the client, a use which is not considered a sensitive receptor to ground contamination. It is assumed that this development will be mostly, if not entirely, covered by buildings or hardstanding thus limiting the potential for future site users to come into contact with sub-surface contaminants. Therefore, the potential risk to future users is rated as

**Low to Moderate**, potentially reducing with any protective / remediation / earthworks undertaken at the site. Conversely, if any landscaped areas are proposed as part of the redevelopment, the risk to future site users is increased.

#### **Construction Workers:**

Given the potential risks from landgas and the potential for significant ground and groundwater contamination and hazardous wastes, ground workers may come into contact, either dermally or via inhalation, to such substances upon removal of the hardstanding and disturbance of underlying soils. The potential risk to future construction workers is therefore rated as **High**. However, the use of appropriate PPE and Health & Safety considerations will reduce this risk rating to a more acceptable level.

#### **Adjacent Land Uses - Environmental Risk Posed from the Site**

Excluding surface waters, which are considered separately, the site is located in an industrial and commercial setting. In addition historical plans and the information gleaned during this study suggest surrounding landuse is likely to have significant contamination issues of its own. Therefore, risk from the site to adjoining land uses is currently considered to be of **Low to Moderate** order. However, in the event of the future development and/or remediation of adjacent plots, the risk associated with offsite migration may be increased.

#### **Adjacent Land Uses - Environmental risk posed to the site**

The local area has historically and currently been used for various industrial applications which are likely to have had a degree of impact to the underlying soils and groundwater. The risks posed from adjacent areas, to the subject site, are rated as **Moderate**.

#### **Future Infrastructure**

The chemical characterisation of Made Ground at the site may have some impact to future infrastructure (services, foundations etc.). The generation of landgas on site will also present a hazard to future buildings. In addition, the significant depths of fill present are likely to be structurally poor and subject to settlements and compression although this will decrease over time. The potential risk to future infrastructure is therefore rated as **Moderate**. Emplacement of appropriate protection/remediation measures and adoption of suitable foundation techniques would reduce this risk to acceptable levels however.

#### **Landscaping/Vegetation**

The site is not currently vegetated although the effects of phytotoxic metals and soils vapours within shallow soils may result in stunted growth of any future landscaping. Therefore the potential risk to vegetation and landscaping is considered **Moderate** reducing with use of appropriate measures.

**7.6 Ground Contamination Risk Summary**

A summary of the potential environmental risks associated with ground contamination at the site with regard to proposed use and ownership is outlined below:

<b>Description of Receptor</b>	<b>Risk Rating</b>
Shallow groundwater	Moderate to High
Deep groundwater	Low to Moderate/ Moderate to High
Surface water	Moderate to High
Current site users	Moderate
Future site users	Low to Moderate
Construction workers	High
Offsite migration	Low to Moderate
Onsite migration	Moderate
Future infrastructure	Moderate
Landscaping/vegetation	Moderate
<b>Overall Ground Contamination Liability Risk Rating For The Site.</b>	<b>Moderate to High</b>

Therefore, the overall environmental risk at this site associated with ground contamination in relation to site ownership and future development is assessed to be of **Moderate to High** order.

## 8.0 CONCLUSIONS

### 8.1 Summary

- The site is indicated to have been part of the Hornchurch Marshes and was landfilled until the 1960s. The nature of the fill is currently unknown; consequently a wide range of possible contaminants may be present within the fill. In addition land gas, likely to be generated from the fill material beneath the site, is considered to be a risk source.
- The site is currently used as a car holding compound for newly produced cars. In the absence of any works being performed on the cars the current use of the site is not considered to be of contaminative.
- The site lies in a location of moderate sensitivity with respect to groundwater (Minor Aquifer) and surface water/ecology. The site is located above a Minor Aquifer which is considered to be in hydraulic continuity with the Rivers Thames. The Chalk Aquifer situated at depth is classified as a Major Aquifer by the Environment Agency. However the presence of London Clay deposits is considered to act as an aquiclude or aquitard impeding potential vertical groundwater migration from the Minor Aquifer to the underlying Chalk
- Overall, the site is considered to present a **Moderate to High** risk with regards to ground contamination levels.
- It is considered likely that piled foundations extending in the Thanet Beds will generally be required for the structures at the site. However, for more lightly loaded structures, vibrated concrete columns or short piles extending into the River Terrace Gravels may be suitable whilst raft foundations could also be considered depending upon the tolerance of the structures to total and differential settlements. It is anticipated that floor slabs will also need to be piled. The use of piled foundations, particularly extending below the London Clay and Lambeth Group, will require discussion and agreement with the Environment Agency.
- Measures to reduce settlements for infrastructure and services are likely to be required. These could include dynamic compaction, the use of geogrids beneath roads and hardstanding, the use of flexibly jointed services or the piling of major services.
- Soakways are unlikely to be suitable for use at the site due to their potential to create contamination pathways into the underlying strata.

### 8.2 Site Investigation

Subject to an appropriate acceptance of risk, prior to the purchase or acquisition of a lease on this site, it is recommended that a general intrusive investigation should be undertaken to characterise soil/groundwater/landgas chemical and geotechnical conditions. The data retrieved from this investigation will provide sufficient information to characterise baseline conditions to submit to the Council as part of the planning application and to the Environment Agency as part of the PPC application required for the gasification plant. The investigation will also provide geotechnical data to enable the principles of foundation design for the proposed structures to be

developed and identify any abnormalities associated with such. The data retrieved will also be in the appropriate format and quantity to enable subsequent quantitative risk assessment modelling, if required.

The investigation scope outlined below is more comprehensive than would otherwise be recommended prior to acquisition of the site. This is at the client's request and results from programme restrictions and the requirement to gain a more detailed understanding of ground conditions at an earlier stage so that they may progress foundation and remediation design.

Therefore, the scope of site investigation, to achieve the aims as outlined above, is considered to include the following:

**Proposed Site Investigation Scope**

Investigation Item	Reasoning
3 Deep boreholes up to 30m with deep standpipes	Assess geotechnical characteristics of deeper soils/rock for foundation design and to monitor and sample deeper groundwater (Chalk or Thanet)
2 Shallow boreholes with standpipes installed plus shallow standpipes within each of the three deep boreholes.	Groundwater monitoring (Minor Aquifer) - this groundwater body is likely to be the primary contaminant pathway to the River. Groundwater samples from the Minor Aquifer will be retrieved for chemical analysis. Soil samples will be retrieved from varying depths and locations to characterise chemical conditions laterally and vertically across the site. These will also be used to obtain geotechnical information from the Made Ground. Landgas monitoring from the Alluvium.
One day Trial Pitting	Allow visual inspection of fill materials (up to 5m depth depending upon sub-surface stability). Soil samples will be retrieved from varying depths and locations to characterise chemical conditions laterally and vertically across the site. Geotechnical data required for running a QRA model will also be retrieved.
Window Sampling with shallow standpipes	Low impact boring method to retrieve soil & perched groundwater samples from the Made Ground. Monitoring of landgas generated from fill materials.
Soil and groundwater testing (laboratory)	Chemical analysis testing for a wide range of determinands commonly encountered on industrial sites plus those specific to landfills and gasworks including asbestos screening. Groundwater from each borehole standpipe will be tested from 2 monitoring

Investigation Item	Reasoning
	rounds. Leachate testing will also be undertaken on soils. The chemical testing suite will include all parameters required for a QRA model (eg hydrocarbon speciation).
Surface water analysis	Chemical analysis of water taken from the pond currently situated on/adjacent to site and the adjacent River Thames to assess any contaminant pathways.
Groundwater and landgas monitoring – 3 rounds	To measure flows and composition of common landgases and the groundwater flow regime.
Tidal Monitoring over 12 Hours	To assess the impact of the tide on shallow groundwater movements to assist in assessing contaminant pathways.
In situ and laboratory geotechnical assessment	To enable the progression of the principles of foundation design for the proposed development and to identify any abnormalities associated with such, eg a requirement for ground improvement.

The cost of the above investigation is anticipated to be in the range of £36,500 to £38,500 excl VAT. Note that this cost does not include professional fees (eg for reporting/enhanced qualitative risk assessment) or for undertaking a QRA.

Appropriate revisions will then be made to the risk assessment and recommendations made with regard to remediation, health and safety, building design criteria and waste disposal options. This would ultimately allow the acquisition and redevelopment to proceed on a more assured basis.

Although the scope of the above investigation is considered comprehensive for a site of this size and nature, the requirement for further investigation cannot be entirely ruled out. For example, unexpected ground conditions may require additional assessment in one area of the site, further footprint specific landgas monitoring may be required for detailed landgas design, the development layout may be altered from that currently proposed or varied to include additional features such as landscaping. In such circumstances, it may be necessary to undertake some limited further investigation.

### 8.3 Redevelopment Considerations

For the proposed redevelopment of the site, there are several aspects that require consideration as discussed below.

- It is likely given the risk ratings, in particular relating to historical usage of the site and surrounding areas, that the intrusive investigation will identify areas of soil that may be considered as unacceptable. The results of any ground investigation may indicate that remediation of the soils and groundwater are required. Such remediation should reflect the proposed end use development of the site although for the purposes of this report this has been detailed as being of an industrial nature with no landscaping/soft cover. Additionally, and following with

current industry best practice, a quantitative risk assessment (QRA) should be considered to detail both the baseline risks and also the scope of any remedial activities. This has significant cost and programme advantages in that it essentially prevents 'over remediation' of the site.

The desk top study has identified that the site may be contaminated by a wide range of residues resulting from infilling on site. The scope of any remedial activities are to a large extent controlled by the treatability of the contaminants such that on site techniques (eg soils washing, bioremediation) can prove more cost effective than off-site disposal. However, any remediation on the site would require consideration in light of the area context, recognising that the site is unlikely to present the sole source of contamination in the area.

With relation to the final development, it is indicated by the London Borough of Havering that there will be a need to effect 'mitigation' measures into the design of the buildings. Such mitigation measures would include for landgas protection and similarly with any landscaping if such should be incorporated.

- Any removal and disposal of soil arisings and/or groundwater from site during future development i.e. removal of hardstandings, installation of services, should be undertaken in a controlled manner to a licensed facility with due regard to current Duty of Care responsibilities. The disposal of sub-soil associated with construction activities may attract landfill premiums. As such, arisings from foundations, regarding, etc should be minimised where practicable. These arisings will require detailed chemical classification for waste disposal purposes by the developer/contractor undertaking the work.
- An appropriate high degree of Health, Safety and Welfare provision should be incorporated into the works in order to protect site workers, the general public and other sensitive receptors.

## SKETCHES

# **APPENDIX A**

## **REPORT CONDITIONS**

## WHITE YOUNG GREEN ENVIRONMENTAL

## APPENDIX A - REPORT CONDITIONS

## GROUND CONTAMINATION DESK TOP REVIEW

*This report is produced solely for the benefit of **Novera Energy Ltd**. No liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.*

*This report refers, within the limitations stated, to the condition of the site at the time of the inspections. No warranty is given as to the possibility of future changes in the condition of the site.*

*This report is based on a visual site inspection, reference to accessible referenced historical records, information supplied by those parties referenced in the text and preliminary discussions with local and Statutory Authorities. Some of the opinions are based on unconfirmed data and information and are presented as the best that can be obtained without further extensive research. Where ground contamination is suspected but no physical site test results are available to confirm this, the report must be regarded as initial advice only, and further assessment should be undertaken prior to activities related to the site. Where test results undertaken by others have been made available these can only be regarded as a limited sample. The possibility of the presence of contaminants, perhaps in higher concentrations, elsewhere on the site cannot be discounted.*

*Whilst confident in the findings detailed within this report because there are no exact UK definitions of these matters, being Gateway to risk analysis, we are unable to give categoric assurances that they will be accepted by Authorities or Funds etc. without question as such bodies often have unpublished, more stringent objectives. This report is prepared for the proposed uses stated in the report and should not be used in a different context without reference to WYGE. In time, improved practices or amended legislation may necessitate a re-assessment.*

*The report is limited to those aspects of land contamination specifically reported on and is necessarily restricted and no liability is accepted for any other aspect especially concerning gradual or sudden pollution incidents. The opinions expressed cannot be absolute due to the limitations of time and resources imposed by the agreed brief and the possibility of unrecorded previous use and abuse of the site and adjacent sites. The report concentrates on the site as defined in the report and provides an opinion on surrounding sites. If migrating pollution or contamination (past or present) exists further extensive research will be required before the effects can be better determined.*