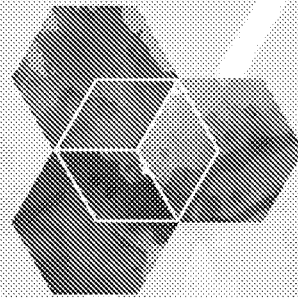


PHASE I GEO-ENVIRONMENTAL ASSESSMENT
for the site at
THE LAND AT TODDINGTON LANE, WICK, WEST SUSSEX, BN17 7PP
on behalf of
RABBIT WASTE MANAGEMENT LTD

Land
Science



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The Old Police Station, Jobs Lane, Sayers Common, West Sussex, BN6 9HE

Title:	PHASE I GEO-ENVIRONMENTAL ASSESSMENT
Site:	THE LAND AT TODDINGTON LANE, WICK, WEST SUSSEX, BN17 7PP
Development:	RESIDENTIAL DEVELOPMENT
Client:	RABBIT WASTE MANAGEMENT LTD
Agent:	RAPLEYS LLP
Date:	11th MAY 2017
Reference:	LS 2711
Version:	V2.0
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FIGURE 1:	Site Location Plan
FIGURE 2:	Existing Layout
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APPENDICES

APPENDIX A:	Photographs
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1.0 INTRODUCTION

1.1 General

Land Science was instructed by Rapleys LLP on behalf of Rabbit Waste Management Ltd to undertake a phase I Geo-environmental Assessment in relation to the proposed redevelopment at the land at Toddington Lane, Wick, Littlehampton, West Sussex, BN17 7PP. The location of the site is shown on Figure 1, which is centred at grid reference TQ 03400, 03855.

1.2 The Site

The area under investigation comprised a two-storey warehouse and a large yard area. The layout of the existing site is indicated on Figure 2, and a walkover survey is presented in section 3.0. The area was approximately 0.36 hectares. It was understood that the Client was in ownership of the site, and that this investigation was not a pre-purchase appraisal.

1.3 Form of Development

The proposed development was understood to comprise the construction of ten new homes (eight houses and two flats) with associated gardens and infrastructure. Figure 3 illustrates the layout of the proposed redevelopment.

1.4 Previous Investigations

Land Science was not aware of any previous desk studies or ground investigation(s) undertaken on this site and for this scheme. A number of investigations were understood to have been carried out in the surrounding area (see sections 2.20 and 2.21).

1.5 Geo-Environmental Objectives

A preliminary phase I assessment ("desk study") was required, to consider possible risks posed to the redevelopment, adjacent land uses, and the wider environment, in the context of planning.

1.6 Standards

Where practicable, the investigation was undertaken in accordance with the following standards and guidance:

- Model Procedures for the Management of Contaminated Land, DEFRA and Environment Agency, September 2004 ("CLR11").
- Guiding Principles for Land Contamination, Environment Agency, March 2010, ("GPLC").
- National Planning Policy Framework, March 2012.
- Building Regulations Approved Document C: Site preparation and resistance to contaminants and moisture, HM Government, July 2013.
- NHBC Standards Chapter 4.1: Land Quality - Managing Ground Conditions, 2016 edition.

Other technical sources have been cited in respect of specific aspects of the investigation, as referenced throughout the text.

2.0 PHASE I DESK STUDY

2.1 General

A detailed geo-environmental desk study was prepared, and included a review of:

- Maps and historical borehole records from the British Geological Survey
- Information publically available online from the Environment Agency
- Historical Ordnance Survey maps
- An environmental data report
- A Radon report from Public Health England
- A local archives search at Worthing Library
- A request for information from Environmental Health at Arun District Council

Copies of relevant data are presented in Appendices B to D.

2.2 Geological Setting

Based on mapping published online by the British Geological Survey (BGS), the geology of the site was anticipated to comprise the following succession:

Strata	Generic description
River Terrace Deposits	Sand and gravel, locally with lenses of silt, clay or peat.
New Pit Chalk Formation	Principally blocky, white firm to moderately hard chalk with numerous marls or paired marl seams. Flint occurs sporadically in the upper part in the deeper basin areas of the Southern Province. In some localities flint, in seams, occurs towards the base of the formation most notable over structural highs, towards the margins of the outcrop and within the "Transitional" Province.

2.3 Historical Borehole Records

Records of old boreholes held by the BGS were inspected. A number of borehole records were identified 125m north-west (ref. TQ00SW50) and 200m south (ref. TQ00SW48) of the site, and a summary of the encountered geology is given on the following table.

Strata	Base Depth (m)	Summary Description
"Drift Deposits (Brickearth)"	3.66-3.96m	"Clay, sand and gravel"
"Middle Chalk"	45.72m	"Chalk with flints"

The borehole records for the ground investigation of the adjacent site (Hollyacre Farm) to the west are summarised in the following table.

Strata	Base Depth (m)	Summary Description
Made Ground	0.06-1.10	Sandy gravel or silty sandy clay with brick fragments, with some visual and olfactory evidence of contamination.
River Terrace Deposits	2.35-4.45+	Sandy clay with bands of slightly clayey slightly gravelly sand.
New Pit Chalk Formation	2.85-4.45+	Structureless sub-angular chalk gravel (Dc).

2.4 Hydrogeology

The BGS borehole records identified groundwater standing at depths in the range of 5.33-5.49mbgl. The ground investigation for the neighbouring site (Hollyacre Farm) recorded groundwater seepages at 1.20mbgl and 2.00mbgl with a rest level of 1.02mbgl (corresponding with the base of the Made Ground / top of the River Terrace Deposits).

Based on the geology and topography of the local area, a relatively shallow groundwater table was anticipated.

2.5 Aquifer Designations

The Environment Agency classifies geological units across England and Wales into different designations as Aquifers. The designations for strata beneath the site are given below, which corresponds to an overall designation as a Principal Aquifer.

Strata	Classification	Details
Superficial	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Bedrock	Principal Aquifer	Strata that have high inter-granular and/or fracture permeability, usually providing a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

2.6 Source Protection Zones

A groundwater Source Protection Zone (SPZ) is an area of protection placed around a well or borehole that supplies groundwater of potable quality. The following data has been identified on and within 250m of the site according to Environment Agency mapping:

Location	Classification	Details
Within 250m	No SPZ	No groundwater Source Protection Zones were identified.

2.7 Drinking Water Protection Zones

A Drinking Water Protection Zone is similar to a SPZ. The following data has been identified on and within 250m of the site according to Environment Agency mapping:

Location	Classification	Details
Within 250m	Surface water	No protection zone identified
	Groundwater	

2.8 Water Abstractions

Water abstractions identified as part of the desk study within a radius of 500m of the site are summarised below.

Location	Purpose	Details
165m SE	Agriculture	Licence 10/41/414019 held by Yoder Toddington Ltd then by D W P Dales & Co for a single point groundwater abstraction at Foxdale Nursery.
260m S	Agriculture	Licence 10/41/414025 held by Yoder Toddington Ltd for a single point groundwater abstraction at Firview Nursery.
266m S	Agriculture	Licence 414025A held by Firview Nursery for abstraction from a pond or lake.
341m E	Agriculture	Licence 10/41/414031 held by Yoder Toddington Ltd for a single point groundwater abstraction at Foxdale Nursery.
366m NW	Agriculture	Licence 24/067 held by Kirin Agribo Toddington Ltd for a single point groundwater abstraction at Toddington Nursery.

2.9 Hydrology

Two large ponds were noted to the north and east of the site, approximately 215m and 115m respectively. The Black Ditch river was also noted approximately 575m to the north of the site, running east to west.

Land potentially susceptible to flooding from seas, rivers, reservoirs and surface water is identified by the Environment Agency. Current mapping indicated the following:

Source	Details
Coastal waters, Rivers and Reservoirs	The site does not lie within an area classified as being susceptible to significant flooding from these sources and therefore does not lie within an area benefiting from flood defences.
Surface water	The site did not appear to be at risk of flooding from surface water, however the adjacent site to the west and Toddington Lane did.

It is recommended that further more accurate details of potential flooding within the local area be obtained from the Environment Agency, in order to ascertain the level of any risk posed. It may become necessary to undertake a Flood Risk Assessment (FRA).

2.10 Industrial Sources

No pollution incidents were identified within a 250m radius of the site. Discharge consents identified within a radius of 250m are summarised on the following table:

Location	Purpose	Details
20m W	Sewage disposal	Final/Treated Effluent was licensed to discharge into the land (ref. P00690).
114m SE	Trade discharge	Process water was licensed to discharge into the land (ref. App/So/65su). Licence revoked as of 21 st April 2004.

Searches of various databases were made to identify industrial land uses within 250m of the site, as summarised on the following tables:

Points of Interest	Details	Location
Commercial Services	Arun Autogas Ltd, Repair and Servicing (Vehicle Repair, Testing and Servicing)	23m W
	South East Vehicle Valeting, Personal, Consumer and other Services (Vehicle Cleaning Services)	96m NE
	P S Autotechnik Ltd, Repair and Servicing (Vehicle Repair, Testing and Servicing)	96m NE
	A A G, Repair and Servicing (Vehicle Repair, Testing and Servicing)	96m NE
	Total Paintworks, Repair and Servicing (Vehicle Repair, Testing and Servicing)	96m NE
	Bennett Autos, Repair and Servicing (Vehicle Repair, Testing and Servicing)	97m NE
	Pro Design Scooter Engineering, Repair and Servicing (Vehicle Repair, Testing and Servicing)	178m N
Manufacturing and Production	Tank, Industrial Features (Tanks -Generic)	193m SE

Classification	Details	Location
Contemporary trade directories	Outback Trailers, Trailers & Towing Equipment, Inactive	23m W
	Sussex Scaffolding, Scaffolding & Work Platforms, Inactive	25m W
	P S Autotechnik Ltd, Car Customisation & Conversion Specialists, Inactive	96m NE
	Total Paintworks, Car Paint & Lacquer Manufacturers & Suppliers, Active	96m NE
	R J B Haulage, Sand, Gravel & Other Aggregates, Active	97m NE
	Temple Spa, Cosmetic Manufacturers, Inactive	116m S
	C S Developments Ltd, Concrete Contractors, Inactive	139m N
	Bennett Autos, Garage Services, Active	166m NE
	House Of Tees, T-Shirts, Active	201m SW
	Superior, Window Frame Manufacturers, Inactive	214m SW
	Total Packaging Supplies, Packaging & Wrapping Equipment & Supplies, Inactive	224m E

2.11 Waste Management Facilities

A search of various waste management databases revealed the following facilities within 500m:

Location	Type	Details
27m S	Licensed Waste Management Facility	Licensed Waste Management Facility (ref. 19665) at Tulley's Nurseries, Toddington Lane, Wick, Littlehampton receiving non-biodegradable wastes (not construction). Licence issued 10 th November 1993 and currently closed.
480m S	Historic landfill	Historic landfill recorded along Worthing Road, Littlehampton receiving inert, commercial and household waste between 31 st December 1960 and 31 st December 1970.

2.12 Potentially Infilled Land

A search of various databases revealed the following potentially infilled land within 250m:

Location	Type	Details
11m SE	Potentially Infilled Land	Unknown filled ground (Pond, marsh, river, stream, dock etc.) mapped in 1962.
135m S	Potentially Infilled Land	Unknown filled ground (Pond, marsh, river, stream, dock etc.) mapped in 1913.
189m S	Potentially Infilled Land	Unknown filled ground (Pond, marsh, river, stream, dock etc.) mapped in 1962.

2.13 Radon Gas

The requirement for Radon Protection Measures (RPM) has been assessed in accordance with BRE 211:2007¹. The following data obtained from Public Health England applies to the site:

Aspect	Classification	Details
Probability	Not at risk	Less than 1% of homes are estimated by PHE to exceed the threshold for Radon gas in residential dwellings.
Protection Measures	No RPM required	No Radon Protection Measures (RPM) are required for new dwellings or extensions constructed at this location.

2.14 Historical Maps

Large scale (e.g. 1:2,500) historical maps and aerial photographs dating between 1876 and 1999 were reviewed to identify the history of the site and local area. The outline of the site shown is geo-referenced to the current grid system; due to inaccuracies in mapping techniques the actual boundary on older maps may vary. Smaller scale (e.g. 1:10,000) maps were reviewed, but did not provide further relevant historical information. Given the size of these files sizes, smaller scale maps are not appended to the report but are available separately.

In summary, the site comprised open fields with two buildings, assumed to be agricultural, along the western edge in 1876. A fence line was noted across the site running east to west, partitioning off the southern tip of the site. By 1897, the southernmost building had been demolished and a small structure (possible animal pens) were noted along the northern site boundary. By 1911, two further buildings had been constructed near the centre of the site, these were also assumed to be agricultural buildings. By 1931, another additional building was noted in the southern part of the site, running along the existing fence line across the site. By 1969, all previous buildings had been removed, and the site comprised an access road from Toddington Lane, with a large building located centrally on site and three smaller buildings surrounding it (one to the west and two to the east). By 1980, the western building had been demolished, but part of the wall remained mapped. By 1994 the main central building had been removed along with one of adjoining buildings to the east, leaving one building and a wall mapped on site. By 1999, the wall was no longer mapped and the site was commensurate with the present day.

The site was located in a rural area in 1876, surrounded by open fields and farms with a railway line running east to west past the southern boundary of the site. In 1969, large numbers of nurseries comprising of many large glasshouses, were noted within the immediate vicinity of the site. By 2017, several of these areas were noted to have undergone or in the process of undergoing redevelopment for residential purposes.

The key apparent features noted on site and the surrounding area are summarised below.

Land use	Location	Dates	Description
Pond	Adjacent SE	1876-1911	A small pond was noted to the south-east of the site in 1876, but was no longer mapped by 1932 indicated potential infilling.
Railway line	Adjacent S	1876-present	A railway line was noted to run directly past the southern border of the site.
Farm	Adjacent W	1969-1999	<i>Hollyacre Farm</i> was noted directly adjacent to the site in 1969, and included several buildings. - By 1994, the area was just labelled as <i>Hollyacre</i>, and included several additional buildings and an above ground tank.
Farm	30m NE	1876-1974	- A farm was noted to the north-east of the site in 1876. - It was noted as <i>Toddington Farm</i> in 1969. - By 1979 some of the buildings remained, but it was believed to be in use for residential purposes. - The buildings were still present in 2017.
Nursery	50m N	1969-1999	<i>Longacre Nursery</i> was noted directly to the north of the site and comprised a collection of glasshouses and buildings. - By 2017 it was noted that this area was part of a large ongoing residential development.
Nursery	60m NW	1969-1999	<i>Holland Nursery</i> was noted directly to the north of the site and comprised a collection of glasshouses and buildings as well as several above ground tanks and silos. - By 2017 it was noted that this area was part of a large ongoing residential development.
Nursery	90m SE	1969-1999	<i>Foxdale Nursery</i> was noted to the west of the site, and comprised a collection of glasshouses and buildings. - By 2017, the area was noted to be occupied by a residential development.
Nursery	175m E	1969-present	<i>Tulley Nursery</i> was noted to the east of the site and comprised a collection of glasshouses and buildings as well as several above ground tanks. - By 2017, the nursery was noted to still be active.
Nursery	225m S	1969-1999	<i>Inglecroft Nursery</i> was noted to the south of the site and comprised a collection of glasshouses and buildings. - By 2017, the area was noted to be occupied by a residential development.
Nursery	240m SE	1969-present	<i>Firview Nursery</i> was noted to the south of the site and comprised a collection of glasshouses and buildings. - By 2017, the nursery was noted to have reduced in size, but was still active.

2.15 Historical Trade Directories

Available historical trade directories were inspected at Worthing Library to provide further historical land use information. Due to the size of the village of Toddington (Wick) between 1932 and 1953 the directories were listed as occupiers in this area, rather than by street. A summary of the relevant data pertaining to the area is given below.

Address	Dates	Land Use
Toddington	1932	L.U.D.C. Isolation Hospital
	1932-1953	The Farm
	1932-1953	Hollyacre Farm
	1953	Toddington Farm

From 1963, the directories were listed by street. The following entries were listed being present along Toddington Lane.

Address	Dates	Land Use
Toddington Lane (north of the railway)	1963-1969/70	Toddington Farm
	1967/68-1969/70	Longacre Nursery
	1967/68-1969/70	Holland Nursery
	1967/68-1969/70	Toddington Nuseries Ltd
	1969/70	K.C. Tulley Nursery Ltd
Toddington Lane (south of the railway)	1967/68	Inglecroft Nursery
	1967/68	Firview Nursery

Despite the relevant directories between 1872-1930 being available, no records for Toddington or Toddington Lane were found.

2.16 Background Geochemistry

The BGS publish data on background concentrations of selected contaminants across England and Wales. Data relevant to the site is summarised below:

Element	Estimated Concentration (mg/kg)
Arsenic	<15
Cadmium	<1.8
Chromium	60-90
Lead	<100
Nickel	15-30

2.17 Sensitive Land Uses

A search was made of environmentally sensitive areas, including areas of green belt, scenic or natural beauty, parks, reserves, nitrate zones, or protected conservation and scientific areas.

No such sensitive land uses were identified on site, although a Nitrate Vulnerable Zone for groundwater was identified to the 174m to the north of the site (DEFRA).

2.18 Statutory Authority Searches

An enquiry was made to the Environmental Health Officer at Arun District Council in order to confirm relevant information obtained as part of the desk study. The response did not detail any additional information to what has already been covered in this report.

2.19 Planning Search

A search was made of the planning records available online by Adur District Council. Two planning applications were found for two residential developments in close proximity to the site.

- Worthing Homes Development - Hollyacre Farm (Ref. LU/116/13, LU/109/14 and LU/389/15)
- Persimmon Homes Development - Land to the North of Toddington Lane (Ref. LU/47/11 and LU/164/15)

Both of these developments included planning conditions relating to contaminated land. The findings of the Phase I and Phase II reports, including any remediation are detailed in the following sections.

2.20 Worthing Homes Development

The Hollyacre Farm development was located adjacent to the west of the site. The proposed residential development was being undertaken in two phases, with the first completed and the second (the part of Hollyacre Farm immediately adjacent to our site) yet to start. The following reports were available via the planning register.

- Desk Study Report, Opus International Consultants (UK) Ltd, dated December 2012 (ref. E-E1524/LJP/CDS)
- Geo-environmental Ground Investigation, Opus International Consultants (UK) Ltd, dated February 2013 (ref. E-E1524.00)
- Topsoil Validation Stage 1, Opus International Consultants (UK) Ltd, dated December 2015 (ref. E-E1571.00)

The ground investigation was undertaken following the findings of the Desk Study and included 14no shallow boreholes, 2no hand-excavated trial pits to 1.20mbgl and 12no trial pits excavated using a JCB. A summary of the encountered conditions is presented in Section 2.3.

A series of chemical laboratory tests were undertaken on samples collected across the site. No areas of concern were identified for the stage 1 area of the site. However, Asbestos was identified in samples from the stage 2 area.

A validation report including the certificates for imported topsoil for stage 1 was available via the planning register, along with accompanying comment from the EHO, stating their satisfaction with

the works. The development for stage 1 was noted to have been completed by 2017 with the works on stage 2 yet to commence.

2.21 Persimmon Homes Development

The land to the north of Toddington Lane (formerly *Holland Nursery*) was located approximately 50m to the north-west of the site. The following reports were available via the planning register or referenced as part of other submitted documents.

- Ground Condition Desk Top Assessment Report, White Young Green Environmental Ltd, dated June 2008 (ref. A044029/AP/DTS/JUN08/V1)
- Ground Condition Assessment Report, White Young Green Environmental Ltd, dated October 2008 (ref. A044029/AP/GCAR/OCT08/V1)
- Geo-environmental assessment, Idom Merebrook, dated February 2014 (ref. GEA-18426-14-69)
- Gas Risk Assessment, Idom Merebrook, dated July 2014 (ref. L-18426-2.4.2-14-S326-MSG)
- Remediation Strategy, Idom Merebrook, dated October 2014 (ref. RMS-18426C-14-288)

The Ground Condition Assessment Report, by White Young Green Environmental Ltd, used the findings of the desk top study to target specific areas of concern across the site. The following contaminants were noted to be present within the near surface Made Ground and some shallow and deep natural soils in excess the screening values used.

Contaminant	Concentration (mg/kg)
Arsenic	50 (WS2 2.00m) and 65 (WS21 3.30m)
Lead	2100 in Made Ground
Nickel	54 (WS2 2.00m), 63 (WS9 0.40m) and 180 (WS14 0.20m)
Copper	160 (WS5 0.60m), 150 (WS5 4.50m) and 4700 (WS14 0.30m)
Zinc	5500 (WS14 0.30m)
Benzo(a)pyrene	1.2 (WS5 0.60m), 1.3 (WS5 4.50m), 16.0 (WS18 0.50m) and 1.5 (WS21 0.50m)
Di-benzo(a,h)anthracene	2.9 (WS18 0.50m)
TPH	2900 in Made Ground 350 in natural soils (maximum values)

The recommendations by White Young Green Environmental Ltd were for tank removal and validation sampling, a full ground gas risk assessment, a DQRA, an Asbestos survey, groundwater sampling and a remediation plan detailing a capping system. In addition, the EHO requested that a non-targeted ground investigation should be carried out.

The letter report by Idom Merebrook were assumed to address these recommendations and were referenced as part of the Remediation Strategy as part of the planning application (ref. LU/164/15). The following contaminants were noted to be exceedance of their respective screening values.

- Heavy metals (Arsenic, Lead)
- Phytotoxic metals (Copper, Zinc)
- PAH's (Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Di-benzo(a,h)anthracene)
- Total Petroleum Hydrocarbons (TPH)

Asbestos and Japanese Knotweed were also noted across the site. The groundwater monitoring assessment concluded that there was localised contamination of PAH's and TPH. The monitoring suggested that the groundwater was not laterally continuous and instead comprised a series of groundwater pockets.

It was noted as of 2017 that work on this development had commenced, and was being completed in stages.

3.0 SITE WALKOVER

3.1 General

A site walkover was undertaken on 13th February 2017. Photographs are provided in Appendix A.

3.2 Site Layout

In summary, the site comprised an irregular shaped parcel of land with a single building located centrally on site surrounded by a yard area. The site was understood to be in use by a scaffolding contractor. Access was gained via a tarmacked road from *Toddington Lane* to the east of the site.

The central building on site was a concrete frame, steel clad warehouse. This building had a concrete floor and was being used for the storage of equipment and materials relating to scaffolding, including poles, couplings, ladders and boards. Several gas canisters and containers of hydraulic oil were also noted within the building. No signs of visual or olfactory contamination were noted within the building. The roof appeared to comprise corrugated cement board sheeting; given the age of the structure the roofing might potentially contain asbestos.

The yard area surrounding the building was noted to be covered in compacted hardcore, including brick, concrete, plastic and tile fragments. Across the area was further scaffolding equipment including poles, couplings, ladders, boards and corrugated metal sheets. Some foam insulation boards were also noted in the north-west corner of the site. Several vehicles were also noted on site, including two large flatbed trucks, a small courier van and a 4x4 truck mounted on a trailer.

The entire site was covered by varying densities of overgrown vegetation.

3.3 Surrounding Area

The site was bordered by *Toddington Lane* to the north and east, with residential properties noted opposite. A series of commercial units were noted adjacent to the west of the site, believed to be part of the stage 2 development for the former Hollyacre Farm. The companies present were listed as *Bennett Autos* (aka *Bennett Bros Ltd*) (car repairs, servicing and MOTs), *Hollyacre Tunmore Builders* and *Hollyacre Produce*. A railway line was noted to run directly past the southern site boundary. Immediately adjacent to the site, to the south-east was located a small terrace of houses (*Toddington Farm Cottages*).

3.4 Elevation and Topography

The site and surrounding area sloped gently up to the west from 4.0mOD along Toddington Lane to 7.3mOD along the western edge of the site. The main yard of the site was noted to be covered by hardcore, assumed to create a more useable level surface. A steep bank ran along the northern and eastern borders of the site following the path of Toddington Lane.

3.5 Ground Conditions

No evidence of existing soil conditions was observed, such as open excavations or the like. Due to the site being covered by hardcore, Land Science were unable to find any evidence of any buildings that used to be on-site and had since been demolished.

No immediate evidence of significant structural movement was observed, or was reported to Land Science. However, our inspection was cursory and a full survey was outside the scope of this report.

3.6 Surface Water and Groundwater

No surface water features were identified on site or in the immediate vicinity. No evidence of shallow groundwater, such as boggy waterlogged soils or water loving plants etc., were noted.

3.7 Trees and Vegetation

The majority of the site was noted to be overgrown with brambles and other small vegetation. The vegetation was very sparse at the centre of the site and becoming denser the further out. No evidence of any Japanese Knotweed or other invasive species was noted in the areas that could be inspected, however, they could still be present within areas that could not be accessed where the dense, overgrown vegetation was noted.

A detailed arboricultural survey was outside the scope of this report. A survey may be required for tree root protection purposes or for assessing the depth of foundations in the vicinity of trees.

4.0 CONCEPTUAL SITE MODEL

4.1 General

A preliminary geo-environmental Conceptual Site Model (CSM) was formulated for the site in light of the proposed development. In accordance with best practice, the model has been used to identify possible contamination risks following a source-pathway-receptor ('SPR') approach.

The model may require revision where the development proposals differ, and should be reviewed in light of any ground investigation data or where unexpected conditions are encountered.

4.2 Site Setting

Based on the anticipated ground conditions revealed in the desk study, the following generalised soil and groundwater model is anticipated:

Strata	Base Depths	Soil types	Groundwater
Made Ground	unknown	Brick, concrete, plastic and tile fragments	Shallow groundwater is likely to be encountered within these strata (anticipated to be 1.00-2.00mbgl).
River Terrace Deposits	2.35-4.50m	Sandy clay with bands of sand	
New Pit Chalk Formation	>2.85m	Structureless chalk (Dc).	The chalk is designated a Principal Aquifer.

4.3 Potential Sources

In general terms, contaminants in the ground may partition themselves between different "compartments", primarily including the soil matrix, groundwater, volatile vapours, or decay and generate ground gases. This partitioning is used as the basis of the risk assessment, to group potential sources as summarised below:

Environmental Compartment	Summary description
Soil	Contaminants bound into or entrained with the soil matrix, for instance ashes, clinkers, bituminous materials, asbestos containing materials, etc. Contaminant may also enter the soil from anthropogenic sources such as leaking chemical storage, drainage and the like, becoming bound into the soil mineralogy or organic matter.
Volatile vapours	Many organic compounds are either volatile or semi volatile (at different temperatures and pressures) which mean they will volatilise and generate vapours. In an enclosed system, the ratio of vapours to other compartments will come into equilibrium, but in open systems the process may continue until the source has been depleted.

Ground gases	Organic matter in soils, including putrescible materials, hydrocarbons and other compounds, may decay in the environment through microbial action. This will primarily release Carbon Dioxide but may also release Methane under anaerobic conditions. This may be an issue in natural soils (such as alluvium and dock silt) in man-made soils (such as landfill sites and filled ground) and other environments (such as mine workings).
Ground water	Contaminants may dissolve into pore water which in turn may reside within the soil or percolate downwards into the groundwater table. Influx of fluid wastes or discharges may discharge rapidly and enter groundwater directly. Organic compounds may form separate light or heavy non-aqueous phase liquids upon or at the base of the water column.

It should be noted that groundwater may both be a receptor (as in the background chemical quality of an aquifer or resource) and in turn become a source (contaminated waters impacting on for instance deep buried structures such as concrete piles).

Identified sources of possible contamination arising in soils on site are summarised on the following table.

Soil Source	Description	Contaminants
Made Ground	Made Ground exists across the site. Fill may also occur under buildings and hardstandings etc. The provenance of such materials is unknown and may be contaminated.	Wide range of possible metals, non-metals, organic contaminants, asbestos, etc.
On site land use	The site was identified as having been in use as a scaffolding contractors yard, and is also believed to have been used for agriculture. Potentially contaminative activities may be carried out including: - Storage of fuels and oils - Storage of machinery/vehicles - Use of herbicides and pesticides - Livestock handling	Contaminants associated with these uses may include: - Fuels and oils (hydrocarbons) - Heavy metals - Phytotoxic metals - Herbicides and Pesticides (e.g. OCP, ONP, OPP) - Ammonia (animal urine) - Organic compounds - Inorganic compounds
Off-site land use	The following potentially contaminative activities were identified off-site: - Large nurseries (including above ground tanks and fertilisers) - Agricultural buildings and land - Industrial units (car repairs, builders etc.)	Contaminants associated with these uses may include: - Fuels and oils (hydrocarbons) - Heavy metals - Phytotoxic metals - Herbicides and Pesticides (e.g. OCP, ONP, OPP)

Vapours	Description	Contaminants
Vapours	The use of and potential for the storage of fuels and oils on-site given the previous site usage.	VOC's may be generated.

Ground Gas Source	Description	Contaminants
Potentially infilled land	Several areas of potentially infilled land were noted within the immediate vicinity of the site, including a pond adjacent to the south-east of the site.	Decomposition of wastes may generate ground gases. Methane (typically up to 20-65%) and Carbon Dioxide (typically up to 15-40%).
Waste management facility	A licensed waste management facility for no-biodegradable wastes was identified 27m south of the site.	
Decay of organic matter	Microbial decay of organic materials contained within Made Ground may generate ground gases. This is generally only significant where the depth of fill exceeds 1m and the organic content exceeds 1% SOM.	Low levels of Methane (typically <0.5%) and Carbon Dioxide (typically <5.0%). May also result in depleted levels of oxygen.

Groundwater Source	Description	Contaminants
Mobile contaminants	Mobile contaminants may leach out from the soil and migrate vertically downwards into the water table.	All contaminants identified in this column in the above tables have the potential to be mobile in the environment.

Due to the findings of the ground investigation reports for the land to the north of Toddington Lane (see Section 2.20), it is concluded that off-site sources of contamination from any sites not within the immediate vicinity of the site are potentially insignificant. The monitoring in these investigations indicated that the groundwater beneath the site was not laterally continuous and instead comprises a series of localised pockets of groundwater, thereby removing the pathway for off-site contaminants not within the immediate vicinity of the site.

The historic landfill site, 480m to the south of the site was deemed to be too far away from the site to be a source of potential contamination impacting the site.

4.4 Identified Receptors

Potential receptors associated with the site and the proposed development are summarised on the following table:

Receptor	Description	Notes
End users	Occupants of the proposed redevelopment.	Residential development.
Soft landscaping	Areas of planting including lawns, shrubs, trees, etc.	Private domestic gardens and communal soft landscaping is proposed.
Adjacent land users	Sensitive land uses identified locally	Residential properties (existing and proposed) were identified immediately adjacent to the site. Pathways for contamination could be liberation of dust during groundworks, etc.
Building materials	Built elements in contact with the ground.	Water supply pipework and buried structural concrete susceptible to chemical attack.
Ground water	Water below ground in permeable strata.	The site was noted to overly a Principal Aquifer, and shallow groundwater is anticipated.

The following receptors have not been identified:

Receptor	Description	Notes
Surface water	Surface water in lakes and rivers etc.	No significant surface water bodies have been identified in the immediate vicinity.

Finally, the following potential receptors were excluded from the assessment as they are covered by other legislative controls and are outside the remit of this report.

Receptor	Description	Notes
Ecological receptors	Statutory protected species or wildlife areas	An assessment of such risks was outside the scope of this report.
Site workers	Persons involved in construction works	Any risks posed to site workers would be controlled through other regimes including Health & Safety legislation, the CDM regulations and COSHH regulations etc.

4.5 Source-Pathway-Receptor Linkages

Whilst the various possible sources and receptors have been identified, the following matrix illustrates the identified pathways by which a contaminant linkage might plausibly exist. Off-site sources impacting on off-site receptors have not been considered.

		Sources			
		Soils	Vapours	Gases	Groundwater
Receptors	End users	Ingestion, dermal contact, inhalation of dust	Inhalation of vapours	Inhalation, ignition	None
	Soft landscaping	Plant Uptake	None	None	Plant Uptake
	Adjacent land users	Inhalation of dust	None	None	None
	Building materials	Chemical attack	Diffusion and advection	Not applicable	Chemical attack
	Groundwater	Leaching, downward and lateral migration	None	Not applicable	Not applicable

Ground gases are only a risk to soft landscaping at very high concentrations, and such concentrations are unlikely to exist at this site. This is usually only of concern for instance on or close to actively gassing landfill sites.

Contaminated Land Assessment Guidance 03/01/14UK considers risks from VOC and SVOC vapours from soil as a source

4.6 Other Factors

The following other areas of possible concern were identified, but were outside the geo-environmental risk assessment:

Asbestos	Asbestos may exist within buildings on site, including for instance in cement boarding. An appropriate survey should be undertaken to assess the presence of asbestos within the building fabric.
Invasive Plant Species	A number of non-native plant species have become invasive in the UK, such as Japanese knotweed, giant hogweed and Himalayan balsam. It is an offence under section 14(2) of the Wildlife and Countryside Act 1981 to "plant or otherwise cause to grow in the wild" any plant listed in Schedule nine, Part II of the Act. To have an invasive species growing on an urban property is not currently an offence itself and there is no specific legislation or regulations requiring control. However, the spread of such species onto adjoining land may cause a statutory nuisance, and the plant matter and soils contaminated by rhizomes may be subject to special controls. Advice should be sought by specialists where these species are identified on site. In addition, injurious weeds as classified under the Weeds Act 1959 may be a further consideration on or near agricultural land.

Leptospirosis	Weil's Disease is a bacterial infection spread by animals caused by leptospira bacteria. Leptospirosis generally causes mild flu-like symptoms, such as headache, chills and muscle pain, but in severe cases can be life-threatening and cause organ failure and internal bleeding. Leptospirosis can be caught by touching soil or water contaminated with the urine of wild animals (generally cattle, pigs, dogs and rodents, particularly rats) infected with the bacteria. Higher risks may arise through contact with sewage or freshwater. Leptospirosis is rare in the UK; only 44 cases were reported in England and Wales during 2011 (15 originated overseas and none were fatal).
Ecologically Sensitive areas	Damaging, disturbing or removing protected species can result in prosecution under a range of environmental legislation. Potential impacts on the ecological environment include: • Disturbance of birds, badgers, bats and other protected species • Removal and fragmentation of habitats • Disturbance to aquatic wildlife and water quality • Disturbance to wildlife from noise and vibration • Damage to trees and hedgerows. It is recommended that the advice of an appropriately qualified ecologist should be sought prior to undertaking any works.

5.0 CONCLUSIONS

5.1 Preliminary Risk Evaluation

A qualitative estimate of the level of risk associated with the identified source-pathway-receptor linkages has been made. The estimate is based on the likely significance of an identified source and the sensitivity of the identified receptor, as follows:

		Source				
		Unlikely	Very low	Low	Moderate	High
Receptor	Very Low	Negligible	Negligible	Very low	Low	Low to moderate
	Low	Negligible	Very low	Low	Low to moderate	Moderate
	Moderate	Negligible	Low	Low to moderate	Moderate	High
	High	Negligible	Low	Moderate	High	Very High

The identified sources have been rated as follows:

- Soil contamination: **High**
- Ground gas contamination: **Moderate**
- Vapours: **Moderate**
- Groundwater contamination: **Moderate**

Identified receptors have been assigned a qualitative sensitivity rating as follows:

- End users: **High**
- Adjacent land users: **Moderate**
- Groundwater: **Moderate**
- Soft landscaping: **High**
- Building Materials: **Moderate**

5.2 Qualitative Ratings

Sources	Media	Pathway	Receptor	Risk Rating
• Contaminated soils • Vapours • Ground gases • Mobile contaminants	Soil	Ingestion, dermal contact, inhalation	End Users	Very High
		Plant Uptake	Soft Landscaping	Very High
		Inhalation of dust	Adjacent land users	High
		Chemical attack	Building Materials	High
		Leaching and downward and lateral migration	Groundwater	High
	Vapours	Inhalation of vapours	End Users	High
		Diffusion and advection	Building Materials	Moderate
	Gases	Inhalation of vapours	End users	High
	Groundwater	Chemical attack	Building Materials	Moderate
		Plant Uptake	Soft Landscaping	High

Overall, the level of risk ranged between Moderate and Very High. Consequently, a **Very High** level of risk has been assigned to the site in respect of the proposed development.

5.3 Recommendations

It would be necessary to undertake basic ground investigation works, which may include;

- Drilling of shallow boreholes using a window sampler or similar to assess the composition and depth of Made Ground and any field evidence of contamination into the underlying soils.
- A number of boreholes should be extended down into the water table and into the the aquifer to install standpipes and in turn enable groundwater quality to be sampled and tested. Any perched water encountered should also be sampled.
- A number of standpipes should be installed, some into the Made Ground and some sealed through the Made Ground into the natural soils beneath, to allow for a series of gas monitoring visits to assess the potential ground gas contamination risk.
- Boreholes should be located in areas of concern; i.e. targeted to specific points of potential contamination such as within the footprint the existing building and historic buildings, in receptor sensitive locations such as in proposed garden areas, below the footprint of dwellings, in the location of buried services, etc.
- Boreholes should be located adjacent to the site boundaries in western and southern area, to evaluate the potential for contamination to have migrated laterally off site and impact on adjacent land users
- Soil samples should be screened for vapours using a PID.
- Selected samples (including materials bearing field evidence of contamination) should be sent for laboratory analysis. The main suite is identified below.
- Where encountered, water samples should be collected, for laboratory analysis. The main suite is identified below.

The analytical suite, based on the known site history and walkover survey, should include:

- General parameters: Acidity (pH), fraction of organic carbon, sulphates.
- Metals; Arsenic, Barium, Cadmium, Chromium (total), Copper, Mercury, Molybdenum, Nickel, Lead, Antimony, Selenium and Zinc.
- Organic Compounds; TPH, BTEX and Speciated PAH's.
- Inorganic Compounds; PCBs, Cyanide (total) and Ammonia
- Visual asbestos screening of all Made Ground samples. Where possible asbestos fibres or ACMs are identified, these should be examined under a microscope to determine type.
- A selection of shallow samples should be screened for pesticides and herbicides, with further testing for Organochlorine, Organonitrogen and Organophosphorus Pesticides (OCP, ONP and OPP) on any positive detections.

In addition, the requirement for Waste Acceptance Criteria (WAC) testing should be considered to correctly categorise soils in terms of disposal.

Further boreholes may be required, additional samples analysed or additional determinands added to the analysis, as appropriate, based on any field evidence of possible contamination encountered.

It would be prudent to confirm the scope of ground investigation works with the Local Authority and other stakeholders before carrying out these works.

REPORT CONDITIONS

Interpretation of ground conditions inherently depends on the conditions revealed by a limited data set. Land Science takes all reasonable professional care in preparation of this report, using current standards and industry best practice. However, we accept no liability whatsoever expressed or implied in respect of:

- The scope, extent or design of an investigation.
- Any conditions not directly revealed by the investigation.
- Published standards or methodologies used or adopted in this report.
- The opinion or position of any other party including any regulator, authority or stakeholder.
- Any dispute, claim or consequential loss arising from any finding or result in this report.
- Any matter other than ground conditions in the area under investigation.

Information contained in this report is intended for the use of the Client and his agents for the purposes set out, and we accept no liability for its use by other party or for any other purpose.

This report makes no representation on other matters such as ecology, agronomy, arboriculture, structural condition, building materials, boundaries and planning etc.

No aspect of this report should be taken as a guarantee whatsoever that a site is free of pollution, contamination or hazardous materials.

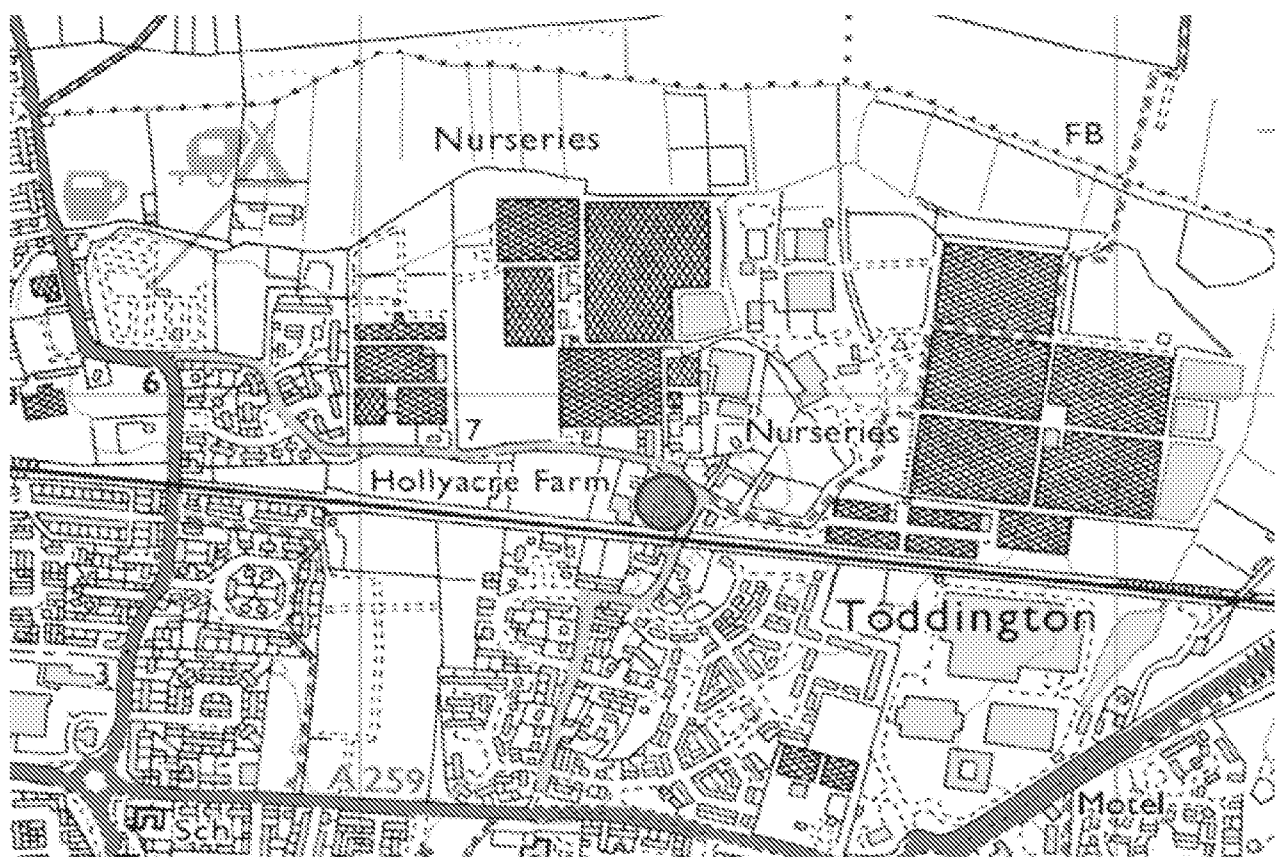
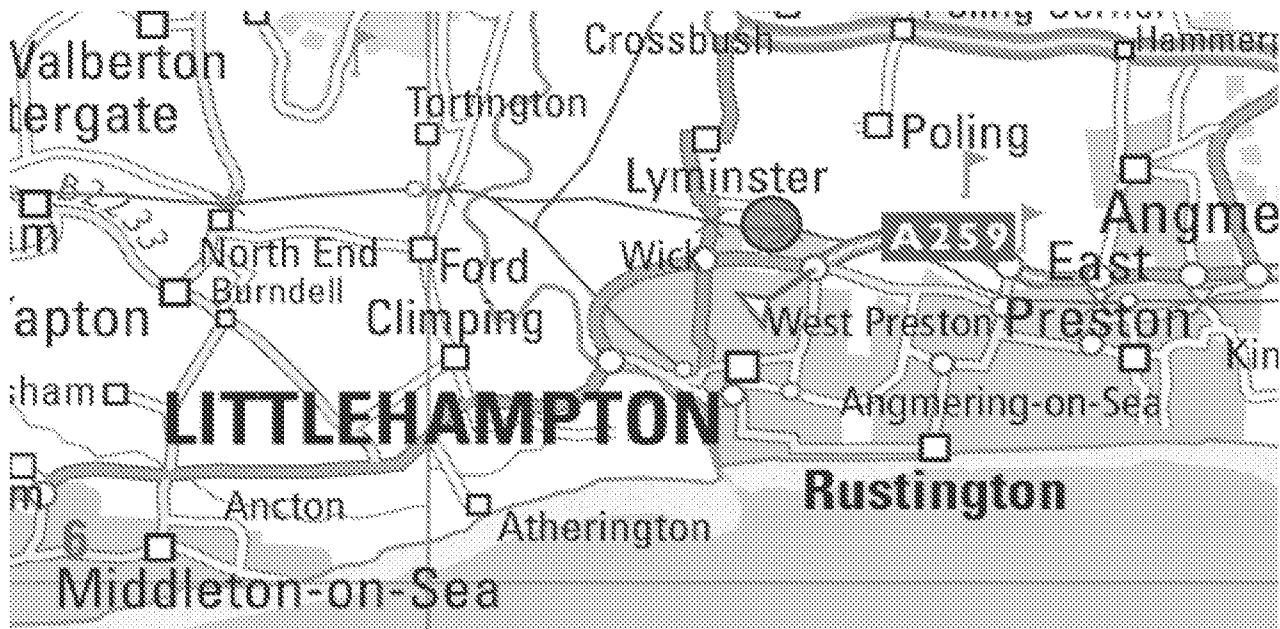
The levels of mobile liquid or gaseous contaminants may vary over time. Further or additional investigation may be necessary.

GLOSSARY OF TERMS

ACM	Asbestos Containing Material
BGS	British Geological Survey
BRE	Building Research Establishment
BSI	British Standards Institute
CBR	California Bearing Ratio
CDM	Construction Design and Management regulations
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment model
CLR	Contaminated Land Remediation report
CLR11	Model Procedures for the Management of Land Contamination, DEFRA & EA, 2004
COSHH	Control of Substances Hazardous to Human Health regulations
COMAH	Control of Major Accident Hazards regulations
CSM	Conceptual Site Model
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department for Environment, Transport and the Regions
DQRA	Detailed Quantitative Risk Assessment
DP	Dynamic Probe
EA	Environment Agency
EQS	Environmental Quality Standards
F.O.C	Fraction of Organic Carbon
GAC	Generic Assessment Criterion
GQRA	Generic Quantitative Risk Assessment
HSE	Health and Safety Executive
ICRCL	Inter-departmental Committee for the Redevelopment of Contaminated Land
IPC	Integrated Pollution Control
IPPC	Integrated Pollution Prevention and Control
MBGL	Meters Below Ground Level
NHBC	National House Building Council
NIHHS	Notification of Installations Handling Hazardous Substances
OD	Ordnance Datum
PAH's	Polycyclic Aromatic Hydrocarbons
PBET	Physiological Based Extraction Testing
PHE	Public Health England
PID	Photo-Ionisation Detector
PQRA	Preliminary Quantitative Risk Assessment
PSD	Particle Size Distribution Test
RMS	Remediation Method Statement
SGV	Soil Guideline Value
SOM	Soil Organic Matter
SPZ	Source Protection Zone
SPT	Standard Penetration Test
SSSI	Sites of Special Scientific Interest
ST-WEL	Short Term Workplace Exposure Limit
SVOC's	Semi-Volatile Organic Compounds
TPH	Total Petroleum Hydrocarbons
TRRL	Transport Road Research Laboratory
TWA-WEL	Time Weighted Average Workplace Exposure Limit
UK HBF	United Kingdom House Building Federation
VOC's	Volatile Organic Compounds
WAC	Waste Acceptance Criteria

REFERENCES

- ¹ Radon: Guidance on protective measures for new buildings, BRE Report BR 211, 2007 2ND edition



- Indicator of Site Location

Locations are indicative. Not to scale.

TITLE: Site Location			REF: LS 2711
PROJECT: Land at Toddington Lane, Wick, Littlehamptonm, BN17 7PP			VERSION v1
CLIENT: Rabbit Waste Management Ltd			FIGURE: 1
PREPARED: JH	CHECK: ET	DATE: 09/02/2017	SHEET No: page: 1 of 1

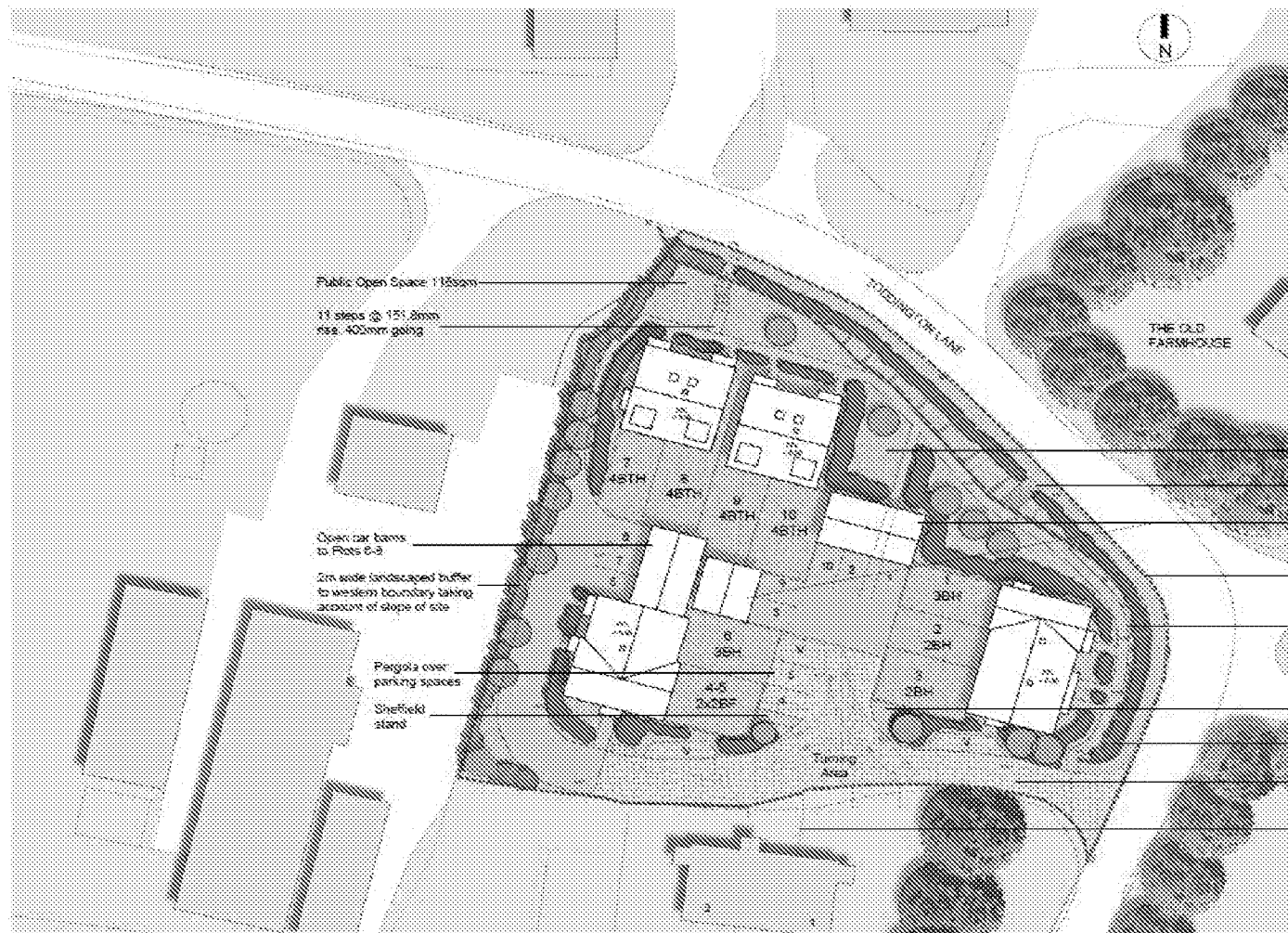


COM 2015 Health & Safety Information:
This document is for information only and should not be used for any other purpose.
It is the responsibility of the user to ensure that the information is correct and up to date.



Locations are indicative. Not to scale.

TITLE:	Exisiting Layout	REF:	LS 2711	PREPARED:	JH
PROJECT:	Land at Toddington Lane, Wick, Littlehampton, West Sussex, BN17 7PP	VERSION:	v1	CHECKED:	ET
CLIENT:	Rabbit Waste Management Ltd	FIGURE:	2	DATE:	11/05/2017



CDM 2015 Health & Safety Information:
www.landscape-architect.co.uk/health-safety
 15/05/2017 10:00:00 AM 10/05/2017 10:00:00 AM

Accommodation Schedule

Plot 1	3-Bedroom House	c. 84sqm
Plot 2	2-Bedroom House	c. 78sqm
Plot 3	2-Bedroom House	c. 78sqm
Plot 4	2-Bedroom Flat	c. 54sqm
Plot 5	2-Bedroom Flat	c. 60sqm
Plot 6	3-Bedroom House	c. 93sqm
Plot 7	4-Bedroom Townhouse	c. 117sqm
Plot 8	4-Bedroom Townhouse	c. 117sqm
Plot 9	4-Bedroom Townhouse	c. 117sqm
Plot 10	4-Bedroom Townhouse	c. 117sqm

Total 10no. Dwellings

Car Parking: 1 space per flat
 2 spaces per House
 Vehicle Parking of 0.3 spaces per dwelling
 Cycle Parking 2 spaces per dwelling in car lane and Sheffield stands

Public Open Space 115sqm

11 steps @ 150.8mm rise, 400mm going

Open car bays to Plots 6-9

2m wide landscaped buffer to western boundary taking account of slope of site

Pergola over parking spaces
 Sheffield stand

Turning Area

Public Open Space 255sqm

11 steps @ 150.1mm rise, 400mm going

Open Car Bays to Plots 1-3 and 9-10

Red Line indicates edge of road - 1.5m wide footpath suggested around northern site boundary with bank retained as required

Blue Line indicates approximate extent of current top of bank, this accords with ownership red-line

Sheffield stand

Low level (0.0m) planting to access road entrance

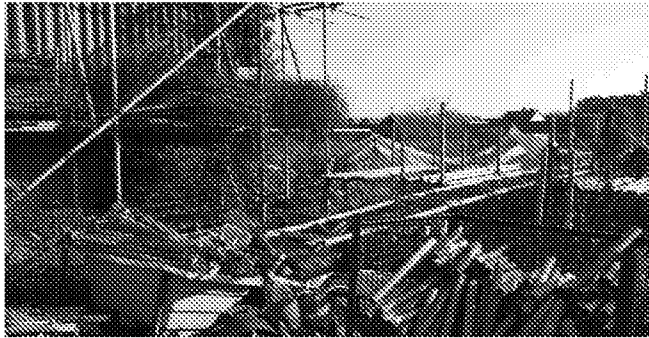
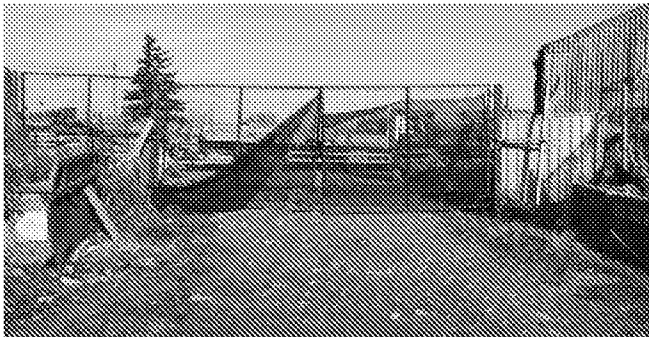
Pedestrian priority shared surface access road finished in block paving

Access maintained to and from Toddington Cottages

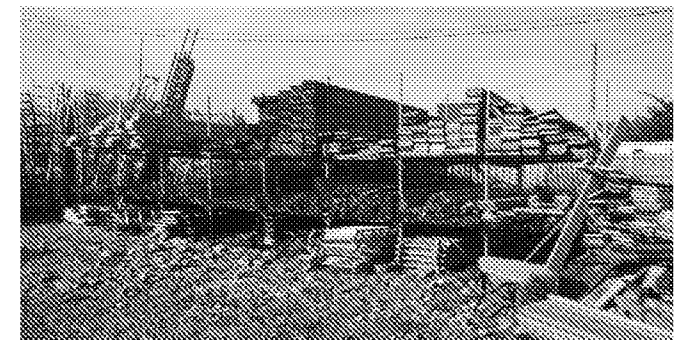
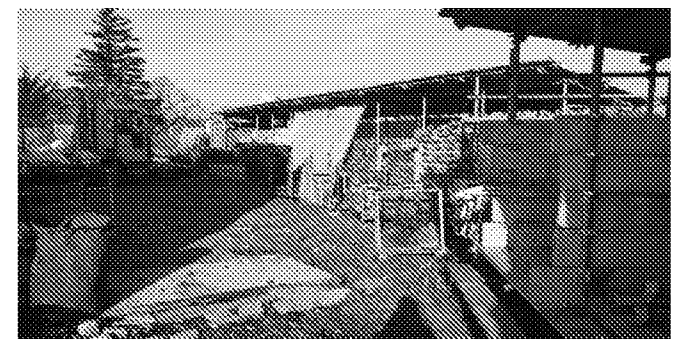
Locations are indicative. Not to scale.

TITLE:	Proposed Layout	REF:	LS 2711	PREPARED:	JH
PROJECT:	Land at Toddington Lane, Wick, Littlehampton, West Sussex, BN17 7PP	VERSION:	v1	CHECKED:	ET
CLIENT:	Rabbit Waste Management Ltd	FIGURE:	3	DATE:	11/05/2017

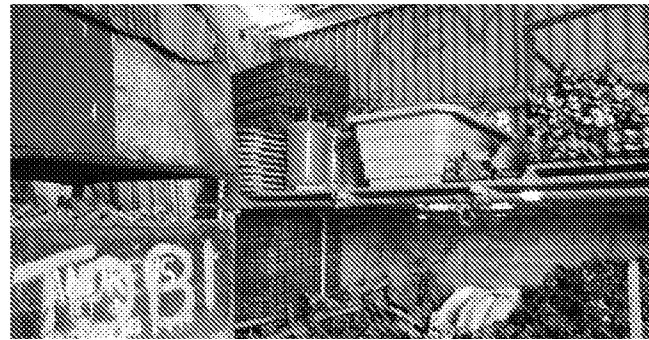
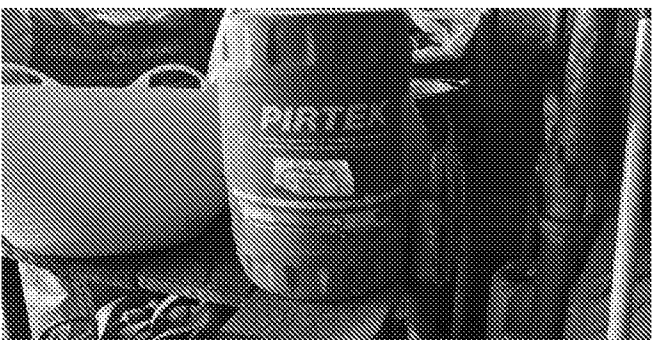
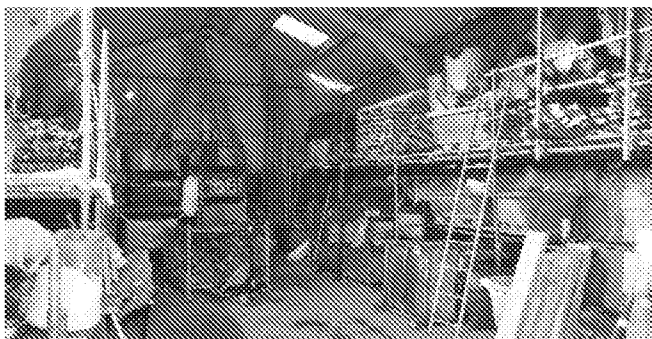
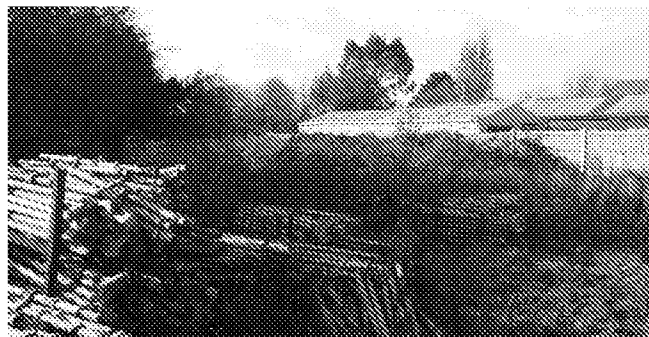
APPENDIX A



TITLE:	Photographs	REF:	LS 2711	PREPARED:	JH
PROJECT:	Toddington Farm Site, Toddington Lane, Littlehampton, West Sussex, BN17 7PP	VERSION:	v1	CHECKED:	ET
CLIENT:	Rabbit Waste Management Ltd.	Sheet No.:	1 of 3	DATE:	17/02/2017



TITLE:	Photographs	REF:	LS 2711	PREPARED:	JH
PROJECT:	Toddington Farm Site, Toddington Lane, Littlehampton, West Sussex, BN17 7PP	VERSION:	v1	CHECKED:	ET
CLIENT:	Rabbit Waste Management Ltd.	Sheet No.:	2 of 3	DATE:	17/02/2017



TITLE:	Photographs	REF:	LS 2711	PREPARED:	JH
PROJECT:	Toddington Farm Site, Toddington Lane, Littlehampton, West Sussex, BN17 7PP	VERSION:	v1	CHECKED:	ET
CLIENT:	Rabbit Waste Management Ltd.	Sheet No.:	3 of 3	DATE:	17/02/2017

APPENDIX B