

**Proposed Development of Land at A259
New Road / Brook Lane, Rustington
Phase 1 Ground Condition Assessment**

On behalf of **Commercial Development Projects Ltd**



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	Name	Position	Signature	Date
Prepared by:	Charlotte Totterdell	Graduate Engineer		15/01/15
Reviewed by:	James Godfrey	Senior Engineer		15/01/15
Approved by:	Paul Jeffery	Senior Associate		15/01/15
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved

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1 Introduction

1.1 Background

Peter Brett Associates LLP (PBA) has been instructed by Commercial Development Projects Ltd (the Client) to undertake a Phase 1 Ground Condition Assessment for land at A259 New Road / Brook Lane, Rustington, West Sussex.

This report presents a Phase 1 ground condition assessment comprising a desk study, site walkover, Tier 1 preliminary qualitative contamination risk assessment and a preliminary ground stability appraisal.

This report has been prepared to support a planning application for the commercial development of the site.

It should be noted that the Phase 1 is a land condition assessment and does not purport to be an ecological, flood risk or archaeological survey and additional specific surveys may be required to support a planning application. These assessments have been carried out by other consultants. Guidance on the use of this report is provided in Section 7.

1.2 Objectives

The objective of the Phase 1 is to identify the likely ground conditions and environmental setting which might have associated environmental liabilities or which may affect redevelopment of the site.

1.3 Scope of Work / Terms of Reference

The primary aim of this assessment is to meet the requirements of the National Planning Policy Framework (NPPF) Clauses 120, 121 and 122. Under the definition 'Site Investigation Information' given in the NPPF glossary page 56, the Phase 1 Desk Study and contamination risk assessment is the minimum requirement under the NPPF to support any planning application on a site that might be potentially affected by contamination. Similarly, a desk study and site reconnaissance is the minimum information that should be provided for a site potentially at risk from ground instability.

Guidance on ground condition assessment is given in CLR 11 Model Procedures for the Management of Contaminated Land (EA, 2004), which sets out a process based on a tiered risk assessment with increasing level of detail required to progress through the tiers. 1.3.4

This report presents the findings of the study together with a qualitative assessment of any hazards and constraints posed by the existing ground conditions to the proposed development.

It should be noted that the Phase 1 is a land condition assessment and does not purport to be an ecological, flood risk or archaeological survey and additional specific surveys may be required to support a planning application.

1.4 Site Location and Setting

The site is located about 1.5km to the north of Rustington Village Centre and is centred at National Grid Reference (NGR) TQ 05213 03416. A site location plan is presented as **Figure 1**.

The site is situated immediately to the south of the A259 New Road with the South Coast Main Line railway forming the southern site boundary. Agricultural land and a golf course lie immediately to the north of the A259 and to the south of the railway line is a mixed commercial, industrial and residential area.

The subject site occupies approximately 2.94 hectares (ha) and largely comprises unmanaged grassed fields accessed from Brook Lane, which runs between the fields from north to south, and the A259 New Road on the northern boundary of the site.

1.5 Proposed Development

According to the proposed Site Plan (Add Architects Ltd, 2014 reproduced in **Appendix 1**) the proposed development will include two commercial units comprising ground floor space of 1,022sqm and 581sqm. The units are located towards the northern site boundary with further provision for 196 parking spaces, a new access junction on Brook Lane, a cycle path and associated soft landscaping.

1.6 Methodology and Report Format

The PBA methodology for ground condition assessment is presented in **Appendix 2**.

The underlying principle is the evaluation of *pollutant linkages* in order to assess whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements:

- A source of contamination or hazard that has the potential to cause harm or pollution;
- A pathway for the hazard to move along / generate exposure; and
- A receptor which is affected by the hazard.

For each potential pollutant linkage identified the risk is estimated through consideration of the magnitude of the potential consequences and the likelihood or probability of an event occurring.

This report is divided into chapters identifying potential sources (hazard identification), potential pathway and receptor identification and risk estimation and assessment.

1.7 Sources of Information

The following sources of information were used in the preparation of this report:

- Landmark Information Group (Landmark 2014) were commissioned to provide historical maps and environmental setting data searches (Envirocheck report), and this information is presented in its entirety in **Appendix 4**;
- PBA walkover inspection – photographs are presented in **Appendix 3**;
- BGS Geology Map held by PBA;
- Borehole Logs held by the British Geological Society (BGS) as accessed via their website, www.bgs.ac.uk/data/boreholescans/home.html. Where logs have been referred to they have been included in their entirety in **Appendix 5**;
- Ground stability information was obtained from the Natural Cavity and Artificial non-coal (underground) mining cavity databases managed and enhanced by Peter Brett Associates LLP (PBA);

- Environment Agency web site "What's in Your Back Yard?", <http://maps.environment-agency.gov.uk>;
- Magic web site, <http://www.magic.gov.uk>; and
- Third Party Reports for adjacent site (Card Geotechnics, 2007).

1.8 Third Party Reports

As part of this Phase 1 assessment reference has been made to Card Geotechnics (2007) Preliminary Geotechnical and Geo-environmental Interpretive Report (reference CG/4604), which is in the public domain on the Arun Planning Portal (www.arun.gov.uk). The Report is for a site located immediately to the east of the subject site boundary. The assessment included a preliminary Phase 1 Desk Study and Phase 2 Intrusive Investigation.

The Phase 1 desk study did not reveal any significant potential for contamination at the neighbouring site, however there were concerns that the site may have been used for the disposal of arisings and waste construction materials during the construction of the A259 road immediately to the north, and as such a Phase 2 investigation was commissioned for the site.

The site investigation included 15No. trial pits across the site with associated limited contamination testing and California Bearing Ratio (CBR) tests. The findings of the investigation are discussed in Section 3.2.

2 Land Use Information

2.1 Introduction

This section presents a summary of current and historical land uses on and immediately adjacent to the site. Land use is used to inform the hazard identification element of the risk assessment.

The current land use information is based on a walkover inspection undertaken by PBA on the 4th November 2014. Photographs taken during the site walkover (Plates 1 to 10) are presented in **Appendix 3**. The historical land use information is based on Ordnance Survey maps and aerial photography provided by Landmark and is presented in **Appendix 4**.

Particular attention is given to potentially contaminative land uses or evidence of land instability within or adjacent to the site boundary. The main features noted during the site walkover are marked on the Site Layout Plan (**Figure 2**).

2.2 Current Land Use

2.2.1 On-Site

The site covers an area of approximately 2.94ha and comprises two fields, hereinafter referred to as Field A and Field B, which are divided by the northern section of Brook Lane. Field A is to the west of Brook Lane being an approximately 0.3ha triangular parcel of land and Field B approximately 2.6ha, roughly rectangular field to the east. Field A is accessed from the east from Brook Lane and Field B is accessed from the north via the A259 New Road.

Currently both Fields A and B are unmanaged open grassed land with a mix of wooden fencing and wire fencing around the boundaries of the fields, with the exception of the eastern boundary of Field B which has no fencing.

The relative topography of Field A could not be determined due to the overgrown vegetation, although it is expected to be relatively flat and level. Across some areas of Field A, surface water ponding was evident.

Field B slopes from the north to the south, towards the Rustington Stream. An area of surface water ponding was present along the western boundary of Field B at the time of the site walkover.

2.2.2 Off-Site

The site is bounded by the A259 (New Road) to the north with a golf course and arable agricultural fields beyond. The South Coast Railway Line forms the southern boundary, beyond which are commercial and industrial warehouses (used for storage and distribution), allotments and residential dwellings.

Immediately to the east is an arable field; however this area has recently gained planning permission for three commercial units (Arun District Council planning reference A/125/13/). Preparatory earthworks for the development were evident at the time of the site walkover. A 2m high bund had been created along the northern boundary of the field from earth from across the site. The precise purpose of such bund is unknown and could purport to be temporary soils storage.

To the immediate west of the subject site is a small arable field, giving way to commercial greenhouses and residential dwellings.

2.3 Summary of On-Site Historical Land Use

Available historical Ordnance Survey (OS) mapping as presented in **Appendix 4**, from 1876 to 2013 show the site as undeveloped and assumed agricultural land, however the on-site field boundaries have changed over time.

- The earliest available OS map (1879) marks the watercourse (Rustington Stream) that runs from the east of the site flowing in a westerly and north-westerly direction. The watercourse forms the southern boundary and runs adjacent to the southwestern and western site boundary. An area of marshy ground is marked within the southeast corner of the site.
- The 1879 OS map shows the site as being divided from the northwest to the south east, however this boundary line is not present on the 1912 OS map, when the site is incorporated into a single larger field extending east to South Road.
- By 1932, the site is divided by a tree lined field boundary running north south with the site forming part of larger fields that extend to the north. The area of marshy ground is reduced and confined to the land between the watercourse and the railway line.
- Brook Lane is marked on the OS map dated 1993. It is understood to have been constructed between 1989 and 1993 at the same time as the A259. No further land use changes were identified on-site up to the most recent map (1995).

2.4 Summary of Off-Site Historical Land Use

- The earliest available OS map (1879) shows that the site is located in an agricultural setting with fields surrounding the site on all sides and the South Coast Railway Line immediately to the south. Ham Manor is located 500m northeast of the site.
- The OS map dated 1899 shows a brick works marked some 200m south of the site boundary along with a "brick field". The 1913 OS map shows the brick works have been relabelled as "brick and tile works", and the brick field has been extended north and now lies 90m to the south of the site boundary. A nursery is marked approximately 450m southeast of the site.
- The 1932 OS map shows residential dwellings, brick fields and nursery's some 500m to the south of the site. By 1943 the brick works and brick fields are shown to have been redeveloped into residential dwellings. A nursery is marked some 70m to the south of the site boundary.
- By 1976, the OS maps show development has reached the South Coast Main Line. Commercial and Industrial warehouses are adjacent to the south of the railway line with residential dwellings surrounding these to the south and east. A large nursery is situated 600m to the southwest of the site as shown on OS mapping from 1977 to 2006.
- The 1993 mapping shows the development of the A259 New Road adjacent to the north of the site and Brook Lane which now separates the western portion of the site.

3 Environmental Setting

3.1 Introduction

3.2 Geology – Published Information

3.2.1 BGS Geological Map

The 1:50000 British Geological Survey (BGS) geology map (Sheet 317/332 Chichester and Bognor), indicates the following sequence of strata in the local area:

- Superficial – Drift deposits including Raised Beach Deposits, Alluvium and Aeolian Deposits. Alluvium outcrops at the surface across the entire site footprint, with the exception of the far western corner of the site which is shown to be underlain by Raised Beach Deposits (where the alluvium is shown to be absent). The Aeolian Deposits are present at the southern boundary of the site. The Alluvium is described as clays, silts and sands locally organic with gravels. The Raised Beach Deposits are described as sands and gravels. The Aeolian Deposits are described as silts and gravels.
- Bedrock – New Pit Chalk Formation (formally designated as being the Middle Chalk Formation) described as principally blocky, white firm to moderately hard chalk with many thin marl beds. The stratum is of Cretaceous Age and is shown to directly underlie the Superficial Deposits within the site area.

3.2.2 BGS Borehole Records

The BGS' web-hosted 'Onshore borehole records' database contains records of 9 boreholes within 250m of the site boundary. The locations of the closest boreholes are shown on **Figure 2** with copies of selected borehole logs presented in **Appendix 5**.

The borehole records show that the area is underlain with topsoil of typically around 0.3m thickness. Five of the boreholes, TQ00SE52, 53, 55, 57 & 58 prove soft to very soft Alluvium to depths of between 2.5m and 5.7m below ground level (bgl). The alluvium is directly underlain by Chalk proven to borehole termination depths of between 5.5 mbgl and 14.7 mbgl.

Boreholes TQ00SE54 & 59 proved soft to firm "Brickearth" considered to be associated with the Aeolian Deposits to 1.5 mbgl, underlain by the New Pit Chalk Formation.

The nearby BGS borehole records appear to confirm the anticipated published geology in the area surrounding the site of Alluvium or Aeolian Deposits overlying the New Pit Chalk Formation.

Groundwater strikes recorded by the BGS logs indicate that there are two groundwater bodies. A shallower perched groundwater body was encountered within the granular Alluvium at depth between 1.0 mbgl and 1.8 mbgl, assumed to be flowing towards the west. A deeper groundwater body within the Chalk strata was encountered between 2.1 mbgl to 4.5 mbgl, assumed to be flowing towards the south or southwest.

3.2.3 Third Party Reports

The Card Geotechnics Investigation (2007) comprised the excavation of 15 trial pits on a site immediately to the east of the proposed development. The following sequence of strata were identified:

- Topsoil recorded as Made Ground across the site between 0.4m and 0.8m thickness.

- The topsoil was reportedly underlain by "Brickearth" at thicknesses of between 0.4m and 1.7m across the majority of the site with the exception of the far southeast corner, described as being *soft to firm yellow/orange brown slightly sandy clay*.
- The topsoil in the southeast corner is directly underlain by Alluvium between 0.9m and 1.2m in thickness, described as being *soft black silty clay containing plant debris*.
- In Trial Pit TP6 the "Brickearth" is underlain by a 2.4m thickness Raised Beach Deposits, being described as *medium dense yellow/orange fine to coarse sand*.
- The New Pit Chalk Formation underlies the entire site at depth. The top of the strata was encountered at depths between 1.0 mbgl and 3.8 mbgl. The chalk is recorded as 'Decomposed Chalk', described as small angular blocks of Chalk set within a matrix of deeply weathered Chalk. The Chalk is described as moderately weak to moderately strong, friable and rubbly Chalk with closely spaced open joints. Generally the Chalk was encountered closest to the surface in the west of the site (typically less than 1 mbgl), and at depths greater the 2 mbgl in parts of the north and northeast of the site.
- Groundwater was encountered within the Chalk Formation only at depths of between 1.8 mbgl and 4.5 mbgl, typically at greater depth towards north of the site and is assumed to flow in a southerly direction.
- 15No. soil samples were tested for contamination. The results of the contamination testing did not reveal any potential contaminants that exceeded their respective guideline values at the time of the investigation.
- CBR tests were carried out on soil samples from trial pits TP6, TP8 and TP10, which indicated CBR values of between 0.89% to 3.20%.

3.2.4 Summary of Expected On-Site Geology

On the basis of the information reviewed it is likely that some parts of the site are underlain by Alluvium, especially along the southern site boundary along the course of Rustington Stream. Remaining parts of the site, away from the southern boundary are likely to be underlain by Aeolian Deposits and possibly by Raised Beach Deposits overlying the New Pit Chalk Formation.

3.3 Naturally Occurring Geological Hazards

An assessment of potential geological hazards that may give rise to instability or adverse foundation or construction conditions as supplied by the British Geological Survey (BGS) from their National Geoscience Information Service (NGIS) are presented in the Envirocheck Report reproduced in **Appendix 4**. The generic assessment is generated automatically based on digital geological maps and the scope and the accuracy is limited by the methods used to create the dataset and is therefore only indicative for the search area.

The information contained in the Envirocheck Report has been reviewed and where considered necessary reassessed considering the specific information available for the site. The modified assessment of the potential for geological hazards to be present on the site is summarised in **Table 3.1** below.

Table 3.1 Summary of Geological Hazards from Envirocheck Report

Hazard	BGS-NGIS Assessed Hazard Potential	PBA Assessment
Coal Mining Affected Areas	Might not be affected	Agree
Collapsible Ground Stability Hazards	Very Low	Agree
Compressible Ground Stability Hazards	Moderate	Agree
Dissolution Hazard	Very Low	Agree
Landslide Ground Stability	Very Low	Agree
Running Sand	Very Low	Agree
Shrinking or Swelling Clay	Very Low	Agree

PBA would generally agree with the above assessments indicating that the site has a very low potential for being affected by the majority of geological hazards. The exception to this is the potential for being affected by compressible ground stability hazards due to the site being predominately underlain by low strength Alluvium which may be compressible under loading

Further discussion on the “compressible ground stability hazards” is given in Section 5.2.

3.4 Radon

The Envirocheck Report indicates the site is located in an area where ‘no radon protection measures are required for the construction of new dwellings or extensions’.

3.5 Natural and Non-Coal Mining Cavity Records – Cavity Searches

A search of the PBA Natural and Non-Coal Mining Cavities Databases indicates that there are no known cavity locations within 1000m of the site boundary.

The Envirocheck Report details four ceased mineral sites within 500m of the site boundary. The four sites were open cast mines of River Terrace Deposits. The closest site is 213m to the south of the site boundary.

3.6 Landfill Records

The Envirocheck Report has identified two historical landfill sites: Penfold Lane located 57m to the west of the site; and Norway Farm located 829m west of the site boundary.

- Penfold Lane received waste that included “inert, commercial and household” materials. The site first received waste in December 1945 and last received waste in December 1955. During the walkover, the Penfold Lane landfill was inspected. The site was observed to be grassed and level, measuring some 40m by 120m. A residential development is located adjacent to the south of the landfill area understood to be constructed in the 1990’s.
- Norway Farm contained received waste that included “industrial and special waste”. The site first received waste in December 1950 and last received waste in December 1960.

3.7 Contemporary Trade Directory

According to Envirocheck Report there are 41 active contemporary trade directory entries within 1km of the site. There is one fuel station within 1km of the site which is located 293m to the south of the site boundary.

3.8 Substantiated Pollution Incidents

One substantiated pollution incident is recorded some 478m to the southeast of the site. This is recorded as Category 2 (Minor Impact) to water in September 2009, by 'Crude Sewage'.

3.9 Sites Determined as Contaminated Land under Part 2A

There are no contaminated Land Register Entries or Notices within 1km of the site boundary.

3.10 Controlled Waters - Groundwater

The following **Table 3.2** summarises information recorded in the Envirocheck Report and from a review of geological conditions (Section 3.2 above) regarding hydrogeology and groundwater vulnerability.

Table 3.2 Summary of Hydrogeology and Groundwater Vulnerability Related Information

Item	Details
Aquifer Classification	Bedrock (Middle Chalk) – Principal Aquifer Superficial (Alluvium) – Secondary A Aquifer
Depth to Groundwater	Based on BGS records and SI information adjacent to the site, likely depths to groundwater are as follows: Possible perched groundwater in the Alluvium at 1.0-1.8 mbgl and within the New Pit Chalk Formation at 2.1-4.5 mbgl.
Groundwater Flow Direction	Presumed to be flowing to the south within the deeper New Pit Chalk Formation towards the English Channel and to the west within the alluvium, in the direction of the Rustington Stream
Source Protection Zone (SPZ)	The site is not located within a Groundwater Source Protection, Zone (SPZ) however a Zone 3 (Total Catchment) is located 664m to the south of the site boundary, with a Zone 1 (Inner Protection Zone) located some 780m to the south of the site.
Groundwater Abstraction	Eleven groundwater abstractions are recorded within 2km of the site. The closest abstraction is identified 706m to the northeast of the site for Spray Irrigation at Ham Manor Golf Club.

3.11 Controlled Waters - Surface Water

The following **Table 3.3** summarises the information recorded in the Envirocheck Report regarding hydrology.

Table 3.3 Summary of Surface Water Related Information

Item	Description
Name	Rustington Stream flows westerly along the south boundary and crosses the site and continues in a northwest direction. This water course is a tributary of Black Ditch which it joins some 500m to the northwest of the site boundary.
Quality	Unknown
Abstraction	Six surface water abstractions are recorded within 2km of the site. The closest abstraction is identified 790m to the northeast of the site used for spray irrigation (golf courses).
Pollution Incidents	See Section 3.8
Discharge Consents	None recorded on-site. Seven records within 250m of the site boundary. One remains effective for surface water discharge 73m southwest. A sewerage discharge is present 373m to the west of the site.
River Flood Risk *	The southern half of the site adjacent to the onsite watercourse is within Flood Zone 2.
Groundwater Flood Risk*	Unknown
* The scope of this report does not include a flood risk assessment.	

3.12 Ecological Systems

The site is in the outer buffer of two Site of Special Scientific Interest (SSSI) Impact Risk Zones. The SSSI's are Arundel Park located 5.1km to the northwest and Climping Beach located 3.8km to the southwest of the site.

It should be noted the statement regarding ecological systems does not purport to be an ecological risk assessment. The presence of a protected species (if applicable) requires a site specific survey and is outside the scope of this report.

4 Tier 1 Preliminary Risk Assessment

4.1 Introduction

The methodology developed and adopted by PBA for the assessment of ground conditions is presented in **Appendix 1**. In accordance with guidance presented in CLR 11 (EA Model Procedures for the Management of Land Contamination) we adopt a staged approach to risk assessment and this report presents a preliminary Tier 1 assessment.

The underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences.

4.2 Conceptual Site Model

The Tier 1 Preliminary Risk Assessment includes the development of a conceptual site model (CSM). The CSM describes the types and locations of potential contamination sources, the identification of potential receptors and the identification of potential transport/migration pathways.

For a pollutant linkage to be identified a connection between all three elements (source-pathway-receptor) is required.

4.3 Geoenvironmental Hazard Identification

4.3.1 On-site and Off-site

The site is currently an unmanaged grassed field, and historical map information suggests it has never been developed or used for anything other than agriculture. Current or historical potential sources of contamination were not identified on-site. There is potential that the site is underlain by Alluvium Deposits at anticipated thickness of between 2.0m to 4.0m, which could pose a risk of land gas.

Surrounding adjacent land-uses include residential, agricultural and commercial.

The historical landfill 57m to the southwest of the site could pose a potential source of contamination, however the landfill last received waste around 60 years ago, and it is therefore unlikely to be actively gassing. In addition, it is located off-site, on the far side of a water course and it is not anticipated to be hydraulically up gradient of the site. It is therefore unlikely that there are any plausible significant transmission pathways for ground gas or contaminated groundwater to reach the subject site and as such the landfill is considered to pose a very low risk to the proposed development.

Potential sources of contamination associated with the warehouse and distribution units on the south site of the railway line were not identified; the units being predominately used for storage and distribution. The units are also hydraulically down gradient of the site and on the opposite side of Rustington Stream. As such it is considered unlikely that any plausible significant transmission pathways would be active between the industrial estate/railway line and the subject site.

It is likely that Alluvium is present within the site boundary, especially in the south of the site along and adjacent to Rustington Stream. There is a potential for naturally occurring ground gases associated with decomposition of any organic rich materials within this strata, and as such the presence of these should be investigated as part of any future investigations.

Overall, the potential for contamination to be present based on the past and present site use is assessed as classification score '1'; Very Low (see Table 1, **Appendix 1**).

4.4 Hazard Assessment and Risk Estimation

From the Tier 1 assessment there is considered to be a very low risk of potential human health and controlled water hazards associated with the on-site ground conditions. Potential pollutant linkages have not been identified because no on-site or feasible off-site potential significant sources of contamination have been identified from the Tier 1 assessment.

Based on the known current and historical land uses, the overall potential for significant or widespread contamination to be present on the site is considered to be **Very Low**. Based on the available information on ground conditions, the potential for any deleterious material producing hazardous ground gases to be present is also considered to be **Very Low**.

It is anticipated that the risks to human health arising from naturally occurring ground gases in the alluvium beneath the site will be **Low to Moderate**, and it is anticipated (subject to testing) that any confined spaces may require gas protection measures and/or passive ventilation.

4.5 Risk Evaluation

Possible pollutant linkages are determined using professional judgement. If a linkage is considered possible, it is considered that this represents a potentially 'unacceptable risk' and therefore requires further consideration. This may be through remediation or mitigation or through further tiers of assessment.

4.6 Confidence and Uncertainty

Based on the known current and historical land uses, the overall potential for significant or widespread contamination to be present on the site is considered to be **Very Low**. Based on the available information on ground conditions, the potential for any deleterious material producing hazardous ground gases to be present is considered to be **Low to Moderate**.

5 Preliminary Geotechnical Appraisal

5.1 Introduction

National Planning Policy Framework (NPPF) Clause 121 requires an assessment for a site potentially at risk from ground instability. The aspects considered with regards to ground instability are related to:

- Natural and Artificial Cavities
- Adverse Foundation Conditions

Consideration is given below to the risk of these potential causes of instability arising from existing ground conditions across the site, as identified by the data review. Comments are also provided on likely development requirements to mitigate ground conditions. As this geotechnical appraisal has been based on publically available information obtained as part of a desk based data collection the comments made herein should therefore be considered as preliminary.

5.2 Natural and Artificial Cavities

The PBA Natural Cavities and Mining Cavities (Non-Coal) databases contain no records within 1km of the site centre.

The database and published records reviewed during the desk study works have identified no known records of coal or non-coal mining activity in this general locality and the Envirocheck Report does not identify the site to be within a coal mining affected area.

While there are no records pertaining to natural or mining cavities within the site footprint, we would draw your attention to the fact that the absence of existing records for the site should not be considered as conclusive.

The BGS-NGIS hazard assessment for soluble rocks within the site boundary is classed as Very Low within the Envirocheck Report. PBA consider that there may be a dissolution hazard potential owing to the presence of the underlying chalk which can be susceptible to dissolution and the formation of solution features such as swallow holes or sink holes.

However, since the New Pit Chalk Formation is described as being marly and generally less susceptible to dissolution, and because there is anticipated to be a notable thickness of low permeability alluvium or brickearth overlying the chalk, it is not expected that the on-site ground conditions are likely to have promoted the development of solution features through the concentration of infiltration of surface water; and as such the hazard potential is assessed by PBA as Low.

5.3 Site Preparation

It is considered that the site is likely to be underlain by potentially soft compressible soils with relatively high ground water levels. The full extent, thickness and nature of the strata, and groundwater conditions at the site have not been determined at the current time. In due course this information, particularly within the superficial deposits, will be required to inform detailed foundation and infrastructure design.

5.4 Structural

It is recommended that a detailed structure specific ground investigation is undertaken prior to development to confirm the ground conditions and the level of geohazards (compressible alluvial soils and natural cavity risk) in order to determine the most appropriate foundation solution for each structure.

5.4.1 Foundations

In general, the type and capacity of foundations adopted for this site will be dependent on the soil structure interaction i.e. load, size and spacing of the footings, the stiffness of the soil and tolerances of the structure to settlement, particularly differential settlement.

Foundation design may also be influenced by the potential for geohazards in the form of weak/ soft and/ or compressible deposits (alluvial soils) where present. Where these geohazards are present then foundations will need to be deepened to found upon suitable bearing strata.

The shallow soft Alluvium that is expected to underlie parts the site is not considered to be suitable as a founding stratum for conventional shallow spread foundations, and with a potentially variable thickness of up to circa 4.0m, to reach a more competent formation (New Pit Chalk Formation), it is possible that conventional spread foundations taken down will not be practical or economical to construct. Similarly, heavily loaded structures, wide span or settlement intolerant, may require an alternative foundation solution.

Therefore it is possible that piled foundations or some form of ground improvement system will be required on the site. Piled foundations into the underlying chalk could be an option, although this is likely to be a more costly option than ground improvement although this will depend on the size and loads of the structures being proposed. Recognition of the varying weathering profile of the chalk deposit should be determined such that appropriate pile design can be made. This should be completed in line with CIRIA Report C574 Engineering in Chalk (CIRIA 2002).

Therefore It is likely that structure specific ground investigations will be required to determine the actual ground conditions beneath the proposed structures. In the unlikely event that a tangible solution risk is present then the typical foundation types needed to overcome any potential instability may include a grillage of ground beams or a raft. For large scale features ground stabilisation may be necessary.

5.4.2 Floor /Ground Bearing Slabs

Based on the nature of the ground conditions encountered at the site ground bearing floor slabs are unlikely to be suitable for the anticipated structures on this site, owing to the likely differential settlement issues associated with the variable consistency cohesive alluvial deposits

In areas of any proposed fill, ground bearing floor slabs could be adopted on engineered fill; however, NHBC requirements state that suspended slabs are required where fill thicknesses of greater than 600mm are present.

Organic rich alluvial soils may also be encountered within the south of the site adjacent to Rustington Stream. Localised removal of any organic rich Made Ground or organic alluvial soils if of limited depth may be feasible will mitigate the risk of potential geohazards and land gas generation. However it should be recognised that given the potential for land gas to be present albeit recognised as potentially being a low risk, it is recommended that monitoring of land gas should be undertaken in accordance with current guidance, notably, CIRIA C665 (2007) which suggests that a minimum of 6 visits over a three month period should be undertaken as a minimum data set, subject to inclusion of low pressure atmospheric conditions, such that the risk to the development can be further assessed and an appropriate

degree of land gas protection be afforded to the development, designed in accordance with the principles of BS 8485 (2007) and BS 5925 (1991).

5.5 Pavement Design

It is anticipated that there will be areas of road pavement and hardstanding at the site related to the proposed development. The weather and seasonal conditions prevailing at the time of construction will affect the California Bearing Ratio (CBR) of the sub-grade soil and its strength, although standard forms of road construction are likely to be appropriate subject to appropriate CBR testing.

5.6 Excavations and Dewatering

Excavation of natural soils across the site is likely to be possible during the ground works using conventional excavation plant. It is likely that the anticipated relatively soft alluvial deposits may be present at depths well in excess of 3m bgl and any excavations are likely to require temporary support.

Shallow groundwater within the alluvium is expected to be present at depths around 1.0 – 1.5 mbgl across the site based on the findings of the previous investigations on the adjacent land. Therefore, groundwater control measures may be required in excavations across parts of the site.

Any excavations should be adequately supported in accordance with the Health and Safety at Work Act.

5.7 Infiltration Drainage

It is probable that the underlying New Pit Chalk Formation is fully saturated and that the ground conditions underlying the site will therefore be unsuitable for infiltration drainage.

6 Conclusions and Recommendations

6.1 Conclusions

The site appears to have been largely undeveloped; and the land surrounding the site has a predominantly historical agricultural usage, with the exception of brickfields and brick manufacture to the south and some localised historical landfilling. The land to the north of the site is predominately agricultural land use and a golf course. The land to the south of the site is occupied by residential dwellings, allotments and commercial storage and distribution warehouses.

From the Tier 1 assessment there is considered to be a Very Low risk of potential human health and controlled water hazards associated with the on-site ground conditions. Potential pollutant linkages have not been identified with no on-site or feasible off-site potential sources of contamination identified from the Tier 1 assessment.

The site is not likely to be determined as Contaminated Land under Part 2A of the Environmental Protection Act (1990).

On the basis of the geological, hydrogeological and geomorphological conditions at the site location it appears that the potential for solution feature formation within the chalk surface at the site is Low.

6.2 Recommendations

The study has identified a potential low contamination risk and ground gas production. It is recommended that intrusive ground investigation works are not considered necessary in support of a planning application.

It is however recommended that a Phase 2 ground investigation is undertaken at the site in advance of development to determine the ground conditions and provide site specific information to allow confirmation of the geoenvironmental risk assessment and provide geotechnical parameters for earthworks, foundation and infrastructure design. The scope of the ground investigation should include:

- Confirmation of the geological sequence and ground water conditions across the site area, including identification and delineation of areas of alluvial soils;
- Characterisation of the various soil strata across the site, including compaction studies to enable development of an earthworks specification.
- Determination of the compressibility characteristics of the alluvial soils;
- Monitoring of groundwater conditions and the potential for ground gas production;
- Assessment of the geochemical and geotechnical properties of any near surface soils.
- Determination of the weathering profile of the chalk strata should deep foundation solutions be required.

7 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints they are described in the report text.

The opinions and recommendations expressed in this report are based on statute, guidance, and best practice current at the time of its publication. Peter Brett Associates LLP (PBA) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and the report should be returned to us and reassessed if required for re-use after one year from date of publication. Following delivery of the report PBA has no obligation to advise the Client or any other party of such changes or their repercussions.

Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third party data used. Historical maps and aerial photographs provide a "snap shot" in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the express written authorisation of PBA. Any such party relies upon the report at its own risk.

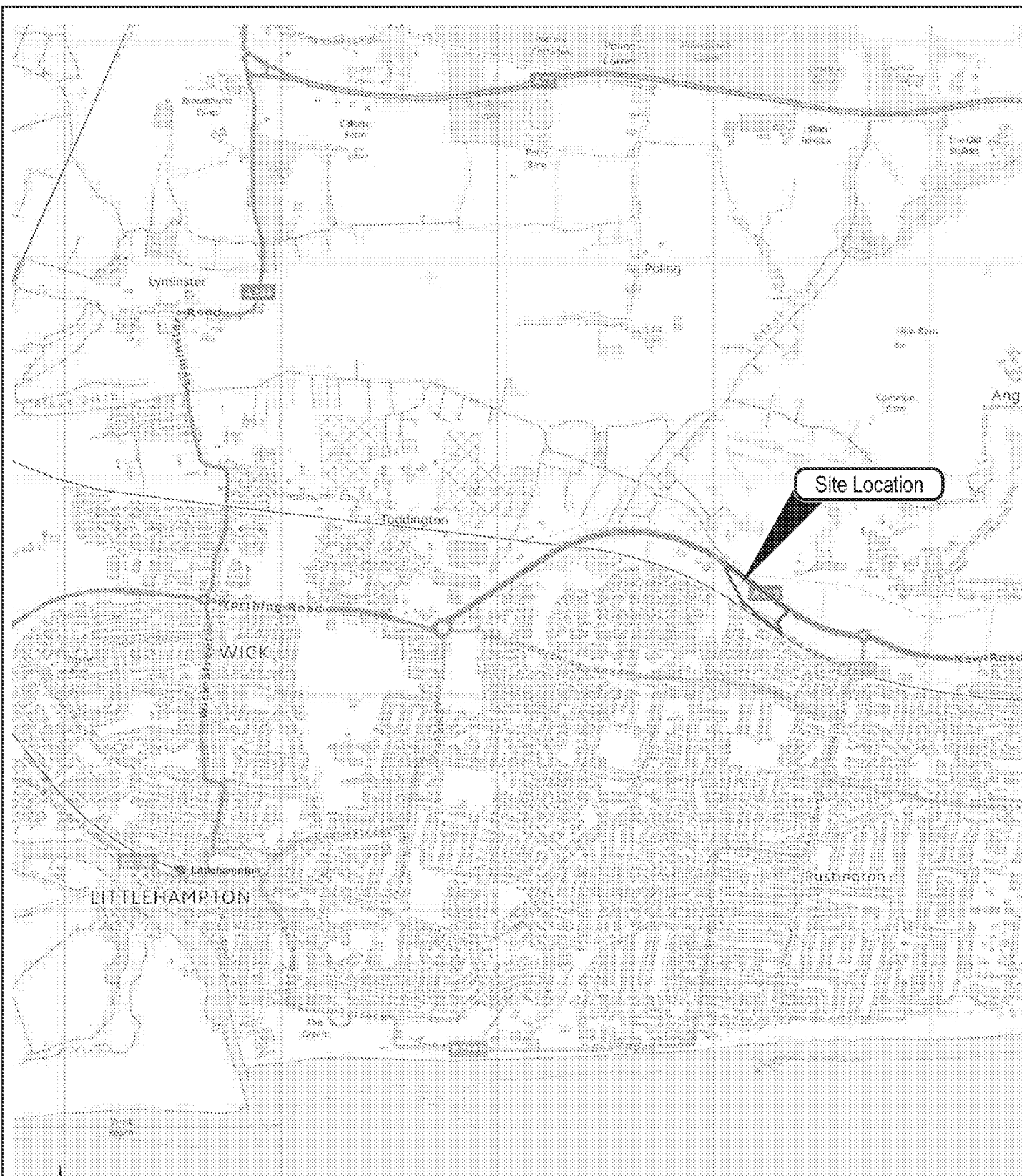
The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc, unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

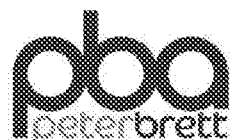
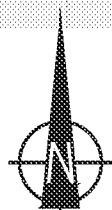
8 References

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FIGURES



 Approximate Site Boundary
 Site Grid Ref: TQ 052 034



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Client
**Commercial Development
 Projects Ltd**

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**LAND AT A259 NEW ROAD,
RUSTINGTON**

SITE LOCATION PLAN

Date	04.11.2014
Scale	1:25 000
Drawn by	davoo
Checked by	CT
Revision	0

FIGURE 1



LAND AT A259 NEW ROAD, RUSTINGTON

SITE LAYOUT PLAN

APPENDIX 1

PRELIMINARY
09/01/14

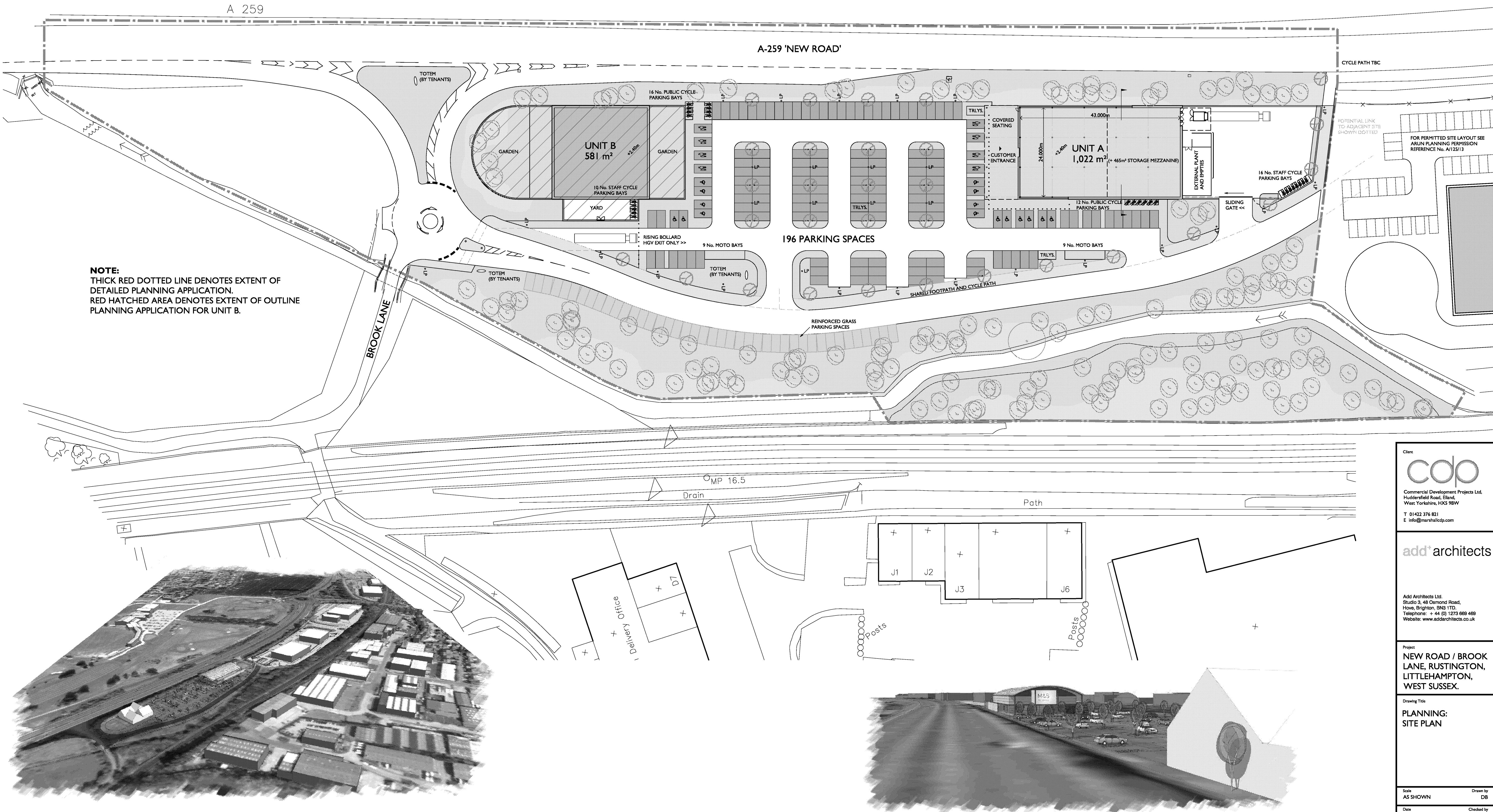
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Do not work from reduced scale drawings. Please refer to scale and sheet size as indicated.
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Revision, Date

1



AERIAL VIEW FROM THE WEST

SITE PLAN, 1:500@A1, 1:1000@A3

VIEW FROM A-259, TRAVELLING EAST

Client:
cdp
Commercial Development Projects Ltd.
Huddersfield Road, Eland,
West Yorkshire, HX5 9BW
T 01422 376 821
E info@marshalldcp.com

add* architects
Add Architects Ltd
Studio 8, 46 Osmond Road,
Hove, Brighton, BN3 1TD.
Telephone: + 44 (0) 1273 669 468
Website: www.addarchitects.co.uk

Project:
NEW ROAD / BROOK LANE, RUSTINGTON, LITTLEHAMPTON, WEST SUSSEX.

Drawing Title:
PLANNING: SITE PLAN

Scale AS SHOWN	Drawn by DB
Date OCT. 2014	Checked by HD
Drawing Number 1117-P-11	Revision -

APPENDIX 2

PBA Methodology for Assessment of Potentially Contaminated Land

1 Introduction

This document defines the approach adopted by PBA in relation to the assessment of potentially contaminated land in England. The aim is for the approach to (i) be systematic and objective, (ii) provide for the assessment of uncertainty and (iii) provide a rational, consistent, transparent framework.

When preparing our methodology we have made reference to various technical guidance documents and legislation referenced in Section 7 of which the principal documents are Contaminated Land Statutory Guidance (Defra 2012) the Model Procedures for the Management of Contamination (CLR 11) (EA 2004) Contaminated land risk assessment: A guide to good practice (C552) (CIRIA 2001) and the National Planning Policy Framework (DCLG 2012).

2 Dealing with Land Contamination

UK legislation aims to help address the problem of historic contamination of land and the risks it can pose to people's health, controlled water and the environment by determining if a contaminant linkage exists. This requires the three elements of receptor; pathway and source (hazard) to be present.

There are several ways in which land contamination can be addressed. For example, voluntarily where action is taken independently by landowners, when land is developed (or redeveloped) under the planning system, during the building control process using building regulations, or, forced remediation under the Part 2A regime. Other legislative regimes may also provide a means of dealing with land contamination issues, such as the regimes for waste, water, environmental permitting, and environmental damage. Further, the law of statutory nuisance may result in contaminants being unacceptable to third parties whilst not attracting action under Part 2A or other environmental legislation.

2.1 Part 2A

The Environment Act 1995 introduced Part 2A into the Environmental Protection Act 1990. Part 2A, its accompanying regulations and original Statutory Guidance came into force in England in April 2000. The legislation was extended in August 2006 to include radiological hazards.

Revised Statutory Guidance was issued April 2012. (Defra 2012) to clarify how the regime should operate. The guidance states that enforcing authorities should seek to use Part 2A only where no appropriate alternative solution exists.

Part 2A defines contaminated land as *"land which appears to the Local Authority in whose area it is situated to be in such a condition that, by reason of substances in, on or under the land that significant harm is being caused, or there is a significant possibility that such harm could be caused, or pollution of controlled waters is being, or likely to be, caused"*.

Harm is defined as *"harm to the health of living organisms or other interference with the ecological systems of which they form part, and in the case of man, includes harm to his property"*.

For the purposes of Part 2A, land is contaminated if it poses a significant possibility of significant harm (SPOSH).

Part 2A provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment, and under the guidance enforcing authorities should seek to find and deal with such land. It states that *"under Part 2A the starting point should be that land is not contaminated land unless there is reason to consider otherwise. Only land where unacceptable risks are clearly identified, after a risk assessment has been undertaken in accordance with the Guidance, should be considered as meeting the Part 2A definition of contaminated land"*. Further the guidance makes it clear that *"regulatory decisions should be based on what is reasonably likely, not what is hypothetically possible"*.

The overarching objectives of the Government's policy on contaminated land and the Part 2A regime are:

- "(a) To identify and remove unacceptable risks to human health and the environment.*
- (a) To seek to ensure that contaminated land is made suitable for its current use.*
- (b) To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development"*.

In accordance with the guidance, the enforcing authority may need to decide whether and how to act in situations where decisions are not straightforward, and where there is uncertainty. *"In so doing, the authority should use its judgement to strike a reasonable balance between: (a) dealing with risks raised by contaminants in land and the benefits of remediating land to remove or reduce those risks; and (b) the potential impacts of regulatory intervention including financial costs to whoever will pay for remediation, health and environmental impacts of taking action, property blight, and burdens on affected people"*. The authority is required to *"take a precautionary approach to the risks raised by contamination, whilst avoiding a disproportionate approach given the circumstances of each case"*. The aim is *"that the regime produces net benefits, taking account of local circumstances"*.

The guidance recognises that *"normal levels of contaminants in soils should not be considered to cause land to qualify as contaminated land, unless there is a particular reason to consider otherwise"*.

Normal levels are quoted as:

- "a) natural presence of contaminants' such as from underlying geology 'that have not been shown to pose an unacceptable risk to health and the environment*
- b) ...low level diffuse pollution, and common human activity..."*

Similarly the guidance states that significant pollution of controlled waters is required for land to be considered contaminated and the *"fact that substances are merely entering water"* or *"where discharge from land is not discernible at a location immediately downstream"* does not constitute contaminated land.

PBA Methodology for Assessment of Potentially Contaminated Land

The guidance considers four categorisations to establish if land is contaminated by either presenting an unacceptable risk to human health or significant pollution of controlled waters (Categories 1 and 2) or where not (Categories 3 and 4).

Category 1: *“unacceptably high probability, supported by robust scientific evidence, that significant harm or significant pollution would occur”*. These situations can arise where similar land or exposures are known or strongly suspected to have caused harm.

Category 4: *“no risk or that the level of risk is low”*. These situations can arise where no contaminant linkage is established or normal/background levels of contaminants are present, or where the exposure from soil is only a small proportion of what the receptors may be exposed to.

For land that cannot be readily placed into Categories 1 or 4 further assessment is required. If there is a sufficiently strong case that the risks are of sufficient concern to cause significant harm/pollution or have the significant possibility of significant harm/pollution the land is to be placed into Category 2. If the concern is not met land is considered Category 3.

The technical guidance clearly states that the currently published SGV and GAC's represent *“cautious estimates of level of contaminants in soils”* which should be considered *“no risk to health or, at most, a minimal risk”*. These values do not represent the boundary between categories 3 and 4 and *“should be considered to be comfortably within Category 4”*.

2.2 Planning

The Local Planning Authority (LPA) is responsible for the control of development, and in doing so it has a duty to take account of all material considerations, including contamination.

Section 11, Paragraph 109 of the National Planning Policy Framework (NPPF) (DCLG 2012) states the planning system should contribute to and enhance the natural and local environment by *“preventing both new and existing developments from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water pollution”* and *“remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate”*. Paragraphs 120 and 121 describe the policy considerations the Government expects LPA to have in regard to land affected by contamination when preparing policies for development plans and in taking decisions on applications.

For planning purposes, the NPPF requires that the assessment of risks arising from contamination and remediation requirements should be considered on the basis of the current environmental setting, the current land use, and the circumstances of its proposed new use.

In most other respects, however, the underlying approach to identifying and dealing with risk, and the overall policy objective of safeguarding human health and the environment, are similar to that outlined in Part 2A.

However, the level at which contamination is deemed to be unacceptable, or, gives rise to adverse effects under a planning context has not been identified but is envisaged to be more precautionary than the level required to determine land as contaminated under Part 2A.

The current SGV and GAC are not considered target values for the planning regime. In paragraph 121 the developer is required to ensure that land, after development, is not capable of being determined as contaminated land under Part 2A of the EPA 1990.

The principal planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural and historical environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks. In order to grant a planning permission the Local Planning Authority (LPA) has to be satisfied that there is sufficient information about the condition of the land, its impacts and the availability of viable remedial options. NPPF Paragraph 21 states that *“planning policies and decisions should also ensure that adequate site investigation information, prepared by a competent person, is presented”*. Site investigation information is further defined in the NPPF Glossary page 56 and that also states that investigations should be carried out in accordance with established procedures, including BS10175 (BSI 2011) that in turn links procedure to the requirements of CLR11.

2.3 Building Control

The building control department of the local authority (along with the private sector approved inspectors) are responsible for the operation and enforcement of the Building Regulations 2010 (DCLG 2010) to protect the health, safety and welfare of people in and around buildings and Building Control Regulations Approved Document C. Specifically requires the protection of buildings and associated land from the effects of contamination, to be applied (non-exclusively) in all changes of use from commercial or industrial premises, to residential property.

3 Approach

CLR 11 recommends a phased or tiered approach to risk assessment with the three tiers being:-

- Tier 1 - preliminary – a qualitative assessment forming part of a Phase 1 report,
- Tier 2 - generic - a quantitative assessment using published criteria to screen site specific ground condition data forming part of a Phase 2 report
- Tier 3 - detailed – a quantitative assessment involving the generation of site specific assessment criteria

Each tier of risk assessment comprises the following four stages:-

1. Hazard Identification – identifying potential contaminant sources on and off site;
2. Hazard Assessment – assessing the potential for unacceptable risks by identifying what pathways and receptors could be present, and what pollutant linkages could result (forming the Conceptual Site Model (CSM));

PBA Methodology for Assessment of Potentially Contaminated Land

3. Risk Estimation – estimating the magnitude and probability of the possible consequences (what degree of harm might result to a defined receptor and how likely); and
4. Risk Evaluation – evaluating whether the risk needs to be, and can be, managed.

A PBA Phase 1 report normally comprises a desk study, walkover and Tier 1 risk assessment (the project specific offer defines the actual scope of work). This is the minimum requirement as defined by the NPPF, pp56. At Tier 1 the PBA approach to risk estimation involves identifying the magnitude of the potential consequence (taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is promoted in current guidance such as R&D 66 (NHBC 2008).

The PBA approach is that if a pollution linkage is identified then it represents a potential risk which requires further consideration and either (1) remediation / direct risk management or (2) further tiers of assessment.

A PBA preliminary Phase 2 report comprises an intrusive investigation to collect site specific information, a Tier 2 quantitative generic risk assessment and a refinement of the CSM using the site specific data. Depending on the findings further investigation and/or progression to Tier 3 risk assessment and the generation of site specific assessment criteria may be required.

The PBA methodology provides an estimate of the level of risk, it does not identify a risk level at which the risk is considered “significant” and/or “unacceptable” as this is dependant on the view of the individual / stakeholder. For example; to a risk adverse stakeholder even a risk level of “very low” may be considered unacceptable and as such this stakeholder may require risk management options to be implemented.

4 Identification of Pollutant Linkages and Conceptual Site Model (CSM)

For all Tiers the underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements:-

- A source/hazard – a substance or situation which has the potential to cause harm or pollution;
- A pathway – a means by which the hazard moves along / generates exposure; and
- A receptor/target – an entity which is vulnerable to the potential adverse effects of the hazard.

The *Conceptual Site Model* identifies the types and locations of potential contaminant sources/hazards and potential receptors and potential migration/transportation pathway(s). The CSM is refined as the assessment progresses through the Tiers.

4.1 Hazard Identification

A hazard is a substance or situation that has the potential to cause harm. Hazards may be chemical, biological or physical (e.g. explosive gases).

At Tier 1 the potential for hazards to be present is determined from consideration of the previous or ongoing activities on or near to the site in accordance with the criteria presented in the **Table 1**.

Based on the land use information Potential Contaminants of Concern (PCOC) are identified. The PCOC direct the scope of the collection of site specific data and the analytical testing selected for subsequent Tiers.

At Tier 2 the site specific data is screened using published assessment criteria (refer to PBA document entitled *Rationale for the Selection of Tier 2 Assessment Criteria*). In general, published criteria have been developed using highly conservative assumptions and therefore if the screening criterion is not exceeded then the PCOC is eliminated as a potential Hazard. It should be noted that exceedance does not necessarily indicate that a site is contaminated and/or unsuitable for use only that the PCOC is retained as a potential Hazard. Published criteria are generated using models based on numerous and complex assumptions. Whether or not these assumptions are appropriate in a site-specific context requires confirmation on a project by project basis and would form part of a Tier 3 assessment.

When reviewing or assessing site specific data PBA utilise published guidance on comparing contamination data with a critical concentration (CL:AIRE/CIEH 2008) which presents a structured process for employing statistical techniques for data assessment purposes. The benefit of the statistical tool is uncertainty is quantified and decisions are made knowing the strength of the evidence. Correct decision probability is a function of sample size, difference in the mean and the critical concentration, variation in measured values and the significance level.

4.2 Receptor and Pathway Identification

For all Tiers the potential receptors (for both on site and adjoining land) that will be considered are:

- Human Health – including current and future occupiers, construction and future maintenance workers, and neighbouring properties/third parties;
- Ecological systems; ^{*1}
- Controlled waters ^{*2} – including surface water and groundwater;
- Property, Animal or Crop (existing or proposed) - including buildings, service lines and pipes, crops, livestock, pets, woodland; and
- Archaeological sites and ancient monuments.

^{*1} International or nationally designated sites (as defined in the statutory guidance (Defra Circular 04/12)) “in the local area” will be identified as potential ecological receptors. A search radius of 1, 2 or 5km will be utilised depending on the site specific circumstances (see also pathway identification). The Environment Agency has published an ecological risk assessment framework (EA 2008) which promotes (as opposed to statutorily enforces) consideration of additional receptors to include locally protected sites and protected or notable species. These additional potential receptors will only be considered if a Phase 1 habitat survey, undertaken in accordance with

PBA Methodology for Assessment of Potentially Contaminated Land

guidance (JNCC 1993), is commissioned and the data provided to PBA. It should be noted that without such a survey the Tier 1 risk assessment may conclude that the identification of potential ecological receptors is inconclusive (see Specification).

^{*2} the definition of "pollution of controlled water" was amended by the introduction of Section 86 of the Water Act 2003. For the purposes of Part 2A groundwater does not include waters above the saturated zone and our assessment does not therefore address perched water other than where development causes a pathway to develop.

If a receptor is taken forward for further assessment it will be classified in terms of its sensitivity, the criteria for which are presented in **Table 2**. Table 2 has been generated using descriptions of environmental receptor importance/value given in various guidance documents including R&D 66 (NHBC 2008) and Transport Analysis Guidance (based on DETR 2000). Human health and buildings classifications have been generated by PBA using the attribute description for each class.

The exposure pathway and modes of transport that will be considered are presented in **Table 3**.

4.3 Note regarding Ecological Systems

The Environment Agency (EA) has developed an ecological risk assessment framework which aims to provide a structured approach for assessing the risks to ecology from chemical contaminants in soils (EA 2008). In circumstances where contaminants in water represent a potential risk to aquatic ecosystems then risk assessors will need to consider this separately.

The framework consists of a three tiered process:-

- Tier 1 is a screening step where the site soils chemical data is compared to a soil screening value (SSV)
- Tier 2 uses various tools (including surveys and biological testing) to gather evidence for any harm to the ecological receptors
- Tier 3 seeks to attribute the harm to the chemical contamination

Tier 1 is preceded by a desk study to collate information about the site and the nature of the contamination to assess whether pollutant linkages are feasible. The framework presents ten steps for ecological desk studies and development of a conceptual site model as follows.

- 1 Establish Regulatory Context
- 2 Collate and Assess Documentary Information
- 3 Summarise Documentary Information
- 4 Identify Potential Contaminants of Concern
- 5 Identify Likely Fate Transport of Contaminants
- 6 Identify Potential Receptors of Concern
- 7 Identify Potential Pathways of Concern
- 8 Create a Conceptual Site Model
- 9 Identify Assessment and Measurement Endpoints
- 10 Identify Gaps and Uncertainties

The information in a standard PBA Phase 1 report covers Steps 1 to 4 inclusive. Step 5 considers fate and transport of contaminants and it should be noted that our standard report adopts a simplified approach considering only transport mechanisms. A simplified approach has also been adopted in respect of Steps 6 and 7 receptors (a detailed review of the ecological

attributes has not been undertaken) and pathways (a food chain assessment has not been undertaken). Step 9 is outside the scope of our standard Phase 1 report.

The Tier 1 prepared by PBA as part of a Phase 1 report will assess the viability of the mode of transport given the site specific circumstances not specific pathways. As with receptor identification it should be noted that without a habitat survey the Tier 1 risk assessment may conclude that the risk to potential ecological receptors is inconclusive (see PBA Specification for Phase 1 Assessment of Potentially Contaminated Land).

4.4 Note regarding Water Framework Directive

The Water Framework Directive (WFD) (2000) aims to protect and enhance the quality of surface freshwater, groundwaters and dependent eco systems, estuaries and coastal waters. The WFD was transposed into UK law in 2003 (Statutory Instruments 2003). Member states must aim to reach good chemical and ecological status as defined in the Directive by 2015.

To address the WFD, a River Basin Management Plan (RBMP) has been developed for the 11 River Basin Districts in England and Wales. These were released by Defra in 2009 (Defra 2009).

These RBMP's establish the current status of waters within the catchments of the respective Districts and the current status of adjoining waters identified. As part of a Tier 2 risk assessment water quality data is screened against the WFD assessment criteria. Compare to the RBMP's current status of waters for the catchment under consideration would form part of a Tier 3 assessment.

5 Risk Estimation

Risk estimation classifies what degree of harm might result to a receptor (defined as consequence) and how likely it is that such harm might arise (probability).

At Tier 1 the consequence classification is generated by multiplying the hazard classification score and the receptor sensitivity score. This approach follows that presented in the republished R&D 66 (NHBC 2008).

The criteria for classifying probability are set out in **Table 4** and have been taken directly from Table 6.4 CIRIA C552 (CIRIA 2001). Probability considers the integrity of the exposure pathway.

The consequence classifications detailed in **Table 5** have been adapted from Table 6.3 presented in C552 and R&D 66 (Annex 4 Table A4.3).

The Tier 1 risk classification is estimated for each pollutant linkage using the matrix given in **Table 6** which is taken directly from C552 (Table 6.5). Subsequent Tiers refine the CSM through retention or elimination of potential hazards and pollutant linkages.

6 Risk Evaluation

In order to put the Tier 1 risk classification into context the likely actions are described in **Table 7** which is taken directly from C552 (Table 6.6). Subsequent Tiers identify potential risk management options through remediation and/or mitigation measures.

PBA Methodology for Assessment of Potentially Contaminated Land

7 References

BSI 2007 BS 8485 Code of Practice for characterisation and remediation from ground gas in affected developments.

BSI 2011 BS 10175 (2011) Code of practice - Investigation of potentially contaminated sites

CIRIA 2001: Contaminated land risk assessment – a guide to good practice C552.

CIRIA 2008: Assessing risks posed by hazardous ground gases to buildings C655

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PBA Methodology for Assessment of Potentially Contaminated Land

Table 1: Criteria for Classifying Hazards / Potential for Generating Contamination

Classification/Score	Potential for generating contamination/gas based on land use
Very Low 1	Land Use: agriculture, residential, allotment, recent retail or office use Contamination: None or low level residual concentrations. Gas generation potential : Inert Made Ground
Low 2	Land Use: recent small scale industrial, railway tracks, small scale fuel storage (heating). Contamination: Locally or slightly elevated concentrations. Gas generation potential : Shallow thickness of Alluvium
Moderate 3	Land Use: railway yards, collieries, scrap yards, light industry, engineering works. Contamination: Locally elevated concentrations. Gas generation potential : Dock silt and substantial thickness of organic alluvium/peat
High 4	Land Use: gas works, chemical works, heavy industry, non-hazardous landfills. Contamination: Possible widespread elevated concentrations. Gas generation potential : Shallow mine workings Pre 1960's landfill
Very High 5	Land Use: hazardous waste landfills. Contamination: Likely widespread elevated concentrations. Gas generation potential : Domestic landfill post 1960

"Greenfield" is land which has not been developed including not used for crop production or animal husbandry and no contamination source therefore no pollutant linkages.

Table 2: Criteria for Classifying Receptor Sensitivity/Value

Classification/Score	Definition
Very Low 1	Receptor of limited importance Groundwater: Unproductive Surface water: None and/or >250m hydraulically down gradient Ecology: No local designation Buildings: Replaceable Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement Groundwater: Secondary B Surface water: Tertiary <100m hydraulically down gradient Ecology: local habitat resources Buildings: Local value Human health: Minimum score of 4
Moderate 3	Receptor of local or county importance with potential for replacement Groundwater: Secondary A Surface water: Tertiary <50m or Secondary <100m hydraulically down gradient Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) Buildings: Area of Historic Character Human health: Commercial
High 4	Receptor of county or regional importance with limited potential for replacement Groundwater: Principal Surface water: Secondary <50m or Primary <100m hydraulically down gradient Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) Buildings: Conservation Area Human health: Minimum score where human health identified as potential receptor
Very High 5	Receptor of national or international importance Groundwater: Source Protection Zone Surface water: Primary <50m hydraulically down gradient Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (RAMSAR) Buildings: World Heritage site Human health: Residential, open spaces and uses where children are present

Table 3: Exposure Pathway and Modes of Transport

Receptor	Pathway	Mode of transport
Human health	Ingestion	Fruit or vegetable leaf or roots
		Contaminated water
		Soil/dust indoors
		Soil/dust outdoors
	Inhalation	Particles (dust / soil) – outdoor
		Particles (dust / soil) - indoor
		Vapours – outdoor - migration via natural or anthropogenic pathways
		Vapours - indoor - migration via natural or anthropogenic pathways
	Dermal absorption	Direct contact with soil
		Direct contact with waters (swimming / showering)
		Irradiation
Groundwater	Leaching	Gravity / permeation
	Migration	Natural – groundwater as pathway Anthropogenic (e.g. boreholes, culverts, pipelines etc.)
Surface Water	Direct	Runoff or discharges from pipes
	Indirect	Recharge from groundwater
	Indirect	Deposition of wind blown dust
Buildings	Direct contact	Sulphate attack on concrete, hydrocarbon corrosion of plastics
	Gas ingress	Migration via natural or anthropogenic paths
Ecological systems	See Notes	Runoff/discharge to surface water body
	See Notes	Windblown dust
	See Notes	Groundwater migration
	See Notes	At point of contaminant source
Animal and crop	Direct	Wind blown or flood deposited particles / dust / sediments
	Indirect	Plants via root up take or irrigation. Animals through watering
	Inhalation	By livestock / fish - gas / vapour / particulates / dust
	Ingestion	Consumption of vegetation / water / soil by animals

Table 4: Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event either appears very likely in the short-term and almost inevitable over the long-term, or there is already evidence at the receptor of harm / pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter-term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

PBA Methodology for Assessment of Potentially Contaminated Land

Table 5: Classification of Consequence (score = magnitude of hazard Table 1 and sensitivity of receptor Table 2)

Classification / Score	Examples
Severe 20-25	Human health effect - exposure likely to result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Equivalent to EA Category 1 incident (persistent and/or extensive effects on water quality leading to closure of potable abstraction point or loss of amenity, agriculture or commercial value. Major fish kill. Ecological effect - short-term exposure likely to result in a substantial adverse effect. Catastrophic damage to crops, buildings or property
Medium 10-16	Human health effect - exposure could result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 2 incident requiring notification of abstractor Ecological effect - short-term exposure may result in a substantial adverse effect. Damage to crops, buildings or property
Mild 6-9	Human health effect - exposure may result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 3 incident (short lived and/or minimal effects on water quality). Ecological effect - unlikely to result in a substantial adverse effect. Minor damage to crops, buildings or property. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor 1-5	No measurable effect on humans. Protective equipment is not required during site works. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects to crops, buildings or property. The loss of plants in a landscaping scheme. Discolouration of concrete.

Table 6: Classification of Risk (Combination of Consequence Table 5 and Probability Table 4)

	Consequence			
Probability	Severe	Medium	Mild	Minor
High likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/low	Low
Low likelihood	Moderate	Moderate/low	Low	Very low
Unlikely	Moderate/low	Low	Very low	Very low

Table 7: Description of Risks and Likely Action Required

Risk Classification	Description
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation is likely to be required in the short term.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.