

3. Current Land Uses

3.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site:

24

The following records are represented as points on the Current Land Uses map.

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	22.0	S	G C Compactors	494477 101394	Lennox House Works 10, Beeding Close, Bognor Regis, PO22 9TS	General Purpose Machinery	Industrial Products
2	34.0	S	Solartron Metrology Ltd	494285 101340	1, Steyning Way, Bognor Regis, PO22 9ST	Measurement and Inspection Equipment	Industrial Products
3	58.0	S	Electricity Sub Station	494320 101322	PO22	Electrical Features	Infrastructure and Facilities
4A	71.0	W	Gas Governor Station	494188 101351	PO22	Gas Features	Infrastructure and Facilities
5A	81.0	W	Gas Governor	494178 101347	PO22	Gas Features	Infrastructure and Facilities
6	90.0	SE	Pumping Station	494365 101306	PO22	Water Pumping Stations	Industrial Features
7	120.0	S	Cameron Measurement Systems	494271 101251	3, Steyning Way, Bognor Regis, PO22 9TT	Measurement and Inspection Equipment	Industrial Products
8B	136.0	S	Bognor Tyre & Exhaust Centre	494233 101237	Unit 8 Southern Cross Trading Estate, Bognor Regis, PO22 9SE	Vehicle Parts and Accessories	Motoring
9B	152.0	S	Electricity Sub Station	494251 101219	PO22	Electrical Features	Infrastructure and Facilities
10B	159.0	S	Parkers Food Machinery Plus	494198 101223	38, Oldlands Way, Bognor Regis, PO22 9SE	Food and Beverage Industry Machinery	Industrial Products
11	165.0	SW	Electricity Sub Station	494126 101269	PO22	Electrical Features	Infrastructure and Facilities
12C	166.0	SW	Labfacility Ltd	494192 101218	Units 5-7 Block K Southern Cross Industrial Estate, Shripney Road, Bognor Regis, PO22 9SE	Measurement and Inspection Equipment	Industrial Products
13C	172.0	SW	Southern Cross Garage	494184 101214	33-36, Oldlands Way, Bognor Regis, PO22 9SE	Vehicle Repair, Testing and Servicing	Repair and Servicing
14C	172.0	SW	Autosolution Ltd	494184 101214	33-36, Oldlands Way, Bognor Regis, PO22 9SE	Vehicle Repair, Testing and Servicing	Repair and Servicing
15	172.0	NW	Electricity Poles	494082 101880	PO22	Electrical Features	Infrastructure and Facilities
16	173.0	S	Paul Mathew Transport Ltd	494339 101208	Q House Southern Cross Trading Estate, Steyning Way, Bognor Regis, PO22 9SB	Distribution and Haulage	Transport, Storage and Delivery
17D	184.0	S	Acopia Group	494226 101189	Steyning Way, Bognor Regis, PO22 9SB	Packaging	Industrial Products

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
18D	204.0	S	Southern Cross Industrial Estate	494237 101168	PO22	Business Parks and Industrial Estates	Industrial Features
19	215.0	S	Electricity Sub Station	494272 101157	PO22	Electrical Features	Infrastructure and Facilities
20	223.0	SW	F & G Transport Bognor Ltd	494078 101237	Unit 1 Oldlands Way, Bognor Regis, PO22 9SD	Container and Storage	Transport, Storage and Delivery
21	227.0	E	Electricity Poles	494971 102088	PO22	Electrical Features	Infrastructure and Facilities
22	237.0	SW	F & G Transport Bognor Ltd	494103 101190	Unit 2 Oldlands Way, Bognor Regis, PO22 9SA	Distribution and Haulage	Transport, Storage and Delivery
23	239.0	SE	Tank	494411 101161	PO22	Tanks (Generic)	Industrial Features
24	246.0	E	Wind Sock	494801 101492	PO22	Aeronautical Features	Air

3.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: 1

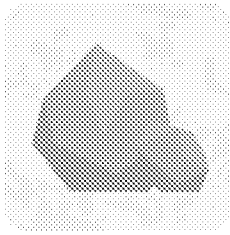
The following petrol or fuel site records provided by Catalist are represented as points on the Current Land Use map:

ID	Distance (m)	Direction	NGR	Company	Address	LPG	Status
25	288.0	SW	494025 101199	Obsolete	Bognor Garage, Shripney Road, Shripney Road, Bognor Regis, West Sussex, PO22 9NJ	Not Applicable	Obsolete

3.3 Underground High Pressure Oil and Gas Pipelines

Records of high pressure underground pipelines within 500m of the study site: 0

Database searched and no data found.



4. Geology

4.1 Artificial Ground and Made Ground

Database searched and no data found.

The database has been searched on site, including a 50m buffer.

4.2 Superficial Ground and Drift Geology

The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
RTDU-SSCL	RIVER TERRACE DEPOSITS (UNDIFFERENTIATED)	SAND, SILT AND CLAY
RMD-CSSG	RAISED MARINE DEPOSITS	CLAY, SILT, SAND AND GRAVEL

4.3 Bedrock and Solid Geology

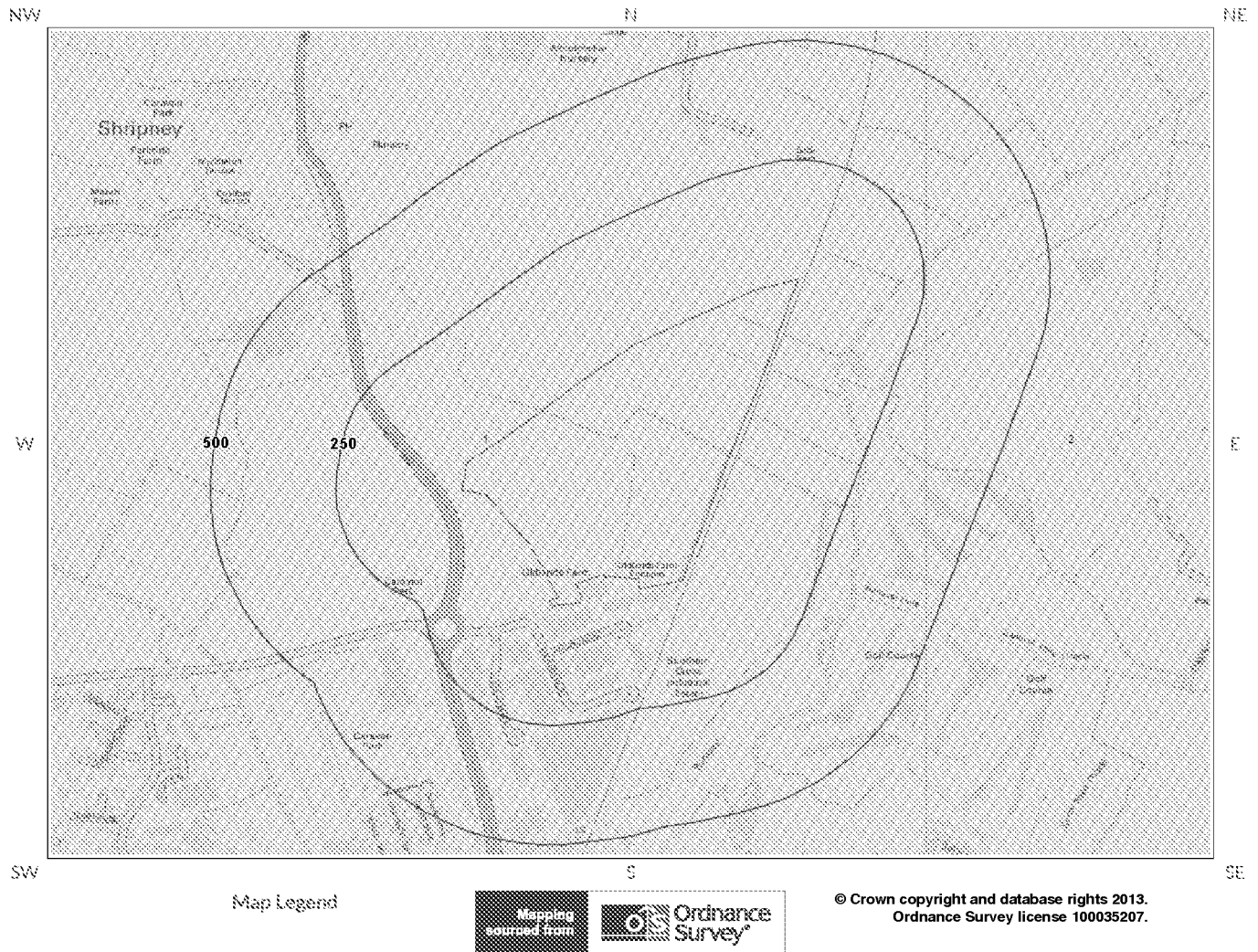
The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
LPCK-CHLK	LEWES NODULAR CHALK FORMATION, SEAFORD CHALK FORMATION, NEWHAVEN CHALK FORMATION, CULVER CHALK FORMATION AND PORTSDOWN CHALK FORMATION (UNDIFFERENTIATED)	CHALK

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

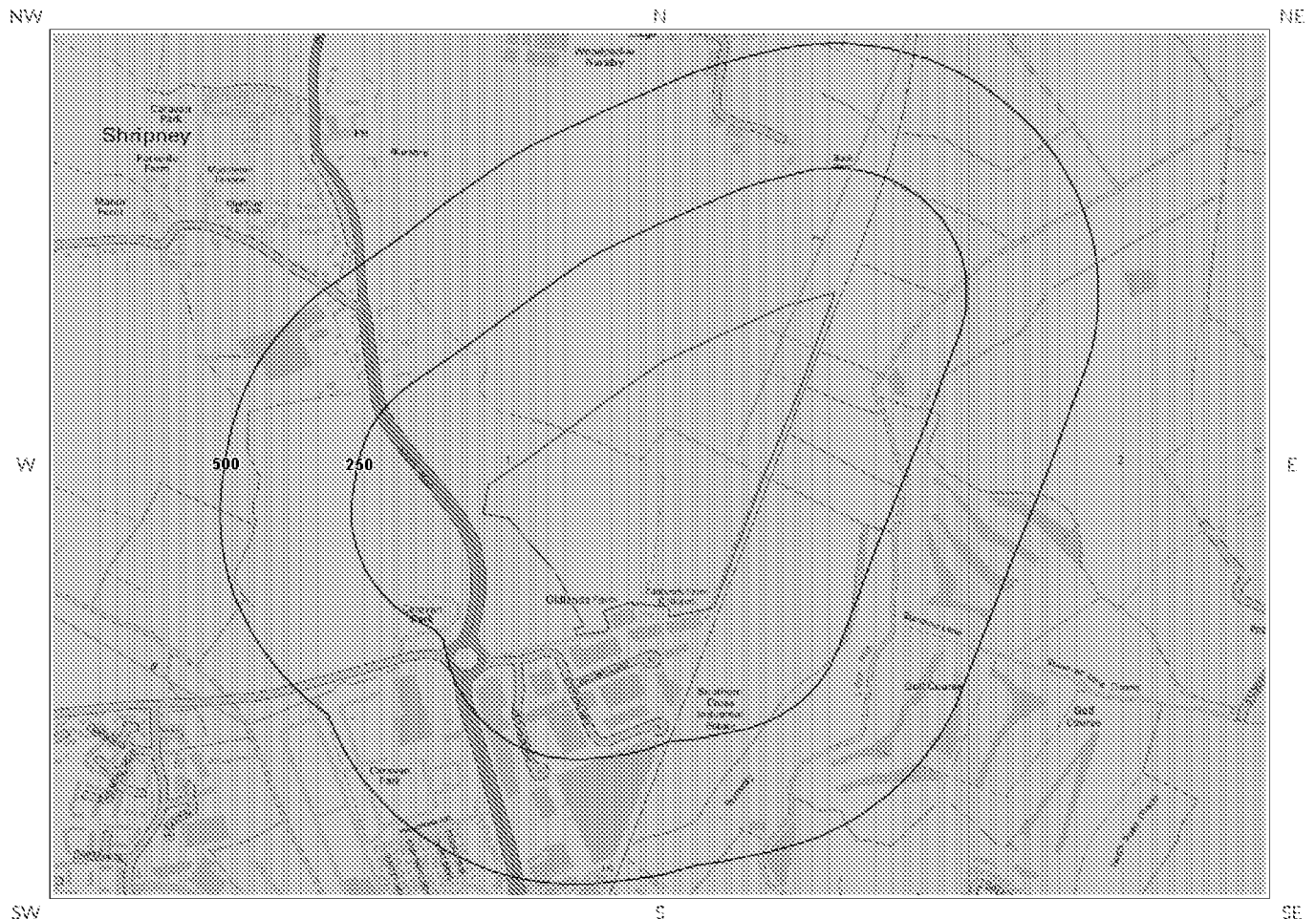
5. Hydrogeology and Hydrology

5a. Aquifer Within Superficial Geology



	Site Outline		Principal Aquifer		Secondary Aquifer - Undifferentiated Layers
	250m Search Buffers (m)		Secondary (A) Aquifer - Permeable Layers		Unproductive
	500m Search Buffers (m)		Secondary (B) Aquifer - Lower Permeability Layers		Unknown (lakes and landskip)

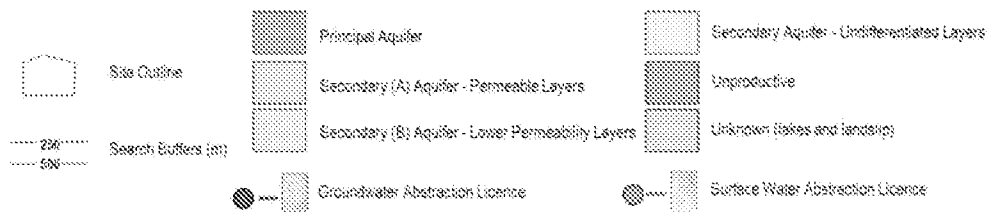
5b. Aquifer Within Bedrock Geology and Abstraction Licenses



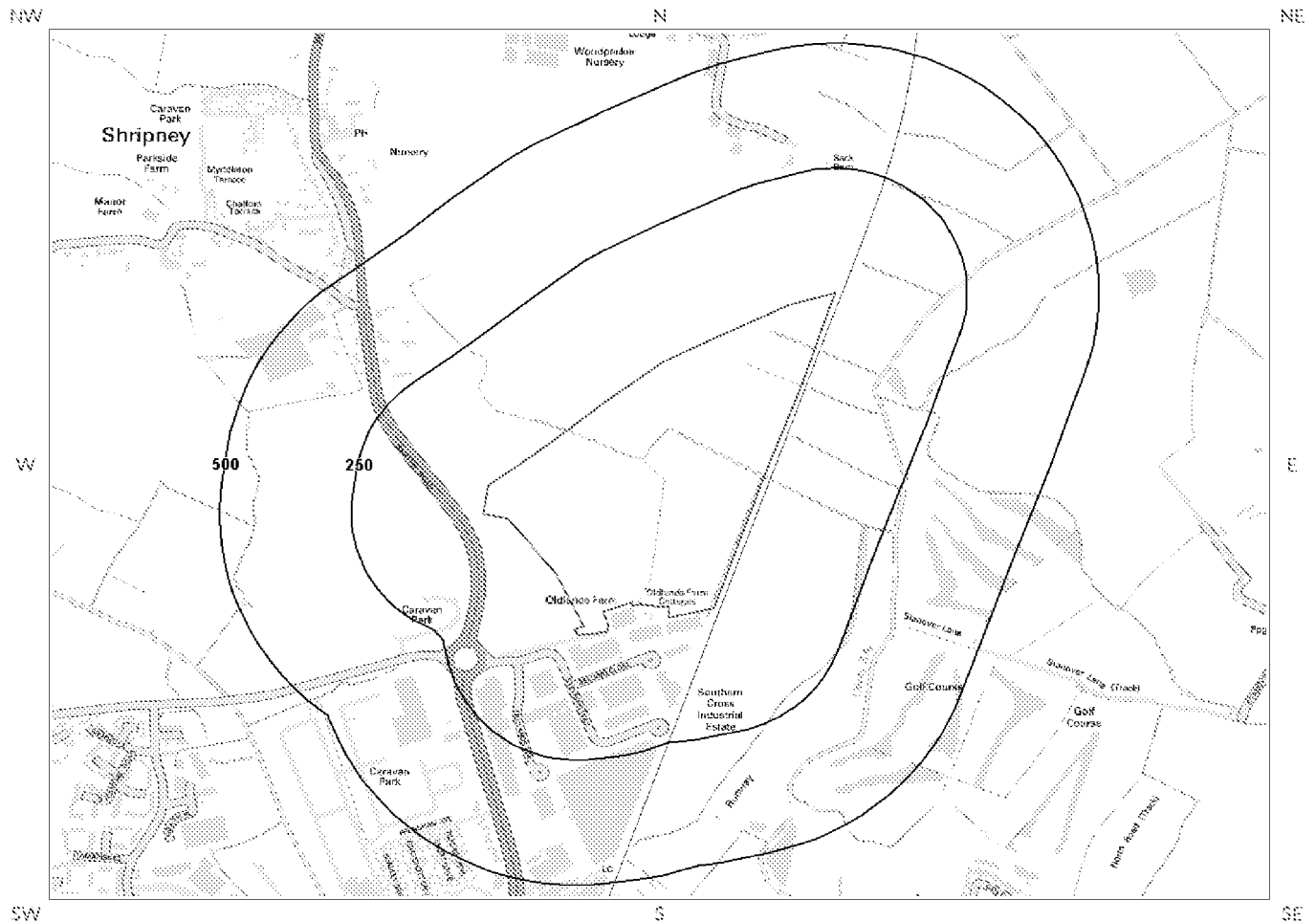
Map Legend



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5c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses

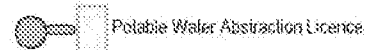


Map Legend



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- | | | | |
|---|--------------------|---|---|
|  | Site Outline |  | Source Protection Zone 1 - Inner Catchment |
|  | Search Buffers (m) |  | Source Protection Zone 2 - Outer Catchment |
| | |  | Source Protection Zone 3 - Total Catchment |
| | |  | Source Protection Zone 4 - Zone of Special Interest |



5d. Hydrology – Detailed River Network and River Quality



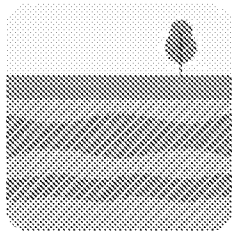
Map Legend



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	Primary River		Canal
	Secondary River		Canal Tunnel
	Tertiary River		Culvert
	Lake/Reservoir		Multiple Channel Culvert
	Underground River (inferred)		Underground River (Potential Sewer)
	General Quality Assessment: Biology		Underground River (local knowledge)
	General Quality Assessment: Chemistry		

Report Reference: HYD-1466354
Client Reference: N5752 / C14459



5. Hydrogeology and Hydrology

5.1 Aquifer within Superficial Deposits

Are there records of strata classification within the superficial geology at or in proximity to the property? **Yes**

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

The following aquifer records are shown on the Aquifer within Superficial Geology Map (5a):

ID	Distance (m)	Direction	Designation	Description
1	0.0	On Site	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. These are generally aquifers formerly classified as minor aquifers
2	254.0	E	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. These are generally aquifers formerly classified as minor aquifers

5.2 Aquifer within Bedrock Deposits

Are there records of strata classification within the bedrock geology at or in proximity to the property? **Yes**

From 1 April 2010, the Environment Agency's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the GroundSure Enviroinsight User Guide.

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (5b):

ID	Distance (m)	Direction	Designation	Description
1	0.0	On Site	Principal	Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers
2	254.0	E	Principal	Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers

5.3 Groundwater Abstraction Licences

Are there any Groundwater Abstraction Licences within 2000m of the study site?

Yes

The following Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (5b):

ID	Distance (m)	Direction	NGR	Details
Not shown	1439.0	NW	492870 102440	Licence No: 10/41/541004 Details: Spray Irrigation - Direct Direct Source: Southern Region Groundwater Point: At Shripney Farm, Bognor Regis Data Type: Point Annual Volume (m ³): 45460 Max Daily Volume (m ³): 547.2 Original Application No: WR.0009 Original Start Date: - Expiry Date: - Issue No: 102 Version Start Date: 10/6/2009 Version End Date:
Not shown	1460.0	E	496080 101450	Licence No: 10/41/542002 Details: General Farming & Domestic Direct Source: Southern Region Groundwater Point: At Flansham Farm, Flansham Data Type: Point Annual Volume (m ³): 9092 Max Daily Volume (m ³): 27.2 Original Application No: WR.0265 Original Start Date: - Expiry Date: - Issue No: 100 Version Start Date: 7/12/1992 Version End Date:
Not shown	1720.0	E	496440 101760	Licence No: 10/41/541002 Details: General Farming & Domestic Direct Source: Southern Region Groundwater Point: Point 2 At Shripney Farm & Flansham Farm Data Type: Point Annual Volume (m ³): - Max Daily Volume (m ³): - Original Application No: WR.0009 Original Start Date: - Expiry Date: - Issue No: 100 Version Start Date: 21/3/2001 Version End Date:
Not shown	1858.0	NW	492580 102760	Licence No: 10/41/541002 Details: General Farming & Domestic Direct Source: Southern Region Groundwater Point: Point 1 At Shripney Farm & Flansham Farm Data Type: Point Annual Volume (m ³): - Max Daily Volume (m ³): - Original Application No: WR.0009 Original Start Date: - Expiry Date: - Issue No: 100 Version Start Date: 21/3/2001 Version End Date:

5.4 Surface Water Abstraction Licences

Are there any Surface Water Abstraction Licences within 2000m of the study site?

Yes

The following Surface Water Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (5b):

ID	Distance (m)	Direction	NGR	Details
7	0.0	On Site	494950 102740	Licence No: 10/41/542102 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Between Points C&D At Lidsey, Bersted Data Type: Line Annual Volume (m ³): 19639 Max Daily Volume (m ³): 909.2 Application No: WR.0714 Original Start Date: 20/5/1966 Expiry Date: 31/3/2016 Issue No: 101 Version Start Date: 10/6/2009 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
8	616.0	SW	492920 101610	Licence No: 10/41/541001 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Aldingbourne Rife At Whitehouse Farm. Data Type: Line	Annual Volume (m³): - Max Daily Volume (m³): - Application No: WR 1265 Original Start Date: - Expiry Date: - Issue No: 100 Version Start Date: 7/12/1996 Version End Date:
Not shown	786.0	N	494310 103260	Licence No: 10/41/542010 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Lidsey Rife Reach A-b, lidsey Data Type: Line	Annual Volume (m³): 14092 Max Daily Volume (m³): 227.3 Application No: 169/0197 Original Start Date: - Expiry Date: - Issue No: 101 Version Start Date: 10/6/2009 Version End Date:
Not shown	1086.0	N	494930 103540	Licence No: 10/41/542010 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Lidsey Rife Reach C-d, Lidsey Data Type: Line	Annual Volume (m³): - Max Daily Volume (m³): - Application No: 169/0197 Original Start Date: - Expiry Date: - Issue No: 100 Version Start Date: 10/5/1995 Version End Date:
Not shown	1115.0	E	495837 102285	Licence No: SO/041/0024/005 Details: Spray Irrigation - Storage Direct Source: Southern Region Surface Waters Point: Ryebank Rife - Stakers Farm, Yapton Data Type: Point	Annual Volume (m³): 295053 Max Daily Volume (m³): 7800 Application No: NPS/WR/006679 Original Start Date: 23/6/2011 Expiry Date: 31/3/2028 Issue No: 1 Version Start Date: 23/6/2011 Version End Date:
Not shown	1342.0	N	494380 104320	Licence No: 10/41/542102 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Between Points A&b At Lidsey, bersted Data Type: Line	Annual Volume (m³): 19639 Max Daily Volume (m³): 909.2 Application No: WR.0714 Original Start Date: 20/5/1966 Expiry Date: 31/3/2016 Issue No: 101 Version Start Date: 10/6/2009 Version End Date:
Not shown	1350.0	N	494281 103329	Licence No: SO/041/0024/007 Details: Spray Irrigation - Storage Direct Source: Southern Region Surface Waters Point: Lidsey Rife (west Branch) At Headhone Farm Data Type: Point	Annual Volume (m³): 125000 Max Daily Volume (m³): 2400 Application No: NPS/WR/014692 Original Start Date: 7/2/2014 Expiry Date: 31/3/2028 Issue No: 1 Version Start Date: 7/2/2014 Version End Date:
Not shown	1358.0	N	494290 103340	Licence No: 27/208 Details: Spray Irrigation - Storage Direct Source: Southern Region Surface Waters Point: West Branch Of The Lidsey Rife Data Type: Point	Annual Volume (m³): 45000 Max Daily Volume (m³): 600 Application No: 1695/0020 Original Start Date: 31/5/2007 Expiry Date: 31/3/2016 Issue No: 1 Version Start Date: 16/6/2009 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
Not shown	1408.0	N	494930 103540	Licence No: 10/41/542010 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Lidsey Rife Reach C-d, Lidsey Data Type: Line	Annual Volume (m³): 14092 Max Daily Volume (m³): 227.3 Application No: 169/0197 Original Start Date: - Expiry Date: - Issue No: 101 Version Start Date: 10/6/2009 Version End Date:
Not shown	1449.0	E	496190 101940	Licence No: 10/41/411016 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Ryebank Rife - New Reach Data Type: Line	Annual Volume (m³): 27272 Max Daily Volume (m³): 2182 Application No: - Original Start Date: - Expiry Date: - Issue No: 101 Version Start Date: 8/6/2009 Version End Date:
Not shown	1660.0	E	496390 101830	Licence No: 27/209 Details: Spray Irrigation - Storage Direct Source: Southern Region Surface Waters Point: Ryebank Rife, Point A - Bilsham Data Type: Point	Annual Volume (m³): 250402 Max Daily Volume (m³): 7800 Application No: 1695/0025 Original Start Date: 18/12/2007 Expiry Date: 31/3/2016 Issue No: 1 Version Start Date: 16/6/2009 Version End Date:
Not shown	1870.0	NW	492430 102540	Licence No: 10/41/541001 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Left Bank Of The Aldingbourne Rife Looking Downstream Data Type: Point	Annual Volume (m³): 9092 Max Daily Volume (m³): 545.5 Application No: WR.265 Original Start Date: - Expiry Date: - Issue No: 101 Version Start Date: 10/6/2009 Version End Date:
Not shown	1870.0	NW	492430 102540	Licence No: 10/41/541309 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Left Bank Of The Aldingbourne Rife Looking Downstream Data Type: Point	Annual Volume (m³): 12274 Max Daily Volume (m³): 909.2 Application No: WR.714 Original Start Date: - Expiry Date: 31/3/2016 Issue No: 101 Version Start Date: 10/6/2009 Version End Date:
Not shown	1870.0	NW	492430 102540	Licence No: 27/186 Details: Spray Irrigation - Storage Direct Source: Southern Region Surface Waters Point: Left Bank Of The Aldingbourne Rife Looking Downstream Data Type: Point	Annual Volume (m³): 90920 Max Daily Volume (m³): 1440 Application No: - Original Start Date: - Expiry Date: - Issue No: 103 Version Start Date: 16/6/2009 Version End Date:
Not shown	1870.0	NW	492430 102540	Licence No: 10/41/542102 Details: Spray Irrigation - Direct Direct Source: Southern Region Surface Waters Point: Left Bank Of The Aldingbourne Rife Looking Downstream Data Type: Point	Annual Volume (m³): 19639 Max Daily Volume (m³): 909.2 Application No: WR.0714 Original Start Date: 20/5/1966 Expiry Date: 31/3/2016 Issue No: 101 Version Start Date: 10/6/2009 Version End Date:

ID	Distance (m)	Direction	NGR	Details
Not shown	1978.0	NW	492490 102840	Licence No: 27/185 Details: Spray Irrigation - Storage Direct Source: Southern Region Surface Waters Point: Right Bank Of The Aidingbourne Rife Looking Downstream. Data Type: Point Annual Volume (m³): 61371 Max Daily Volume (m³): 1440 Application No: - Original Start Date: - Expiry Date: - Issue No: 101 Version Start Date: 16/6/2009 Version End Date:
Not shown	1984.0	S	494560 99410	Licence No: 27/201 Details: Make-Up Or Top Up Water Direct Source: Southern Region Surface Waters Point: Aidingbourne Rife At Butlins Holiday Village, Point 'a' Data Type: Point Annual Volume (m³): 40000 Max Daily Volume (m³): 360 Application No: 169/1783 Original Start Date: 23/12/2002 Expiry Date: 31/3/2016 Issue No: 1 Version Start Date: 23/12/2002 Version End Date:

5.5 Potable Water Abstraction Licences

Are there any Potable Water Abstraction Licences within 2000m of the study site? No

Database searched and no data found.

5.6 Source Protection Zones

Are there any Source Protection Zones within 500m of the study site? No

Database searched and no data found.

5.7 River Quality

Is there any Environment Agency information on river quality within 1500m of the study site? Yes

5.7.1 Biological Quality:

Biological Quality data describes water quality in terms of 83 groups of macroinvertebrates, some of which are pollution sensitive. The results are graded from A ('Very Good') to F ('Bad').

The following Biological Quality records are shown on the Hydrology Map (5d):

ID	Distance (m)	Direction	NGR	River Quality Grade	Biological Quality Grade				
					2005	2006	2007	2008	2009
Not shown	871.0	S	494270 100500	River Name: Aldingbourne Rife Reach: Coast - Barnham Rife Conf End/Start of Stretch: Start of Stretch NGR	C	C	C	C	C
Not shown	871.0	S	494270 100500	River Name: Lidsey Rife Reach: Aldingbourne/barnham Rifes - Westergate End/Start of Stretch: End of Stretch NGR	C	C	C	C	C

5.7.2 Chemical Quality:

Chemical quality data is based on the General Quality Assessment Headline Indicators scheme (GQAHI). In England, each chemical sample is measured for ammonia and dissolved oxygen. In Wales, the samples are measured for biological oxygen demand (BOD), ammonia and dissolved oxygen. The results are graded from A ('Very Good') to F ('Bad').

The following Chemical Quality records are shown on the Hydrology Map (5d):

ID	Distance (m)	Direction	NGR	River Quality Grade	Chemical Quality Grade				
					2005	2006	2007	2008	2009
Not shown	871.0	S	494270 100500	River Name: Aldingbourne Rife Reach: Coast - Barnham Rife Conf End/Start of Stretch: Start of Stretch NGR	E	E	E	E	E

5.8 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site?

Yes

The following Detailed River Network records are represented on the Hydrology Map (5d):

ID	Distance (m)	Direction	Details	
1	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
2	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
3	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
4	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
5	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
6	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
7	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
8	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
9	0.0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
10	57.0	NW	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
11	76.0	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
12	130.0	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
13	136.0	E	River Name: Ryebank Rife Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
14	144.0	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
15	144.0	E	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
16	166.0	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
17	206.0	E	River Name: Ryebank Rife Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
18	207.0	E	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
19	207.0	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
20	231.0	E	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
21	233.0	E	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined

ID	Distance (m)	Direction	Details	
22	243.0	NE	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
23	253.0	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
24	270.0	E	River Name: Lidsey Rife Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
25	310.0	NW	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
26	336.0	N	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
27	343.0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
28	350.0	E	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
29	351.0	SE	River Name: Lidsey Rife Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
30	355.0	E	River Name: Ryebank Rife Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
31	372.0	SE	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
32	404.0	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
33	404.0	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
34	404.0	S	River Name: Lidsey Rife Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
35	413.0	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
36	433.0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
37	437.0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
38	437.0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
39	445.0	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
40	450.0	NW	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
41	456.0	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
42	470.0	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined

ID	Distance (m)	Direction	Details	
43 A	475.0	W	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
44	476.0	SW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
45 A	479.0	W	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
46	480.0	S	River Name: Lidsey Rife Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
47	481.0	SW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
48	481.0	SW	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
49	484.0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
50	485.0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
51	486.0	E	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
52	488.0	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
53	489.0	N	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
54	489.0	E	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined

5.9 Surface Water Features

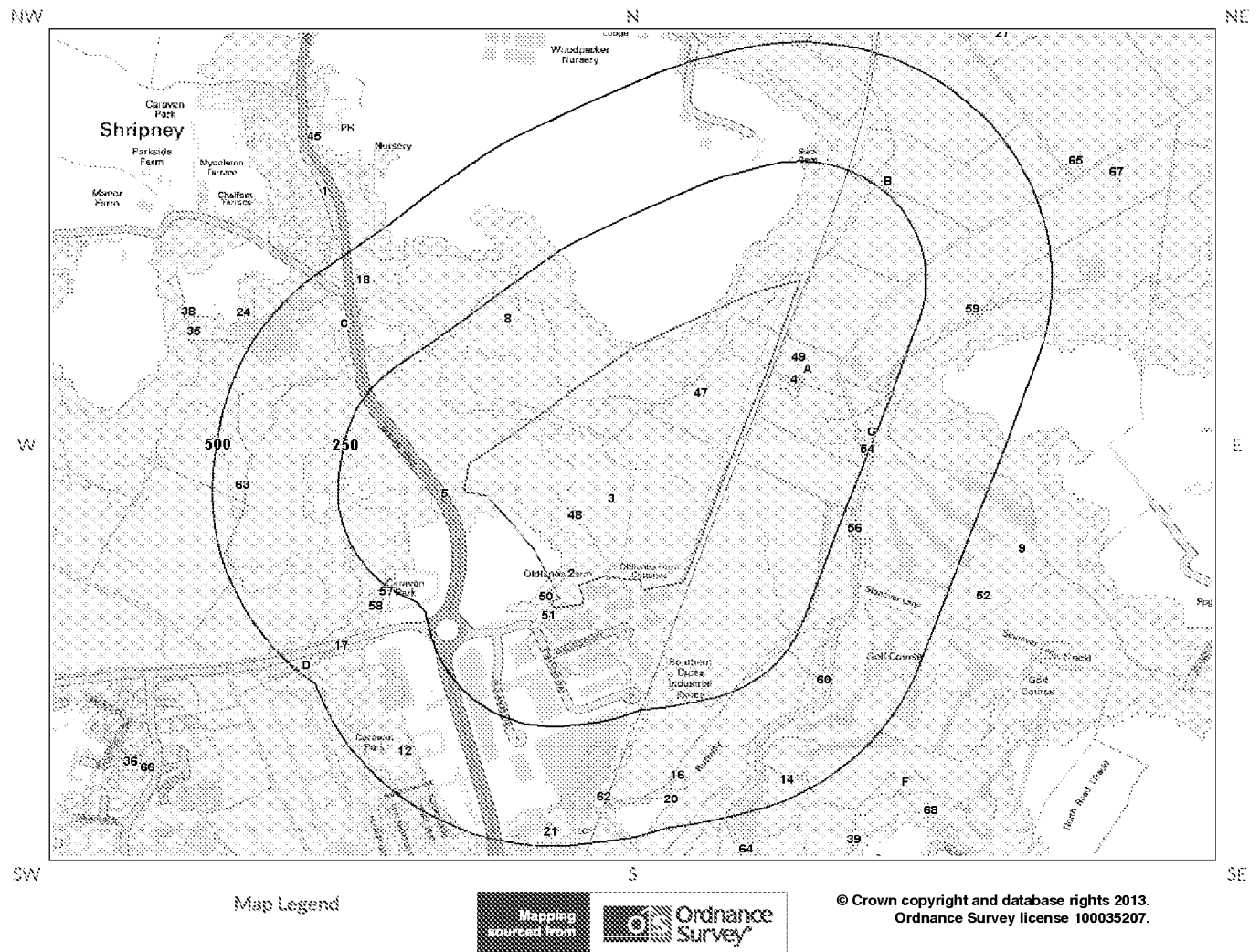
Are there any surface water features within 250m of the study site?

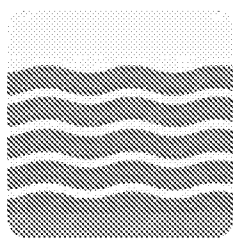
Yes

The following surface water records are not represented on mapping:

Distance (m)	Direction
0.0	On Site
0.0	On Site
0.0	On Site
0.0	On Site
0.0	On Site
0.0	On Site
0.0	On Site
0.0	On Site
24.0	E
49.0	E
67.0	NW
189.0	E
218.0	NW

6. Environment Agency Flood Map for planning (from rivers and the sea)





6. Flooding

6.1 Zone 2 Flooding

Environment Agency Zone 2 floodplains estimate the annual probability of flooding as between 1 in 1000 (0.1%) and 1 in 100 (1%) from rivers and between 1 in 1000 (0.1%) and 1 in 200 (0.5%) from the sea. Any relevant data is represented on Map 1 – Environment Agency Flood Map for Planning:

Is the site within 250m of an Environment Agency Zone 2 floodplain? Yes

The following floodplain records are represented as green shading on the Flood Map:

ID	Distance (m)	Direction	Update	Type
1	0.0	On Site	27-Feb-2014	Zone 2 - (Tidal Models)
2	0.0	On Site	27-Feb-2014	Zone 2 - (Tidal Models)
3	0.0	On Site	27-Feb-2014	Zone 2 - (Fluvial / Tidal Models)
4	30.0	E	27-Feb-2014	Zone 2 - (Tidal Models)
5	53.0	SW	27-Feb-2014	Zone 2 - (Tidal Models)
6A	64.0	E	27-Feb-2014	Zone 2 - (Tidal Models)
7A	65.0	E	27-Feb-2014	Zone 2 - (Tidal Models)
8	104.0	NW	27-Feb-2014	Zone 2 - (Tidal Models)
9	121.0	E	27-Feb-2014	Zone 2 - (Tidal Models)
10B	246.0	NE	27-Feb-2014	Zone 2 - (Tidal Models)

6.2 Zone 3 Flooding

Zone 3 shows the extent of a river flood with a 1 in 100 (1%) or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year. Any relevant data is represented on Map 1 – Environment Agency Flood Map for Planning.

Is the site within 250m of an Environment Agency Zone 3 floodplain? Yes

The following floodplain records are represented as blue shading on the Flood Map:

ID	Distance (m)	Direction	Update	Type
47	0.0	On Site	27-Feb-2014	Zone 3 - (Fluvial / Tidal Models)
48	0.0	On Site	27-Feb-2014	Zone 3 - (Tidal Models)

ID	Distance (m)	Direction	Update	Type
49	7.0	E	27-Feb-2014	Zone 3 - (Fluvial / Tidal Models)
50	13.0	W	27-Feb-2014	Zone 3 - (Tidal Models)
51	35.0	SW	27-Feb-2014	Zone 3 - (Tidal Models)
52	212.0	E	27-Feb-2014	Zone 3 - (Tidal Models)
53G	226.0	E	27-Feb-2014	Zone 3 - (Tidal Models)
54	238.0	E	27-Feb-2014	Zone 3 - (Tidal Models)
55G	245.0	E	27-Feb-2014	Zone 3 - (Tidal Models)

6.3 Flood Defences

Are there any Flood Defences within 250m of the study site? No

Database searched and no data found.

6.4 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site? No

6.5 Areas benefiting from Flood Storage

Are there any areas used for Flood Storage within 250m of the study site? No

6.6 Groundwater Flooding Susceptibility Areas

6.6.1 Are there any British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site?

Yes

Does this relate to Clearwater Flooding or Superficial Deposits Flooding? Clearwater Flooding

Notes: Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding), or with unconfined aquifers (Clearwater Flooding).

6.6.2 What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions?

Potential below Surface

Where potential for groundwater flooding of property situated below ground level is indicated, this means that given the geological conditions there may be a groundwater flooding hazard to basements and other below surface infrastructure. Unless other relevant information, e.g. records of previous flooding, suggests groundwater flooding has occurred before in this area you need take no further action in relation to groundwater flooding hazard. If there are records of previous incidences of groundwater flooding, then is recommended that other information e.g. rainfall history, property type, and land drainage information in addition to previous records of flooding be investigated in order to establish relative, but not absolute, risk of groundwater flooding.

6.7 Groundwater Flooding Confidence Areas

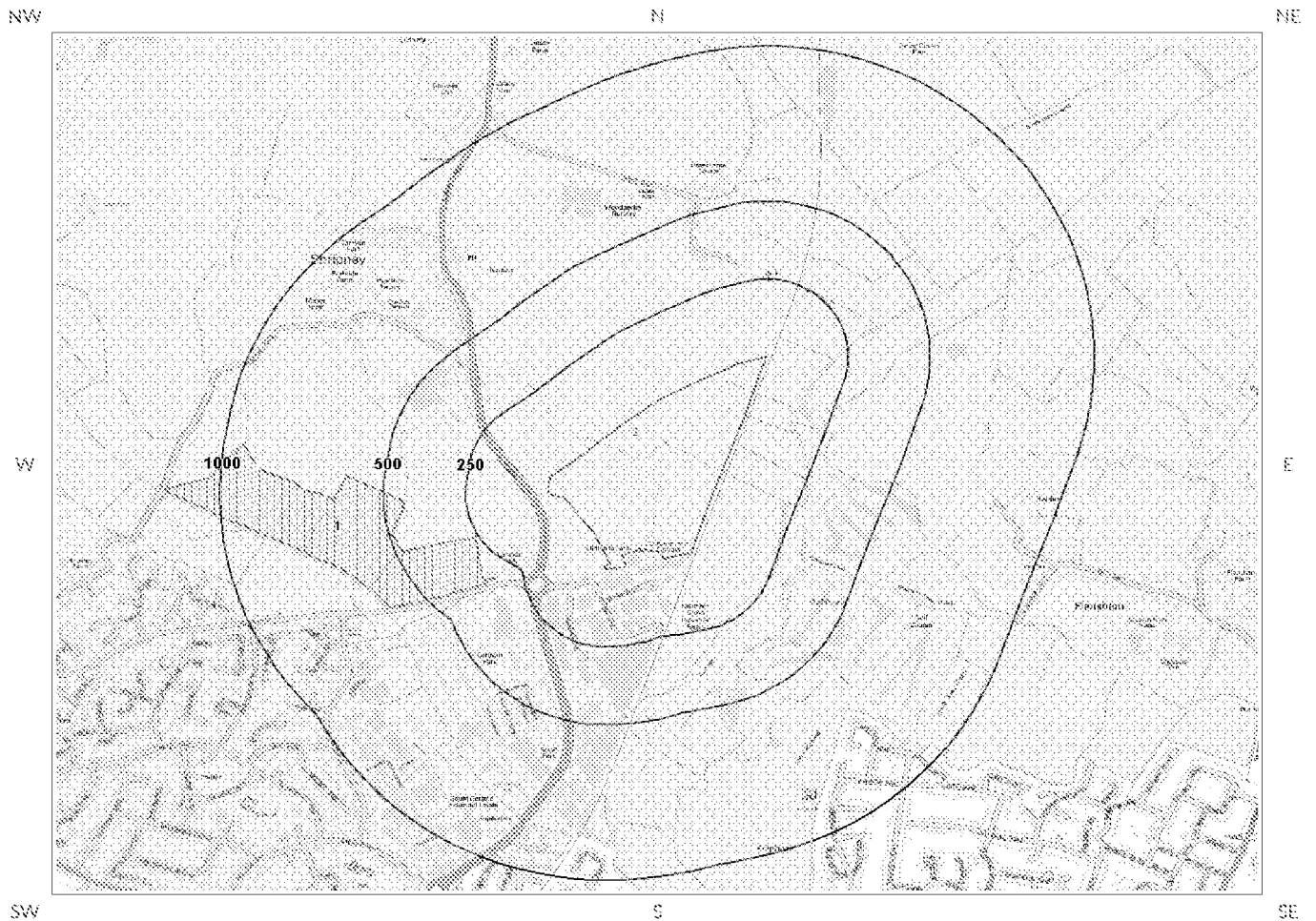
What is the British Geological Survey confidence rating in this result?

High

Notes: Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The confidence rating is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

7. Designated Environmentally Sensitive Sites Map

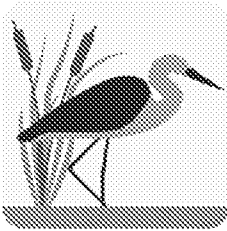


Map Legend



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 Site Outline	 SAC	 SSSI	 NNR	 World Heritage Sites
 Areas of Outstanding Natural Beauty	 SPA	 Ramsar	 LNR	 Environmentally Sensitive Areas
	 Nitrate Vulnerable Zones	 Nitrate Sensitive Areas	 National Parks	 Ancient Woodlands



7. Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 2000m of the study site? Yes

7.1 Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site: 0

Database searched and no data found.

7.2 Records of National Nature Reserves (NNR) within 2000m of the study site: 0

Database searched and no data found.

7.3 Records of Special Areas of Conservation (SAC) within 2000m of the study site: 0

Database searched and no data found.

7.4 Records of Special Protection Areas (SPA) within 2000m of the study site: 0

Database searched and no data found.

7.5 Records of Ramsar sites within 2000m of the study site: 0

Database searched and no data found.

7.6 Records of Ancient Woodland within 2000m of the study site: 0

Database searched and no data found.

7.7 Records of Local Nature Reserves (LNR) within 2000m of the study site:

1

The following Local Nature Reserve (LNR) records provided by Natural England/Countryside Council for Wales and Scottish Natural Heritage are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	LNR Name	Data Source
1	260.0	SW	The Brooks	Natural England

7.8 Records of World Heritage Sites within 2000m of the study site:

0

Database searched and no data found.

7.9 Records of Environmentally Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

7.10 Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site:

0

Database searched and no data found.

7.11 Records of National Parks (NP) within 2000m of the study site:

0

Database searched and no data found.

7.12 Records of Nitrate Sensitive Areas within 2000m of the study site:

0

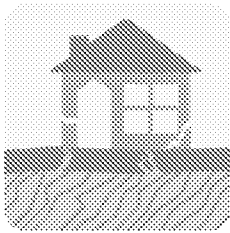
Database searched and no data found.

7.13 Records of Nitrate Vulnerable Zones within 2000m of the study site:

4

The following Nitrate Vulnerable Zone records produced by DEFRA are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	NVZ Name	Data Source
2	0.0	On Site	NVZ Area	DEFRA
Not shown	1371.0	S	NVZ Area	DEFRA
Not shown	1371.0	S	NVZ Area	DEFRA
Not shown	1904.0	SW	NVZ Area	DEFRA



8. Natural Hazards Findings

8.1 Detailed BGS GeoSure Data

BGS GeoSure Data has been searched to 50m. The data is included in tabular format. If you require further information on geology and ground stability, please obtain a **GroundSure GeolInsight**, available from [our website](#). The following information has been found:

8.1.1 Shrink Swell

What is the maximum Shrink-Swell* hazard rating identified on the study site?

Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Ground conditions predominantly medium plasticity. Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a possible increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a possible increase in insurance risk, especially during droughts or where vegetation with high moisture demands is present.

8.1.2 Landslides

What is the maximum Landslide* hazard rating identified on the study site?

Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

* This indicates an automatically generated 50m buffer and site.

8.1.3 Soluble Rocks

What is the maximum Soluble Rocks* hazard rating identified on the study site?

Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.

8.1.4 Compressible Ground

What is the maximum Compressible Ground* hazard rating identified on the study site?

Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

8.1.5 Collapsible Rocks

What is the maximum Collapsible Rocks* hazard rating identified on the study site?

Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Slight possibility for collapsible deposit problems after major changes in loading or groundwater conditions. Normal maintenance to avoid large amounts of water entering the ground through pipe leakage or soak-aways should reduce the likelihood of problems due to collapsible deposits. For new build, assess the possibility of collapsible (loessic) deposits in ground investigation. For existing property, no significant increase in insurance risk from collapsible deposits is likely.

8.1.6 Running Sand

What is the maximum Running Sand* hazard rating identified on the study site?

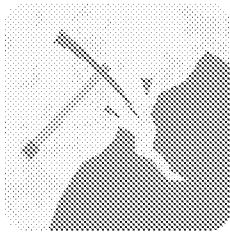
Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard

Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site. Unlikely to be an increase in construction costs due to potential for running sand. For existing property no significant increase in insurance risk due to running sand problems is likely.

* This indicates an automatically generated 50m buffer and site.



9. Mining

9.1 Coal Mining

Are there any coal mining areas within 75m of the study site?

No

Database searched and no data found.

9.2 Shallow Mining

What is the subsidence hazard relating to shallow mining on-site*?

Low

*Please note this data is searched with a 150m buffer.

9.3 Brine Affected Areas

Are there any brine affected areas within 75m of the study site?

No

Guidance: No Guidance Required.

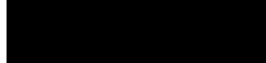
Contact Details

Hydrock
Telephone: 01752 347 515
marcushaes@hydrock.com



British Geological Survey Enquiries

Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG



Web: www.bgs.ac.uk

BGS Geological Hazards Reports and general geological enquiries



Environment Agency

National Customer Contact Centre, PO Box 544
Rotherham, S60 1BY



Public Health England

Public information access office
Public Health England, Wellington House
133-155 Waterloo Road, London, SE1 8UG
<https://www.gov.uk/government/organisations/public-health-england>



The Coal Authority

200 Lichfield Lane
Mansfield
Notts NG18 4RG



Ordnance Survey

Adanac Drive, Southampton
SO16 0AS



Local Authority

Authority: Arun District Council

Web: www.arun.gov.uk

Address: The Arun Civic Centre, Maltings Road, Littlehampton, West Sussex,
BN17 5LF

Getmapping PLC

Virginia Villas, High Street, Hartley Witney,
Hampshire RG27 8NW



Acknowledgements: Site of Special Scientific Interest, National Nature Reserve, Ramsar Site, Special Protection Area, Special Area of Conservation data is provided by, and used with the permission of, English Nature who retain the Copyright and Intellectual Property Rights for the data. PointX © Database Right/Copyright, Thomson Directories Limited © Copyright. Link Interchange Network Limited © Database Right/Copyright and Ordnance Survey © Crown Copyright and/or Database Right. All Rights Reserved. Licence Number [03421028].
This report has been prepared in accordance with the GroundSure Ltd standard Terms and Conditions of business for work of this nature.

Standard Terms and Conditions

1 Definitions

In these terms and conditions unless the context otherwise requires:

"Beneficiary" means the person or entity for whose benefit the Client has obtained the Services.

"Client" means the party or parties entering into a Contract with GroundSure.

"Commercial" means any building or property which is not Residential.

"Confidential information" means the contents of this Contract and all information received from the Client as a result of, or in connection with, this Contract other than

(i) information which the Client can prove was rightfully in its possession prior to disclosure by GroundSure and

(ii) any information which is in the public domain (other than by virtue of a breach of this Contract).

"Support Services" means Support Services provided by GroundSure including, without limitation, interpreting third party and in-house environmental data, providing environmental support advice, undertaking environmental audits and assessments, Site investigation, Site monitoring and related items.

"Contract" means the contract between GroundSure and the Client for the provision of the Services, and which shall incorporate these terms and conditions, the Order, and the relevant User Guide.

"Third Party Data Provider" means any third party providing Third Party Content to GroundSure.

"Data Reports" means reports comprising factual data with no accompanying interpretation.

"Fees" has the meaning set out in clause 5.1.

"GroundSure" means GroundSure Limited, a company registered in England and Wales under number 03421028.

"GroundSure Materials" means all materials prepared by GroundSure and provided as part of the Services, including but not limited to Third Party Content, Data Reports, Mapping, and Risk Screening Reports.

"Intellectual Property" means any patent, copyright, design rights, trade or service mark, moral rights, data protection rights, know-how or trade mark in each case whether registered or not and including applications for the same or any other rights of a similar nature anywhere in the world.

"Mapping" means a map, map data or a combination of historical maps of various ages, time periods and scales.

"Order" means an electronic, written or other order form submitted by the Client requesting Services from GroundSure in respect of a specified Site.

"Ordnance Survey" means the Secretary of State for Business, Innovation and Skills, acting through Ordnance Survey, Adanac Drive, Southampton, SO16 0AS, UK.

"Order Website" means the online platform through which Orders may be placed by the Client and accepted by GroundSure.

"Report" means a Risk Screening Report or Data Report for Commercial or Residential property.

"Residential" means any building or property used as or intended to be used as a single dwelling.

"Risk Screening Report" means a risk screening report comprising factual data with an accompanying interpretation by GroundSure.

"Services" means any Report, Mapping and/or Support Services which GroundSure has agreed to provide by accepting an Order pursuant to clause 2.6.

"Site" means the area of land in respect of which the Client has requested GroundSure to provide the Services.

"Third Party Content" means data, database information or other information which is provided to GroundSure by a Third Party Data Provider.

"User Guide" means the user guide, as amended from time to time, available upon request from GroundSure and on the website (www.GroundSure.com) and forming part of this Contract.

2 Scope of Services, terms and conditions, requests for insurance and quotations

2.1 GroundSure agrees to provide the Services in accordance with the Contract.

2.2 GroundSure shall exercise reasonable skill and care in the provision of the Services.

2.3 Subject to clause 7.3 the Client acknowledges that it has not relied on any statement or representation made by or on behalf of GroundSure which is not set out and expressly agreed in writing in the Contract and all such statements and representations are hereby excluded to the fullest extent permitted by law.

2.4 The Client acknowledges that terms and conditions appearing on a Client's order form, printed stationery or other communication, or any terms or conditions

implied by custom, practice or course of dealing shall be of no effect, and that this Contract shall prevail over all others in relation to the Order.

2.5 If the Client or Beneficiary requests insurance in conjunction with or as a result of the Services, GroundSure shall use reasonable endeavours to recommend such insurance, but makes no warranty that such insurance shall be available from insurers or that it will be offered on reasonable terms. Any insurance purchased by the Client or Beneficiary shall be subject solely to the terms of the policy issued by insurers and GroundSure will have no liability therefor. In addition you acknowledge and agree that GroundSure does not act as an agent or broker for any insurance providers. The Client should take (and ensure that the Beneficiary takes) independent advice to ensure that the insurance policy requested or offered is suitable for its requirements.

2.6 GroundSure's quotations or proposals are valid for a period of 30 days only unless an alternative period of time is explicitly stipulated by GroundSure. GroundSure reserves the right to withdraw any quotation or proposal at any time before an Order is accepted by GroundSure. GroundSure's acceptance of an Order shall be binding only when made in writing and signed by GroundSure's authorised representative or when accepted through the Order Website.

3 The Client's obligations

3.1 The Client shall comply with the terms of this Contract and

(i) procure that the Beneficiary or any third party relying on the Services complies with and acts as if it is bound by the Contract and

(ii) be liable to GroundSure for the acts and omissions of the Beneficiary or any third party relying on the Services as if such acts and omissions were those of the Client.

3.2 The Client shall be solely responsible for ensuring that the Services are appropriate and suitable for its and/or the Beneficiary's needs.

3.3 The Client shall supply to GroundSure as soon as practicable and without charge all requisite information (and the Client warrants that such information is accurate, complete and appropriate), including without limitation any environmental information relating to the Site and shall give such assistance as GroundSure shall reasonably require in the provision of the Services. Including, without limitation, access to the Site, facilities and equipment.

3.4 Where the Client's approval or decision is required to enable GroundSure to carry out work in order to provide the Services, such approval or decision shall be given or procured in reasonable time and so as not to delay or disrupt the performance of the Services.

3.5 Save as expressly permitted by this Contract the Client shall not, and shall procure that the Beneficiary shall not, re-sell, alter, add to, or amend the GroundSure Materials, or use the GroundSure Materials in a manner for which they were not intended. The Client may make the GroundSure Materials available to a third party who is considering acquiring some or all of, or providing funding in relation to, the Site, but such third party cannot rely on the same unless expressly permitted under clause 4.

3.6 The Client is responsible for maintaining the confidentiality of its user name and password if using the Order Website and the Client acknowledges that GroundSure accepts no liability of any kind for any loss or damage suffered by the Client as a consequence of using the Order Website.

4 Reliance

4.1 The Client acknowledges that the Services provided by GroundSure consist of the presentation and analysis of Third Party Content and other content and that information obtained from a Third Party Data Provider cannot be guaranteed or warranted by GroundSure to be reliable.

4.2 In respect of Data Reports, Mapping and Risk Screening Reports, the following classes of person and no other are entitled to rely on their contents:

- (i) the Beneficiary,
- (ii) the Beneficiary's professional advisers, (iii) any person providing funding to the Beneficiary in relation to the Site (whether directly or as part of a lending syndicate),
- (iv) the first purchaser or first tenant of the Site, and
- (v) the professional advisers and lenders of the first purchaser or tenant of the Site.

4.3 In respect of Support Services, only the Client, Beneficiary and parties expressly named in a Report and no other parties are entitled to rely on its contents.

4.4 Save as set out in clauses 4.2 and 4.3 and unless otherwise expressly agreed in writing, no other person or entity of any kind is entitled to rely on any Services or Report issued or provided by GroundSure. Any party considering such Reports and Services does so at their own risk.

5 Fees and Disbursements

5.1 GroundSure shall charge and the Client shall pay fees at the rate and frequency specified in the written proposal, Order Website or Order acknowledgement form, plus (in the case of Support Services) all proper disbursements incurred by GroundSure. The Client shall in addition pay all value added tax or other tax payable on such fees and disbursements in relation to the provision of the Services (together "Fees").

5.2 The Client shall pay all outstanding Fees to GroundSure in full without deduction, counterclaim or set off within 30 days of the date of GroundSure's invoice or such other period as may be agreed in writing between GroundSure and the Client ("Payment Date"). Interest on late payments will accrue on a daily basis from the Payment Date until the date of payment (whether before or after judgment) at the rate of 8% per annum.

5.3 The Client shall be deemed to have agreed the amount of any invoice unless an objection is made in writing within 28 days of the date of the invoice. As soon as reasonably practicable after being notified of an objection, without prejudice to clause 5.2 a member of GroundSure's management team will contact the Client and the parties shall then use all reasonable endeavours to resolve the dispute within 15 days.

6 Intellectual Property and Confidentiality

6.1 Subject to

(i) full payment of all relevant Fees and
(ii) compliance with this Contract, the Client is granted (and is permitted to sub-licence to the Beneficiary) a royalty-free, worldwide, non-assignable and (save to the extent set out in this Contract) non-transferable licence to make use of the GroundSure Materials.

6.2 All Intellectual Property in the GroundSure Materials are and shall remain owned by GroundSure or GroundSure's licensors (including without limitation the Third Party Data Providers) the Client acknowledges, and shall procure acknowledgement by the Beneficiary of, such ownership. Nothing in this Contract purports to transfer or assign any rights to the Client or the Beneficiary in respect of such Intellectual Property.

6.3 Third Party Data Providers may enforce any breach of clauses 6.1 and 6.2 against the Client or Beneficiary.

6.4 The Client shall, and shall procure that any recipients of the GroundSure Materials shall:

(i) not remove, suppress or modify any trade mark, copyright or other proprietary marking belonging to GroundSure or any third party from the Services;

(ii) use the information obtained as part of the Services in respect of the subject Site only, and shall not store or reuse any information obtained as part of the Services provided in respect of adjacent or nearby sites;

(iii) not create any product or report which is derived directly or indirectly from the Services (save that those acting in a professional capacity to the Beneficiary may provide advice based upon the Services);

(iv) not combine the Services with or incorporate such Services into any other information data or service;

(v) not reformat or otherwise change (whether by modification, addition or enhancement), the Services (save that those acting for the Beneficiary in a professional capacity shall not be in breach of this clause 6.4(v) where such reformatting is in the normal course of providing advice based upon the Services);

(vi) where a Report and/or Mapping contains material belonging to Ordnance Survey, acknowledge and agree that such content is protected by Crown Copyright and shall not use such content for any purpose outside of receiving the Services; and

(vii) not copy in whole or in part by any means any map prints or run-on copies containing content belonging to Ordnance Survey (other than that contained within Ordnance Survey's OS Street Map) without first being in possession of a valid Paper Map Copying Licence from Ordnance Survey.

6.5 Notwithstanding clause 6.4, the Client may make reasonable use of the GroundSure Materials in order to advise the Beneficiary in a professional capacity. However, GroundSure shall have no liability in respect of any advice, opinion or report given or provided to Beneficiaries by the Client.

6.6 The Client shall procure that any person to whom the Services are made available shall notify GroundSure of any request or requirement to disclose, publish or disseminate any information contained in the Services in accordance with the Freedom of Information Act 2000, the Environmental Information Regulations 2004 or any associated legislation or regulations in force from time to time.

7 Liability: Particular Attention Should Be Paid To This Clause

7.1 This Clause 7 sets out the entire liability of GroundSure, including any liability for the acts or omissions of its employees, agents, consultants, subcontractors and Third Party Content, in respect of:

(i) any breach of contract, including any deliberate breach of the Contract by GroundSure or its employees, agents or subcontractors;

(ii) any use made of the Reports, Services, Materials or any part of them; and

(iii) any representation, statement or tortious act or omission (including negligence) arising under or in connection with the Contract.

7.2 All warranties, conditions and other terms implied by statute or common law are, to the fullest extent permitted by law, excluded from the Contract.

7.3 Nothing in the Contract limits or excludes the liability of the Supplier for death

or personal injury resulting from negligence, or for any damage or liability incurred by the Client or Beneficiary as a result of fraud or fraudulent misrepresentation.

7.4 GroundSure shall not be liable for

- (i) loss of profits;
- (ii) loss of business;
- (iii) depletion of goodwill and/or similar losses;
- (iv) loss of anticipated savings;
- (v) loss of goods;
- (vi) loss of contract;
- (vii) loss of use;
- (viii) loss or corruption of data or information;
- (ix) business interruption;
- (x) any kind of special, indirect, consequential or pure economic loss, costs, damages, charges or expenses;

(xi) loss or damage that arise as a result of the use of all or part of the GroundSure Materials in breach of the Contract;

(xii) loss or damage arising as a result of any error, omission or inaccuracy in any part of the GroundSure Materials where such error, omission or inaccuracy is caused by any Third Party Content or any reasonable interpretation of Third Party Content;

(xiii) loss or damage to a computer, software, modem, telephone or other property; and

(xiv) loss or damage caused by a delay or loss of use of GroundSure's internet ordering service.

7.5 GroundSure's total liability in relation to or under the Contract shall be limited to £10 million for any claim or claims.

7.6 GroundSure shall procure that the Beneficiary shall be bound by limitations and exclusions of liability in favour of GroundSure which accord with those detailed in clauses 7.4 and 7.5 (subject to clause 7.3) in respect of all claims which the Beneficiary may bring against GroundSure in relation to the Services or other matters arising pursuant to the Contract.

8 GroundSure's right to suspend or terminate

8.1 If GroundSure reasonably believes that the Client or Beneficiary has not provided the information or assistance required to enable the proper provision of the Services, GroundSure shall be entitled to suspend all further performance of the Services until such time as any such deficiency has been made good.

8.2 GroundSure shall be entitled to terminate the Contract immediately on written notice in the event that:

(i) the Client fails to pay any sum due to GroundSure within 30 days of the Payment Date; or

(ii) the Client (being an individual) has a bankruptcy order made against him or (being a company) shall enter into liquidation whether compulsory or voluntary or have an administration order made against it or if a receiver shall be appointed over the whole or any part of its property assets or undertaking or if the Client is struck off the Register of Companies or dissolved; or

(iii) the Client being a company is unable to pay its debts within the meaning of Section 123 of the Insolvency Act 1986 or being an individual appears unable to pay his debts within the meaning of Section 268 of the Insolvency Act 1986 or if the Client shall enter into a composition or arrangement with the Client's creditors or shall suffer distress or execution to be levied on his goods; or

(iv) the Client or the Beneficiary breaches any term of the Contract (including, but not limited to, the obligations in clause 4) which is incapable of remedy or if remediable, is not remedied within five days of notice of the breach.

9 Client's Right to Terminate and Suspend

9.1 Subject to clause 10.1, the Client may at any time upon written notice terminate or suspend the provision of all or any of the Services.

9.2 In any event, where the Client is a consumer (and not a business) he/she hereby expressly acknowledges and agrees that:

(i) the supply of Services under this Contract (and therefore the performance of this Contract) commences immediately upon GroundSure's acceptance of the Order; and

- (ii) the Reports and/or Mapping provided under this Contract are
 - (a) supplied to the Client's specification(s) and in any event
 - (b) by their nature cannot be returned.

10 Consequences of Withdrawal, Termination or Suspension

10.1 Upon termination of the Contract:

(i) GroundSure shall take steps to bring to an end the Services in an orderly manner, vacate any Site with all reasonable speed and shall deliver to the Client and/or Beneficiary any property of the Client and/or Beneficiary in

GroundSure's possession or control; and

(ii) the Client shall pay to GroundSure all and any Fees payable in respect of the performance of the Services up to the date of termination or suspension. In respect of any Support Services provided, the Client shall also pay GroundSure any additional costs incurred in relation to the termination or suspension of the Contract.

11 Anti-Bribery

11.1 The Client warrants that it shall:

(i) comply with all applicable laws, statutes and regulations relating to anti-bribery and anti-corruption including but not limited to the Bribery Act 2010;

(ii) comply with such of GroundSure's anti-bribery and anti-corruption policies as are notified to the Client from time to time; and

(iii) promptly report to GroundSure any request or demand for any undue financial or other advantage of any kind received by or on behalf of the Client in connection with the performance of this Contract.

11.2 Breach of this Clause 11 shall be deemed a material breach of this Contract.

12 General

12.1 The Mapping contained in the Services is protected by Crown copyright and must not be used for any purpose other than as part of the Services or as specifically provided in the Contract.

12.2 The Client shall be permitted to make one copy only of each Report or Mapping Order. Thereafter the Client shall be entitled to make unlimited copies of the Report or Mapping Order only in accordance with an Ordnance Survey paper map copy license available through GroundSure.

12.3 GroundSure reserves the right to amend or vary this Contract. No amendment or variation to this Contract shall be valid unless signed by an authorised representative of GroundSure.

12.4 No failure on the part of GroundSure to exercise, and no delay in exercising, any right, power or provision under this Contract shall operate as a waiver thereof.

12.5 Save as expressly provided in this Contract, no person other than the persons set out therein shall have any right under the Contract (Rights of Third Parties) Act 1999 to enforce any terms of the Contract.

12.6 The Secretary of State for Business, Innovation and Skills ("BIS") or BIS' successor body, as the case may be, acting through Ordnance Survey may enforce a breach of clause 6.4(vi) and clause 6.4(vii) of these terms and conditions against the Client in accordance with the provisions of the Contracts (Rights of Third Parties) Act 1999.

12.7 GroundSure shall not be liable to the Client if the provision of the Services is delayed or prevented by one or more of the following circumstances:

(i) the Client or Beneficiary's failure to provide facilities, access or information;

(ii) fire, storm, flood, tempest or epidemic;

(iii) Acts of God or the public enemy;

(iv) riot, civil commotion or war;

(v) strikes, labour disputes or industrial action;

(vi) acts or regulations of any governmental or other agency;

(vii) suspension or delay of services at public registries by Third Party Data Providers;

(viii) changes in law; or

(ix) any other reason beyond GroundSure's reasonable control.

In the event that GroundSure is prevented from performing the Services (or any part thereof) in accordance with this clause 12.6 for a period of not less than 30 days then GroundSure shall be entitled to terminate this Contract immediately on written notice to the Client.

12.8 Any notice provided shall be in writing and shall be deemed to be properly given if delivered by hand or sent by first class post, facsimile or by email to the address, facsimile number or email address of the relevant party as may have been notified by each party to the other for such purpose or in the absence of such notification the last known address.

12.9 Such notice shall be deemed to have been received on the day of delivery if delivered by hand, facsimile or email (save to the extent such day is not a working day where it shall be deemed to have been delivered on the next working day) and on the second working day after the day of posting if sent by first class post.

12.10 The Contract constitutes the entire agreement between the parties and shall supersede all previous arrangements between the parties relating to the subject matter hereof.

12.11 Each of the provisions of the Contract is severable and distinct from the others and if one or more provisions is or should become invalid, illegal or unenforceable, the validity and enforceability of the remaining provisions shall not in any way be tainted or impaired.

12.12 This Contract shall be governed by and construed in accordance with English

law and any proceedings arising out of or connected with this Contract shall be subject to the exclusive jurisdiction of the English courts.

12.13 GroundSure is an executive member of the Council of Property Search Organisation (CoPSO) and has signed up to the Search Code administered by the Property Codes Compliance Board (PCCB). All Risk Screening Reports shall be supplied in accordance with the provisions of the Search Code.

12.14 If the Client or Beneficiary has a complaint about the Services, written notice should be given to the Compliance Officer at GroundSure who will respond in a timely manner.

12.15 The Client agrees that it shall, and shall procure that each Beneficiary shall, treat in confidence all Confidential Information and shall not, and shall procure that each Beneficiary shall not (i) disclose any Confidential Information to any third party other than in accordance with the terms of this Contract; and (ii) use Confidential Information for a purpose other than the exercise of its rights and obligations under this Contract. Subject to clause 6.6, nothing shall prevent the Client or any Beneficiary from disclosing Confidential Information to the extent required by law. © GroundSure Limited June 2013

SU 90 SW 54	9428 8141	Oldlands Farm	Sheet 8
Surface level +3.2 m	Water not struck	September 1981	Waste 2.8 m Bedrock 1.2 m*

LOG

Geological classification	Lithology	Thickness m	Depth m
Soil	Soil	0.4	0.4
Brickearth	Clay, brown, silty near top, sandier near base	1.5	1.9
Raised Beach Deposits (younger)	'Very clayey' pebbly sand Gravel: coarse and fine; silt with chalk Sand: fine with traces of medium and coarse Fines: silt	0.9	2.8
Upper Chalk	Chalk, rubbly, silty near top	1.2*	4.0

*Based on borehole log

*Based on borehole log

*Based on borehole log

GRADING

Mean for deposit percentages			Depth below surface (m)	Percentages						
Fines	Sand	Gravel		Fines	Sand		Gravel			
				-½	+½ -1	+1 -2	+2 -4	+4 -16	+16 -64	+64 mm
39	48	13	1.9-2.8	39	42	3	3	6	7	0

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log

*Based on borehole log



Appendix E

Previous Site Investigation

30 June 2013

Your ref:

Planning ref:

Our ref: J12134/DB/c01a

Mr J Godfrey
Hanbury Properties Ltd
17 Northgate
Chichester
PO19 1BJ

Dear Mr Godfrey,

RE: OLDLANDS FARM SITE< BOGNOR REGIS

**DESK STUDY REVIEW & PRELIMINARY GROUND APPRAISAL LETTER
REPORT FOR THE PROPOSED COMMERCIAL REDEVELOPMENT**

Further to instruction from Hanbury Properties Limited, we have carried out desk study research and have subsequently attended site to carry out a site walkover survey and preliminary ground investigation to determine the current status of the site and assess the prevailing ground conditions. It is understood that consideration is being given to the commercial development of this site through the construction of a number of light industrial, commercial and retail units, together with associated access roads, car parking and areas of ancillary soft landscaping.

The comments made in this letter are limited to those that can be made on the basis of the information obtained by Wilson Bailey Partnership as part of the limited research and site walkover visit carried out to date. Our comments should be viewed in the context of the limited scope of the investigation, the locations of the accessible sampling points and the range of data sources consulted, no liability can be accepted for information in other data sources. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by Wilson Bailey Partnership.

Scope of Work

A desk study has been carried out in accordance with current guidelines for best practice to establish the environmental site setting and history of the site and the surrounding area. The desk study has been followed by a preliminary ground investigation to provide information to determine the prevailing ground conditions and provide an initial assessment of their implications with regards to the proposed redevelopment scheme

The ground investigation has been carried out in a single phase comprising a walkover survey together with a series of seven small diameter boreholes drilled by means of an open drive percussive soil sampling rig to a depth of up to 5.45 m, together with a series of 15 trial pits excavated using a JCB across the site. Combined soil gas and groundwater monitoring standpipes have been installed into a number of the boreholes located across the site to facilitate future monitoring.

It should be noted that at the time of the preliminary ground investigation, consideration was being given to the redevelopment of a slightly different site area, such that the ground investigation does not now provide a complete coverage of the site, although it still establishes an appropriate preliminary assessment of the prevailing ground conditions within the site and immediately surrounding area.

The soils encountered in the trial pits and boreholes were inspected by a Chartered Geologist and representative soil samples were recovered, although the scope of investigation was limited and did not include laboratory testing for geotechnical properties or contaminated land purposes.

As part of the ground investigation work, temporary soil samples of any materials that were assessed by visual inspection or olfactory means to be contaminated were screened using a photo-ionisation detector (PID) to determine the presence of any detectable concentrations of volatile organic compounds (VOCs) which may be an indication of the presence of fuel related hydrocarbons. No detectable concentrations of VOCs were recorded.

In accordance with current best practice, the findings of the desk study and ground investigation have been used to formulate a conceptual model for the site and facilitate a preliminary qualitative risk assessment and discussion of the implications of any identified issue of potential concerns with regards to ground contamination. On the basis of this assessment, the requirement for any further assessment or remedial action as part the redevelopment of this site for commercial purposes has been determined.

Site Description

The site comprises an irregularly shaped area that measures approximately 400 m by 400m and is currently occupied by open agricultural land. The southern boundary to the site is formed by the northerly extent of the Southern Cross Trading Estate, with the eastern part of the southern boundary formed by the rear of various commercial / light industrial units. The western part of the southern boundary is formed by a single track rough surfaced lane which leads to a derelict concrete portal frame barn and a pair of semi-detached former farm workers houses, which adjoin the rear of the Trading Estate.

The eastern site boundary is formed by the single track railway branch line than carried trains from Barnham mainline station to the Bognor Regis terminus. Adjacent to the site this railway is formed on an embankment formed of track ballast.

The western site boundary and the majority of the northern site boundary are formed by the extent of further open agricultural land, with the majority of the northern site boundary marked by the presence of an overgrown field drainage ditch. The western part of the northern site boundary is formed by the extent of the landscaping works associated with the new Bognor Northern Relief Road (BNRR), which is currently under construction. Access to the site is to be provided from the new roundabout that has been constructed on the A259 at the western end of the BNRR.

The site is sensibly levelled, which is consistent with the local topography, with a slight fall downwards to the east. The site is currently used for agriculture and has been planted with a range of arable crops.

As part of the site walkover survey a shallow well has been identified within the southwestern part of the site. This well appears to have been partially backfilled and to be brick lined, with a stone capping stone. The depth to the top of the in filled soil and rubble within the well is 2.20 m below ground level. In addition a former cattle drinking trough and water supply pipe was identified within the central southern part of the site.

Site History

The site history has been determined through a review of publically available historical Ordnance Survey maps together with a search of publically available environmental information sourced from the Envirocheck database, copies of the search results and selected historical maps and aerial photographs are enclosed with this letter report.

The earliest map studied, dated 1879, indicates the site to have been occupied by open fields within a predominantly rural setting, although by that time the railway line and the buildings of Oldlands Farm are shown to have been constructed. At that time, within the extreme southwestern corner of the site a pond is shown to have been present, presumably associated with the adjoining farm yard buildings adjoining the southern boundary to the site.

Subsequent maps studied indicate that the site and surrounding area remained essentially unchanged to the present day, although by 1979 the trading estate and commercial estates to the south and southwest of the site are shown to have become constructed, and by 1992, they are shown to have been fully constructed and occupied. The map dating 1992 also indicates that by that time the pond within the southwestern corner of the site is no longer shown to have been present, having presumably been infilled.

It is understood from local knowledge that Oldlands Farm was a mixed arable and dairy farm and that the dilapidated concrete portal frame barn that is located to the south of the site was used as the main barn for housing dairy cattle. There are no known details of the location of any slurry pits or lagoon that may have been associated with the former dairy farm. It is also understood that the former pond was backfilled in the early 1980s with arisings from the excavation works carried out as part of the reconstruction of the farm access track to the south of the site. It is understood that dairy farming ceased shortly after and the farm became purely arable prior to the closure of the farm and amalgamation of the land to form part of the larger farm based at Lidsey Lodge Farm to the north.

Site Environmental Setting

Information provided by the British Geological Survey indicates the site to be underlain by River Terrace Deposits overlying Raised Beach Deposits and subsequently the Lewes Nodular Chalk of the Upper White Chalk Group. Locally outcrops of Brickearth Clay are shown to be present, together with tracks of alluvium associated with the Lidsey Rife, located approximately 250 m to the east of the site.

Information provided by the Environment Agency indicates the superficial soils to be classified as a Secondary A Superficial Aquifer, whilst the underlying chalk is shown to be classified as a Principal Bedrock Aquifers, although the site is not shown to be located within any class of Source Protection Zone associated with any licensed groundwater abstraction points.

Further information provided by the Environment Agency indicates the presence of two historical landfill sites approximately 430 m and 550 m to the south of the site, which were formerly operated by LEC Refrigeration, a fridge and white goods manufacturer formerly based on Shripney Road to the south of the site, prior to closure and redevelopment of the site as a supermarket. These landfills are understood to have been licensed to accept a range of wastes and are understood to have closed prior to 1981.

Information provided by the Health Protection Agency in searches indicate the site to be located in an area where less than 1% of houses are affected by radon, such that radon protective measures are not required to be incorporated into the design of any new buildings to be constructed at this site.

Preliminary Conceptual Site Model Summary and Risk Assessment

The use of the majority of the site as open agricultural land from at least 1879 to the present day is not considered to pose a risk of contamination. It is likely that a range of pesticides and herbicides may have been used at this site as part of routine agricultural practice, although it is not likely that these would be biologically persistent and their use is understood to have been limited due to the close proximity of a number of ditches and the Lidsey Rife.

The presence of a former dairy farm barn directly to the south of the site presents a potential risk of the presence of a former slurry lagoon, although it is understood that the adjacent farm ceased dairy farming in the 1980s, such that this is not likely to now present a risk of potentially putrescible material.

The infilling of the former pond that is located within the extreme southwestern part of the site may present a potential risk of ground contamination as the material used to infill the pond may not have been controlled and segregated and may not have been geotechnically suitable. It is however considered likely that the time that has elapsed since infilling will have reduced the potential risks posed by any unsuitable materials placed within this pond backfill.

The former landfill sites located approximately 500 m to the south of the site are understood to have closed in 1980, with a range of open space and occupied buildings located within the intervening land. As a result of the distance from these landfill sites, the time that has elapsed since their closure and the anticipated flow direction of the nearby Lidsey Rife towards the south, these landfills are not considered to pose a risk to this site.,

Ground Conditions

Across the majority of the site a variable depth of topsoil has been encountered to depths of between 0.25 m and locally up to 0.70 m below ground level, although across the majority of the site topsoil has been proved to a depth of about 0.40 m below ground level.

Within the southwestern corner of the site, within the location of the former backfilled pond, made ground comprising reworked topsoil and brown clay with occasional fragments of metal, rope, timber and gravel was encountered to a depth of 1.80 m below ground level.

Underlying the topsoil and made ground where encountered, across the western part of the site the ground conditions were found to be relatively consistent; a locally desiccated but generally soft and very soft orange-brown sandy clay was encountered to depths of between 0.90 m and 2.30 m below ground level, below which a pale brown and off-white chalk derived silt with occasional and locally abundant flint gravel was encountered to depths of between 3.00 m and 3.80 m, below which completely weathered chalk was encountered to the maximum depth of investigation. These soils are consistent with the published geological records indicating the presence of River Terrace Deposits and Brickearth Clay overlying Raised Beach Deposits and subsequently Chalk.

Within the eastern part of the site, the near surface soils were found to comprise a very soft variably dark and pale bluish grey alluvium with occasional bands and layers of fibrous peat. These soils are consistent with the local presence of alluvium associated with the Lidsey Rife overlying Chalk.

Groundwater was encountered within a number of the exploratory positions. Within the western part of the site occasional groundwater seepages were noted at depths of about 1.50 m to 2.00 m, with a shallower inflow of perched water encountered within the backfilled former pond area at a depth of 1.00 m below ground level. Within the alluvium present within the eastern part of the site more substantial inflows of groundwater were identified at a depth of about 2.00 m in a number of locations.

Monitoring standpipes have been installed within the three of the boreholes in order to monitor for the presence of groundwater and soil gasses, although a programme of soil gas and groundwater monitoring has not been established to date.

Preliminary Contaminated Land Discussion

The site is not considered to have a potentially contaminative history other than the potential presence of unsuitable materials within the backfill to the former pond within the southwestern corner of the site

and the potential presence of a slurry lagoon or similar, which may be present on or near to the site and associated with the former farm complex directly to the south of the site.

The preliminary ground investigation carried out to date has not indicated the presence of visual or olfactory indications of ground contamination across the site in general and where sampled, the material use to backfill the former pond does not show visual or olfactory indications of gross contamination. No indications of the presence of a former dairy cattle slurry lagoon have been identified on site as part of the limited ground investigation works carried out to date.

It is considered that further ground investigation will need to be carried out in due course, including soil sampling and testing for a wide range of potential soil contaminants. As part of this work it may also be beneficial to carry out a limited number of soil pesticide analyses to confirm the anticipated absence of elevated concentrations of pesticides and herbicides. Soil samples should be recovered from the near surface topsoil in order to determine their suitability for reuse on or off site. Samples should also be recovered from the underlying natural soils to determine the potential requirement for mitigation measures as part of the proposed commercial redevelopment, although the potential requirement for mitigation measures due to ground contamination at this site is considered likely to be low.

Further ground characterization across the site will be necessary, together with further assessment of the soils used to infill the former pond.

Whilst detailed discussions will need to be held with the regulatory authorities in due course, it is considered likely that it would be appropriate to maintain a watching brief for ground contamination as part of the ground works for the proposed development in order that should any localised pockets of suspicious soils be encountered, they may be dealt with in accordance with best practice by a suitably qualified and experienced geo-environmental engineer in conjunction with the Local Authority Contaminated Land Officer.

Preliminary Geotechnical Discussion

Within the western part of the site, where River Terrace Deposits have been found to overly Raised Beach Deposits and subsequently chalk strata, very lightly loaded spread foundations, may be viable at shallow depth.

Within this part of the site it is considered likely that all but very lightly loaded floor slabs would require vibro-ground improvement to prevent unpredictable and variable ground settlements that may occur. If vibro ground improvement were to be selected for the ground floor slabs, it is considered likely that it would be economically viable to improve the ground below foundations as well in order that smaller foundations sizes may be adopted with a bearing capacity in the region of 120 kPa following ground improvement.

Consideration could also be given to lime stabilisation of near surface soils to mitigate the potential for settlements. Structures may then be constructed as a rigid raft that would be expected to have a very low bearing capacity.

Within the eastern part of the site, where a potentially significant of assumed compressible alluvium with layers and bands of peat have been encountered, the compressibility and presence of peat within these soils may prevent the use of ground improvement techniques. Whilst further ground investigation and assessment should be carried out within this part of the site, recourse to a piled foundation solution may be required to support structures and any particularly sensitive of heavily loaded ground floor slabs.

The use of lime and potentially cement stabilisation may still be viable within this part of the site providing buildings can be designed as relatively lightweight structures founding upon a relatively rigid raft foundation.

There is a potential that the presence of peat within this part of the site may present a source of ground gasses that could require gas protection measures to be incorporated into buildings, although soil gas monitoring would be necessary to determine long term flow of any soil gasses to robustly assess this issue.

The presence of variable bands and layers of peat within this part of the site could also result in differential settlements over unpredictable times for external areas of hard standing, although this could be mitigated through a combination of methods including vibro ground improvement and lime stabilisation to areas of external hardstanding.

Within the southwestern corner of the site where an in filled former pond has been identified, should the location of this pond correspond with any areas of buildings or sensitive hard landscaping, consideration may need to be given to excavating and replacing the backfill, or potentially some form of ground improvement or stabilisation. Should this area be located within a less sensitive area of hard landscaping or within soft landscaping, then it is not likely that further work would be required, subject to the findings of a more detailed contaminated land assessment of this area.

Conclusions

This investigation has achieved its intended goal of providing an initial assessment and appraisal of the site development history, environmental site setting and prevailing ground conditions at this site.

Whilst this greenfield development site is not considered to have a potentially contaminative history, further work including a more detailed ground investigation, monitoring of groundwater and soil gasses, and potentially a watching brief during ground works may be required in order to facilitate a robust assessment of this site with regards to ground contamination.

Further geotechnical focused ground investigation should also be carried out in due course, once the design layout for the proposed development has been finalised, in order to determine the most suitable design of foundations and floor slabs.

We trust that this letter provides sufficient information although please do not hesitate to contact me should you have any queries or questions.

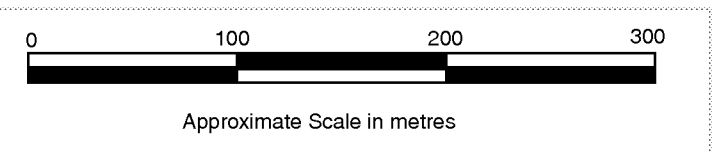
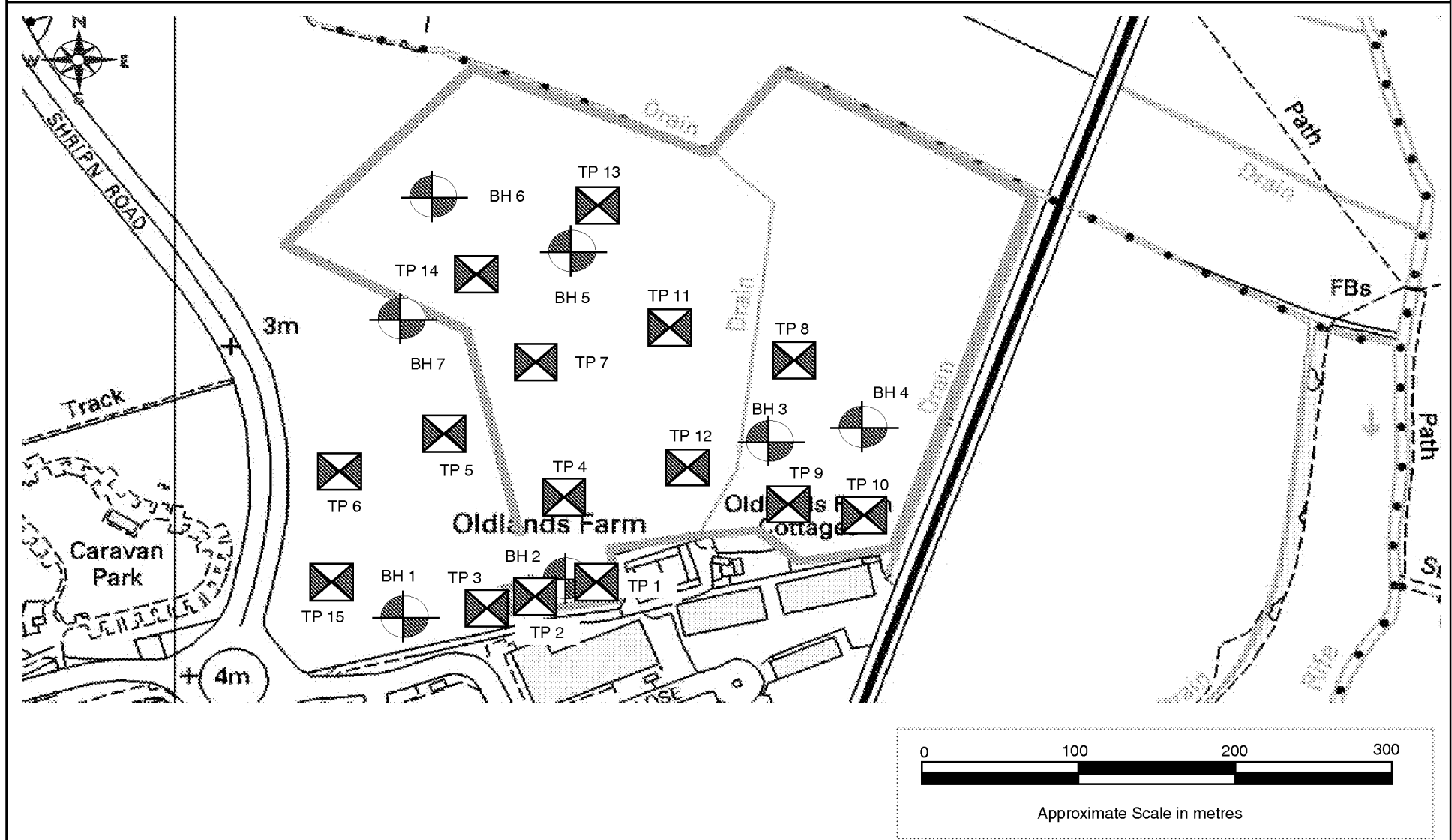
Yours sincerely
Wilson Bailey Partnership

Dominic Brightman
BSc MSc DIC FGS CGeol ARSM

Encs

Site Oldlands Farm, Bognor Regis, West Sussex

Client Hanbury Properties



Project Name
Oldlands Farm

Project No.
J12134

Co-ords: -

Hole Type
WLS

Location: Bognor Regis, West Sussex

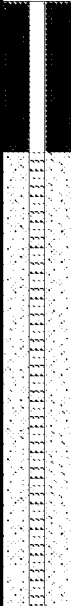
Level: -

Scale
1:50

Client: Hanbury Properties

Dates: 06/09/2012

Logged By
DPB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.45			TOPSOIL	
		0.50	D					Stiff brown sandy silty CLAY - desiccated soil	
		1.00 1.00	SPT D	N=4 (1,1,1,1,1,1)	1.10			Soft pale yellowish brown and occasionally pale grey mottled fine sandy SILT with occasional fine to medium flint gravel	1
		1.50	D						
		2.00 2.00	SPT D	N=4 (1,0,1,1,1,1)					2
		2.50	D						
		3.00 3.00	SPT D	N=12 (1,2,3,3,3,3)	3.30			CHALK: Recovered as white chalk	3
		3.50	D						
		4.00 4.00	SPT D	N=11 (2,2,2,3,3,3)	4.45				4
								End of Borehole at 4.45 m	5
									6
									7
									8
									9

Remarks: Groundwater seepage at 1.70 m. Standpipe installed with a response zone from 1.00 m to 4.00 m.



Project Name
Oldlands Farm

Project No.
J12134

Co-ords: -

Hole Type
WLS

Location: Bognor Regis, West Sussex

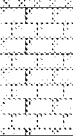
Level: -

Scale
1:50

Client: Hanbury Properties

Dates: 06/09/2012

Logged By
DPB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	D		0.70			TOPSOIL - "desiccated"	
					0.90			Stiff grey very silty CLAY - "desiccated"	
		1.00	SPT	N=4					
		1.00	D	(1,1,1,1,1,1)	1.10			Soft and very soft pale grey silty CLAY	1
		1.50	D						
		2.00	SPT	N=6					
		2.00	D	(1,1,1,1,2,2)	2.30			Very soft locally soft pale brown very silty CLAY with occasional fine medium chalk gravel	2
		2.50	D						
		3.00	SPT	N=1					
		3.00	D	(1,0,1,0,0,0)	3.60			Soft off white and pale grey clayey sandy SILT with chalk gravel	3
		3.50	D						
		4.00	D		4.45			CHALK: Recovered as white chalk	4
								End of Borehole at 4.45 m	5
									6
									7
									8
									9

Remarks: Groundwater not encountered. Standpipe installed with a response zone from 1.00 m to 3.00 m.



Project Name
Oldlands Farm

Project No.
J12134

Co-ords: -

Hole Type
WLS

Location: Bognor Regis, West Sussex

Level: -

Scale
1:50

Client: Hanbury Properties

Dates: 06/09/2012

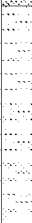
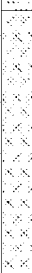
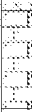
Logged By
DPB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.40			TOPSOIL	
		0.50	D					Soft pale brown silty CLAY	
		1.00 1.00	SPT D	N=4 (1,1,1,1,1,1)					1
		1.50	D		1.60			PEAT - (fibrous)	
		2.00 2.00	SPT D	N=6 (1,1,1,1,2,2)	2.00			Very soft grey and dark grey CLAY with black organic flecks and occasional fine flint gravel	2
		2.50	D						
		3.00 3.00	SPT D	N=5 (1,1,1,1,1,2)					3
		3.50	D						
		4.00	D		3.90			CHALK: Recovered as white chalk	4
					4.45			End of Borehole at 4.45 m	
									5
									6
									7
									8
									9

Remarks: Groundwater encountered at 2.20 m.



Project Name Oldlands Farm	Project No. J12134	Co-ords: -	Hole Type WLS
Location: Bognor Regis, West Sussex		Level: -	Scale 1:50
Client: Hanbury Properties		Dates: 06/09/2012	Logged By DPB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
	▽	0.50	D		0.50			TOPSOIL	
		1.00 1.00	SPT D	N=4 (1,1,1,1,1,1)				Soft locally very soft brown CLAY with occasional flints	1
		1.50	D						
		2.00 2.00	SPT D	N=1 (1,0,1,0,0,0)	2.00			Very soft pale grey and of white locally clayey sandy SILT	2
		2.50	D						
		3.00 3.00	SPT D	Error					
		3.50	D						
		4.00 4.00	SPT D	N=9 (2,2,2,2,2,3)	3.80			CHALK: Recovered at white chalk	4
		4.45							
									End of Borehole at 4.45 m
								6	
								7	
								8	
								9	

Remarks: Groundwater encountered at 1.90 m.



Project Name
Oldlands Farm

Project No.
J12134

Co-ords: -

Hole Type
WLS

Location: Bognor Regis, West Sussex

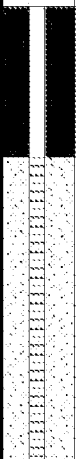
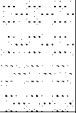
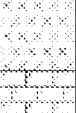
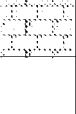
Level: -

Scale
1:50

Client: Hanbury Properties

Dates: 06/09/2012

Logged By
DPB

Well	Water Strikes	Samples & In Situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.35			TOPSOIL	
		0.50	D					Firm locally soft rown silty sandy CLAY with occasional fine flint gravel	1
		1.00 1.00	SPT D	N=7 (1,1,1,2,2,2)	1.10			Very soft pale yellowish brown and off white clayey sandy SILT with occasional chalk and flint gravel	
		1.50	D						
		2.00 2.00	SPT D	N=1 (1,0,1,0,0,0)					2
		2.50	D						
		3.00 3.00	SPT D	Error					3
		3.50	D						
		4.00 4.00	SPT D	N=11 (1,1,2,2,3,4)	3.80			CHALK: Recovered as white chalk	4
					4.45			End of Borehole at 4.45 m	
									5
									6
									7
									8
									9

Remarks: Groundwater encountered at 2.00m. Standpipe installed with a reponse zone from 1.00 m to 3.00 m.





Appendix F

Hydrock Methodology

Hydrock desk study report appendix on Hydrock Methodology, version 02 updated 19-09-13 applies to this report.

This appendix may not be included in the printed report to reduce the document size.

It is presented in the PDF version of the report on the CD enclosed with the printed report. Alternatively, it can be supplied on request by quoting the version number and date.



Enclosure C

Hydrock Report. July 2014 "Oldlands Farm, Bognor Regis - Ground Investigation", reference R/14459/003/Rev002a.



Oldlands Farm

Bognor Regis

Ground Investigation

Final Report for



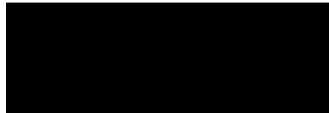
July 2014

Hydrock Ref: R/14459/003



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Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.



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Executive Summary and Conceptual Site Model

SITE INFORMATION AND SETTING	Report Purpose	Phase 2 interpretative ground investigation and risk assessment.
	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 494263E, 101433N.
	Current Land Use and Description	The site covers approximately 22.5 ha in total. The industrial development site is approximately 10 ha with a flood compensation scheme to the north totalling approximately 12.5 ha. The site is currently in agricultural use and is sown with crops including wheat, potatoes and oilseed rape. The topography gently slopes downward from west to east with levels ranging between approximately 3.10m OD and 1.20m OD respectively. There are a number of drainage ditches, mature hedgerows and occasional trees on site. There are over-head power lines and an underground gas main present in the flood compensation area. There are two backfilled ponds and a well in the south of the main site
	Development	The development is to consist of two industrial buildings with associated infrastructure in the main site and a flood compensation basin in the north.
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, there are two ponds which appear to have been infilled in the late 19th and late 20th centuries. In the late 20th Century there has been the development of an industrial estate adjacent to the southern site boundary.
	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.
	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. 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 proposed development is currently located within Flood Zones 1, 2, and 3. Please refer to Hydrock report R/14443/001.Rev004 for further details.
PHASE 2 – GROUND INVESTIGATION	Hydrock Site Works	The Hydrock Ground investigation was undertaken between 2nd June and 18th June 2014 and comprised: • 6 cable percussive borehole to 10.00m bgl; • 49 trial pits to a maximum depth of 3.80m bgl; • 17 static Cone penetration Tests to a maximum depth of 16.80m bgl; • 6 installations for groundwater level and ground gases; • 5 soakaway tests; • monitoring of groundwater level and ground gases; • geotechnical testing of soil; • geo-chemical testing of soil and groundwater A number of the exploratory holes were located to target potential contamination sources (backfilled ponds).



ASSESSMENT AND CONCLUSIONS	Findings of the Ground Investigation	The geology of the site (from ground level, down) comprises: • Made Ground – to between 0.10m and 0.80m below ground level (bgl), comprising sandy clay and clayey sand topsoil; • Made Ground (pond areas in south of main site) – to between 0.30m and 1.70 m bgl consisting of variable sandy gravelly clay, clayey sandy gravel and gravelly sand with some cobbles and occasional boulder sized particles. Gravel includes ash, metal, glass, concrete, brick and asbestos containing materials , over • Raised Marine Deposits – (eastern part of main site) - very soft organic clay, sandy silt, silty sand and sand, locally with plant remains; • River Terrace Deposits – soft to firm sandy clay and clayey sandy gravel. Gravel is predominantly of flint and chalk. • White Chalk Subgroup – comprising clayey slightly sandy gravel sized fragments of weak, low density chalk and with occasional flint gravel. (Grade Dc). Groundwater strikes occurred at varying elevations between 1.27m AOD and -3.35m AOD. However the standing groundwater level was apparently around 0.00m AOD at the time of fieldworks. There was visual evidence of contaminated soils within the backfilled ponds, elsewhere, no specific evidence of land contamination was observed.
	Conclusions of Contamination Generic Risk Assessment	Human health: • No significant risks over the majority of the site (main site and flood compensation area) from pervasive contamination. • Pervasive PAH (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene and indeno(1,2,3,cd)pyrene) in backfilled ponds. • asbestos containing material in western pond. Plant growth: • No significant risks. Controlled Waters: • Exceedance of the DWS/EQS for sodium, chloride, manganese, silver and nitrite. However, these are considered not to be a significant risk in the context of the development proposals. Human health / property from ground gases: • No radon protective measures are necessary according to current guidance. • Low risk from ground gases with monitoring indicating CS-1 conditions. Monitoring is ongoing.
	Construction Materials and Water Supply Pipework	Until proven or agreed otherwise, it is recommended that barrier pipe provision is assumed pending liaison with the supply company. Subject to demonstration that water pipelines will not be laid through any of the backfilled pond areas and agreement with the water supply authority, it may be possible to dispense with the requirement for barrier pipework.
	Flood Risk	Flood risk assessment and drainage design is to be undertaken by others.
	Site Preparation, Earthworks and Landscaping	It is recommended that all services are confirmed as “dead” by testing or located by careful hand digging and clearly marked prior to undertaking groundworks on the site. Excavation in close proximity to live services will need to ensure that the excavation walls are stable or appropriately battered to a safe angle. Temporary slope stability works may be required in any deep excavations. There is currently a well in the south of the site. It is recommended that the existing cover slab is removed and the well filled with a suitably graded single size stone (Class 6A) material prior to commencing earthworks filling over the area. Topsoil and unsuitable Made Ground should be removed from beneath all building, hardstanding areas and from the base of any earthworks embankments and will be suitable for reuse from the perspective of land contamination, with the exception of material from pond areas.



	Site Preparation, Earthworks and Landscaping (Cont.)	It is cautioned that excavation within the former pond areas will create arisings that are hazardous to site workers and may constitute hazardous waste from the perspective of off-site disposal. A Materials Management Plan should be created for the site to enable appropriate handling and relocation of these materials. Excavations undertaken during site works were unstable and given the soft and loose nature of the shallow soils and the high water table, all excavations should be supported. It is recommended that no site personnel enter any trenches unless there is adequate support and this has been assessed by a competent person and is subject to an appropriate schedule of inspection on site. Based on the groundwater observations made, it is envisaged some form of groundwater control will be necessary for excavations. In view of the variable and significantly cohesive soils present on site, it may be the case that traditional well points are unfeasible and groundwater ejectors will be necessary. Care should be taken to ensure fines are not removed from the soil during groundwater control. The groundwater levels at the site are subject to significant seasonal variation and it has been observed that water had apparently been standing at the ground surface a relatively short time prior to undertaking works in June. It is anticipated that there will be significant difficulties in trafficking the site and drainage during construction in the wetter months.
	Ground Settlement	Site levels are to be increased on the main site for flood and drainage reasons. To raise site levels will generate consolidation settlement from the Raised Marine Deposits. An assessment has been undertaken which indicates that the predicted land raise settlement will range between approximately 6mm and 220mm across the main site. Based on the laboratory data and a conservative assessment of the drainage path length, the duration of consolidation settlement would be in the order of 7 months to 2 years without any form of surcharging. Subject to design, it may be possible to significantly reduce the period of consolidation required by the use of a surcharge load and the installation of vertical drains on a suitable spacing. One additional benefit of surcharging is that it can be designed in such a way as to minimise post construction settlements and secondary compression (creep) in addition to the predicted land raise settlement. There is the potential for long term secondary compression (creep) settlement which will continue beyond the primary (load induced) consolidation. Whilst it is possible to mitigate creep to some extent by pre-loading and surcharging, the anticipated magnitude of creep settlement at this site would preclude the use of pre-loading and surcharging in isolation for the support of a ground bearing floor slab.
	Foundations	Based on the poor load bearing characteristics of the Raised Marine Deposits and River Terrace Deposits, coupled with the relatively high groundwater table, it is envisaged that shallow foundations will not be suitable for the development and fully piled foundations are recommended. Piled foundations should be designed to extend through the Raised Marine and River Terrace Deposits and carry their load in the White Chalk strata in skin friction or a combination of skin friction and end bearing. A number of piled solutions could be given consideration at the site, e.g. continuous flight auger (CFA) piles or similar bored and cast in situ techniques. Advice should be sought from piling contractors on the application of their proprietary system in view of the ground conditions present. Where a bored and cast in-situ piling methodology is considered, there may be practical difficulties in casing pile bores to their base prior to placement of concrete because of the groundwater conditions. It is recommended not to adopt a driven piling methodology in the White Chalk as experience has shown there may be a tendency to macerate chalk around the annulus of the pile without a corresponding mobilisation of skin friction when driving piles. It is recommended that the load/settlement relationship is determined by test piling to determine the final safe working load to be adopted. It is also recommended that a selected number of piles installed are load tested to ensure a satisfactory performance has been achieved.



	Foundations (Cont.)	The adoption of a bored piling methodology will generate a substantial quantity of spoil and this should be incorporated into the fill or landscaping where possible to minimise disposal. Preliminary calculations suggest working loads in the order of 1500 kN/m² to 2000 kN/m² should be achievable for a single pile of 25m length and 450mm to 600mm diameter, subject to design by the specialist contractor. Where significant loads are proposed, structural elements could be supported by pile groups. Where piles are to be installed through the Raised Marine Deposits or fill there is the possibility of negative skin friction creating downdrag on the piles and it will be necessary to consider slip sleeving of piles to mitigate against downdrag. Alternatively, it may be possible to account for downdrag by adjusting the working load of the pile.
	Floor Slabs	Whilst pre-loading and surcharging is recommended in mitigation for settlement occurring due to the land raising in external areas, it is considered not to be suitable for the preparation of a subgrade to support a ground bearing floor slab owing to the anticipated long term creep settlement. Therefore there are two design options: • Floor slab supported on piles; or • Ground bearing design following ground improvement. With regard to the ground improvement option, a system of rigid inclusions consisting of either Vibro-Concrete Columns (VCC) or Controlled Modulus Columns (CMC) may be appropriate. The feasibility and design options for such a scheme should be discussed with a specialist contractor who would undertake the works. With the use of VCC or CMC consideration of negative skin friction would need to be made, much the same as would for piles. It will be necessary to transfer of load from the floor slab to the rigid columns either using a granular load transfer platform, or alternatively (and subject to design by the specialist contractor), a flared head on the column to facilitate transfer of loads from the slab.
	Working Platform	For piling of vibro ground improvement works, a working platform will be required to be designed and installed in accordance with BRE 470.
	Roads	Based on the test results, it is considered likely a CBR of < 2.5% will be available over the majority of the site for design purposes. Following ground improvement and earthworks a higher CBR may be achievable. However, this may require the use of: • excavation and re-engineering or replacement of weaker soils; • the inclusion of geosynthetic reinforcement within the unbound layers of the capping and sub-grade; or • modification and/or stabilisation techniques on the formation.
	Drainage	Soakaway drainage is considered to be unfeasible at the site.
	Reuse of Site Won Soils	Site-won materials are likely to be classified as Class 2 cohesive which may be able to be used for General Fill Material and will be slightly wet of optimum in the majority of cases. There is a significant variation in the compaction characteristics and control of the compaction on site must take account in the variation in the material properties. It will be necessary to develop an appropriate Site Specific Earthworks Specification which can be adopted as part of the contract documentation. Based on the testing to date, it is considered that there will be no constraints on the use of hydraulic binders to modify the River Terrace Deposits posed by the presence of sulphate bearing minerals. However, testing has shown the Raised Marine Deposits are a potential source of sulphates. These soils are located entirely within the fill area and will not be used to construct bulk earthworks. However, Raised Marine Deposits will be present in the subgrade in the east of the site and in pile arisings and care should be undertaken during the earthworks to ensure these materials are not affected by sulphate heave where use of hydraulic binders is undertaken.
	Buried Concrete	Based on guidelines provided in BRE Special Digest 1, the soils can be classified as Design Sulphate Class DS-3 and ACEC Class AC-3.



FUTURE CONSIDERATIONS	Uncertainties and Limitations	The gas monitoring undertaken to date may be considered sufficient to provide a preliminary characterisation of the ground gas regime as CS-1. Additional monitoring is required and is ongoing to finalise the ground gas requirements for the site. Whilst Hydrock are confident in the conclusions regarding the absence of a significant risk to Controlled Waters in view of development proposals, it cannot be guaranteed that the conclusions of this report will be accepted without question. Therefore, it is recommended that this report is presented to the Local Planning Authority for comment prior to any irreversible action being taken.
	Further Work	The following further works will be required: • Presentation of this report to the Local Planning Authority Environmental Health Officer; • Further gas monitoring; • Preparation of an Earthworks Specification; • Preparation of a Geotechnical Design Report; • Preparation of a Remediation Method Statement; • Consideration of any excavations within the former pond areas and preparation of a Materials Management Plan if necessary; • Discussions with piling contractors and, subject to design, ground improvement contractors.

This Executive Summary forms part of Hydrock Consultants Limited report number R/14459/003 (Issue 002a) 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 to undertake a ground investigation at Oldlands Farm, Bognor Regis. A desk study has been prepared previously for the site; reference R/14459/002, June 2014.

The main development site covers 10.0 ha and is currently arable farmland. The ground investigation included investigation of a separate area to the northwest of the development site to be used as a flood compensation area. The flood compensation area totals approximately 12.5 ha in area.

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), topographic survey plan (Hydrock drawing 14459/002) and Site Layout Plan (Hydrock drawing 14459/D007) are presented in Appendix A.

1.2 Objectives

The objectives of this investigation are to assess the ground and groundwater conditions to provide geotechnical design recommendations and to carry out a risk assessment of potential chemical contaminants.

1.3 Scope

The scope of work for this commission comprises:

- an ground investigation including trial pitting, cable percussive boring, static cone penetration tests, gas and groundwater monitoring, laboratory chemical and geotechnical testing; and
- reporting on findings of the ground investigation, geo-environmental assessment of the site conditions and geotechnical interpretation of the ground and groundwater conditions.

The following report excludes a desk study of the site as has been prepared previously, however for clarity a review of the main findings of the desk study is included.

1.4 Provided Information

The following has been provided to Hydrock by 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 DESK STUDY REVIEW

A comprehensive desk study report has been prepared for the site and is presented in Hydrock report reference R/14459/002, dated June 2014, herein referred to as the Desk Study Report. The Desk Study Report includes a review of any historical reports in relation to the site. The main findings are summarised in the following section, however, reference should be made to the Desk Study Report for comprehensive coverage of the subject.

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. 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 22.5 ha in total, the development site is approximately 10 ha with a flood compensation scheme to the north totalling approximately 12.5 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. Whilst the levels change across the site, 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.



Item	Brief Description
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.
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

The historical map evidence suggests the site has been farmland since the earliest map editions of the late 19th Century. However, there are two ponds which appear to have been infilled in the late 19th and late 20th centuries.

In the late 20th Century there has been the development of an industrial estate adjacent to the southern site boundary.

2.4 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 2.3: 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

*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 which is located off-site to the south.



2.5 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 present at a shallow depth.

2.6 Hydrogeology

The aquifer designations given in Table 2.4 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 2.4: 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.

There is a well located on site which does not appear to be in current use.

2.7 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.

Historically there have been two ponds in the south of the main site.

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.

2.8 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.

2.9 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).



3.0 PRELIMINARY CONCEPTUAL SITE MODEL

The Desk Study Report has been used to formulate a preliminary conceptual site model.

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.

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.

The main details of the site and potential hazards are summarised on the Site Zonation Plan (Appendix A).

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.



4.0 GROUND INVESTIGATION

4.1 Investigation Rationale

The ground investigation rationale based on the findings of the preliminary risk assessment is summarised in Table 4.1.

Table 4.1: Investigation Rationale

Exploratory Holes	Purpose
<i>Main Site</i>	
Cable percussive boreholes BH01 to BH06	Characterise geology. Undertake sampling and in-situ testing. Install gas/groundwater standpipes.
Trial Pits (all)	Characterise geology. Undertake sampling and in-situ testing.
Trial Pits TP33, 47, 48 & 49	Additional excavations to investigate suspected areas of contamination (ponds).
CPTs (all)	Provide continuous geotechnical profile of soils. Assess lateral variation in ground conditions.
<i>Flood Compensation Area</i>	
Trial Pits (all)	Characterise geology. Undertake sampling and in-situ testing.

4.2 Site Works

The position of site investigation locations were set out by a Land surveyor using a GPS system and are shown on the Ground Investigation Plan in Appendix A.

The site works undertaken for this investigation are summarised in Table 4.2. The logs, including details of ground conditions, soil sampling, *in-situ* testing and any installations, are presented in Appendix B.

Table 4.2: Summary of Site Works

Activity	Method	No.	Max. Depth	In Situ Tests	Installations / Notes
Drilling, Pitting and Probing					
Boreholes	Cable percussive	6	10.45	SPT	63mm HDPE wells with gas taps in all holes
Trial pits	JCB 3CX	49	3.80	HSV	Backfilled with arisings
Probes	CPT electric piezocone	17	16.80	Qt, fs, U	-
Other In Situ Testing or Monitoring					
Soakaway	BRE Digest 365	5	2.20	Infiltration rate	TPs, 15, 17, 26, 34 & 40



4.3 Geo-Environmental Testing

4.3.1 Sampling Strategy and Protocols

The locations of the investigatory holes were determined by reference to the conditions identified in the preliminary risk assessment. Certain specific targets such as backfilled ponds were identified but a reasonably even spacing was used for the remainder of the site. No specific sampling statistics or grid were utilised in this instance.

Samples were taken stored and transported in general accordance with BS 10175:2011+A1:2013.

4.3.2 Monitoring

Gas monitoring boreholes were monitored on three occasions at weekly intervals. The results are presented in Appendix E.

4.3.3 Laboratory Analyses

The findings of the preliminary risk assessment have been used to scope the analyses of chemicals of potential concern as follows.

The following were performed on samples of **soil or other solids**:

- 24 Hydrock default suite of determinands for solids comprising: As, B (water soluble), Be, Cd, Cr (III), Cr(VI), Cu, Hg (inorganic), Ni, Pb, Se, V, Zn, cyanide (free), pH, asbestos screen, speciated polycyclic aromatic hydrocarbons (PAH, by GC-MS), total phenols and fraction of organic carbon;
- 4 total petroleum hydrocarbons by GC-FID (Hydrock Level 2 suite comprising aliphatic / aromatic split and the following carbon banding: aliphatic - EC5-EC6, >EC6-EC8, >EC8-EC10, >EC10-EC12, >EC12-EC16, >EC16-EC35, aromatic - EC5-EC7, >EC7-EC8, >EC8-EC10, >EC10-EC12, >EC12-EC16, >EC16-EC21, >EC21-EC35 plus BTEX and MTBE by GC-MS);
- 6 other organic compounds suspected as a result of former land use, namely pesticide screen;
- 1 asbestos identification a sample of suspected cement-bound tile; and
- 1 topsoil assessment in accordance with BS 3882.
- X bio-accessibility of As (PBET extraction).

The following were performed on samples of **groundwater**:

- 3 Hydrock default waters suite of determinands comprising: Ag, Al, As, B, Ba, Cd, Co, Cr (III), Cr(VI), Cu, Fe, Hg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sn, Zn, V, cyanide (free and total), phenols (total). The chemical test results are provided in Appendix F.



4.4 Geotechnical Laboratory Testing

In order to address the geotechnical risks identified in Section 3.0 the following geotechnical testing was scheduled on samples retrieved from the above site works. The testing laboratory was UKAS accredited.

- 67 natural moisture contents;
- 34 Atterberg limits;
- 17 analyses for sulphate and aggressive chemical environment classification for buried concrete consisting of the full suite of determinands in accordance with BRE SD1;
- 4 organic matter contents;
- 32 particle size distribution analyses;
- 2 sedimentation of fines fraction in conjunction with the above;
- 12 particle densities;
- 8 intact dry density of chalk;
- 2 multistage undrained triaxial shear strength tests;
- 3 oedometer consolidation tests;
- 10 2.5kg compaction tests; and
- 10 remoulded CBR tests.

The geotechnical test results are provided in Appendix D.



5.0 GROUND INVESTIGATION DATA

5.1 Physical Ground Conditions

The ground conditions over the entire site as proven during the current works are in general accordance with the published geological literature and expectations from the desk study and previous investigation works on the site.

Details are provided in the logs in Appendix B and a summary is presented in Table 5.1 and Table 5.2. The individual strata are described in the sections below. Relevant cross-sections / contour plans / isopachyte diagrams are presented in Appendix A.

Table 5.1: Strata Encountered in the Main Site

Stratum Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Made Ground – reworked topsoil consisting of sandy clay and clayey sand.	0.00	0.10 – 0.80	0.10 – 0.80
Made Ground – refuse materials present in former pond areas consisting of variable sandy gravelly clay, clayey sandy gravel and gravelly sand with some cobbles and occasional boulder sized particles. Gravel is flint and ash, metal, glass concrete, brick and asbestos containing materials.	0.00	0.30 – 1.70	0.30 – 1.70
Subsoil – locally present underlying topsoil consisting of soft sandy clay.	0.20 – 0.40	0.25 – 1.20	0.00 – 0.90
Raised Marine Deposits – present in the east of the site and consisting of very soft organic clay, sandy silt, silty sand and sand, locally with plant remains.	0.10 – 1.20	2.00 – 8.70	0.00 – 8.40
River Terrace Deposits – present in the west and centre of the site and locally underlying the Raised Marine Deposits, typically consisting of soft to firm sandy clay and clayey sandy gravel. Gravel is predominantly of flint and chalk.	0.20 – 4.10	1.90 – 5.20	0.00 – 4.60
White Chalk Subgroup – comprising clayey slightly sandy gravel sized fragments of weak, low density chalk and with occasional flint gravel. (Grade Dc)	1.90 – 8.70	unproven	unproven

Table 5.2: Strata Encountered in the Flood Compensation Area

Stratum Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Made Ground – reworked topsoil consisting of sandy clay and clayey sand.	0.00	0.30 – 0.60	0.30 – 0.60
Subsoil – locally present underlying topsoil consisting of soft sandy clay.	0.30 – 0.50	1.00 – 1.20	0.00 – 0.90
River Terrace Deposits – consisting of soft to firm sandy clay and clayey sandy gravel. Gravel is predominantly of flint and chalk.	0.30 – 1.40	1.90 – 2.80	1.60 – 2.40



Stratum Description	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
White Chalk Subgroup – comprising clayey slightly sandy gravel sized fragments of weak, low density chalk and with occasional flint gravel. (Grade Dc).	1.90 – 2.80	unproven	unproven

The spatial distribution of the geology on site is indicated on the Site Zonation Plan (Hydrock drawing 14459/D006) at Appendix A. The deposition of soils is reflected in the topography of the site with Raised Marine Deposits in the east of the site and River Terrace Deposits occupying the higher ground in the centre and west. The flood compensation area lies a considerable distance beyond the northwestern extent of the Raised Marine Deposits.

A thin surface cover of Made Ground (reworked topsoil) is present across the entire site. Locally in the south and southwest of the main site, deeper areas of Made Ground were encountered which are consistent with the location of former ponds identified in the desk study.

5.1.1 Made Ground

Nominal Made Ground consists of a clayey topsoil, notably the topsoil was more sandy in the flood compensation area.

There are two distinct areas of Made Ground associated with former ponds in the south and southwest of the main site. The easternmost of the two ponds was found to be up to 1.7m deep, whilst the westernmost is known to be at least 1.6m deep, however excavation was terminated at shallow depth due to the presence of asbestos containing materials.

The ponds are understood to have been infilled by historical occupiers of the farm and are filled with natural clay, chalk and flint gravel along with man-made materials such as ash, clinker, metal, glass concrete, brick, asbestos containing materials and occasional plastics. The deposits were predominantly granular, consisting of sandy gravel and gravelly sand with a variable fines content, however locally sandy gravelly clay horizons were observed and cobble and boulder sized fragments were present.

5.1.2 Subsoil

Locally underlying the Made Ground (topsoil) a gradational transition with the underlying geology was observed extending to a depth of up to 1.20m and characterised by an intermediate soft to firm sandy clay soil with occasional rootlets and flint gravel. It should be appreciated that interpretation of this horizon is to some extent subjective.

5.1.3 Raised Marine Deposits

The Raised Marine Deposits consist of soft clay and sandy clay, becoming very soft and organic with depth and with frequent plant remains. In places, deposits of very loose, variably silty fine to medium grained sand are present within the Raised Marine Deposits, possibly as a relict of coastal sand.



5.1.4 River Terrace Deposits

The near surface River Terrace Deposits were found to consist of variably soft to stiff sandy clay with occasional flint gravel. Deeper deposits typically consist of clayey sandy gravel, with gravel predominantly of fine to medium subrounded chalk and fine to coarse flint.

5.1.5 White Chalk Subgroup

Strata of the White Chalk Subgroup were encountered in all boreholes and CPTs and a number of trial pits. The chalk was found to be structureless and consist of a clast supported melange (Grade Dc) of weak to moderately weak, medium density fragments with flint gravel. The chalk is white, cream and occasionally light grey in colour with some orange-brown staining observed.

Deeper probing with the CPT equipment suggested there was an improvement in the strength and intactness of the chalk with depth between approximately 7.5m and 13.0m, however in some locations, the chalk remained extremely soft to depths of greater than 15m.

The elevation of the upper surface of the White Chalk is shown on the contour plot (Drawing 14459/D008) in Appendix A.

5.2 Obstructions

A buried concrete obstruction was encountered in the southern end of trial pit TP38. The nature and origin of the obstruction is not known however the location is coincident with the easternmost of the backfilled ponds.

5.3 Visual and Olfactory Evidence of Contamination

There were no specific indications of contamination other than the presence of man-made materials and refuse within the ponds.

The evidence of potentially contaminated soils occurred only within the ponds in the main site area and there was no evidence of contamination in the flood compensation area.

5.4 Summary of Geotechnical Results

The following sections tabulate the main findings and give interpretations where appropriate.

5.4.1 Plasticity Index

The soil plasticity for the various soil types is summarised in Table 5.3 with reference to the BS 5930 A-line.

For comparison, the equivalent volume change potential in terms of NHBC Standards is included as an indication of the volume change potential in respect of building near trees.



Table 5.3: Summary of Soil Plasticity

Stratum	No. Tests	Plasticity Index (%)	Modified Plasticity Index (%)	Plasticity Designation	Equivalent NHBC Volume Change Potential
Subsoil	1	14	14	low	low
Raised Marine Deposits (silt and sand)	3	NP	-	Non-plastic	-
Raised Marine Deposits (clay)	13	15 – 53 (36)	15 – 53 (30)	Low to very high	Low to high
River Terrace Deposits	16	11 – 35 (18)	1.8 – 30 (14)	Low to high	Low to medium
White Chalk Subgroup	1	NP	-	Non-plastic	-

5.4.2 Particle Size Distribution (PSD)

Thirty two PSD (wet sieve) tests were undertaken on soils at the site and are summarised in Table 5.4.

Table 5.4: PSD Results Summary

Stratum	Silt/Clay %	Sand %	Gravel %	Description
Subsoil	87	12	1	Sandy slightly gravelly clay.
Raised Marine Deposits	20 - 99	1 - 80	0 - 2	Sandy slightly gravelly clay / clayey slightly gravelly sand.
River Terrace Deposits (clay)	63 - 97	3 - 53	0 - 15	Slightly sandy/ sandy/ slightly gravelly / gravelly clay
White Chalk Subgroup	33 - 43	10 - 17	30 - 57	Clayey sandy gravel sized fragments (Grade Dc)

5.4.3 Intact Dry Density of Chalk

The bulk and intact dry density of the chalk was determined for eight samples and the findings are summarised in Table 5.5 below.

Table 5.5: Chalk Density Summary

Location	Depth (m)	Moisture Content (%)	Bulk Density (Mg/m ³)	Intact Dry Density (Mg/m ³)	CIRIA 574 Density Grade
BH01	6.50 – 8.00	22	2.00	1.64	Medium
BH01	9.50 – 10.00	25	2.00	1.60	Medium
BH03	3.00 – 4.00	21	2.03	1.68	Medium



Location	Depth (m)	Moisture Content (%)	Bulk Density (Mg/m ³)	Intact Dry Density (Mg/m ³)	CIRIA 574 Density Grade
BH04	8.00 – 9.50	21	2.08	1.72	High
TP03	1.90 – 2.60	24	1.99	1.60	Medium
TP04	2.50 – 3.20	25	1.99	1.59	Medium
TP44	2.20 – 3.00	24	2.00	1.61	Medium

It should be appreciated that the intact dry density relates to chalk fragments and is not necessarily reflective of the soil mass where structureless chalk is indicated.

5.4.4 Soil Strength

Table 5.6 summarises derived¹ soil strength parameters and factual results for laboratory tests, field tests (e.g. hand shear vane) and uncorrected Standard Penetration Tests (SPT).

Table 5.6: Soil Strength Results and Derived Values

Stratum	SPT (N-Value) (Range)	Shear Strength (Range)			Method	No. of Results
		c _u (kPa)	c' (kPa)	phi' (°)		
Made Ground	-	n/a	n/a	28	Assumed with reference to soil description	-
Raised Marine Deposits (GL – 1.20m)	-	49 – 99 (68)	n/a	n/a	Hand shear vane	25
Raised Marine Deposits (>1.20m)	1 - 5	10 – 73 (31)	n/a	n/a	Hand shear vane	21
		4 – 25 (10)	n/a	n/a	SPT correlation (Stroud)	6
		17.8	n/a	n/a	Multistage undrained triaxial	1
River Terrace Deposits (clays)	1 - 9	16 – 91 (51)	n/a	n/a	Hand shear vane	82
		6 – 55 (34)	n/a	n/a	SPT correlation (Stroud)	8
		76.3	n/a	n/a	Multistage undrained triaxial	1
White Chalk Subgroup	7 – 39 (24)	n/a	n/a	29 – 38 (34)	SPT correlation (Peck et al.)	30

¹ **Derived values** of geotechnical parameters and/or coefficients are obtained from test results, by theory, correlation or empiricism in line with BS EN 1997-2:2007, Section 1.6.



A total of 17 static cone penetration tests were undertaken across the main site. The results including continuous correlation of geotechnical parameters (C_u , E_d , ϕ) is presented in Appendix C.

5.4.5 Compressibility

The compressibility parameters from in-situ and laboratory tests are summarised in Table 5.7.

Table 5.7: Compressibility coefficients

Stratum	No. Tests	Method	SPT N Value (range)	m_v (m^2/MN)	C_v $m^2 / year$
Raised Marine Deposits	6	SPT correlation (Stroud)	1 - 5	0.43 – 2.17 (1.43)	-
	2	Laboratory oedometer		0.21 – 0.55	3.45 – 11.51
River Terrace Deposits (clays)	8	SPT correlation (Stroud)	1 - 9	0.17 – 0.56 (0.49)	-
	1	Laboratory oedometer		0.38	2.57

5.4.6 California Bearing Ratio (CBR)

The CBR results are summarised in Table 5.8 including recommended values that can be assumed for preliminary design purposes within the scope of this report.

Table 5.8: CBR Results and Derived Values

Stratum	Method	No. Tests	CBR (%) (Range)
Raised Marine Deposits	Laboratory remoulded	1	0.7
River Terrace Deposits	Laboratory remoulded	7	0.3 – 4.0
White Chalk subgroup	Laboratory remoulded	1	2.0

5.4.7 Compaction Characteristics

The compaction characteristics of the soils are summarised in Table 5.9 below.

Table 5.9: Summary of Compaction Testing

Stratum	Method	No. Tests	Natural Moisture Content (%)	Maximum Dry Density (Mg/m^3)	Optimum Moisture Content (%)
Subsoil	2.5 kg	1	19	1.77	17
River Terrace Deposits	2.5 kg	8	14 - 25	1.62 – 1.82	14 – 23
White Chalk subgroup	2.5 kg	2	21 – 23	1.71 – 1.74	20



5.4.8 Sulphate Content

In accordance with BRE (Special Digest 1), the Design Sulphate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in Table 5.10.

Table 5.10: Aggressive Chemical Environment Concrete Classification

Stratum	No. Tests	DS	ACEC
Raised Marine Deposits	4	DS-3	AC-3
River Terrace Deposits	8	DS-1	AC-1
White Chalk Subgroup	5	DS-1	AC-1
Groundwater	3	DS-1	AC-1

5.4.9 Organic Matter Content

The organic matter content of the Raise Marine Deposits is summarised in Table 5.11.

Table 5.11: Organic Matter Content

Stratum	Number of tests	Organic Matter Content (%)
Raised Marine Deposits	4	0.2 – 1.2

5.5 Groundwater

5.5.1 Groundwater Levels

Groundwater strikes encountered during the investigation are summarised in Table 5.12.

Table 5.12: Groundwater Strikes

Borehole	Date	Depth to Groundwater (m bgl)	Ground Level (mOD)	Groundwater Elevation (Reduced Level) (mOD)
BH01	05/06/2014	1.30	0.88	-0.42
BH02	04/06/2014	3.00	0.89	-2.11
BH04	09/06/2014	3.90	2.59	-1.31
BH05	04/06/2014	4.10	0.86	-3.24
BH06	03/06/2014	4.60	1.25	-3.35
TP01	11/06/2014	2.20	1.90	0.30
TP02	11/06/2014	2.30	1.90	0.40
TP03	12/06/2014	3.00	2.40	0.60
TP04	11/06/2014	2.20	2.50	-0.30



Borehole	Date	Depth to Groundwater (m bgl)	Ground Level (mOD)	Groundwater Elevation (Reduced Level) (mOD)
TP06	12/06/2014	3.40	3.00	0.40
TP07	11/06/2014	2.60	2.50	0.10
TP08	11/06/2014	2.10	2.00	0.10
TP09	12/06/2014	1.60	2.00	-0.40
TP10	11/06/2014	0.00	2.80	-2.80
TP11	11/06/2014	2.10	2.40	-0.30
TP12	12/06/2014	1.65	2.00	-0.35
TP13	11/06/2014	1.80	2.00	-0.20
TP14	11/06/2014	2.30	2.00	0.30
TP15	04/06/2014	1.20	2.00	-0.80
TP16	04/06/2014	1.01	1.10	-0.09
TP17	04/06/2014	0.86	1.50	-0.64
TP18	04/06/2014	0.95	1.20	-0.25
TP19	04/06/2014	1.00	3.50	-2.51
TP21	04/06/2014	2.20	2.00	0.20
TP22	05/06/2014	0.88	2.80	-1.92
TP23	06/06/2014	0.80	3.00	-2.20
TP24	03/06/2014	0.91	2.40	-1.49
TP25	05/06/2014	1.90	1.70	0.20
TP26	04/06/2014	1.39	1.80	-0.41
TP27	03/06/2014	0.89	2.90	-2.01
TP28	03/06/2014	0.87	2.90	-2.03
TP29	06/06/2014	0.98	2.40	-1.42
TP30	06/06/2014	0.88	3.00	-2.12
TP31	03/06/2014	1.21	3.20	-1.99
TP32	03/06/2014	2.99	2.90	0.09
TP34	04/06/2014	1.05	1.50	-0.45
TP36	06/06/2014	1.49	3.20	-1.71
TP38	05/06/2014	2.34	2.30	0.04



Borehole	Date	Depth to Groundwater (m bgl)	Ground Level (mOD)	Groundwater Elevation (Reduced Level) (mOD)
TP39	06/06/2014	1.09	2.40	-1.31
TP41	03/06/2014	1.89	2.70	-0.81
TP42	05/06/2014	1.03	3.20	-2.17
TP44	05/06/2014	2.57	1.30	1.27
TP46	03/06/2014	2.20	1.50	0.70
TP47	13/06/2014	2.01	2.00	0.01

Groundwater records from piezometers or wells obtained during subsequent monitoring visits are given in Appendix E and are summarised in Table 5.13.

Table 5.13: Groundwater Monitoring Summary (18th June to 4th July, 2014)

Borehole	Response Zone	Depth to Groundwater (m bgl)	Ground Level (mOD)	Groundwater Elevation (Reduced Level) (mOD)
BH01	Chalk	0.76 – 0.96	0.88	-0.08 – 0.12
BH02	Drift (Raised Marine Deposits)	0.82 – 1.15	0.89	-0.26 – 0.07
BH03	Drift (River Terrace Deposits)	1.47 – 3.05	1.48	-1.57 – 0.01
BH04	Chalk	2.41 – 2.62	2.59	-0.03 – 0.18
BH05	Drift (Raised Marine Deposits)	0.71 – 0.91	0.86	-0.05 – 0.15
BH06	Chalk	1.06 – 1.19	1.25	0.06 - 0.19

5.5.2 Infiltration Tests

The results of soakaway testing are summarised in Table 5.14. The results sheets are given in Appendix B.

Table 5.14: Infiltration Test Results

Stratum	Trial Pit no.	Depth	Infiltration Rate (m/s)		
			Test 1	Test 2	Test 3
Raised Marine Deposits	TP15	2.20	Infiltration rate too low to quantify from data		
	TP17	1.50	Infiltration rate too low to quantify from data		
	TP26A	1.70	Infiltration rate too low to quantify from data		
	TP34	1.70	Infiltration rate too low to quantify from data		
	TP40	2.20	Infiltration rate too low to quantify from data		



5.6 Geo-Environmental Results

The chemical test results for soil, leachate and groundwater are given in Appendix F which also includes summary tables of the data.

The occurrence of contaminants, notable metals, PAH and asbestos, is confined to the former pond areas in the south of the main site.

5.7 Ground Gases (Carbon Dioxide and Methane)

Records from the gas monitoring boreholes are summarised in Appendix E. The results of monitoring between 18th June and 4th July, 2014 can be summarised as follows:

- no methane has been detected in any borehole on any of the visits;
- carbon dioxide has been detected at concentrations of up to 4.9% v/v in one instance and typically ranging between 0.0 to 2.0% v/v;
- oxygen concentrations of between 19.3% v/v and 21.2% v/v; and
- gas flow measurements indicated emission rates of between -0.1l/hr and 0.2l/hr.



6.0 PRELIMINARY RISK ASSESSMENT

6.1 Updated Ground Model

The preliminary conceptual site model initially developed from the desk study and walk-over survey (Section 3.1) has been confirmed using the findings of the ground investigation. The main features of the site are summarised on the Site Zonation Plan (Appendix A).

The bedrock geology comprises the White Chalk Subgroup. The superficial geology comprises River Terrace Deposits over the majority of the west and centre of the Main site, with Raised Marine Deposits in the east. In the Flood Compensation Area, the superficial deposits consist of River Terrace Deposits.

The Raised Marine Deposits are characterised by clayey sand and very soft organic clay. The River Terrace Deposits are characterised by soft and firm sandy clay and clayey gravelly sand.

In the south of the site and southwest of the main site there are two ponds which have been backfilled with waste materials including ash, clinker, brick, concrete, glass and asbestos containing materials.

The soils on site are a source of ground gas however measured concentrations and flow rates are typically low.

Monitoring data from June and July 2014 has indicated that the groundwater table is standing at approximately 0.00m AOD. The lower lying ground in the east of the site is known to flood hence the development proposals include the creation of a flood alleviation basin and the raising of site levels at the development platform.

The soils on site, notably the Raised Marine Deposits but locally also the River Terrace Deposits, are poor in terms of load bearing capacity and are highly compressible. Therefore, consolidation settlement will require consideration in the design of the earthworks scheme.

6.2 Updated Exposure Model

Following the site investigation, the plausible contaminant sources and receptors identified in Section 3.0 have been updated or confirmed.

6.2.1 Sources

The following potential sources have been removed from the exposure model:

A total of six soil samples from the Main Site and the Flood Compensation Area were screened for a selection of commonly used pesticides and herbicides. In no instance were any pesticide or herbicide compounds detected.



6.2.2 Receptors

No potential receptors have been removed from the preliminary conceptual exposure models.

6.2.3 Pathways

No pathways have been removed from the exposure models.

With reference to the updated ground model and updated exposure model reported above, generic risk assessment is undertaken in the Section 7.0 and the geotechnical recommendations made in Section 9.0.



7.0 GENERIC QUANTITATIVE RISK ASSESSMENTS

There are plausible contaminant linkages which require further consideration, either in the form of subsequent tiers of risk assessment against generic or site-specific assessment criteria, or by proceeding directly to some form of risk management strategy (including possible remedial actions).

Generic risk assessment is a two stage process. Firstly, the measured contaminant concentrations are compared to the relevant GACs. This is the Risk Estimation stage. Where there is a suitable dataset, this is done after carrying out statistical analysis to determine the upper confidence limit on the true mean. Otherwise, maximum or specific data points are compared directly.

The second stage, Risk Evaluation, comprises an authoritative review of the findings with other pertinent information, in cases where the GACs are exceeded, in order to consider if exceedance may be acceptable in the particular circumstances.

7.1 Scope

The purpose of this risk assessment is to determine the potential contamination risks at the site for the proposed development. The aspects of risk from substances in the ground considered below are as follows:

- human health;
- plant life;
- pollution of Controlled Waters; and
- ground gases.

7.2 Human Health and Plant Life

This is a Tier 2 assessment using soil screening values and involves generic human health risk assessment for the commercial / industrial CLEA land use scenario.

Priority phytotoxic chemical concentrations are screened against published values to determine the likely risk to **plant growth**.

In Appendix F the soil chemical analysis results have been screened against guideline soil concentrations to provide an assessment of potential risks associated with contamination at the site. In the cases where all the samples tested for a given substance were below the GAC, no further consideration is necessary for that substance. However, for completeness all data is statistically assessed in the sections below. Note that the Category 4 Screening Levels (C4SL) for lead have been used in preference to the withdrawn SGV (DEFRA, March 2014) and the use of the term “GAC” in this report includes these.

It should be noted that the term “further assessment required” is used to denote soil concentrations that are equal to, or exceed, a GAC. This does not necessarily mean that the soil is “contaminated”.



A copy of the Hydrock risk assessment methodology is available upon request as a separate document.

7.2.1 Risk Estimation (Including Statistical Testing)

The 'averaging areas' used in this report are based on the conceptual model and the proposed development and are summarised as:

- Main Site;
- Flood compensation Area; and
- Former ponds (Main Site).

Initial Data Review

The data set for each chemical determinand has been assessed for the presence of potential outliers (based on the conceptual model) and to determine if the data are normally or non-normally distributed.

No outliers have been removed.

Statistical Testing

A suitable data set is available for statistical testing for the Hydrock default suite of determinands.

In line with the guidance provided by the CIEH (May 2008) the 95th upper confidence level on the true mean (US₉₅) has been calculated from the sample data.

Data have been assessed using the one-sample t-test or the one-sided Chebychev Theorem, as appropriate to the distribution.

Appendix F contains the detailed results of the statistical assessment for each chemical of potential concern, together with summary sheets for human health and plant life. The results are summarised below.

Human Health

With regards to human health, based on a US₉₅ exceedance of the GAC, the pervasive chemicals of potential concern which require further assessment are summarised in Table 7.1.

Table 7.1: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Human Health)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion	US ₉₅ (mg/kg)
Main Site – Nil							
Flood Compensation Area - Nil							



Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion	US ₉₅ (mg/kg)
Pond Areas							
Benz(a)anthracene	97	LQM/CIEH + CLEA 1.06	4	0.1	140	1	187.34
Benzo(a)pyrene	14	LQM/CIEH + CLEA 1.06	4	0.1	120	1	160.57
Benzo(b)fluoranthene	100	LQM/CIEH + CLEA 1.06	4	0.1	140	1	187.37
Chrysene	140	LQM/CIEH + CLEA 1.06	4	0.05	130	0	173.86
Dibenz(a,h)anthracene	13	LQM/CIEH + CLEA 1.06	4	0.1	19	1	25.43
Indeno(1,2,3,cd)pyrene	62	LQM/CIEH + CLEA 1.06	4	0.1	57	0	76.30

There are no chemicals of concern failing the mean value test from the Main Site (excluding ponds) and Flood compensation Area.

Plant Life

For plant life, based on a US₉₅ exceedance of the GAC, the pervasive chemicals of potential concern which require further assessment are summarised in Table 7.2.

Table 7.2: Pervasive Chemicals of Potential Concern for Which Further Assessment is Required (Risk to Plants)

Chemical of Potential Concern	Generic Criterion (mg/kg)	Basis for Generic Criterion	No. Samples	Min. (mg/kg)	Max. (mg/kg)	No. Samples Exceeding Generic Criterion	US ₉₅ (mg/kg)
Main Site – Nil							
Flood Compensation Area - Nil							
Pond Area							
Zinc	300	BS3882 2007	4	46	290	0	314.39

7.2.2 Risk Estimation (Without Statistical Testing)

In this section the results are discussed for determinands for which the data set does not allow application of statistical analysis by virtue of low sample numbers and/or spatial distribution (e.g. where sampling is targeted at specific sources identified in the preliminary investigation).



Petroleum Hydrocarbons (PHC)

Petroleum hydrocarbons were apparently detected in one sample (TP46 at 0.55m) which was located within the southwest pond area on the site. A significant quantity of ash is present within the former pond and consequently high concentrations of PAH (refer to Section 7.2.1). The detections for petroleum hydrocarbons were entirely aromatic hydrocarbons in the C10 to C44 range which would indicate, in the absence of any visual or olfactory evidence of petroleum hydrocarbons, that the detected substances were in fact PAH.

Therefore, it is concluded that there is no source of petroleum hydrocarbons on site and no further consideration of petroleum hydrocarbons is necessary.

Asbestos

Suspected asbestos containing materials were found in the westernmost of the backfilled ponds. The presence of asbestos (chrysotile) has subsequently been confirmed in the laboratory within a sample of cement bound tile material. Whilst the asbestos encountered was in the form of cement bound sheeting, it is considered likely that loose fibres may be present within the backfilled pond.

7.2.3 Risk Evaluation – Human Health

The screening exercise identified the following substances at concentrations above their relevant GACs. These are considered further here to assess if the exceedance may be acceptable with respect to the proposed development.

The concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene and indeno(1,2,3,cd)pyrene and asbestos within the pond areas pose an unacceptable risk to human health to the proposed development. Therefore, consideration of the location and any movement and handling of these materials will need to be made in the development plans. Remediation or off-site disposal will be required where it is not possible to deal with these materials under a materials management plan.

7.2.4 Risk Evaluation – Plant Life

Within the pond area, zinc is significantly elevated when compared to the GAC (see Table 7.2). As this material will be unsuitable for reuse within landscaping from the perspective of human health the zinc concentrations are considered not to be of any significance.

7.3 Pollution of Controlled Waters

7.3.1 Risk Estimation

The risks to groundwater and surface water from contaminants on site have been assessed according to the Environment Agency (2006) Remedial Targets Methodology (RTM). Pollutants from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) and as such are regulated under the Agency's 'limit' pollution objective.



Acceptable Water Quality Targets (WQT) are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)). For the purposes of this report, the site data are compared with the various targets as set out according to the Hydrock scenario(s) in Table 7.3:

- the White Chalk Subgroup is a Principal Aquifer;
- the Raised Marine Deposits and River Terrace Deposits are Secondary Aquifers;
- there are surface water drains on site; and
- there is hydraulic continuity between all groundwater and surface water bodies.

Table 7.3: Summary of Water Quality Risk Assessment Protocol

Hydrock Scenario	Water Body Receptors	Secondary Receptors	Example Contaminant Linkages	RTM Level and Data Used	Water Quality Targets
D	Groundwater. Surface water.	Human health (abstraction). Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be used for human consumption and is an aquatic ecosystem.	RTM Level 2 - Groundwater.	DWS EQS (inland)
Notes: Some EQS are water hardness dependent. This is measured either in the receiving water or in groundwater (if it is part of the pathway), or is estimated from national maps. Inland waters EQS applicable to freshwater, other waters EQS applicable to marine or transitional waters. Where both DWS and EQS are applicable, it is assumed that the EQS is for inland waters. This table and the results of the assessment are considered as a first screening for potential risks of pollution of Controlled Waters. More specific requirements may be stipulated by the Environment Agency.					

The results of the Remedial Targets Methodology assessment are presented in Appendix F and are summarised in Table 7.4.

It should be noted that in some instances the reporting limit (or detection limit) quoted by the laboratory may be greater than the WQT that it is being assessed against. As the current exercise is an initial screening assessment, further assessment of these chemicals of concern has not been undertaken.

Table 7.4: Chemicals of Potential Concern for Which Further Assessment is Required (Controlled Waters)

Chemical of Potential Concern	Water Quality Target (ug/l)	Basis for Water Quality Target	No. Samples	Min. (ug/l)	Max. (ug/l)	No. Samples Exceeding Target
Sodium	200,000	DWS	3	45,000	390,000	1
Chloride	250,000	DWS/EQS	3	51,000	270,000	1
Nitrite	500	DWS	3	82	3000	1
Manganese	50	DWS	3	72	250	2
Silver	0.05	EQS	3	0.18	0.50	2



7.3.2 Risk Evaluation

There have been exceedances of the DWS and/or EQS for a number of chemicals. In the case of sodium and chloride, it is highly likely the exceedances are caused by brackish waters given the proximity to the English Channel and therefore these are considered to be of natural origin. Similarly, there is no evidence of a source of silver or manganese on site and therefore these contaminants are believed to be sourced from the underlying geology.

In the case of nitrite, the sources are likely to be agricultural both on site and within the wider area. It is not known whether fertilisers have been applied to the crops sown at the time of the investigation. Hydrock believe that no specific action is necessary because the site is not within a Source Protection Zone, and furthermore, upon development agriculture will cease and therefore the development process will achieve betterment from the perspective of protection of Controlled Waters.

7.4 Ground Gases

7.4.1 Carbon Dioxide and Methane

The risks associated with the ground gases methane (CH₄) and carbon dioxide (CO₂) are assessed using BS 8485:2007 (Code of practice for the characterisation and remediation from ground gas in affected developments) and guidelines from CIRIA 665 (Wilson *et al* 2007) and the NHBC (Boyle and Witherington 2007). In the above CIRIA guidance:

- 'Situation A' covers all forms of development (residential and industrial/commercial developments), other than those in Situation B; and
- 'Situation B' is defined as the specific development of low-rise (one to three storeys in height) housing with a vented sub-floor void (min. 150 mm).

The development proposals require consideration of Situation A.

It is judged from the available evidence that the gas generation potential at the site is low and the sensitivity of the development is low. This is on account of geology consisting of slightly organic alluvial soils and localised pockets of Made Ground, and an industrial development, Consequently, an appropriate minimum monitoring regime is 6 readings over 2 months, provided other monitoring requirements are also met, such as prevailing atmospheric pressure conditions (for example, BS 8485:2007 suggests monitoring shall include a period of falling atmospheric pressure).

The monitoring strategy reported in Appendix E may not have detected the worst-case conditions because of the temporal limitations of this investigation and the results to date are discussed below. However, it is recommended that the available information be discussed with the Environmental Health Officer and Building Control.

The guidance requires identification and use of the gas flow rate and the concentration of both carbon dioxide and methane across the whole site to calculate a Gas Screening Value (GSV). The typical worst case GSV have been calculated as <0.0001 l/hr for methane and 0.0098 l/hr for carbon dioxide and the site is classified as Characteristic Situation 1 in accordance with CIRIA 665.



Based on the GSV no mitigation is required, however subject to discussions with the Local Authority it may be necessary to undertake additional monitoring to meet the monitoring frequency and duration stipulated in the CIRIA guidance.

7.4.2 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 no radon protection measures are required.

7.5 Findings of the Generic Risk Assessments

Particular areas of the site which are of potential concern are indicated on the Site Zonation Plan in Appendix A. Site-wide issues are not mapped on the plan, but are listed in the notes. The source-pathway-receptor linkages given in Table 7.5 are those which, following the risk evaluation process, require further consideration and are discussed further in Section 8.0.



Table 7.5: Final Conceptual Model and Residual Risks Following Risk Evaluation

Sources	Pathways	Receptors	General Comments	Mitigation Comments
PAH in the backfilled ponds.	Ingestion, inhalation or direct contact.	Human health.	GACs are exceeded for a number of PAH species within the backfilled pond areas.	These risks will require consideration as part of the development proposals. Materials outside of cut areas or drainage runs may remain in-situ. Materials management may enable impacted soils to be moved to less sensitive areas of the development beneath hard-standings.
Asbestos in the backfilled ponds.	Ingestion, inhalation or direct contact.	Human health.	Asbestos containing materials are present in the backfilled pond areas.	
Asbestos fibres from asbestos-containing materials in the Made Ground	Inhalation of fugitive dust.	Human health.	Made Ground seen to contain asbestos-containing materials. Asbestos fibres measured in soil samples.	Requires mitigation measures.
Zinc in backfilled ponds.	Root uptake.	Plant life.	Marginal exceedance of the GAC.	The impacted material will not be used in areas of landscaping, therefore no further consideration is required.
Nitrite	Leaching through unsaturated zone.	Groundwater and possible abstractors.	Nitrate exceeds DWS in groundwater.	Development of the site will remove potential source of nitrite on site.



8.0 GEO-ENVIRONMENTAL CONCLUSIONS AND RECOMMENDATIONS

8.1 Human Health

The risk assessment indicates that the Made Ground within the former ponds is a pervasive source PAH and asbestos fibres. It is envisaged that the long term risk can be mitigated by Materials Management during construction under a Materials Management Plan prepared by an appropriately qualified Environmental Engineer.

Removal of the material could be considered as an alternative if preferred by the developer.

8.2 Plant Life

There are no significant risks to plant life.

8.3 Controlled Waters

The Level 2 risk assessment undertaken in Section 7.3 indicates that whilst there are elevated concentrations of chemicals of potential concern Hydrock does not believe the site poses a significant risk to Controlled Waters because the contaminants of concern are either of natural or agricultural origin.

8.4 Water Pipelines

The current guidance on selection of materials for water supply pipes to be laid in contaminated land is contained in UKWIR Report 10/WM/03/02 (re-issued 2010) and supplemented by guidance issued by Water UK (January 2014). The latter document sets out in Table 1 threshold values for a selection of contaminants that may have a detrimental effect on pipes and fittings. However, the document is for guidance and is not mandatory and has not been adopted universally by all water suppliers.

A formal water pipe risk assessment is beyond the scope of this report, however, the findings of this investigation have been compared to the threshold values in Water UK Table 1 as far as is practicable to give an indication of the possible restrictions to the use of plastic pipes for water supply to the site.

Until proven or agreed otherwise, it is recommended that barrier pipe provision is assumed pending liaison with the supply company. Subject to demonstration that water pipelines will not be laid through any of the backfilled pond areas and agreement with the water supply authority, it may be possible to dispense with the requirement for barrier pipework.

The implications for buried concrete are discussed in Section 9.10.

8.5 Precautions Against Ground Gases

8.5.1 Radon

Current advice based on the BR 211 Report is that no radon protection is required for new buildings at this location.



8.5.2 Carbon Dioxide and Methane

Hydrock have undertaken 3 ground gas monitoring visits and monitoring is ongoing. In accordance with CIRIA 665, 6 monitoring visits are required to provide a full understanding of the ground gas regime. The ground gas readings derived from the current works are not sufficiently comprehensive to characterise the site.

Whilst additional monitoring is required, for guidance, the site may be classified as Characteristic Situation 1 for Situation A (CIRIA 665). However additional monitoring is required and the worst-case conditions may not have been observed. The anticipated worst case conditions would be CS-2.

For Characteristic situation 1, no special precautions will be required. To design for the anticipated worst case conditions (Characteristic Situation 2), the following measures would be necessary;

- Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM; or
- Beam and block or pre-cast concrete and 2000g DPM / reinforced gas membrane.
- Possibly underfloor venting or pressurisation in combination with the above depending on use.
- All joints and penetrations sealed.

See also text following CIRIA Table 8.6 (Wilson *et al* 2007) which gives additional details.

BS 8485:2007, Table 2 indicates a score of 3 points for public buildings, 2 points for commercial buildings and 1 point for industrial buildings (up to a maximum of 20% methane for industrial). A combination of venting and barrier systems whose scores total at least this number of points is required from the list in Table 3 of the standard. Mitigation measures will require detailed design. However, this could be achieved by the use of:

- passive sub-floor ventilation using gravel;
- reinforced concrete ground bearing slab; and
- proprietary gas membrane, taped and sealed, with appropriate CQA integrity testing.

8.5.3 Ground Workers

It is noted that concentrations of carbon dioxide (an asphyxiant) in the soil exceed HSE Workplace Exposure Limits for personnel in the working environment of 1.5% for short term (15 minutes) exposure or 0.5% for long term exposure. Furthermore, soil concentrations of oxygen are below the HSE recommendations of 18%.

Whilst risks to construction workers are not generally discussed in this report, and soil gas concentrations are not necessarily reflected by those in the breathing zone, all contractors and maintenance workers should be made aware of the possible presence of carbon dioxide and should take all necessary health and safety precautions when working in trenches or confined spaces.



8.6 Waste Management

All wastes going to landfill must be classified as 'inert', 'non-hazardous' or 'hazardous', with a sub-category of hazardous waste known as 'stable non-reactive hazardous waste'. Individual landfill sites must operate in accordance with their Environmental Permits.

Defining the class of waste is carried out on the actual waste being disposed of and the destination landfill site will have the final decision on acceptability of the waste. Therefore, it is recommended that if soils are to be removed from the site, the appointed contractor should approach a landfill site with the available chemical data and seek a formal waste characterisation.

Prior to disposal, the characteristics of any excavated soils will need classification in consultation with landfill sites and waste disposal contractors. Testing and analysis will be required to be carried out on the actual soil arisings which will constitute the waste. However, based on the data to date, the majority of the soils are likely to be classified as inert (natural soils and stones). However, the backfilled pond material will be classified potentially as hazardous.

8.7 Materials Management

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose.

One of the ways this can be achieved is set out in the Development Industry Code of Practice (CoP) (CL:AIRE, March 2011).

The handling, re-use or disposal of waste is regulated by the Environment Agency. The Agency will take into account the use of the CoP in deciding whether to regulate materials as waste. If materials are dealt with in accordance with the CoP, the Agency considers that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development. Hydrock would recommend that a Materials Management Plan (MMP) is used for the site to allow the re-use of soils at the site.

The MMP must be signed off by a Qualified Person as defined in the CoP.



9.0 GEOTECHNICAL INTERPRETATION AND RECOMMENDATIONS

9.1 Geotechnical Categorization of the Proposed Development

Eurocode 7, Section 2 advocates the use of geotechnical categorization of the proposed structures to establish the design requirements. For the purposes of this investigation, the proposed structures have been classed as follows:

- Geotechnical Category 1: within the proposed development works hard-standings and drainage excavations are considered to be within this category.
- Geotechnical Category 2: with the proposed development earthworks and foundation designs are considered to be within this category;
- Geotechnical Category 3: There are not considered to be any structures classified within this category associated with the proposed development.

As this site includes Category 2 works a specific Geotechnical Design Report is required.

Geotechnical aspects of the site are discussed in the following sections. Specific areas of potential concern are indicated on the Site Zonation Plan in Appendix A with site-wide issues listed in the notes.

The Raised Marine Deposits in the east of the main site are highly compressible and the land raising and subsequent loading of these strata will cause significant displacement of the ground surface. Therefore ground improvement will be required to limit post construction settlement in external areas to within acceptable limits. Ground improvement to external areas may consist of pre-loading and surcharging using material imported for the land raising.

In view of the presence of organic, Raised Marine Deposits, there is the potential for long term secondary compression (creep) settlement which will continue beyond the primary (load induced) consolidation. Whilst it is possible to mitigate creep to some extent by pre-loading and surcharging, it is not stress dependent and therefore can affect any structural element not supported by either piles or rigid inclusions extended through the Raised Marine Deposits. Local experience at the North Berstead Relief Road scheme has shown creep settlement in the order of 20mm occurring within 6 months following a two year preload and surcharge operation. As creep is related to the logarithm of time, settlement of the same order would be anticipated over the next five and in turn fifty years. It is therefore concluded that pre-loading and surcharging is not suitable for supporting ground bearing floor slabs at this site.

In light of the above, attention could be given to a rigid inclusion form of ground improvement (vibro-cement columns, controlled modulus columns) or a fully piled ground floor slab. Traditional vibro-stone columns are considered to be unsuitable for this site in view of the ground conditions encountered.

9.2 Flooding

In response the risk of flooding it is proposed to raise site levels. The land raising will be undertaken with material won from the flood compensation area to the northwest of the main site. Specialist advice should be sought in relation to flood risk and drainage.



9.3 Site Preparation, Earthworks, Groundworks and Landscaping

Currently, there are live services present in the Flood compensation Area including overhead power lines crossing the centre of the area and a medium pressure gas main present along the western edge. However, Hydrock has not undertaken any discussions with statutory undertakers and there remains a possibility of further live services being present within the site (Main Area or Flood Compensation Area). Therefore, it is recommended that statutory undertakers are consulted in respect of the location of their apparatus within the site. It is recommended that all suspected dead services are confirmed dead by testing. All dead services must be located by careful hand digging and clearly marked or confirmed 'dead' prior to undertaking demolition or groundworks on the site. Excavation in close proximity to live services will need to ensure that the excavation walls are stable or appropriately battered to a safe angle. Temporary slope stability works may be required in any deep excavations.

There is currently a well in the south of the site. It is recommended that the existing cover slab is removed and the well filled with a suitably graded single size stone (Class 6A) material prior to commencing earthworks filling over the area.

Topsoil and unsuitable Made Ground should be removed from beneath all building, hardstanding areas and from the base of any earthworks embankments and will be suitable for reuse from the perspective of land contamination, with the exception of material from the pond areas. A BS 3882 certificate is appended to this report (Appendix F) and should be provided to a Landscape Architect to assess the reuse potential of topsoil won from this site.

It is cautioned that any excavation within the former pond areas will create arisings that are hazardous to site workers and may constitute hazardous waste from the perspective of off-site disposal. Where it is intended to excavate these materials, a Materials Management Plan should be created for the site to enable appropriate handling and relocation of these materials.

Excavations undertaken during site works were unstable and given the soft and loose nature of the shallow soils and the high water table, all excavations should be supported. It is recommended that no site personnel enter any trenches unless there is adequate support and this has been assessed by a competent person and is subject to an appropriate schedule of inspection on site.

Groundwater was encountered in the majority of trial pits on site and in all boreholes. Standing groundwater levels have been found to be in the order of 0.0m AOD during the monitoring period. It should be noted that monitoring was undertaken in the Summer and levels may vary seasonally. Based on the groundwater observations made, it is envisaged some form of groundwater control will be necessary for excavations. In view of the variable and significantly cohesive soils present on site, it may be the case that traditional well points are unfeasible and groundwater ejectors will be necessary. Care should be taken to ensure fines are not removed from the soil during groundwater control.

The groundwater levels at the site are subject to significant seasonal variation and it has been observed that water had apparently been standing at the ground surface a relatively short time prior to undertaking works in June. It is anticipated that there will be significant difficulties in trafficking the site and drainage during construction in the wetter months.



Reuse of materials is discussed in Section 9.9. Where different material classes and natural moisture contents are present within the source materials there may be a benefit in segregating materials for reuse.

9.4 Consolidation Settlement from Land Raising

The proposed formation level of 3.00m AOD will be achieved by raising of site levels as indicated on the Cut to Fill drawing reference C14443-201-P3. A maximum increase of 2.0m from existing site level will be necessary in the north of the site.

To raise site levels will generate significant consolidation settlement from the Raised Marine Deposits, and to a lesser extent within the River Terrace Deposits. A Contour Plot indicating the anticipated ground settlement from the land raise is appended (14459/D004). The contour plot indicates anticipated land raise settlement ranging between approximately 6mm and 220mm with increasing magnitudes of settlement corresponding to increasing thickness of the Raised Marine Deposits. This assessment does not include the significant secondary creep settlement that will be mobilised due to any change in the stress conditions.

In undertaking the land raise exercise, it should be appreciated that the induced settlement must be accounted for to attain the final proposed ground level.

Based on the laboratory data and a conservative assessment of the drainage path length, the duration of consolidation settlement would be in the order of 7 months to 2 years without any form of surcharging. However, it is cautioned that laboratory derived coefficients of consolidation are often found to be significantly in error when compared with field measured values and it is recommended that field trials are undertaken as part of the development of a ground improvement scheme for the site.

Subject to design, it may be possible to significantly reduce the period of consolidation required by the use of a surcharge load and the installation of vertical drains on a suitable spacing. One additional benefit of surcharging is that it can be designed in such a way as to minimise post construction settlements and secondary compression (creep) in addition to the predicted land raise settlement.

9.5 Foundations

The preliminary foundation designs in this section are based on the parameters given in Section 5.4. Recommendations for Geotechnical Category 2 and 3 structures (according to EC7) are presented to aid development proposals. Selection of geotechnical design parameters should be undertaken in conjunction with the design process and discussed in a separate Geotechnical Design Report.

Based on the poor load bearing characteristics of the Raised Marine Deposits and River Terrace Deposits, coupled with the relatively high groundwater table, it is envisaged that shallow foundations will not be suitable for the development and fully piled foundations are recommended.



9.5.1 Piled Foundations

Piled foundations should be designed to extend through the Raised Marine and River Terrace Deposits and carry their load in the White Chalk strata in skin friction or a combination of skin friction and end bearing.

A number of piled solutions could be given consideration at the site, e.g. continuous flight auger (CFA) piles or similar bored and cast in situ techniques. Advice should be sought from piling contractors on the application of their proprietary system in view of the ground conditions present. Where a bored and cast in-situ piling methodology is considered, there may be practical difficulties in casing pile bores to their base prior to placement of concrete because of the groundwater conditions.

It is recommended not to adopt a driven piling methodology in the White Chalk as experience has shown there may be a tendency to macerate chalk around the annulus of the pile without a corresponding mobilisation of skin friction when driving piles.

It is recommended that the load/settlement relationship is determined by test piling (to include both static and dynamic testing) to determine the final safe working load to be adopted. It is also recommended that a selected number of piles installed are load tested to ensure a satisfactory performance has been achieved.

The adoption of a bored piling methodology will generate a substantial quantity of spoil. There will be costs associated with the disposal of this material unless an appropriate use can be made for the material within the development.

The working load achievable should be determined by the specialist piling contractor appointed to undertake the works. With reference to CIRIA report PR86, "Shaft Friction of CFA Piles in Chalk" (2003), the results of the investigation suggests medium density chalk is present throughout the White Chalk Subgroup at the site. On this basis, a shaft friction coefficient (β) of 0.8 may be adopted for design in the Chalk.

In light of the above, the findings of the investigation suggest working loads in the order of 1500 kN/m² to 2000 kN/m² should be achievable for a single pile of 25m length and 450mm to 600mm diameter, subject to design by the specialist contractor. Where significant loads are proposed, structural elements could be supported by pile groups.

Where piles are to be installed through the Fill and/or Raised Marine Deposits, there is the possibility of negative skin friction creating downdrag on the piles. In this instance it will be necessary to consider slip sleeving of piles to mitigate against downdrag. Alternatively, it may be possible to account for downdrag by adjusting the working load of the pile.

9.5.2 Working Platform

For piling or installation of rigid inclusions, a working platform will be required to be designed and constructed prior to arrival on site of tracked plant. This should be designed and installed in accordance with BR470 (BRE 2004) based on data on the piling plant in accordance with an FPS certificate for the rig loadings.



9.6 Ground Floor Slabs

Whilst pre-loading and surcharging is recommended in mitigation for settlement occurring due to the land raising in external areas, it is considered not to be suitable for the preparation of a subgrade to support a ground bearing floor slab owing to the anticipated long term creep settlement. Therefore there are two design options:

- Floor slab supported on piles; or
- Ground bearing design following ground improvement.

Recommendations for support of the floor slab on piles would be broadly similar to those made in respect of foundations.

With regard to the ground improvement option, a system of rigid inclusions consisting of either Vibro-Concrete Columns (VCC) or Controlled Modulus Columns (CMC) may be appropriate. The feasibility and design options for such a scheme should be discussed with a specialist contractor who would undertake the works. In some instances it is possible to increase the carrying capacity of the column by providing a bulb at the base of the column.

With the use of VCC or CMC consideration of negative skin friction would need to be made, much the same as would for piles.

It will be necessary to transfer of load from the floor slab to the rigid columns either using a granular load transfer platform, or alternatively (and subject to design by the specialist contractor), a flared head on the column to facilitate transfer of loads from the slab.

9.7 Roads and Pavements

Based on the test results, it is considered likely a CBR of less than 2.5% will be available over the majority of the site for design purposes. As such, the sub-grade may be unsuitable for both the trafficking of site plant and as support for a permanent foundation, without improvement works being undertaken. Improvement works should be carried out in accordance with DMRB IAN 73/06 Rev 1 Chapter 5. In summary, consideration may be given to the following potential remedial techniques:

- excavation and re-engineering or replacement of weaker soils;
- the inclusion of geosynthetic reinforcement within the unbound layers of the capping and sub-grade; or
- where cohesive soils are present and they are deemed suitable for treatment with hydraulic binders, to employ modification and/or stabilisation techniques on the formation.

Proof rolling of the formation level will be required and any loose or soft spots to be removed and replaced with an engineered fill, in accordance with a suitable Specification. The formation level will also need to be protected during inclement weather from deterioration; all slopes shall be trimmed to falls to shed rain water and the surface sealed to limit infiltration.

Prior to the placement of the founding materials and the construction of the road pavement, the sub-formation and formation will need to be inspected and checked in accordance with a suitable Specification to ensure the ground conditions are as expected. All testing should be carried out in accordance with DMRB IAN 73/06 and confirm that the ground conditions at time of construction are consistent with the previous design parameters.



9.8 Reuse of Site-Won Materials

An initial assessment has been completed on the potential to re-use site-won materials as an engineered fill material as it is understood this is being considered as part of the proposed development.

The geotechnical assessment of the site-won materials indicates the soils which are likely to be re-used can be classified as Class 2 cohesive (more than 15% passing the 63µm) which may be able to be used for General Fill Material. Where an increased end-performance of the material is required over and above those defined for general fill materials additional testing and specification will be required, which is outside of the scope of the current assessment.

It is envisaged that the majority of the earthworks will be constructed from the River Terrace Deposits won from the flood compensation area. Based on the testing undertaken the River Terrace Deposits have been found to be slightly wet of optimum in the majority of cases, with natural moisture contents typically in the order of 3% above the optimum. As summarised in Table 5.9 the maximum dry densities vary between 1.62 Mg/m³ and 1.82 Mg/m³ with optimum moisture contents ranging between 14% to 25%. Control of the compaction on site must take account in the variation in the material properties, for example by the use of MCV in determining material acceptance.

It will be necessary to develop an appropriate Site Specific Earthworks Specification which can be adopted as part of the contract documentation. The basis for the Specification should be BS 6031 and the latest version of the SHW, Series 600 Earthworks.

Based on the testing to date, it is considered that there will be no constraints on the use of hydraulic binders to modify the River Terrace Deposits posed by the presence of sulphate bearing minerals.

Testing has shown the Raised Marine Deposits are a potential source of sulphates with total sulphate of up to 0.13% and total potential sulphate of up to 0.76%. These soils are located entirely within the fill area and will not be used to construct bulk earthworks. However, care should be undertaken during the earthworks to ensure these materials are not affected by sulphate heave where use of hydraulic binders is undertaken. If necessary, measures such as addition of binders ex-situ in an area away from the Marine Deposits, the use of bitumastic sealing layers or segregation between layers compacted without binder addition could be used to minimise the risk.

9.9 Soakaways and Drainage

Due to slow infiltration rates and the relatively high groundwater table (typically in the order of 1.0m to 1.5m below existing ground level), soakaway drainage is not considered feasible.

9.10 Buried Concrete

Based on guidelines provided in BRE Special Digest 1, the soils can be classified as Design Sulphate Class DS-3 and ACEC Class AC-3.



10.0 UNCERTAINTIES AND LIMITATIONS

10.1 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.

Hydrock has used reasonable skill, care and diligence in the design of the investigation of the site. The inherent variation of ground conditions allows only definition of the actual conditions at the locations and depths of trial pits and boreholes at the time of the investigation. At intermediate locations, conditions can only be inferred.

Groundwater findings described are only representative of the dates on which they were made and levels may vary.

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.

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 chemical analyses reported were scheduled for the purposes of risk assessment with respect to human health, plant life, ecosystems and controlled waters as discussed in the report. Whilst the results may be useful in applying the Hazardous Waste Assessment Methodology given in Environment Agency Technical Guidance WM2, they are not primarily intended for that purpose and additional analysis may be required should waste classification be required for consideration of off-site disposal of contaminated soils. Separate analyses will be required to meet the Waste Acceptance Criteria for specific landfill sites.

Unless otherwise stated, the chemical testing carried out for this report was not scoped to comply with the requirements of the water supply company and further work may be required.