



Oldlands Farm

Bognor Regis

Ground Conditions Desk Study Report

Final Report for



June 2014

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Executive Summary and Conceptual Site Model

SITE INFORMATION AND SETTING	Purpose of This Report	The objectives of this investigation are to assess the readily available information on the likely ground conditions at the site and the determination of a geological and hydrogeological Conceptual Site Model.
	Client	Bericote Properties.
	Site	Oldlands Farm, Bognor Regis.
	Site Location	Adjacent to the A29 Shripney Road/Rowan way, northern edge of Bognor Regis, West Sussex. The nearest postcode is PO22 9ST and the approximate National Grid Reference is 494263E, 101433N.
	Current Land Use and Description	The site is in use as arable fields. The topography gently slopes downward from west to east with levels ranging between approximately 3.10m OD and 1.20m OD respectively. The western and southern sections of the site slope gentle downwards to the north. The northeastern section is relatively flat. There are no significant breaks in slope with the exception of the drainage ditches. There are numerous ditches on the site. There is a central drainage ditch which flows from the south to the north and in the north ditches flow to the east, in-line with the general topography. There is a well in the south of the site associated with an adjacent farm in the southwest of the site. The farm buildings are disused and in a dilapidated condition.
	Development	The proposed development is to comprise warehousing, with associated access, car parking, waste storage and landscaping to the south of the Northern Relief Road (currently under construction) and a flood compensation area north of the road.
PHASE 1 (DESK STUDY)	Site History	The historical map evidence suggests the site has been farmland since the earliest map editions of the late 19th Century. However, it is possible two ponds have been infilled in the south of the site. In the late 20th Century there has been the development of an industrial estate adjacent to the southern site boundary.
	Unexploded Ordnance	A non-specialist assessment indicates the site to be in an area where the bomb risk is moderate. Consideration should be given to undertaking a specialist risk assessment in accordance with CIRIA C681, Chapter 5.
	Geology	The site is underlain by Raised Marine Deposits in the east and River Terrace Deposits in the west. These superficial deposits overlie Undifferentiated Chalk deposits.
	Mining/Mineral Extraction	No evidence of mining or mineral extraction.
	Ground Stability	Natural cohesive soils are likely to be compressible and likely to settle significantly, especially where associated with the Raised Marine Deposits. Excavations are likely to be unstable. Although the presence of solution features in the Chalk cannot be discounted, Hydrock consider the likelihood of such features at the site is low.
	Hydrogeology	The Raised Marine Deposits and River Terrace Deposits are Secondary A Aquifers. The Undifferentiated Chalk is a Principal Aquifer. The site is not within a Source Protection Zone.
	Hydrology	There are numerous drains on site, especially in the east and north. These drains discharge into the Ryebank Rife approximately 135m to the east. The English Chancel is located approximately 2km to the south.



	Flood Risk	The site is located in Flood Zone 2 to 3. No further assessment of flood risk is made in this report.	
	Previous Site Data	A historical ground investigation was undertaken by Wilson Bailey in the south of the current site and comprised a: - Phase 1 desk study review; and - Phase 2 intrusive investigation comprising 15 trial pits, 7 windowless sampler boreholes and the installation of groundwater and ground gas monitoring standpipes. The data from this ground investigation is limited and not all appendices have been provided to Hydrock. However, the information is useful in the creation of a Conceptual Site Model.	
	Radon	No radon protective measures are necessary according to current guidance.	
	Geotechnical Hazards from Desk Study	- Flooding - the site is within a known flood plain. - Made Ground (backfill of former ponds) – excessive settlement (creep and inundation settlement or differential settlement of foundations and infrastructure elements. - Attack of buried concrete by aggressive ground conditions – the development site may contain unknown Made Ground and potentially sulphate bearing soils. The natural soils are likely to be low in sulphate concentrations. - Shrinkage/swelling of clay – settlement/heave of foundations when located within the influence of trees and vegetation. - Low strength, compressible ground. - Running sands, loose landfill and shallow groundwater, leading to difficulty with excavation due to trench collapse. - Constructability – the soils may be too soft or loose to allow ground improvement by the use of vibro-stone columns.	
	Possible Contaminant Linkages of Moderate or Greater Risk Level - From Desk Study	The possible pollutant linkages on an un-remediated site determined by desk study and walk-over are summarised below for risk levels of moderate or greater.	
		Source(s)	◀ potential Impact on ▶
Metals, PAH and asbestos in backfilled ponds.		Ingestion Dermal contact Inhalation Plant life	
	Ground gas from natural soils and Made Ground	End users	
ASSESSMENT AND CONCLUSIONS	Conclusions	Based on historic land uses and its current operational use, the overall risk from land contamination at the site is considered to be low for the current development but would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation. It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990. Additional site investigation will be required to determine the geotechnical risks.	
	Further Work	In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. Based on the current data, this site investigation is proposed to comprise: - the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability, over break potential and “diggability” and allow soil infiltration rate testing to be undertaken; - the undertaking of soil infiltration rate testing; - cable percussive boreholes to allow collection of samples for geotechnical and chemical	



		analysis of deeper soils and allow in-situ testing (SPTs) to be undertaken to assess density of the sands and gravel to allow foundation design, and allow the installation of gas and groundwater monitoring wells; • Dutch Cone Penetration Testing to determine the vertical extent of the very soft to soft soils; • gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored; • assessment of the risk to contractors and future users from ground gas; • gas concentration and groundwater level monitoring; • geotechnical testing of soils and rock; • contamination analyses of soil and groundwater; • assessment of risk from soils to future site users; and • geotechnical assessment of the soils with regards to the proposed distribution.
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This Executive Summary forms part of Hydrock Consultants Limited report number R/14459/001 (Issue 1) and should not be used as a separate document.



1.0 INTRODUCTION

1.1 Terms of Reference

In May 2014, Hydrock Consultants Limited (Hydrock) was commissioned by Bericote Properties (the Client) to undertake a ground conditions desk study report at Oldlands Farm, Bognor Regis.

The site is located to the east of Shripney Road and to the south of the Northern Relief Road (A259, currently under construction) and is currently an operational arable farm.

The proposed development is to comprise warehousing, with associated access, car parking, waste storage and landscaping to the south of the Northern Relief Road (A259) and a flood compensation area north of the road. The first phase of the development is shown on the Bericote Properties drawing, "Site Layout Plan", reference 99603-ss-25, dated May 2014 which is presented in Appendix A.

A Site Location Plan (Hydrock drawing 14459.D001) and topographic survey plan (Hydrock drawing 14459/002) are presented in Appendix A.

1.2 Objectives

The objectives of this investigation are to assess the readily available information on the likely ground conditions at the site and the determination of a geological and hydrogeological Conceptual Site Model.

1.3 Scope

The scope of work for this commission comprises:

- a desk study and site walk-over reconnaissance to determine the nature of the site and its surroundings including current and former land uses, geology, hydrogeology, hydrology and
- reporting on findings.

See Appendix F for detailed reporting methodology.

1.4 Provided Information

The following has been provided to Hydrock by the Client for use in the preparation of this report:

- Site Layout Plan, reference 99603-ss-25, dated May 2014;
- Survey Area Plan 1, reference 99603-ss-33, dated May 2014;
- Survey Area Plan 2, reference 99603-ss-34, dated May 2014;
- Hydrock drawing Volumetric Cut and Fill, reference OF/SK003/P1, dated May 2014;
- Wilson Bailey Geotechnical & Environmental report 'Oldlands Farm, Bognor Regis', reference J12134/DB/c01a, dated June 2013; and



- Malcolm Hughes Land Surveyors Topographical Survey, reference 16473, dated May 2014.



2.0 PRELIMINARY INVESTIGATION (PHASE 1 STUDY)

A number of desk study sources have been used to assemble the following information, including a proprietary environmental data report which has been obtained (dated 23rd May 2014) and which is presented in Appendix D.

2.1 Site Referencing

The site is referenced in Table 2.1.

Table 2.1: Site Referencing Information

Item	Brief Description
Site name	Oldlands Farm, Bognor Regis.
Site location and grid reference	Adjacent to the A29 Shripney Road/Rowan way, northern edge of Bognor Regis, West Sussex. The nearest postcode is PO22 9ST and the approximate National Grid Reference 494263E, 101433N. The site is approximately 2km north of the English Channel.

A Site Location Plan is provided in Appendix A (Hydrock drawing 14459.001).

2.2 Site Description and Walk-Over Survey

A walk-over reconnaissance survey was undertaken to confirm the findings of the desk study and assess visually any potential hazards and receptors. Photographs are presented in Appendix B. The basic description of the current site conditions is summarised in Table 2.2.

Table 2.2: Site Description

Item	Brief Description
Site access	Via a track off Steyning Way.
Land area	Approximately 9.9 ha.
Elevation and topography	The topography gently slopes downward from west to east with levels ranging between approximately 3.10m OD and 1.20m OD respectively. The western and southern sections of the site slope gentle downwards to the north. The northeastern section is relatively flat. There are no significant breaks in slope with the exception of the drainage ditches. There are numerous ditches on the site. There is a central drainage ditch which flows from the south to the north and in the north ditches flow to the east, in-line with the general topography.
Site boundaries	The site is bound by a railway to the east, agricultural land to the north and west and Oldlands Farm to the south. The Northern Relief Road (A259) is currently under construction beyond the site boundary to the north.
Geomorphological features	The topography mirrors the geology, with the northeast part of the site (where there are Raised Marine Deposits) being flat and level and the area of higher elevation coinciding with the River Terrace Deposits.



Item	Brief Description
Present land use	The site is divided into two fields separated by a drainage ditch orientated south to north across the site. The land is currently used for arable agriculture and at the time of fieldworks was sown with wheat. There is a well in the south of the site associated with an adjacent farm in the southwest of the site. The farm buildings are disused and in a dilapidated condition. These are understood to have historically been a dairy and included an underground slurry pit.
Vegetation	At the time of visiting the site was sown with wheat. There are hedgerows aligning the field boundaries and a number of mature bushes aligning the central drainage ditch. The land surrounding the farm buildings is overgrown with weeds (branches and nettles).
General site sensitivity	Generally the site is of rural character. Hydrock understand archaeological and ecological assessments associated with the site are in process.
Surrounding land	The Southern Cross industrial Estate lies beyond Oldlands Farm to the south. Surrounding land to the north, west and east is generally agricultural.

2.3 Site History

A study of historical Ordnance Survey maps (Appendix C) has been undertaken to identify any former land uses at the site and surrounding areas which may have geotechnical or geo-environmental implications for the proposed development and is summarised in Table 2.3.

Table 2.3: Key Features from Historical Mapping

Map Edition and Scale	Key Features on Site	Key Features off Site
1876: 1:10,560	The site comprises eight fields separated by field boundaries. The fields in the northeast are separated by tracks and there is a footpath in the northern most part of the site. A single tree is indicated to be present in the central north of the site. There is a round pond and a linear pond in the south of the site. Drainage is present in the north of the site flowing from east to west. In the south a drain is seen to issue adjacent to the southern site boundary and flow to the north.	The eastern boundary is defined by the London to Brighton railway line which appears to be level with the site. The southern boundary is defined by the farm buildings of Oldlands Farm. The remainder of the area is rural and comprises fields, roads and occasional farm buildings. The Ryebank Rife is located approximately 135m to the east of the site and is the general receptor for the site drainage. Ryebank Rife ultimately drains into the Linsey Rife approximately 250m to the east. A well is indicated to be present in a farm compound approximately 400m to the north of the site. The village of Shripney is located approximately 700m to the northwest of the site.
1896 1:10,560	The linear pond in the south of the site is no longer present. A footpath now bisects the entire length of the site from north to south.	No significant change.
1910 - 1950 1:10,560	No significant change.	No significant change.



Map Edition and Scale	Key Features on Site	Key Features off Site
1961 1:10,560	No significant change.	A works has been constructed adjacent to the Linsey Rife approximately 500m to 750m to the south.
1978 1:10,000	The field boundaries in the east of the site are shown to contain drains and these appear to the flow to the southeast and the Ryebank Rife.	There has been development of additional buildings to the works to the south of the site. An airfield is located approximately 500m to the south. There is a refuse pit located 525m to the south. There is residential development in Shripney and 800m to the southwest and 750m to the southeast
1993 1:10,000	The round pond in the south is no longer indicated.	The works to the south has been developed adjacent to the southern site boundary and the area is collectively known as the Southern Cross Industrial Estate. This now includes the former farm buildings adjacent to he southern site boundary. There are tanks located approximately 250m to the north of the site.
2012 1:10,000	No significant change.	No significant change.

The historical map evidence suggests the site has been farmland since the earliest map editions of the late 19th Century. However, it is possible two ponds have been infilled at the site. In the late 20th Century there has been the development of an industrial estate adjacent to the southern site boundary.

2.4 Unexploded Ordnance/Bombs

A non-specialist UXO assessment indicates the site to be in an area where the bomb risk is moderate. Consideration should be given to undertaking a specialist risk assessment in accordance with CIRIA C681, Chapter 5.

2.5 Geology

The general geology of the site area is shown on the 1:50,000 geological map of Chichester and Bognor (Sheet 317 and 332) and is summarised in Table 2.4.



Table 2.4: Geology

Location	Age	Stratigraphic name	Description
East of the site	Quaternary	Raised Marine Deposits	Normally consolidated clays, silts and sands. Likely to include organic material.
On site		River Terrace Deposits	Possibly syndepositional with, and likely to be beneath any, Raised Marine Deposits. Sandy gravel and gravelly sand. Likely to be formed from chalk and flint. May initially by a sandy silt*
	Cretaceous	Undifferentiated Chalk	Chalk with flints.

*Please note, originally the area was historically described by the BGS as containing Brickearth but this has now been reclassified as part of the River Terrace Deposits.

The ponds identified on the historic maps appear to have been infilled. It is anticipated that localised volumes of Made Ground will be present in this area. Made Ground is also anticipated associated with the former dairy.

2.6 Mining or Mineral Extraction

There are no records of mining or mineral extraction to have taken place at the site. It is possible there may have been unrecorded chalk mining. However the risk of such activity having taken place is considered very low.

2.7 Ground Stability

The Raised Marine Deposits are likely to be cohesive in nature and the River Terrace Deposits may be partially cohesive with both stratum being normally consolidated. These deposits may therefore be compressible and the Raised Marine Deposits may be highly compressible. The soils are likely to settle when a load is applied (e.g. raising site levels).

Excavations are likely to be unstable and it is anticipated the groundwater level will be resented at a shallow depth.

Although the presence of solution features in the Chalk cannot be discounted, given the anticipated shallow groundwater level Hydrock consider the likelihood of such features at the site is low.

2.8 Hydrogeology

The aquifer designations given in Table 2.5 are based on the Environment Agency interactive aquifer designation map. Additional information on the hydraulic characteristics of the geological units has been abstracted from Allen *et al* (1997) and Jones *et al* (2000).



Table 2.5: Hydraulic Characteristics of Strata

Stratum	Aquifer Designation	Hydraulic Characteristics
Raised Marine Deposits	Secondary A Aquifer	Moderate to high porosity because of unconsolidated nature, but permeability likely to be constrained to low or low to moderate because of poor sorting and clay content.
River Terrace Deposits		
Undifferentiated Chalk.	Principal Aquifer	Possible large storage capacity both from fractures and porosity. Permeability likely to be controlled by fracture flow. An important strategic aquifer.

It is considered groundwater flow will be to the south and it is possible groundwater on the site will be in hydraulic continuity with the surface waters. There is a possibility the groundwater may be partially or wholly influenced by the tide.

The site is not within a Source Protection Zone (SPZ) and there are no groundwater abstraction licenses within 1km of the site although there is a well present on the site.

2.9 Hydrology and Flooding

There are numerous drains on the site which are classified as Tertiary and Secondary Rivers. The nearest Primary River is the Ryebank Rife which is located 135m to the east of the site boundary and flows to the south and the English Channel (2km to the south).

The majority of the surface drainage on the site coincides with the anticipated presence of the Raised Marine Deposits. These deposits are therefore considered likely to have a lower permeability than the River Terrace Deposits.

There is a surface water abstraction license present on the site for use in spray irrigation.

Sewage was once discharged into the site drainage but this practise ceased in 1963 and no further consideration is given.

There are no recorded pollution incidents at, or in the vicinity of, the site.

With the exception of the southwest, which is within a Flood Zone 1 and the remainder of the site is in Flood Zone 3, with high/significant probability of flooding.¹

No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

¹ Note that the probabilities of flooding and the risk designations differ between the Environment Agency and the Technical Guidance to the National Planning Policy Framework (DCLG March 2012) and that the published flood map only relates to flooding from rivers, estuaries and the sea and does not include other potential sources such as surface water, groundwater, sewers, canals and reservoirs. Note also that the presence on the map of flood defences, or areas benefiting from flood defences, should not be taken to imply that a proposed development in these areas is acceptable, see Appendix F for details.



2.10 Waste Management and Hazardous Substances

A refuse pit identified on the historical maps, which is located 525m to the south of the site. This was licensed to accept inert, industrial and liquid sludge and the license was surrendered in 1983. There are no other waste sites within 750m of the site.

Hydrock are not aware if animal burial has been undertaken on the site. The Local Authority has been contacted regarding the possibility of such a practise having taken place at the site (response pending).

2.11 Current Land Use

The Southern Cross Industrial Estate is located adjacent to the southern site boundary. The estate includes numerous manufacturers and industrial processes but as the groundwater flow direction is assessed to be to the south it is considered unlikely to have an impact on the site.

2.12 Previous Evidence of Known Contamination Events

There are no records of previous contamination events.

2.13 Natural Soil Chemistry

Information contained within the environmental data report (Appendix D) gives indicative natural concentration values (estimated) for the natural soils at the site for a selection of Contaminants of Potential Concern (CoPC). These have been reproduced in Table 2.6 below.

Table 2.6: Natural Soil Chemistry

Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Nickel (mg/kg)
<15	<1.8	60 - 90	<150	15 - 30

2.14 Radon

Reference to the Indicative Atlas of Radon in England and Wales (Miles et al 2007) and BR 211 (Scivyer 2007) indicates that the site is not in a Radon Affected Area and therefore no radon protection measures are required.

2.15 BGS Borehole Archive

There is one historical borehole present in the BGS borehole archive, located in the southwest of the site. This indicates the following stratigraphic sequence (with original interpretation):

- Topsoil to 0.40m bgl: over
- silty and sandy clay (Brickearth); over
- very clayey pebble sand (Raised Beach Deposits); over
- Chalk (Upper Chalk).



2.16 Previous Site Investigations

2.16.1 Wilson Bailey Geotechnical & Environmental, reference J12134/DB/c01a, June 2013

This is a combined desk study review and ground investigation review undertaken on the southern two fields of the site Hydrock are reporting. The desk study includes anecdotal evidence that the former ponds may have been infilled with arisings from excavations associated with an access track to the south of the site. A copy of this report (as provided to Hydrock) is presented in Appendix E. It should be noted that the desk study data and trial pit logs have not been provided to Hydrock.

The scope of site work includes:

- 7 windowless sampler boreholes to a maximum depth of 5.45m bgl;
- 15 machine excavated trial pits;
- laboratory testing;
- reporting; and
- installation and monitoring of ground gas and groundwater monitoring wells.

The following general ground conditions were encountered (please note the use of Brickearth which has now been classified as River Terrace Deposits):

- Topsoil to depths of between 0.25m and 0.70m bgl; and/or
- Made Ground (including metal, rope and timber) in the area of the former pond to a maximum depth of 1.80m bgl; over
- soft and very soft clay to between 0.90m and 2.30m bgl; over
- brown to off-white chalky silt to between 3.00m and 3.80m bgl; over
- Chalk; and

Groundwater was encountered between 3.00m and 3.80m bgl

The report concludes this sequence is River Terrace Deposits, Brickearth, Raised Beach Deposits and Chalk. However, Hydrock consider this sequence is more likely to represent the River Terrace Deposits or Chalk.

In the east of the site a very soft, dark blue, locally fibrous peat was encountered. This is considered by Wilson Bailey to be Alluvium although Hydrock interpret this as Raised Marine Deposits. Groundwater was encountered in this area at 2.00m bgl.

No groundwater or ground gas monitoring data is provided.

Whilst useful as an indicator of the ground conditions, Hydrock have only used the provided data as supplementary data for the Conceptual Site Model.



3.0 PRELIMINARY RISK ASSESSMENT

3.1 Preliminary Ground Model

The site is occupied by a number of relatively flat arable fields. The topography gently slopes downward from west to east with levels ranging between approximately 3.10m OD and 1.20m OD respectively. The western and southern sections of the site slope gentle downwards to the north. The northeastern section is relatively flat.

There are no significant breaks in slope with the exception of the drainage ditches.

Historical mapping suggest the site has not been developed although it is known there were two ponds on the site which have been subsequently infilled with construction materials. There is an industrial estate adjacent to the southern site boundary.

There are numerous drains in the northeast of the site which drain to the southeast. A Secondary River drains from west to east in the centre of the site and there is a confluence in the centre of the site with a drain which rises on the southern boundary and flows northwards. There is an active license for the use of surface water in spray irrigation at the site.

The site is underlain by Raised Marine Deposits in the west and River Terrace Deposits in the east. These deposits overlie Undifferentiated Chalk. Made Ground is anticipated to be present where the former ponds have been backfilled.

The Raised Marine Deposits and River Terrace Deposits are Secondary A Aquifers and the Undifferentiated Chalk is a Principal Aquifer. The site is not within a Source Protection Zone and there are no groundwater abstractions within the vicinity of the site.

An historic landfill is located approximately 525m to the south of the site boundary.

The proposed development is to comprise a number of warehouses, with associated access, car parking, waste storage and landscaping. A flood storage area is proposed to the west.

3.2 Preliminary Exposure Model

The preliminary exposure model is used for geo-environmental hazard identification and establishing potential contaminant linkages in line with the Statutory Guidance to Part 2A of the Environmental Protection Act 1990, also known as 'potential pollution linkages' in the Model Procedures of CLR11 (Environment Agency, 2004). This is based on the contaminant-pathway-receptor linkage approach.

3.2.1 Potential Contaminants

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from on-site or off-site sources.



Potential On-Site Sources of Contamination

- Pond backfill including Made Ground possibly comprising metals, metalloids, asbestos, PAH and petroleum hydrocarbons.
- Ground gases (gases carbon dioxide and methane) from organic materials present in the pond backfill and Raised Marine Deposits.

Potential Off-Site Sources of Contamination

- No potential off-site sources have been identified.

3.2.2 Potential Receptors

- Humans (site end users, neighbours).
- Development end use (buildings, utilities and landscaping).
- Groundwater: Secondary A and Principal Aquifers.
- Surface water: on-site drainage.

It should be noted that health and safety risks to Contractors have not been assessed during these works and will need to be considered separately.

3.2.3 Potential Pathways

- Humans: ingestion, dermal contact, inhalation of dust and air.
- Buildings: direct contact with substances deleterious to building materials.
- Buildings: methane ingress via permeable soils and/or construction gaps.
- Underlying groundwater: migration of contaminants.
- Surface water: overland flow.
- Surface water: drainage discharge.
- Surface water: base flow from groundwater.

3.2.4 Summary of Potential Contaminant Linkages

Table 3.1 lists the plausible contaminant linkages which have been identified. These are considered as potentially unacceptable risks in line with guidelines published in CLR 11 and additional risk assessment is required.

Linkages has been assessed in general accordance with guidance in CIRIA Report C552 (Rudland *et al* 2001) but with the addition of a 'no linkage' category. More details are given in Appendix F including descriptions of typical examples of probability and consequences.



Table 3.1: Exposure Model – Preliminary Risk Assessment of Source-Pathway-Receptor Contaminant Linkages

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
Metals, PAH and asbestos in backfilled ponds.	Ingestion Dermal contact Inhalation	End users Neighbours	Likely	Medium	Moderate	Backfill is described by the Wilson Bailey report to contain metal, rope and timber. It is likely there will be elevated Chemicals of Concern and possibly asbestos containing material.
	Root uptake	Plant life	Low	Low	Low	
Metals, PAH and asbestos in Made Ground.	Ingestion Dermal contact Inhalation	End users Neighbours	Low	Medium	Low	There may be localised pockets of Made Ground beyond the area of the backfilled ponds which may contain elevated Chemicals of Concern and possibly asbestos containing material.
	Root uptake	Plant life	Low	Low	Low	
Ground gas from natural soils and Made Ground.	Inhalation	End users	Likely	Medium	Moderate	The Wilson Bailey report describes organic material in the natural Raised Beach Deposits which may generate ground gas. It is possible putrescible materials within Made Ground may also generate ground gas.



3.3 Geotechnical Hazard Identification

Potential geotechnical hazards based on the expected ground conditions are listed below:

- Flooding - the site is within a known flood plain.
- Made Ground (backfill of former ponds) – excessive settlement (creep and inundation settlement or differential settlement of foundations and infrastructure elements.
- Attack of buried concrete by aggressive ground conditions – the development site may contain unknown Made Ground and potentially sulphate bearing soils. The natural soils are likely to be low in sulphate concentrations.
- Shrinkage/swelling of clay – settlement/heave of foundations when located within the influence of trees and vegetation.
- Low strength, compressible ground.
- Running sands, loose landfill and shallow groundwater, leading to difficulty with excavation due to trench collapse.
- Constructability – the soils may be too soft or loose to allow ground improvement by the use of vibro-stone columns.



4.0 DESK STUDY CONCLUSIONS

Table 3.1 is a summary of the geo-environmental risks identified and the overall risk associated with the site has been designated using qualitative judgement according to the risk categories given in Table 4.1.

Based on historic land uses and its current operational use, the overall risk from land contamination at the site is considered to be low for the current site and low to moderate for the proposed development, but would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.

It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990.

Table 4.1: Assessed Overall Risk Categories for the Site from Land Contamination

Risk Category	Definition
Very High Risk	A significant contaminant linkage, including actual evidence of significant harm or significant possibility and significant harm, is clearly identifiable at the site (e.g. from visual or documentary evidence) under current conditions, with potential for legal and/or financial consequences for the site owner or other Responsible Person. Remediation advisable based on acute impacts being likely. Immediate action should be considered.
High Risk	A contaminant linkage is identifiable at the site under current and future use conditions. Although likely, there is no obvious actual evidence of significant harm or significant possibility and significant harm under current conditions. Extent of risk is therefore subject to confirmation by investigation and risk assessment and most likely to be deemed significant. Realisation of the risk is likely to present a substantial liability to the site owner or other Responsible Person. Remediation required for redevelopment and may also be required under Part 2A for existing receptors.
Moderate Risk	A contaminant linkage is identifiable at the site under current and future use conditions. However, it is not likely to be a significant linkage under current conditions. It is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Actual extent of risk subject to confirmation by additional investigation and risk assessment and most likely to lie between no possibility of harm (under current conditions) and significant possibility of significant harm (under conditions created by new use). Remediation may be required for redevelopment.
Low Risk	Potential pathways and receptors exist but history of contaminative use or site conditions indicates that contamination is likely to be of limited extent and below the level of possibility of harm. It is unlikely that the site owner or other Responsible Person would face substantial liabilities from such a risk. Precautionary investigations and risk assessment advisable on change of use. Any subsequent remedial works are likely to be relatively limited.
Very Low Risk	No contaminant linkage likely to exist under current or future conditions, but this cannot be completely discounted. If harm is realised, it is likely at worst to be mild or minor. Site not capable of being determined under Part 2A where the Local Authority inspects the site. No further action recommended.
No Risk	No contaminant linkage exists.



5.0 UNCERTAINTIES AND LIMITATIONS

5.1 General Comments

This report details the findings of work carried out in June 2014. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

The report has been prepared for the exclusive benefit of Bericote Properties and those parties designated by them for the purpose of providing geotechnical and geo-environmental recommendations for the site. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness.

The work has been carried out in general accordance with recognised best practice as detailed in guidance documents such as the CLR 11 Model Procedures (Environment Agency 2004), BS 5930:1999 +A2:2010 and BS 10175:2011+A1:2013.

The rationale behind the assessments carried out for this report is given in Appendix F.

Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase “suitable for use” is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The preliminary risk assessment process may identify potential risks to site demolition and redevelopment workers. However, consideration of occupational health and safety issues is beyond the scope of this report.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds such as Japanese knotweed, this report does not constitute a formal survey of these potential hazards.

Any site boundary line depicted on plans does not imply legal ownership of land.



6.0 RECOMMENDATIONS FOR FURTHER WORK

In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. Based on the current data, this site investigation is proposed to comprise:

- the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability, over break potential and “diggability” and allow soil infiltration rate testing to be undertaken;
- the undertaking of soil infiltration rate testing;
- cable percussive boreholes to allow collection of samples for geotechnical and chemical analysis of deeper soils and allow in-situ testing (SPTs) to be undertaken to assess density of the sands and gravel to allow foundation design, and allow the installation of gas and groundwater monitoring wells;
- Dutch Cone Penetration Testing to determine the vertical extent of the very soft to soft soils;
- gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored;
- assessment of the risk to contractors and future users from ground gas;
- gas concentration and groundwater level monitoring;
- geotechnical testing of soils and rock;
- contamination analyses of soil and groundwater;
- assessment of risk from soils to future site users; and
- geotechnical assessment of the soils with regards to the proposed distribution .



7.0 REFERENCES

- ALLEN, D. L., BREWERTON, L. J., COLEBY, L. M., GIBBS, B. R., LEWIS, M. A., MACDONALD, A. M., WAGSTAFF, S. J. and WILLIAMS, A.T. 1997. The physical properties of major aquifers in England and Wales. *British Geological Survey Technical Report WD/97/34*. 312pp. Environment Agency R&D Publication 8.
- BRITISH STANDARDS INSTITUTION. 1999. Code of practice for Site Investigations. *BS 5930 Incorporating Amendment No.2:2010*. BSI, London.
- BRITISH STANDARDS INSTITUTION. 2011. Code of Practice for Investigation of Potentially Contaminated sites. *BS 10175 Incorporating Amendment No.1:2013*. BSI, London.
- DCLG. March 2012. National Planning Policy Framework. DCLG, London.
- DCLG. March 2012. Technical Guidance to the National Planning Policy Framework. DCLG, London.
- ENVIRONMENT AGENCY. 2004. Model procedures for the management of land contamination. *Contaminated Land Report 11*. The Environment Agency.
- JONES, H. K., MORRIS, B. L., CHENEY, C. S., BREWERTON, L. J., MERRIN, P. D., LEWIS, M. A., MACDONALD, A. M., COLEBY, L. M., TALBOT, J. C., MCKENZIE, A. A., BIRD, M. J., CUNNINGHAM, J. and ROBINSON, V. K. 2000. The physical properties of minor aquifers in England and Wales. *British Geological Survey Technical Report WD/00/04*. 234pp. Environment Agency R&D Publication 68.
- MILES, J. C. H., APPLETON, J. D., REES, D. M., GREEN, B. M. R., ADLAM, K. A. M. and MYRES, A. H. 2007. Indicative Atlas of Radon in England and Wales. Health Protection Agency and British Geological Survey. Report HPA-RPD-033.
- RAWLINS, B. G., McGRATH, S. P., SCHEIB, A. J., CAVE, N., LISTER, T. R., INGHAM, M., GOWING, C. and CARTER, S. 2012. *The advanced geochemical atlas of England and Wales*. British Geological Survey, Keyworth.
- RUDLAND, D. J., LANCEFIELD, R. M. and MAYELL, P. N. 2001. Contaminated land risk assessment. A guide to good practice. *CIRIA Report C552*. CIRIA, London. 158 pp.
- SCIVYER, C. 2007. Radon: Guidance on protective measures for new buildings, extensions, conversions and refurbishment (2007 edition). Building Research Establishment Report BR 211. BRE, Garston.
- STONE, K., MURRAY, A., COOKE, S., FORAN, J. and GOODERHAM, L. 2009. Unexploded ordnance (UXO), a guide to the construction industry. *CIRIA Report C681*. CIRIA, London. 141 pp.
- WILSON, S., OLIVER, S., MALLETT, H., HUTCHINGS, H. and CARD, G. 2007. Assessing risks posed by hazardous ground gases to buildings. *CIRIA Report C665*. CIRIA, London. 182pp.



Appendix A

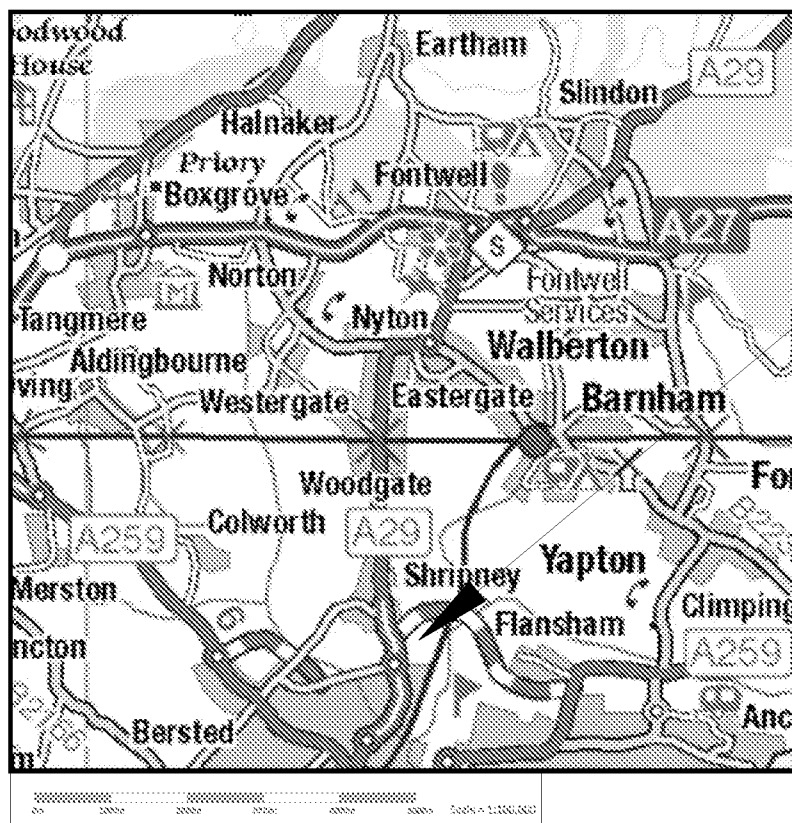
Drawings

Drawings included in this report:

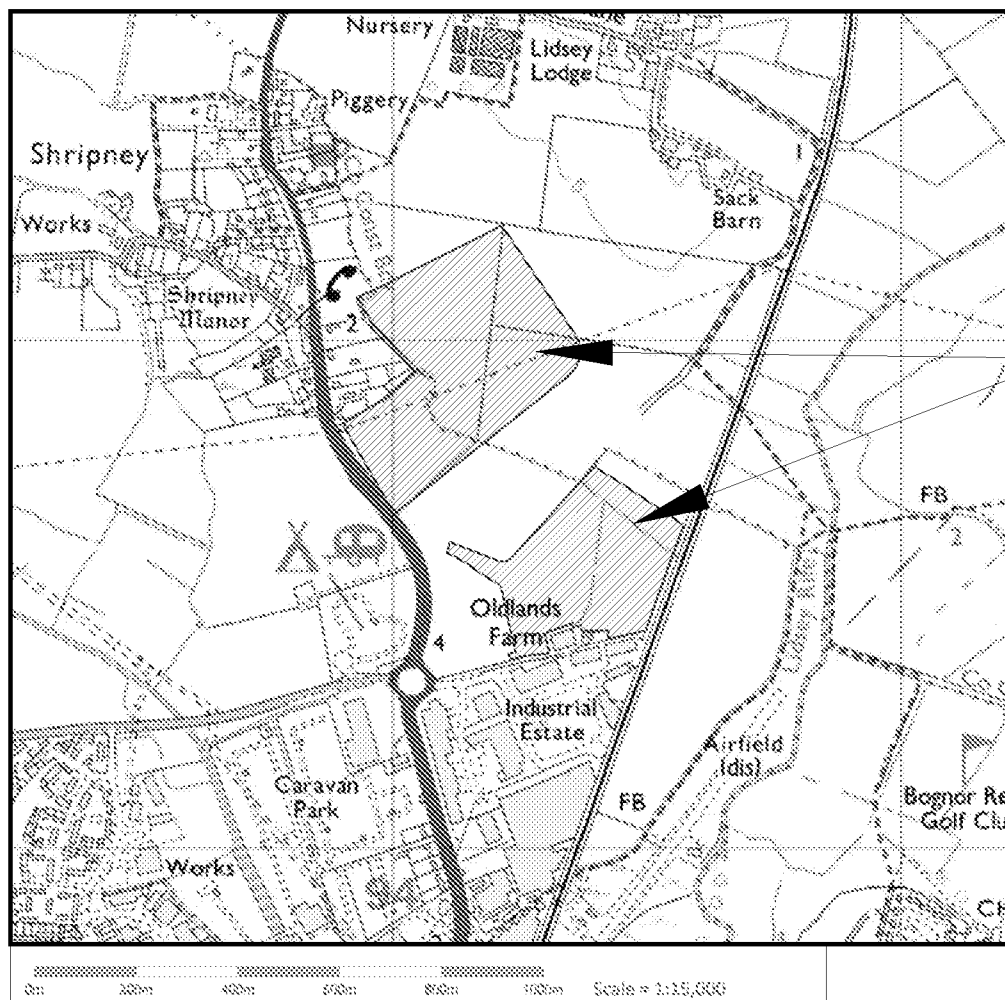
14459.D001 – Site Location Plan

14459.D002 – Topographic Survey

Site Layout Plan, reference 99603-ss-25

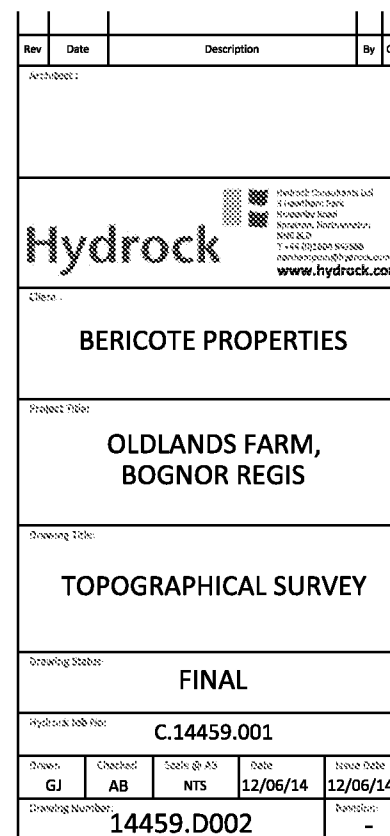
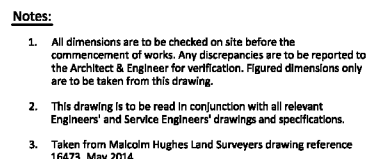


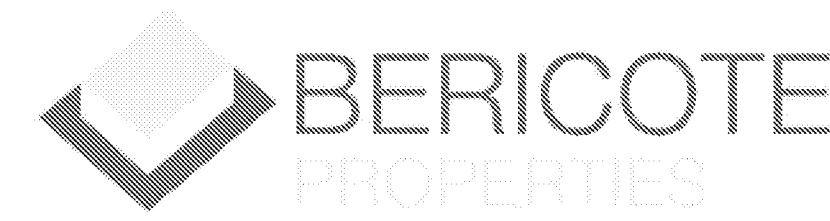
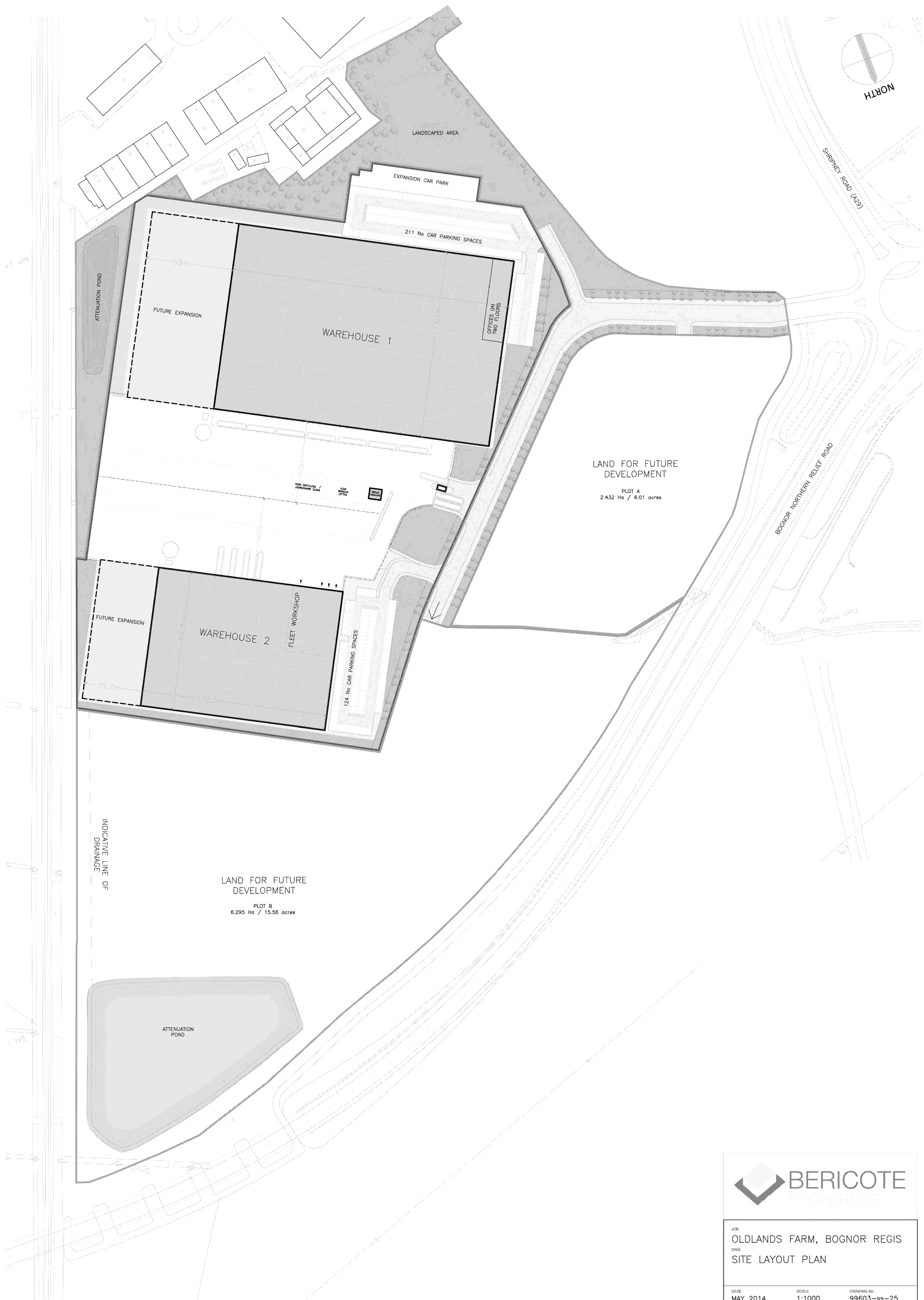
THE SITE



THE SITE

Rev	Date	Description	By	Ck
14459/D001  Hydrotek 14459/D001 www.hydrotek.com				
14459/D001 BERICOTE PROPERTIES				
14459/D001 OLDLANDS FARM, BOGNOR REGIS				
14459/D001 Site Location Plan				
14459/D001 FINAL				
14459/D001 C14459				
Drawn	Revised	Issue	Date	Issue
RP	AB	See Drawing	13/06/14	13/06/14
14459/D001				13/06/14





JOB
OLDLANDS FARM, BOGNOR REGIS
DWS
SITE LAYOUT PLAN

DATE
MAY 2014
SCALE
1:1000
DRAWING NO
99603-ss-25



Appendix B

Site Walkover Photographs



Figure 1: General view of the site.



Figure 2: General view of the site.



Figure 3: Farm buildings to the south of the site.

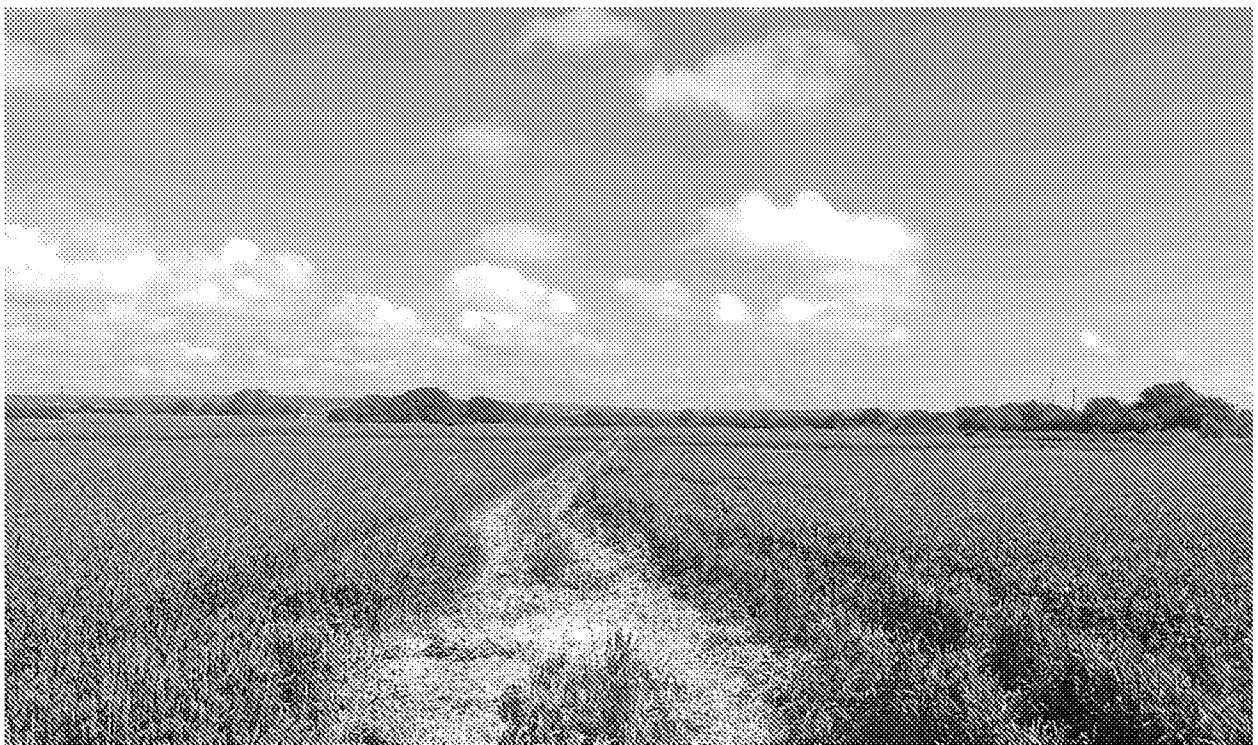


Figure 4: General view of the site.



Appendix C

Historical Ordnance Survey Maps



Site Details:

Land at Oldlands Farm, Bognor
Regis, PO22 9ST

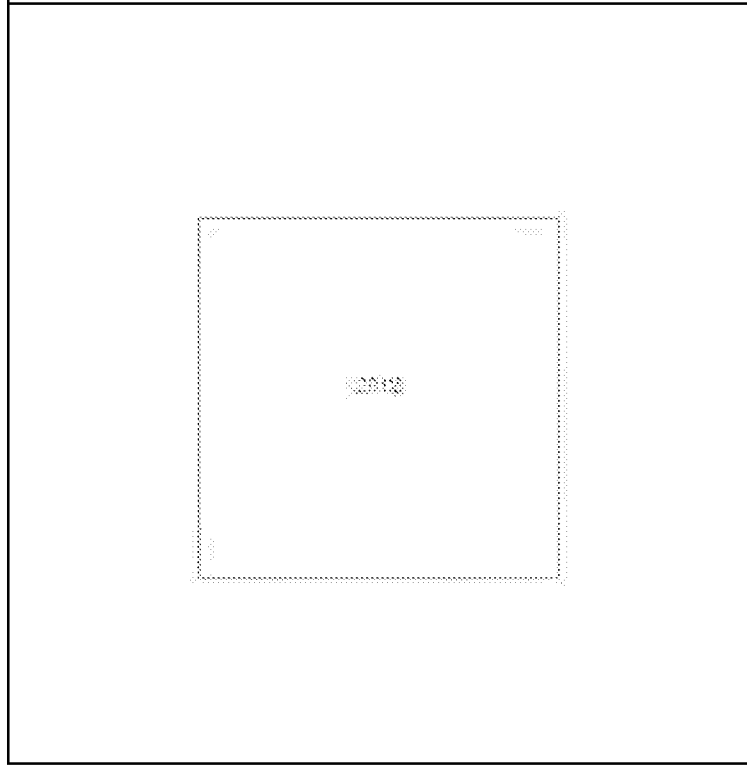
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Report Ref: HYD-1466353
Grid Ref: 494377, 101684

Map Name: National Grid

Map date: 2012

Scale: 1:10,000

Printed at: 1:10,000



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To view map legend click here [Legend](#)

