

Address: A5036 Waterloo Road Vauxhall, Liverpool,
Date: 9 Oct 2018
Reference: CMAPS-AAG-747728-4165-091018GEO
Client: CENTREMAPS



Aerial Photograph Capture date: 11-Jun-2015
Grid Reference: 333452,391297
Site Size: 3.31ha

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Overview of Findings

The Groundsure Geo Insight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 and 1:10,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Non-coal mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and Groundsure's unique database including historical surface ground and underground workings.

For further details on each dataset, please refer to each individual section in the report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1: Geology 1:10,000 Scale

1.1 Artificial Ground	1.1 Is there any Artificial Ground/ Made Ground present beneath the study site at 1:10,000 scale?	Yes
1.2 Superficial Geology and Landslips	1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site at 1:10,000 scale?*	Yes
	1.2.2 Are there any records of landslide within 500m of the study site boundary at 1:10,000 scale?	No
1.3 Bedrock, Solid Geology and linear features	1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	1.3.2 Are there any records of linear features within 500m of the study site boundary at 1:10,000 scale?	No

Section 2: Geology 1:50,000 Scale

2.1 Artificial Ground	2.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	Yes
	2.1.2 Are there any records relating to permeability of artificial ground within the study site*boundary?	Yes
2.2 Superficial Geology and Landslips	2.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?*	Yes
	2.2.2 Are there any records of permeability of superficial ground within 500m of the study site?	Yes
	2.2.3 Are there any records of landslide within 500m of the study site boundary?	No
	2.2.4 Are there any records relating to permeability of landslips within the study site* boundary?	No

Section 2: Geology 1:50,000 Scale

2.3 Bedrock, Solid Geology and linear features

2.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.

2.3.2 Are there any records relating to permeability of bedrock ground within the study site boundary?

Yes

2.3.3 Are there any records of linear features within 500m of the study site boundary?

No

Section 3: Radon

3. Radon

3.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?

The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.

3.2 Radon Protection

No radon protective measures are necessary.

Section 4: Ground Workings

	On-site	0-50m	51-250	251-500	501-1000
4.1 Historical Surface Ground Working Features from Small Scale Mapping	10	0	0	Not Searched	Not Searched
4.2 Historical Underground Workings from Small Scale Mapping	3	0	0	7	18
4.3 Current Ground Workings	0	0	0	0	0

Section 5: Mining, Extraction & Natural Cavities

	On-site	0-50m	51-250	251-500	501-1000
5.1 Historical Mining	0	0	0	0	13
5.2 Coal Mining	0	0	0	0	0
5.3 Johnson Poole and Bloomer Mining Area	0	0	0	0	0
5.4 Non-Coal Mining*	0	0	0	0	0
5.5 Non-Coal Mining Cavities	0	0	0	0	0
5.5 Natural Cavities	0	0	0	0	0

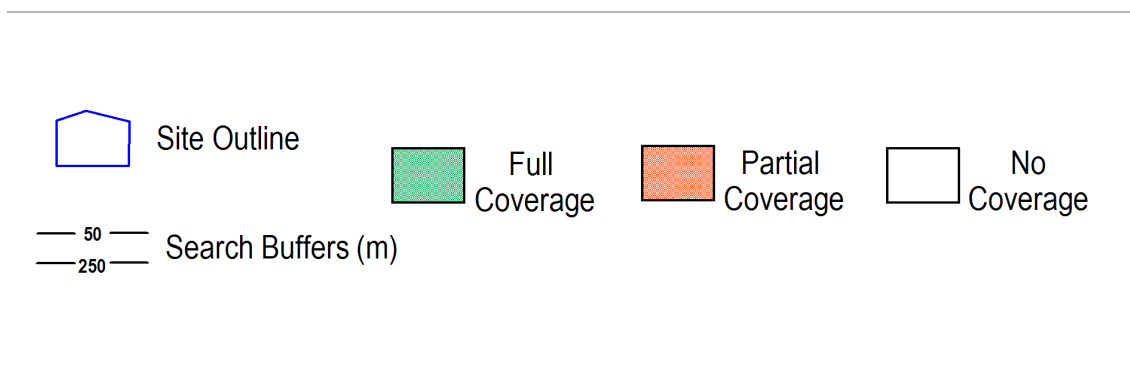
Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.6 Brine Extraction	0	0	0	0	0
5.7 Gypsum Extraction	0	0	0	0	0
5.8 Tin Mining	0	0	0	0	0
5.9 Clay Mining	0	0	0	0	0
Section 6: Natural Ground Subsidence	On-site				
6.1 Shrink-Swell Clay	Very Low				
6.2 Landslides	Very Low				
6.3 Ground Dissolution of Soluble Rocks	Negligible				
6.4 Compressible Deposits	Moderate				
6.5 Collapsible Deposits	Negligible				
6.5 Running Sand	Very Low				
Section 7: Borehole Records	On-site	0-50m	51-250		
7 BGS Recorded Boreholes	2	1	35		
Section 8: Estimated Background Soil Chemistry	On-site	0-50m	51-250		
8 Records of Background Soil Chemistry	2	1	0		
Section 9: Railways and Tunnels	On-site	0-50m	51-250	250-500	
9.1 Tunnels	0	0	0	Not Searched	
9.2 Historical Railway and Tunnel Features	21	16	28	Not Searched	
9.3 Historical Railways	0	0	1	Not Searched	
9.4 Active Railways	2	2	2	Not Searched	
9.5 Railway Projects	0	0	0	0	

1:10,000 Scale Availability



1_10,000 Availability Legend

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Availability of 1:10,000 Scale Geology Mapping

The following information represents the availability of the key components of the 1:10,000 scale geological data.

ID	Distance	Artificial Coverage	Superficial Coverage	Bedrock Coverage	Mass Movement Coverage
1	0.0	Some deposits are mapped	Full	Full	No coverage
N2	1143.0	Some deposits are mapped	Full	Full	Some deposits are mapped
3	1461.0	Some deposits are mapped	Full	Full	No coverage
N4	1871.0	Some deposits are mapped	Full	Full	No coverage

Guidance: The 1:10,000 scale geological interpretation is the most detailed generally available from BGS and is the scale at which most geological surveying is carried out in the field. The database is presented as four types of geology (artificial, mass movement, superficial and bedrock), although not all themes are mapped or available on every map sheet. Therefore a coverage layer showing the availability of the four themes is presented above.

The definitions of coverage are as follows:

Geology	Full Coverage	Partial Coverage	No Coverage
Bedrock	The whole tile has been mapped	Some but not all the tile has been mapped	No coverage
Superficial	The whole tile has been mapped	Some but not all of the tile has been mapped	No coverage
Artificial	Some deposits are mapped on this tile	-	No deposits are mapped
Mass Movement	Some deposits are mapped on this tile	-	No coverage

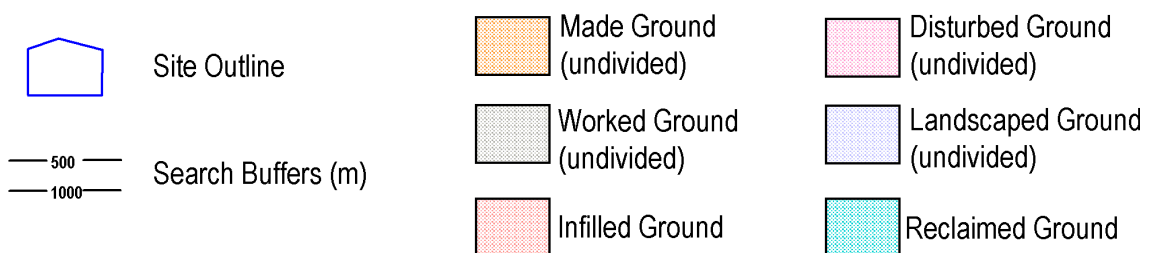
1 Geology (1:10,000 scale).

1.1 Artificial Ground map (1:10,000 scale)



Artificial Ground Legend

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1. Geology 1:10,000 scale

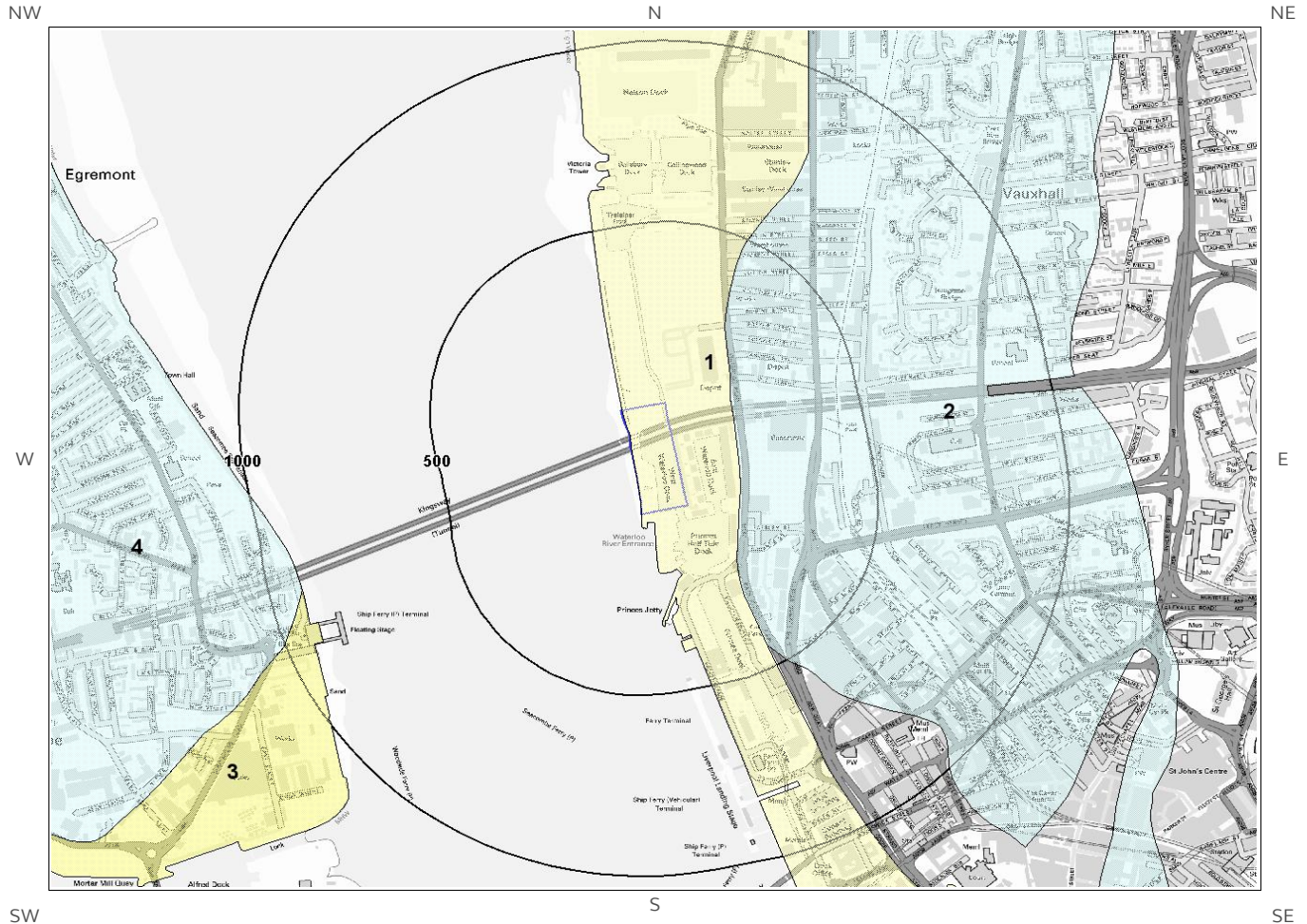
1.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

Are there any records of Artificial/ Made Ground within 500m of the study site boundary at 1:10,000 scale? Yes

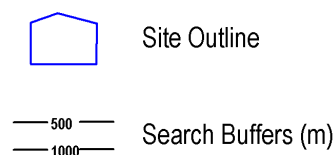
ID	Distance	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	MGR-FILLU	Made Ground (Undivided)	Fill
2	0.0	On Site	MGR-FILLU	Made Ground (Undivided)	Fill
3	206.0	SE	WGR-VOID	Worked Ground (Undivided)	Void
4	282.0	E	WGR-VOID	Worked Ground (Undivided)	Void
5	378.0	E	WGR-VOID	Worked Ground (Undivided)	Void

1.2 Superficial Deposits and Landslips map (1:10,000 scale)



Artificial Ground Legend

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1.2 Superficial Deposits and Landslips

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping

1.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary at 1:10,000 scale? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	ITDU-CZS	Intertidal Deposits (undifferentiated) - Silty Sandy Clay	Clay, Silty, Sandy
2	136.0	E	TILLD-CSVL	Till, Devensian - Sandy Gravelly Cobbly Clay	Clay, Sandy, Gravelly, Cobbly

1.2.2 Landslip

Are there any records of Landslip within 500m of the study site boundary at 1:10,000 scale?

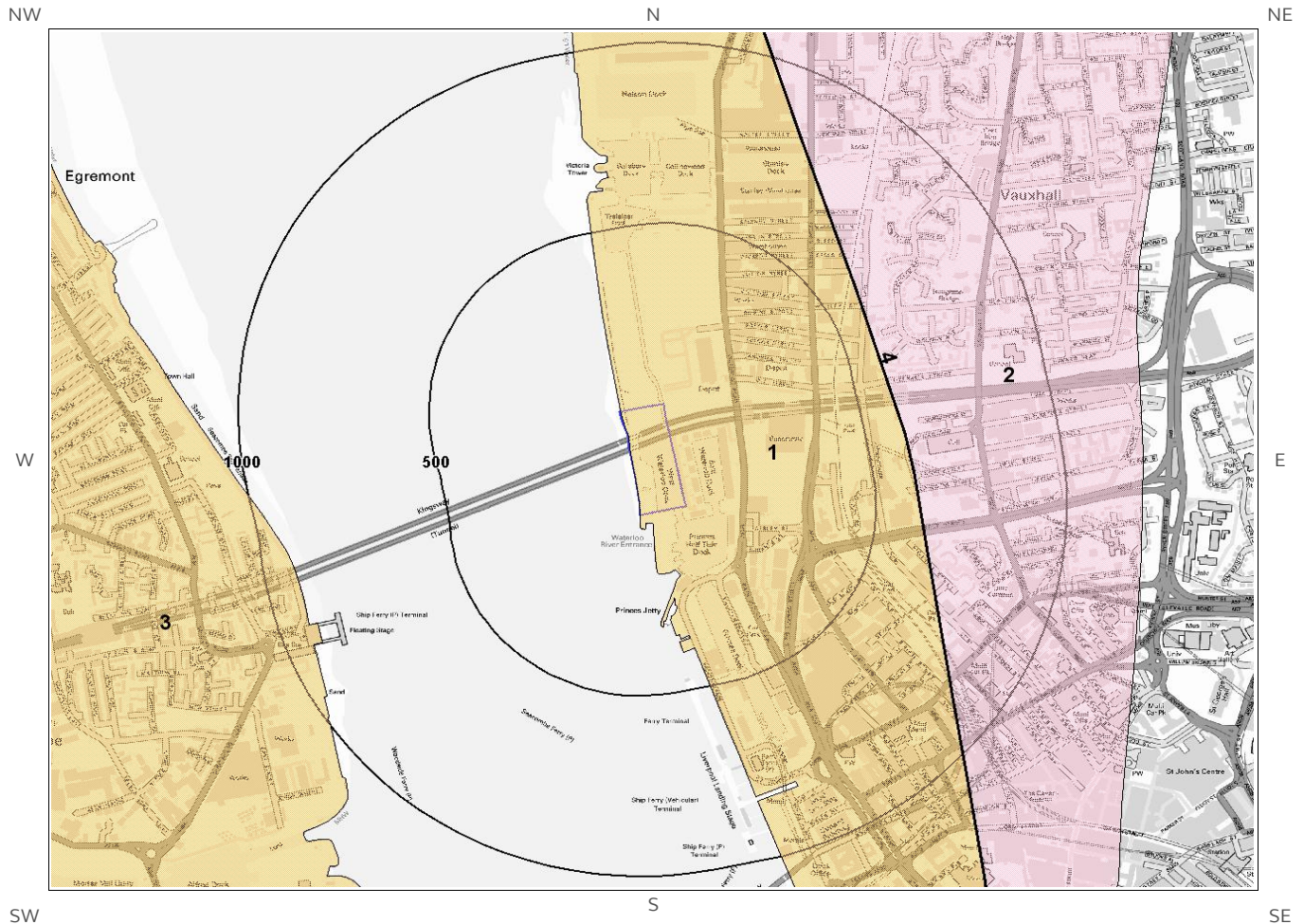
No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:10,000 scale

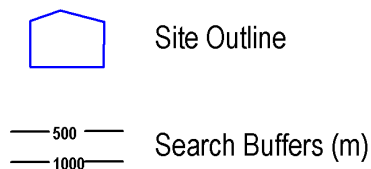
This Geology shows the main components as discrete layers, these are: Artificial / Made Ground, Superficial / Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

1.3 Bedrock and linear features map (1:10,000 scale)



Bedrock and linear features Legend

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1.3 Bedrock and linear features

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

1.3.1 Bedrock/ Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary at 1:10,000 scale.

ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	CPB-SDST	Chester Pebble Beds Formation - Sandstone	Early Triassic Epoch

1.3.2 Linear features

Are there any records of linear features within 500m of the study site boundary at 1:10,000 scale? No

Database searched and no data found at this scale.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of great Britain at 1:10,000 scale.

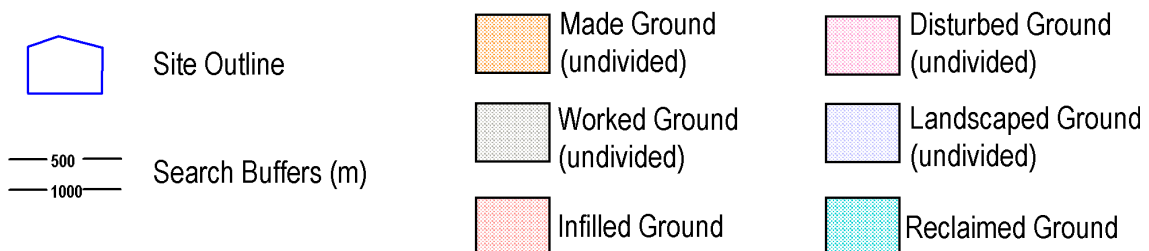
This Geology shows the main components as discrete layers, these are: Bedrock/ Solid Geology and linear features such as faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2 Geology 1:50,000 Scale

2.1 Artificial Ground map



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2. Geology 1:50,000 scale

2.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 096

2.1.1 Artificial/ Made Ground

Are there any records of Artificial/ Made Ground within 500m of the study site boundary? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	MGR-ARTDP	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT
2	205.0	SE	WGR-VOID	WORKED GROUND (UNDIVIDED)	VOID

2.1.2 Permeability of Artificial Ground

Are there any records relating to permeability of artificial ground within the study site boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Mixed	Very High	Low

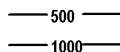
2.2 Superficial Deposits and Landslips map (1:50,000 scale)



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Site Outline



Search Buffers (m)

2.2 Superficial Deposits and Landslips

2.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary? Yes

ID	Distance	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	TFD-XCZS	TIDAL FLAT DEPOSITS	CLAY, SILT AND SAND
2	2.0	W	TFD-S	TIDAL FLAT DEPOSITS	SAND
3	134.0	E	TILLD-CSVL	TILL, DEVENSIAN	CLAY, SANDY, GRAVELLY, COBBLY
4	354.0	N	TFD-S	TIDAL FLAT DEPOSITS	SAND

2.2.2 Permeability of Superficial Ground

Are there any records relating to permeability of superficial ground within the study site boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Intergranular	Low	Low

2.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, there are: Artificial/ Made Ground, Superficial/ Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2.2.4 Landslip Permeability

Are there any records relating to permeability of landslips within the study site boundary? No

Database searched and no data found.

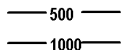
2.3 Bedrock and linear features map (1:50,000 scale)



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Site Outline



Search Buffers (m)

2.3 Bedrock, Solid Geology & linear features

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 096

2.3.1 Bedrock/Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary:

ID	Distance	Direction	LEX Code	Rock Description	Rock Age
1	0.0	On Site	CHES-PESST	CHESTER FORMATION - SANDSTONE, PEBBLY (GRAVELLY)	OLENEKIAN

2.3.2 Permeability of Bedrock Ground

Are there any records relating to permeability of bedrock ground within the study site boundary? Yes

Distance	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Mixed	High	Moderate

2.3.3 Linear features

Are there any records of linear features within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/Solid Geology and linear features such as faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nation wide coverage.

3 Radon Data

3.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.

The radon data in this report is supplied by the BGS/Public Health England and is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland. The dataset was created using long-term radon measurements in over 479,000 homes across Great Britain and 23,000 homes across Northern Ireland, combined with geological data. The dataset is considered accurate to 50m to allow for the margin of error in geological lines, and the findings of this report supercede any answer given in the less accurate Indicative Atlas of Radon in Great Britain, which simplifies the data to give the highest risk within any given 1km grid square. As such, the radon atlas is considered indicative, whereas the data given in this report is considered definitive.

3.2 Radon Protection



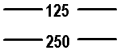


Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary.

4 Ground Workings map



Ground Workings Legend

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-  Site Outline
-  Historic Surface Ground Workings
-  Search Buffers (m)
-  Historic Underground Workings
-  Current Ground Workings

4 Ground Workings

4.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on Groundsure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Use	Date
1A	0.0	On Site	333679 390688	Docks	1890
2A	0.0	On Site	333599 390697	Docks	1906
3B	0.0	On Site	333314 391857	Docks	1938
4B	0.0	On Site	333314 391857	Docks	1909
5C	0.0	On Site	333551 390802	Docks	1982
6	0.0	On Site	333578 391220	Docks	1990
7C	0.0	On Site	333551 390802	Docks	1973
8	0.0	On Site	333566 391367	Docks	1938
9D	0.0	On Site	333466 391572	Docks	1973
10D	0.0	On Site	333466 391572	Docks	1982

4.2 Historical Underground Working Features derived from Historical Mapping

This data is derived from the Groundsure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? Yes

The following Historical Underground Working Features are provided by Groundsure:

ID	Distance (m)	Direction	NGR	Use	Date
11E	0.0	On Site	332953 391163	Tunnel	1990
12E	0.0	On Site	332953 391163	Tunnel	1982

ID	Distance (m)	Direction	NGR	Use	Date
13E	0.0	On Site	332953 391163	Tunnel	1973
14	395.0	E	333949 391375	Tunnel	1973
15F	482.0	E	335047 390885	Tunnel	1906
16F	485.0	E	335048 390893	Tunnel	1938
Not shown	496.0	E	334360 391203	Tunnel	1909
Not shown	496.0	E	334360 391203	Tunnel	1938
Not shown	496.0	E	334365 391194	Tunnel	1973
Not shown	496.0	E	334365 391194	Tunnel	1967
Not shown	684.0	SE	334192 390366	Tunnel	1967
Not shown	686.0	SE	334192 390366	Tunnel	1990
Not shown	686.0	SE	334192 390366	Tunnel	1982
Not shown	686.0	SE	334192 390366	Tunnel	1973
Not shown	689.0	E	334183 391475	Air Shafts	1982
Not shown	689.0	E	334183 391475	Air Shafts	1990
Not shown	720.0	E	334214 391478	Air Shafts	1982
Not shown	720.0	E	334214 391478	Air Shafts	1990
Not shown	752.0	E	334246 391480	Air Shafts	1990
Not shown	752.0	E	334246 391480	Air Shafts	1982
Not shown	784.0	E	334278 391484	Air Shafts	1982
Not shown	850.0	E	334345 391489	Air Shafts	1982
Not shown	850.0	E	334345 391489	Air Shafts	1990
Not shown	868.0	E	334362 391490	Air Shafts	1990
Not shown	868.0	E	334362 391490	Air Shafts	1982
Not shown	884.0	E	334378 391493	Air Shafts	1990
Not shown	884.0	E	334378 391493	Air Shafts	1982
Not shown	997.0	S	333225 389663	Tunnel	1938

4.3 Current Ground Workings

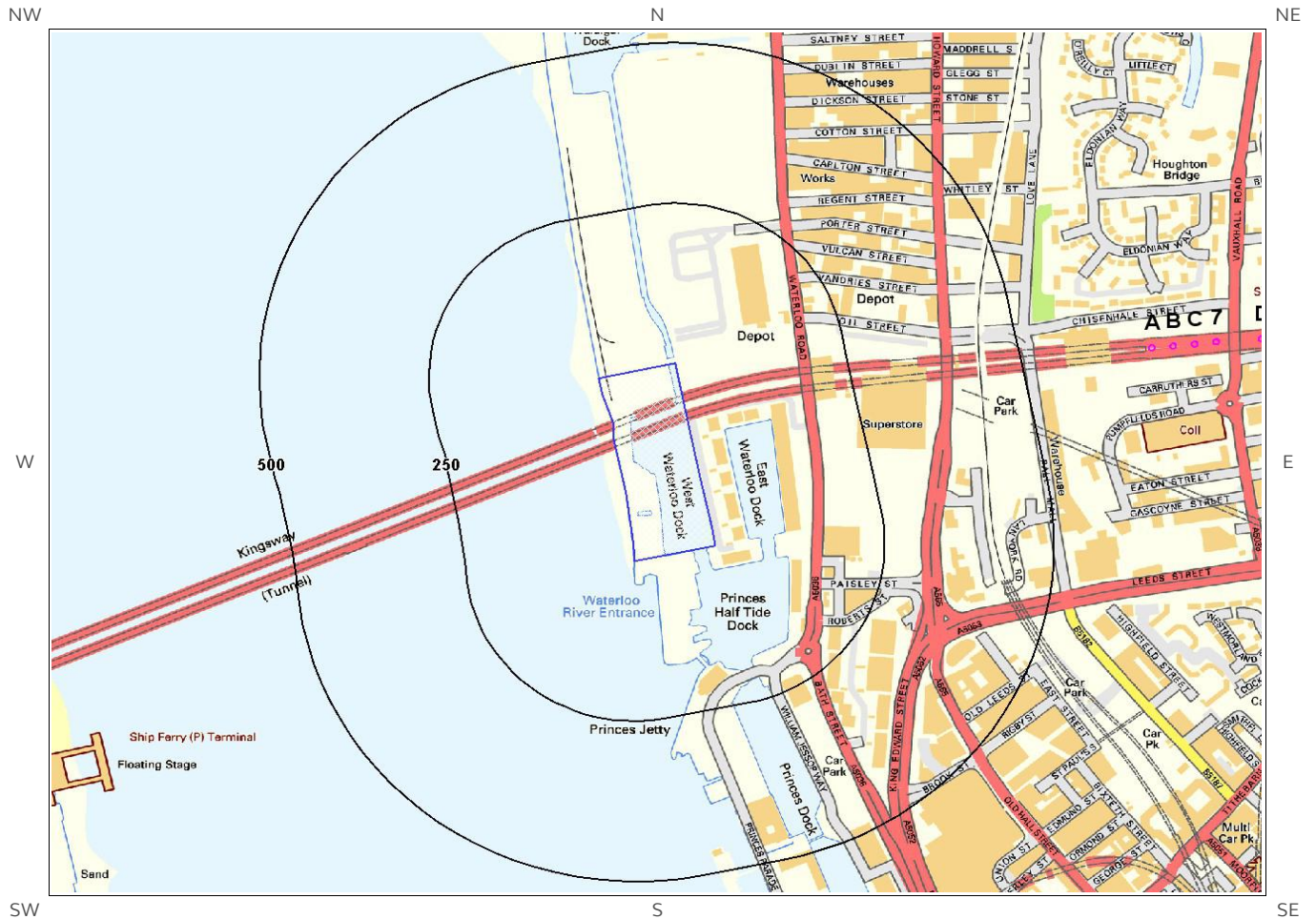
This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

Are there any BGS Current Ground Workings within 1000m of the study site boundary?

No

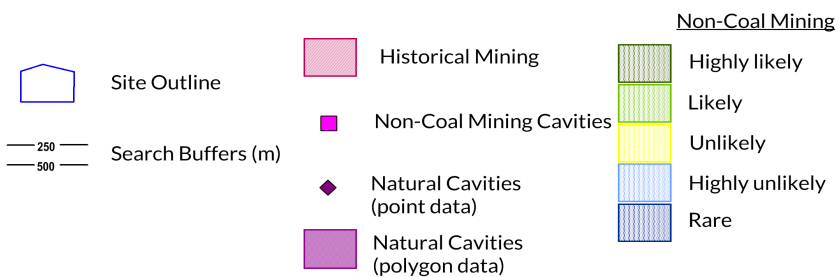
Database searched and no data found.

5 Mining, Extraction & Natural Cavities map



Mining, Extraction and Natural Cavities Legend

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5 Mining, Extraction & Natural Cavities

5.1 Historical Mining

This dataset is derived from Groundsure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary? Yes

The following Historical Mining information is provided by Groundsure:

ID	Distance (m)	Direction	NGR	Details	Date
1A	689.0	E	334183 391475	Air Shafts	1990
2A	689.0	E	334183 391475	Air Shafts	1982
3B	720.0	E	334214 391478	Air Shafts	1982
4B	720.0	E	334214 391478	Air Shafts	1990
5C	752.0	E	334246 391480	Air Shafts	1990
6C	752.0	E	334246 391480	Air Shafts	1982
7	784.0	E	334278 391484	Air Shafts	1982
8D	850.0	E	334345 391489	Air Shafts	1982
9D	850.0	E	334345 391489	Air Shafts	1990
Not shown	868.0	E	334362 391490	Air Shafts	1990
Not shown	868.0	E	334362 391490	Air Shafts	1982
Not shown	884.0	E	334378 391493	Air Shafts	1990
Not shown	884.0	E	334378 391493	Air Shafts	1982

5.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? No

The following information provided by JPB is not represented on mapping: Database searched and no data found.

5.4 Non-Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.5 Non-Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled "Review of mining instability in Great Britain, 1990" PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.6 Natural Cavities

This dataset provides information based on the Peter Brett Associates natural cavities database. The dataset is made up of points and polygons. Where polygons are used these represent an area in which it is expected the cavities could be found. It does not indicate that cavities are present everywhere within the polygon, and caution should be used in the interpretation of this data.

Are there any Natural Cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.7 Brine Extraction

This data provides information from the Coal Authority issued on behalf of the Cheshire Brine Subsidence Compensation Board.

Are there any Brine Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary?

No

Database searched and no data found.

5.9 Tin Mining

This dataset provides information on tin mining areas and is derived from tin mining records. This search is based upon postcode information to a sector level..

Are there any Tin Mining areas within 1000m of the study site boundary?

No

Database searched and no data found.

5.10 Clay Mining

This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

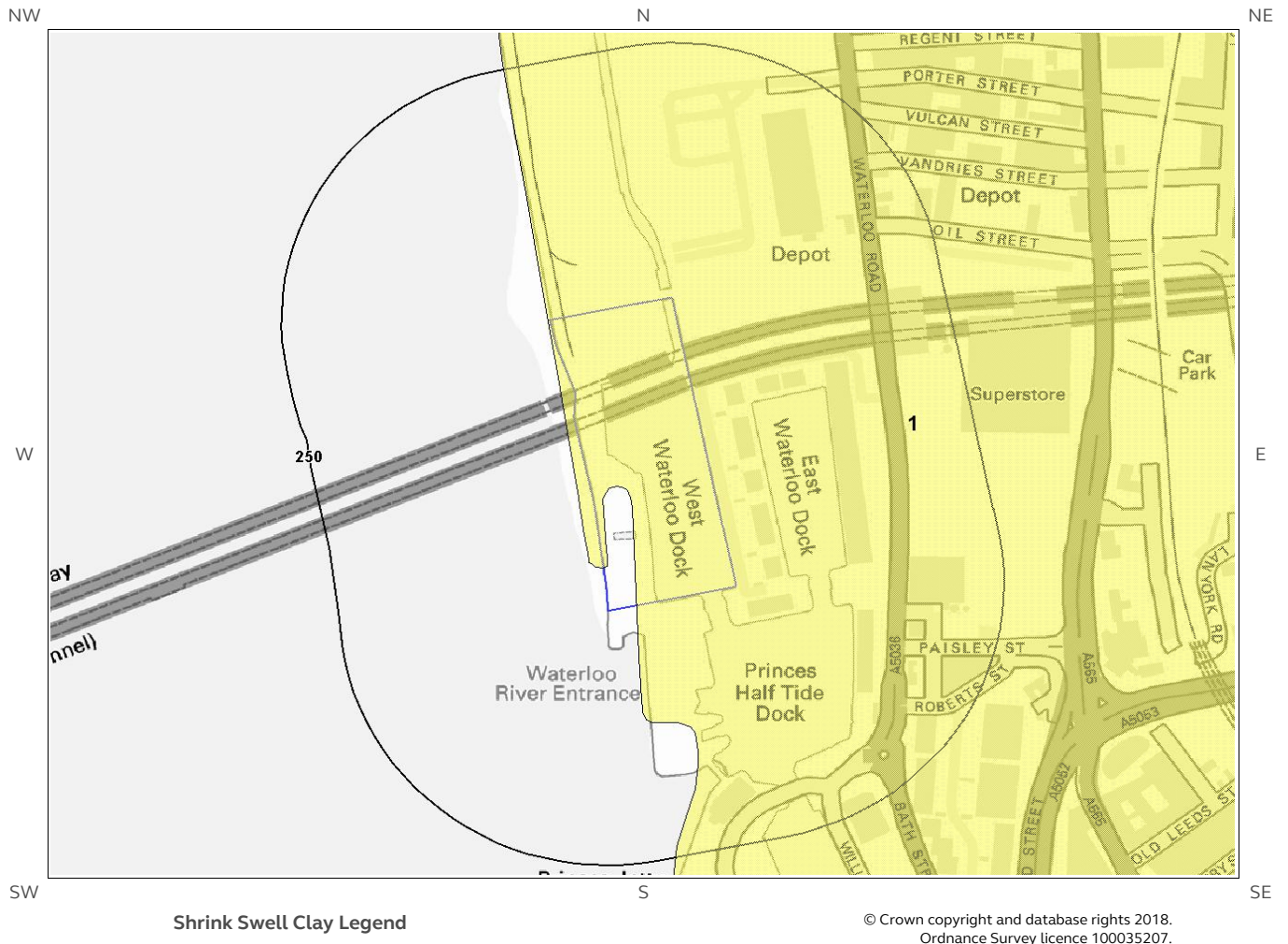
Are there any Clay Mining areas within 1000m of the study site boundary?

No

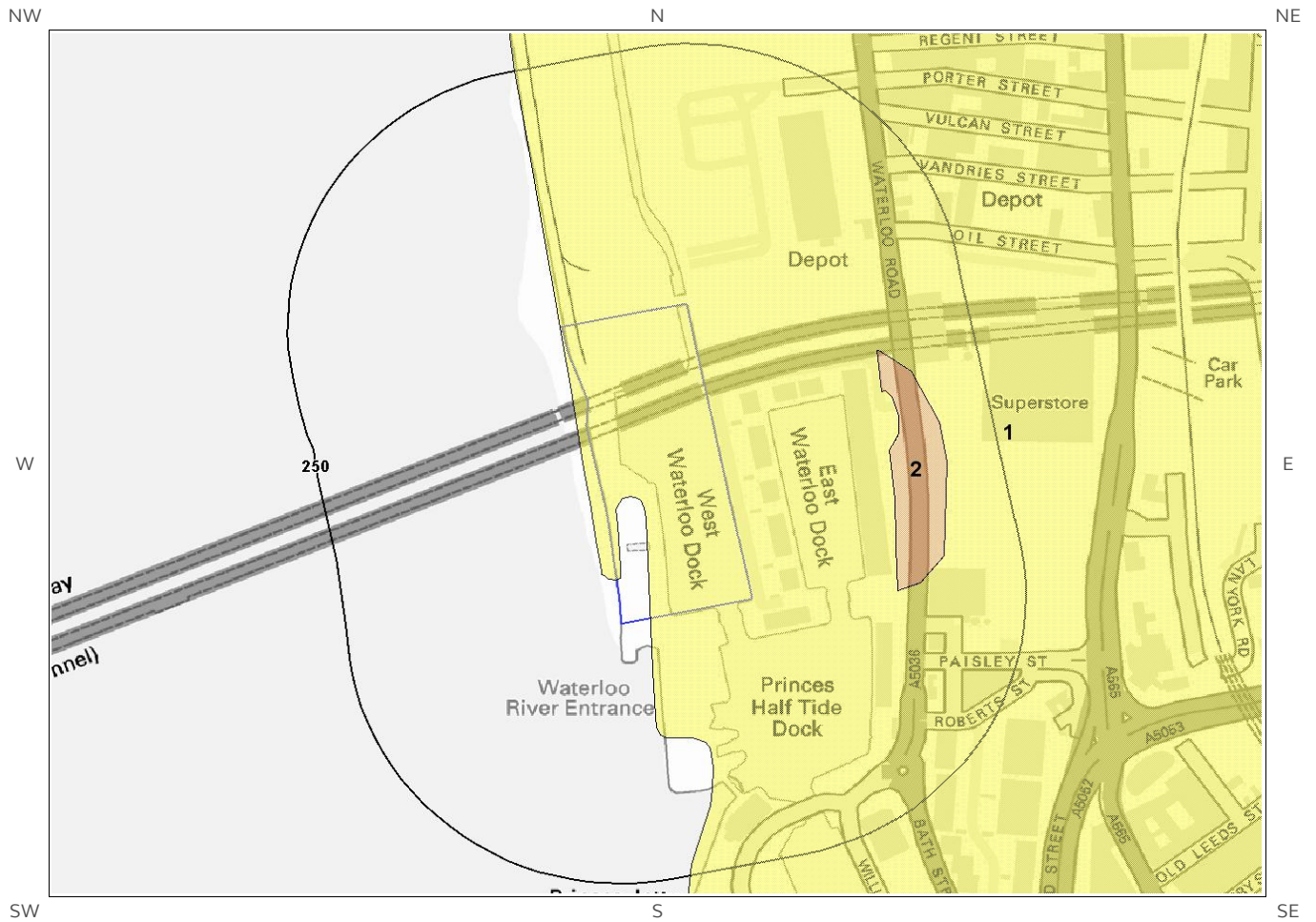
Database searched and no data found.

6 Natural Ground Subsidence

6.1 Shrink-Swell Clay map



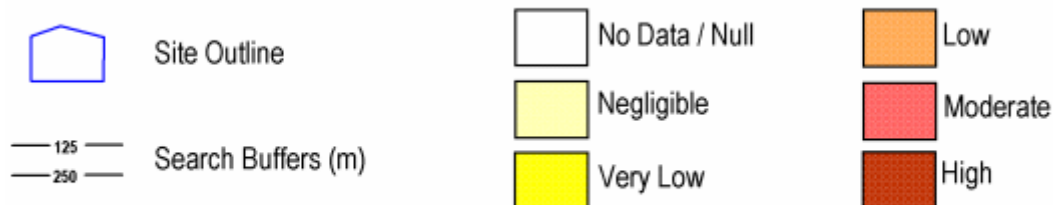
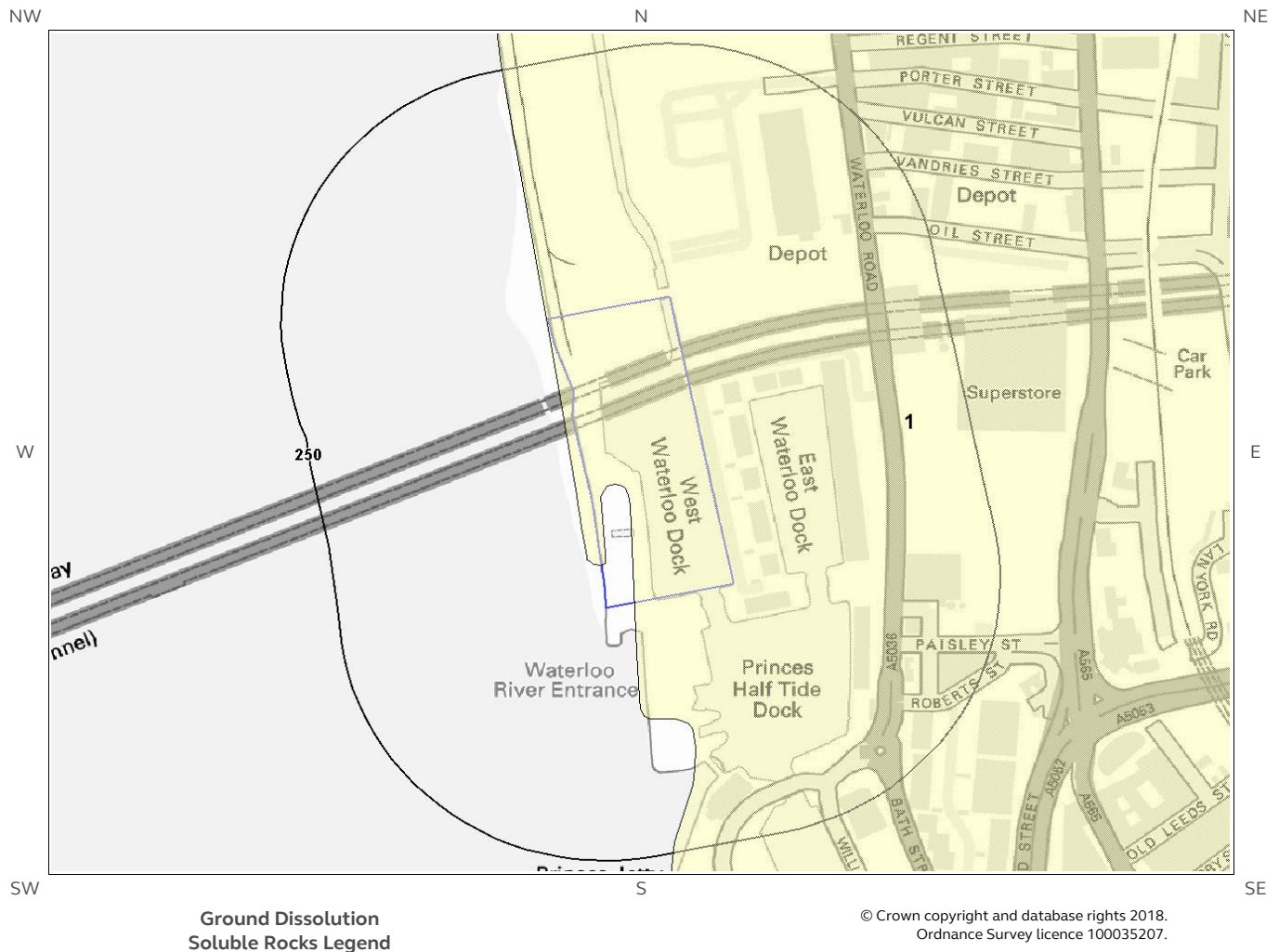
6.2 Landslides map



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6.3 Ground Dissolution of Soluble Rocks map



6.4 Compressible Deposits map



Compressible Deposits Legend

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6.5 Collapsible Deposits map



Collapsible Deposits Legend

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6.6 Running Sand map



Running Sand Legend

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6 Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

The following GeoSure data represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

What is the maximum hazard rating of natural subsidence within the study site* boundary? **Moderate**

6.1 Shrink-Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.

6.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	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.

6.3 Ground Dissolution of Soluble Rocks

The following Ground Dissolution information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

* This includes an automatically generated 50m buffer zone around the site

6.4 Compressible Deposits

The following Compressible Deposits information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Very low potential for compressible deposits to be present. 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.
2	0.0	On Site	Moderate	Significant potential for compressibility problems. Avoid large differential loadings of ground. Do not drain or de-water ground near the property without technical advice. For new build - consider possibility of compressible ground in ground investigation, construction and building design. Consider effects of groundwater changes. Extra construction costs are likely. For existing property - possible increase in insurance risk from compressibility, especially if water conditions or loading of the ground change significantly.

6.5 Collapsible Deposits

The following Collapsible Rocks information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for collapsible deposits identified. No actions required to avoid problems due to collapsible deposits. No special ground investigation required, or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

6.6 Running Sands

The following Running Sands information provided by the British Geological Survey:

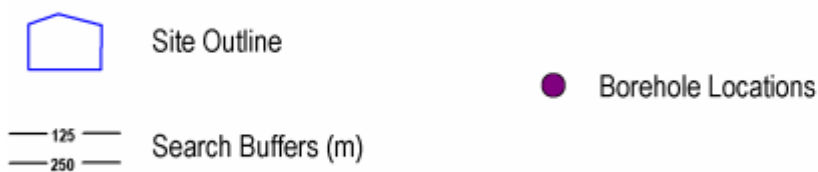
ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
2	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

7 Borehole Records map



Borehole Records Legend

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7 Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary:

38

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
1A	0.0	On Site	333450 391170	SJ39SW853	-1.0	PRINCES DOCK LIVERPOOL 1
2A	0.0	On Site	333440 391180	SJ39SW876	-1.0	PRINCES DOCK LIVERPOOL TP1
3	19.0	S	333450 391130	SJ39SW877	-1.0	PRINCES DOCK LIVERPOOL TP2
4	125.0	W	333248 391382	SJ39SW940	-1.0	TRAFALGAR RIVER BERTH AP2
5	144.0	W	333224 391404	SJ39SW933	-1.0	TRAFALGAR RIVER BERTH A10
6	147.0	W	333220 391446	SJ39SW932	-1.0	TRAFALGAR RIVER BERTH A9
7	162.0	E	333700 391160	SJ39SW950	5.2	GREAT HOWARD STREET LIVERPOOL 8
8B	171.0	E	333701 391226	SJ39SW679	-1.0	MERSEY ESTUARY POLL.ALLV TP4
9B	171.0	E	333701 391226	SJ39SW678	-1.0	MERSEY ESTUARY POLL.ALLV TP3
10	174.0	W	333195 391463	SJ39SW931	-1.0	TRAFALGAR RIVER BERTH A8
11	177.0	E	333700 391260	SJ39SW949	5.7	GREAT HOWARD STREET LIVERPOOL 7
12	181.0	E	333662 391461	SJ39SW677	-1.0	MERSEY ESTUARY POLL.ALLV TP2
13C	185.0	E	333700 391300	SJ39SW1053	-1.0	J. BIBBY & SONS
14C	185.0	E	333700 391300	SJ39SW1054	-1.0	J. BIBBY & SONS
15C	185.0	E	333700 391300	SJ39SW1055	-1.0	J. BIBBY & SONS
16	190.0	NW	333198 391516	SJ39SW930	-1.0	TRAFALGAR RIVER BERTH A7
17	191.0	S	333610 390990	SJ39SW865	-1.0	PRINCES DOCK LIVERPOOL CH1
18	196.0	SE	333696 391051	SJ39SW680	-1.0	MERSEY ESTUARY POLL.ALLV TP5
19D	197.0	N	333323 391620	SJ39SW936	-1.0	TRAFALGAR RIVER BERTH A13
20	201.0	N	333352 391630	SJ39SW942	-1.0	TRAFALGAR RIVER BERTH L2
21	203.0	NW	333284 391614	SJ39SW935	-1.0	TRAFALGAR RIVER BERTH A12
22	206.0	E	333680 391500	SJ39SW960	3.0	GREAT HOWARD STREET LIVERPOOL TP 7

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
23D	209.0	N	333331 391634	SJ39SW941	-1.0	TRAFALGAR RIVER BERTH L1
24	211.0	S	333580 390960	SJ39SW854	-1.0	PRINCES DOCK LIVERPOOL 2
25	213.0	N	333520 391660	SJ39SW1277	6.5	CLARENCE DOCK POWER STATION LIVERPOOL 9
26E	217.0	SE	333630 390970	SJ39SW864	-1.0	PRINCES DOCK LIVERPOOL 12
27	219.0	NW	333231 391601	SJ39SW934	-1.0	TRAFALGAR RIVER BERTH A11
28E	222.0	SE	333640 390970	SJ39SW894	-1.0	PRINCES DOCK LIVERPOOL TP23
29	223.0	E	333750 391250	SJ39SW947	3.0	GREAT HOWARD STREET LIVERPOOL 5
30F	230.0	S	333580 390940	SJ39SW879	-1.0	PRINCES DOCK LIVERPOOL TP4
31F	230.0	S	333580 390940	SJ39SW866	-1.0	PRINCES DOCK LIVERPOOL CH2
32	231.0	E	333770 391160	SJ39SW948	7.1	GREAT HOWARD STREET LIVERPOOL 6
33	232.0	E	333710 391480	SJ39SW959	3.0	GREAT HOWARD STREET LIVERPOOL TP 6
34	232.0	NW	333163 391540	SJ39SW929	-1.0	TRAFALGAR RIVER BERTH A6
35	236.0	E	333750 391310	SJ39SW28	153.31	BIBBY & SON LTD 2
36	237.0	E	333730 391410	SJ39SW954	2.2	GREAT HOWARD STREET LIVERPOOL TP 1
37	241.0	N	333450 391690	SJ39SW1278	7.2	CLARENCE DOCK POWER STATION LIVERPOOL 10
38	249.0	E	333770 391280	SJ39SW30	213.66	BIBBY & SON LTD 3

The borehole records are available using the hyperlinks below: Please note that if the donor of the borehole record has requested the information be held as commercial-in-confidence, the additional data will be held separately by the BGS and a formal request must be made for its release.

#7: scans.bgs.ac.uk/sobi_scans/boreholes/161919
 #11: scans.bgs.ac.uk/sobi_scans/boreholes/161918
 #13C: scans.bgs.ac.uk/sobi_scans/boreholes/162022
 #14C: scans.bgs.ac.uk/sobi_scans/boreholes/162023
 #15C: scans.bgs.ac.uk/sobi_scans/boreholes/162024
 #22: scans.bgs.ac.uk/sobi_scans/boreholes/161929
 #25: scans.bgs.ac.uk/sobi_scans/boreholes/17292443
 #29: scans.bgs.ac.uk/sobi_scans/boreholes/161916
 #32: scans.bgs.ac.uk/sobi_scans/boreholes/161917
 #33: scans.bgs.ac.uk/sobi_scans/boreholes/161928
 #35: scans.bgs.ac.uk/sobi_scans/boreholes/160987
 #36: scans.bgs.ac.uk/sobi_scans/boreholes/161923
 #37: scans.bgs.ac.uk/sobi_scans/boreholes/17292444
 #38: scans.bgs.ac.uk/sobi_scans/boreholes/160989

8 Estimated Background Soil Chemistry

Records of background estimated soil chemistry within 250m of the study site boundary:

3

For further information on how this data is calculated and limitations upon its use, please see the Groundsure Geo Insight User Guide, available on request.

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	RuralSoil	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	200 - 300 mg/kg
0.0	On Site	RuralSoil	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	200 - 300 mg/kg
49.0	N	RuralSoil	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	200 - 300 mg/kg

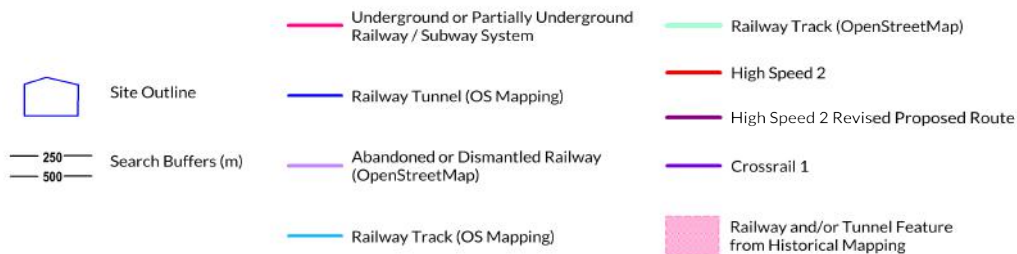
*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

9 Railways and Tunnels map



Railways and Tunnels Legend

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9 Railways and Tunnels

9.1 Tunnels

This data is derived from OpenStreetMap and provides information on the possible locations of underground railway systems in the UK - the London Underground, the Tyne & Wear Metro and the Glasgow Subway.

Have any underground railway lines been identified within the study site boundary? No

Have any underground railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels map.

This data is derived from Ordnance Survey mapping and provides information on the possible locations of railway tunnels forming part of the UK overground railway network.

Have any other railway tunnels been identified within the site boundary? No

Have any other railway tunnels been identified within 250m of the site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels map.

9.2 Historical Railway and Tunnel Features

This data is derived from Groundsure's unique Historical Land-use Database and contains features relating to tunnels, railway tracks or associated works that have been identified from historical Ordnance Survey mapping.

Have any historical railway or tunnel features been identified within the study site boundary? Yes

Have any historical railway or tunnel features been identified within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Details	Date
1	0	On Site	333633 392501	Railway Sidings	1967
2	0	On Site	333647 391051	Railway Sidings	1927
3	0	On Site	333616 391304	Railway Sidings	1928
4G	0	On Site	333372 391447	Railway Sidings	1990
5A	0	On Site	333633 392501	Railway Sidings	1973
6A	0	On Site	333633 392501	Railway Sidings	1982

ID	Distance (m)	Direction	NGR	Details	Date
7B	0	On Site	333652 391060	Railway Sidings	1909
8B	0	On Site	333652 391060	Railway Sidings	1938
9C	0	On Site	333650 391048	Railway Sidings	1938
10C	0	On Site	333650 391048	Railway Sidings	1906
17	0	On Site	333250 391297	Tunnel	1975
18	0	On Site	333250 391266	Tunnel	1975
33H	0	On Site	333376 391444	Railway Sidings	1953
34G	0	On Site	333376 391444	Railway Sidings	1975
35I	0	On Site	333646 391500	Railway Sidings	1953
36	0	On Site	333566 391148	Railway Sidings	1927
37H	0	On Site	333376 391444	Railway Sidings	1962
38I	0	On Site	333646 391500	Railway Sidings	1962
63P	0	On Site	332953 391163	Tunnel	1973
64P	0	On Site	332953 391163	Tunnel	1982
65P	0	On Site	332953 391163	Tunnel	1990
19D	2	E	333652 391408	Tunnel	1996
20D	2	E	333652 391408	Tunnel	1993
21D	2	E	333649 391409	Tunnel	1975
22D	3	E	333651 391409	Tunnel	1983
23D	3	E	333651 391409	Tunnel	1982
39	7	E	333657 391063	Railway Sidings	1908
11	9	SE	333652 391276	Railway Sidings	1890
24E	9	E	333630 391434	Tunnel	1975
25E	9	E	333630 391434	Tunnel	1983
26E	9	E	333630 391434	Tunnel	1982
27E	9	E	333632 391434	Tunnel	1993
28E	9	E	333632 391434	Tunnel	1996
40J	17	E	333657 391334	Railway Sidings	1969
41J	17	E	333657 391334	Railway Sidings	1953

ID	Distance (m)	Direction	NGR	Details	Date
42	19	E	333674 391215	Railway Sidings	1893
43	23	E	333576 391154	Railway Sidings	1953
44	64	N	333620 391541	Railway Sidings	1958
45	88	E	333657 391310	Railway Sidings	1975
46K	88	E	333669 391213	Railway Sidings	1983
47K	88	E	333669 391213	Railway Sidings	1982
12	107	SE	333447 390884	Railway Sidings	1928
48	134	E	n/a	Railway	1890
13	159	E	333892 391186	Railway Sidings	1967
49L	167	E	333710 391380	Railway Sidings	1953
50M	168	E	333659 391442	Railway Sidings	1969
51M	168	E	333659 391442	Railway Sidings	1953
52M	172	E	333668 391433	Railway Sidings	1927
53M	172	E	333668 391433	Railway Sidings	1908
14N	180	S	333577 390929	Railway Sidings	1990
54N	183	SE	333561 390932	Railway Sidings	1984
55	184	SE	333550 390866	Railway Sidings	1978
29F	187	E	333703 391420	Tunnel Ventilating Station	1983
30F	187	E	333703 391420	Tunnel Ventilating Station	1982
31F	187	E	333703 391420	Tunnel Ventilating Station	1982
32F	188	E	333703 391419	Tunnel Ventilating Station	1975
56	199	SE	333759 390757	Railway Sidings	1978
57	200	SE	333665 390941	Railway Sidings	1908
58	204	E	333716 391385	Railway Sidings	1969
59	204	N	333515 391658	Railway Sidings	1958
60O	218	SE	333662 390962	Railway Sidings	1968
61O	218	SE	333662 390962	Railway Sidings	1954
62O	218	SE	333662 390961	Railway Sidings	1954
15	240	E	333805 391381	Railway Sidings	1890

ID	Distance (m)	Direction	NGR	Details	Date
16L	247	E	333767 391396	Railway Sidings	1928

Any records that have been identified are represented on the Railways and Tunnels map.

9.3 Historical Railways

This data is derived from OpenStreetMap and provides information on the possible alignments of abandoned or dismantled railway lines in proximity to the study site.

Have any historical railway lines been identified within the study site boundary? No

Have any historical railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Status
109	E	Abandoned

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels map.

9.4 Active Railways

These datasets are derived from Ordnance Survey mapping and OpenStreetMap and provide information on the possible locations of active railway lines in proximity to the study site.

Have any active railway lines been identified within the study site boundary? Yes

Have any active railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Name	Type
0	On Site	Not given	Multi Track
0	On Site	Not given	Multi Track
48	N	Not given	Multi Track
48	N	Not given	Multi Track
68	N	Not given	Multi Track
68	N	Not given	Multi Track

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels map.

9.5 Railway Projects

These datasets provide information on the location of large scale railway projects High Speed 2 and Crossrail 1 .

Is the study site within 5km of the route of the High Speed 2 rail project? No

Is the study site within 500m of the route of the Crossrail 1 rail project? No

Further information on proximity to these routes, the project construction status and associated works can be obtained through the purchase of a Groundsure HS2 and Crossrail 1 Report.

The route data has been digitised from publicly available maps by Groundsure. The route as provided relates to the Crossrail 1 project only, and does not include any details of the Crossrail 2 project, as final details of the route for Crossrail 2 are still under consultation.

Please note that this assessment takes account of both the original Phase 2b proposed route and the amended route proposed in 2016. As the Phase 2b route is still under consultation, Groundsure are providing information on both options until the final route is formally confirmed. Practitioners should take account of this uncertainty when advising clients.

Contact Details

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BGS Geological Hazards Reports and general geological enquiries



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Standard Terms and Conditions

Groundsure's Terms and Conditions can be viewed online at this link:
<https://www.groundsure.com/terms-and-conditions-may25-2018>

APPENDIX Q

NOTES ON LIMITATIONS

Notes on Limitations For Geoenvironmental and Geotechnical Consultancy Services

General

This document has been prepared by CC GEOTECHNICAL LTD within the terms of the contract, scope of work, and resources agreed in writing with the client. The limitations of liability of CC GEOTECHNICAL LTD for the contents of this document have been agreed with the Client, as set out in the terms and conditions of offer and related contract documentation.

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The findings and opinions are relevant to the dates when the assessment was undertaken, but should not necessarily be relied upon to represent conditions at a substantially later date. In particular, seasonal groundwater levels, with the effects of precipitation, may affect the conditions found during the investigation. The report should be read in conjunction with the further Notes on Limitations included in Appendix A.

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Phase I Environmental Audits / Desk Studies

The work undertaken to provide the basis of a Phase 1 Desk Study report comprises a study of available documented information from a variety of sources (including the client), together with (where appropriate) a brief walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The opinions given in a Desk Study report have been dictated by finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in the report, CC GEOTECHNICAL LTD reserves the right to review such information and to modify the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Environmental Audits

The investigation of the site has been carried out with the intention of providing sufficient information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. The objectives of the investigation have been limited to establishing the risks associated to potential human targets, building materials, the environment (including adjacent land), and surface and groundwater.

The amount of exploratory work and chemical testing undertaken may have been restricted by the timescale available, and the locations of the exploratory holes may have been restricted to areas unoccupied by the building(s) on the site, and further restricted by the existence of buried services. A more comprehensive investigation may be required if the site is to be redeveloped as, in addition to risk assessment, a number of important engineering and environmental issues may need to be resolved.

For those reasons, if costs have been included in relation to site remediation these must be considered as tentative only and must, in any event, be confirmed by a qualified quantity surveyor.

The exploratory holes undertaken, investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of site conditions. The number of sampling points and the methods of sampling and testing do not preclude the existence of localised “hotspots” of contamination where concentrations may be significantly higher than those actually encountered.

Geoenvironmental Ground Investigations

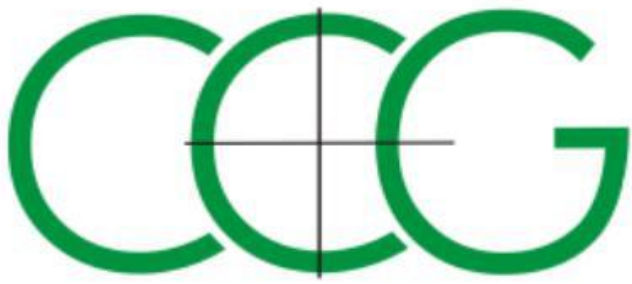
The investigation of the site has been carried out to provide sufficient information within the agreed scope of the investigation, under the general headings of type and degree of contamination, geotechnical characteristics, and ground and groundwater conditions, to provide a reasonable assessment of the environmental risks together with engineering and development implications.

If costs have been included in relation to the site remediation, these must be confirmed by a qualified quantity surveyor.

The exploratory holes undertaken, investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of the site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site of each of the exploratory holes. There may be ground conditions present on the site which have not been disclosed by this investigation, and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that groundwater levels will vary owing to seasonal, tidal, weather, or other effects.

The risk assessment and opinions provided, inter alia, take into consideration currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

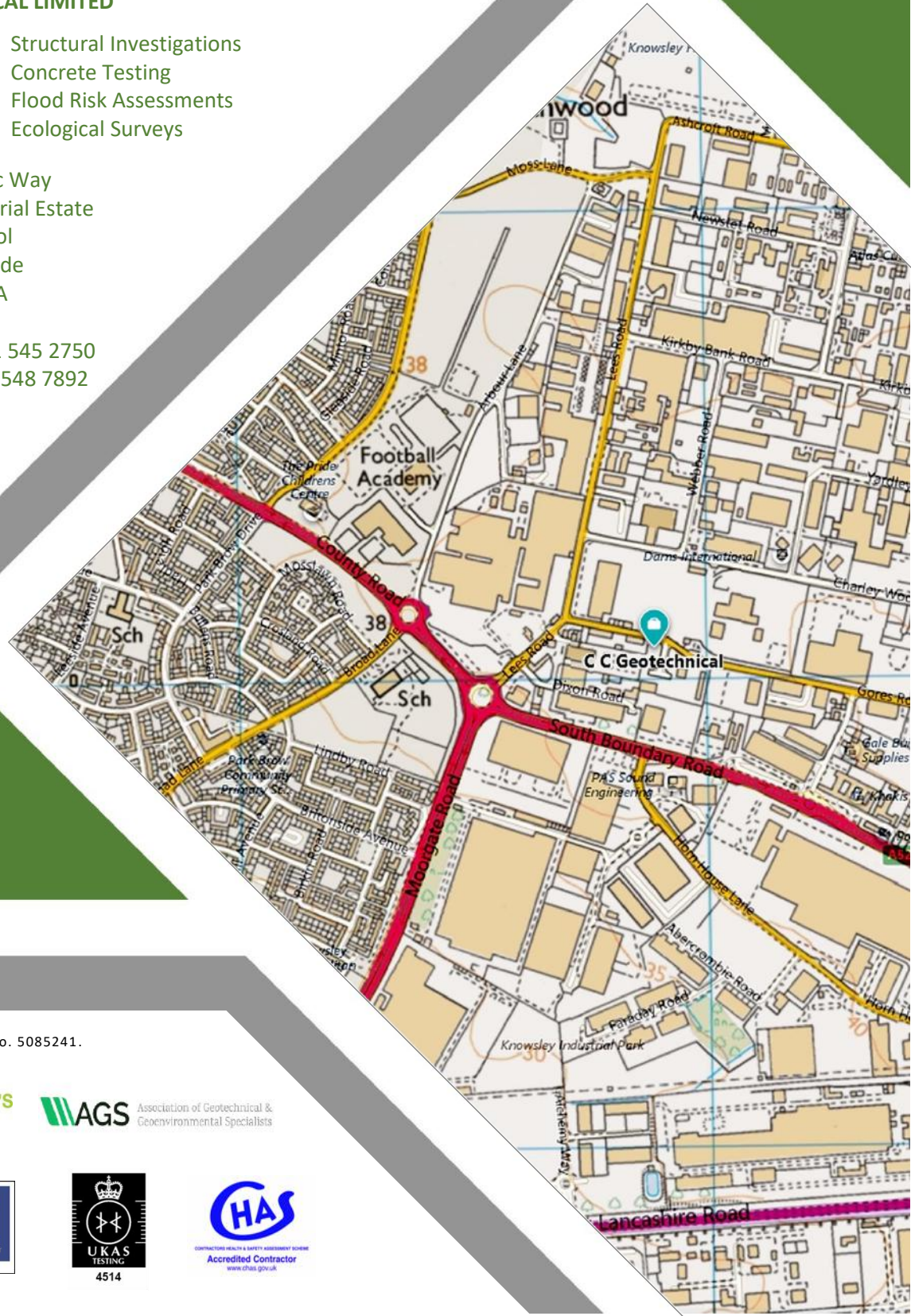


CC GEOTECHNICAL LIMITED

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 Contaminated Land Studies ⊕ Concrete Testing
 Landfill Gas Studies ⊕ Flood Risk Assessments
 Soils and Materials testing ⊕ Ecological Surveys

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Appendix 11A

Dock Infill Methodology



Dock Infill Methodology

Revision 3

Liverpool Waters
Plot CO2
East Waterloo Dock

24th October 2019

Ref: 4/6679/DIM/2

Prepared on Behalf of:

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DOCK INFILL METHODOLOGY
Liverpool Waters Plot CO2*Report Reference:* 4/6679/DIM*Revision* 3*Date originated:* 28th November 2018*Prepared for:* Romal Capital Group Ltd*Prepared by:* Clancy Consulting Limited
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for and on behalf of CLANCY CONSULTING LTD**Revision List**

REVISION	REASON FOR ISSUE	DATE OF ISSUE
0	Issued for Comment	28 th November 2018
1	Additional Comments Incorporated	29 th November 2018
2	Revised Application	24 th October 2019
3	Revised Application	27 th October 2019

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Appendix B -	Concept Piling Solutions General Arrangement Drawing 4/6679-CCL-CO2-GA-C-SK01-01
Appendix C -	CCGeotechnical Ground Investigation Report (October 2018)

1.0 INTRODUCTION

1.1 General

- 1.1.1 This report has been prepared on instructions received from Romal Capital Group Ltd and relates to the proposed development works at West Waterloo Dock as part of Liverpool Waters Project. The development is currently referred to as Plot CO2.
- 1.1.2 CC Geotechnical Ltd (CCG) were commissioned to undertake a combined Phase 1 Desk Study / Phase 2 Ground Investigation Report providing information relevant to the detailed design and construction of foundations and infrastructure elements of the proposed development, and to secure discharge of relevant pre-commencement planning conditions.
- 1.1.3 A copy of the Ground Investigation can be found in Appendix C.
- 1.1.4 This report outlines the findings of this report and the initial methodology philosophy for the infill of the dock and the piling operations for the proposed development.
- 1.1.5 This report is prepared solely for the benefit of the Client. This report may not be assigned without prior written permission from Clancy Consulting (CC).
- 1.1.6 This report is based upon existing and proposed plans for the development as well as data obtained from site investigations undertaken by CCG.

2.0 SITE CHARACTERISTICS

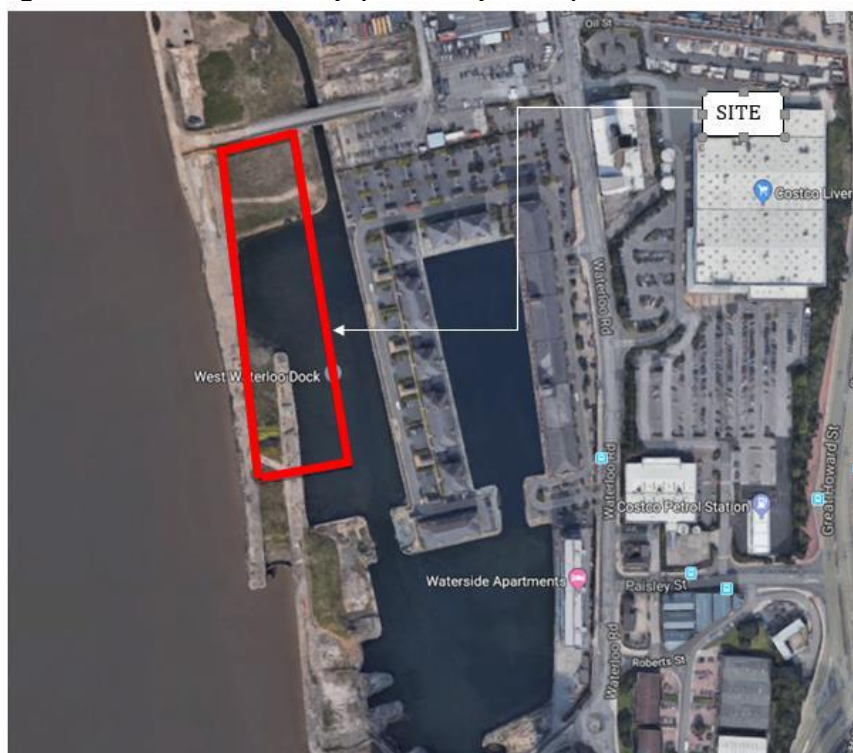
2.1 Existing Site Characteristics

- 2.1.1 The site is situated on West Waterloo Dock and the adjacent infilled Waterloo Lock as shown Figure 1.0.
- 2.1.2 The quaysides within the site stand at an elevation of around 8m AOD.

Table 1 - Site Location References (streetmap.co.uk)

OS X (Eastings)	333455
OS Y (Northings)	391242
Nearest Post Code	L3 0BT
Lat (WGS84)	N53:24:50 (53.413770)
Long (WGS84)	W3:00:09 (- 3.002624)
LR	SJ334912
mX	-334250
mY	7025569

Figure 1 - Site Location Map (streetmap.co.uk)



2.2 Site Description

- 2.2.1 The development is located North of Liverpool City Centre within West Waterloo Dock on the waterfront. The development is bordered by the Liverpool Canal Link to the West, Princes Half Tide Dock to the South, The River Mersey (and river wall) to the East and undeveloped land to the North.
- 2.2.2 The area proposed for development was historically West Waterloo Docks and warehouses. Over time, the warehouses have been demolished and the dock itself has been partially infilled along with Waterloo Lock system, whilst other areas remain as the dock.
- 2.2.3 The development contains the 'quayside/ dockside' formed when Waterloo Lock was introduced. Waterloo Lock has been infilled to match current site levels and it is understood that the three lock gates and their manoeuvring mechanisms remain in place with the gates in the 'closed' position.
- 2.2.4 The North end of the development contains an area of infill sloping down to the canal level.
- 2.2.5 The development falls within the wider Liverpool Waters masterplan – covering the re-development of up to 60 hectares of former dock land along Liverpool Waterfront providing mixed use developments and an extension from Liverpool City Centre northwards.
- 2.2.6 Outline planning was granted by Liverpool City Council in June 2013 (Application no. 100/2424).
- 2.2.7 The overall area proposed for re-development within this application is approximately 1.12 hectares
- 2.2.8 Site ground levels along the dock sides are generally flat at a level of approximately 8.000m AOD. The canal level is generally kept at approximately 4.770m AOD.

2.3 Site Proposals

- 2.3.1 The development comprises initially of land reclamation from the dock by installing a new dock wall within West Waterloo Dock to provide a separation between the Leeds-Liverpool canal and the development.
- 2.3.2 Once the new dock wall has been installed, the area behind the wall will be infilled with imported materials to raise existing levels to proposed before piling operations can then commence for the foundations for the four new mixed-use blocks (A-D). These blocks are 10 storeys and provide a total of 538 apartments (one – three bedrooms), along with associated commercial space, car parking, landscaping, servicing and access.
- 2.3.3 Three of the four blocks (A-C) will sit within the infilled dock with the remaining block (D) straddling over the quayside and partially within Waterloo Lock.
- 2.3.4 The development will also include a canal-side walkway along the canal perimeter of the development to provide access between the blocks and the canal itself.

- 2.3.5 Along this walkway, Blocks A and B will extend over the dock to create a colonnade with the ends of the buildings constructed within Waterloo Dock itself off a piled solution.
- 2.3.6 To the North of the blocks, this will be developed into car parking, access and communal spaces to provide access between the blocks.

3.0 SITE INVESTIGATION REPORT SUMMARY

3.1 Site History

- 3.1.1 CCG's report established Waterloo Dock opened in 1834 and by 1868 was separated into two distinct basins – West Waterloo Dock and East Waterloo Dock.
- 3.1.2 Waterloo Lock was constructed with the three lock gates by 1949 with the dock closed to shipping in 1988 and by 1993, maps show that the dock has partially infilled with the lock disused and infilled by 2010.
- 3.1.3 The report draws attention to the fact that modifications to the dock infrastructure have the potential to have left structures/ foundations in place which are now covered but may be obstructive to piling operations.

3.2 Credible Potential Sources of Contamination

- 3.2.1 CCG's report highlights four potential sources of contamination with the current site arrangement;
 - 1. The infill within Waterloo Lock
 - 2. The deposits making up the infill within West Waterloo Dock.
 - 3. Water entrapped within Waterloo Lock
 - 4. Water within West Waterloo Dock.

3.3 Phase II Intrusive Investigations

- 3.3.1 The Phase II Intrusive Investigation involved sinking/taking a series of boreholes through the made ground deposits within the dock and the made ground deposits in the infilled lock, into the underlying natural drift strata, and into the bedrock strata. These were undertaken between September and October 2018.
- 3.3.2 Trial pits were undertaken and gas/ groundwater pipes installed and monitored
- 3.3.3 In all instances, subsampling of borehole recovery for soil contamination and soil classification testing was also completed.

3.4 Observations

- 3.4.1 The investigations found West Waterloo Dock is infilled to an average depth of about 3m below standing dock water level (understood to be generally kept at 4.77m AOD). The infill is classified as 'Made Ground' and consists of a mixture of brick, concrete and stone, etc. with occasional glass, wood, ceramics. This is classified as very loose to medium dense.
- 3.4.2 Natural sandstone bedrock was found to be between 8m below ground level (-0.6m AOD) within the dock extending to a maximum depth of 26.6m below ground level (-18.6m AOD) within Waterloo Lock.
- 3.4.3 Groundwater in each of the boreholes and is consistent with the dock water level.
- 3.4.4 Details of the testing and the results can be found within CCGeotechnical's Ground Investigation report.

3.5 Chemical Testing

- 3.5.1 Samples have been assessed for a range of contaminants with all contaminants below their respective threshold values and therefore no potential risk to human health is identified.
- 3.5.2 Details of the testing and the results can be found within CCGeotechnical's Ground Investigation report (Appendix C).

3.6 Waste Classification

- 3.6.1 If existing materials are removed as part of the construction, all soil analyses conform to a Non-Hazardous waste classification. If destined for landfill, it is recommended that consultation with landfill operators be undertaken during the development of the waste management plan.

4.0 INFILL METHODOLOGY

4.1 Cut-off Wall Construction

- 4.1.1 A new dock wall is to be constructed within West Waterloo Dock to form the separation between the development and the existing Leeds-Liverpool Canal.
- 4.1.2 This wall will follow a line that will encapsulate the existing Waterloo Lock and the quayside, running parallel with the opposite dock wall to create a channel for continued and uninterrupted vessel navigation along the Leeds – Liverpool Canal.
- 4.1.3 The line of the new wall is highlighted in Appendix B.
- 4.1.4 It is expected that the new dock wall will be coordinated with the new dock wall proposed at the neighbouring development – The Isle of Man Ferry Terminal. During detailed design, it will be imperative that both developments liaise with one another to ensure dock wall construction does not hinder each other's development.
- 4.1.5 At this stage, it is anticipated that the cut-off wall between the development and the dock will be constructed using a 'Combi-wall' piling solution or a similar type of arrangement.
- 4.1.6 This type of construction typically consists of tubular steel piles taken into the underlying sandstone bedrock in rock sockets at consistent centres along the length of the wall line with sheet piles installed between the tubular piles and taken down to the surface of the bedrock
- 4.1.7 The design of this type of arrangement considers the tubular piles acting as cantilever posts fixed into the sandstone bedrock, supporting the applied loading from the retained backfill to new site levels and the surcharges from, initially, the construction activities and then the car parking in the permanent condition. The sheet piles span between the tubular piles supporting the aforementioned backfill and surcharges which are then transferred into the tubular piles.
- 4.1.8 To ensure that the tubular piles are capable of supporting all relevant applied loads, the piles are likely to be secured into the bedrock by installing them with deep sockets which would then need to be grouted up.
- 4.1.9 It is likely, as CCG's report suggests, that the pile installation for the wall will use floating rigs loaded onto pontoons/ barges as opposed to undertaking these works from piling rigs running across the existing dock infill material and imported fill to raise it above existing water levels. This is for predominantly practicality reasons and are explored within CCG's report.
- 4.1.10 In terms of finalising the technical aspects of the design, some further investigation may be required to confirm the position of existing structures in relation the proposed line of the wall. For example, at the North end of the development, initial overlays of proposed with historical drawings suggest there is the potential for the wall to run across the buried abutments of an old swing bridge.

4.2 Dock Infilling and Settlement Potential

- 4.2.1 On completion of the dock wall installation, land reclamation works behind the new dock wall line can commence. This is likely to involve the introduction of approximately 6m in depth of imported fill to raise levels (within the existing dock/ infilled lock) to proposed finished ground levels.
- 4.2.2 Initial proposed site levels can be found on the Site Plan within Appendix A.
- 4.2.3 Due to the known nature of the existing fill within the dock (worst case results are consistent with very loose made ground), filling the site with approximately 6m of imported material will impose loadings onto the existing fill which will settle/ depress under these conditions.
- 4.2.4 It is imperative that the imported fill is placed under controlled conditions – with attention drawn to the depth at which new layers of the imported fill are introduced and how each of these layers is compacted before the next layer can be introduced. A full a detailed method statement would be produced to demonstrate this.
- 4.2.5 Details of these conditions, along with an outline material specification and suggested testing regime are included in the outline specification which is as follows;

Acceptable materials	Virgin or recycled aggregates containing not more than 10% bituminous planings and excluding materials containing tar and tar-bitumen binders, chalk, unburnt colliery spoil
Grading limits	Conforming to Table 6/1 of DTp Specification for Highway Works – 6F2 material. Max particle size 125mm. Max passing 63um 12%
Acceptable moisture content	OMC +/- 3% as determined by BS1377: 1990: Part 4: Cl3.6
Compacted layer thickness	250mm
Compactive effort	In accordance with Table 6/4 of DTp Specification for Highway Works using vibratory roller of minimum mass per unit width of 2900kg and minimum 10 passes per layer
Acceptance testing	<ul style="list-style-type: none"> • Particle size analysis – 1 test for 200m³ • Plate load tests at 2 per layer with max settlement of 2mm under 450mm dia plate loaded to 20kN/m² • Broad spectrum soil contamination analyses for compliance with LQM/CIEH criteria for Residential without Plant Uptake – 1 analysis per 250m³ - see Table A in Appendix M for acceptance criteria • Broad spectrum soil leachate analyses for compliance with EQS criteria for Estuarine Waters – 1 analysis per 250m³ – see Table B in Appendix M for acceptance criteria
Monitoring	Installation of rod and plate settlement gauges at surface of insitu soil at say 6 locations prior to commencement of filling and monitoring settlement at monthly intervals

Table 2 – Dock Infilling Specification (Source: CC Geotechnical Ground Investigation Report)

- 4.2.6 The method of achieving the required density of the imported fill to be used as a platform may be achieved in a number of ways, including but not restricted to;
- Reducing the water level within the ‘dock’ which is now enclosed within this development to a level below the top of the existing fill to allow compaction of the upper levels of the existing fill.

- Raise the existing fill levels beyond the existing dock water level within the area now enclosed on the development with self-compacting rock fill typically graded to between 250mm down to 100mm.
 - Introduction of hydraulically placed dredged sand to raise fill levels above the existing levels within the dock.
- 4.2.7 The options noted above each have their own advantages and disadvantages – with each discussed briefly within CCG’s report and subject to further deliberation and investigation during the detailed design phase of the development.
- 4.2.8 It is estimated approximately 55,500m³ of imported fill will be required for this development.
- 4.2.9 Following review of the ground conditions encountered, a potential settlement of 200mm is estimated at the surface of the existing submerged fill across the development once the 6m of imported fill has been installed in accordance with the suggested specification.
- 4.2.10 The neighbouring development for the new Isle of Man Ferry Terminal also involves land reclamation as a result there will be an interface between the two developments.
- 4.2.11 During detailed design, it will be imperative that both developments liaise with one another to ensure the infill works do not hinder each other’s development.

4.3 Individual Block Foundations

- 4.3.1 The potential for high levels of settlement to the existing infill material within the dock make the use of conventional concrete foundations bearing onto the fill implausible.
- 4.3.2 Therefore, the individual buildings are likely to utilise piled foundation solutions and this section will discuss the suggested design concepts to overcome the known obstructions and ground conditions of the development.
- 4.3.3 Blocks A, B and C will be sited within the West Waterloo Dock. Based on overlays of current with proposed, a small percentage of Block C overlays with the quayside.
- 4.3.4 As Blocks A, B and C sit within the newly infilled dock, it is likely Continuous Flight Augured (CFA) piles will be taken down to and socketed into the sandstone bedrock.
- 4.3.5 Block D sits across a number of ground conditions and existing structures – in particular over the existing quayside and into the infilled Waterloo Lock.
- 4.3.6 Similarly to the other blocks where these sit within the infilled dock, Block D will likely use CFA piles taken down to and socketed into the sandstone bedrock.
- 4.3.7 Where Block D spans across the existing quayside and the potential chambers, voids and mechanisms for the gates hidden within this quayside, there are a number of potential solutions to be considered for the foundation solution here. These include, but are not limited to;
- Bridging over the quayside with CFA piles likely to the West Waterloo Dock side and rotary piles likely to be installed within Waterloo Lock.

- Piling through the quayside structure into the underlying sandstone bedrock using rotary percussive methods (ODEX or similar).
 - Removing the soil infill and mass filling with concrete to provide a large spread foundation to support the superstructure above.
- 4.3.8 Each of the above options have their advantages and disadvantages in providing a suitable foundation structure over the quayside, with each proposal discussed within CCG's report. These will be subject to further deliberation and investigation during the detailed design phase of the development.
- 4.3.9 It is likely that within Waterloo Lock, the depth to the natural sandstone bedrock (approximately 21m below ground level) will make the use of CFA piling unlikely as there is a 3m thick concrete slab at the base of the lock.
- 4.3.10 It is anticipated rotary piling methods will be required and due to the depth of loose materials around the piles, there may be a requirement for permanent casings around the piles to be used.
- 4.3.11 Existing structures may result in offset bases/ cantilever ground beams in order to avoid said structures. This will need to be established with a detailed overlay of the proposed footprint on site with digs undertaken on site to identify any potential clashes.
- 4.3.12 CCGeotechnical Limited within their report discuss in detail the implications of piling in the vicinity of Merseytravel asset The Kingsway road tunnel, setting out some initial calculations and advising of vibration limits.
- 4.3.13 Outside of the superstructure and their foundations, the levels of potential settlement will necessitate that items such as drainage access chambers will need to be supported off piles to minimise the differential settlement between the neighbouring ground and the cover levels.

4.4 Quality Assurance, Method Statements, Risk Assessments

- 4.4.1 A stringent regime of material selection, compaction control, monitoring and validation testing will be employed for the dock infilling and the piling methods used on this development to ensure accountability can be identified at any point along the design and construction process.
- 4.4.2 This will not only support the integrity of the design solutions chosen for the dock infill and piling solution but ensure the wider environmental risks have been considered.
- 4.4.3 It is anticipated the information required to demonstrate compliance with the regulations and conditions in place for the works will include (but not be limited to) the type and source of imported fill and test reports to demonstrate acceptability of the fill materials, along the lines of the specification previously referred to within this report.
- 4.4.4 All documentation presented should be accompanied by relevant certification
- 4.4.5 Method Statements will be presented to show the safe method of works to be used and that those undertaking the works have the competency and relevant experience to achieve this.

- 4.4.6 Risk Assessments will be presented in accompaniment to the Method Statements and reflect the proposed works – to cover not just the health and safety of those undertaking the works, but the surrounding environment effecting a number of receptors.
- 4.4.7 This can be undertaken and included within the preparation of a Construction Environmental Management Plan (CEMP). The CEMP will be implemented and adhered to throughout the Works.
- 4.4.8 The details of the CEMP will be agreed with LCC and the Marine Management Organisation (MMO) prior to the commencement of the Works and would comprise, in effect, an operational manual detailing the management, monitoring, auditing and training procedures to be followed during the Works to ensure compliance with relevant legislation, planning policy, regulations and best practice. It would also set out the specific roles and responsibilities of on-site personnel.
- 4.4.9 The CEMP includes but is not limited to:
- Details of the operations and phasing of the proposed dock infill and piling works.
 - Prohibited or restricted operations;
 - A framework for compliance with relevant legislation and guidance;
 - Proposed Plant to be used;
 - Details of proposed routes for vehicles travelling to and from the site;
 - Roles and responsibilities of key staff including training of staff, liaison with stakeholders and management of enquiries and complaints;
 - Details of emergency procedures which would be implemented;
 - Details of general site management practices, including working hours, hoarding, access, lighting, site facilities, energy and water use, waste, materials procurement and storage;
 - Details of environmental management and control procedures, covering issues such as traffic and access, noise and vibration, dust, archaeology, contamination, hazardous materials, drainage and pollution control;
 - Requirements for auditing, monitoring and record-keeping;
 - Mechanisms for third parties to register complaints and the procedures for responding to complaints; and
 - Provisions for reporting, public liaison and prior notification, especially where dispensations would be required.
- 4.4.10 During the consideration of piling options, a piling risk assessment will be undertaken in accordance with the Environment Agency 2001 report – Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention.
- 4.4.11 The Piling Risk Assessment will identify any potentially unacceptable risks from the proposed piling works (i.e. creation of pathways for contamination to become a risk to a variety of receptors).

5.0 SUMMARY

- 5.1 The development of Plot CO2 will consist of the construction of a new dock wall within West Waterloo Dock and the subsequent infilling of this dock to provide a platform to construct seven new residential blocks with additional areas for commercial use.
- 5.2 The desktop study and intrusive site investigations undertaken by CC Geotechnical and presented in their Ground Investigation Report (October 2018), established West Waterloo Dock has an extensive history and has undergone significant alterations since its opening in 1834.
- 5.3 The report indicates the dock has previously been backfilled with loose granular material classified as 'Made Ground' with the water at a consistent depth of approximately 3m and the fill ranging in depth between 2.5 – 15m before the natural sandstone bedrock is encountered.
- 5.4 It is anticipated that the dock wall between the development and the dock will be constructed using a 'Combi-wall' piling solution or a similar type of arrangement.
- 5.5 It is estimated in the region of 6m depth of imported fill will be required to increase existing levels to the proposed development levels.
- 5.6 An outline specification has been provided for the imported fill, laying and testing procedures to be followed.
- 5.7 The introduction of the imported fill will result in settlement of the existing loose fill within the dock and this has been estimated to be in the region of 200mm.
- 5.8 A variety of piling techniques are suggested to support the superstructures of the proposed blocks due to the range of ground conditions and obstructions (dock walls, gate mechanisms, etc) likely to be encountered.
- 5.9 Some of the piling operations are likely to be over or in the vicinity of the existing Kingsway Road Tunnel with some initial recommendations noted with the Ground Investigation Report.
- 5.10 The proposed works will require stringent regime of material selection, compaction control, monitoring and validation testing will be employed for the dock infilling and the piling methods used on this development along with all relevant certification.
- 5.11 A Construction Environmental Management Plan (CEMP) will be necessary to ensure compliance with legislation, regulations, planning policy and best practice.
- 5.12 A Piling Risk Assessment will be required to show consideration of potential contamination, pathways and receptors.
- 5.12.1 The neighbouring development for the new Isle of Man Ferry Terminal also involves land reclamation and piling works and as a result there will be an interface between the two developments. During detailed design, it will be imperative that both developments liaise with one another to ensure the works do not hinder each other's development.

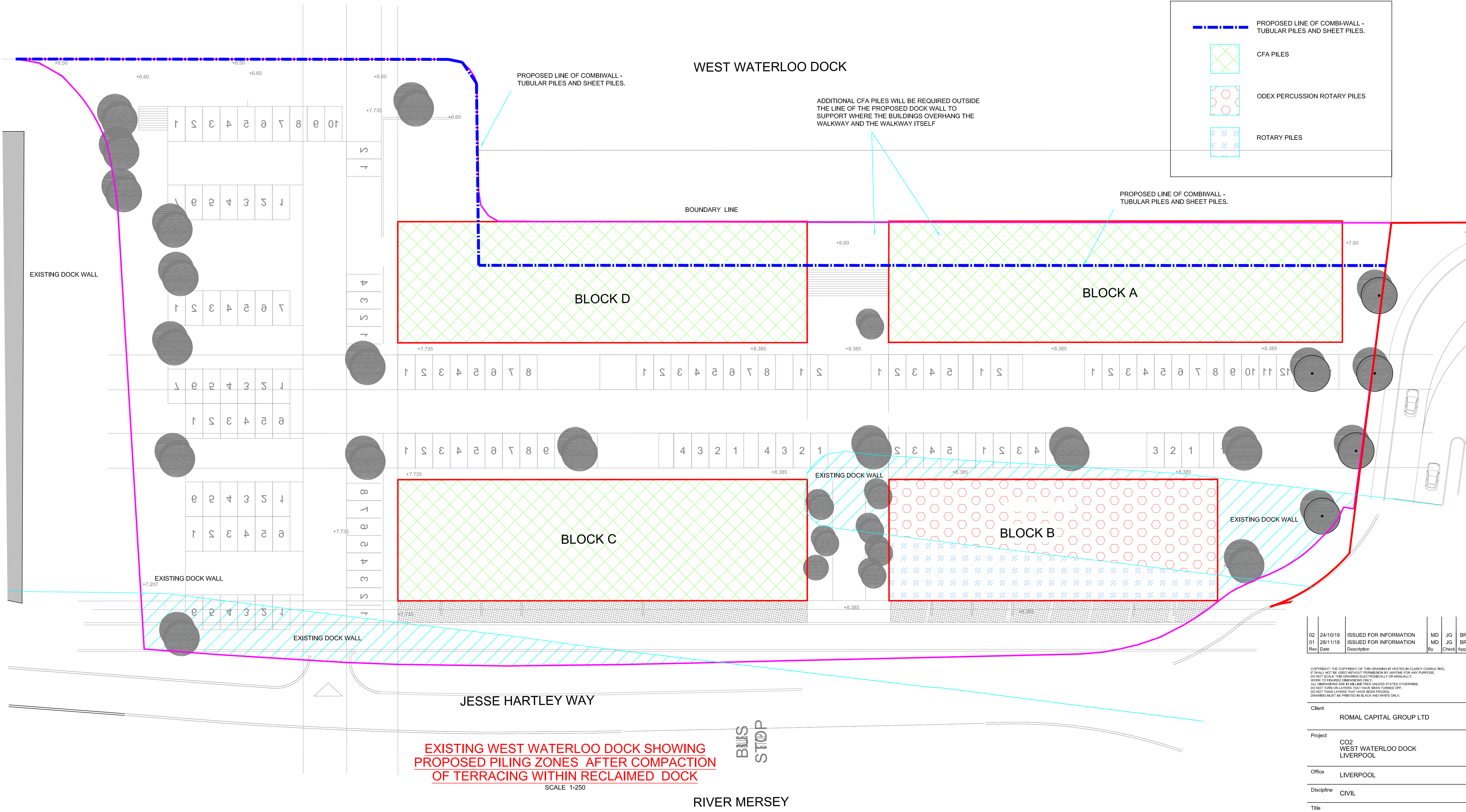
APPENDIX A

Proposed Site Plan



APPENDIX B

Concept Piling Solutions General Arrangement Drawing



AREAS OUTSIDE OF THE AREAS DENOTED FOR PILING (I.E. BETWEEN BLOCKS, CAR PARKING, ETC) WILL BE SUBJECT TO BACKFILLING WITH ENGINEERING FILL IN ACCORDANCE WITH SPECIFICATIONS TO PROVIDE A PLATFORM SUITABLE FOR LOADING TO VEHICULAR/ FOOT TRAFFIC.

NOTES

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS AND ARCHITECTS DRAWINGS AND SPECIFICATION.

DO NOT SCALE OFF THIS DRAWING


REFER TO EXISTING SITE INVESTIGATION REPORTS FOR GROUND CONDITIONS.

ANGLE OF CUT ASSUMED 45 DEGREES .

02	24/10/19	ISSUED FOR INFORMATION	MD	JG	BRH
01	28/11/18	ISSUED FOR INFORMATION	MD	JG	BRH
Rev	Date	Description	By	Check	App.

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Client	ROMAL CAPITAL GROUP LTD				
Project	CO2 WEST WATERLOO DOCK LIVERPOOL				
Office	LIVERPOOL				
Discipline	CIVIL				
Title	CONCEPT PILING SOLUTIONS GENERAL ARRANGEMENT				
Scale @ A1	AS STATED	Status	INFORMATION		

			
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Job Number	Originator	Building/Zone	Level
4_6679	CCL	CO2	EXT
Type	Discipline	Drawing No.	Revision
GA	C	SK02	01

APPENDIX C

CCGeotechnical Ground Investigation Report (October 2018)