PHASE 1 DESK STUDY AND PHASE 2 INTRUSIVE INVESTIGATION; INTERPRETATIVE REPORT

Northstowe Phase 2 – Phase 2B

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Phase 1 Desk Study and Phase 2 Intrusive Investigation; Interpretative Report.

Northstowe Phase 2 – Phase 2B

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1 Introduction

1.1 Terms of Reference

Arcadis Consulting (UK) Limited (Arcadis) was instructed by Homes England, 'the Client', to undertake a ground investigation at the proposed site, known as Phase 2B (the "Site") within the Northstowe development near, Cambridge.

The investigation has been integrated with existent data, to provide improved ground condition information to potential developers. Due to a revision of the land boundary by Homes England, the reader should note that this report covers a larger area than the current Phase 2B boundary.

It should be noted that it is proposed to increase site levels across Phase 2B by up to 0.5m, as part of the water management scheme. Therefore, near surface soil conditions, are likely to change from those recorded by some exploratory holes and as reported herein. The quality of the imported fills will therefore define near surface land quality in those areas that are filled. Full details of fill areas are not yet known.

A review of the existing ground information data was undertaken to inform design of the supplementary investigation. The Phase 2B area was not widely investigated previously due to access constraints and the priorities of the Client at that time.

The investigation undertaken across Phase 2B was based on a 40m grid, in order to provide greater certainty of the ground conditions and better investigate the presence of the sand and gravel channels that are present in this area.

Details of the most recent (supplementary) investigation are provided within the factual report [6].

1.2 Proposed Development

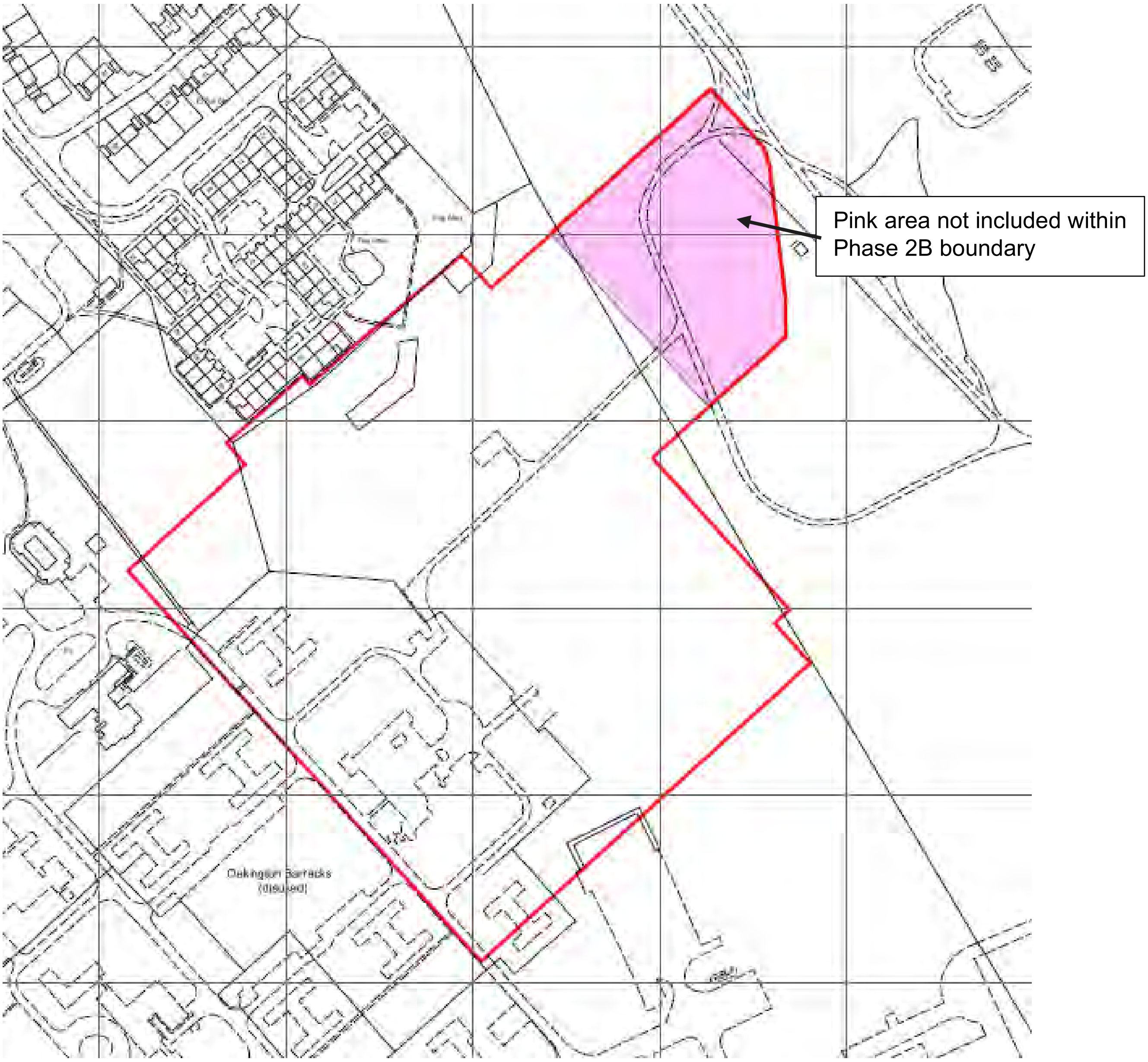
At the time of writing no fixed development layout plans are available for the Phase 2B. It is therefore assumed that the majority of the development will be of mixed use with low rise residential dwellings. The area to the north east is within the town centre and is therefore likely to contain high-rise mixed-use structures.

The wider Phase 2 Northstowe development scheme comprises the following;

- Development of the main Phase 2 development area into approximately 3,500 dwellings, schools, town centre including employment uses, formal and informal recreation space and landscaped areas, the eastern sports hub, the busway, a primary road to the southern access, construction haul route and engineering and infrastructure works, and
- Construction of a highway link (Southern Access Road (West) (SARW)) between the proposed new town of Northstowe and the B1050, improvements to the B1050 and associated landscaping and drainage.

Plan 1, below, shows the Phase 2B area within the main Phase 2 development area. The pink shaded area relates to the proposed town centre area which due to a boundary change, is not now included within Phase 2B.

Plan 1 – Redline Boundary for the Northstowe Phase 2B



1.3 Supplementary Reporting

The assessment and recommendations made in this report are based upon the following documents which should be referred to for factual data:

- Arcadis, Northstowe Phase 2B – Factual Ground Investigation Report, October 2019 [6];
- Arcadis, Northstowe Phase 2 – Factual Ground Investigation Report, 2017 [7];
- WSP Environmental (UK) (2007) Northstowe Zone B - Interim Factual Report [8];
- WSP Environmental (UK) (2007) Northstowe Zone C - Interim Factual Report [9].

A combined exploratory hole location plan is presented within Appendix A.

1.4 Limitations

This report has been prepared for the client in accordance with the terms and conditions of appointment. Arcadis cannot accept any responsibility for any use of or reliance on the contents of this report by any third party. The copyright of this document, including the electronic format shall remain the property of Arcadis.

This report has been compiled from a number of sources, which Arcadis believes to be trustworthy. However, Arcadis is unable to guarantee the accuracy of information provided by others. The report is based on information available at the time. Consequently, there is a potential for further information to become available, which may change this report's conclusion and for which Arcadis cannot be responsible.

It should be noted that ground conditions between exploratory holes may vary from those identified during and ground investigations; any design should take this into consideration. It should also be noted that groundwater levels may be subject to diurnal, seasonal, climatic variations and those recorded in this report are solely dependent on the time the ground investigations were carried out and the weather before and during the investigations, (carried out at different times).

This report has been prepared for the Phase 2B boundary which includes the town centre (pink area). Due to a boundary change by Homes England, the pink area is now not included within Phase 2B. The assessment within this report has been undertaken on all the data for the original boundary and this should be taken into consideration when using this report.

2 Site Setting

2.1 Site Location and Description

The Northstowe development is centered on the former RAF Oakington Airfield and surrounding farmland which is situated approximately 10km northwest of Cambridge. The National Grid Reference (NGR) is TL 408 665.

The Phase 2B site is approximately 8.5 hectares and is generally flat, with levels falling slightly to the north and east. It is located on the western side of the main Northstowe Phase 2 development and is currently mainly covered with soft landscaping. Three buildings were previously located on the western boundary of the Site and a small building was located in the centre. All have been demolished to ground level. The southern area of the Site has been excavated by archaeologists and has been left at a lower level than the surrounding area.

Previous specialist work, for example, ground investigations (undertaken between 2005-2007) and UXO surveys have been undertaken by others across the area which includes the Phase 2 development. The Phase 1 development, which is to the north of this site, is currently being developed by Gallaghers.

2.2 Site History

The Phase 2B development area 'the Site' includes open space and limited hardstanding associated with the former RAF Oakington airfield, former barracks, and immigration centre. Three H-shaped buildings (accommodation blocks) were previously located on the southern and western boundary of the Site and these have been demolished to ground level. A small building was located in the centre.

It is not the intention of this report to provide a full history, but to identify those past uses on and within the vicinity of the Site that could have resulted in contamination of the soils and/or waters. Significant changes to the land use of the Site and surrounding areas are summarised in Table 2.1 below.

Table 2.1 – Site History

Year	On Site	Off Site
1886 – 1938	The site is undeveloped fields.	The surrounding area is farmland and associated buildings
1938 – 1952	No change.	The area to the south of site is now listed as Airfield.
1958 – 1973	The site now contains the H shaped accommodations blocks as well as roads and associated infrastructure, and a small building in the centre of site.	The airfield to the south and east of site has been further developed with additional buildings shown and runways.
1981 – 2006	The site is now listed as Oakington Barracks.	The airfield is now listed as Oakington Airfield, there have been changes to the layout of the runways.
2018	The site is now listed as Oakington Barracks (disused).	The airfield is now listed as Oakington Airfield (disused).

2.3 Published Geology, Hydrogeology, Hydrology and Relevant Environmental Information

Below is a summary of site information to assist with providing context to the report.

Geology / Aquifer Status	**Superficial Deposit:** River Terrace Deposits comprised of clay, sand and gravel. The superficial deposits (River Terrace Deposits) on the site are classified as a Secondary A aquifer by the Environment Agency (EA). Secondary A aquifers are defined as “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”. Their mode or occurrence is naturally variable and is not persistent across all areas. Where present there is a strong influence on local groundwater conditions. **Solid Geology:** Based on Geological Mapping at 1:50,000 scale, Sheet 187 (drift) Huntingdon and Sheet 188 (solid and drift) Cambridge, the geological sequence underlying the locality is River Terrace Deposits over Kimmeridge Clay and Ampthill Clay. The bedrock (Kimmeridge Clay Formation and Ampthill Clay Formation) is classified as Unproductive Strata. Unproductive Strata is defined as “rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow” Phase 2B is mapped as underlain by the Kimmeridge Clay only.
Additional Geological Information	There are no geological faults located on the site, according to the BGS mapping. The previous borehole/investigations, undertaken by the British Geological Survey between 1980’s and 1990’s across the whole Northstowe Phase 2 area, encountered between 0.2 m and 1.2 m of medium dense made ground overlying medium dense to dense River Terrace Sand and Gravel between 4 m and 6 m thick before proving the bedrock.
Radon	The radon risk has been assessed and indicates that the site is not in a radon affected area, as less than 1% of properties are above the action level, therefore no protective measures are necessary.
Source Protection Zone	The site is not situated within a Source Protection Zone (SPZ).
Licensed Groundwater Abstraction Points	There are a number of groundwater abstractions within 2000m of the site, with groundwater being utilised by multiple sources for spray irrigation and agriculture purposes.
Surface Water Features	A number of field drains within the surrounding agricultural land and Beck Brook located approximately 1km east of the Phase 2B site, which flows in a northerly direction.
Likely Groundwater Flow Direction	Groundwater flow is likely to be to the north and northeast and it is considered likely that groundwater is in continuity with Beck Brook to the east of the site. Groundwater is often found to be close to the surface.

3 Preliminary Conceptual Site Model

Geo-environmental assessments are required, in accordance with current regulatory guidance (CIRIA C552 [5] and CLR 11 [12]), to consider the significance of potential contamination in terms of plausible contaminant source-pathway-receptor contaminant linkages. As part of this process, it is necessary to develop a conceptual model of these potential contaminant linkages by identifying the potential contamination sources, sensitive receptors and potential exposure pathways.

3.1 Potential Contaminant Sources

Based on the information obtained from the environmental site setting, historical mapping and previous investigations, there are a number of potential contaminative sources identified on and off-site. These are summarised in Table 3.1 below.

It should be noted that it is considered unlikely that all these substances would be present at significant concentrations across the Site.

Table 3.1 Potential Contaminant Sources

Source	Potential Contaminants
On Site	
Made Ground/ reworked ground/ imported ground associated with current use and historical use as the RAF Oakington	Metals, polyaromatic hydrocarbons (PAHs), Fuel Spillages – petroleum hydrocarbons (TPHs), asbestos, ground gases and vapours, UXO.
Off Site	
RAF Oakington and former Barracks	Metals, PAH, TPH, asbestos, ground gases, UXO

3.2 Potential Receptors

The potential receptors detailed below take into consideration the most sensitive proposed future land use (residential housing with private gardens) as a precautionary approach. It is considered possible that any potential contamination within the soils could be disturbed during the construction phase, or during gardening or landscaping undertaken by future Site users.

3.2.1 Human Health

- Site Users (residents, visitors, maintenance workers and contractors).

Contamination risks to construction workers are not appraised by chronic (long term) exposure human health risk assessments. There are no appropriate published criteria applicable to assessment of potential risks to construction workers. The potential risks should be addressed by a site-specific construction workers risk assessment and implementation of appropriate health and safety measures, to adequately mitigate any potential risks. All works should be conducted in accordance with the CDM Regulations (2015) or any other relevant guidance. Construction workers are not considered further in this assessment.

3.2.2 Controlled Waters

Groundwater - Secondary A Aquifer underlying the majority of the Site (River Terrace Deposits)

Surface Water - Beck Brook approximately 1km east of the Site and several surface water drains across the Site.

3.2.3 Buildings

- Underground building structures/services (water pipes, concrete).
- Proposed buildings and foundations.

3.3 Potential Pathways

Potential pathways are the routes that link the receptor to the contamination. The potential pathways for this site are summarised in the table below.

Table 3.1 Potential Pathways

Potential Pathway	Receptor
Accidental ingestion of contaminants within soil, water and dust Inhalation of dust, vapours and ground gases Dermal contact with contaminants within soil, water and dust Accidental ingestion of contaminated vegetables/ crops or contaminated soil adhered to vegetables	Human Health - residents, visitors, maintenance workers and contractors
Leaching of potential contaminants in soil or Made Ground into groundwater. Vertical migration of soluble contaminants through the unsaturated zone into groundwater beneath the Site. Lateral migration of dissolved contaminant via groundwater flow Surface run-off of contaminants into surface water Migration of contaminants via surface water drains/ channels/ preferential pathways	Controlled Waters (groundwater and surface water)
Direct contact of building services or foundations with contaminants in the soil and Made Ground. Gas accumulation in confined and poorly ventilated spaces.	Buildings, services and foundations

4 Intrusive Ground Investigation

4.1 Historic Ground Investigations

Multiple ground investigations have been conducted on the wider Northstowe site, by WSP in 2007 and Arcadis Consulting in 2017, a summary of the locations falling within the Phase 2B redline boundary is given below;

WSP 2007

- Trial Pits – TPB041, TPB041A, TPB041B, TPC001, TPC001A, TPC002, TPC003, TPC004, TPC005, TPC006, TPC007, TPC008, TPC024A, TPC024B
- Boreholes – BHC001, WSC008, WSC009, WSC016, WWC001

Arcadis 2017

- Trial Pits – TPSA813, TPSA856, TPSA 1004, TPSA1103, TP1001
- Boreholes - BH1001

These locations are also presented on the exploratory hole location plan in Appendix A.

4.2 Arcadis 2019 Ground Investigation

The most recent phase of ground investigation works were carried out in two phases between the 12th - 22nd August 2019 and the 16th - 17th September 2019. The ground investigation scope, which was determined by Arcadis Consulting (UK) Limited, comprised:

- 7 no. cable percussive boreholes with dual 50mm HDPE installations;
- 40 no. trial pits;
- 3 no. trial trenches;
- 7 no. BRE 365 Soakage test within nominated Trial pits;
- 3 no. Falling head test within nominated boreholes;
- 20 no. TRL Dynamic Cone Penetrometer Tests;
- Geotechnical and contamination sampling; and
- Gas, vapour and groundwater monitoring from exploratory holes;

4.3 Ground Conditions & Geotechnical Testing

Full details of the ground conditions encountered are included in the exploratory hole logs presented in the factual reports and are summarised below.

Topsoil

Topsoil was encountered in most locations across the site, other than where it was previously stripped prior to archeological investigation in areas to the east and south of site. In addition, ongoing works adjacent to the northern boundary of Phase 2B including the laying of services and creation of a haul road have reworked the natural deposits during excavations.

Where Topsoil was encountered it was variable and is believed to be sourced from the River Terrace Deposits, the Kimmeridge Clay, and Made Ground deposits. The topsoil thickness ranged from 0.10m to 0.40m thick.

The Topsoil generally comprises grass over dark brown sandy clay or slightly gravelly clayey sand with roots and rootlets.

Geotechnical classification tests were undertaken on 4no. samples of Topsoil at depths of between 0.00m and 0.45m bgl, 1no. sample returned a non-plastic result and is not included in the summary below. The remaining 3no. sample tests recorded the following;

Table 4.1 Summary of Topsoil Classification

Test	Range of Values
Natural Moisture Content	8 – 22
Liquid Limit	29 – 36
Plastic Limit (%)	15 – 20
Plasticity Index (%)	14 – 16
Fraction Passing <0.425mm (%)	72 – 78
Modified Plasticity Index (%)	10.92 – 11.52

The classification test results indicate that these samples have a modified plasticity index of 10.92 to 11.52%, which corresponds to a low shrink-swell potential.

Geotechnical classification tests undertaken on 5no. samples of the Topsoil between 0.00m and 0.50m bgl indicated that soils consist of slightly gravelly sandy to very sandy SILT/CLAY, slightly gravelly to gravelly very silty/clayey SAND, and clayey to very clayey very gravelly SAND.

2no. particle density by gas jar test were carried out on samples of Topsoil from 0.00m and 0.30m bgl and gave a particle density of between 2.45 and 2.55Mg/m^3.

1no dry density/moisture content relationship test was undertaken on a sample of Topsoil from TB2B32 from 0.00 to 0.30m bgl, and indicated the following;

Table 4.2 Summary of the Dry Density / Moisture Content Relationship of Topsoil

Test	Result
Initial Moisture Content	9.9%
Maximum Dry Density	1.99Mg/m^3
Optimum Moisture Content	10%

Note - Particle density measured at 2.55Mg/m^3.

Made Ground

Made Ground was found within the Phase 2B site, notably in areas of former accommodation blocks. Made Ground was generally cohesive and encountered as dark brown gravelly clay with varying amounts of brick, concrete, and flint. The cohesive Made Ground is likely to be derived from re-worked natural deposits. Made Ground varied between 0.30m and 1.10m thick.

Granular Made Ground was recovered typically as fine to medium GRAVEL with fragments of brick and gravel, demolition rubble comprised of mainly cobble sized fragments, or gravelly SAND.

Geotechnical classification tests undertaken on 1no. sample of Made Ground between 0.00m and 0.40m bgl indicated that the soil consisted of gravelly very sandy SILT/CLAY.

1 no. laboratory remoulded CBR test was undertaken on cohesive Made Ground and recorded a CBR value of 1.1%.

1no. particle density by gas jar test was carried out on a sample of Made Ground from TP2B40 at 0.00m and 0.40m bgl and gave a particle density of 2.50Mg/m3.

1no dry density/moisture content relationship test was undertaken on a sample of Made Ground from TB2B40 from 0.00 to 0.40m bgl, and indicated the following;

Table 4.3 Summary of the Dry Density / Moisture Content Relationship of Topsoil

Test	Result
Initial Moisture Content	25%
Maximum Dry Density	1.85Mg/m^3
Optimum Moisture Content	11%

Note - Particle density measured at 2.50Mg/m^3.

Due the inconsistent presence, and shallow depth of Made Ground across the Phase 2B site, no representative SPT tests were undertaken within the strata.

River Terrace Deposits (RTDs)

The River Terrace Deposits (RTDs) mainly consist of sands and gravels (granular deposits) with layers of clay (cohesive deposits) across the Phase 2B site, recorded to a maximum depth of 7.70m bgl.

These deposits are, by the nature of deposition, likely to be highly heterogeneous, and variation in lithology should be anticipated both laterally and with depth beyond the locations of each exploratory hole. This natural variation will strongly influence permeability and entry of water into excavations, and stability of excavations, in the presence of groundwater.

Geotechnical classification tests undertaken on 8no. samples of RTDs between 0.00m and 5.00m bgl indicated that soils consisted of slightly to very silty/clayey very gravelly SAND and slightly gravelly sandy SILT/CLAY

3no. laboratory remoulded CBR tests were undertaken on cohesive and granular RTDs and recorded a CBR value ranging from 18.0% to 31.8%.

2no. particle density by gas jar test was carried out on samples of RTDs from 0.70m to 1.40m bgl and both recorded a particle density of 2.50Mg/m3.

2no dry density/moisture content relationship test was undertaken on samples of RTDs from between 0.70m and 1.40m bgl and indicated the following;

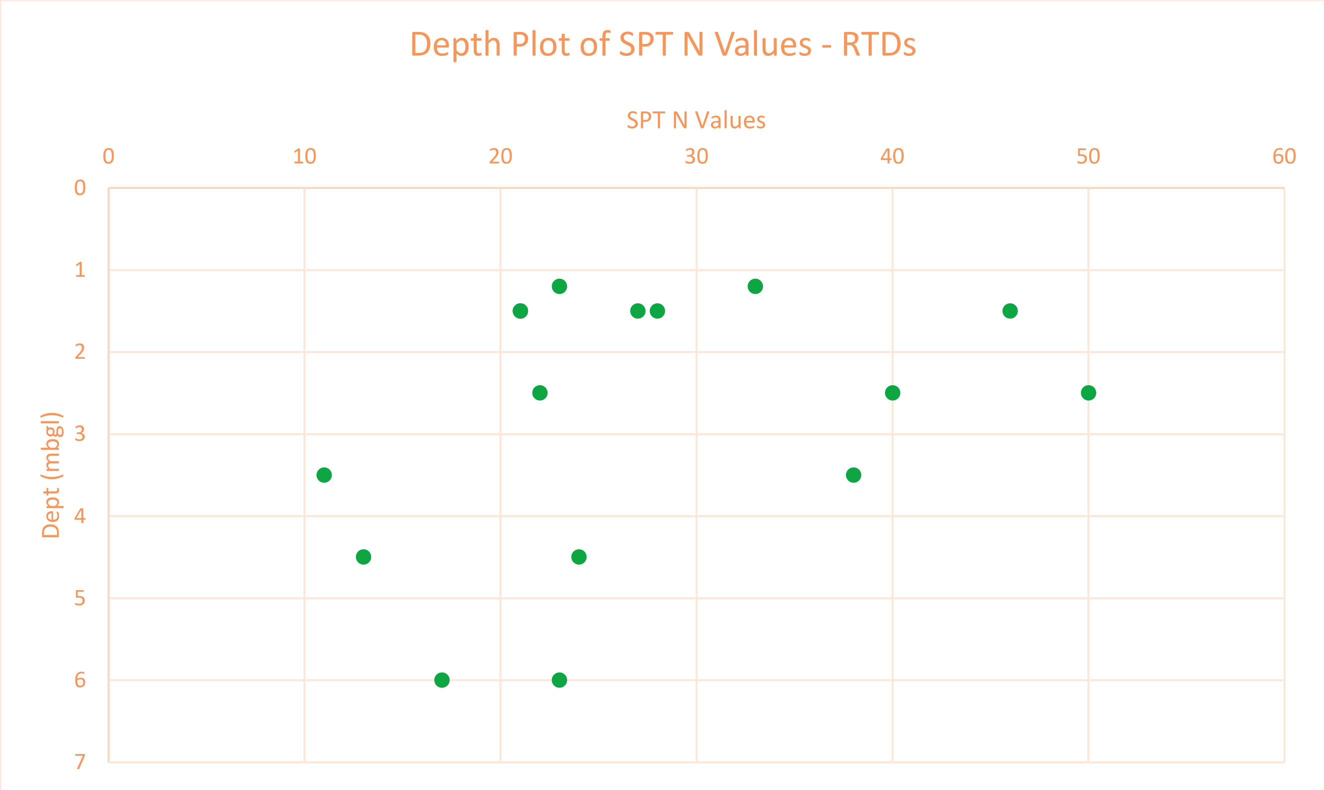
Table 4.4 Summary of the Dry Density / Moisture Content Relationship of the RTDs

Test	Result
Initial Moisture Content	7.2 – 15.0%
Maximum Dry Density	1.85 – 1.95Mg/m^3
Optimum Moisture Content	10 - 11%

Note - Particle density measured at 2.50Mg/m^3.

SPT testing undertaken within the RTDs recorded SPT N-values of between 11 and 50 indicating medium dense to dense consistencies. In general, no clear trend is observed within the dataset, which highlights the variability of the RTDs. Figure 4.5 below displays the relationship between depth and SPT N-value.

Figure 4.5 Depth Plot of SPT N Values – RTDs



Kimmeridge Clay Formation

The Kimmeridge Clay was encountered below the River Terrace Deposits across the site, and is encountered at depths from 1.1m bgl (TP2B40).

The Kimmeridge Clay typically comprises a firm to stiff dark grey silty Clay with bands of weathered grey siltstone up to 0.6m thick. Selenite crystals (<5mm), gypsum crystals, siltstone, shells and pockets of sand and silt were encountered at depth. Orange mottling and reddish-brown oxidation spots were also encountered.

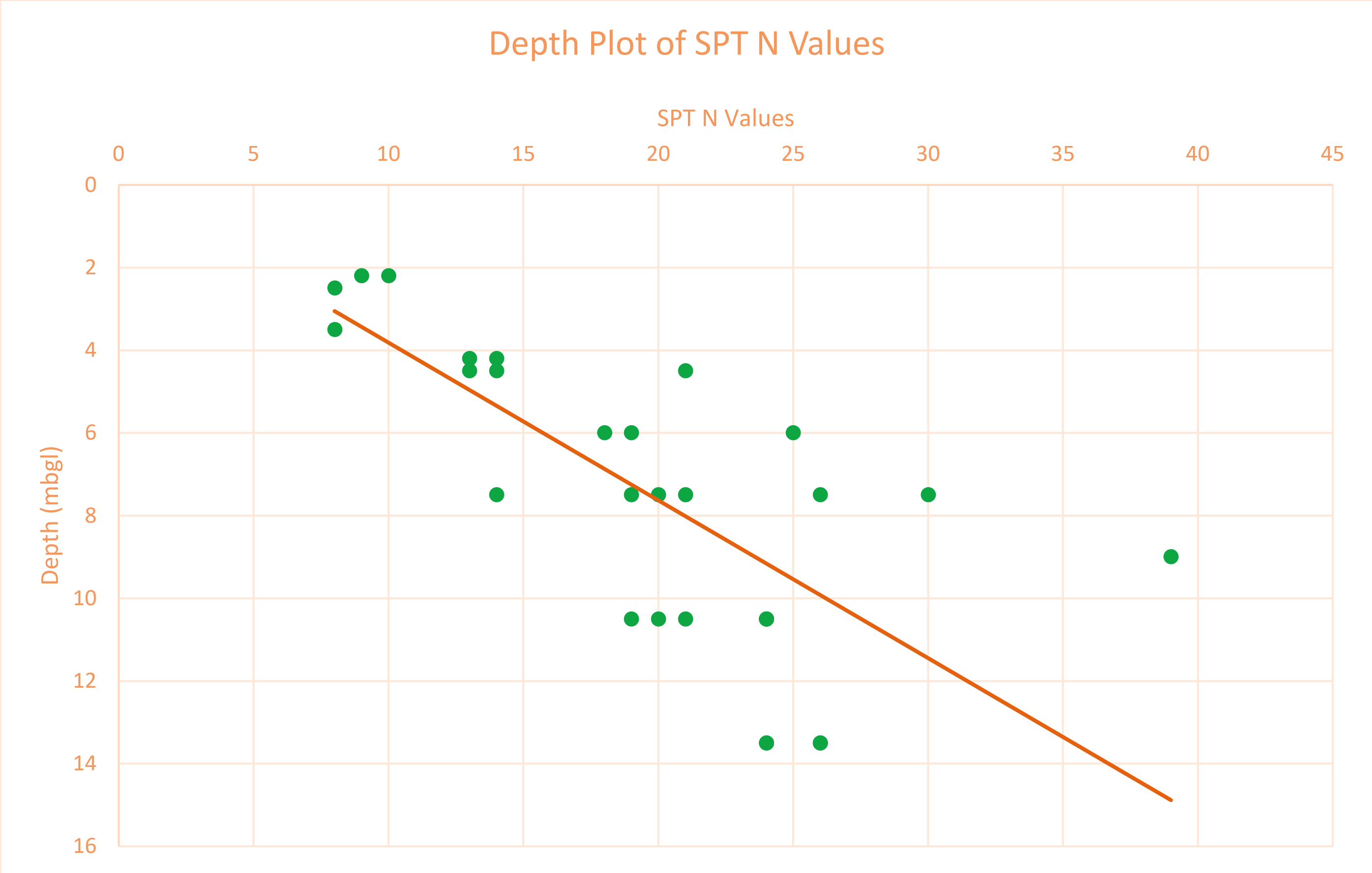
The base of the Kimmeridge Clay was not proven during the multiple phases of investigation.

Hand vane testing undertaken on site within the cohesive Kimmeridge Clay recorded peak undrained shear strengths of between 54kPa and 75kPa, with residual undrained shear strengths of between 18kPa and 32kPa.

13no. lab based Natural Shear Strength by Hand Vane tests were conducted on 12no. UT samples and 1no. bulk sample of cohesive Kimmeridge Clay. The tests recorded peak shear strengths of between 30kPa and 232kPa and residual shear strengths of between 2kPa and 73kPa.

SPT testing undertaken within the Kimmeridge Clay recorded SPT N-values of between 8 and 39 indicating soft to very stiff consistencies. In general, an overall increase in strength with depth was noted within the data set. Figure 4.6 below displays a general trendline and the relationship between depth and the increase in SPT N-value.

Figure 4.6 Depth Plot of SPT N Values – Kimmeridge Clay



Geotechnical classification tests undertaken on 13no. samples of the cohesive Kimmeridge Clay Formation at depths of between 1.60m and 12.45m bgl recorded the following;

Table 4.7 Summary of Cohesive Kimmeridge Clay Classification

Test	Range of Values
Natural Moisture Content	12 – 35
Liquid Limit	27 – 102
Plastic Limit (%)	16 – 32
Plasticity Index (%)	10 – 74
Fraction Passing <0.425mm (%)	65 – 100
Modified Plasticity Index (%)	7.15 – 74

The classification test results indicate that these samples have a modified plasticity index of 7.15 to 74%, which corresponds to a low to high shrink-swell potential.

Geotechnical classification testing on 1 cohesive sample of the Kimmeridge Clay indicated that the soils consist of slightly gravelly slightly sandy Silt/Clay.

1no. particle density by gas jar test was carried out from a sample of the Kimmeridge Clay and gave a particle density of 2.45Mg/m^3.

1no dry density/moisture content relationship test was undertaken on a sample of the Kimmeridge Clay from TB2B19 from 2.00 to 2.30m bgl, and indicated the following;

Table 4.8 Summary of the Dry Density / Moisture Content Relationship of the Kimmeridge Clay

Test	Result
Initial Moisture Content	23%
Maximum Dry Density	1.81Mg/m^3
Optimum Moisture Content	11%

Note - Particle density measured at 2.45Mg/m^3.

9 no "undisturbed" samples were submitted for multi-stage unconsolidated-undrained triaxial tests to determine the undrained shear strength (cohesion) of the material. A summary of the results is presented in the following table;

Table 4.9 Summary of Undrained Triaxial Classification – multistage

Exploratory Hole	Depth (m bgl)	Cell Pressure (kPa)	Undrained Shear Strength (kPa)	Mode of Failure
BH2B01	12.00 – 12.45	120	107	Compound
		240	124	
		360	128	
	15.00 – 15.45	150	236	Compound
		300	238	
		450	244	
BH2B02	3.20 – 3.65	75	78	Compound
		100	87	
		125	89	
	9.00 – 9.45	90	93	Compound
		180	97	
		270	98	
	12.00 – 12.45	120	110	Compound
		240	122	
		360	129	
	15.00 – 15.45	150	115	Compound
		300	125	
		450	132	

Exploratory Hole	Depth (m bgl)	Cell Pressure (kPa)	Undrained Shear Strength (kPa)	Mode of Failure
BH2B03	9.00 – 9.45	90	72	Compound
		180	81	
		270	84	
	12.00 – 12.45	120	103	Compound
		240	106	
		260	110	
	15.00 – 15.45	150	115	Compound
		300	118	
		450	120	

The results correspond to the description of stiff clay soil.

3 no "undisturbed" samples were submitted for one dimensional consolidation tests. A summary of the results is presented in the following table;

Table 4.10 Summary of One-Dimensional Consolidation Tests

Exploratory Hole	Depth (m bgl)	Pressure Range	Mv m^2/MN	Cv m^2/yr
BH2B01	2.50 – 2.95	25 - 75	0.44	6.2
		75 – 125	0.39	3.0
		125 - 175	0.30	4.3
		175 – 225	0.22	1.6
		225 - 25	0.19	1.1
BH2B03	3.20 – 3.65	35 – 85	0.24	4.0
		85 – 135	0.28	3.2
		135 – 185	0.20	4.6
		185 – 235	0.089	6.3
		235 – 35	0.14	0.86
BH2B06	3.50 – 3.95	35 – 85	0.28	4.8
		85 – 135	0.24	4.6
		135 – 185	0.20	4.6
		185 – 235	0.12	2.7
		235 - 35	0.13	3.5

Groundwater

Groundwater strikes within cable percussive boreholes were noted at depths of between 4.10mbgl to 11.00mbgl within the River Terrace Deposits and the Kimmeridge Clay Formation. A number of strikes coincided with the top of the Kimmeridge Clay Formation or bands of siltstone within the Kimmeridge Clay Formation and are potentially an indication of “semi-perched” water condition atop of the predominantly cohesive bedrock unit (lower relative permeability).

Rest water levels within monitoring wells were recorded in the shallow response zones (standpipes) at depths of between 1.60m bgl and 2.76m bgl and in the standpipes with deeper response zones, between 0.87m bgl and 4.45m bgl.

It should be appreciated that ground and groundwater conditions may vary between and away from the exploratory hole positions, and that no account can be taken in this report of such variations.

It should also be noted that groundwater levels may be affected by seasonal variations such as rainfall and that no account can be taken of such variations in this report due to the short monitoring period.

Details of groundwater strikes are presented on the exploratory hole logs and within the groundwater monitoring data in the factual reports.

4.4 Soak Away Testing

Soak Away tests were completed at the subject site. The soil infiltration rate was determined by conducting a soakaway tests in accordance with the methodology described in BRE 365. The tests were conducted in trial pits dug to the anticipated soakaway depth. Summary information of the tests and detailed test sheets are presented with the Factual Report [6]. The results of the testing are detailed below.

Table 4.11 Summary of trial pit soakage tests

Location ID	Strata	Depth of pit (m)	Soil Infiltration Rate f (ms-1)	Comment/limitations
TP2B04	River Terrace Deposits	2.00	Void test, see notes.	Test cancelled due to pit collapse.
TP2B12	River Terrace Deposits	2.00	4.98×10^{-6}	Extrapolated data used to calculate infiltration rate.
TP2B14	River Terrace Deposits	2.00	Very low soakage, value cannot be determined	Test terminated due to time constraints
TP2B20	River Terrace Deposits	2.00	Void test, see notes.	Test cancelled due to pit collapse.
TP2B26	Kimmeridge Clay	2.00	Void test, see notes.	Test cancelled due to pit collapse.
TP2B30	River Terrace Deposits	2.00	Void test, see notes.	Test cancelled due to pit collapse.
TP2B39	River Terrace Deposits	2.00	Void test, see notes.	Test cancelled due to pit collapse.

The tests completed within Phase 2B display a marked difference in the stability and permeability of shallow soils. Thus the potential for Sustainable Drainage Systems (SuDS) on this site may not be feasible. TB2B12 was undertaken within granular River Terrace Deposits and recorded a soil infiltration rate indicative for a moderate soakage potential. However other tests undertaken within similar deposits recorded very limited drainage and tests were subsequently aborted due to pit collapse or time constraints.

TP2B26 was completed within the Kimmeridge Clay and results were comparable to tests completed within the wider Phase 2 site, recording negligible soakage potential and was terminated due to the collapse of River Terrace Deposits above the test section.

4.5 TRL Probe Testing

Twenty DCP (Dynamic Cone Penetrometer) TRL (Transport Research Laboratory) probes were advanced across the site area, and generally recorded correlations relating to CBR values ranging from 2.90% to 145.15%.

Thus a number of anomalous high CBR values were recorded, and these are considered representative of the probe encountering and passing through coarse gravel or cobbles. They are not representative of a design CBR suitable for highways preliminary design purposes.

The results have been assessed in terms of the CBR-value using the relationship given as:

Log10 (CBR) = 2.48 - 1.057 x Log10 (mm/blow)

Full details of the DCP TRL testing and CBR results can be found within the Factual Report [6].

4.6 Visual or olfactory evidence of contamination

Visual/Olfactory evidence of hydrocarbon contamination was observed within a single location, TP2B29. The observations were described as “strong hydrocarbon odour, dark grey layer” between 1.10m to 1.30m bgl, and “hydrocarbon odour and distinctive red layer” from 2.20m bgl onwards. This was located in an area adjacent to hardstanding and the former accommodation blocks. Contamination was not anticipated in this area, and as a result further areas of contamination may be present.

No other visual or olfactory evidence of contamination was observed during the intrusive investigations across the Phase 2B site.

5 Geo-Environmental Assessment – Soil

5.1 Human Health Risk Assessment

5.1.1 Data Used

The investigation undertaken by Arcadis in 2019 was designed to complement the investigation undertaken by WSP in 2007. The soil results relevant to this Phase 2B development from the WSP reports and the results from the recent Arcadis investigation have both been assessed as detailed below. The ability to identify the source of the data has been retained with the two chemical data sets having been kept separate.

The samples were selected to approximate to a random stratified sampling pattern, to be representative the overall ground quality present at the site.

5.1.2 Soil Screening Values (SSVs)

The proposed end use of the site may include some mixed use, with the majority anticipated to be residential development. In advance of development specifics, for the purpose of this assessment, all soil samples have been conservatively screened against criteria protective of residential development with gardens/soft landscaping. As such an end use of residential with plant uptake has been used for screening purposes.

As an initial screen, all the soil chemical data has been screened against the current LQM/CIEH Suitable for Use Levels (S4ULs)[1] [1] for Human Health Risk Assessment for a residential with plant uptake scenario. In the absence of a S4UL for lead, the Category 4 Screening Level (C4SL) has been adopted [2].

For organic contaminants SSVs corresponding to a Soil Organic Matter (SOM) content of 1% has been used as Tier 1 screening values in the assessment. This is based on the average measured concentration of total organic carbon in the samples (1.7%).

5.1.3 Tier 1 Screening Assessment

5.1.3.1 Inorganics

The chemical results were assessed against the SSV for a residential with plant uptake land use. No results from the Arcadis 2019, 2017, or WSP 2007 ground investigations recorded concentrations above the relevant SSVs.

5.1.3.2 Organics

The soil samples were analysed for a suite of organic compounds including PAH compounds, TPH, Phenol and BTEX.

The results from the Arcadis 2019 were generally below the laboratory limit of detection, with exceedances of the relevant SSV detected in one sample from TP2B23 at 0.1-0.4m bgl only.

In total, 3 exceedances of PAH species within TP2B23 at 0.1 – 0.4m bgl were detected, comprising Benzo(b)fluoranthene at 5.3mg/kg compared to an SSV of 2.6 mg/kg, Benzo(a)pyrene at 4.4 mg/kg compared to an SSV of 2.2 mg/kg, and Dibenz(a,h)anthracene at 0.69 mg/kg compared to an SSV of 0.24 mg/kg. This sample came from strata containing brick and concrete, classified as Made Ground. Samples taken at this location from 1.6 – 2.6m bgl show these contaminants to be below the laboratory limit of detection, indicating this is localised contamination only.

Site levels are assumed to be rising by up to 1m across the site and as a result this currently shallow contamination will not be at surface, after site levels are raised.

A hydrocarbon odour was noted within TP2B29, however no elevations or exceedances of the SSVs were recorded within any of the 3 samples obtained from this location.

No other organic contaminants concentrations exceeded the SSV criteria.

The results from the Arcadis 2017 within Phase 2B did not record any exceedances of the SSV criteria.

The WSP 2007 investigation within Phase 2B recorded two exceedances within shallow Made Ground soils samples for Naphthalene, one from WSC009 at 0.5m bgl of 54 mg/kg, and one from TPC24A at 0.65m bgl of 6.9 mg/kg compared to an SSV of 2.3 mg/kg. These exceedances were located in close proximity to each other on the south east redline boundary of Phase 2B underneath an area of hardstanding. This area of hardstanding will be stripped during ground preparation works for the development, with site levels then assumed to be rising by up to 1m and as a result this contamination will not be left at surface.

5.1.3.3 Asbestos

Samples from all 3 phases of ground investigation were submitted for asbestos identification analysis. Asbestos was not identified at any of the samples submitted from the Phase 2B site.

5.2 Risk to Controlled Waters

5.2.1 Data

Ten groundwater samples were taken from the installations across the site during the 2019 investigation and analysed for a suite of contaminants.

5.2.2 Water Quality Standards (WQS)

To assess the groundwater and soil leachate in terms of its potential as a source of contamination to Controlled Waters, the contaminant concentrations have been compared against appropriate Water Quality Standards (WQS). Given the location of the site above the Secondary A Aquifer and the close proximity of watercourses and especially Beck Brook (to the east), for completeness the results have been compared to both UK Drinking Water Standards (UK DWS) and Environmental Quality Standards for freshwater (EQS).

The EQS values have been taken from the Water Framework Directive (WFD) [11] which provides screening values to be protective to the surface water environment.

For some of the metals, the EQS guideline for copper, zinc, lead and nickel are based on bioavailability. PNECs (Predicted No Effect Concentration) are calculated based on assumed Ca^{2+} and Dissolved Oxygen Concentrations.

Only the results from the 2019 Arcadis investigation have been compared against the WQS as this will provide a current view of the water quality across the site.

5.2.3 Groundwater Assessment

From the monitoring round, 10 groundwater samples from 7 standpipes were analysed for a general suite of metals, non-metals and hydrocarbons (PAH, TPH, BTEX and phenol). In many of the boreholes, water was present in both the shallow and deep installations. Where present, water was sampled from both. Groundwater levels are detailed on the gas monitoring sheets in the Arcadis Factual report. It is noted that generally the standing level of the water in the shallow and deep wells was very similar which indicates a general continuity of groundwater between shallow and the slightly deeper strata i.e. generally non-confined conditions.

5.2.3.1 Inorganics

The table below shows the exceedances on inorganic contaminants against WQS.

Table 5.1 Exceedances of Groundwater assessment criteria

Determinand	Range of Concentrations (ug/l)	WQS (EQS / DWS) (ug/l)	Exceedances (Yes / No) (Number)	Location of exceedance
Arsenic	0.2 – 16.0	50 / 10	No EQS Yes DWS (1)	BH2B04 Deep (16 ug/l)
Selenium	1.0 – 52.0	10 / 10	Yes EQS Yes DWS (4)	BH2B01 D (28ug/l), BH2B02 D (47ug/l), BH2B06 D (52 ug/l), BH2B07 D (41 ug/l)

The only exceedances for inorganic contaminants are for Arsenic and Selenium.

The Arsenic exceedance was recorded at 16 ug/l in BH2B04 D only, with this concentration exceeding the DWS threshold of 10ug/l. Exceedances for Selenium, of up to 52ug/l with respect to EQS/DWS threshold of 10ug/l were only detected within standpipes screening the deeper Kimmeridge Clay, and have also been detected over the wider Northstowe site. The Contaminated Land Officer has accepted that the presence of selenium is representative of background conditions, and do not indicate a soil source of Selenium, or groundwater contamination of significance at the site.

All other concentrations are below the relevant criteria, and no exceedances were recorded.

5.2.3.2 Organics

The groundwater samples were analysed for organic compounds (TPH – total petroleum hydrocarbons, PAH – Polycyclic Aromatic Hydrocarbons, BTEX – Benzene, Toluene, Ethylbenzene and Xylene and phenol, cyanide). The results were all below the limit of laboratory detection.

5.3 Ground Gas Risk Assessment

5.3.1 Introduction

To establish the ground gas regime for the site, the boreholes installations were monitored on three occasions between 27th August 2019 and 12th September 2019. There are considered to be no potential source of ground gases on site (e.g. no landfill sites or significant Made Ground) and therefore the monitoring is included with an expectation to confirm this conceptual model.

The ground gas monitoring was undertaken using an infra-red gas analyser and flow pod. Concentrations of methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) in %, Hydrogen Sulphide (H_2S) and Carbon Monoxide in ppm and ground gas flow in litres per hour (l/hr) were recorded during each visit.

After the monitoring was undertaken, each well was dipped to record the groundwater level in each location.

5.3.2 Atmospheric Pressure

Atmospheric pressure can impact ground gas flow. According to CIRIA C665 Assessing the risks posed by hazardous ground gases to buildings [4]:

"*at falling pressure increased emission rates occur as the gas increases in volume. Rising pressure causes air to flow into the ground, diluting soil gas concentrations. The rate of change in barometric pressure is also important. A swift drop over a small range has the potential to release a greater volume of gas than a gradual drop over a greater pressure range*".

Atmospheric pressure data from the ground gas monitor utilised on site was recorded at each monitoring location. The following atmospheric pressure conditions were noted during the monitoring rounds:

- 27th August 2019 – **low and rising** pressures from 1012 to 1015 millibars
- 4th September 2019 – **low and falling** pressures of 1013 to 1011 millibars
- 12th September 2019 - **high and rising** pressures of 1023 to 1026 millibars

5.3.3 Gas Monitoring Results

Below is a summary of the range of ground gas monitoring results recorded during the three monitoring rounds. Full details are provided in the factual report.

Table 5.2 Summary of gas monitoring data

Parameter	Range of Results		
	First	Second	Third
Methane (%v/v)	< 0.1 – **0.1** (BH2B05 S, BH2B05 D, BH2B07 D)	< 0.1	< 0.1
Carbon Dioxide (%v/v)	<0.1 – **6.0** (BH2B02 S)	<0.1 – **6.0** (BH2B02 S)	0.0 – 5.3 (BH2B03 S)
Oxygen (%v/v)	16.2 (BH2B03 S) - 21.9	**9.5** (BH2B02 S) – 21.9	15.3 (BH2B01 S) – 21.6
Carbon Monoxide (ppm)	2.0 – **12.0** (BH2B03 S)	2.0 - 6.0 (BH2B02 D)	2.0 – 7.0 (BH2B03 S, BH2B01 D)
Hydrogen Sulphide(ppm)	0.0 – **2.0** (BH2B07 D)	0.0 – 1.0 (BH2B04 S)	0.0 – 1.0
Ground Gas Flow (l/h)	<0.1 – 0.3	-1.8 – **0.4** (BH2B04 S)	-4.8 – 0.1
Atmospheric Pressure	1012 – 1015	1011 - 1013	1023 - 1026

1 Location in brackets represents the highest ground gas concentration or lowest Oxygen concentration

A maximum concentration of 12.0 ppm of Carbon Monoxide (CO) was recorded in BH2B03 S during the first round of monitoring. Hydrogen sulphide was found to be generally below the limit of detection with a maximum concentration of 2.0ppm recorded in BH2B07 D during the second round of monitoring. The short-term occupation exposure limit (15 minutes) for CO is 200ppm with the long-term exposure limit of 30ppm [3]. The concentrations recorded on site are considerably lower than these limits and therefore not considered to be significant.

5.3.4 Hazardous Ground Gas Assessment

A ground gas risk assessment has been undertaken to evaluate the risk posed to potential receptors of the proposed development. As the proposed development is mainly residential properties, a risk assessment appropriate for this land use has been completed.

BS 8485(2019) +A1 guidance [13] has been used to inform the ground gas assessment.

The Q_{hg} is calculated using the following equation:

Q_{hg} = borehole flow rate (l/h) x gas concentration (%v)/100

The following parameters have been used in the equation:

CH_4 (max recorded concentration) = 0.1 % v/v

CO_2 (max recorded concentration) = 6.0 % v/v

Flow Rate (max steady flow rate) 0.4 l/hr

Q_{hg} CH_4: 0.1/100 x 0.4 = 0.0004 – **CS1 Very Low risk**

Q_{hg} CO_2: 6.0/100 x 0.4 = 0.024 – **CS1 Very Low Risk**

With reference to BS8485 *Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* the calculated Q_{hg} fall into the CS1 'very low risk' category.

No elevated concentrations of Methane were recorded at the site above the CS1/CS2 threshold of 1.0%v/v.

Elevated concentrations of Carbon Dioxide were recorded at the site above the CS1/CS2 threshold of 5%v/v during two monitoring visits within a single borehole (BH2B02 S) during periods of both falling and rising atmospheric pressure (although it should be noted that no elevated flow rates have been recorded at the site).

With reference to BS 8485 *Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings*, if a carbon dioxide concentration greater than 5% v/v is encountered, consideration should be given to assigning a CS2 classification.

In this instance, there is not considered to be source of ground gas such as landfill or waste on site, the 5% limit for carbon dioxide was only exceeded in one borehole (BH2B02 S) and the steady measured gas flow was low. Therefore, a **CS1- very low risk** is considered to be appropriate. This finding should be discussed with the Regulator early in the development planning, to ensure they accept this finding.

6 Quantitative Risk Assessment

6.1 Methodology

Geo-environmental assessments are required to consider the significant of potential contamination in terms of plausible contaminant source-pathway-receptor contaminant linkages. As part of this process, it is necessary to develop a conceptual model of these potential contaminant linkages by identifying the potential contamination sources, sensitive receptors and potential exposure pathways. A risk assessment is then undertaken to determine the likelihood and significance of these potential linkages.

Risk assessment involves identifying hazards and determining their potential severity and likelihood, if an impact occurs on identified receptors. Risks are generally managed by changing the receptor, isolating the sensitive receptor by intercepting or interrupting the exposure pathway, or removing the source. If no pollutant linkages are formed, there is no risk. The following risk assessment focuses on the potential contaminants identified on the site and the proposed development of the site.

CIRIA guidance C552 [5] states that the designation of risk is based upon a consideration of both:

- The likelihood of an event (probability); (takes into account both the presence of the hazard and the receptor and the integrity of the pathway).
- The severity of the potential consequence (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

Under such a classification system the following categorisation of risk has been developed and the terminology adopted as follows (Table 6.1):

Table 6.1: Risk Categorisation

Risk Term	Description
Very High Risk	There is a high probability that significant harm could arise to a designated receptor from an identified hazard at the site without appropriate remedial action.
High Risk	Significant Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remedial action.
Moderate Risk	It is possible that without appropriate remedial action, harm could arise to a designated receptor but it is relatively unlikely that any such harm would be severe and if any harm were to occur, it is likely that such harm would be relatively mild.
Low Risk	It is possible that significant harm could arise to a designated receptor from an identified hazard but it is likely that at worst this harm if realised would normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.

Further risk assessment terminology is included in Appendix B.

6.2 Pollutant Linkages – Conceptual Site Model

As discussed above in Section 6.1, for a pollutant linkage to be present on the site, a source, pathway and receptor must all be present at the site. An updated Conceptual Site Model is presented below;

Table 6.2 Conceptual Site Model – Pollutant Linkages

RPL No	Contaminant Source	Sensitive Receptor	Pathway	Hazard (Severity)	Likelihood	Potential Risk	Comments
RPL1	PAH Compounds in underlying soils including Benzo(b)fluoranthene' Benzo(a)pyrene; and Dibenz(a,h)anthracene in shallow Made Ground from TP2B23 and Naphthalene in shallow Natural Soils in WSC009 and TPC24A	Human Health	Ingestion / Inhalation / Dermal Contact / Veg uptake	Chronic damage, carcinogenic compounds (**Medium**)	**Low to Likely** Contaminant concentrations have been found to be elevated in proposed residential areas, however the contamination is not widespread. In areas of proposed housing with private gardens, a large proportion of the site would be soft landscaping and therefore it is likely that receptors would come into contact with contaminants if present in the surface soils if no remediation / mitigation is undertaken.	**Moderate / Low to Moderate**	Contamination has been encountered in the near surface soils in specific sample locations across the site, however contamination is not found to be widespread. The level of remediation / mitigation required will depend on the final design of the development in the areas where elevated results have been encountered. Either offsite removal or "clean" cover protection is likely to be warranted, focused in soft landscaping areas.
RPL2		Controlled Waters (Groundwater and Surface water)	Leaching and migration into water environment	Reduction of water quality, although unlikely to be a potable resource. (Mild - **Medium**)	**Unlikely.** No exceedances of WQS for these contaminants have been recorded in the groundwater analysis undertaken. This indicates that contaminants are not typically being mobilised via infiltration. Resolution of RCL1 would be required to be protective from local discrete soil sources.	**Low**	Elevated contaminants concentrations of PAH compounds have not been encountered in the groundwater.
RPL3		Buildings / Services	Contact of contaminants with buildings and structures (excluding	Damage to structures (**Mild**)	**Low.** Identified contaminants are unlikely to cause significant damage to new buildings, if appropriate concrete design is used.	**Low**	No pH concentrations outside the normal range of 6-9 units have been detected.

RPL No	Contaminant Source	Sensitive Receptor	Pathway	Hazard (Severity)	Likelihood	Potential Risk	Comments
			potable water supply pipes)		Contamination is not widespread across the site.		
RPL4	No on-site or off-site source of Ground Gases (methane and carbon dioxide) is present.	Human Health	Inhalation in confined spaces	Asphyxiation (**Severe**)	**Unlikely.** Low concentrations and low flow volumes of methane and carbon dioxide were recorded in areas across the site. Based on the current information, the risk to residential end users is considered to be low.	**Moderate / Low**	No credible source has been identified. The precautionary (limited) ground gas monitoring is consistent with this conceptual model and accords with CIRIA Characteristic Situation 1. No special precautions from ground gases are likely to be required. This finding should be reviewed with the Regulator, early in the development programme, to confirm that additional confirmatory monitoring is not required.
RPL5		Buildings (on-site)	Accumulation in confined spaces	Explosion (**Severe**)	**Unlikely.** Low concentrations of methane and carbon dioxide were recorded in areas across the site. Based on the current information, the risk to the proposed buildings is considered to be low.	**Moderate / Low**	
RPL6	Elevated inorganic contaminants (Selenium, Arsenic)	Controlled Waters (Groundwater and Surface water)	Leaching and migration into water environment (off-site)	Reduction of water quality (**Medium**)	**Likely.** Contaminant concentrations greater than water quality standards have been detected in the groundwater. Groundwater flow is to the north east towards Beck Brook (500m) and therefore it is considered likely that the groundwater may migrate and discharge into the Brook.	**Moderate**	Due to the distances involved, the risk to the Brook is deemed low and contaminant concentrations are likely to be representative of background conditions. However, discussions with the EA should be undertaken to determine their position. Monitoring of groundwater may be required during re-development to ensure that groundwater quality is not affected during site works.

RPL = Residential Pollutant Linkages

6.3 Pollutant Linkages Discussion

Concentrations above the appropriate SSVs for Benzo(b)fluoranthene, Benzo(a)pyrene and Dibenz(a,h)anthracene (one sample, TP2B23), and Naphthalene (two samples, WSC009 and TPC24A) were obtained during the Arcadis 2019 and WSP 2007 intrusive investigations.

The results are not indicative of gross site wide contamination. An area of localised contamination has been identified within the vicinity of WSC009 and TPC24A. All exceedances were found within shallow Made Ground.

The human health exposure pathways for Arsenic and the PAH compounds comprise direct exposure including soil ingestion/inhalation and dermal contact. Therefore, in areas with buildings/external hard-standing or similar, no such potential pollution linkage would exist, and hence no specific remedial measures would be required. However, in the areas of soft landscaping and private garden areas the potential contamination linkage will need to be broken, either by physical excavation of these materials, or by capping with a suitable thickness (likely to be 600mm) of uncontaminated cover soils. In general landscaping areas this thickness could likely be reduced. Clean cover soils in landscaped areas will also prevent new planting from being affected by phytotoxic conditions. Site levels are predicted to rise by up to 0.5m, and this could be utilised to deliver breaking this pathway.

Once development plans are known, the extent of the localised contamination can be proven and confirmed through close-centre sampling and laboratory analysis of soil samples. If it coincides with a sensitive use, such as gardens, the impacted soils could be removed and disposed of to an appropriate waste treatment facility. This action would also remove potential risk to Controlled Waters. Once removed offsite, the soils left in-situ would be validated to confirm their suitability to remain onsite. If suitable, no further remedial measures would be required for the proposed development, as the source-pathway-receptor linkage would be broken.

Gas concentrations and flow rates recorded at the subject site indicate that the site is classified as Characteristic Situation 1. Subject to liaison and regulatory agreement, special measures are unlikely to be required. Further confirmatory monitoring may be requested.

A number of minor Selenium exceedances of the WQS have been recorded within the groundwater samples, however these are in keeping with Selenium concentrations over the wider site and most probably representative of background concentrations. Therefore, the risk to Controlled Water is deemed low.

In order to satisfy and enable the discharge of the likely future relevant Planning Conditions (including pre-commencement conditions), it is recommended that the findings of this report (with respect to contamination) be formalised in a development-specific Remediation Statement (detailing the development scheme and most appropriate remedial option) and be submitted to the Local Planning Authority for their approval.

7 Geotechnical Assessment

7.1 Groundwater

Rest water levels are often close to ground level. Within monitoring wells groundwater was recorded in the shallow standpipes at depths of between 1.60m bgl and 2.76m bgl and in the deep standpipes between 0.87m bgl and 4.45m bgl.

Typically, groundwater was not initially encountered within the upper few meters of strata penetrated, during the very short period exploratory holes were open during site work. However, groundwater levels are generally high, and the absence of immediate entry is more likely a function of the lower permeability of clay materials and the smearing effect of forming exploratory holes.

Excavations at the site should be feasible using an appropriate scale of hydraulic plant. All excavations at the site will require adequate lateral support, or battering back to a safe angle, to ensure their stability.

Based on the available data, it is considered likely that perched groundwater will be encountered in shallow excavations (i.e. within 3.0mbgl) at the site, especially during periods of wet weather and in this scenario appropriate groundwater control/dewatering provisions would likely be required.

7.2 Soakaway Performance

BRE365 Soak Away tests were attempted across the Phase 2B site within ground conditions representative of River Terrace Deposits and the Kimmeridge Clay respectively. This is deemed representative of the wider site conditions, considering the ground conditions which were encountered during the intrusive works.

The result of the infiltration test within the River Terrace Deposits were indicative of a low soakage potential, with the exception of TP2B12 which was indicative of moderate soakage potential. However, high groundwater conditions may prevent the application of standard designs, as there will be little or no unsaturated zone beneath soakaways. Early consultation with the Environment Agency would be prudent.

The result of the infiltration tests undertaken within the Kimmeridge Clay is indicative of negligible/poor soakage and a corresponding low permeability and an infiltration drainage solution will not be suitable at the site within areas where the Kimmeridge Clay is encountered at a shallow depth.

If a partial SuDs solution needs to be assessed further, close centred, detailed investigations would be required to locate and zone the occurrence of River Terrace Deposits. Further assessment of this limited potential should be confirmed through the use of ‘full scale’ BRE 365 soak away testing, taking into account specific development proposals available for the site.

Taking the high groundwater into account, the site has very low feasibility for a soakage based SuDs drainage solution.

7.3 Road Pavements

It is likely that the pavement subgrade exposed at formation levels will comprise the both granular and cohesive River Terrace Deposits, variable Made Ground or cohesive strata of the Kimmeridge Clay Formation. In filled areas, the imported fill would become the formation material, and the fill specification should set minimum CBR for acceptability.

Laboratory remoulded CBR tests were undertaken on cohesive Made Ground and recorded a CBR value of 1.1%. Laboratory remoulded CBR tests undertaken on cohesive and granular RTDs recorded a CBR value ranging from 18.0% to 31.8%.

Twenty DCP (Dynamic Cone Penetrometer) TRL (Transport Research Laboratory) probes were advanced across the site area, and generally recorded CBR values ranging from 2.90% to 145.15%.

A number of anomalous high CBR values were recorded, and these are not considered representative for road pavement design. These are likely to be a consequence of the probe encountering and passing through coarse gravel or cobbles. The overall CBR recorded across the site is variable and will be a function of the placed fill or lithology changes in lateral ground conditions that are present.

Pavement and road design should be based upon a suitable (equilibrium) CBR value for such formation soils. It is recommended that new road pavement and road construction design should be based upon a CBR value within the range 2 to 5%. Areas of soft ground should be excavated when identified during proof rolling. A conservative estimate for the cohesive Kimmeridge Clay and cohesive rich RTDs ranges from 2-3%, while more granular RTDs can be expected to fall within the range of 4-5%.

The design value will need to be reviewed and confirmed by suitable in-situ testing at formation levels following earthwork operations (raising of site levels) and prior to pavement construction.

Notwithstanding this, the formation at all levels should be proof-rolled prior to pavement construction, and any soft zones thus revealed should be excavated out, with the resulting excavation in-filled with appropriately graded engineered granular fill.

It would thus be prudent to adopt a relatively low CBR in the preliminary design and to open discussions with the local authority highways department in order to agree pavement design approaches. This should be done at an early stage, as design traffic, drainage arrangements and thickness/stiffness of a pavement all play a part in achieving a satisfactory performance and an adoptable design.

7.4 Ground Floor Slabs

In accordance with NHBC guidance 5.1 “substructure and ground bearing floors”, shrinkable soil, expansive materials or other unstable soils may require suspended floor construction. Shrinkable soils are classified as those containing more than 35% fine particles (silt and clay) and have a modified Plasticity Index of 40% or greater (see NHBC Chapters 4.2 ‘Building near trees’ (each section) and 5.2 ‘Suspended ground floors’ (each section)).

Foundations on the Kimmeridge Clay would meet this criterion of “shrinkable soil”.

The majority of RTDs do not meet this criterion of “shrinkable soil”, as a result suspended ground floors are unlikely to be required.

If imported fill will be the founding strata, the imported material should also be specified to have geotechnical parameters resulting in low shrink-swell potential, or suitable precautions would need to be taken.

Where site levels are raised, the quality of this fill will have an influence on house types and ground floor arrangements. Early consultation with Building Control and the homes insurance body (e.g. NHBC) should take place, in advance of site filling if possible, to reach agreement in principle.

7.5 Foundations

It is understood that the development will comprise both low rise residential dwellings with gardens and associated infrastructure and high rise mixed use blocks to the north of the site. Therefore this assessment has been split to consider two broad development options. It is understood that site levels are to be raised by approximately 0.5m in some areas.

In addition, areas of the Phase 2B site have had topsoil and subsoil stripped and undergone archaeological investigations including the excavation of pits and trenches greater than 1.0m deep. These locations have not been backfilled, and as a result some areas of site will require raising by over 1.0m in order to return them to current site levels.

Where filling has occurred, and particularly in areas of archaeological investigation, minimum founding depths will need to take this into consideration. Soil moisture deficit tests may be required, or alternatively, the minimum depth could be derived based on original pre-fill ground levels.

Low Rise Residential

For low rise residential dwellings it has been assumed loadings will be modest, however the specific loadings have not been provided for this assessment. Made Ground soils are not considered to be a suitable founding stratum.

The target founding stratum would ideally be the Kimmeridge Clay Formation due to more uniform properties and the typical increase in strength with depth. However due to the thickness of RTD’s within the Phase 2B site this may not be practical in all areas.

The RTDs are generally variable and the interbedded nature of the granular and cohesive strata would make selection of a founding solution more difficult, with greater uncertainty of settlement response.

A number of foundation solutions are deemed viable including strip foundations, mass trench fill, or mini piles in areas where competent strata is encountered at a depth of greater than approximately 2m bgl. This is primarily due to the variation in the depth that the Kimmeridge Clay formation was encountered across the development area. In general trench or strip foundations are not economical at depths of greater than 2m bgl. Groundwater entry and the control required to maintain dry conditions prior to concrete pours is another consideration and likely to be more of a limitation within more granular water bearing RTDs.

The increase in site levels across the site by up to 0.5m, and the backfilling of the archaeological investigation areas will mean that depth to reach competent bearing strata will be greater in these areas. Some plots may require a deeper founding solution. Alternatively, provided fill has been placed to a good engineering standard, a raft or semi-raft solution may be feasible.

Foundation excavations may require de-watering works due to the shallow nature of groundwater which has been encountered at the subject site.

In areas where the River Terrace Deposits are present and deemed viable as a founding stratum, a raft or semi-raft foundation may be preferred to help control and minimise the effects of differential settlements. It is understood that raft foundations are currently being used in Phase 2A. It is recommended that once fixed development plans become available, settlement analysis is undertaken.

Detailed pile designs (in terms of pile type, depths, and method of installation) would be dependent upon the required working loads and should be undertaken in conjunction with a reputable, specialist, piling contractor; ideally with local experience.

If the hotspots of contamination are to remain on site (rather than excavation and removal) piling works in that area should adhere to the EA guidance on piling through contaminated soils, so as to prevent any mobilisation of contamination into underlying natural soils.

High Rise Mixed Use

The required loadings for high rise development have not been provided for this assessment. Made Ground soils are not considered to be a suitable founding stratum.

The target founding stratum will ideally be the Kimmeridge Clay Formation. It is envisaged that a pile design will be able to utilise both end bearing and shaft friction properties of the clay.

Detailed pile designs (in terms of pile type, depths, and method of installation) would be dependent upon the required working loads and should be undertaken in conjunction with a reputable, specialist, piling contractor; ideally with local experience.

7.6 Buried Concrete

In accordance with BRE Special Digest 1 2005 Third Edition, "Concrete in Aggressive Ground, and results of BRE BR 279 Chemical Analysis, below ground concrete should comply with Table C1 design sulphate class DS-2 and ACEC class AC-2. Design/mix of buried concrete should be undertaken in accordance with these classifications.

7.7 Other Development Considerations

7.7.1 Material Management

In the case of managing soil movements or earthworks (e.g. raising of the site level) it is important to also manage the intention to re-use materials, when a genuine need for the materials exists.

This will help avoid unnecessary additional regulation that can sometimes arise from a "waste management" perspective.

Providing materials are suitable for use, both chemically and geotechnically, and that re-use is certain, regulators should be able to agree that such materials do not need to enter the waste regulation system. A good approach to the management of this risk is via development of a Materials Management Plan (MMP) in line with the CL:AIRE Code of Practice, DoWCoP.

If certain materials do require regulation as waste exemptions have changed significantly in recent years and there are strict limitations on the quantity of soil that can be used and the thickness to which it can be deposited. The use of a permit could stigmatise the site for future conveyance. It is on this basis that we would recommend the development of the MMP route.

The MMP once drafted would be reviewed together with the approved site investigation and remediation documents by a Qualified Person, with their Declaration being issued to the Environment Agency; ultimately allowing the development to go ahead under a self regulation approach.

The development of an MMP would require a "Cut and Fill" model and a detailed materials management strategy to identify the sources of and destinations for site-won materials. It is envisaged that site formation levels will need to be raised by 0.5m, so formation levels should be designed to accommodate the required thickness for construction.

If removal of the localised contamination areas was undertaken, such materials would be waste and would require disposal at an appropriately permitted waste facility.

7.7.2 Local Contamination Areas and Excess Arisings

On the basis of the current information it is likely that if materials became excess to requirements, the majority of the Made Ground and natural soils would classify as "Inert" for landfill disposal. However a couple of zones have been identified that would likely classify as potentially hazardous.

An appropriate waste classification can only be undertaken on the material due to be disposed of via further chemical testing; which should be completed prior to making disposal arrangements. In all cases where excess soils require off-site disposal, the materials need to be managed under the appropriate waste legislation and consideration given to any remedial techniques that could be used to improve the soil.

For Inert Waste and Hazardous Waste disposal, an allowance will need to be made for adequate Waste Acceptance Criteria (WAC) testing with appropriate consideration of the additional time and cost associated with this.

7.7.3 Health, Safety & Environment

Whilst very few samples tested were found to have contamination at concentrations of regulatory concern, there remains a low potential for more-significantly impacted soils to be encountered; consideration should therefore be given to the level of PPE that should be provided to future site operatives.

A watching brief should be established to check for such as yet undiscovered impact.

All work on site should be conducted in accordance with appropriate Health and Safety guidance, with particular reference to HSG66 (HSE, 1991).

Care should be taken to minimise the risk of potentially contaminative incidents occurring during redevelopment. Good working practices should be adopted during construction works in order to minimise the risk of contamination occurring as a result of spillage or leakage of fuels, oils or chemicals stored or used at the site during re-development. All such materials should be sited on an impervious base within a bund and should be adequately secured. In particular, care should be taken to prevent fuel, oils or other mobile contamination sources from entering any surface water drains at the site.

Throughout all redevelopment works, due regard should be given to potential detrimental effects on the surroundings including noise, vibration, odour and dust.

7.7.4 Buried Structures / Obstructions

Three trial trenches (TT01 – TT03) were completed in order to investigate the presence of any remaining buried structures relating to the H-shaped accommodation blocks which have been demolished. All three trenches found evidence of buried concrete and brick related to the accommodation blocks. Hence, whilst these have been demolished above ground, the building foundations remain.

Before any development work within these areas takes places, these foundations may need to be removed and imported fill would be required to maintain existing site ground levels.

7.7.5 Potable Water Supply

There are currently no (fully adopted) national Standards for the protection of potable water supply pipes in potentially contaminated ground. However, the UKWIR has published guidance in this respect and site testing should be undertaken with due recognition of this guidance.

On the basis of the ground conditions encountered, it is unlikely that specific protection measures may be required for potable water supply for the development. It is recommended that consultation is undertaken with the local supplier to confirm this and a Water Pipeline Risk Assessment undertaken.

8 Conclusions and Recommendations

8.1 Conclusions

The investigation has provided supplementary data for the area of Northstowe known as Phase 2B. This report is based on the combined data of several reports, including the most recent.

The Phase 2B development area 'the Site' includes open space and limited hardstanding associated with the former RAF Oakington airfield and former barracks, and immigration centre. Three H-shaped buildings (accommodation blocks) were previously located on the western boundary of the Site and these have been demolished to ground level. A small building was located in the centre.

No specific point sources of contamination have been identified on site. Sampling has therefore been undertaken on a spatial coverage basis.

The ground investigation identified Made Ground deposits overlying the River Terrace Deposits and the cohesive Kimmeridge Clay Formation.

Concentrations above the appropriate SSVs for PAH compounds were identified within one sample of Made Ground from the Arcadis 2019 investigation, and two samples of Made Ground from the WSP 2007 investigation. The underlying natural deposits across the site have been found to be "non-contaminated". There are therefore considered to be isolated and localised areas of contamination.

The driving exposure pathways for the PAH compounds comprise direct exposure pathways including soil ingestion/inhalation and dermal contact. Therefore, in areas with buildings/external hard-standing or similar, no such potential pollution linkage would exist, and hence no specific remedial measures would be required. However, in the areas of soft landscaping and private garden areas the potential contamination linkage will need to be broken either by source removal (excavation and disposal) or by capping with a suitable thickness (likely to be 600mm) of uncontaminated cover soils. In general landscaping areas this thickness could likely be reduced. Clean cover soils in landscaped areas will also prevent new planting from being affected by phytotoxic conditions.

The localised contamination areas should be delineated. The impacted soils should then be removed and disposed of to an appropriate waste treatment facility. Once removed offsite, the soils left in-situ should be validated to confirm their suitability to remain onsite. If suitable, no further remedial measures are likely to be required for the proposed development.

Gas concentrations and flow rates recorded indicate that the site is classified as Characteristic Situation 1, very low risk, and as such no special protection measures are likely to be required to protect the proposed structures from hazardous ground gas subject to regulatory liaison.

Minor Selenium exceedances of the WQS have been recorded within the groundwater samples however these are deemed to be minor and are most likely representative of background concentrations. Therefore, the risk to Controlled Waters is low.

Adequate soakage potential is unlikely to be present across the site. Irrespective of this, the application of standard designs is likely to have limited potential due to the high groundwater level, and the resultant absence of an adequate unsaturated zone beneath soakaways.

Based on the available data, it is considered likely that perched groundwater will be encountered in shallow excavations (i.e. <2.0mbgl) at the site, especially during periods of wet weather. Appropriate groundwater control/dewatering provisions are likely to be required in excavations.

8.2 Recommendations

Contaminant sources have been identified in three locations and pollutant linkages are considered present. In order to satisfy and enable the discharge of the likely future relevant Planning Conditions (including pre-commencement conditions), it is recommended that the findings of this report (with respect to contamination) be formalised in a development-specific Remediation Statement (detailing the chosen remedial option) and be submitted to the Local Planning Authority for their approval once fixed development plans are available for the site.

While contamination of concern has been encountered infrequently on site during the investigation, during the redevelopment of the site a watching brief approach should be adopted. If any evidence of significant made ground or visual or olfactory evidence of contamination is encountered during excavation works, work in that area should be suspended and analysis should be undertaken to determine if the material can remain on site. Whilst the contractor should be responsible for the watching brief, inspection of any finds and sampling should be undertaken by an experienced Geo Environmental Engineer.

Whilst contamination levels are typically not elevated, it is recommended that construction workers use appropriate PPE during the redevelopment.

A number of foundation solutions are deemed viable, and these will need to respond to the variable geology encountered and the differing development proposals. In general trench or strip foundations are likely to be suitable in areas of the site where there has not been an increase in site levels. In general trench or strip foundations are not generally economical at depth of greater than 2mbgl.

Owing to the requirement for site levels to be raised by up to 0.5m over the site the re-use or importation of materials should be discussed with regulators and controlled under a Material Management Plan. Use of the CL:AIRE CoP or similar good practice is recommended to help secure maximum re-use opportunities for site soils, and minimise risk of materials requiring additional and potentially unnecessary regulation as waste.

Contaminated materials being excavated for off-site disposal and other materials excess to requirements and requiring disposal will be waste and will require management under appropriate waste regulations.

Early consultation with local authority highways is recommended to help inform selection of design CBR.

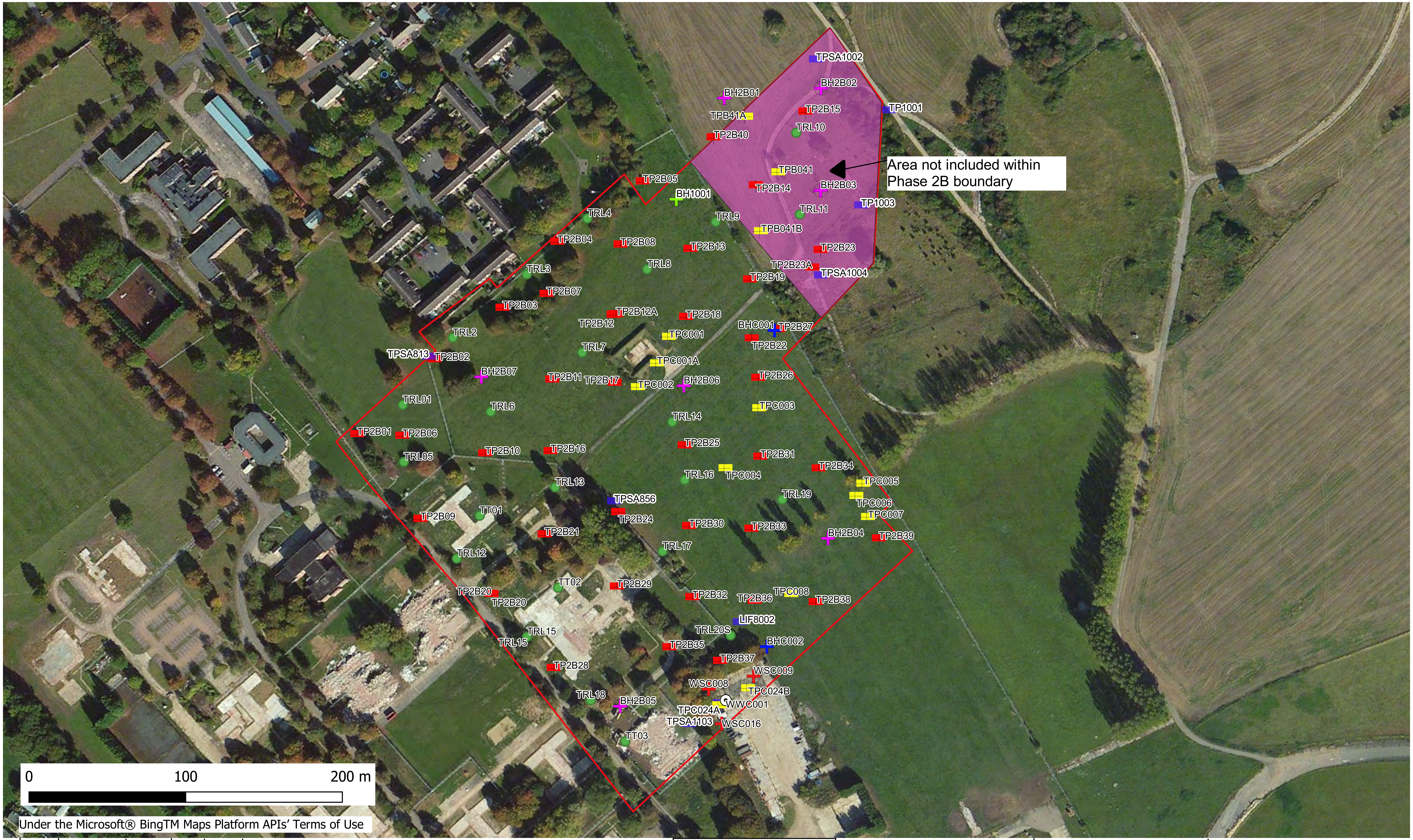
It is unlikely that specific protection measures will be required for potable water supply. It is recommended that consultation is undertaken with the local supplier to confirm this and a Water Pipeline Risk Assessment undertaken.

9 References

1. LQM / CIEH (2015) The LQM / CIEH S4ULs for Human Health Risk Assessment
2. Defra (2012) SP0101 Development of Category 4 Screening Levels Main Report
3. HSE (2011) EH40/2005 Workplace exposure limits ISBN 978 0 7176 6446 7
4. CIRIA C665. (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings
5. CIRIA C552 (2001) Contaminated land risk assessment. A guide to good practice
6. Arcadis, Northstowe Phase 2B – Factual Ground Investigation Report, October 2019
7. Arcadis, Northstowe Phase 2 – Factual Ground Investigation Report, 2017
8. WSP Environmental (UK) (2007) Northstowe Zone B - Interim Factual Report
9. WSP Environmental (UK) (2007) Northstowe Zone C - Interim Factual Report
10. Water Framework Directive (2000/60/EC)
11. The Water Supply (Water Quality) Regulations 2016 No 614
12. Environment Agency (2004) The Model Procedures for the Management of Land Contamination (CLR 11)
13. British Standard (BS8485(2009) +A1 Guidance) Assessing risk posed by hazardous gases to buildings

APPENDIX A

Exploratory Hole Plan



REV	Date	Description	Drawn	Check	Approved
1	19-11-2019	Groundwater Location Plan	[redacted]	[redacted]	[redacted]

Legand

WSP 2007
- Cable Percussive Boreholes
- Dynamic Sample
- Trial Pit
- Water Well

Arcadis 2017
- Cable Percussive Boreholes
- Trial Pit

Arcadis 2019
- Cable Percussive Boreholes
- Trial Pit
- TRL Probe
- 2B Red Line Boundary

N

Issued for Information

Design	[redacted]	19-11-2019		
Drawn	[redacted]	19-11-2019		
Checked	[redacted]	19-11-2019		
Approved	[redacted]	19-11-2019		
Scale	1:2200	Datum:	AOD	
Original Size	A3	Grid:	OS	
Suitability Code:		Project Number	10018973	

Client:

Homes England

Homes England

Northstowe Phase 2B

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PROJECT:

Northstowe Phase 2B

TITLE:

Exploratory Hole Location Plan

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Drawing Number: 10018973-ARC-XX-XX-DR-ZZ-0001-P1-EXPLORATORY HOLE LOCATION PLAN

APPENDIX B

Risk Assessment Terminology

CONCEPTUAL SITE MODEL

General

The aim of the initial conceptual model and risk assessment is to provide a preliminary identification of the risks to controlled waters, proposed future site users and the surrounding area posed by any contamination present on site. The assessment is based on identification of 'contaminant linkages', i.e. contaminant-pathway-receptor relationships. This approach accords with the guidance that accompanies Part 2A of the Environmental Protection Act of 1990 where land is considered to be contaminated when 'significant harm' is occurring, or where there is the 'significant possibility of significant harm' or where significant pollution of controlled waters is being, or is likely to be caused. In such cases the contaminant linkage itself is defined as being 'significant'.

A source of contamination and a pathway to receptors must be present for there to be a risk. The preliminary risk assessment assesses the strength of the link between the source, the pathway and the receptor.

Source - Contaminant that has potential to cause harm to environmental receptors. In a wider sense, sources can include particular ground conditions, for example the existence of redundant footings, which have the potential to impact on development proposals.

Pathway - The route by which the source is brought into contact with the receptor. This can include the transport of contamination via groundwater, wind-blown dust, vapours, excavation and deposition etc.

Receptor - Human beings, other living organisms, physical systems and built structures that could be affected by the source. A receptor will only be affected if a pathway from the source to the receptor is present. Groundwater and surface water systems can be considered as receptors in their own right as their quality is regulated by the statutory bodies, as well as being pathways for contaminant migration to other receptors.

ENVIRONMENTAL RISK ASSESSMENT

Qualitative Methodology

The risk assessment considers the potential sources, receptors and pathways identified in the Conceptual Site Model.

The environmental assessment has been undertaken with due regard to Contaminated Land Guidance Documents issued by the Department of the Environment Food and Rural Affairs (DEFRA). The Guidance requires a risk-based approach; with the potential environmental risk assessed qualitatively using the 'source-pathway-target' contaminant linkage concept contained in Part 2A of the Environment Protection Act. Unless specifically stated as relating to 'Contaminated Land' as defined in the Environmental Protection Act 1990 (as amended), references to 'contamination' and 'contaminants' relate in general terms to the presence of potentially hazardous substances, in, on or under the subject site.

Based on information presented in

- CIRIA C552 (2001) Contaminated Land Risk Assessment: A guide to good practice; and
- NHBC / EA/ CIEH (2008) R&D Publication 66: (Volume 1) Guidance for the Safe Development of Housing on Land Affected by Contamination
- DEFRA (2012) Environmental Protection Act 1990: Part 2A. Contaminated Land Statutory Guidance

Risk assessment considers the identified sources, the potential receptors and the pathways linking them together.

The designation of risk is based upon the consideration of both:

a. **the severity of the potential consequence -** this takes into account both the potential severity of the hazard and the sensitivity of the receptor
b. **the magnitude of probability** (i.e. likelihood) - this takes into account both the presence of the hazard and receptor and the integrity of the pathway

Severity (consequence) can be defined as the adverse effects (or harm) arising from a defined hazard, which impairs the quality of human health or the environment in the short or longer term. Definitions of different categories of severity are detailed in Table 1 below.

Probability can be defined as the chance of a particular event occurring in a given period of time. Definitions of different categories of probability are detailed in Table 2 below.

A contaminant linkage must first be established before tests for probability and consequence are applied. If there is no contaminant linkage then there is no potential risk.

Table 1 - Classification of Potential Consequence (Severity)

	Human Health	Controlled Water	Built Environment[1]	Ecosystems[2]
Severe	Short term (acute) risk to human health. Concentrations present likely to result in "significant harm" as defined by Part 2A.	Substantial pollution of sensitive water resources.	Catastrophic damage to buildings, structures or the environment, including building collapse.	Major damage to aquatic or other ecosystem, which is likely to result in a substantial adverse change or irreversible change in its functioning or harm to a species of special interest.
Medium	Chronic damage to human health. Concentrations present that could result in significant harm.	Pollution of sensitive water resources or small scale pollution of sensitive water resources	Significant damage to buildings, structures or the environment making it unsafe to occupy, or damage that may impair a scheduled ancient monument.	Significant damage to aquatic or other ecosystems or organism forming part of an ecosystem that could endanger the long term maintenance of a population at that location.
Mild	Slight short term health effects to humans. Exposure to human health unlikely to lead to significant harm.	Pollution to non-sensitive water resources	Minor damage to sensitive buildings, structures, services or the environment.	Minor or short lived damage to aquatic or other ecosystems.
Minor	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.)	Insubstantial pollution to non-sensitive water resources	Easily repairable effects of damage to buildings or structures	Harm (although not necessarily significant harm which may result in financial loss or expenditure to resolve e.g. loss of plants in a landscape scheme).

1. Property includes crops including timber, produce grown domestically (gardens or allotments for consumption), livestock, other owned or domesticated animals or wild animals which are subject to shooting or fishing rights. It also includes buildings, meaning any structure or erection, but does not include plant or machinery within a building or buried services.

2. Where ecological system effects relate to a Site of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Marine Nature Reserve (MNR), and areas of Special Protection for Birds, a "European site", or any habitat or site afforded protection under the Wildlife & Countryside Act 1981 and The Conservation of Habitats and Species Regulations 2010, i.e. candidate Special Areas of Conservation, potential Special Protection Areas and listed Ramsar sites.

Table 2 Classification of Probability

(Only applies if there is a possibility of a contaminant linkage being present)

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

Table 3 Classification of Risk

Once the severity and probability have been classified for a contaminant linkage they can be compared to produce a risk category from very high risk to very low risk as shown in the matrix below.

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

Table 4 Risk Classification Descriptions

Table 4 below describes the risk classifications.

Risk Term	Description
Very High Risk	There is a high probability that significant harm could arise to a designated receptor from an identified hazard at the site without appropriate remedial action or there is evidence that significant harm to a designated receptor is already occurring.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remedial action. Remediation works may be necessary in the short-term and are likely over the longer term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However it is either relatively unlikely that any such harm would be severe or if any harm were to occur it is more likely that such harm would be relatively mild. Some remediation work may be required in the longer term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely, at worst, that this harm if realised would normally be mild. Any subsequent remediation works are likely to be relatively limited.
Very Low Risk	It is a low possibility that harm could arise to a receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.

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MEMO

SUBJECT
Northstowe Phase 3B: Hydrogeological assessment of groundwater levels due to a reduction in recharge

DATE
17/05/2019

DEPARTMENT
Hydrogeology, Part of SER

COPIES TO

TO
[redacted]

OUR REF
10019646-ARC-XX-XX-VS-ZZ-P1-SEEPW

PROJECT NUMBER
10019646

FROM
[redacted];
[redacted]@arcadis.com

1. Introduction

This memorandum describes an assessment of the change in groundwater levels that may occur at the Northstowe Phase 3 site (see Figure 1 for location) because of interception of rainfall by the surface water drainage scheme and subsequent reduction in the amount of groundwater recharge.

The following information sources have been used in the assessment:

- Ordnance Survey Terrain data (Ordnance Survey, 2018);
- Web Map Services (WMS) layers for British Geological Survey (BGS) superficial and bedrock mapping (British Geological Survey, 2019)
- Interim Factual Report: Northstowe, Cambridgeshire, Zone B. English Partnerships & Gallagher Longstanton Ltd, December 2007 (English Partnerships & Gallagher Longstanton Ltd., 2007); and
- Northstowe Phase 2 Groundwater Levels, Arcadis, 2017., UA008426-ARC-XX-XX-VS-P1.3-GWLevels (Arcadis (c), 2018).

MEMO

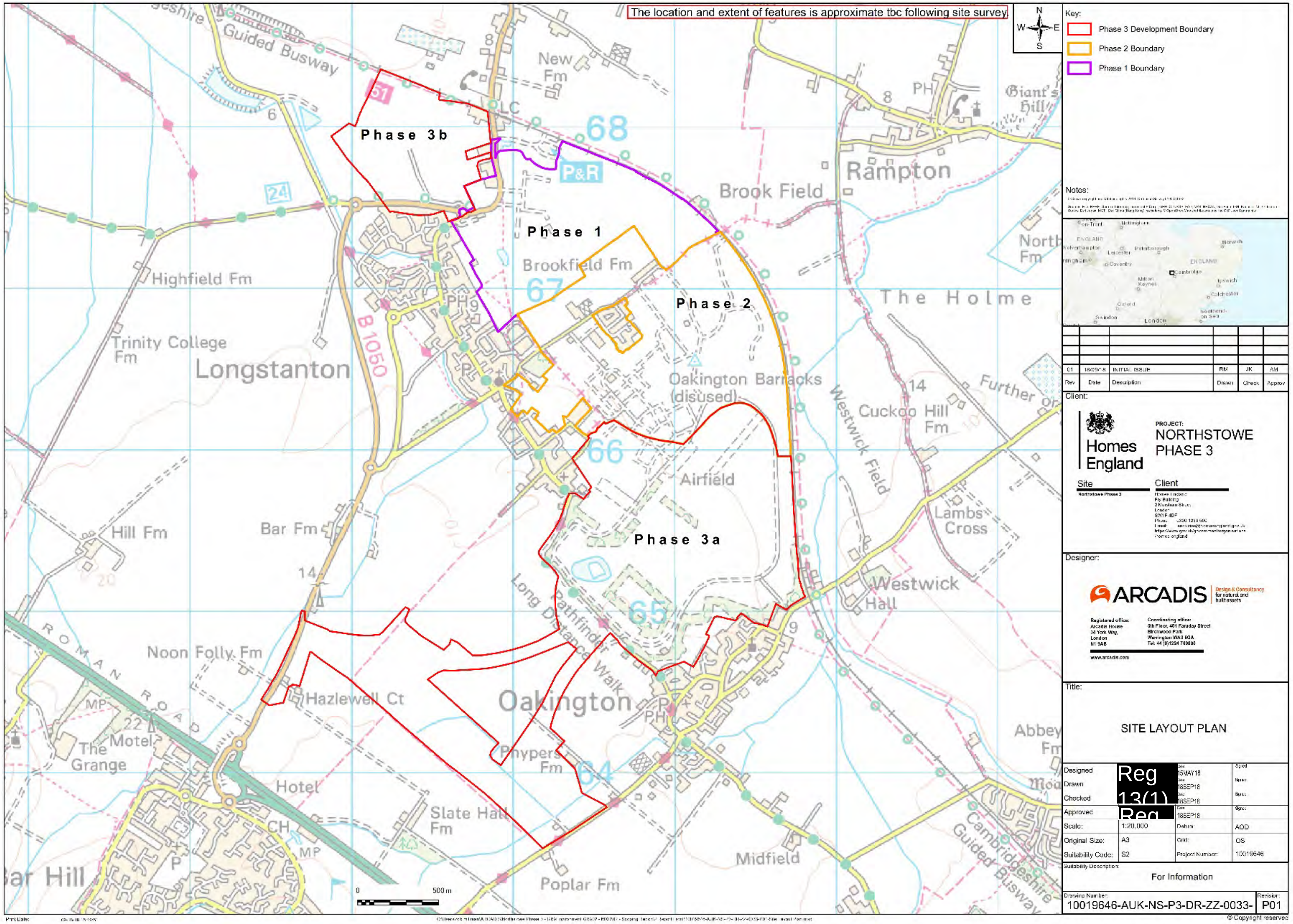

Figure 1 Site location plan

2. Hydrogeology

The materials and geology present at the Northstowe Phase 3 site as described in the Interim Factual Report for Zone B (English Partnerships & Gallagher Longstanton Ltd., 2007) is analogous to that of Northstowe Phase 2, which has been summarised previously by Arcadis in 2017). Essentially, a non-extensive layer of River Terrace Deposits (comprised of sandy clays, clays and gravels) that overlie bedrock of the Kimmeridge Clay Formation and Woburn Sands Formation in the south east. The thickness of the River Terrace Deposits is variable (up to 7 m thick), though it is absent along the southern edge of the site and towards Oakington. East of the site, the township of Oakington is situated on outcrop Woburn Sands Formation.

Figure 2 provides a plan showing the geology, groundwater levels, groundwater flow direction and borehole locations at Northstowe Phase 3. The topography of the area rises from the north-east towards the south-west, however the Military Lake is situated in a localised low point. Groundwater monitoring has shown that the groundwater level at Northstowe Phase 3 is at its highest elevation in the centre of the site around BHB040 and in proximity (230 m north-east) of the Military Lake. This area forms an apparent groundwater mound with groundwater flowing away in all directions away from it towards the perimeter drains.

The Military Lake being situated in a topographic low has no superficial geological cover and lies immediately on the Kimmeridge Clay Formation. Groundwater levels around the lake suggest that groundwater flows towards it and are likely to provide some support to the lake water level. Anecdotal reports from site personnel also indicate that it overflows to the east after periods of ‘higher’ rainfall.

The hydraulic conductivity of the River Terrace Deposits and Kimmeridge Clay has been previously described by at between 8 m/d to 12 m/d and 0.1 m/d to 16 m/d, respectively (Arcadis (c), 2018).

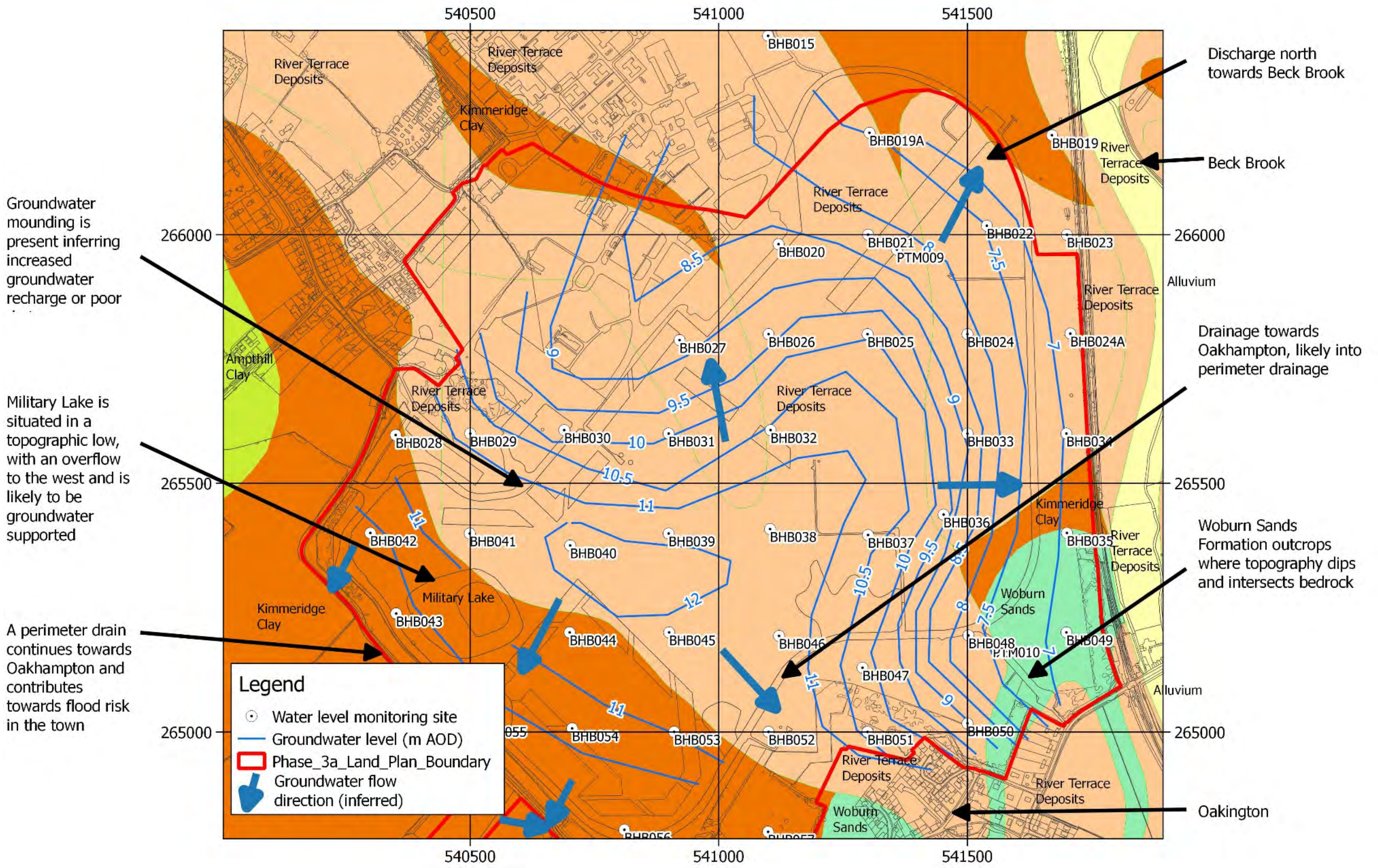

Figure 2 Hydrogeology at Northstowe Phase 2

3. Groundwater modelling

3.1 Model cross sections

Two cross sections have been produced using groundwater modelling software (SEEPW). The location of the cross sections are shown on Figure 3, which are approximately perpendicular to each other. The cross section locations have been chosen to show the predicted change in the groundwater level towards the Military Lake and towards Oakington.

The hydraulic conductivity applied in the models is 1.1×10^{-4} m/s (equivalent to 9.5 m/d) for the River Terrace Deposits and 1×10^{-5} m/s (equivalent to 0.9 m/d) for the Kimmeridge Clay Formation. A fully saturated model has been assumed for simplicity (although this will over-estimate seepage rates and is therefore conservative). These values are based on site investigation data and were reported in the hydrogeological assessment for Phase 2 (Arcadis (c), 2018).

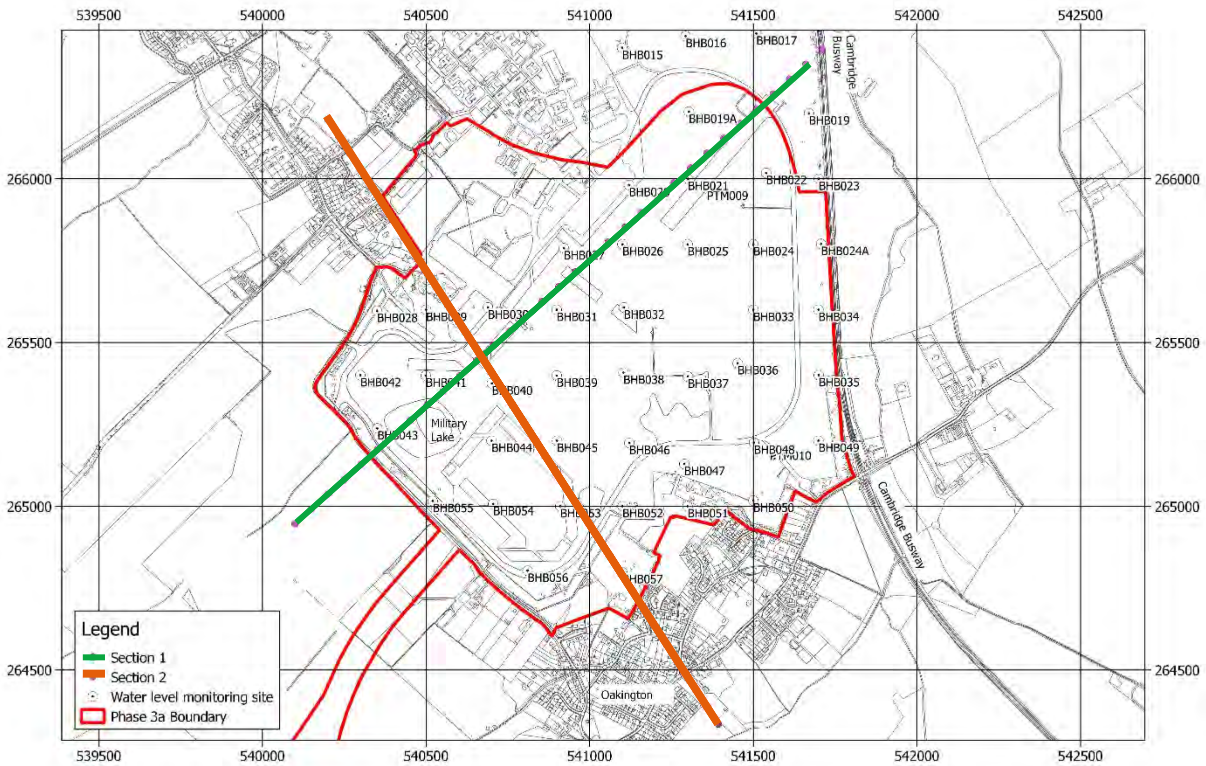

Figure 3 Cross section locations

3.1.1 Model Section 1

Model Section 1 (Figure 4) is orientated north-west to the south-east, with the purpose to assess potential groundwater level change effects caused by a reduction in recharge after construction of hardstanding at the site. The cross section is based on our interpretation of geological mapping and site derived borehole information. The cross section shows where the River Terrace Deposits form the ground on Northstowe Phase 3 and then pinch out along the south-eastern edge of the site. The geology directly underlying Oakington is the Woburn Sands Formation, which stratigraphically overlies the Kimmeridge Clay Formation.

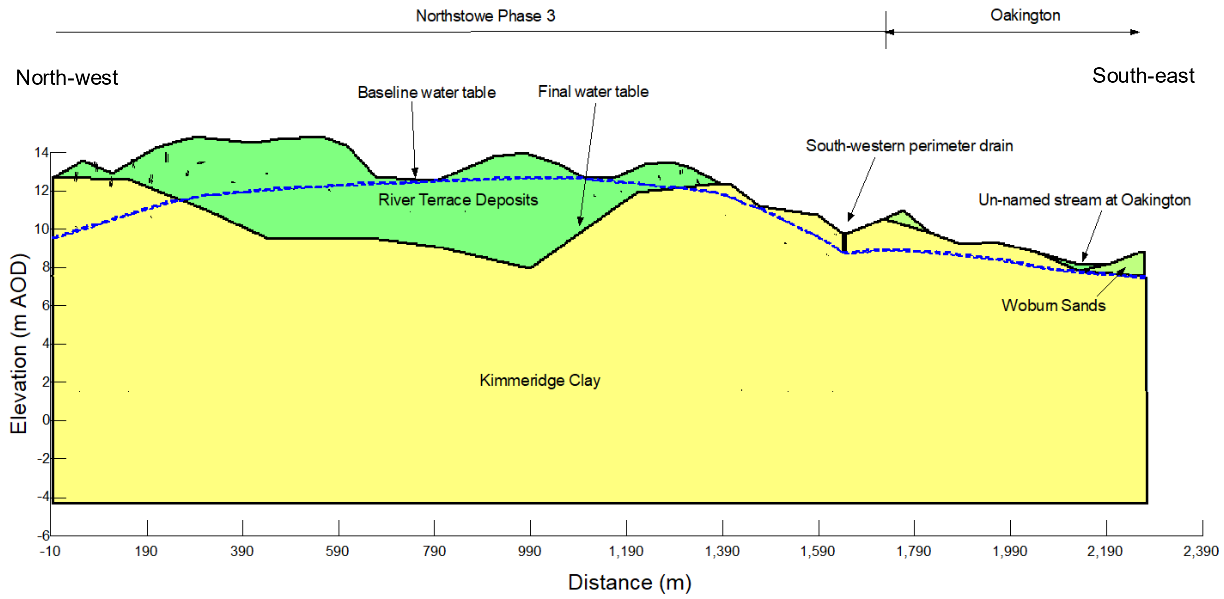

Figure 4 Model Section 1

3.1.2 Model Section 2

Model Section 2, shown on Figure 5, is orientated north-east to south-west, extending from the Cambridge Busway to the Northstowe Phase 3 south-western perimeter drain. The purpose of the model is to assess the potential change in groundwater levels beneath the Military Lake following development, and in turn whether there is any reduction in groundwater support provided to the lake. The cross section shows where the Kimmeridge Cay Formation dips from southwest to northeast and where the bedrock is overlain by River Terrace Deposits northeast of the lake. The topographic profile of the lake shows where it connects with groundwater (dashed blue line).

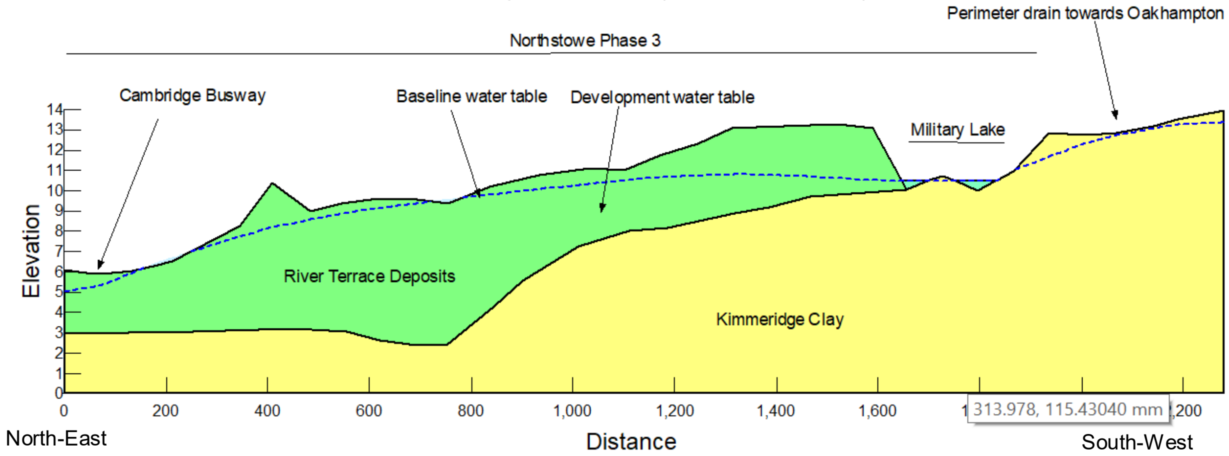

Figure 5 Model Section 2

3.2 Model scenarios

Two scenarios have been considered for both model cross-sections for pre- and post- development stages of Northstowe Phase 3, in which the amount of recharge is varied as follows:

- Pre-development condition, the baseline recharge rate is assumed to be 20% of average total annual rainfall for Cambridge between 1981 and 2010 (20% of 568 mm/year (Metoffice, 2019)); and

- Post-development condition, in which 20% of the baseline recharge rate (see previous bullet) is applied in areas that are proposed to be covered by the Northstowe Phase 3 (the remaining, undeveloped, areas have recharge applied as for the pre-development model).

3.3 Model results

3.3.1 Model Section 1

Figure 6 shows the change in the groundwater level between the 'pre-development' and 'post-development' model output. As a result of the potential reduction in recharge over the Northstowe Phase 3 area, groundwater levels are predicted to lower by up to 2.5 m across the site. However, there is no predicted change in groundwater level beneath the Oakington area, as groundwater levels between the site boundary and Oakington are controlled by existing perimeter drains. The result of the post-development model indicates that groundwater flows within the perimeter drains may be lower than current (pre-development) flows.

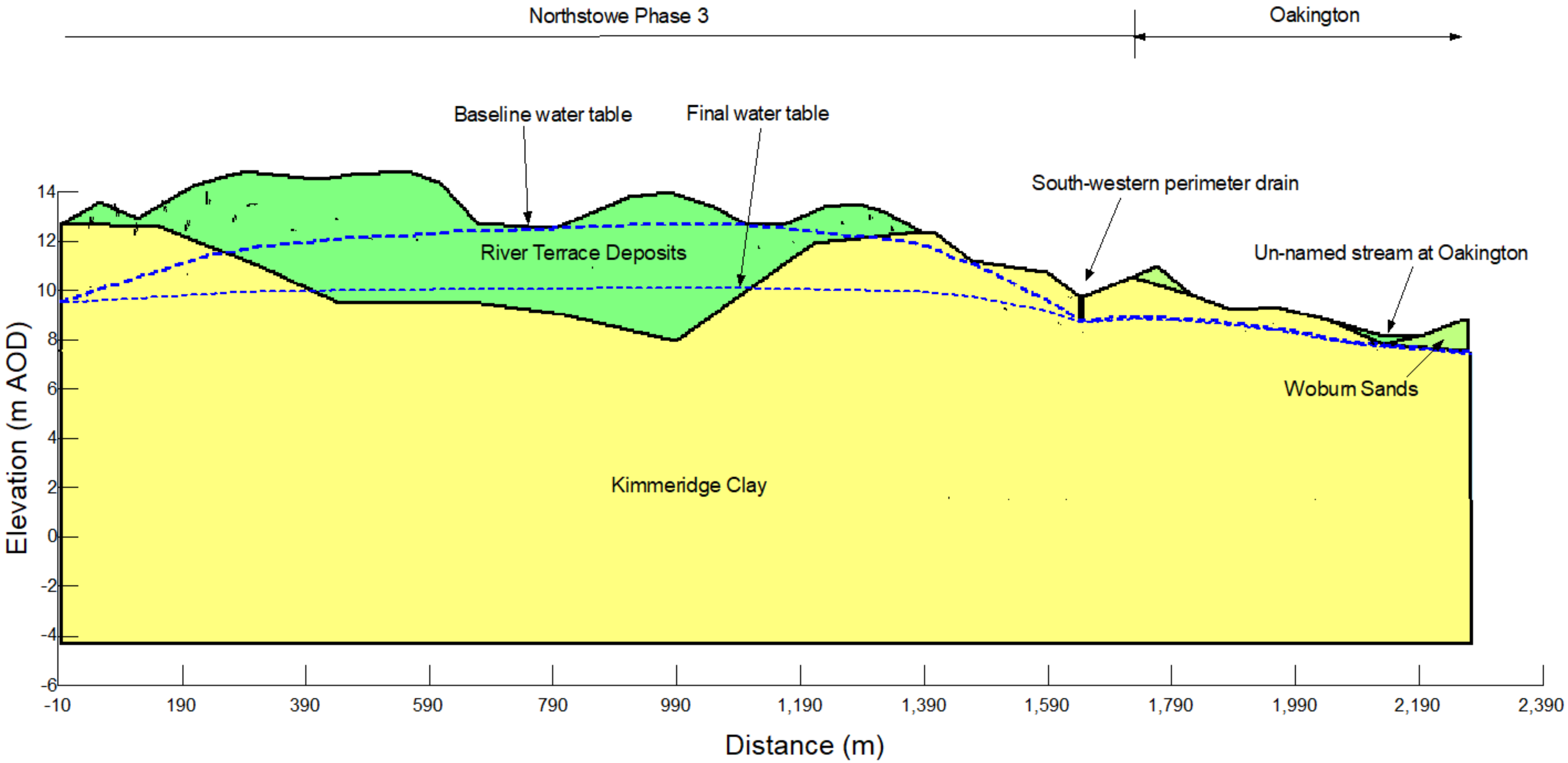

Figure 6 Results of the 'pre-development and 'post-development' model output for Section 1

3.3.2 Model Section 2

Figure 7 shows the results of the ‘pre-development’ and ‘post-development’ model output for Section 2. As a result of the potential reduction in recharge over the Northstowe Phase 3 area groundwater levels are predicted to lower by up to 2.5 m across the site.

Groundwater levels beneath the Military Lake do not appear to be affected, however the groundwater contribution (inflow) to the Military pond was calculated using the model to fully appreciate any effects. In the pre-development condition the groundwater contribution to the pond was calculated to be 0.29 m^3/d, which reduces to 0.01 m^3/d in the post-development condition.

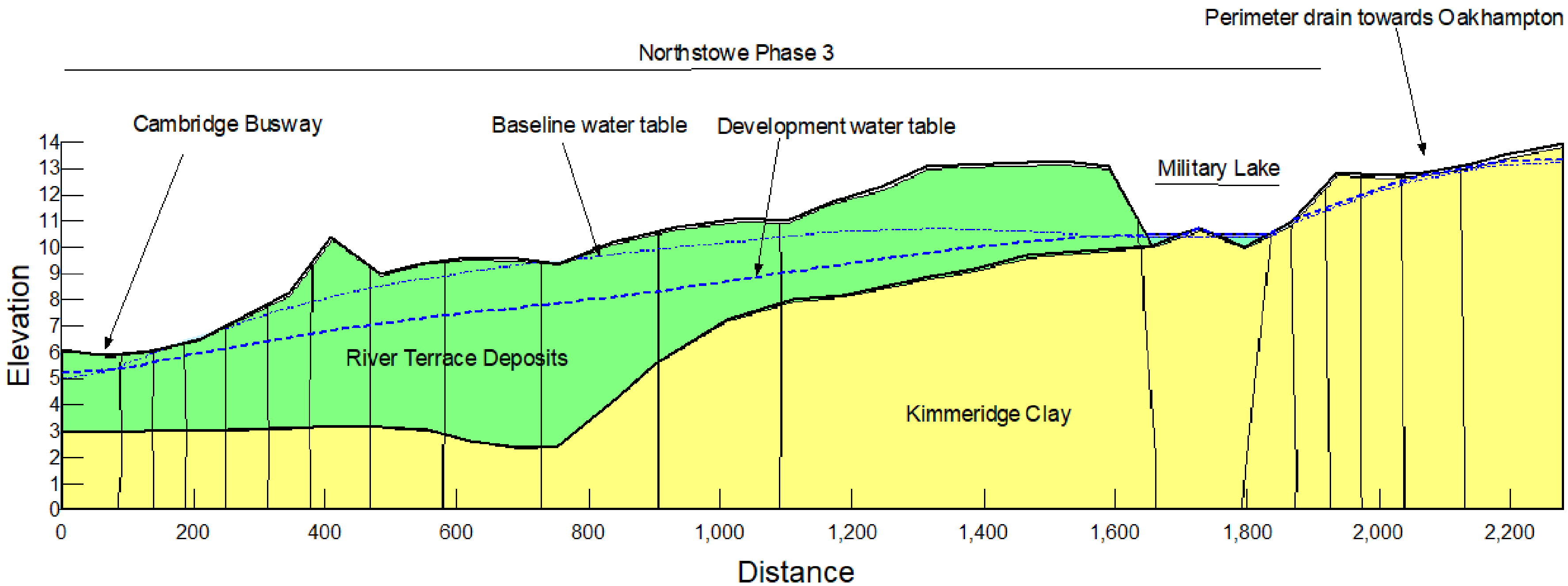

Figure 7 Results of the 'pre-development' and 'post-development' model output for Section 2

4. Conclusions

Development of Northstowe Phase 3 would likely lead to a reduction in recharge to underlying groundwater that may in turn affect water features in the surrounding area. Two SEEPW model cross sections were therefore produced to assess the effects of development. The model outcomes are discussed, as follows:

- In general, the modelled reduction in recharge is predicted to lower the groundwater level beneath the development by up to 2.5 m;
- A change in groundwater level was not predicted to occur east of the Northstowe Phase 3 site perimeter drainage towards Oakington;
- Modelling of the groundwater contribution (inflow) to the Military Lake as a result of groundwater lowering post-development indicates a reduction from 0.29 m^3/d (pre-development) to 0.01 m^3/d (post-development). Such a change could potentially lead to a significant reduction in lake levels during the summer months.
- The reduction in groundwater levels in the River Terrace Deposits and Kimmeridge Clay and reduction in the groundwater contribution to the Military Lake will in turn likely lead to a reduction in groundwater discharging into the perimeter drains along the southern boundary of the site.

As this simple model is in 2-dimensions, it does not include the full complexity of the geology, groundwater flow conditions and drainage of the site and so the calibration and accuracy of the model is limited to along the cross section line only.

NORTHSTOWE
Phase 3A
Outline Planning Application
Flood Risk Assessment and Drainage Strategy
April 2020

Homes England

NORTHSTOWE PHASE 3A

Flood Risk Assessment and Drainage Strategy

APRIL 2020

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1 Introduction

1.1 Overview

1.1.1 Arcadis Consulting (UK) Ltd (Arcadis) has been commissioned by Homes England to prepare a Flood Risk Assessment (FRA) and foul and surface water drainage strategy to support the Outline Planning Application for Phase 3A of Northstowe new town in Cambridgeshire. Northstowe forms part of the UK Government's nationwide initiative to deliver new housing across the country. Northstowe is part of NHS England's 'Healthy New Town' programme.

1.1.2 The Application Site lies within the administrative area of South Cambridgeshire District Council (SCDC).

1.1.3 The proposed Development is for the construction and operation of the majority of the third phase of the Northstowe new town and is referred to hereafter as 'Northstowe Phase 3A'. Please see the submitted application forms for the full description of development. Provision is also made within the application boundary and as shown on the Parameter Plan 02 (Drawing 5709-OPA-3A-02 V1) for the delivery of a Southern Access Road East (SARE) connecting Phase 3A to Dry Drayton Road.

1.1.4 This Flood Risk Assessment (FRA) and Foul and Surface Water Drainage Strategy has been prepared to support the outline planning application in accordance with the National Planning Policy Framework (NPPF) (MGHLG, 2019) and the associated Flood Risk and Coastal Change guidance (Planning Practice Guidance - PPG) (Department for Communities and Local Government, 2014) and the local planning policy and guidance. The Scope of this study is to provide an assessment of all potential sources of flooding and where required, outline mitigation options and proposals.

1.1.5 This report establishes the key principles for the strategy of flood mitigation and for the management of surface water and foul drainage for the proposed Development in line with national and local planning policy.

1.1.6 The report also provides the technical information required to address the Exception Test in accordance with NPPF and PPG, in as much as it is required for those areas of the site within Flood Zone 3 and constituting essential infrastructure or more vulnerable development.

1.1.7 The effects of residual flood risk on the development proposals are also reported and addressed through assessments of exceedance events or failure of any proposed mitigation measures. In this way the proposed flood management and drainage strategies are shown to be resilient.

2 Site Location and Description

2.1 Northstowe

Location

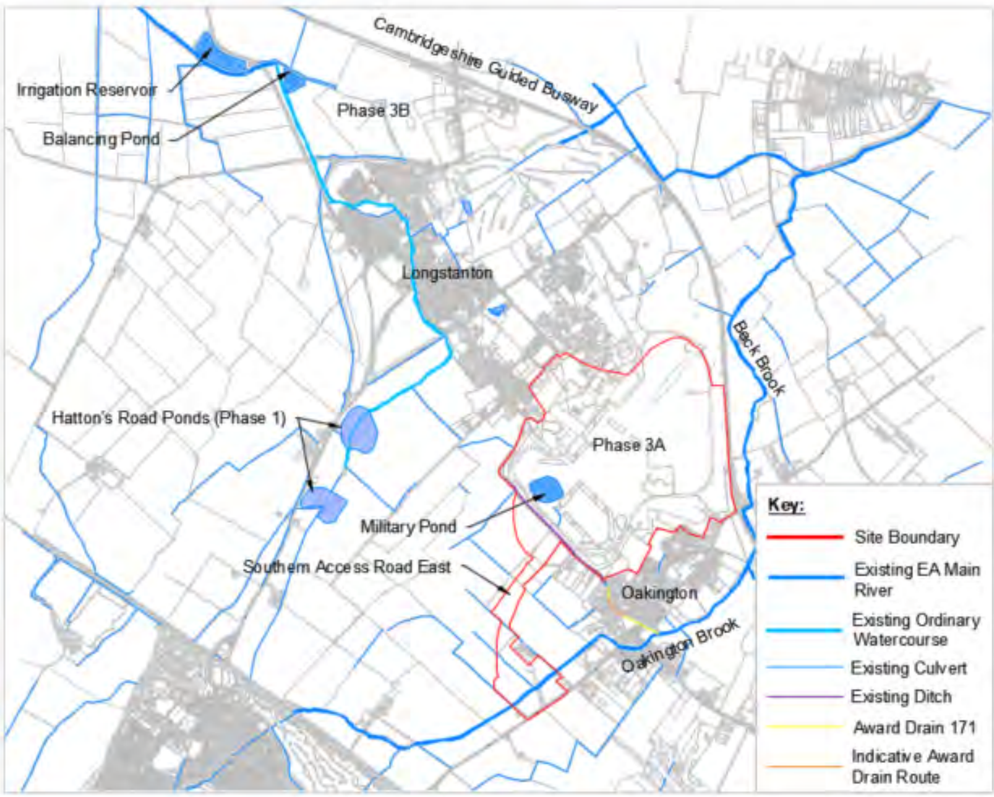
2.1.1 Northstowe forms part of the UK government's nationwide initiative to deliver new housing across the country. Northstowe is part of NHS England's 'Healthy New Town' programme. The site allocation is to deliver 10,000 dwellings in the vicinity of Longstanton and Oakington, to the north of Cambridge.

2.1.2 The Phase 3A development proposals lie to the south of Phases 1 and 2 (which already have planning consent), to the north of Oakington and is bounded on the east by the Cambridge Guided busway and on the west by Longstanton Road.

2.1.3 The Application Site of the proposed Development comprises approximately 210ha of land that forms the southern part of former Oakington airfield and barracks (then owned by the Ministry of Defence) and is bounded to the north largely by Northstowe Phase 2, the Cambridgeshire Guided Busway (CGB) line to the east, the village of Oakington to the south and arable farmland to the west. Of the 210ha of land, approximately 180ha comprises the former Oakington airfield and barracks, with land to the south east providing for the Southern Access Road East, connecting Phase 3A to Dry Drayton Road near to the Oakington Business Park.

2.1.4 The location of the Application Site is shown in the wider context in ***Figure 1*** Longstanton Road also runs through the site which connects Longstanton to Oakington. Award Drain 171 runs along the west side of Longstanton Road and into Oakington Brook to the south.

Figure 1: Site Location Map and Key Features



2.1.5 To the west of the site lies the B1050 which runs in a north-south alignment and connects the A14 approximately 500m south of the site. The Longstanton Brook also runs parallel to the B1050, flowing from Bar Hill, to the south, towards and through Longstanton eventually connecting into Swavesey Drain to the north. The village of Longstanton also borders the north-western side of the site which also runs parallel to Phase 1 and 2.

Background

2.1.6 This report supports the outline planning application for the Phase 3A development located to the south of the existing Phase 2 development. Northstowe Phase 1 was granted outline planning permission in April 2014 for up to 1,500 dwellings and is currently being built out by five housing developers. The first approximately 530 homes were occupied as of January 2020.

2.1.7 Northstowe Phase 2 was granted outline planning permission in January 2017 for ‘up to’ a further 3,500 homes. The programmed start on site occurred in spring 2018 (Infrastructure) and house building is planned for 2020. The secondary school opened in October 2019. Phase 2 includes a ‘town centre’ comprising up to retail, commercial and other destination non-residential space.

2.1.8 The infrastructure for the Phase 2 development extends into the Northstowe Phase 3A site, including the delivery of the primary road connecting south to the Southern Access Road West (SARW), and the Busway linking through Northstowe from the Cambridgeshire Guided Busway (CGB).

2.2 Site Description

2.2.1 The majority of the Northstowe Phase 3A Application Site is a former airfield and associated hardstanding, surrounded by grassland and woodland, however approximately 29ha of the Application Site is a corridor across of existing arable land between Longstanton Road and Dry Drayton Road to the South.

2.2.2 The land is currently occupied by the former military airfield and comprises of a mixture of open grassland, arable land and fields interspersed woodland belt, groups of trees, small watercourses and the ‘Military Lake’, highlighted in ***Figure 1*****.**

2.2.3 The Northstowe Phase 2 access road (referred to as Southern Access Road West (SARW)) is located to the west of the Northstowe Phase 3A Application Site, with a connecting central spine road running through the Northstowe Phase 3A Application Site and up towards Phase 2. This is currently being constructed, along with the Busway link to the CGB to the east.

2.2.4 Part of the former airfield perimeter road within Northstowe Phase 3A is currently being used as a haul road as part of the Phase 2 planning permission, providing access between the Phase 2 and SARW works area. Towards the northern end of the site, there are large hardstanding areas associated with the former airfield taxiway and runway. The southern narrower portion of the site where the Southern Access Road East is proposed, is currently occupied by arable land in which the Oakington Brook passes through in a north-easterly direction.

Development Proposals

2.2.5 Please see the submitted Planning Statement and Design and Access Statement for full scheme details. The description of development is:

2.2.6 *‘Outline planning application for the development of Northstowe Phase 3A for up to 4,000 homes, two primary schools, a local centre (including employment, community, retail and associated services, food and drink, community, leisure, residential uses and other accommodation), secondary mixed use zones (including employment, community, retail and associated services, food and drink, community, leisure, residential uses), open space and landscaped areas, sports pitches, associated engineering and infrastructure works, including the retention of the existing military lake and creation of a new lake, with details of appearance, landscaping, layout, scale and access reserved. Application is accompanied by an Environmental Statement and involves works to/affecting existing Public Rights of Way’.*

Site Topography

2.2.7 Aerial Survey has been obtained for the proposed Development site from Total Surveys Ltd (JJG-TS-11011-1-3D-RevA, dated 26/07/2004)), and from this it can be seen that the Application Site topography is crested, to form two distinct catchment areas as shown in ***Figure 2.*** Levels in the drawing are expressed in metres AOD.

2.2.8 Topographical survey has been obtained for key boundaries within the site from Greenhatch Group (9451J_T-Rev 1, 13/12/18) to confirm topography around the edges including:

- Southern Boundary adjacent to Oakington
- Longstanton Road
- Dry Drayton Road
- Military Lake

2.2.9 These surveys confirm that there is a high point in the centre of the site where levels range from 14.14m AOD to 17.47m AOD. Ground levels across the site then slope downwards:

- towards the north and east to levels of 7.7m AOD on the eastern edge of the site adjacent to the Cambridgeshire Guided Busway. This is broadly towards the existing Phase 2 Waterpark and outfall to Beck Brook.
- towards the south western corner of the site to a level of 9.4m AOD adjacent to Longstanton Road and Award Drain 171 which runs along the eastern edge of Longstanton Road at this location.

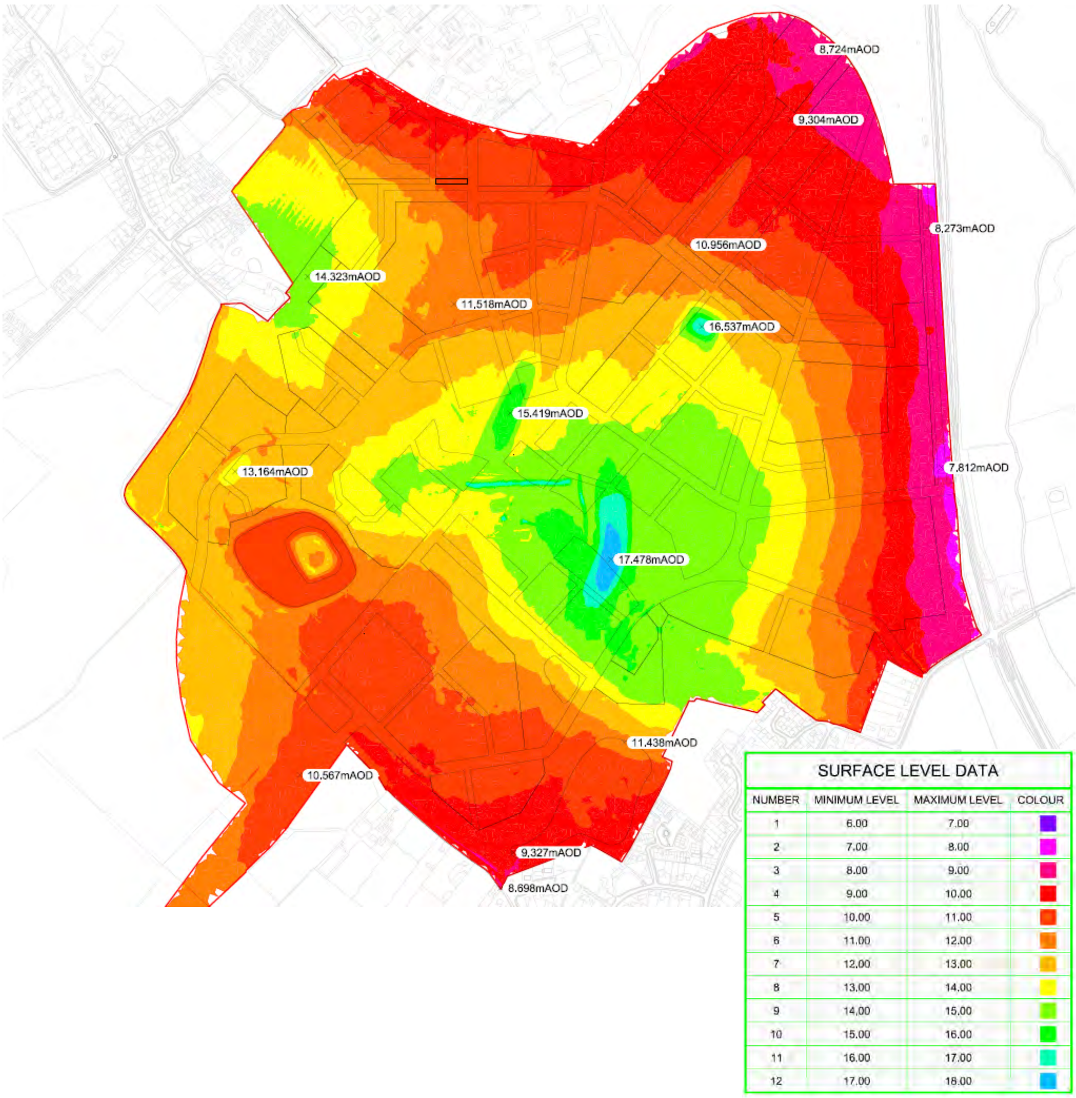


Figure 2: Existing Topography

2.2.10 The land between Longstanton Road and Dry Drayton Road is relatively flat, with levels along Longstanton Road of 11m AOD and levels on Dry Drayton Road of 11m AOD. Levels increase along the route to circa 12m AOD and there are several field ditches that cross this area, as well as Oakington Brook with flows from west to east and is located slightly north of Dry Drayton Road.

2.2.11 The aerial survey and topographical survey are included within ***Appendix B.***

Watercourses and Waterbodies

2.2.12 There are several watercourses and waterbodies within and in the vicinity of the Application Site as indicated in *Error! Reference source not found.*

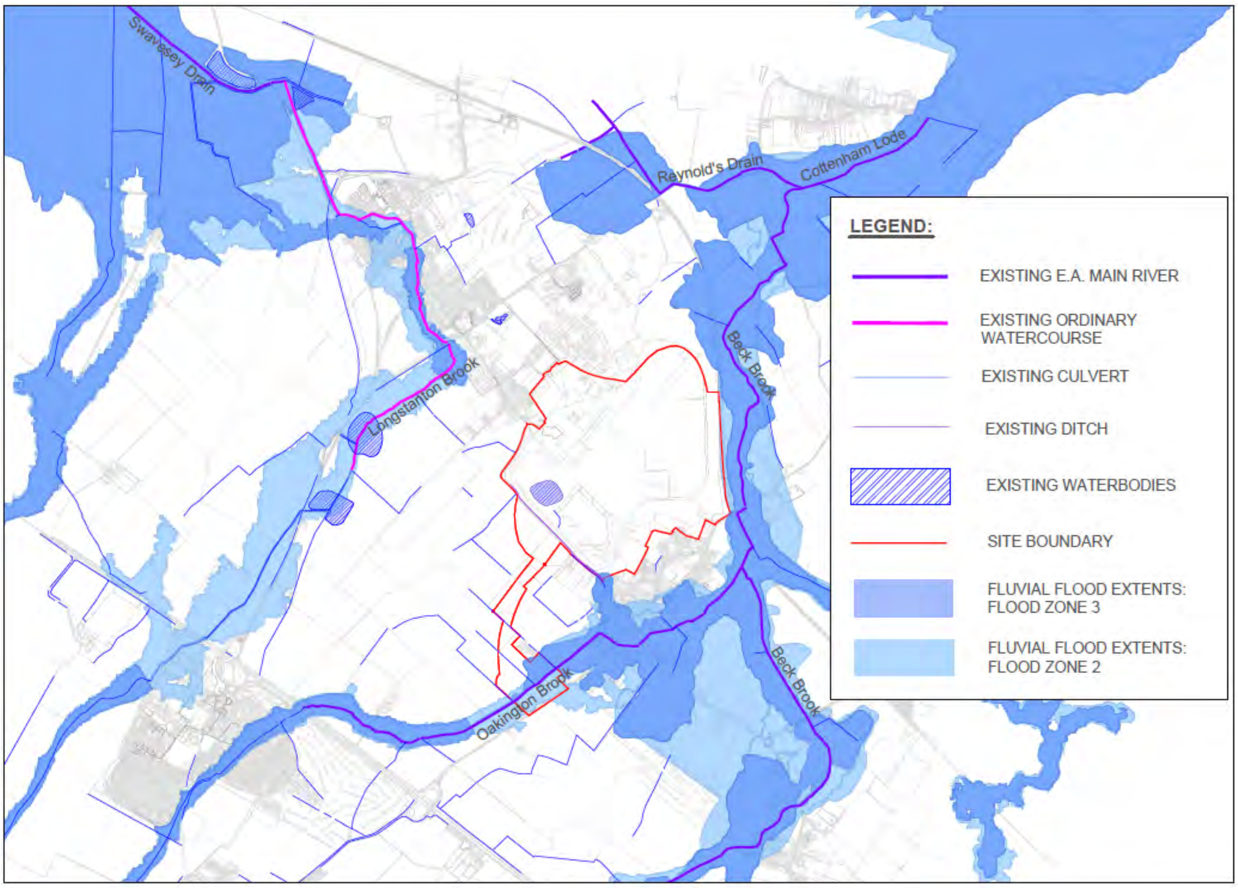


Figure 3: Watercourses and Waterbodies

2.2.13 The key water bodies and features are listed below according to their designation and/or the body responsible for them and discussed further within the Site-Specific Flood Risk Assessment in ***Chapter 4***.

2.2.14 Riparian Ownership

- Channels within the Application Site – there are a series of small channels throughout the site that flow intermittently north east and south west respectively.
- Field drainage – a series of field drains run from north to south through arable fields and across the area of the Application Site between Longstanton Road and Dry Drayton Road.
- Military Lake – is a waterbody within the Application Site that was built as part of the airfield, this is locally fed through surface water runoff from the adjacent area.
- Phase 2 Waterpark – surface water attenuation ponds constructed as part of the Phase 2 development proposals – these are predominantly constructed and are located to the north east of Northstowe Phase 3A, adjacent to the CGB.

- Waterbodies located within Oakington – surface and groundwater fed features.

2.2.15 Ordinary Watercourses (Riparian Ownership)

- Longstanton Drain is located to the west of the Application Site, running north towards Swavesey Drain, parallel to the B1050. This watercourse and the associated Hatton ponds (incorporated as part of the Northstowe Phase 1 development to reduce flood risk for Longstanton) lie outside of the catchment for this site and will not be affected by the proposed Development.

2.2.16 South Cambridgeshire District Council (SCDC)

- Award Drain 171 – located adjacent to Longstanton Road within the Phase 3A site. This serves a slightly wider catchment than Northstowe Phase 3A and flows to the south, towards Oakington and connects through a series of ditch and culvert sections to the Oakington Brook to the south of the site. This watercourse is the responsibility of SCDC.[1]

2.2.17 Environment Agency (EA) Main River

- Beck Brook – located to the east of the Cambridgeshire Guided Busway, to the east of the Application Site. Phase 2 discharges into this Main River (responsibility of the EA) through an existing drainage channel under the CGB. Beck Brook flows towards the north east and into Cottenham Lode to the north.
- Oakington Brook – flows from west to east parallel to Dry Drayton Road, and then through Oakington, connecting to Beck Brook to the east of the CGB.

2.3 Ground Conditions

Soils and Geology

2.3.1 Several sources of information are available for undertaking desk studies of the underlying ground conditions including freely available Soilscape Maps and BGS mapping.

2.3.2 A desk-based review indicates that the majority of the site is underlain by impeded drainage soils, with a small area of the site towards the CGB being categorised as freely draining lime rich soils.

2.3.3 This is supported by the intrusive ground investigations undertaken by WSP in 2007 and by Arcadis in 2018, as summarised within the Arcadis Factual and Interpretive reports (2019) which set out that the geology of the Phase 3A site is underlain by superficial River Terrace deposits. These deposits form a north west to south east line across the Phase 3A area with no superficial deposits present within the south west corner of the site, along Longstanton Road and the southern boundary of the site. The solid bedrock geology is the Kimmeridge Clay Formation (Mudstone).

2.3.4 Ground conditions therefore are such that infiltration drainage is not considered to be feasible, at the south western corner of the site.

2.3.5 However, there may be opportunities for some ground water recharge and this would be considered, as part of the detailed design.

Hydrogeology

2.3.6 A review of the ground water levels across the site, as set out within the ES Chapter 10:Ground Conditions, Contamination and Hydrogeology**,** show that the ground water catchments split in a similar fashion to the topography, with ground water generally flowing both to the south and to the east.

2.3.7 Average groundwater levels from data collected have been mapped along with indicators of the direction of groundwater flow in ***Figure 4*** below. A groundwater divide is present in the Northstowe Phase 3A area, that follows the topographical catchment split shown from the north-west through to the south-east of the site. There are gravel River Terrace deposits on the site, which are quite thick at

[1] Award drains are watercourses maintained by a Local Authority and not the Environment Agency or Internal Drainage Board. Award watercourses are any watercourses for which responsibility has been transferred to the Council under Enclosure Acts.

the highest point in the centre of the site and have an elevated water table most likely supported by recharge infiltration given the strata type.

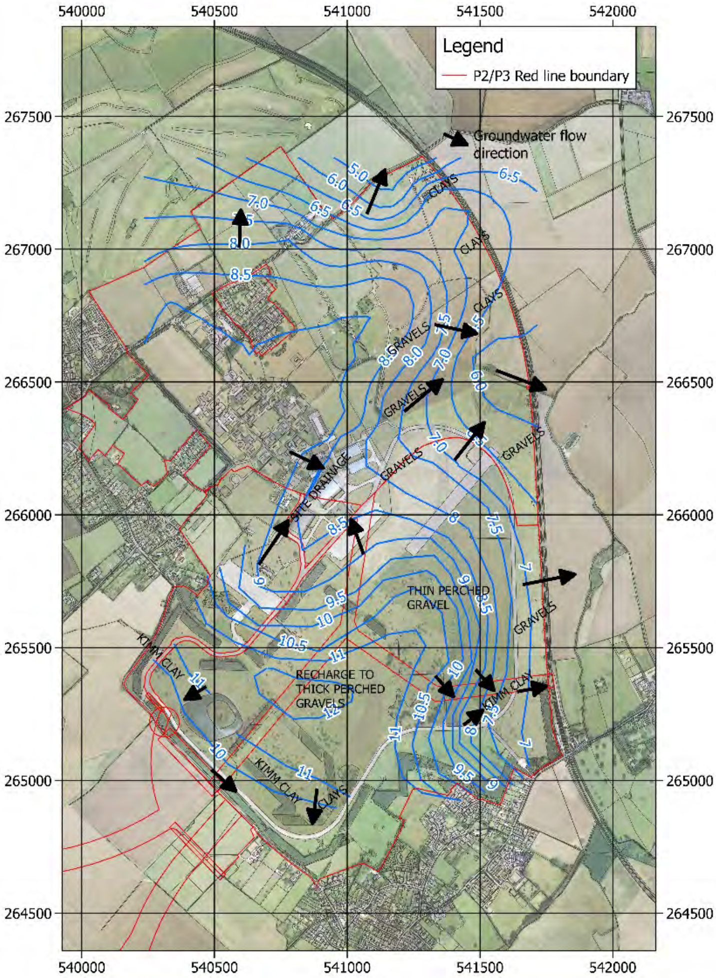


Figure 4: Average Groundwater Levels and Direction of Groundwater

2.3.8 Generally, the gravel layers across the site are relatively thin bands which surface sporadically across the site.

2.3.9 Where the site slopes towards the south, and towards Oakington, the geology is the Kimmeridge Clay Formation (Mudstone), and therefore groundwater does not contribute substantially to the Military Lake water levels (which is predominantly surface water fed), but do flow towards Oakington to be intercepted by perimeter drains within the site.

2.3.10 As such it can be concluded that whilst both groundwater and surface water from the southern part of the Application Site tends to flow to the south towards Oakington and ultimately contributes to flows in Oakington Brook, as high groundwater will tend to be intercepted and drain into surface water systems.

3 Policy Context

3.1 National Policy

3.1.1 The NPPF (2019) and its accompanying Practice Guidance set out Government planning policy for England. The principal aim of the NPPF is to contribute to the achievement of sustainable development. This includes ensuring that flood risk is taken into account at all stages of the planning process, avoiding inappropriate development in areas at risk of flooding and directing development away from those areas where risks are highest. Where development is necessary in areas at risk of flooding, the NPPF aims to ensure that it is safe for the whole of its lifetime, without increasing flood risk elsewhere.

3.1.2 Early adoption of and adherence to the principles set out in the NPPF and its Practice Guidance, with respect to flood risk, can ensure that detailed designs and plans for developments take due account of the importance of flood risk and the need for appropriate mitigation, if required.

3.1.3 The risk-based Sequential Test in accordance with the NPPF aims to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1).

3.1.4 As the development proposals are located within Flood Zone 1, the proposed Application Site complies with the sequential approach.

3.1.5 One new access will cross Flood Zone 2 and 3 associated with the Oakington Brook and this Essential Infrastructure will be designed in accordance with EA guidance and to address the technical requirements of the Exception Test.

3.2 Local Planning Context

3.2.1 The local planning policy context relevant to the Flood Risk Assessment and Drainage Strategy is set out in the text below.

Northstowe Area Action Plan

3.2.2 The Integrated Water Strategy for the NAAP was adopted in July 2007 and sets out the requirements for the provision of strategic flood risk management, drainage and water supply infrastructure that should be considered as part of the Northstowe development proposals. The main objectives with regards to flood risk are:

- Ensure that the development will not be at risk of flooding either from itself or surrounding watercourses, for up to the 1 in 100-year event including the forecast effects of climate change.
- Not increase the flood risk to surrounding properties and communities, particularly Oakington and Longstanton, or downstream areas.
- Mitigate current flood risk affecting Oakington and Longstanton village. The other objectives refer to maintaining the natural catchments, maintaining the Fen-edge character of the surrounding area, ensuring a net increase of biodiversity, appropriate surface and foul systems, use of Sustainable Drainage Systems (SuDS) and water minimisation, conservation and recycling.

3.2.3 Policy NS/21 for land drainage sets out the requirement for the use of SuDS and the release of surface water runoff into the surrounding watercourse at greenfield rates. All flood mitigation measures should make allowance for the forecast effects of climate change. If practicable, such measures will take the opportunity to mitigate the existing flood risk to Oakington and Longstanton by providing balancing ponds.

Cambridgeshire Flood and Water Supplementary Planning Document (SPD) (November 2016)

3.2.4 This document sets out that in order to reduce impact on the water environment and promote sustainable development, development must be appropriately located, and well designed and managed. It must also take account of climate change.

3.2.5 The SPD provides guidance for developers on how to manage flood risk and the water environment as part of new development proposals.

3.2.6 The guidance and requirements outlined in the SPD has been followed in order to produce a comprehensive Flood Risk Assessment and Drainage Strategy. Details of compliance with this policy are set out within this report.

Greater Cambridge Sustainable Design and Construction Supplementary Planning Document (January 2020)

3.2.7 This document sets out the standards required to meet the visions, objectives and policies of the Cambridge and South Cambridgeshire Local Plans as sustainably as possible.

3.2.8 The SPD sets out the guidance to assist applicants in producing their Sustainability Statement and associated Checklist, together with documents to support planning applications. The checklist enables applicants to show that specific design guidance has been considered on issues including water conservation, biodiversity, flood reduction, sustainable drainage methods and many more. The completed checklist is included as an Appendix to the Sustainability Statement.

Cambridgeshire Surface Water Drainage Guidance for Developers (December 2016)

3.2.9 The Surface Water Drainage Guidance for Developers states the information required within a surface water drainage strategy as follows:

- Areas of permeable and impermeable land for the existing and proposed development.
- An examination of existing drainage arrangements. For greenfield sites, this includes natural contours, flow paths and points of discharge which must be identified, including and sub-catchments within the site.
- Existing runoff rates, including calculations of existing peak runoff rates for the 100 % Annual Exceedance Probability (AEP), 33% AEP and 1% AEP rainfall events.
- Allowable discharge rate, which for greenfield sites, should be calculated as follows:
  - Where a simple flow control is proposed, the peak runoff rate should be limited to QBAR (mean annual flow rate).
  - Where a complex flow control is proposed the peak runoff rate from the developed site for events up to the 1% AEP plus climate change event should not exceed the greenfield equivalents.
- The runoff volume to any surface water body or sewer, which for greenfield sites, in the 1% AEP, 6-hour rainfall event should not exceed the greenfield runoff volume for the same event.
- Demonstration of how SuDS have been considered and incorporated throughout the development site.
- An assessment of the volume of attenuation storage that will be required on site, based on the 1% AEP with climate change storm event and allowable discharge rate for the site.
- For climate change the ‘upper end’ of 40% should be used in sensitivity analysis to assess the potential flood risk implications on and off-site in the critical duration design rainfall event.
- An assessment of the need for long term storage, which addresses the additional volume of runoff generated by the proposed development.

South Cambridgeshire Local Plan (September 2018)

3.2.10 The Local Plan was adopted in September 2018, covering the period of 2011 – 2031.

3.2.11 The updated National Planning Policy Framework (NPPF) (published in February 2019) states that the policies in the previous framework (i.e. NPPF 2012) apply where the Local Plan was submitted to the Secretary of State for examination before 24 January 2019 (NPPF 2018, paragraph 214). The South Cambridgeshire Local Plan was submitted in March 2014 and references to the NPPF in this

Local Plan refer to the NPPF 2012 and not the NPPF 2019. There are no substantial differences in the latest NPPF relative to flood risk.

3.2.12 Policy CC7 Water Quality: In order to protect and enhance water quality, all development proposals must demonstrate that:

- There are adequate water supply, sewerage and land drainage systems (including water sources, water and wastewater infrastructure) to serve the whole development, or an agreement with the relevant service provider to ensure the provision of the necessary infrastructure prior to the occupation of the development. Where development is being phased, each phase must demonstrate sufficient water supply and wastewater conveyance, treatment and discharge capacity;
- The quality of ground, surface or water bodies will not be harmed, and opportunities have been explored and taken for improvements to water quality, including re-naturalisation of river morphology, and ecology;
- Appropriate consideration is given to sources of pollution, and appropriate SuDS measures incorporated to protect water quality from polluted surface water runoff.

3.2.13 Policy CC9 Managing Flood Risk: In order to minimise flood risk, development will only be permitted where:

- The sequential test and exception tests established by the National Planning Policy Framework demonstrate the development is acceptable (where required).
- Floor levels are 300mm above the 1 in 100-year flood level plus an allowance for climate change where appropriate and where appropriate and practicable also 300mm above adjacent highway levels.
- Suitable flood protection / mitigation measures are incorporated as appropriate to the level and nature of flood risk, which can be satisfactorily implemented to ensure safe occupation, access and egress. Management and maintenance plans will be required, including arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime;
- There would be no increase to flood risk elsewhere, and opportunities to reduce flood risk elsewhere have been explored and taken (where appropriate), including limiting discharge of surface water (post development volume and peak rate) to natural greenfield rates or lower; and
- The destination of the discharge obeys the following priority order:
  - Firstly, to the ground via infiltration,
  - Then, to a water body;
  - Then, to a surface water sewer;
  - Discharge to a foul water or combined sewer is unacceptable.

3.2.14 Details of compliance with this policy is set out within this report.

South Cambridgeshire and Cambridge City SFRA

3.2.15 The main aim of the Strategic Flood Risk Assessment (SFRA) prepared in 2010 was to set out the flood risk constraints to help inform the preparation of the Local Development Framework (LDF). The South Cambridgeshire District Council and Cambridge City Council Level 1 Strategic Flood Risk Assessment (WSP, 2010) provided a detailed assessment of the extent and nature of the risk of flooding in the areas of South Cambridgeshire District which are likely to accommodate significant growth in the next plan period (through to 2016).

3.2.16 The SFRA assessed the potential for flooding associated with the watercourses in the vicinity of the site and the SFRA confirmed the Northstowe development area lies within a defended Flood Zone 1 (low risk).

3.2.17 The SFRA identified that although the Northstowe development area itself is not likely to be affected by fluvial flooding, the surrounding villages of Oakington and Longstanton are in areas with potential for flooding. It sets out that the EA have a long-term aspiration to provide improvements in this area, and this has been in part included and addressed as part of the already consented Phase 1 and 2 development proposals.

3.2.18 Details of the surface water attenuation proposals to minimise any increase in risk to the surrounding area is set out within this report.

4 Site Specific Flood Risk Assessment

4.1 Overview

4.1.1 All sources of flooding have been considered. These are:

- Fluvial (river) Flooding,
- Coastal Flooding,
- Surface Water Flooding,
- Groundwater Flooding,
- Sewer Flooding, and
- Flooding from Artificial Drainage Systems/Infrastructure

4.2 Fluvial Flooding

Fluvial Flooding at the Site

4.2.1 The EA has completed modelling across the country to determine the indicative floodplain extent for key design events and this has been used to confirm the extent of various flood zones. The flood zones are a planning tool to highlight areas where flooding is a key consideration in determining the suitability of a site for development and for selecting appropriate land uses. **Error! Reference source not found.** provides the definition of the flood zones and associated potential for fluvial flooding as set out in the Flood Risk and Coastal Change Planning Policy Guidance (PPG).

Table 1: Summary of NPPF Flood Zones

Flood Zone	Annual Probability of Flooding	Corresponding Annual Chance of Flooding (1 in X)
1. Low Probability	Fluvial and Tidal <0.1%	> 1,000
2. Medium Probability	Fluvial 0.1-1.0% Tidal 0.1-0.5%	1,000-100 1,000-200
3a. High Probability	Fluvial >1.0% Tidal >0.5%	<100 <200
3b. The Functional Floodplain	Fluvial and Tidal >5.0%* *Starting point for consideration. LPAs should identify Functional Floodplain, which should not be defined solely by rigid probability parameters.	<20

4.2.2 The Environment Agency Flood Map for Planning shows that the majority of the Phase 3A site lies within Flood Zone 1 and therefore has a low potential (less than 0.1%AEP) of fluvial flooding as shown in ***Figure 5.***

4.2.3 Model data has also been obtained from the EA and reviewed to provide further detail on the potential for flooding at the site and in the wider area.

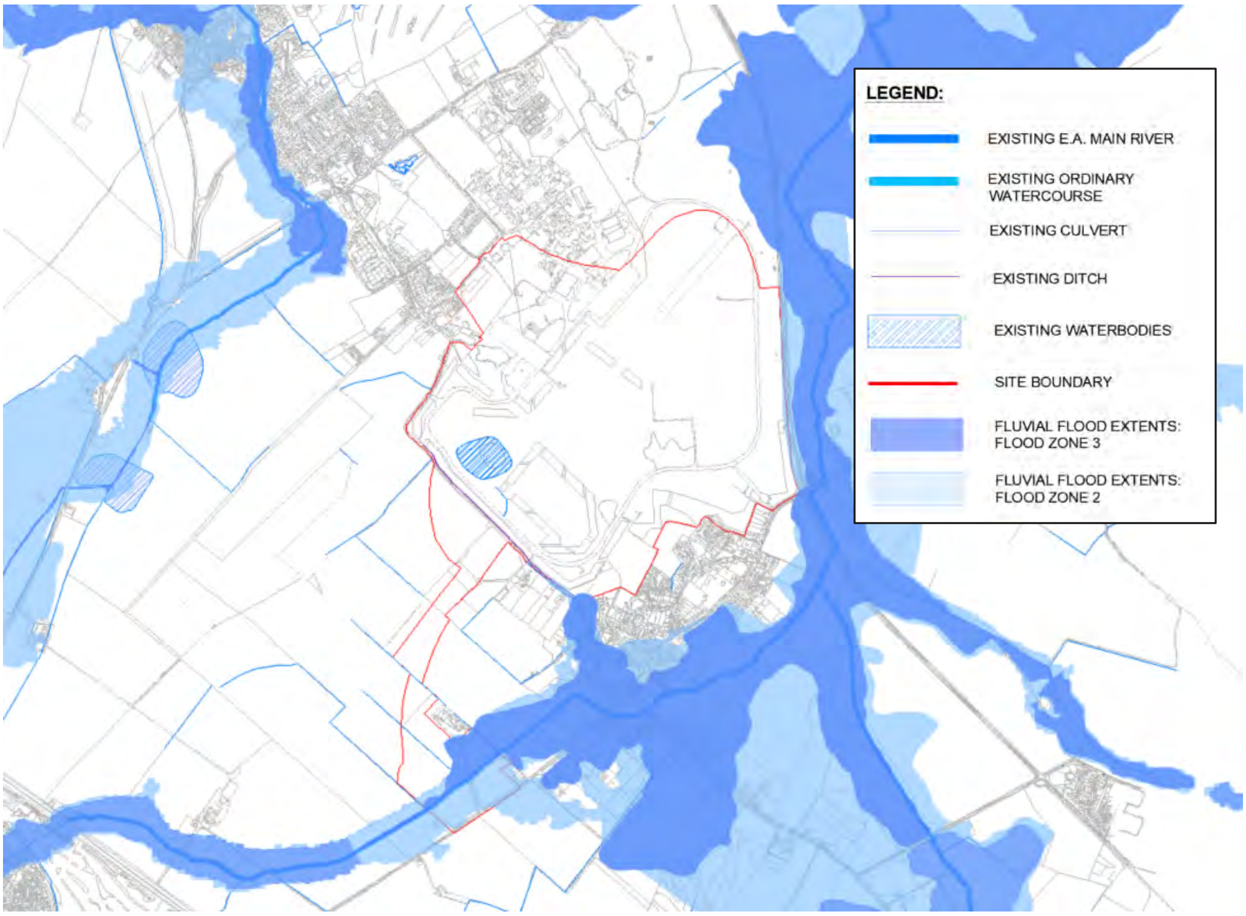


Figure 5: EA Flood Map for Planning (EA)

4.2.4 According to EA modelled data, whilst the majority of the Application Site is in Flood Zone 1, there are small areas towards the edges of the Application Site which are within Flood Zones 2 and 3. These areas include the land at the eastern most part of the Application Site which encroaches into Flood Zone 2 only and a small part of the Application Site adjacent to Dry Drayton Road which lies within Flood Zones 2 and 3 associated with were the proposed SARE crosses Oakington Brook.

4.2.5 According to flood risk vulnerability and flood zone compatibility set out in the Flood Risk and Coastal Change PPG (and reproduced in Table 2*Error! Reference source not found.*), there should be no residential development at those locations, although essential infrastructure could be located there. At Dry Drayton Road this would allow for the provision of the SARE, a highway connection onto Dry Drayton Road.

4.2.6 This access road would include a crossing of the Oakington Brook designed to provide appropriate clearance and capacity for onward flow within Oakington Brook. Depending on the final form for this crossing, it may provide an opportunity for improving an existing bottleneck and reducing the existing potential for flooding at the business park access. This FRA is therefore deemed to satisfy the exception test for this Essential Infrastructure.

4.2.7 The Beck Brook runs parallel to the east side of the Application Site and the floodplain extends up to the Application Site boundary, however the CGB which also runs parallel to the site acts as an embankment, protecting the site from fluvial flooding to the east.

4.2.8 Whilst there have been reports of flooding in the local area, it has been confirmed that the land within Phase 3A was unaffected in these events.

Table 2: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test Required	✓	✓
Zone 3a	Exception Test Required	✓	✓	Exception Test Required	✓
Zone 3b	Exception Test Required	✓	✓	✓	✓

Local Flooding Context and Historic Flooding

4.2.9 Data gathered from South Cambridgeshire's District Council (SCDC's) Strategic Flood Risk Assessment (SFRA) in 2010 outlines a number of historic flood events in the local area from a range of sources. The main risks have been shown to be fluvial and sewer flooding.

4.2.10 Longstanton, which is situated north-west of Phase 3A has suffered from a number of sewer flooding events. The main cause of these events is the current drains being overwhelmed and eventually surcharging. This has been significantly improved as part of the Phase 1 development and is not impacted by the Northstowe Phase 3A development proposals.

4.2.11 Oakington has also experienced a number of fluvial events. In May 1978 flood water overtopped the east bank of the Beck Brook, located to the east of the CGB, adjacent to Phase 3A and towards Cottenham. Data from the EA indicates that this was a 1 in 30-year (3.33% AEP) return period with 60mm of rainfall within 24 hours.

4.2.12 In October 2001, a larger event flooded Dry Drayton Road and Cambridge Road within Oakington as well as most of the land on the eastern side of the CGB. This event was a 1 in 200-year (0.5% AEP) return period event with 100mm of rainfall within 12 hours.

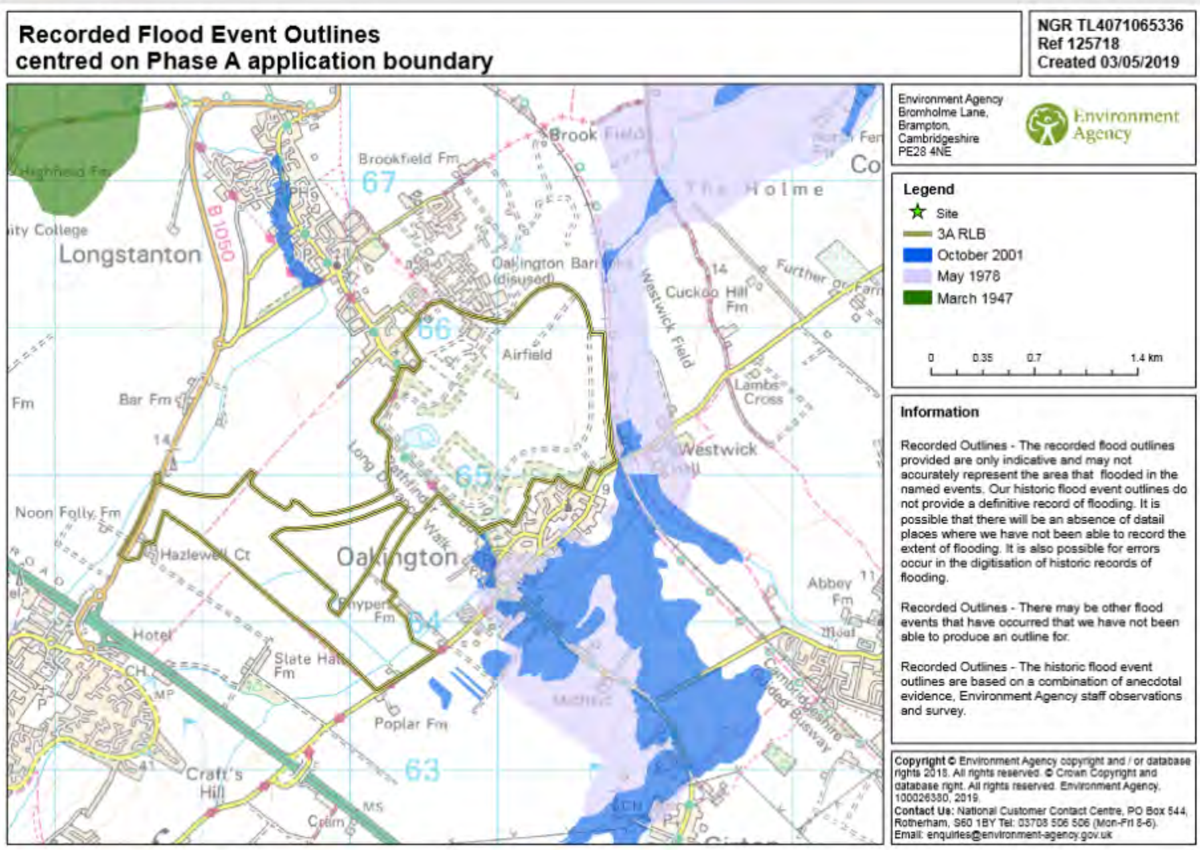


Figure 6: Recorded Flood Outlines

4.2.13 *Error! Reference source not found.* above shows both the 1978 and 2001 flood extent which confirms that Phase 3A was not impacted by either event.

4.2.14 More recently, in August 2014, severe rainfall caused flooding of up to 0.9m in depth to Oakington Village, along Dry Drayton Road, Cambridge Road and Longstanton Road. The extent of this flood can be seen in ***Figure 7*** which displays an interpreted modelled outline of the 2014 event.

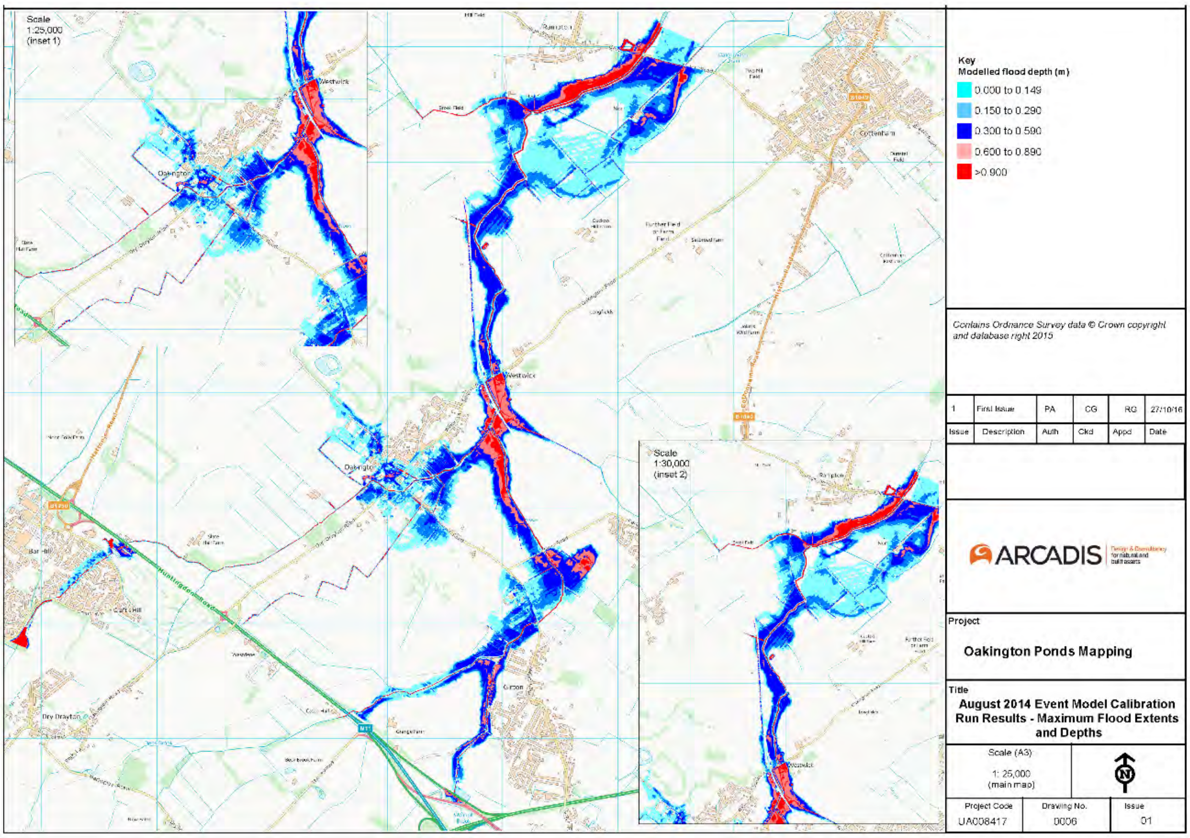


Figure 7: August 2014 Modelled Maximum Flood Extents and Depths

4.2.15 For all three floods outlined above, whilst Oakington was affected, the flood water was held back by the CGB route, which acted as a barrier to the east and subsequently the Phase 3A site was not flooded. It should also be noted that since many of the flood events outlined above, SCDC, EA, IDB and others have invested in a number of projects that now contribute to provide extra flood attenuation and flood defence in the local area, which to date mainly benefitted Longstanton.

4.2.16 As part of the Northstowe Phase 2 development proposals, modelling work was undertaken to understand the existing flood risk to Oakington and specifically to produce a model correlating to the 2014 flood event, to understand how / if attenuation could be provided to reduce flood risk locally for Oakington.

4.2.17 Provision of off-site ponds to help reduce flood risk to Oakington is an ongoing Phase 2 planning requirement and is being dealt with separately to this application. Therefore, this is not covered further within this FRA.

Oakington

4.2.18 High water levels in the Oakington Brook which then overtop the banks are the main source of flood risk in Oakington. These high-water levels are fed by water running off the surrounding areas into the Oakington Brook. In most cases, water is channelled into the Oakington Brook by the drainage ditch network.

4.2.19 Figure 8: Oakington Brook Catchment Area***Figure 8*** shows the areas that contribute flows to the Oakington Brook as it flows through the village, of which runoff from the future Phase 3A Northstowe development is only one small factor and has limited impact.

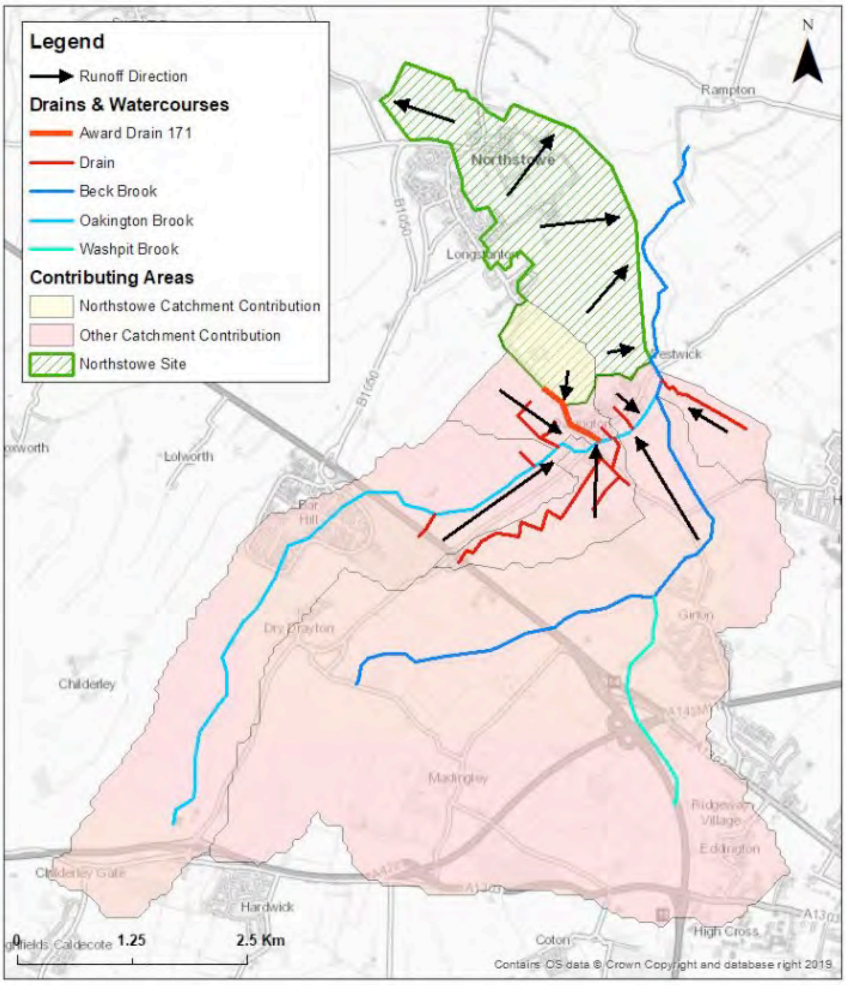


Figure 8: Oakington Brook Catchment Area

4.2.20 Flood events can be classified by rarity. For example, very large flood events such as the August 2014 event, which affected many residents of Oakington, are considered rarer than much smaller floods which could, for example, occur on a yearly basis and would only affect smaller areas. In order to describe these events, the term 'Annual Exceedance Probability' (AEP) is used. This is the chance that a flood of a certain size will occur in any given year. For example, a flood which has a 1% AEP has a 1 in 100 chance of occurring in any given year.

4.2.21 Flow estimations suggest that the August 2014 event was rare. The estimated AEP was 0.1% or a 1 in 1000 chance of occurring in any given year.

4.2.22 The location and depth of flooding predicted by the model for the August 2014 event (Figure 9*Error! Reference source not found.*), prepared and validated by the EA as part of the Phase 2 works, matches well with the location and depth of flooding predicted when a 0.1% AEP (1 in 1000 chance of occurring in any given year) is run through the model (Figure 10).

4.2.23 The model was also run for the 0.5% AEP (1 in 200 chance of occurring in any given year), inclusive of an allowance for climate change (Figure 11), as agreed with the EA. This event was assessed because the attenuation ponds on the Northstowe site have been designed to this standard. The depths and extents of flooding predicted by the model for this event are smaller than both the 0.1% AEP (Figure 10) and the August 2014 event (Figure 9).

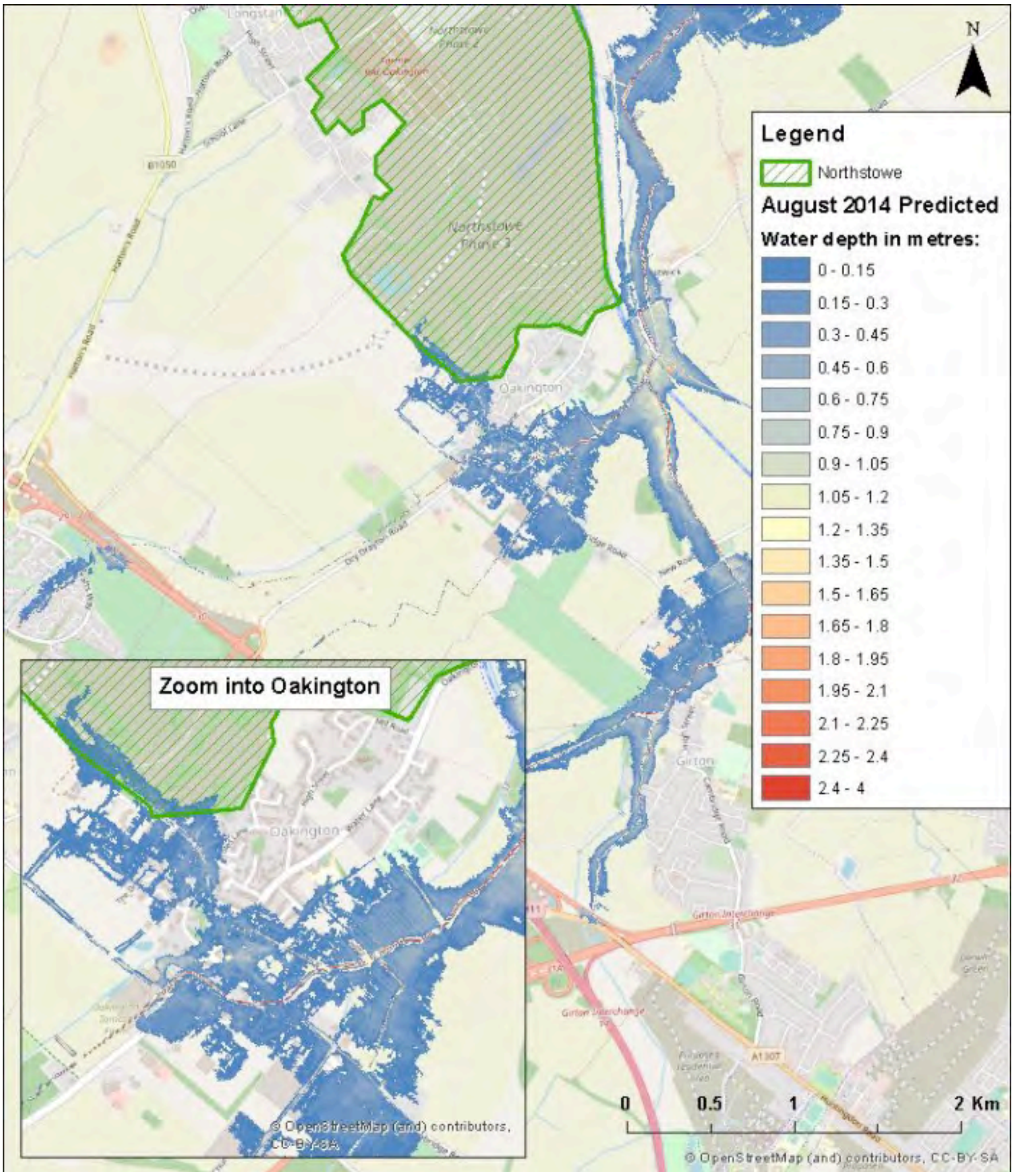


Figure 9: August 2014 Event Location and Depth of Flooding

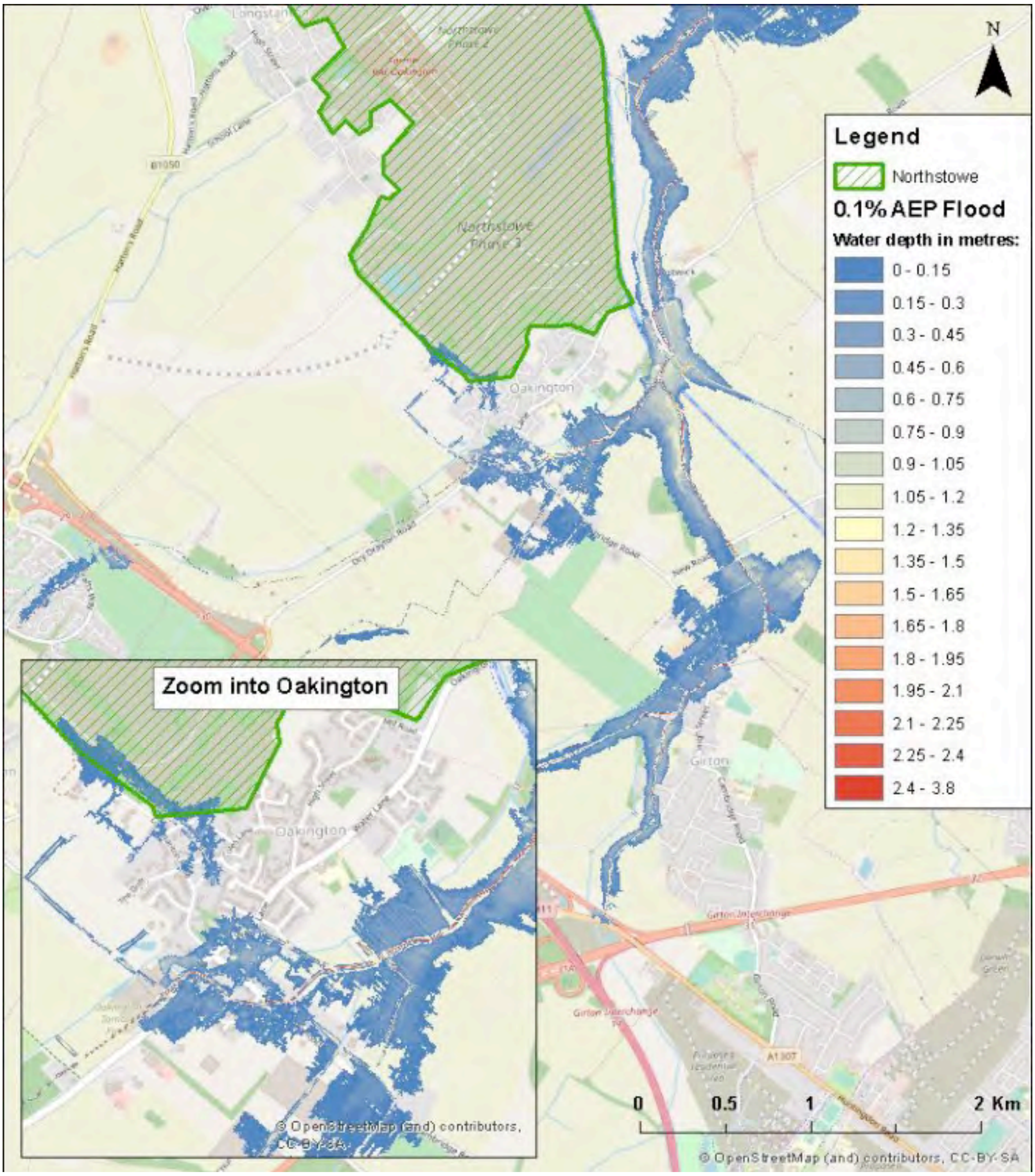


Figure 10: 0.1% AEP (including an allowance for climate change) predicted flood extent and depths from the Arcadis model

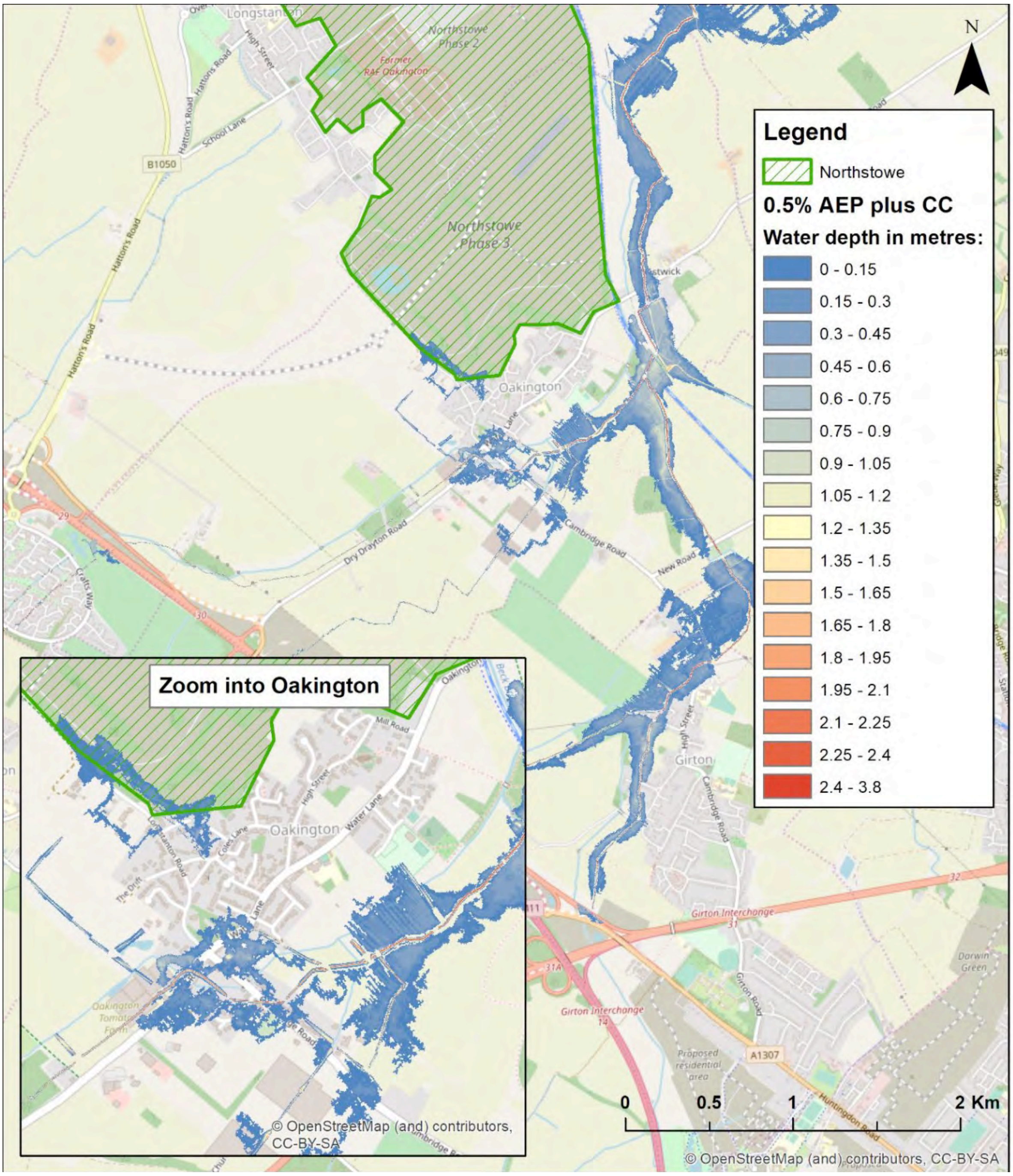


Figure 11: 0.5% AEP (including an allowance for climate change) predicted flood extent and depths from the Arcadis model

4.2.24 It can also be seen in ***Figure 9 to Figure 11*** above that water does appear to back up the Award Drain 171 due to lack of capacity within the Oakington Brook during extreme rainfall events. This could also be due to capacity within the Award Drain itself due to historic lack of maintenance.

4.2.25 It is therefore proposed that for the area of Northstowe Phase 3A that currently drains towards Oakington along this Award Drain, additional measures to retain surface water runoff onsite will be implemented in excess of policy requirements and best practice.

4.2.26 Where flood risk in Oakington is influenced by water sources originating from beyond the Northstowe Phase 3A Application Site, the risks they pose will not be reduced by measures on the Northstowe Phase 3A Application Site.

Award Drain 171

4.2.27 Following consultation with the Oakington Flood Group, it is understood that this existing watercourse which has both open sections and culverted sections, before it discharges into Oakington Brook to the South has reduced storage and conveyance capacity due to excessive silt build up within the channel, which appears to contribute to localised flood risk in the area. This existing Watercourse is maintained by South Cambridgeshire District Council (SCDC). At present the capacity of the culverted section appears to be restricted through silt and sediment build-up of up to 40% in locations, as identified by an initial CCTV survey.

4.2.28 In addition to the above and SCDCs maintenance responsibilities, there may be an opportunity to provide a lower, but more consistent base flow along this watercourse to keep the downstream section clearer, as part of these development proposals.

Summary of Fluvial Flooding

4.2.29 The review of available data and information gathered during the consultation confirms that there are local flooding concerns. However, at the Northstowe Phase 3A Application Site including the SARE itself, only the small area close to Dry Drayton Road and along the Oakington Brook is potentially affected by fluvial flooding and the overall potential for flooding within the Application Site is low. Given the local context, the surrounding area is sensitive to any impacts of the development of the Application Site on the local hydrological regime. By adhering to the policy requirements in NPPF and the local policy, and by agreeing an appropriate approach to discharging surface water runoff, these impacts can be managed appropriately to ensure no detrimental impact elsewhere.

4.2.30 It is therefore considered that the risk of flooding from fluvial sources is **low**.

4.3 Coastal Flooding

4.3.1 The Application Site is a considerable distance from any area influenced by tidal flooding.

4.3.2 Therefore, flooding from this source has not been considered further within this FRA.

4.4 Surface Water Flooding

4.4.1 The rainfall runoff patterns for Northstowe Phase 3A are governed by the topography, soil type and the nature of the overlying surfaces.

4.4.2 The potential for surface water flooding in Northstowe Phase 3A is largely from uncontrolled internal site runoff along drainage features and low points. The ground level data in *Error! Reference source not found.* indicates a high point at the centre of Northstowe Phase 3A along a catchment split, such that approximately two thirds of the site drains towards the north-east and Beck Brook, and the remaining portion drains towards the south-west and Oakington Brook.

4.4.3 The potential for surface water flooding has been considered through review of the risk of flooding from surface water dataset published by the Environment Agency (EA). ***Figure 12*** below indicates limited areas of localised flooding within the development boundary which is predominantly associated with valley features representing drainage routes, such as the Beck Brook. The two main areas that are shown to have a potential for surface water flooding are the northern section near the Oakington airfield and barracks, due to large impermeable structures (e.g. the runway) and to the south end of the Application Site, the low-lying area along Longstanton Road.

4.4.4 The military lake is predominantly fed by surface water runoff from the surrounding area and currently has an informal above ground outfall and overtopping of this water feature may contribute to the saturation of the ground along Longstanton Road in winter months, along with the reduced capacity within the culverted sections of the Award Drain along Longstanton Road, as a result of excessive siltation.

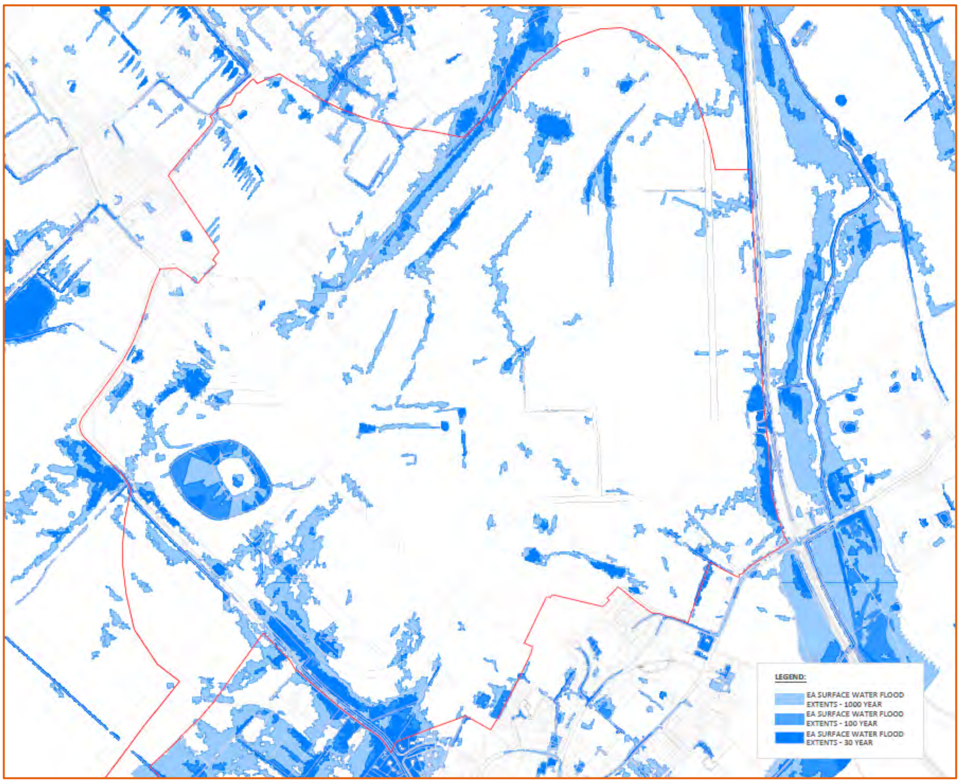


Figure 12: Risk of Flooding from Surface Water Map

4.4.5 It is therefore considered that the potential for flooding at the site from surface water is **low**.

4.5 Groundwater Flooding

4.5.1 Groundwater flooding occurs as a result of water uprising from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall, and the areas at greatest risk are often low lying, where the water table is likely to be at shallow depth.

4.5.2 Groundwater flow beneath the Application Site is thought to be largely contained within the sand and gravel of the River Terrace Deposits and at the contact between the superficial deposits and bedrock. In the south east corner of the site, groundwater within the Solid Geology of Woburn Sands is anticipated and this may overtop into surface water features in the Kimmeridge Clay when the ground becomes saturated.

4.5.3 However, SCDC's SFRA reports that Northstowe Phase 3A lies within an area where water levels have begun to rise. This has not caused any issues in terms of flooding within the Application Site. The nearest ground water flooding event identified in the SFRA is 4.5km south of the Northstowe Phase 3A boundary in the town of Madingley. However, this is due to the underlying layer being a highly productive aquifer. Therefore, it can be concluded that the Application Site lies within an area with a low potential for groundwater flooding.

4.5.4 The materials and geology present at the Northstowe Phase 3A Application Site are essentially, a non-extensive layer of River Terrace Deposits (comprised of sandy clays, clays and gravels) that overlie bedrock of the Kimmeridge Clay Formation and Woburn Sands Formation in the south east. The thickness of the River Terrace Deposits is variable (up to 7 m thick), though it is absent along the south western corner of the Application Site and towards the western end of Oakington. East of the site, the eastern end of the village of Oakington is situated on outcrop Woburn Sands Formation.

4.5.5 As shown in ***Figure 4*** (earlier in this report), ground levels within the area rise from the north-east towards the south-west, however the Military Lake is situated in a localised low point within the

Kimmeridge Clay Formation. Groundwater monitoring has shown that the groundwater level is at its highest elevation in the centre of the site around BHB040 and in proximity (230 m north-east) of the Military Lake, and within the River Terrace Deposits.

4.5.6 From geological mapping, it is likely that superficial geological cover is absent in the area around Military Lake. The base of the lake is believed to be on the Kimmeridge Clay Formation. Review of groundwater levels nearby show that groundwater levels are towards the lake and therefore groundwater potentially provide some support to the lake water level. Anecdotal reports from site personnel indicate that it overflows to the east after periods of 'higher' rainfall.

Groundwater Modelling

4.5.7 To ensure a suitable understanding of the local hydrogeological context, groundwater modelling has been undertaken.

4.5.8 The proposed Development would likely lead to a reduction in recharge to underlying groundwater that may in turn affect water features in the within the site itself, but not the surrounding area. Three SEEPW model cross sections were therefore produced (see ***Figures 14 – 17*** below) to assess the effects and the model outcomes are discussed, as follows:

- In general, the modelled reduction in recharge is predicted to lower the groundwater level beneath the proposed Development by up to 2.5 m, however this is considered worst case and could be mitigated through use of potential recharge SuDS features where feasible;
- A change in groundwater level was not predicted to occur east of the Phase 3A site perimeter drainage towards Oakington;
- Modelling of the groundwater contribution (inflow) to the Military Lake as a result of groundwater lowering post-development indicates a reduction from 0.29 m^3/d (pre-development) to 0.01 m^3/d (post-development). Such a change could potentially lead to a significant reduction in lake levels during the summer months, however this is considered worst case and could be mitigated through use of potential recharge SuDS features where feasible.
- The reduction in groundwater levels in the River Terrace Deposits and Kimmeridge Clay and reduction in the groundwater contribution to the Military Lake will in turn likely lead to a reduction in groundwater discharging into the perimeter drains along the southern boundary of the site.
- This reduction in discharge to the Award Drain adjacent to Longstanton Road can be compensated by a positive drainage outfall from the development proposals.

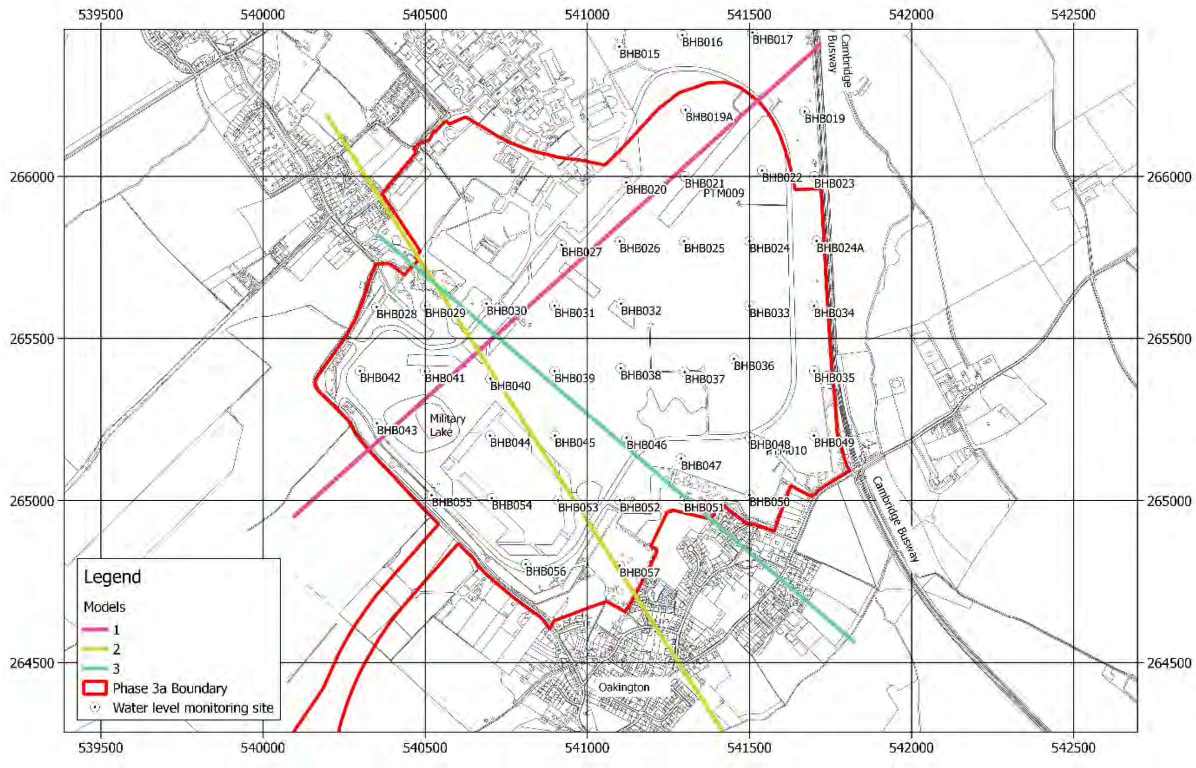


Figure 13: SEEP/W Groundwater Section Location Map

4.5.9 Section 1 shows the anticipated reduction in groundwater within the site towards the Cambridge Guided Busway. Whilst this shows a reduction in levels within the site, the topography across the site indicates that groundwater levels will remain similar on the Cambridge Guided Busway boundary and therefore will not have an impact downstream towards the Beck Brook.

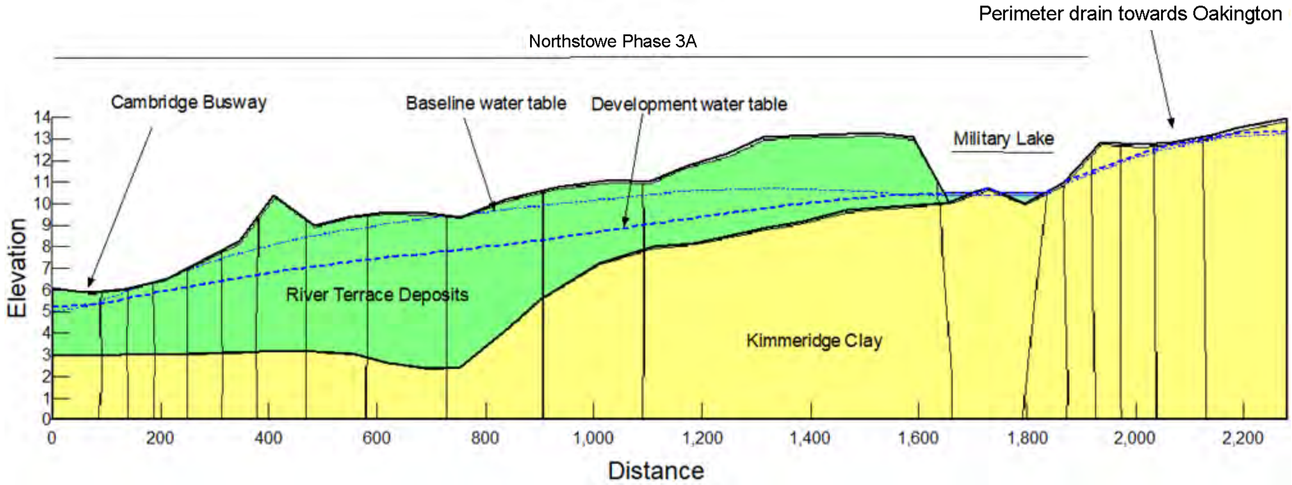


Figure 14: Phase 3A Groundwater Section 1 - Development Impact

4.5.10 Section 2 shows the anticipated reduction in groundwater within the site between Longstanton and Oakington, through the area of the site with Kimmeridge Clays. Again, whilst this shows a reduction in levels within the River Terrace Deposits; the topography across the site, the overlap with the Kimmeridge Clay and the perimeter ditch mean that the future groundwater levels within Longstanton and towards Oakington will remain similar beyond the southern boundary of the site and therefore will not have an impact downstream towards the Oakington.

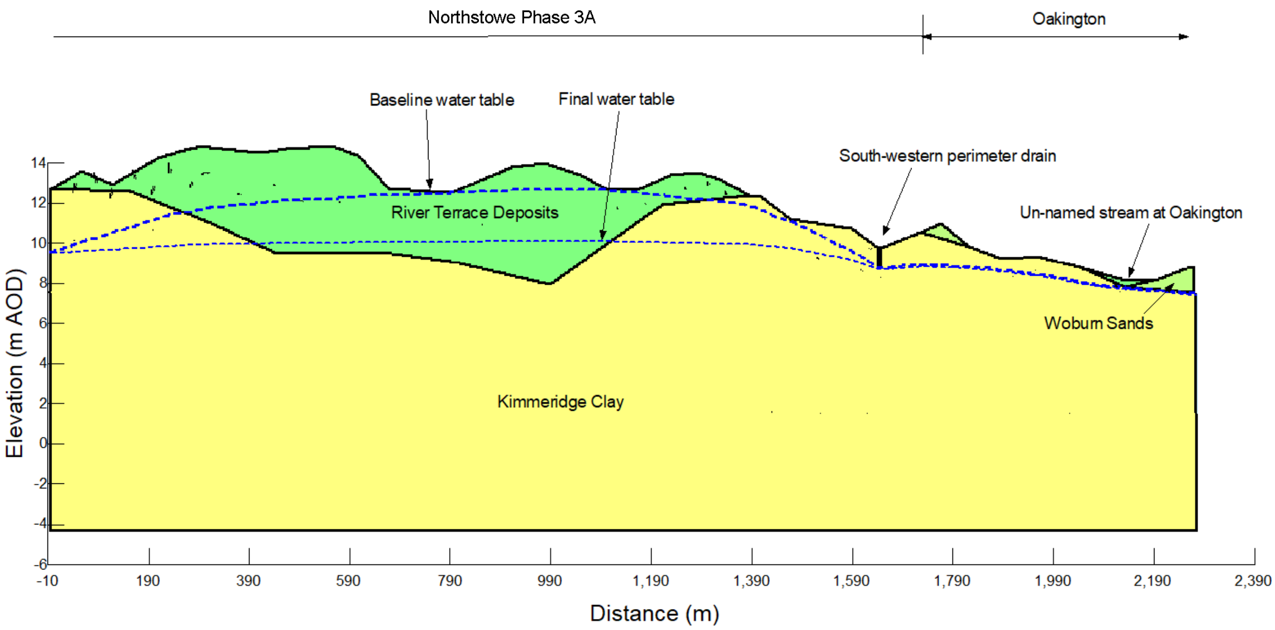


Figure 15: Phase 3A Groundwater Section 2 - Development Impact

4.5.11 Section 3 shows the anticipated reduction in groundwater within the site between Longstanton and Oakington, through the area of the site with River Terrace Deposits along the southern site boundary. Again, whilst this shows a reduction in levels within the River Terrace Deposits within the Application Site, the topography across the site, and the perimeter ditch mean that the future groundwater levels within Longstanton and towards Oakington will remain similar beyond the southern boundary of the site and therefore will not have an impact downstream towards Oakington and Oakington Brook.

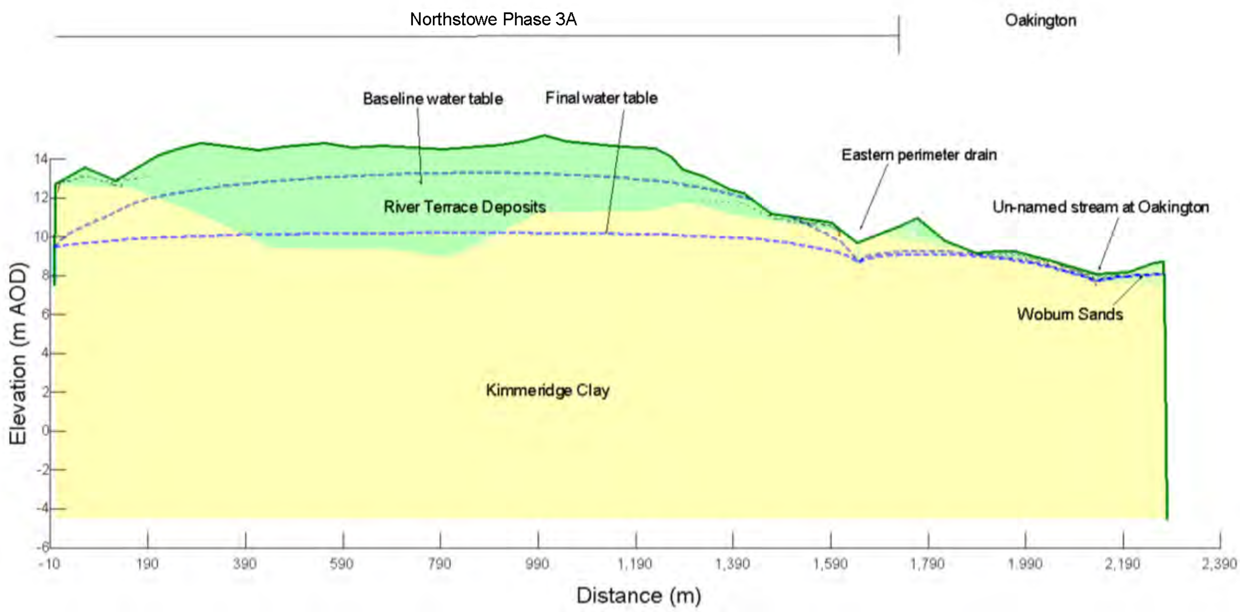


Figure 16: Phase 3A Groundwater Section 3 - Development Impact

4.5.12 It is therefore considered that the risk of flooding from ground water is **low**.

4.6 Potential for Flooding from Artificial Sources

4.6.1 Ordnance Survey mapping indicates there are no significant bodies of water (lakes, reservoirs, or canals), retained above natural groundwater level, upstream of the Phase 3A site. The site is not in an area potentially affected by reservoir flooding, as indicated on the Environment Agency Risk of Flooding from Reservoirs online map ***(Figure 17).***

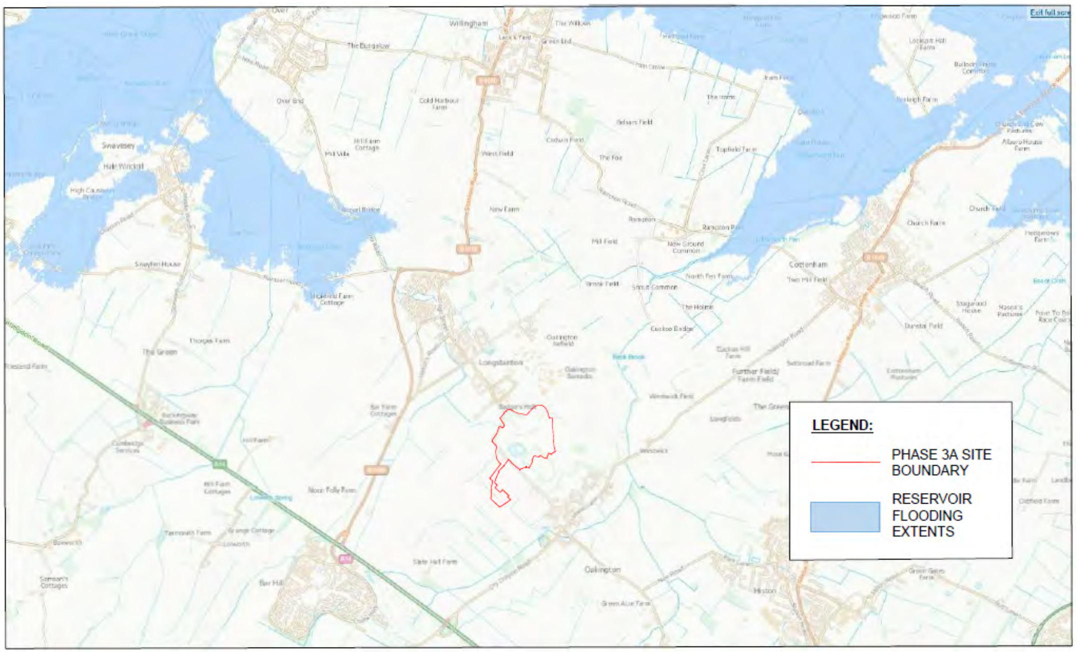


Figure 17: Risk of Flooding from Reservoirs (EA)

4.6.2 It is therefore considered that the potential for flooding from artificial sources is **low**.

4.7 Sewer Flooding

4.7.1 Anglian Water is the Sewerage Undertaker for the area, responsible for the existing and proposed surface and foul water sewerage systems, as well as the sewerage treatment facilities in the area. Foul effluent from Longstanton and the surrounding areas is pumped into existing Wastewater Treatment Works (WWTW) at Over and Uttons Drove. The Over WWTW discharges directly into the Great Ouse, while the Uttons Drove WWTW discharges into the Swavesey Drain system.

4.7.2 Northstowe Phase 1 and Phase 2 foul water is pumped to and will be pumped (as part of current ongoing infrastructure works) to Uttons Drove WWTW respectively. The Phase 2 terminal pump station and rising main is sized to accommodate the Phase 3A proposed Development foul water flows.

4.7.3 The 2010 Stage 1 Cambridge and South Cambridgeshire SFRA details the historic flooding from sewers. The report indicates a number of sewer flooding events have occurred within Longstanton. The cause of these sewer networks flooding is primarily due to the system becoming overwhelmed during large rainfall events, resulting in surcharge and an associated potential for flooding in surrounding areas. The closest occurrence of sewer flooding to the site is 0.5 km west of the Phase 3A site.

4.7.4 As there are no sewers in the vicinity of the Phase 3A site, it is not currently at risk of sewer flooding. Furthermore, the proposed separate foul and surface water sewer network will be sustainably designed to ensure there is a low risk of sewer flooding post development. The use of SuDS will also help attenuate runoff from the development proposals and surface water runoff from the majority of the Phase 3A site will be separate from existing drainage within Longstanton and Oakington. A proportion of the surface water from the Application Site will however continue to drain into the existing Award Drain 171 along Longstanton Road, and the surface water drainage strategy proposed in this report shows how the runoff rate from the site will be managed in more extreme events to provide improvement from the existing scenario over and above policy requirements.

4.7.5 It is therefore considered that the potential for flooding from sewers is **low**.

4.8 Conclusions

4.8.1 It is considered that the potential for flooding at the Northstowe Phase 3A Development is low from the majority of sources, with fluvial and surface water flooding as potential sources of flooding in specific locations within the site. The mitigation measures proposed as part of the development strategy will ensure the development is safe throughout its lifetime and these are outlined in the following sections.

5 Surface Water Management Strategy

5.1 Introduction

5.1.1 The NPPF recognises that flood risk and other environmental impact can be managed by minimising changes in the volume and rate of surface runoff from redeveloped sites and recommends that priority is given to the use of SuDS in new development, this being complementary to the control of development within the floodplain.

5.1.2 The alteration of natural surface water flow patterns through developments can potentially lead to problems elsewhere in the catchment, particularly flooding downstream. Moreover, the increase in impermeable area, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from a development site.

5.1.3 Collection, control and discharge of surface water runoff are a principal planning and design consideration, and this is reflected in the National Sustainable Drainage Systems Standards (2015).

5.1.4 A SuDS Strategy for the site has therefore been developed as set out below to manage and reduce the flood risk posed by the change in the surface water runoff and flow pattern from the site as a result of the proposed Development. An assessment of the existing runoff regime and surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the site. The assessment considers the impact of the development compared to current conditions.

5.2 Existing Site Drainage

5.2.1 Rainfall on the wider Phase 3A site discharges predominantly through the following mechanisms:

- Ground Infiltration – across some parts of the site however due to the geology of the site groundwater is intercepted by the Kimmeridge Clay layers on the south western corner of the site and therefore may overtop into the existing drainage ditch when ground water is elevated and therefore no noticeable change will occur at Oakington, .
- Surface Water Runoff, where water discharges over the ground into water features such as streams, rivers and ponds.
- Evaporation and Transpiration, water which has evaporated from the ground surface or has been taken up by plants.

5.2.2 During large rainfall events, rainfall landing on the site contributes to flows in adjacent watercourses (Beck Brook and Oakington Brook via Award Drain 171).

5.3 Phase 2 Consented Water Management Strategy

5.3.1 The Phase 2 development proposals (which have planning consent and are under construction) include the provision a strategic Waterpark on the eastern edge of the site which provides strategic attenuation for the Phase 2 development, discharging into the Beck Brook. This Waterpark provides attenuation for both Phase 2 and a proportion of Phase 3A which currently drains in that direction.

5.3.2 The existing discharge point to Beck Brook has been utilised for the Phase 2 development proposals, with attenuation being provided onsite limiting runoff to the mean annual greenfield runoff rate (3l/s/ha) up to and including the 1 in 200-year event plus a 40% allowance for climate change. In addition, allowance has been made to have no discharge from the site for up to 48hrs should the water levels in Beck Brook be elevated. This will be managed by a pumped and telemetry system.

5.4 Discharge of Surface Water

5.4.1 The Building Regulations Requirement H3 stipulates several options for the management of surface water runoff, in order or preference, and this hierarchy is also promoted within the NPPF.

5.4.2 Rainwater from roofs and paved areas should discharge to one of the following, listed in order of priority:

a. an adequate soakaway or some other adequate infiltration system,
b. a watercourse, or where that is not practicable,
c. a sewer

Infiltration

5.4.3 As discussed in ***Section 2.3*** it is considered unlikely that infiltration drainage will be a viable as a predominant option for managing the surface water runoff from the redeveloped site. However, substantial green spaces and areas not developed will continue to drain ostensibly to ground, or overland into field drainage.

Watercourse

5.4.4 As set out previously in this report, the existing site topography is such that currently surface water runoff discharges from the site in two directions:

- Approximately 114ha slopes towards the North and east and the Beck Brook
- Approximately 64ha slopes towards the south west and Oakington Brook, via Award Drain 171 adjacent to Longstanton Road.

5.4.5 The development proposal will replicate the existing catchment runoff regimes, maintaining these existing routes of discharge, in line with best practice and the previously agreed Phase 2 principles.

5.4.6 In addition to the above, the SARE route will cross several field ditches and Oakington Brook and any highway drainage associated with this would discharge via gravity into these existing watercourses at an appropriate rate.

Sewer

5.4.7 It is not anticipated to discharge surface water into the existing public sewers within Oakington or Longstanton.

Point of Discharge

5.4.8 For development within the 114ha catchment area that slopes towards the north and east and towards Beck Brook, this will discharge surface water from the site via the Phase 2 Waterpark, utilising the already consented attenuation ponds and discharge point within Phase 2.

5.4.9 For development within the 64ha catchment currently discharging surface water runoff into the Award Drain 171 adjacent to Longstanton Road, this point of outfall will continue to be used with appropriate surface water attenuation provided on site to limit runoff into this existing watercourse to the mean annual greenfield runoff rate. This will be a significant betterment to the existing runoff rates in more extreme rainfall events.

5.4.10 For the SARE, surface water runoff will discharge to the various field drains, and Oakington Brook that cross the proposed highway route following attenuation.

Discharge Rate

5.4.11 The site has some areas of impermeable surfaces as it was previously used as an airfield. As part of this assessment, any increase in surface water runoff from these impermeable areas has been ignored in calculating future discharge rates.

5.4.12 The mean annual greenfield runoff rate of 3l/s/ha was calculated for the Phase 2 development and this has been utilised for the Phase 3A development in line with agreements with the LLFA and EA.

5.4.13 This discharge rate will be utilised for rainfall events up to and including the 1 in 200-year rainfall event (including a 40% allowance for climate change).

5.4.14 This discharge rate provides significant improvement on the existing greenfield peak discharge rates for more intense rainfall events (i.e. 10 year – 200 year) reducing the impact of runoff currently experienced from this catchment.

5.4.15 For the SARE, as within Phase 2, the highway drainage will discharge to the various field drains, and Oakington Brook at the existing greenfield runoff rates.

5.5 Phase 3A SuDS Strategy

Strategic Objectives

5.5.1 The objectives of the drainage strategy are two-fold, given the varying discharge characteristics of the Phase 3A site: to attenuate surface water discharge to within allowable rates, whilst providing measures to improve the quality of this runoff with the use of SuDS.

SuDS Components

5.5.2 SuDS should be considered as an interconnected system. The SuDS management train uses the number of drainage techniques to systematically control the three elements of the runoff, pollution and volumes. This will be achieved in three main steps: Source Control, Conveyance Control and Discharge Control, as shown in ***Figure 18.*** Source control is preferred to those further down the train as they retain pollutants and control of water before it enters into proposed or existing drainage system or watercourse. All the methods suggested are recommended controls considered for SuDs and will be utilised where practical.

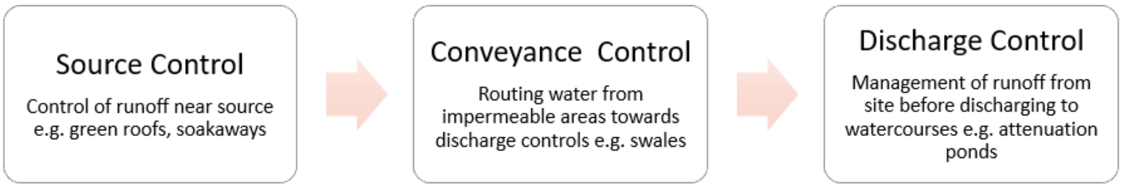


Figure 18: SuDS Treatment Train

5.5.3 To comply with current best practice, the drainage system is to:

- Manage runoff at or close to its source;
- Manage runoff at the surface;
- Integrate with public open space areas and contribute towards meeting the objectives of the urban plan;
- Be cost-effective to operate and maintain.
- The drainage system ensures that:
  - Natural hydrological processes are protected through maintaining interception of an initial depth of rainfall and prioritising infiltration;
  - Flood risk is managed through the control of runoff peak flow rates and volumes discharged from the site;
  - Storm water runoff is treated to prevent detrimental impacts to the receiving water body as a result of urban contaminants.

5.5.4 In addition, to maximise the amenity and ecological benefits associated with the drainage system, the SuDs green infrastructure components provide health benefits and reduce the vulnerability of developments to the impacts of climate change.

5.5.5 Within Phase 3A, following initial source control, conveyance systems will transfer water from plots through to existing waterbodies or proposed attenuation systems, as determined by both the topography and the volume of storage required. The conveyance systems will be a network of small swales and rainwater gardens within development plots, together with roadside swales, connecting into larger conveyance channels alongside piped drainage networks which discharge into waterbodies. Within Phase 3A, one of the conveyance channels is proposed for use as a public swimming area as well as having visual amenity value.

Strategy

5.5.6 As noted above, infiltration is unlikely to be feasible throughout the site, therefore the use of SuDS is proposed within the site to attenuate and manage surface water runoff from the source in a sustainable way. However, infiltration may be used as a first flush and recharge mechanism if considered appropriate at the detailed design stage.

5.5.7 The site is split into two catchments with approximately two thirds of the site falling to the south towards Oakington and one third falling to the north and east towards Phase 2.

5.5.8 The principles of the SuDS strategy are shown on drawing ***10019646-AUK-NS-P3-IE-C-P02*** contained within ***Appendix D*** and include:

- SuDS features to be included within development parcels (i.e. swales, tanked permeable paving, rainwater gardens etc). It is proposed that surface water runoff will be limited within the parcels to ensure management of the runoff at source in line with best practice. It is proposed therefore that runoff from residential parcels will be limited to a maximum rate of 12l/s/ha into the wider site conveyance network. Further details of appropriate SuDS features are contained within ***Appendix C***.
- Water quality / SuDS conveyance provided along highways where feasible to provide water quality treatment to highway runoff.
- Conveyance across site through use of piped drainage and conveyance swales.
- Strategic Attenuation (including water quality cleansing forebay areas) providing a final layer of treatment and protection in more extreme rainfall events, and to accommodate overland flows, before surface water is discharged from the site at the mean annual greenfield runoff rate (3l/s/ha). These areas have also been designed to accommodate all surface water runoff from the site in up to and including the 1 in 200-year rainfall event (including a 40% allowance for climate change) with 0l/s discharge for up to 48h hours when water levels in the receiving watercourses are elevated. This will allow for the surface water runoff from the site to be retained within the site and slowly released once the peak water levels have receded, or after 48hrs.

5.5.9 below highlights the significant betterment provided within our strategy relative to these policy requirements.

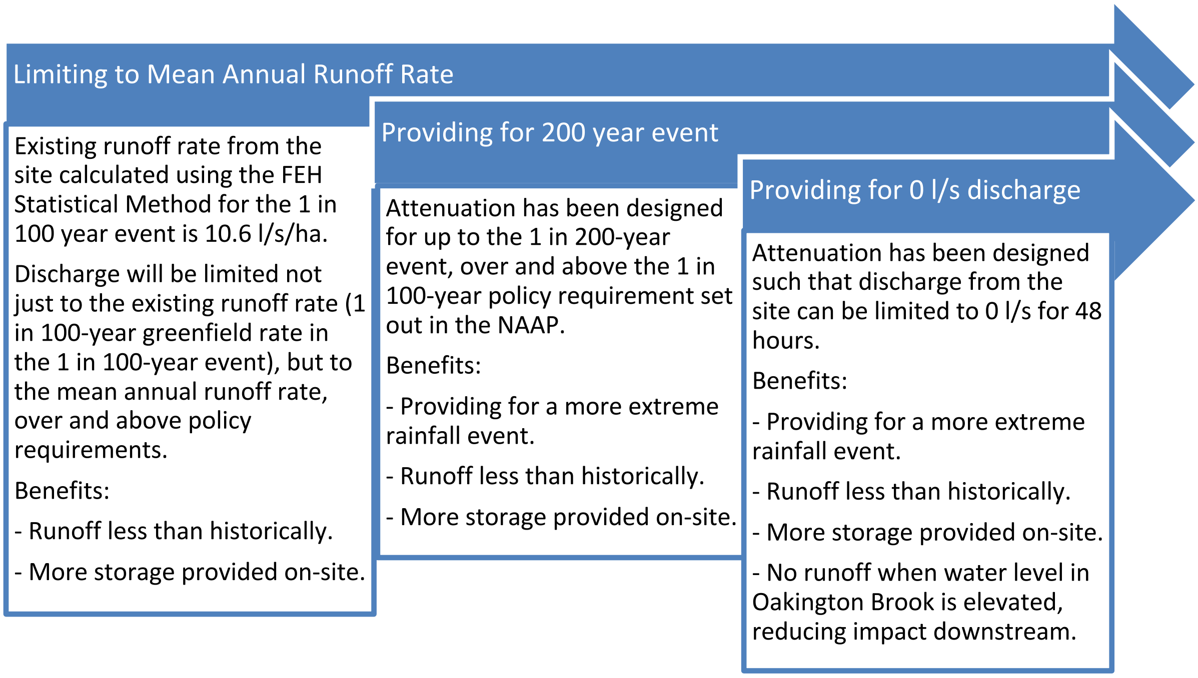


Figure 19: Betterment Provided by Design Parameters Relative to Policy Requirements

Design Guidance

5.5.10 The following design guidance is to be adhered to for the proposed surface water drainage system serving the proposed site.

- Building Regulations Part H (October 2015)
- National Planning Policy Framework (NPPF) (February 2019)
- Sewers for Adoption (7th edition) (August 2012)
- EA Pollution Prevention Guidelines
- BRE Digest 365 Soakaway Design (March 2007)
- SUDS Manual [CIRIA C697] (2015)
- Sustainable Drainage – Cambridgeshire Design and Adoption Guide.
- Cambridgeshire County Council's Surface Water Drainage Guidance for Developers (December 2016)

Proposed Impermeable Areas

5.5.11 At this stage the following impermeable percentages have been applied to development areas within the site:

- Proposed primary and secondary streets and SARE – 100%
- Residential parcels – 62% impermeable (i.e. roads, houses and external areas – this allows for a 10% increase in impermeable area over time due to urban creep).The remaining 38% of the area will remain green being open space, SuDS features and gardens.
- Schools – 40% impermeable (accounting for school building and playing fields)
- Green spaces – an allowance of 20% runoff has been allowed from these areas at this stage.

5.5.12 Therefore, the total impermeable area allowed for at this stage as a result of the development proposals is:

- Northern Catchment – 54.6 ha
- Southern Catchment – 30.0 ha

- SARE – 4.78 ha

5.5.13 A summary of the areas across the site, and the associated impermeable area percentage applied is contained within ***Appendix D***.

Attenuation Requirements

5.5.14 The volume of strategic attenuation required for up to and including the 1 in 200-year rainfall event (including an allowance for climate change) is given below in ***Table 3: Surface Water Storage Requirements.*** The storage allowance and provision are well in excess of policy requirements and therefore considered to be a sustainable solution that will significantly benefit the wider area and downstream catchments.

Table 3: Surface Water Storage Requirements

Site Area	Impermeable Area	Discharge Rate (3 l/s/ha)	Storage Volume (200 year + 40% CC) 3 l/s/ha	Storage Volume (200 year + 40% CC storage for 48 hours at 0 l/s)
Northern Catchment	54.6 ha	164 l/s	47,100 m^3	63,500 m^3
Southern Catchment	30.0 ha	90 l/s	26,100 m^3	34,900 m^3
SARE	4.78 ha	14 l/s	3,900 m^3	N/A

5.5.15 Microdrainage calculations and a summary of attenuation volumes are contained within ***Appendix D***.

5.5.16 It should be noted that the onsite surface water drainage infrastructure will also provide capacity and therefore it is anticipated that at the detailed design stage, the storage required will reduce from that shown above.

Attenuation Provision

5.5.17 Attenuation will be provided throughout the site, and along the SuDS management train, including:

- Within parcels – limiting runoff to a maximum rate of 12l/s/ha
- Within conveyance pipes and channels throughout the site
- Strategic Attenuation within the Phase 2 Waterpark for the northern catchment:
  - Phase 2 ponds (already consented and partially constructed) have been designed to have a capacity of 135,000m3 storage. Only 85,000m3 storage is required for the Phase 2 development proposals, reserving 50,000m3 storage for the Phase 3A development.
  - 3A North pond. An additional Phase 2 Pond is still to be constructed (named on the drawing as Phase 3A North pond) and this will have capacity for circa 50,000m3 storage as shown and will be linked by a culvert to the existing ponds, providing a consistent water level across the ponds, managed by the Phase 2 pumping station to be adopted by Anglian Water. An additional 300mm (minimum) freeboard is also provided for more extreme rainfall events.
  - Runway Lake will be permanently wet and will provide further capacity for attenuation and surface water management.
  - Boundary conveyance channels to manage overland flows and runoff from the site in extreme rainfall events.

- Strategic Attenuation within the southern catchment of Phase 3A:
  - Military Lake – at this stage this has not been assessed for suitability for surface water attenuation but may become part of the SuDS management train as part of the detailed design if water quality is managed appropriately.
  - 3A South pond – this has capacity for 35,000m^3 which is sufficient storage required for a more extreme rainfall event and the 0l/s discharge from the site, however an additional freeboard of 300mm (minimum) will provide additional storage should it be required for more extreme rainfall events.

5.5.18 The Woburn Sands Formation is present along the Cambridgeshire Guided Busway, at the east of the site and in the region of the Phase 3A North pond. Therefore, this pond will be lined to prevent groundwater ingress, to preserve the attenuation volume required.

5.5.19 The area of the Phase 3A South pond appears to be in clay superficial deposits and Kimmeridge clay (as shown in borehole logs BHB053 and BHB056 within the geotechnical report). Lining will be provided where required to prevent groundwater ingress (if required).

5.5.20 A Summary of the area provided for Strategic SuDS features, and the volume of storage provided is provided within ***Appendix D***.

5.5.21 The SuDS features will be designed in accordance with the SuDS Manual and RoSPA guidance including:

- 1 in 3 earthworks where access is provided and typically 1 in 3 elsewhere
- Min freeboard 300mm for extreme rainfall event s/ residual risk
- Retained water levels of up to 2m in the Phase 2 Ponds
- Variable retained water level within the Runway Lake
- Attenuation depths of between 1m (Phase 3A South pond) and 2m (Phase 2 Ponds incorporating the 3A North pond)

Pollution Control

5.5.22 Water Quality Treatment will be provided in a number of ways complying with the SuDS treatment rain as set out within the SuDS Manual:

- On plot SuDS: swales, rain gardens etc.
- Conveyance channels within the site
- Forebay areas within the attenuation ponds

Ecology, Biodiversity and Amenity

5.5.23 The SuDS features proposed above will be a mixture of wet and dry features and will be designed in such a way as to allow some areas to be multifunctional (i.e. walking and cycling routes as well as play areas). This will be set out further at the detailed design stage.

5.5.24 The SuDS features will provide additional opportunities for improving ecology and biodiversity within the area, supporting existing and/or creating new habitats and ecosystems.

Adoption and Maintenance

5.5.25 It is envisaged that Anglian Water will adopt and maintain the onsite Surface Water Management System and associated SuDS, similar to Phase 2.

5.5.26 Highway drainage will be adopted and maintained by the Local Highway Authority (Cambridgeshire County Council).

5.5.27 Detailed design of the SuDs features within the development parcels will be undertaken by developers in line with the principles set out within this Drainage Strategy and will be offered for adoption by Anglian Water.

5.5.28 In the instance that adoption does not come forward, a private maintenance company may be implemented to manage required maintenance, and this will be delivered in line with the Long-Term Management Plan contained in ***Appendix E.***

Award Drain 171

5.5.29 This Award Drain is maintained by SCDC.

5.5.30 The southern catchment of the proposed Development will continue to discharge to this Award Drain. However; the discharge rates proposed from the development in, up to, and including the 1 in 200-year rainfall events including 40% allowance for climate change, are below existing greenfield runoff rates in extreme rainfall events and will therefore provide a significant betterment to the downstream catchment in higher order rainfall events.

5.5.31 It is noted earlier in this report that a CCTV survey of the Award Drain shows that the culverted sections are silted up (in some areas up to 40% of the surface area of the pipe). This will need to be maintained to improve functionality and capacity of the Award Drain

6 Flood Mitigation Measures

6.1.1 The overarching design of the development proposals has been designed around water management and SuDS principles. However, the following specific items should also be noted:

6.1 Proposed Land Uses

6.1.2 Given the low potential for flooding at the site and its location predominantly in Flood Zone 1, this location is considered suitable for 'more vulnerable' developments within the Flood Risk and Coastal Change PPG. In Flood Zone 1, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout, form of the development and the use of flood mitigation measures including SuDS techniques.

6.1.3 The residual potential for flooding from various sources has been mitigated on the site by using a number of techniques outlined in Section 5, and mitigation strategies to manage and reduce the overall flood risk at the site.

6.2 Minimum Floor Levels

6.2.1 There is no specific requirement to set a minimum finished floor level on the basis of potential flooding. However, to further reduce the potential for flooding posed to new buildings within the site, it is recommended that the floor level of all buildings be set a minimum of 150 mm above surrounding ground levels to enable the full capacity of any secondary flood conveyance to be utilised.

6.3 Access and Egress

6.3.1 The majority of the site and immediate road network is located within Flood Zone 1 therefore a permanently safe and dry access can be maintained without any specific mitigation measures.

6.3.2 In addition, appropriate measures will be put in place as part of the SARE construction, where it crosses Flood Zones 2 and 3 associated with Oakington Brook, as to be determined as part of the detailed design phase. Where essential infrastructure is located adjacent to Dry Drayton Road this will be designed in line with the EA requirements to provide appropriate soffit clearance and capacity to Oakington Brook and, where feasible, will seek to improve conditions at the existing pinch point at the business park access.

6.4 Climate Change

6.4.1 Climate change presents a significant challenge to sustainable development.

6.4.2 Climate change is a key consideration in assessing flood risk. The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. To account for climate change and to demonstrate how flood risk will be managed over the lifetime of the development, ***Table 4*** sets out the 'Upper end' rainfall allowances that have therefore been adopted in the assessment of surface water drainage requirements as discussed in Section 5.

Table 4: Rainfall Intensity Increases (adapted from EA NPPF climate change allowances)

Rainfall Allowance Category	Total potential change anticipated for the '2080s' (2070 to 2115)	Status
Upper End	40%	Adopted in Phase 3A design
Central	20%	For information purpose only

6.4.3 Making an allowance for climate change in the design of the future development proposals for Phase 3A will ensure that the development is safe for its lifetime, without increasing flood risk elsewhere and where possible will provide betterment and reduce flood risk.

6.5 Flood Resilience and Resistance

6.5.1 The detailed development of the layout should always consider that the site could potentially be affected by a more extreme event and as such the implementation of flood resilience and resistance methods should be considered. Relatively simple measures such as raising utility entry points, setting minimum floor levels, using first floor or ceiling down electrical circuits and sloping landscaping away from properties can be easily and economically incorporated into the development of the site.

6.6 Residual Risk

6.6.1 Residual risk associated with a severe flood event that exceeds the normal flood management design standard, such as an intense rainfall event which the drainage system cannot cope with, can be managed through the appropriate detailed design of onsite levels, providing overland flow routing within the site to the sustainable drainage infrastructure.

6.6.2 In addition, surface water attenuation within the site will be sized appropriately to manage and maintain runoff from the site in over and above policy required rainfall events.

6.6.3 Residual risk associated with the maintenance of SuDS infrastructure, blockage of a surface water conveyance system, or failure of a pumped drainage system; will be managed through the implementation of maintenance plans, and adoption by appropriate parties will be progressed.

6.6.4 Freeboard will also be provided within all SuDS features, providing additional capacity over and above the designed capacity set out within the drainage strategy below. Freeboard allowances will be:

- Min 150mm within Swales
- Min 300mm within Ponds / basins

6.6.5 These allowances are in line with the design guidance set out within the SuDS Manual CIRIA C753.

6.7 Conclusion on Flooding

6.7.1 In conclusion, the potential for flooding at the site can be considered to be limited; the site is situated predominantly in Flood Zone 1, with a low probability of flooding from all sources. The mitigation measures detailed above show that the potential for flooding at the site can be effectively managed.

6.7.2 The high groundwater levels will be effectively managed through the implementation of a sustainable drainage system, as part of the development proposals.

6.7.3 The site is located close to areas which have been affected by flooding and are shown to be within Flood Zones 2 and 3. Therefore the impacts of the proposed development on the local hydrological regime are of particular sensitivity. This has been accounted for in the design of the surface water management strategy.

7 Foul Drainage

7.1.1 An outline foul drainage strategy is included within Appendix F.

7.1.2 This will be designed in accordance with Sewers for Adoption and will be adopted and maintained by Anglian Water

7.1.3 It is envisaged that gravity drainage will be provided throughout the site, with two pumping stations provided to lift these foul water flows into the existing Phase 2 infrastructure.

7.1.4 A Terminal Pumping Station has been provided within Phase 2 to accommodate both the Phase 2 and 3A development proposals and has been sized appropriately to manage the conveyance of flows to Uttons Drove WWTW. This Terminal Pumping Station and associated rising main is being delivered by Anglian Water who will adopt the wider network including Phase 3A.

8 Conclusions

8.1.1 This Flood Risk Assessment (FRA) and Drainage Strategy has been prepared on behalf of Homes England in support of the planning application for the Phase 3A Northstowe development.

8.1.2 The report assesses the potential for flooding from all sources (rivers, sea, surface water, groundwater, and artificial sources), taking account of the latest climate change predictions. A drainage strategy has been set out that provides a framework for development of both foul and surface water management systems for Phase 3A of the development at Northstowe.

8.1.3 A summary of the review of the potential for flooding at the site is presented in ***Table 5*** below.

Table 5: Summary of Flood Risk

Source of Flooding	Flood Risk			Comments	Further Investigation Required?
	Low	Medium	High		
Rivers	✓			Majority of the site is located within Flood Zone 1	No – Oakington Brook crossing to be designed in accordance with flooding analysis
Sea	✓			Site not at risk	No
Surface Water	✓			Surface water runoff to be managed through use of SuDS features	No – design to be developed based on principles as set out within this report
Ground Water	✓			Shallow ground water levels currently within some areas of the site, however no history of groundwater flooding	This can be manged through appropriate SUDS design as part of development proposals. However ongoing ground water monitoring will also be undertaken
Artificial Sources	✓			Site not at risk of flooding from artificial sources	No

8.1.4 The proposed Development has a mixed flood risk vulnerability classification, ranging from ‘Water Compatible’ to ‘More Vulnerable’ in accordance with NPPF guidance. The lifetime of the development would be at least 100 years.

8.1.5 The application is in accordance with the Local Plan and accords with the key principles of the NPPF Sequential Test, which steers new development away from the highest areas of flood risk.

8.1.6 Flood risk from all sources has been assessed with the following conclusions:

- Fluvial: the majority of Phase 3A is in Flood Zone 1, with flooding chance of less than 1 in 10,000 annual probability. A small section of the south side of the development, where the proposed SARE will be located, is in Flood Zones 2 and 3 of the Oakington Brook. Also, on the west side of the development, Flood Zone 2 encroaches in the site boundary. However, no built development is proposed within these zones except for the access roads.
- Surface Water: For Phase 3A, there are limited areas of the site at potential risk of flooding from surface water, these areas usually following local drains and aligns with local waterbodies like the Oakington Brook, Beck Brook. The surface water strategy considers the impact from both on and offsite surface water and will sustainably manage flood risk.
- Groundwater: Phase 3A has no history of flooding due to groundwater.

- Artificial and Sewer: The development proposals will discharge directly into existing drains and waterbodies. No flood risk is associated within the site from artificial sources including reservoirs.

8.1.7 The proposed Development is considered to be at low flood risk and mitigation measures can be implemented where required.

8.1.8 A review of the impact on Oakington has been undertaken and mitigation to manage surface water discharge to provide a betterment relative to limiting discharge rate and attenuation during extreme rainfall events.

8.1.9 An outline drainage strategy has been prepared for the site in line with best practice which substantially exceeds the requirements of planning policy.

8.1.10 The surface water from the site will maintain existing drainage regime (discharging to watercourses) as ground conditions indicated that infiltration will not be able to be used as a predominant solution.

- 114ha of the site slope towards the north and east and towards Beck Brook and the existing Phase 2 Waterpark
- 64ha currently drains towards the south west towards the Award Drain 171 adjacent to Longstanton Road, and from there into Oakington Brook.

8.1.11 Discharge will be limited to the mean annual greenfield runoff rate of 3l/s, for up to and including the 1 in 200-year rainfall event (including an allowance for climate change). This is substantially above the requirements set out within planning policy.

8.1.12 Discharge from the SARE will be limited to greenfield runoff rates and discharged to the adjacent field drains and Oakington Brook.

8.1.13 In addition to the above, appropriate attenuation will be provided limiting discharge to 0l/s for 48hrs if water levels within the adjacent watercourses are elevated, to allow time for water levels to recede before discharging surface water from the site. This will provide further betterment to receiving watercourses relative to the control of discharge during extreme rainfall events.

8.1.14 Drainage will be designed in accordance with best practice, the SUDS Manual, Sewers for Adoption, CCC design guidance or Building Regulations where applicable.

8.1.15 Adoption of the onsite features will be undertaken by:

- Anglian Water will maintain the public drainage system (foul and surface water) - similar to Phase 2.
- CCC will adopt and maintain highway drainage.
- On plot drainage will be managed and maintained by plot developers; transferring to a management company.

8.1.16 Residual risk will be managed through the appropriate design of onsite levels and corridors to manage overland flows sustainability, and through management of the SuDS features.

8.1.17 Finished floor level of the properties will be set a minimum of 150mm above adjacent levels.

8.1.18 Safe Access and egress can be delivered.

8.1.19 Water quality will be improved by providing a number of SuDS features including permeable paving, vegetated SuDS strips, rainwater gardens, swales, wetland features and other appropriate SuDS components.

8.1.20 Adequate space has been provided with the development proposals to allow for a sustainable management of any increase of surface water runoff as a result of the development.

8.1.21 A sustainable foul drainage network can also be provided for the development proposals connecting into the Phase 2 infrastructure which has been sized to accommodate these flows.

APPENDIX A

Watercourse and Waterbodies Map

APPENDIX B

Topographical Survey and Aerial Survey

APPENDIX C

Site Specific Use of SuDS Features

With the exception of sitewide permeable paving, swales, conveyance channel, below ground attenuation tanks and open ponds, other on plot SuDs components (green roofs and other similar landscaping features) cannot be relied on for storage of large-scale storm events under saturated conditions. However, during the summer months, where ground conditions are not saturated, SuDS components can contribute to the requirements for Interception, i.e. there should normally be no runoff from the site for an initial depth of rainfall - usually 5mm.

The following devices could be incorporated as part of the proposed development. A review has been undertaken of the suitability of various SuDs treatments for the site conditions. A summary of the performance of each treatment device is contained below.

FILTER STRIPS

Filter strips are uniformly graded and gently sloping strips of grass or other dense vegetation that are designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration.

Location and Use on Site: Highways will drain via filter-strips into larger conveyance swales bordering the site.

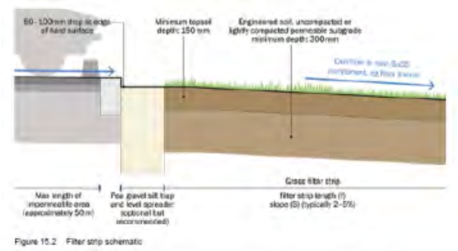
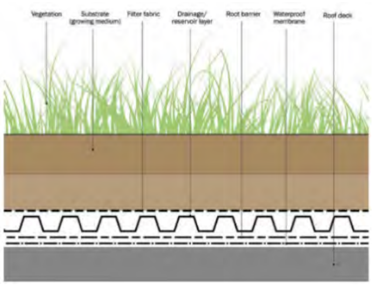


Figure 15.2 Filter strip schematic

Image Ref: Susdrain, https://www.susdrain.org/images/c.7_-_filtration_-_filter_strips.jpg

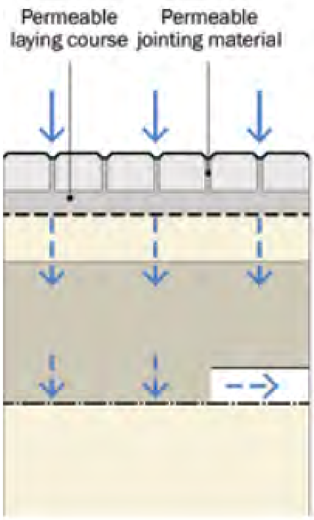
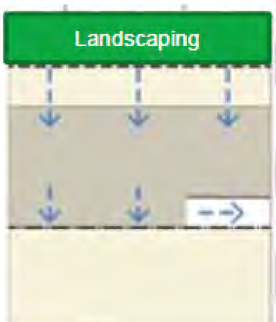
GREEN ROOFS



Green roofs are areas of living vegetation, installed on the top of buildings, for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff” (CIRIA Report C753 – The SuDs Manual v6).

Location and Use: Green roofs may be used on flat roof areas.

Image Ref: CIRIA report C753 – The SuDs Manual v6, 2015

ITEM	DESCRIPTION
TANKED PERMEABLE PAVEMENT  *Image Ref: CIRIA report C753 – The SuDs Manual v6, 2015*	Roof water will be drained into pervious permeable paved areas using diffusers to dissipate the point inflows. Detailed design of the pavement will need to take account of the additional impermeable roof area. The storage would have a flow control device restricting the amount of discharge entering the sewer to allowable rates. The permeable surface is designed to allow water to drain through to the sub-base at a rate greater than the rain that falls into the surface thereby preventing any surface water running along the surface. The permeable sub-base is used to temporarily store infiltrated run-off underground and is then discharged into the drainage system. As with all drainage systems, the permeable surface would require scheduled maintenance to ensure the system works to its optimum performance and prevent the voids within the pavement being blocked with debris. ***Location and Use on Site:*** Permeable pavement may be included in courtyard, parking and associated hard landscaped areas.
TANKED INFILTRATION BLANKET 	A tanked infiltration blanker allows for surface water flows to be attenuated before being discharged off site. An infiltration blanket can be used under a landscaped area, and has a suitable void ratio and depth to cater for storm volumes up to Q100 + 30% Climate Change. As with all drainage systems, the blanket would require scheduled maintenance to ensure the system works to its optimum performance and prevent the voids within the pavement being blocked with debris. ***Location and Use on Site:*** A tanked infiltration blanket could be included underneath hedge planting and other landscaping and connected to a SuDs system such as permeable paving system to direct water to the discharge point.

CONVEYANCE SWALES

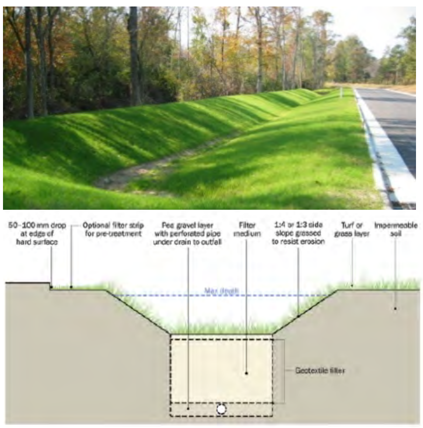


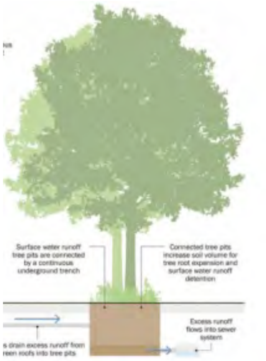
Figure 17.2 Typical dry swale

Swales are shallow, flat-bottomed, vegetated open channels designed to convey, treat and often attenuate surface water runoff. Swales can replace conventional pipework as a means of conveying runoff, and the use of filter strips and/or flow spreaders removed the need for kerbs and gullies.

Location and Use on Site: Larger conveyance swales will border the Phase 3A site, collecting water from roadside filter strips and discharging runoff into the attenuation

Image Ref: CIRIA report C753 – The SuDs Manual v6, 2015

LANDSCAPING



Soft landscaping, such as grassed areas, planted areas and trees, protect and enhance the urban environment. They also facilitate the discharge of surface water runoff to the ground and ultimately into groundwater. These devices will assist in providing water quality improvement and some attenuation of minor storm events.

Location and Use on Site: Soft landscaping, such as trees, gardens and grassed areas are included throughout the site.

Image Ref: CIRIA report C753 – The SuDs Manual v6, 2015

APPENDIX D

Surface Water Drainage Strategy

Impermeable Areas Schedule

Microdrainage Calculations

APPENDIX E

Long Term Management Strategy

This note sets out an outline of the anticipated adoption and maintenance requirements for the Sustainable Drainage Systems on Northstowe Phase 3A, subject to the detailed design of these features.

SuDS Overview

On plot drainage will be designed in detail by the plot developed at a later stage and will include SuDS features to management and limit the increase in surface water runoff as a result of the development proposals.

Highway drainage (conveying runoff from the highway only) will be adopted and maintained by the Local Highway Authority (Cambridgeshire County Council). This includes trapped gullies and their associated connections only at this stage.

All other positive drainage and SuDS features (including the Waterpark) will be offered for adoption by Anglian Water, similar to the Phase 1 and Phase 2 proposals and will be designed in accordance with Sewers for Adoption and the Anglian Water's Sustainable Drainage Systems (SUDS) Adoption Manual.

The SuDS features proposed as part of the surface water strategy for Phase 3A includes swales, attenuation ponds, inlets, outlets and flow control systems.

The specific adoption and maintenance procedures for these features are outlined below, as stated in the SuDS Manual.

Swales

Swales will require regular maintenance to ensure continuing operation to design performance standards. Table 1 outlines the operation and maintenance requirements of swales. The major maintenance requirement for dry swales is mowing. Mowing should ideally retain grass lengths of 75-100mm across the main 'treatment' surface, to assist in filtering pollutants and retaining sediments and to reduce the risk of flattening during runoff events. However, longer vegetation lengths, where appropriate, are not considered to pose a significant risk to functionality.

Occasionally sediment will need to be removed (e.g. once deposits exceed 25 mm in depth), although this can be minimised by ensuring upstream areas are stabilised and by incorporating effective pre-treatment devices. Sediments excavated from a swale that receives runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. For runoff from busy street with high vehicle traffic, sediment testing will be essential. Any damage due to sediment removal or erosion should be repaired and immediately reseeded or planted.

Table 1: Operation and Maintenance Schedule for Swales

Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly

	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for >48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, after plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Ponds

Ponds will require regular maintenance to ensure continuing operation to design performance standards. The treatment performance of ponds is dependent on maintenance, and robust management plans will be required to ensure maintenance is carried out in the long term. Regular inspection and maintenance are important for the effective operation of ponds as designed.

Any invasive maintenance work such as silt or vegetation removal is only required intermittently, but it should be planned to be sympathetic to the requirements of wildlife in a pond. Care should be taken to avoid disturbance to nesting birds during the breeding season and habitats of target species at critical times. The window for carrying out maintenance to achieve this is usually towards the end of the growing season (September/October), although this will vary with species. Invasive silt and vegetation removal should only be carried out to limited areas at any one time of the pond area on one occasion each year to minimise the impact on biodiversity.

Table 2: Operation and Maintenance Schedule for Ponds

Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Cut grass – public areas	Monthly (during growing season)

	Cut meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc. for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and main body of pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check mechanical devices	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level	Annually
	Tidy all dead growth (scrub clearance) before start of growing season. (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay	Every 1-5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required.
Occasional maintenance	Remove sediment from the main body of ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, e.g. every 25-50 years.
Remedial actions	Repair erosion or other damage	As required
	Replant where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/ rehabilitate inlets, outlets and overflows	As required

Inlets, Outlets and Flow Control Systems

Inlets and outlets are the structures or landscape features that manage the flow into and out of a SuDS component. Control structures limit the flow through the outlet and are necessary to meet the site discharge rate. Limiting the flow causes water to back up in the SuDS component, allowing the attenuation storage volume to be filled.

Inlets

Inlets raised above any adjacent permanent water levels are recommended. All concealed infrastructure is likely to be at risk from blockage or lack of maintenance. Where high flows are unavoidable and larger diameter pipes are involved, concrete, brick or stone head walls may be required. There may also be a need for safety/security screening of pipe outfalls.

Flow Control Systems

Float or displacement control systems make use of adjustable gates attached to a float or counterbalance. There can be problems with debris or ice affecting movement of the gate. Active systems that operate in real time require significant additional costs for both installation and operation and maintenance.

Outlets

If not adequately protected, small, low flow orifices can easily block, preventing structural control from meeting its design purpose and potentially causing flooding and other adverse impacts. There are a number of different anti-clogging design approaches, including:

- Gravel surround
- Gabion protection
- Reverse slope outlet pipe for a pond with a permanent pool
- Orifices protected within perforated risers or T-pieces
- Debris guards
- 'Hooded' outlets

The use of trash screens and security grilles requires regular maintenance and do not reflect SuDS best practice. It is recommended that such systems are only used in exceptional circumstances.

APPENDIX F

Foul Drainage Strategy

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NORTHSTOWE PHASE 3

Ground Investigation Report

MAY 2019

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NORTHSTOWE PHASE 3

Ground Investigation Report

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1 INTRODUCTION

Homes England propose to undertake a housing development at Northstowe, in the county of Cambridgeshire. This ground investigation was commissioned by Homes England, 'the Client', to inform on the ground conditions at the site.

The scope of the ground investigation for Phase 3A and 3B was determined by Arcadis Consulting (UK) Limited, and the work was instructed on the 7th September 2018.There have been a number of previous investigations of the Northstowe development area. This phase of the investigation was undertaken in order to further inform of ground conditions to aid design of the housing development.

This report provides a summary of the investigation and factual account of the fieldwork undertaken within the Phase 3 area including engineering descriptions of the various strata encountered, results of *in situ* testing and the subsequent geotechnical and geo-environmental laboratory testing undertaken on samples obtained.

1.1 Limitations

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Arcadis do not accept liability for any use of the information presented in this report unless it is signed by the author, checker and approver and marked as final.

It should be noted that ground conditions between exploratory holes may vary from those identified during this ground investigation; any design should take this into consideration. It should also be noted that groundwater levels may be subject to diurnal, seasonal, climatic variations and those recorded in this report are solely dependent on the time the ground investigation was carried out and the weather before and during the investigation.

1.2 Proposed Development

The wider Northstowe development is to comprise approximately 10,000 homes, a new town centre, schools, health centre and other supporting social infrastructure. Phase 3 will deliver approximately 5,000 homes and represents the final phase of planned development, although further organic growth of the town beyond Phase 3 may take place in the future.

1.3 Existing Information

The following information relating to the site and the ground conditions was made available to Arcadis prior to mobilisation to the site:

a. Ground investigation Scope and Specification [1]; source: Arcadis Consulting (UK) Ltd.
b. Previous Ground Investigation Report [2]; source: Arcadis Consulting (UK) Ltd.
c. Planning Application Strategy [3]; source: Tibbalds.

2 SITE DETAILS

2.1 Site Location and Description

The Phase 3 site area is made up of two separate sites that are not physically connected, with Phase 3A located to the south of Phase 2 within the former airfield of RAF Oakington, and Phase 3B located to the north-west of Phase 1.

Northstowe Phase 3 is situated approximately 10 km northwest of Cambridge, within South Cambridgeshire District; with Phase 3A located 1 km south southeast of Longstanton, at an approximate National Grid Reference (NGR) TL 406651; and Phase 3B located 3 km west of Rampton, at an approximate National Grid Reference (NGR) TL 393679.

Figure 2-1 shows the site location.

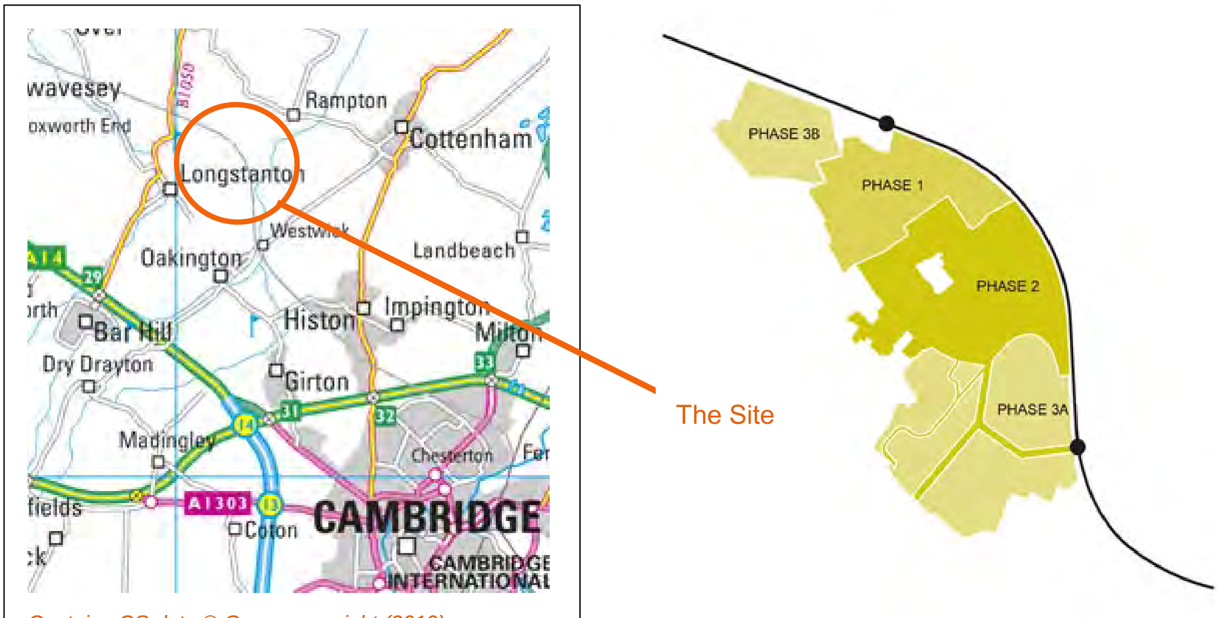

Figure 2-1 Site Location

The Phase 3 development area covers approximately 100 hectares. Phase 3A includes generally flat and level areas of hardstanding and open space associated with the former RAF Oakington Airfield and former barracks, farmlands and a man-made pond-like water feature.

Historically, a sewage treatment works was present to the north western corner of the site, within parcel 2A, and the open space between this and the existing settlement of Rampton Drift supported the former bomb storage and associated infrastructure. The area to the northwest of 3A was the location of the main barrack buildings including the former living quarters and associated welfare / training facilities / offices / vehicle maintenance garages and fuel storage areas.

Phase 3B includes generally flat and level areas of farmland and undeveloped greenfield land.

2.2 Geology

The published 1:50 000 scale British Geological Survey (BGS) maps of the area incorporating the site, Sheet 188 [4], and the BGS online GeoIndex [14] indicate the site to be underlain by superficial deposits of River Terrace Deposits. The underlying bedrock geology consists of mudstone from the Kimmeridge Clay Formation and Ampthill Clay Formation. Although not recorded, made ground can be expected in some aras due to the development history of parts of the site.

The general distribution of the strata at the site is shown in Figure 2-2. A summary of the anticipated geological sequence is shown in Table 2-1.

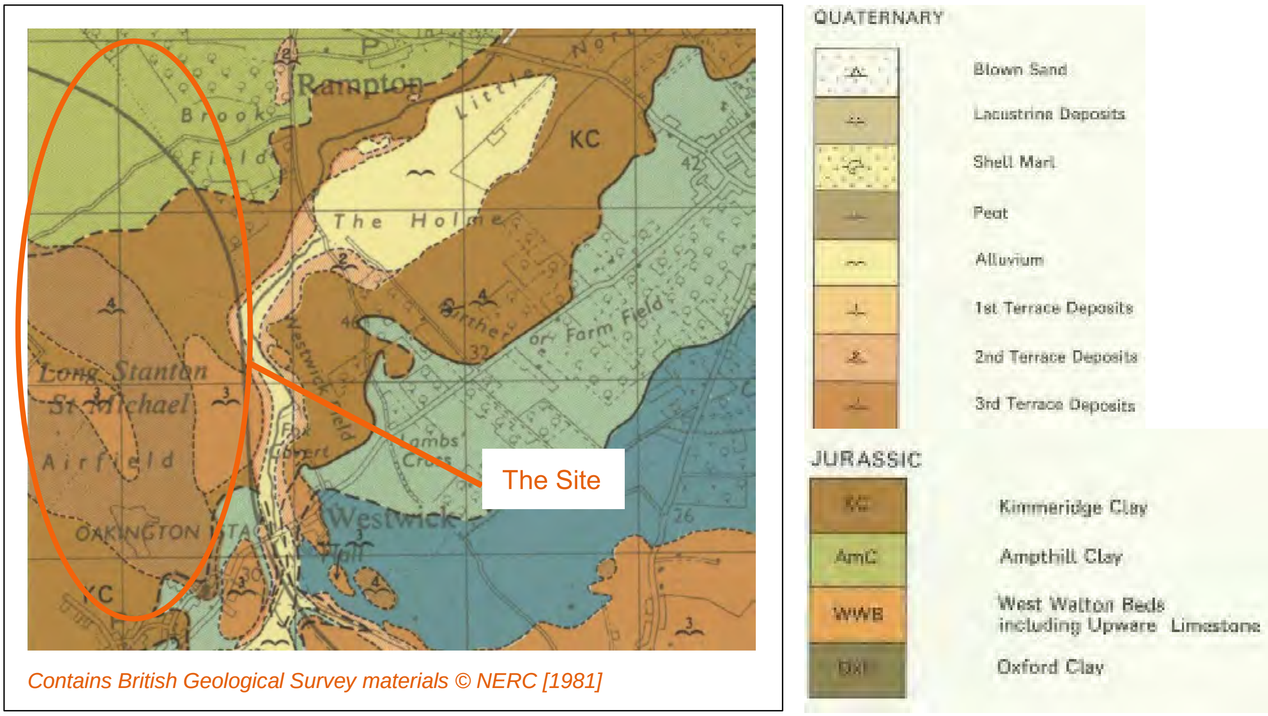

Figure 2-2: Geological Setting.

Period	Formation	Description
Quaternary	Made Ground	Man-made deposits such as embankments and spoil heaps on the natural ground surface.
Quaternary	River Terrace Deposits	Sand and gravel, locally with lenses of silt, clay or peat.
Jurassic	Kimmeridge Clay Formation	Mudstone (calcareous or kerogen-rich or silty or sandy); thin siltstone and cementstone beds; locally sands and silts.
Jurassic	Ampthill Clay Formation	Mainly smooth or slightly silty, pale to medium grey with argillaceous limestone (cementstone) nodules; some rhythmic alternations of dark grey mudstone in the lower part; topmost beds are typically pale grey marls with cementstone.

Table 2-1 Anticipated geological sequence

There are no faults recorded on the site, according to the BGS mapping. Borehole scans (TL46NW6 and TL46NW7) from the Online Geoindex, undertaken by the British Geological Survey between the 1980's and 1990's, encountered between 0.2 m and 1.2 m of medium dense made ground overlying medium dense to dense River Terrace Sand and Gravel between 4 m and 6 m thick before proving Kimmeridge Clay as bedrock.

The Coal Authority website [17] indicates that there is no evidence of coal outcrops or mining activities within the vicinity of the site.

2.3 Hydrogeology and Hydrology

The superficial deposits (River Terrace Deposits) on the site are classified as a Secondary A aquifer by the Environment Agency (EA). Secondary A aquifers are defined as “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” [15]. The superficial deposits are classified as being in a minor aquifer intermediate groundwater vulnerability zone.

The bedrock (Kimmeridge Clay Formation and Ampthill Clay Formation) is classified as Unproductive Strata. Unproductive Strata is defined as “rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow” [15]. The site is not situated within a groundwater source protection zone [15].

The sites do not overlie flood risk zones but areas to the immediate north, east and south of the site are considered to be level 3. There are also level 2 flood risk zones to the east, south and west of the site [16].

The closest surface water feature in Phase 3A is an unnamed pond located in the southeast corner of the former Oakington Barracks. Phase 3B bears a water stream (NW-SE) which was found to be in dry conditions at the time of the site investigation.

3 FIELDWORK

3.1 General

Ground investigation works were carried out in Phase 3A and Phase 3B simultaneously as single phase, between January 21st, 2019 and January 31st, 2019. The scope of the ground investigation, including the location, scheduled depth and type of exploratory hole undertaken was determined by Arcadis Consulting (UK) Limited [1] and is summarised in The ground investigation methods were undertaken in general accordance with the principles set out in BS EN 1997-1:2004 + A1 2013 [7] and with the general practice described in BS5930:2015 [8]. The geo-environmental aspects of the ground investigation complied with the general requirements of BS 10175:2011 [9]. The investigation works were carried out under the supervision of a suitably experienced ground engineer who undertook the logging and reporting of the exploratory holes and in situ testing..

The ground investigation methods were undertaken in general accordance with the principles set out in BS EN 1997-1:2004 + A1 2013 [7] and with the general practice described in BS5930:2015 [8]. The geo-environmental aspects of the ground investigation complied with the general requirements of BS 10175:2011 [9]. The investigation works were carried out under the supervision of a suitably experienced ground engineer who undertook the logging and reporting of the exploratory holes and in situ testing.

Table 3-1 Initial ground investigation scope

Location ID	Hole Type	Scheduled Depth (m)	Requirements
BH1	CP	10.0	Nested 50mm HDPE installations
BH2	CP	10.0	
BH3	CP	10.0	Nested 50mm HDPE installations Permeability Testing
BH4	CP	10.0	
BH5	CP	10.0	Nested 50mm HDPE installations
HDP1	HDTP	0.40	Regular sampling to be taken as each pit progresses
HDP2	HDTP	0.40	
HDP3	HDTP	0.40	
HDP4	HDTP	0.40	
HDP5	HDTP	0.40	
HDP6	HDTP	0.40	
TP3001	TP	3.0	
TP3002	TP	3.0	
TP3003	TP	3.0	
TP3004	TP	3.0	
TP3005	TP	3.0	

Location ID	Hole Type	Scheduled Depth (m)	Requirements
TP3006	TP	3.0	
TP3007	TP	3.0	
TP3008	TP	3.0	
TP3009	TP	3.0	
TP3010	TP	3.0	
TP3011	TP	3.0	

Notes
IP = inspection pit, TP = trial pitting, HDTP = hand excavated trial pit, CP = cable percussive.

3.2 Exploratory Holes

3.2.1 Exploratory Hole Locations

The co-ordinates and elevations of the exploratory hole locations were obtained by the Arcadis supervising engineer using a Trimble VRS NOW GPRS system; allowing an accuracy of +/-50 mm.

Drawing 10019646-GLR-EHP-0001 presented in Appendix A displays the as-constructed exploratory hole locations while the co-ordinates and elevation of the ground surface at each exploratory hole location are given on the individual logs.

3.2.2 Investigation Methodology

The following methods and techniques were undertaken to construct the exploratory holes at the site. The completed scope of investigation is summarised in Table 3-2.

Details of the methods of investigation and associated standards adopted and a key to the notation and symbols used on the logs is presented in are presented in Appendix B; the exploratory hole records are presented in Appendix C.

Table 3-2 Summary of completed exploratory holes

Location ID	Hole Type	Start Date	End Date	Final depth (m)	Termination Reason
BH1	IP + CP	25/01/2019	25/01/2019	10.50	Scheduled Depth
BH2	IP + CP	29/01/2019	30/01/2019	10.50	Scheduled Depth
BH3	IP + CP	24/01/2019	25/01/2019	10.50	Scheduled Depth
BH4	IP + CP	22/01/2019	24/01/2019	10.45	Scheduled Depth
BH5	IP + CP	31/01/2019	31/01/2019	10.43	Scheduled Depth
HDP1	HDTP	22/01/2019	22/01/2019	0.45	Scheduled Depth
HDP2	HDTP	22/01/2019	22/01/2019	0.45	Scheduled Depth
HDP3	HDTP	22/01/2019	22/01/2019	0.47	Scheduled Depth
HDP4	HDTP	22/01/2019	22/01/2019	0.47	Scheduled Depth

Location ID	Hole Type	Start Date	End Date	Final depth (m)	Termination Reason
HDP5	HDTP	22/01/2019	22/01/2019	0.45	Scheduled Depth
HDP6	HDTP	22/01/2019	22/01/2019	0.45	Scheduled Depth
TP3001	TP	25/01/2019	25/01/2019	3.15	Scheduled Depth
TP3002	TP	25/01/2019	25/01/2019	3.00	Scheduled Depth
TP3003	TP	24/01/2019	24/01/2019	3.10	Scheduled Depth
TP3004	TP	25/01/2019	25/01/2019	3.10	Scheduled Depth
TP3005	TP	25/01/2019	25/01/2019	3.10	Scheduled Depth
TP3006	TP	25/01/2019	25/01/2019	3.15	Scheduled Depth
TP3007	TP	24/01/2019	24/01/2019	3.00	Scheduled Depth
TP3008	TP	24/01/2019	24/01/2019	2.80	Unstable Ground
TP3009	TP	24/01/2019	24/01/2019	2.90	Unstable Ground
TP3010	TP	24/01/2019	24/01/2019	3.30	Scheduled Depth
TP3011	TP	24/01/2019	24/01/2019	3.00	Scheduled Depth

Notes
IP = inspection pit, TP = trial pitting, HDTP = hand excavated trial pit, CP = cable percussive.

3.2.3 Cable Percussive Boring

Cable percussive boring was completed using a trailer mounted Dando D150 drilling rig equipped with 150 mm casing and tools to undertake boreholes up to 10.5m bgl.

Samples of the material recovered in borehole were taken to enable representative laboratory testing. Generally small disturbed samples were taken at each change in stratum and at 0.5 m intervals thereafter in clay soils; and bulk samples were taken at 1 m intervals where the sand and gravel content of the soil was significant. In addition, sampling undertaken for contamination testing comprised:

• 1 sample from the topsoil (if present), taken as close to the surface as possible i.e. just below the grass root zone for example at 0.05-0.25 m within the hand dug inspection pit;

• 2 samples from the top 1.0 m within Made Ground;

• 1 sample per metre of Made Ground thereafter or change in strata;

• 1 sample in each natural stratum; and,

• 1 sample of materials that may be of interest e.g. where there is strong visual or olfactory.

Where specified by the engineer, UT100 open drive tube samples were taken using thin walled sampling apparatus from the relatively undisturbed material at the base of the borehole.

Standard penetration tests (SPT) were undertaken at 1.0 m intervals to 5 mbgl then after this at 1.5 m intervals until the termination depth of the hole. Where cohesive soils were encountered, the SPT interval became 1.5m and UT100 samples were taken from 0.5 m below the lower end of the SPT.

3.2.4 Hand Dug Trial Pits

Hand excavated trial pits were dug to a depth of 0.4 mbgl. Each pit was logged and sampled as the pit progressed. In addition, sampling requirements for contamination testing comprised:

• 1 sample from the topsoil (if present), taken as close to the surface as possible i.e. just below the grass root zone for example at 0.05-0.25 m within the hand dug pit;

• 1 sample in each natural stratum

• 1 sample of materials that may be of interest e.g. where there is strong visual or olfactory.

3.2.5 Trial Pitting/Trial Trenches

Trial pits were undertaken using a JCB 3CX wheeled backhoe excavator. The trial pits were logged entirely from surface and arisings obtained from the trial pits.

Samples of the material recovered in the trail pits were taken to enable representative laboratory testing. Generally small disturbed samples were taken at each change in stratum and at 0.5 m intervals thereafter in clay soils; and bulk samples were taken at 1 m intervals where the sand and gravel content of the soil was assessed as significant. Photographic records of the trial pit elevation and arisings were taken and are presented with the associated trial pit log. In addition, sampling requirements for contamination testing comprised:

• 1 sample from the topsoil (if present), taken as close to the surface as possible i.e. just below the grass root zone for example at 0.05-0.25 m within the hand dug inspection pit;

• 2 samples from the top 1.0 m within Made Ground;

• 1 sample per metre of Made Ground thereafter or change in strata;

• 1 sample in each natural stratum; and,

• 1 sample of materials that may be of interest e.g. where there is strong visual or olfactory.

3.3 *In situ* Testing

3.3.1 General

In situ testing was carried out within the relevant exploratory hole or at a specified test location. Where tests were undertaken within or associated with a specific borehole or trial pit, the test data is presented on the relevant exploratory hole log or as additional sheets to that log. As such, the location details will be the same as the associated hole and its position will be the same as the exploratory hole with which it is associated.

3.3.2 Penetration Testing

3.3.2.1 Standard Penetration Tests

Standard penetration tests (SPT) were carried out as required in the investigation scope and in accordance with the methods given in the standard procedures presented within Appendix B. Generally, tests were undertaken at regular intervals throughout the borehole to provide a profile of the soil's resistance with depth and a disturbed soil samples was recovered from the SPT split-spoon tool or a disturbed sample was taken over the range of the test interval.

The N-values as determined in the field are presented on the borehole logs as uncorrected values that do not take into account the energy losses or efficiency of the automatic trip hammer used to drive the test tool into the ground. The calibration certification for the test devices used in the investigation is presented in Appendix D and a summary of the SPT equipment used at each location is presented in Table 3-3.

Table 3-3 Test Hammer Calibrations

Location ID	SPT Hammer Reference No.	Energy Efficiency Ratio, E_r %	Comment
BH01-BH04	DEL1	61	Calibration due 01/03/2019

3.3.3 Strength and Deformation Testing

3.3.3.1 Determination of undrained shear strength using Hand Vane apparatus

Hand shear vane tests were carried out using a Pilcon hand shear vane with a cruciform vane of 19 mm. The tests were conducted in the arisings of trial pits of suitable Quality Class as appropriate.

The test was performed in general accordance with the manufacturer’s instructions and the vane was inserted a minimum distance of 70 mm below the surface tested. The vane head was rotated slowly at a speed not greater than 1 revolution per minute until the soil has failed in shear or the maximum reading of the device was achieved. For valid tests, the remoulded strength of the failed soil was determined by rapidly rotating the vane head for five complete rotations and allowing a minimum rest period of 3 minutes before reapplying torque to the vane.

The undrained soil strength was read directly from the calibrated vane head in kPa. It should be noted that these values are based on an empirical relationship derived by Pilcon from undrained triaxial compression tests on samples of London Clay.

Where possible, three tests were made to provide an average value, however, it should be noted that where natural fissures or discontinuities are present the minimum values may provide a better representation of the mass consistency of the soil and may be significant.

Due to the nature of the samples tested, the results are indicative for assistance in determining soil consistency for logging purposes only and should not be used to classify soil strength.

Hand vane test results are summarised and presented in Table 3-4.

Location ID	Test depth m	Test 1		Test 2		Test 3		Comments
		Peak	Rem	Peak	Rem	Peak	Rem	
TP3001	0.50	36	12	36	13	50	20	
TP3001	1.60	50	10	63	20	55	15	
TP3002	2.60	80	20	105	30	98	25	
TP3002	2.90	64	10	72	20	70	22	
TP3003	0.58	42	16	40	18	52	20	
TP3003	1.10	56	20					Result is average of three readings.
TP3004	0.50	84	15	86	20	88	19	

TP3004	1.90	130		130		130		Result greater than 130 kPa which is the maximum reading for the shear vane, so no residual reading possible.
TP3006	2.00	72	21	70	21	84	22	
TP3006	3.00	80	21	72	21	87	20	
TP3007	2.00	110	25	90	21	84	22	
TP3007	2.90	100	35	100	20	95	28	
TP3008	1.80	52	10	64	15	70	24	

Table 3-4 Summary of hand vane shear strength field test data

3.3.4 Hydraulic Tests

Water permeability tests in open systems were scoped for all installations, however due to the on-site conditions encountered, groundwater was not present in all installations at the time of testing. Where this was the case a soakaway test to BRE 365 [5] was undertaken. Details of the test carried out in each installation can be found in Table 3-4 & Table 3-5.

3.3.4.1 Water Permeability Tests in Open Systems

Falling Head permeability tests were carried out in those boreholes listed in Table 3-5. The tests were carried out in general accordance with the requirements and methods given in BS EN ISO 22282-1:2012 [10] and BS EN ISO 22282-2:2012 [11]. Data sheets presenting the test information are presented with the corresponding exploratory hole record within Appendix C.

Location ID	Test Section top mbgl	Test Section base mbgl	Infiltration rate (f ms^{-1})	Comments
BH4 Shallow	3.10	6.10	4.37E-04	See Appendix C for data sheet. Infiltration rate is calculated using Velocity Method

Table 3-5 Summary of open system variable head permeability tests

3.3.4.2 Soakaway Tests

The soil infiltration rate was determined by conducting soakaway tests in accordance with the methodology described in BRE 365 [5]. The tests were conducted in dry boreholes to the anticipated soakaway depth. Summary information of the tests is presented Table 3-6 while detailed test sheets are presented with the relevant borehole log in Appendix C.

Due to slow infiltration, the rates of infiltration were evaluated through extrapolation of the data and therefore may have a reduced accuracy.

Location ID	Test Section top mbgl	Test Section base mbgl	Infiltration Rate (f ms^{-1})	Comments
BH3 Shallow	3.00	4.61	3.72E-84	See Appendix C for data sheets
BH4 Deep	8.00	10.00	2.81E-06	

Table 3-6 Summary of soakage tests.

3.3.5 VOC Head Space Screening

The presence of Volatile Organic Compounds (VOC) within the ground and groundwater was determined using a photoionization detector (PID) to detect the 'headspace' vapours emitted by the compounds. The method is applicable to a wide range of compounds that have sufficiently high volatility to be effectively liberated from the soil or water matrix in normal temperature and pressure ranges.

The headspace test was undertaken on the freshly extracted soil samples at regular intervals by placing a small amount of material into a screw-top glass jar so that the jar was not more than half-full. The jar opening was covered with an aluminium foil sheet and the lid screwed on to form an air-tight seal. The sample and jar were then shaken for about 15 seconds to break-up and disperse the soil before resting the sample for about 5 minutes. The testing was undertaken using a GA5000 Landfill Gas Analyser. To assess the headspace vapour, the jar lid was removed and the inlet tube was inserted through the foil into the headspace area. The reading recorded was the highest response observed in the first 10 seconds. The screening results are presented on the relevant exploratory holes logs within Appendix C.

3.4 Installations and Post-fieldwork Monitoring

3.4.1 Installations

Installations to enable long term monitoring of the site were made in those boreholes selected by Arcadis Consulting (UK) Ltd and the details are summarised in Table 3-7 and are also provided on the relevant borehole logs.

Location ID	Installation Type	Response Zone Top m bgl	Response Zone Base m bgl	Comments
BH1	SP50	1.00	3.00	Shallow Installation
	SP50	7.00	10.00	Deep installation
BH2	SP50	2.00	5.00	Shallow Installation
	SP50	7.00	10.00	Deep installation
BH3	SP50	3.00	5.00	Shallow Installation
	SP50	7.00	10.00	Deep installation
BH4	SP50	3.10	6.10	Shallow Installation
	SP50	8.00	10.00	Deep installation
BH5	SP50	1.00	4.80	Shallow Installation
	SP50	6.00	10.00	Deep installation

Table 3-7 Summary exploratory hole installations

Notes: SP = standpipe piezometer.

3.4.2 Post-fieldwork Monitoring

Post-field work monitoring was undertaken on two separate visits; one two-day visit on February 7th and 8th and a one day visit on February 22nd 2019. During the first monitoring visit, the well was dipped then purged by removing three well volumes of groundwater and groundwater samples were then taken. In the second visit to the site, land gas emissions and groundwater levels were recorded.

Where installations were purged dry, monitoring and sampling was conducted on groundwater recovered following recharging of groundwater in installations.

The results of the groundwater monitoring are presented within Appendix E.

4 LABORATORY TESTING

4.1 General

Geotechnical and geo-environmental chemical testing was undertaken on selected samples obtained from the exploratory holes. The testing was scheduled by the geotechnical and/or geo-environmental engineer and the testing was undertaken by an Arcadis approved testing laboratory.

4.2 Geotechnical Laboratory Testing

The geotechnical tests detailed in Table 4-1 were carried out in accordance with either BS1377:1990: Parts 1 to 9 [12]; BS EN ISO 17892-1 [13]; BRE SD 1:2005 [6]; or other methods as listed in Table 4-1. The complete results of the geotechnical laboratory testing are presented in Appendix F.

Test	Method	No of Determinations
Moisture content	BS 1377:1990 - Part 2 : 3.2	17
4-point liquid and plastic limit	BS 1377:1990 - Part 2 : 4.3 & 5.3	5
Particle Size Distribution - Wet sieving	BS 1377:1990 - Part 2 : 9.2	2
pH, water soluble sulphate; total sulphate, total sulphur, chloride, nitrate, magnesium	BRE - BR279	3
Organic Matter Content-dichromate method	BS 1377:1990 - Part 3 : 3	2
Dry Den/MC (4.5kg Rammer Method 1 Litre Mould)	BS 1377:1990 - Part 4 : 3.5	1

Table 4 1 Summary of geotechnical test data

4.3 Geo-Environmental Laboratory Testing

Geo-environmental tests were undertaken on soil, groundwater and prepared leachate specimens obtained from the samples collected from the site. Testing was carried out for the contaminants detailed in **Error! Reference source not found.** and Table 4-2. The results of the chemical laboratory testing are presented in Appendix G. Details of the test methodology is presented with the test results.

Test type	Method	No of Determinations
Metals (As, B, Cr, Cd, Cu, Pb, Hg, Ni, Se, Zn), pH, Cyanide Free & Total	Induced Coupled Plasma Optical Emission Spectroscopy (ICP-OES)	27
Speciated Polycyclic Aromatic Hydrocarbon compounds (PAH)	Gas Chromatography –Mass Spectrometry (GC-MS)	27
Total Petroleum Hydrocarbon Criteria Working Croup (TPH CWG)	Gas Chromatography – Flame Ionisation Detector (GC-FID)	27
Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX)	GC-MS	27
Boron, water soluble	ICP-OES	27

Asbestos Screen and Identification	Polarised light microscopy in conjunction with dispersion staining techniques.	27
Sulphate, water soluble	16hr extraction	27
Free cyanide	Distillation followed by colorimetry.	27
pH in soil	Addition of water followed by automated electrometric measurement.	27
Monohydric phenols	Extraction with sodium hydroxide followed by distillation followed by colorimetry	27
Pesticides	GC MS/MS	3

Table 4-1 Summary of geo-environmental test data – soil matrix

Test type	Method	No of Determinations
Metals (As, B, Cr, Cd, Cu, Pb, Hg, Ni, Se, Zn), pH, Speciated PAH, Cyanide Free & Total	ICP-OES	8
Speciated Polycyclic Aromatic Hydrocarbon compounds (PAH)	GC-MS	8
Total Petroleum Hydrocarbon Criteria Working Croup (TPH CWG)	GC-MS	8
Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX)	GC-MS	8
Sulphate, water soluble	ICP-OES	8
Free cyanide	Distillation followed by colorimetry	8
pH in water	Electrometric measurement	8
Phenols	HPLC	8

Table 4-2 Summary of geo-environmental test data – groundwater matrix

5 REFERENCES

General References

1. Arcadis Consulting, 2019. Northstowe Phase 3: Site Investigation Brief. October 2019.
2. Arcadis Consulting, 2018. Ground Investigation Report for Northstowe Phase 2 Parcel 2A. Arcadis Consulting Report 10018973-AFS-GLR-G001. July 2018.
3. Tibbalds. 2018. Northstowe Phase 3 Planning Application Strategy. May 2018.
4. British Geological Survey. 1981. Cambridge. England and Wales Sheet 188. Solid and Drift Deposits. 1:50 000. BGS Keyworth, Nottingham.
5. Building Research Establishment. 2016. Soakaway Design. BRE Digest DG365. BRE, Watford.
6. Building Research Establishment. 2005. Concrete in aggressive ground. BRE Special Digest 1. 3rd Edition. BRE, Watford.

National Standards

7. BS EN 1997-1. 2004.+ A1 2013 *Incorporating corrigendum February 2009.* Eurocode 7: Geotechnical Design. Part 1 General Rules. British Standards Institution.
8. BS 5930. 2015. Code of practice for ground investigations. British Standards Institution.
9. BS 10175. 2011. Investigation of potentially contaminated sites – Code of practice. British Standards Institution.
10. BS EN ISO 22282-1:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 1: General Rules. British Standards Institution.
11. BS EN ISO 22282-2:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 2: Water permeability tests in a borehole using open systems. British Standards Institution.
12. BS 1377. 1990 & 2016 as amended. Method of test for soils for civil engineering purposes. Published in 9 Parts. British Standards Institution.
13. BS EN ISO 17892-1: Geotechnical investigation and testing – Laboratory testing of soil – Determination of water content. British Standards Institution.

Internet References

14. British Geological Survey: http://www.bgs.ac.uk/data/mapViewers/home.html. Accessed January 2019.
15. Natural England Magic Map http://www.magic.gov.uk/MagicMap.aspx. Accessed January 2019.
16. Flood Map for Planning https://flood-map-for-planning.service.gov.uk Accessed January 2019.
17. Coal Authority. http://mapapps2.bgs.ac.uk/coalauthority/home.html Accessed January 2019.

APPENDIX A

DRAWINGS

Drawing 10019646-GLR-EHP-0001: Exploratory Hole Location Plan Phase 3A

Drawing 10019646-GLR-EHP-0002: Exploratory Hole Location Plan Phase 3B

REV	Date	Description	Drawn	Check	Approv
1	18Feb2019		SS	SH	GW

NOTES:

Legend

Trial Pits

Client

Homes England

Homes England

Site

Northstowe Phase 3

414-428 Midsummer Blvd,
Milton Keynes MK9 2EA, UK

Suitability Description:

Issued for Information

Designed	[redacted]	Date 18Feb2019	Signed	[redacted]	
Drawn	[redacted]	Date 18Feb2019	Signed	[redacted]	
Checked	[redacted]	Date 18Feb2019	Signed	[redacted]	
Approved	[redacted]	Date 18Feb2019	Signed	[redacted]	
Scale:	1:5,000	Datum:	AOD		
Original Size:	A3	Grid:	OS		
Suitability Code:	S2	Project Number:	10019646		

PROJECT:

Northstowe Phase 3A

TITLE:

Exploratory Hole Location Plan

ARCADIS Design & Consultancy for natural and built assets

Registered office:
Arcadis House
34 York Way,
London
N1 9AB

Coordinating Office:
10 Medawar Road,
The Surrey Research Park,
Guildford, Surrey GU2 7AR | UK
Office: +44 (0) 1483 803000

www.arcadis.com

Drawing Number: 10019646-GLR-EHP-0001

Revision: 01

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REV	Date	Description	Drawn	Check	Approv
1	18Apr2019		SS	SH	GW

NOTES:

Legend

- Handpits
- Cable percussive boreholes

Client

Homes England

Homes England

Site

Northstowe Phase 3

414-428 Midsummer Blvd,
Milton Keynes MK9 2EA, UK

Suitability Description: Issued for Information

Designed	Reg	Date 18Apr2019	Signed	R
Drawn	Reg	Date 18Apr2019	Signed	R
Checked	Reg	Date 18Apr2019	Signed	R
Approved	Re	Date 18Apr2019	Signed	R
Scale:	1:6,000	Datum:	AOD	
Original Size:	A3	Grid:	OS	
Suitability Code:	S2	Project Number:	10019646	

PROJECT:

Northstowe Phase 3B

TITLE:

Exploratory Hole Location Plan

ARCADIS Design & Consultancy for natural and built assets

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Drawing Number: 10019646-GLR-EHP-0002

Revision: 01

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APPENDIX B

STANDARD PROCEDURES

B0 General Principles

This ground investigation was undertaken in general accordance with the principles of BS EN 1997-1 [1] and BS EN 1997-2 [2] and the advice given in BS5930:2015 [8], which, provides complimentary guidance on the application of the primary standards. Where the requirements of the ground investigation specification differ from these primary standards, the investigation methodology was adapted as required and specific notes regarding methods and techniques employed were made in the appropriate report sections.

B1 Buried Services

Service clearance was undertaken in accordance with Arcadis' *Safety, Health and Environment (SHE) Standard – Avoidance of Sub-Surface Hazards and Structures Standard.* This document details the methods and safe working practices used to undertake excavations safely. Prior to breaking ground, services plans were consulted and the area scanned using a Cable Avoidance Tool (CAT) with detected signals marked on the ground. For all investigation positions, other than for machine excavated trial pits, hand excavated inspection pits are completed to 1.20 m bgl prior to the use of drilling and boring plant.

B2 Sampling requirements

The selection of sample types and sampling techniques has been chosen to take account of the soil fabric, size and quality of sample required based on whether the soils mass properties or the intact material properties of the ground are to be determined in subsequent laboratory tests. BS EN ISO 22475-1 [4] describes three generic sample groups that are:

a. Sampling by drilling. Generally a disturbed sample recovered from the drilling tool or digging equipment, typically meeting Class 3 to Class 5 requirements, with the recovered material being stored in bulk bags or sealed jar or tub containers.
b. Sampling by sampler. Typically referred to as open tube or drive sampling in which a tube with a sharp cutting edge is driven into the ground either by static thrust or dynamically driven to give a relatively undisturbed sample of Class 1 or Class 2 but may result in a Class 3 sample.
c. Block sampling. Cylindrical large diameter samples or cuboid hand-cut samples usually relatively undisturbed Class 1 and Class 2.

The open-tube sampling equipment used on the site was of a type and design that conformed to BS EN ISO 22475-1. For the purpose of this ground investigation block sampling was not required.

Generally, samples were assessed on site and any unexpected deterioration in sample quality was reported to the ground engineer by the lead drilling technician.

Sufficient and representative samples were taken to allow the geo-mechanical properties of the ground to be adequately characterised and to enable the sequence of soil strata to be described by an engineering geologist or geotechnical engineer.

Where samples have been taken for chemical tests the drilling method attempted to adopt dry drilling over the sampling range that generally was achieved by the use of drill casing to separate and isolate the upper soil layers and exclude groundwater. Cross-contamination was further reduced by regular cleaning of sampling tools. Sample integrity was maintained by sealing samples immediately on collection and storing the samples in a temperature controlled cool box. Samples were despatched from the site at the end of the shift on which they were collected or as required in the project specification. Details of best practice storage, preservation and decontamination measures undertaken are given below:

Task	Soil	Groundwater	Ground Gas
Storage	Glass jars and vials supplied by the laboratory were used for the collection of soil samples to be analysed for volatile compounds. Plastic one-litre tubs were used to collect soil samples for metals analysis.	Glass vials supplied by the laboratory were used for the collection of samples to be analysed for volatile compounds. Samples to be analysed for lower volatility compounds were stored in laboratory prepared glass bottles.	1.4L Canisters supplied by the laboratory.
Preservation	Filling of sample containers as far as practicable to minimise headspace and low storage temperature to minimise the potential for volatilisation and biodegradation of petroleum hydrocarbon compounds prior to analysis.		Not required.
Decontamination	Disposable gloves were worn and changed between sample collection to prevent cross-contamination.	Groundwater samples were collected using dedicated disposable tubing / bailers, that were changed between monitoring well locations in order to prevent cross-contamination.	Disposable gloves were worn and changed between sample collection to prevent cross contamination.
Transport	Samples stored in dedicated sample boxes provided by the laboratory. Sample details and analytical requests were recorded on the laboratory chain of custody form included with samples, prior to dispatching to laboratory for analysis. Samples were dispatched to the laboratory on the day of sampling.		

B3 Sample description

Sample description was undertaken by the Arcadis site geologist in accordance with BS 5930: 2015. The descriptions of the individual samples were used to identify the sequence of strata at the exploratory hole location and from which representative exploratory hole logs were drawn.

B4 *In situ* testing

In situ geotechnical tests were undertaken taking account of the investigation scope and requirement to attain the appropriate parameters required in the geotechnical design. The tests were undertaken in accordance with the requirements of the relevant parts of BS EN ISO 22476 [5, 6, 7] and other methods as follows:

Standard penetration testing

Standard penetration tests were carried out in accordance with BS EN ISO 22476-3, BS EN 1997-2 and the national Annex to BS EN 1997-2. The test records are presented on the borehole logs as blow counts for each increment with the N-value as the total number of blows of the four main test increments.

Where the N-value exceeds a total of 50 blows, the test reports the penetration in millimetres for the last test increment recorded, and the N value is indicated as greater than 50,

e.g. 4,5/12,14,18, 6 for 10 mm

indicates that the seating blows (4 and 5) were completed and that the test terminated in the 4th increment after penetrating 10 mm.

Where the seating blows exceeded 25 blows for less than 150 mm; the test was stopped and the rods remarked after which, the main drive was continued. The test is then reported as the number of blows in each seating drive for the recorded penetration with the results of the main drive given as above,

e.g. 14/11 for 45 mm/12,14,16, 8 for 10 mm.

In certain circumstances where groundwater in-flow may affect the test, particularly in fine sand or silt, low SPT blow counts may be recorded. Where the SPT blow count was very low, N values of 5 or less, the test was, at the discretion of the site engineer, continued for a further 300 mm, recording blows for each 75 mm increment. **This is not** a standard penetration test value, it does however give an indication of potential disturbance to the ground.

B5 Data transfer format

The data collated during the ground investigation has been organised and managed using the “AGS data format” that allows data transfer between different disciplines and organisations in accordance with BS 8574 [9].

B6 References

1. BS EN 1997-1. 2004. Eurocode 7: Geotechnical Design. Part 1 General Rules. British Standards Institution, 2013 (revised text).
2. BS EN 1997-2. 2007. Eurocode 7: Geotechnical Design. Part 2 Ground Investigation and testing. British Standards Institution, 2010 (revised text).
3. BS EN ISO 22282-1:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 1: General Rules. British Standards Institution.
4. BS EN ISO 22475-1. Geotechnical investigation and testing – Sampling methods and groundwater measurements – Part 1 Technical principles for execution.
5. BS EN ISO 22476-1:2015. Geotechnical investigation and testing – Field testing – Part 1: Electrical cone and piezocone test. British Standards Institution
6. BS EN ISO 22476-2. Geotechnical investigation and testing – Field testing – Part 2: Dynamic Probing. British Standards Institution
7. BS EN ISO 22476-3 2005. Geotechnical investigation and testing – Field testing – Part 3: Standard penetration test. British Standards Institution
8. BS 5930: 2015. Code of practice for ground investigation. British Standards Institution.
9. BS 8574. Code of practice for the management of geotechnical data for ground engineering projects.
10. BS 1377-9. 1990. Methods of test for soils for civil engineering purposes. Part 9: In-situ tests. British Standards Institution.
11. TRL. 2004. Dynamic cone penetrometer tests and analysis. TRL Technical Report PR IN 277-04. Transport Research Laboratory, Crowthorne, England.

B7 Exploratory Hole Key

Key to Exploratory Hole Symbols and Abbreviations

SAMPLE TYPES

B	Bulk disturbed sample	ES	Environmental soil sample	U	Undisturbed sample
C	Core sample	EW	Environmental water sample	UT	Undisturbed thin wall sample
CBR-D	Disturbed sample from CBR test area	G	Gas sample	W	Water sample
CBR-U	Undisturbed sample from CBR test area	L	Liner sample		
D	Small disturbed sample	SPT	SPT split spoon sample		

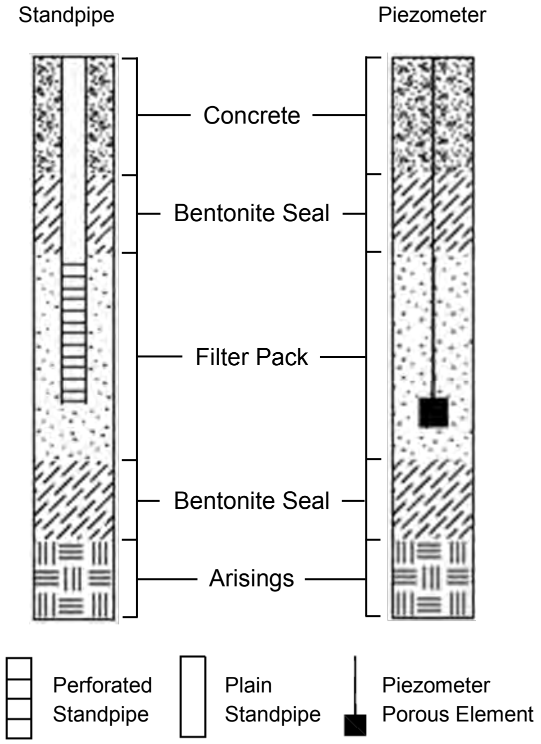
IN-SITU TESTING

SPTs	Standard Penetration Test (using a split spoon sampler)
SPTc	Standard Penetration Test (using a solid 60 degree cone)
N	Recorded SPT ‘N’ Value *
-/-	Blows/Penetration (mm) after seating blows totalling 150 mm
MX	Mexi Probe Test (records CBR as %)
HV	Hand Shear Vane Test (undrained shear strength quoted in kPa)
HP	Hand Penetrometer Test (kg/m^3)
( )	Denotes residual test value
PID	Photo Ionisation Detector (ppm) *
Kf/Kr	Permeability Test (f = falling head, r = rising head quoted in ms^{-1})
HPD	High Pressure Dilatometer Test (pressure meter)
PKR	Packer / Lugeon Permeability Test
CBR	California Bearing Ratio Test

ROTARY CORE DETAILS

TCR	Total Core Recovery, %
SCR	Solid Core Recovery, %
RQD	Rock Quality Designation (% of intact core >100 mm)
FI	Fracture Spacing (average fracture spacing; in mm, over indicated length of core) * *
NI	Non-Intact Core
AZCL	Assumed Zone of Core Loss

INSTALLATION & BACKFILL DETAILS



GROUNDWATER

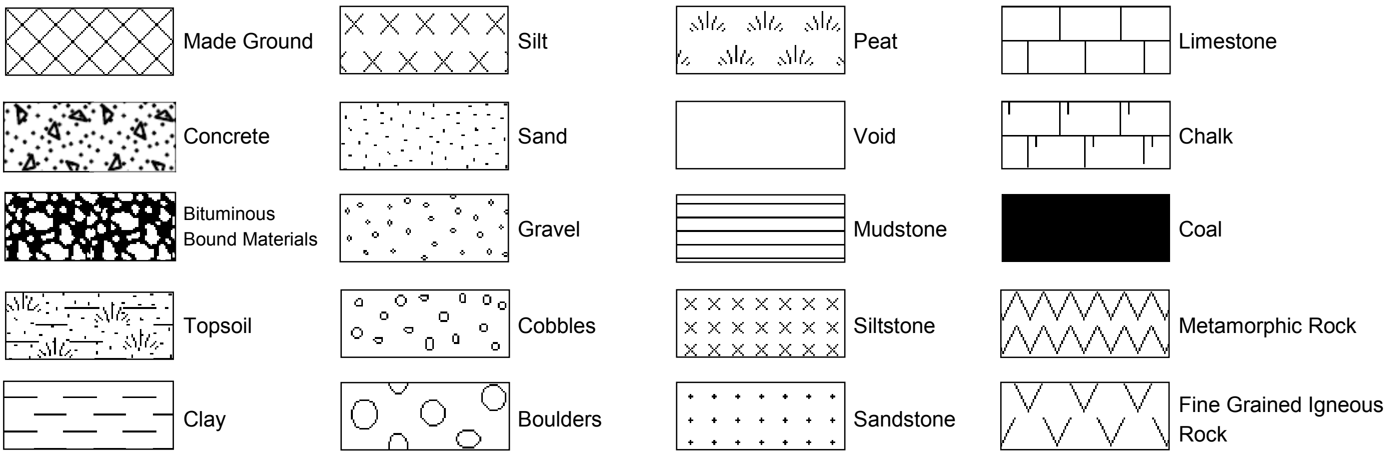
▽ Groundwater strike

▼ Standing water level after 20 minutes; 1st, 2nd etc (number denotes level order)

STRATUM BOUNDARIES

—— Unit boundary

STRATA LEGENDS - Note: Composite strata types are shown by combining symbols



* Where a single value is quoted this is the uncorrected ‘N’ value for a full 300 mm test drive following a seating drive of 150mm. Where the full test drive penetration is not achieved the number of blows is quoted for the penetration below the test total of 300mm, e.g.: 50/75.

* * The minimum, average and maximum are shown e.g. 5/45/125.

APPENDIX C

EXPLORATORY HOLE LOGS

ARCADIS Percussive Borehole Log

BH1

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**9.44**	**25/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539181.13**	**268325.81**	**25/01/2019**	**Sheet 1 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Depth (Thickness)	Level
0.10	D1	0.10	PID	<1ppm		25/01/2019 00:00	0.00	Soft becoming firm brown mottled orange sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of flint. [AMPTHILL CLAY FORMATION]		
0.10 - 0.20	ES1									
0.20	B1	0.30	PID	<1ppm						
0.30	D2									
0.30 - 0.40	ES2	0.50	PID	<1ppm						
0.50	B2									
0.50 - 0.60	ES3									
1.00	D3	1.00	PID	<1ppm						
1.00 - 1.10	ES4									
1.50	B3	1.50	SPT(S)	N=14 (1,1/2,2,5,5)	Dry					
1.50	D4								(3.20)	
2.00	D5	2.00	PID	<1ppm						
2.00 - 2.10	ES5									
2.00 - 2.30	EW1									
2.50	D6	2.50	SPT(S)	N=14 (1,2/3,3,3,5)	Dry					
2.53	B4									
3.00 - 3.10	ES6	3.00	PID	<1ppm						
3.20	D7	3.20	PID	<1ppm				Stiff dark grey slightly sandy CLAY. [AMPTHILL CLAY FORMATION]	3.20	6.24
3.20 - 3.30	ES7									
3.50	B5	3.50	SPT(S)	N=15 (2,2/2,3,5,5)	Dry					
3.50	B6									
3.50	D8									
4.00	D9	4.00	PID	<1ppm						
4.00 - 4.10	ES8									
4.50 - 4.88	UT1			Ublow=35						
4.88	D10									
5.50	B7	5.50	SPT(S)	N=26 (2,3/5,5,7,9)	Dry					
5.50	D11									
6.00 - 6.10	ES9	6.00	PID	<1ppm						
									(7.30)	
7.00	D12									
7.50	B8			Ublow=65						
7.50	UT2									
8.00	D13	8.00	PID	<1ppm						
8.00 - 8.10	ES10									
8.50	B9	8.50	SPT(S)	N=32 (3,5/5,7,9,11)	Dry					
8.50	D14									
8.50 - 9.00	EW2									
9.00	D15									
10.00	D16									

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit										150	10.50	150	3.50			
1.20	10.50	Cable Percussion																

Remarks
Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. No groundwater encountered.

Termination Depth: 10.50m

AGS — Arcadis Cymru House, St Mellons Business Park, Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log

BH1

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**9.44**	**25/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539181.13**	**268325.81**	**25/01/2019**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA		Depth (Thickness)	Level	Install/ Backfill
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend			
						25/01/2019 16:00	3.20	Stiff dark grey slightly sandy CLAY. [AMPTHILL CLAY FORMATION]		10.50	-1.06	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00 1.20	1.20 10.50	Inspection Pit Cable Percussion										150	10.50	150	3.50			

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. No groundwater encountered.

Termination Depth: 10.50m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log — BH2

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**7.91**	**29/01/2019**	**1:50**
Client: **Homes England**	Easting (OS mE): **539668.01**	Northing (OS mN): **268089.67**	End Date: **30/01/2019**	**Sheet 1 of 2**

Samples Depth	Type/No.	Tests Depth	Type/No.	Results	Water Strikes
0.10	B1	0.10	PID	<1ppm	
0.10	ES1				
0.20	D1				
0.30	B2	0.30	PID	<1ppm	
0.30	ES2				
0.50	B3	0.50	PID	<1ppm	
0.50	ES3				
0.70	B4	0.70	PID	<1ppm	
0.70	D2				
0.70	ES4				
1.00	ES5	1.00	PID	<1ppm	
1.50 - 2.00	B5	1.50	SPT(C)	N=32 (2,2/3,7,9,13)	1.3
1.50 - 2.00	EW1				
2.00	ES6	2.00	PID	<1ppm	
2.50 - 3.00	B6	2.50	SPT(C)	N=32 (2,3/5,7,7,13)	2
3.00	ES7	3.00	PID	<1ppm	
3.50 - 4.00	B7	3.50	SPT(C)	N=40 (3,5/5,11,11,13)	3
4.00	ES8	4.00	PID	<1ppm	
4.50 - 5.00	B8	4.50	SPT(C)	N>50 (1,3/7,13,13,17 for 0mm)	3.8
5.00	ES9	5.00	PID	<1ppm	
5.50 - 6.00	B9	5.50	SPT(C)	N=34 (2,5/12,12,5,5)	3.1
5.70	B10	5.70	PID	<1ppm	
5.70	ES10				
6.00	D3				
7.00	D4	7.00	PID	<1ppm	
7.00	ES11				
7.50 - 7.95	D5	7.50	SPT(S)	N=13 (1,2/2,3,3,5)	Dry
7.50 - 8.00	B11				
8.00	D6				
8.50	UT1			Ublow=65	
8.50 - 9.00	B12				
8.50 - 9.00	EW2				
9.00	D7	9.00	PID	<1ppm	
9.00	ES12				
10.00	D8	10.00	SPT(S)	N=25 (2,5/5,5,6,9)	Dry
10.00 - 10.45	D9				

Progress

Date Time	Casing	Water
29/01/2019 08:00	0.00	
29/01/2019 16:00	6.00	
30/01/2019 08:00	6.00	

Strata

Description	Depth (Thickness)	Level
TOPSOIL: Very soft to soft brown silty slightly sandy CLAY. Sand is medium to coarse. Occasional rootlets.	(0.30) 0.30	7.61
Soft grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of flint. Sand is fine and medium. [RIVER TERRACE DEPOSITS]	(0.40) 0.70	7.21
Dense becoming very dense light greyish brown and white slightly silty very gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium flint and siltstone. [RIVER TERRACE DEPOSITS]	(5.00) 5.70	2.21
Stiff to very stiff dark grey and white slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subangular to subrounded fine to medium siltstone. [AMPTHILL CLAY FORMATION]	(4.80)	

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.50	Cable Percussion

Chiselling

Hard Strata From	Hard Strata To	Duration

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
29/01/2019 14:34	4.50	20	4.5		

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
150	10.50	150	6.00

Water Added

From	To	Volume (ltr)
0.70	5.70	200

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl.

Termination Depth: 10.50m

Arcadis Cymru House, St Mellons Business Park, Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	Arcadis Consulting (UK) Ltd	MT	LC

ARCADIS Percussive Borehole Log

BH2

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**7.91**	**29/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539668.01**	**268089.67**	**30/01/2019**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA		Depth (Thickness)	Level	Install/ Backfill
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend			
10.00 - 10.50	B13					30/01/2019 16:00	6.00	Stiff to very stiff dark grey and white slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subangular to subrounded fine to medium siltstone. [AMPTHILL CLAY FORMATION]		10.50	-2.59	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00	1.20	Inspection Pit				29/01/2019 14:34	4.50	20	4.5			150	10.50	150	6.00	0.70	5.70	200
1.20	10.50	Cable Percussion																

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl.

Termination Depth: 10.50m

ARCADIS Percussive Borehole Log — BH3

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**5.85**	**24/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539195.74**	**267955.11**	**25/01/2019**	**Sheet 1 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes
0.10	B1	0.10	PID	<1ppm	
0.10	D1				
0.10	ES80				
0.30	B2	0.30	PID	<1ppm	
0.30	ES81				
0.50	ES82	0.50	PID	<1ppm	
1.00	ES83	1.00	PID	<1ppm	
1.20	D2				
1.50 - 1.88	UT1			Ublow=35	
1.88 - 1.93	D3				
2.00	D4	2.00	PID	<1ppm	
2.00	ES84				
2.50	B3	2.50	SPT(S)	N=10 (2,2/2,2,3,3)	Dry
2.50 - 2.95	D5				
3.00	D6	3.00	PID	<1ppm	
3.00	ES85				
3.50 - 3.79	UT2			Ublow=35	
3.79 - 3.84	D7				
3.80 - 4.00	D8				
4.00	B4	4.00	PID	<1ppm	
4.00	ES86				
4.50 - 4.95	D9	4.50	SPT(S)	N=15 (1,2/3,3,4,5)	Dry
4.50 - 5.00	B5				
5.00	D10				
5.50 - 5.93	U3			Ublow=55	
5.93 - 5.98	D11				
6.00	ES87	6.00	PID	<1ppm	
7.00	D12	7.00	SPT(S)	N=26 (3,3/5,5,7,9)	Dry
7.00 - 7.45	D13				
7.00 - 7.50	B6				
8.00	D14	8.00	PID	<1ppm	
8.00	ES88				
8.50	UT4			Ublow=85	
8.50 - 9.00	B7				
9.00	D15				
10.00	B8	10.00	SPT(S)	N=30 (3,5/5,7,7,11)	Dry
10.00	D16	10.00	PID	<1ppm	

PROGRESS Date Time	Casing	Water
24/01/2019 08:00		0.00

STRATA Description	Depth (Thickness)	Level
Soft brown slightly gravelly sandy CLAY. Sand is fine and medium. Gravel is subangular subrounded fine of flint. [AMPTHILL CLAY FORMATION]	(1.20) 1.20	4.65
Firm brown slightly gravelly CLAY. Gravel is subangular to subrounded fine of flint. [AMPTHILL CLAY FORMATION]	(0.80) 2.00	3.85
Firm greyish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine of flint and siltstone. [AMPTHILL CLAY FORMATION]	(8.50)	
Gravel is fine to medium siltstone.		
Siltstone band		
Becomes stiff.		

DRILLING TECHNIQUE From	To	Type
0.00	1.20	Inspection Pit
1.20	10.45	Cable Percussion

CHISELLING Hard Strata From	To	Duration
3.70	4.00	01:00

WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
24/01/2019 13:00	3.70	20	3.60	3.50	4.00

HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth
150	10.50	150	4.20

WATER ADDED From	To	Volume (ltr)

Remarks
Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. Soakaway test undertaken between 3.00m and 4.61m.

Termination Depth: 10.50m

Arcadis Cymru House, St Mellons Business Park, Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log

BH3

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**5.85**	**24/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539195.74**	**267955.11**	**25/01/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing / Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
10.00 10.00 - 10.45	ES89 D17					24/01/2019 16:00	4.20	Firm greyish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine of flint and siltstone. [AMPTHILL CLAY FORMATION] Becoming stiff and slightly gravelly. Gravel is subrounded to subangular fine to medium siltstone.		10.50	-4.65	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00 1.20	1.20 10.45	Inspection Pit Cable Percussion	3.70	4.00	01:00	24/01/2019 13:00	3.70	20	3.60	3.50	4.00	150	10.50	150	4.20			

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. Soakaway test undertaken between 3.00m and 4.61m.

Termination Depth: 10.50m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log

BH4

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**6.93**	**22/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539324.67**	**267833.26**	**24/01/2019**	**Sheet 1 of 2**

SAMPLES / TESTS / PROGRESS

Samples Depth	Type/No.	Tests Depth	Type/No.	Results	Water Strikes	Date Time	Casing Water
0.10	D1	0.10	PID	<1ppm		22/01/2019 12:00	
0.10	ES81						
0.20 - 0.30	B1						
0.40	D2	0.40	PID	<1ppm			
0.40	ES82						
0.40 - 0.60	B2						
1.00 - 1.50	EW1						
1.20	D3	1.20	PID	<1ppm			
1.20 - 1.50	B3						
1.20 - 1.60	ES83			Ublow=15			
1.50 - 1.77	U1						
1.77 - 1.82	D4						
2.00	D5	2.00	PID	<1ppm			
2.00	ES84						
2.50 - 2.95	D6	2.50	SPT(S)	N=8 (1,1/2,2,2,2)	Dry		
2.50 - 3.00	B4	2.50	PID	<1ppm			
2.50 - 3.00	ES85						
3.00	D7						
3.10 - 3.50	B5	3.10	PID	<1ppm			
3.10 - 3.50	ES86						
3.50 - 4.00	B6	3.50	SPT(C)	N=12 (1,1/2,2,3,5)	2.5		
4.00	D8					22/01/2019 16:00	3.00 / 3.10
4.50 - 5.00	B7	4.50	SPT(C)	N=21 (2,3/4,4,6,7)	2.3		
5.00	D9						
5.50 - 6.00	B8	5.50	SPT(C)	N=48 (3,7/9,9,11,19)	2.1		
5.50 - 6.00	ES87	5.50	PID	<1ppm			
						23/01/2019 08:00	3.00
6.10	B9						
7.00	D10	7.00	SPT(S)	N=14 (2,2/3,3,4,4)	Dry		
7.00 - 7.45	D11						
7.00 - 7.50	B10						
8.00	D12						
8.50	UT2	8.50	PID	<1ppm			
8.50 - 9.00	B11			Ublow=55			
8.50 - 9.00	ES88						
8.50 - 9.00	EW2						
9.00	D13						
10.00	B12	10.00	SPT(S)	N=16 (2,3/3,4,4,5)	Dry		
10.00	D14						

STRATA

Description	Depth (Thickness)	Level
Soft to firm brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to medium of flint [TOPSOIL]	(0.35) 0.35	6.58
Soft orangish brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to medium of flint. [Possible Glacial Deposits]	(0.65) 1.00	5.93
Soft becoming firm greyish brown CLAY. [Possible Glacial Deposits]	(2.10) 3.10	3.83
Medium dense orangish brown , gravelly clayey fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of flint. [Possible Glacial Deposits]	(3.00) 6.10	0.83
Firm grey CLAY. [AMPTHILL CLAY FORMATION]	(4.35)	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.45	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration
5.70	5.70	01:00

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
22/01/2019 14:00	3.10	20	2.50	3.00	

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.00	150	6.10
150	10.45		

WATER ADDED

From	To	Volume (ltr)

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.45m bgl. Falling head test undertaken between 3.10m and 6.10m. Soakaway test undertaken between 8.00m and 10.00m

Termination Depth: 10.45m

Percussive Borehole Log

BH4

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**6.93**	**22/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539324.67**	**267833.26**	**24/01/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/ No.	TESTS Depth	TESTS Type/ No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
10.00 - 10.45	D15							Firm grey CLAY. [AMPTHILL CLAY FORMATION]				
								Becomes stiff.				
						23/01/2019 16:00	6.10			10.45	-3.52	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration
0.00	1.20	Inspection Pit	5.70	5.70	01:00
1.20	10.45	Cable Percussion			

WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
22/01/2019 14:00	3.10	20	2.50	3.00	

HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth
150	10.00	150	6.10
150	10.45		

WATER ADDED From	To	Volume (ltr)

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.45m bgl. Falling head test undertaken between 3.10m and 6.10m. Soakaway test undertaken between 8.00m and 10.00m

Termination Depth: 10.45m

ARCADIS Percussive Borehole Log

BH5

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**8.24**	**31/01/2019**	**1:50**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	**539703.90**	**267510.69**	**31/01/2019**	**Sheet 1 of 2**

SAMPLES

Depth	Type/No.
0.20	B1
0.20	D1
0.20	ES1
0.30	B2
0.30	ES2
0.50	D2
0.50	ES3
1.00	B3
1.00	ES4
1.50 - 2.00	B4
2.00	ES5
2.00 - 2.50	EW1
2.50 - 3.00	B5
3.00	ES6
4.50	B6
4.80	B7
4.80	ES7
5.00	D3
5.50 - 5.95	D4
5.50 - 6.00	B8
6.00	D5
6.00	ES8
7.00	D6
7.00 - 7.38	UT1
7.38 - 7.43	D7
8.00	D8
8.00	ES9
8.00 - 8.50	EW2
8.50 - 8.95	D9
8.50 - 9.00	B9
10.00	D10
10.00	ES10

TESTS

Depth	Type/No.	Results	Water Strikes
0.20	PID	<1ppm	
0.30	PID	<1ppm	
0.50	PID	<1ppm	
1.00	PID	<1ppm	
1.50	SPT(C)	N=28 (3,4/4,6,7,11)	Dry
1.50	PID	<1ppm	
2.50	SPT(C)	N=40 (3,4/7,7,11,15)	Dry
2.50	PID	<1ppm	
3.00	PID	<1ppm	
4.50	SPT(C)	N=39 (4,5/7,7,11,14)	3
4.50	PID	<1ppm	
4.80	PID	<1ppm	
5.00	PID	<1ppm	
5.50	SPT(S)	N=11 (2,2/2,3,3,3)	Dry
5.50	PID	<1ppm	
6.00	PID	<1ppm	
7.00	PID	<1ppm Ublow=55	
8.00	PID	<1ppm	
8.50	SPT(S)	N=24 (3,4/5,5,7,7)	Dry
8.50	PID	<1ppm	
10.00	PID	<1ppm	

PROGRESS

Date Time	Casing	Water
31/01/2019 08:00		0.00

STRATA

Description	Depth (Thickness)	Level
Soft brownish grey slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to medium flint. Frequent rootlets. [TOPSOIL]	(0.30) 0.30	7.94
Medium dense yellowish brown and white slightly silty very gravelly SAND. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of flint and siltstone. [RIVER TERRACE DEPOSITS] Becomes dense.	(4.50) 4.80	3.44
Stiff to very stiff dark grey slightly sandy CLAY. Sand is fine and medium. Occasional shell fragments. [AMPTHILL CLAY FORMATION]	(5.63)	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.43	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
31/01/2019 09:26	3.80	20	3.8		

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.43	150	5.00

WATER ADDED

From	To	Volume (ltr)
0.30	4.70	375

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.43m bgl.

Termination Depth: 10.43m

AGS — Arcadis Cymru House, St Mellons Business Park, Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Percussive Borehole Log

BH5

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**8.24**	**31/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539703.90**	**267510.69**	**31/01/2019**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA		Depth (Thickness)	Level	Install/ Backfill
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend			
10.00 - 10.38	UT2							Stiff to very stiff dark grey slightly sandy CLAY. Sand is fine and medium. Occasional shell fragments. [AMPTHILL CLAY FORMATION]				
10.38 - 10.43	D11					31/01/2019 16:00	5.00			10.43	-2.19	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00 1.20	1.20 10.43	Inspection Pit Cable Percussion				31/01/2019 09:26	3.80	20	3.8			150	10.43	150	5.00	0.30	4.70	375

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.43m bgl.

Termination Depth: 10.43m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

ARCADIS Trial Pit Log

HDP1

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**8.51**	**22/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539437.19**	**268147.40**	**22/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10 0.00 - 0.35	ES201 ES202	0.00	PID	<1ppm		Soft to firm dark brownish grey sandy slightly gravelly CLAY. With rare rootlets. Gravel is subangular medium of flint [TOPSOIL]		(0.10) 0.10	8.41	
0.30 - 0.45	ES203	0.30	PID	<1ppm		Firm dark brownish grey slightly sandy slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of flint. Rare chalk and charcoal. [AMPTHILL CLAY FORMATION]		(0.35) 0.45	8.06	

PLAN DETAILS	Remarks
0.3 x 0.3 Long Axis Orientation: 0 Shoring / Support: None Stability: Stable Groundwater (description): No Groundwater Encountered	Hand dug trial pit excavated to 0.45 m bgl and terminated after reaching scheduled depth. Termination Depth: 0.45m

Equipment Used	Contractor	Logged By	Checked By
Hand Tools	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Hand Dug Pit Photography Sheet

Project	Job No	Ground Level (mAOD)	Start Date	HDP1
Northstowe Phase 3	**10019646**	**8.51**	**22/01/2019**	
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539437.19**	**268147.40**	**22/01/2019**	

[HDP1 0.45 m bgl]

[HDP1 0.45 m bgl]

Arcadis Cymru House
St Mellons Business Park
Cardiff
CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
Hand Tools	**MT**	**SH**

ARCADIS Trial Pit Log

HDP2

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**6.72**	**22/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539183.82**	**267747.43**	**22/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		Soft to firm brownish grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of flint [TOPSOIL].		(0.39)		
0.30 - 0.35	ES202	0.30	PID	<1ppm						
0.38 - 0.40	ES203	0.38	PID	<1ppm				0.39	6.33	
						Firm to stiff yellowish brown slightly sandy silty CLAY. [AMPTHILL CLAY FORMATION]		(0.06) 0.45	6.27	

PLAN DETAILS

0.3

0.3

Long Axis Orientation:

0

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundwater Encountered

Remarks

Hand dug trial pit excavated to 0.45 m bgl and terminated after reaching scheduled depth.

Termination Depth:

0.45m

AGS Arcadis Cymru House St Mellons Business Park Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Hand Tools	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Hand Dug Pit Photography Sheet

HDP2

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**6.72**	**22/01/2019**
Client	Easting (OS mE)	Northing (OS mN)	End Date
Homes England	**539183.82**	**267747.43**	**22/01/2019**

[HDP2 0.45 m bgl]

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ARCADIS Trial Pit Log

HDP3

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**8.34**	**22/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539426.76**	**267567.64**	**22/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		Soft to firm dark grey sandy silty CLAY with frequent rootlets. [TOPSOIL]		(0.20) 0.20	8.14	
0.20 - 0.30	ES202	0.20	PID	<1ppm		Dark grey silty slightly gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium of flint. [RIVER TERRACE DEPOSITES] becoming brownish grey.		(0.27) 0.47	7.87	
0.35 - 0.40	ES203	0.35	PID	<1ppm						

PLAN DETAILS

0.3

0.3

Long Axis Orientation: 0

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundwater Encountered

Remarks

Hand dug trial pit excavated to 0.47 m bgl and terminated after reaching scheduled depth.

Termination Depth: 0.47m

Hand Dug Pit Photography Sheet

HDP3

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**6.72**	**22/01/2019**
Client	Easting (OS mE)	Northing (OS mN)	End Date
Homes England	**539426.76**	**267567.94**	**22/01/2019**

[HDP3 0.47 m bgl]

[HDP3 0.47 m bgl]

Arcadis Cymru House
St Mellons Business Park
Cardiff
CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
Hand Tools	**MT**	**SH**

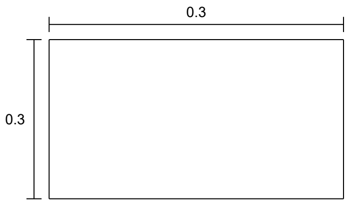
ARCADIS Trial Pit Log

HDP4

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**7.77**	**22/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539701.88**	**267712.63**	**22/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		Grass over soft brownish grey very sandy slightly gravelly SILT. With frequent rootlets. Gravel is angular to subangular fine to medium of flint. [TOPSOIL]		(0.10) 0.10	7.67	
0.20 - 0.31	ES202	0.20	PID	<1ppm		Soft to firm brownish grey sandy slightly gravelly CLAY. With occasional rootlets. Gravel is subangular to subrounded fine to coarse of flint and siltstone. [AMPTHILL CLAY FORMATION]		(0.21) 0.31	7.46	
0.40 - 0.47	ES203	0.40	PID	<1ppm		Firm to stiff yellowish brown sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of flint and siltstone. [AMPTHILL CLAY FORMATION]		(0.16) 0.47	7.30	

PLAN DETAILS



Long Axis Orientation: 0

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundwater Encountered

Remarks

Hand dug trial pit excavated to 0.47 m bgl and terminated after reaching scheduled depth.

Termination Depth: 0.47m

AGS

Arcadis Cymru House
St Mellons Business Park
Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Hand Tools	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

ARCADIS

Hand Dug Pit Photography Sheet

HDP4

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**7.77**	**22/01/2019**
Client	Easting (OS mE)	Northing (OS mN)	End Date
Homes England	**539701.88**	**267712.63**	**22/01/2019**

[HDP4 0.47 m bgl]

[HDP4 0.47 m bgl]

AGS

Arcadis Cymru House
St Mellons Business Park
Cardiff
CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used
Hand Tools

Logged By
MT

Checked By
SH

ARCADIS Trial Pit Log

HDP5

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**6.19**	**22/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539120.35**	**268178.18**	**22/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/ No.	TESTS Depth	TESTS Type/ No.	TESTS Results	Water Strikes	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		Soft to firm slightly sandy slightly gravelly CLAY. With occasional rootless. Gravel is subangular to rounded fine to medium of flint [TOPSOIL].		(0.39)		
0.30 - 0.39	ES202	0.30	PID	<1ppm				0.39	5.80	
0.40 - 0.45	ES203	0.40	PID	<1ppm		Stiff brownish grey and orangish brown slightly sandy CLAY. With occasional rootlets. [AMPTHILL CLAY FORMATION]		(0.06) 0.45	5.74	

PLAN DETAILS

0.3 × 0.3

Long Axis Orientation: 0

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundwater Encountered

Remarks

Hand dug trial pit excavated to 0.40 m bgl and terminated after reaching scheduled depth.

Termination Depth: 0.45m

Hand Dug Pit Photography Sheet

HDP5

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**6.19**	**22/01/2019**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**
Homes England	**539120.35**	**268178.18**	**22/01/2019**

[HDP5 0.45 m bgl]

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ARCADIS Trial Pit Log

HDP6

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**8.08**	**22/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539616.74**	**267958.78**	**22/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/ No.	TESTS Depth	TESTS Type/ No.	TESTS Results	Water Strikes	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		Soft to firm brownish grey sandy slightly gravelly SILT. With occasional rootlets. Gravel is subangular fine to medium of flint [TOPSOIL].		(0.31)		
0.20 - 0.31	ES202	0.20	PID	<1ppm				0.31	7.77	
0.40 - 0.45	ES203	0.40	PID	<1ppm		Firm orangish brown sandy slightly gravelly SILT. Gravel is subangular to subrounded fine to medium of flint and siltstone. [AMPTHILL CLAY FORMATION]		(0.14) 0.45	7.63	

PLAN DETAILS

0.3

0.3

Long Axis Orientation: 0

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundwater Encountered

Remarks

Hand dug trial pit excavated to 0.45 m bgl and terminated after reaching scheduled depth.

Termination Depth: 0.45m

Hand Dug Pit Photography Sheet

Project	Job No	Ground Level (mAOD)	Start Date	
Northstowe Phase 3	**10019646**	**8.08**	**22/01/2019**	**HDP6**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539616.74**	**267958.78**	**22/01/2019**	

[HDP6 0.45 m bgl]

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Arcadis Cymru House
St Mellons Business Park
Cardiff
CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
Hand Tools	**MT**	**SH**

ARCADIS Trial Pit Log — TP3001

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**10.29**	**25/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540954.21**	**264865.48**	**25/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		MADE GROUND: Soft brownish grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of concrete. With frequent rootlets.		(0.25)		
0.25 - 0.35	ES202	0.25	PID	<1ppm		Stiff brownish grey mottled orangish brown slightly sandy CLAY. Sand is fine to medium. [KIMMERIDGE CLAY FORMATION]		0.25 (0.15)	10.04	
		0.50 0.50 0.50	HV(1) HV(2) HV(3)	36(12)kPa 36(13)kPa 50(20)kPa		Firm to stiff pinkish brown mottled bluish grey sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subangular to subrounded fine to medium flint. With occasional 100 mm pockets of brownish orange fine to medium sand. [KIMMERIDGE CLAY FORMATION]		0.40	9.89	
		1.60 1.60 1.60	HV(1) HV(2) HV(3)	50(10)kPa 55(15)kPa 63(20)kPa		occasional to frequent 70 mm white and light brown silt pockets.		(2.75)		
						becoming grey mottled dark grey with frequent angular claystone gravel.				
						frequent elongated gypsum crystals.				
2.60 - 2.70	ES203	2.60	PID	<1ppm		becoming bluish grey with occasional shell fragments.				
								3.15	7.14	

PLAN DETAILS

Plan dimensions: 3.0 × 0.5

Long Axis Orientation: 130

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundwater Encountered

Remarks

Exploratory hole terminated after reaching scheduled depth at 3.15m bgl.

Termination Depth: 3.15m

AGS
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St Mellons Business Park
Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
JCB 3CX	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Trial Pit Photography Sheet

TP3001

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**10.29**	**25/01/2019**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**
Homes England	**540954.21**	**264865.48**	**25/01/2019**

[TP3001 3.15 m bgl]

[TP3001 Arisings]

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
JCB 3CX	**MT**	**SH**

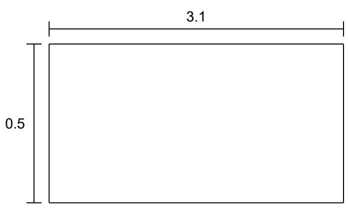
ARCADIS Trial Pit Log

TP3002

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**13.25**	**25/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**541047.62**	**265014.50**	**25/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		Greyish brown clayey slightly gravelly fine to medium SAND. Gravel is subangular to subrounded fine to medium of flint [TOPSOIL]		(0.30)		
0.30 - 0.40	ES202	0.30	PID	<1ppm		Firm brownish orange very sandy slightly gravelly CLAY. Gravel is subrounded fine to medium of flint. [RIVER TERRACE DEPOSITS]		0.30 (1.10)	12.95	
1.40 - 1.50	ES203	1.40	PID	<1ppm		Yellowish brown and light grey slightly silty fine to medium SAND. [RIVER TERRACE DEPOSITES]		1.40 (1.10)	11.85	
2.50 - 2.60	ES204	2.50	PID	<1ppm		subrounded to rounded medium flint gravel.		2.50	10.75	
		2.60	HV(1)	105(30)kPa		Firm to stiff bluish grey slightly sandy CLAY. [KIMMERIDGE CLAY FORMATION]		(0.10)		
		2.60	HV(2)	80(20)kPa		Firm to stiff dark grey CLAY. Occasional reddish brown staining. Rare lignite and partially decomposed plant fragments. [KIMMERIDGE CLAY FORMATION]		2.60 (0.40)	10.65	
		2.60	HV(3)	98(25)kPa						
		2.90	HV(4)	64(10)kPa						
		2.90	HV(5)	70(22)kPa						
		2.90	HV(6)	72(20)kPa				3.00	10.25	

PLAN DETAILS



Long Axis Orientation:

115

Shoring / Support: None

Stability: Partially Stable

Groundwater (description): No Groundwater Encountered

Remarks

Exploratory hole terminated at scheduled depth of 3.00m bgl.

Termination Depth: 3.00m

Trial Pit Photography Sheet

TP3002

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**13.25**	**25/01/2019**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**
Homes England	**541047.62**	**265014.50**	**25/01/2019**

[TP3002 3.00 m bgl]

[TP3002 Arisings]

ARCADIS Trial Pit Log

TP3003

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**9.93**	**24/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**541036.52**	**264797.87**	**24/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	STRATA Description	Depth (Thickness)	Level
0.00 - 0.10	ES1	0.00	PID	<1ppm		Grass over firm brownish grey sandy CLAY. Frequent rootlets. Rare subangular brick cobble [TOPSOIL]	(0.13)	
0.13 - 0.20	ES2	0.13	PID	<1ppm		MADE GROUND: Firm orangish brown and grey sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of flint and concrete. Occasional rootlets.	0.13 (0.45)	9.80
0.58 - 0.65	ES3	0.58 0.58 0.58 0.58	PID HV(1) HV(2) HV(3)	<1ppm 40(18)kPa 42(16)kPa 52(20)kPa		Firm to stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine of flint. Occasional lignite. [KIMMERIDGE CLAY FORMATION]	0.58 (0.21)	9.35
0.79 - 0.85	ES4	0.79 1.10	PID HV(4)	<1ppm 56(20)kPa		Firm grey mottled greyish brown CLAY. Occasional rootlets and relict rootlets. [KIMMERIDGE CLAY FORMATION] Land drain occasional 100-200mm pockets of medium to coarse sand and 100mm pockets or stiff grey clay. Oyster shell and frequent gypsum crystals.	0.79 (2.31)	9.14
							3.10	6.83

PLAN DETAILS

3.2 × 0.5

Long Axis Orientation: 106

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundater Encountered

Remarks

Exploratory hole terminated after reaching scheduled depth at 3.10m bgl. No groundwater encountered.

Termination Depth: 3.10m

Trial Pit Photography Sheet

TP3003

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**9.93**	**24/01/2019**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**
Homes England	**541036.52**	**264797.87**	**24/01/2019**

[TP3003 3.10 m bgl]

[TP3003 Arisings]

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
JCB 3CX	**MT**	**SH**

ARCADIS Trial Pit Log

TP3004

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**12.97**	**25/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**541390.94**	**265136.72**	**25/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		TOPSOIL: Grass over firm dark greyish brown sandy CLAY. Frequent rootlets.		(0.17) 0.17	12.80	
0.17 - 0.25	ES202	0.17	PID	<1ppm		Firm to stiff greyish brown and orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of flint. Occasional rootlets. Rare manganese nodules (1-3mm) and partially decayed vegetation. [KIMMERIDGE CLAY FORMATION]		(0.33) 0.50	12.47	
0.50 - 0.60	ES203	0.50 0.50 0.50 0.50	PID HV(1) HV(2) HV(3)	<1ppm 84(15)kPa 86(20)kPa 88(19)kPa		Stiff orangish brown mottled bluish grey slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to medium of flint and siltstone. Occasional 20mm bands of fine to medium brown sand. [KIMMERIDGE CLAY FORMATION]		(0.30) 0.80	12.17	
		1.90	HV(4)	130(N/A)kPa		Very stiff locally extremely closely fissured. Fissures are smooth, undulating with occasional light grey infill. Bluish grey mottled orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of siltstone and weathered siltstone. Occasional bioturbation, relict rootlet canals and partially decomposed rootlets. Rare flint. [KIMMERIDGE CLAY FORMATION]		(2.30) 3.10	9.87	

PLAN DETAILS

3.0

0.5

Long Axis Orientation: 173

Shoring / Support: None

Stability: Stable

Groundwater (description): No Groundater Encountered

Remarks

Exploratory hole terminated after reaching scheduled depth at 3.10m bgl.

Termination Depth: 3.10m

Trial Pit Photography Sheet

TP3004

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**12.97**	**25/01/2019**
Client	Easting (OS mE)	Northing (OS mN)	End Date
Homes England	**541390.94**	**265136.72**	**25/01/2019**

[TP3004 3.10 m bgl]

[TP3004 Arisings]

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
JCB 3CX	**MT**	**SH**

ARCADIS Trial Pit Log

TP3005

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**14.46**	**25/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**541228.36**	**265145.55**	**25/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/ No.	TESTS Depth	TESTS Type/ No.	TESTS Results	Water Strikes	STRATA Description	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		TOPSOIL: Grass over soft sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of flint. Frequent rootlets	(0.45)		
0.45 - 0.55	ES202	0.45	PID	<1ppm		Firm orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of flint. [RIVER TERRACE DEPOSITS] becoming gravelly.	0.45 (0.31)	14.01	
0.76 - 0.85	ES203	0.76	PID	<1ppm		Light yellowish brown and light grey clayey sandy GRAVEL. Gravel is subangular to subrounded fine to coarse of flint and siltstone. [RIVER TERRACE DEPOSITES]	0.76 (0.94)	13.70	
1.70 - 1.80	ES204	1.70	PID	<1ppm		Light greyish brown and white very gravelly fine to coarse SAND. With a low cobble content. Cobbles are subrounded to rounded flint. Gravel is subangular to subrounded fine to coarse of flint. Rare 10mm bands of soft white extremely closely laminated silt. [RIVER TERRACE DEPOSITES] becoming very light grey and white.	1.70 (1.40)	12.76	
2.70 - 2.80	ES205	2.70	PID	<1ppm	▼ (approx. 2.55)	becoming silty very gravelly with occasional 50mm pockets of fine white and brown sand and silt.	3.10	11.36	

PLAN DETAILS

2.9 × 0.5

Long Axis Orientation: 150

Shoring / Support: None

Stability: Partially Stable

Groundwater (description): Fast flow

Remarks

Exploratory hole terminated after reaching scheduled depth at 3.10m bgl.

Termination Depth: 3.10m

AGS Arcadis Cymru House St Mellons Business Park Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
JCB 3CX	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Trial Pit Photography Sheet

TP3005

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**14.46**	**25/01/2019**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**
Homes England	**541228.36**	**265145.55**	**25/01/2019**

[TP3005 3.10 m bgl]

[TP3005 Arisings]

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
JCB 3CX	**MT**	**SH**

ARCADIS Trial Pit Log

TP3006

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**12.15**	**25/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540350.69**	**265472.91**	**25/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/ No.	TESTS Depth	TESTS Type/ No.	TESTS Results	Water Strikes	STRATA Description	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES201	0.00	PID	<1ppm		TOPSOIL: Firm greyish brown sandy CLAY. Sand is fine to medium. With frequent rootlets.	(0.34)		
0.34 - 0.45	ES202	0.34	PID	<1ppm		Soft to firm brownish grey mottled orangish brown sandy CLAY. Sand is fine to medium. [RIVER TERRACE DEPOSITS]	0.34 (0.33)	11.81	
0.67 - 0.75	ES203	0.67	PID	<1ppm		Firm to stiff light orangish brown mottled bluish grey sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of siltstone. With frequent 200 mm pockets of firm to stiff bluish grey clay and white silt. [RIVER TERRACE DEPOSITS]	0.67 (0.83)	11.48	
1.50 - 1.60	ES204	1.50	PID	<1ppm	▼	Brownish yellow clayey sandy GRAVEL. Sand is fine to coarse. Gravel is angular to subangular fine to medium of flint and siltstone. [RIVER TERRACE DEPOSITES]	1.50 (0.30)	10.65	
1.80 - 1.90	ES205	1.80	PID	<1ppm		Firm to stiff bluish grey mottled orangish brown slightly sandy CLAY. Sand is fine to medium. [KIMMERIDGE CLAY FORMATION]	1.80 (1.35)	10.35	
		2.00 2.00 2.00	HV(1) HV(2) HV(3)	70(21)kPa 72(21)kPa 84(22)kPa					
						becoming dark grey and slightly sandy with occasional fossil fragments (shell)			
		3.00 3.00 3.00	HV(1) HV(2) HV(3)	72(21)kPa 80(21)kPa 87(20)kPa			3.15	9.00	

PLAN DETAILS

2.9 × 0.5

Long Axis Orientation: 160

Shoring / Support: None

Stability: Stable

Groundwater (description): Fast flow

Remarks

Exploratory hole terminated after reaching scheduled depth at 3.15m bgl.

Termination Depth: 3.15m

![ARCADIS]

Trial Pit Photography Sheet

Project	Job No	Ground Level (mAOD)	Start Date	
Northstowe Phase 3	**10019646**	**12.15**	**25/01/2019**	**TP3006**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540350.69**	**265472.91**	**25/01/2019**	

[TP3006 3.20 m bgl]

[TP3006 Arisings]

ARCADIS Trial Pit Log

TP3007

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**11.93**	**24/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540443.26**	**265485.44**	**24/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES1	0.00	PID	<1ppm		TOPSOIL: Grass over dark grey slightly sandy silty CLAY. Frequent rootlets.		(0.16) 0.16	11.77	
0.16 - 0.25	ES2	0.16	PID	<1ppm		Soft to firm orangish brown slightly sandy CLAY. [RIVER TERRACE DEPOSITS]		(0.34) 0.50	11.43	
0.50 - 0.60	ES3	0.50	PID	<1ppm		Firm to stiff orangish brown and white slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded of siltstone. [RIVER TERRACE DEPOSITS]		(0.10) 0.60	11.33	
0.60 - 0.70	ES4	0.60	PID	<1ppm		Firm very light grey clayey sandy SILT. Occasional 20-70mm bands of brown mottled grey fine to medium sand. [RIVER TERRACE DEPOSITS]		(1.30) 1.90	10.03	
					▼	Brown clayey very gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium of flint and siltstone. [RIVER TERRACE DEPOSITES]		(0.10) 2.00	9.93	
2.00 - 2.10	ES5	2.00 2.00 2.00 2.00	PID HV(1) HV(2) HV(3)	<1ppm 110(25)kPa 84(22)kPa 90(21)kPa		Stiff bluish grey mottled orangish brown CLAY. [KIMMERIDGE CLAY FORMATION]		(1.00) 3.00	8.93	
		2.90 2.90 2.90	HV(4) HV(5) HV(6)	100(20)kPa 100(35)kPa 95(28)kPa						

PLAN DETAILS

3.2

0.5

Long Axis Orientation:

43

Shoring / Support: None

Stability: Stable

Groundwater (description): Fast flow

Remarks

Trial pit terminated after reaching scheduled depth at 3.00m bgl.

Termination Depth: 3.00m

AGS Arcadis Cymru House St Mellons Business Park Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
JCB 3CX	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Trial Pit Photography Sheet

TP3007

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**11.93**	**24/01/2019**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**
Homes England	**540443.26**	**265485.44**	**24/01/2019**

[TP3007 3.00 m bgl]

[TP3007 Arisings]

ARCADIS Trial Pit Log

TP3008

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**12.44**	**24/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540620.69**	**265533.97**	**24/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.08 0.08 - 0.20	ES1 ES2	0.00 0.08	PID PID	<1ppm <1ppm		TOPSOIL: Grass over soft brownish grey sandy silty CLAY. With frequent rootlets.		(0.08) 0.08	12.36	
						Soft brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of flint. [KIMMERIDGE CLAY FORMATION]		(0.72)		
0.80 - 0.90	ES3	0.80	PID	<1ppm				0.80	11.64	
					▼	Firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse of siltstone and flint. Occasional 300mm pockets of light grey weathered siltstone. [KIMMERIDGE CLAY FORMATION] becoming gravelly with rare Belemnite fossils. becoming stiff.		(1.00)		
1.80 - 1.90	ES4	1.80 1.80 1.80 1.80	PID HV(1) HV(2) HV(3)	<1ppm 52(10)kPa 64(15)kPa 70(24)kPa				1.80	10.64	
						Firm to stiff bluish grey mottled orangish brown slightly sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse of siltstone and flint. Occasional 300mm pockets of light grey weathered siltstone. [KIMMERIDGE CLAY FORMATION]		(1.00)		
								2.80	9.64	

PLAN DETAILS

2.8 × 0.5

Long Axis Orientation: 44

Shoring / Support: None

Stability: Partially Stable

Groundwater (description): Fast flow

Remarks

Trial pit terminated due to unstable ground at base of pit at 2.80m bgl.

Termination Depth: 2.80m

Arcadis Cymru House
St Mellons Business Park
Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
JCB 3CX	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Trial Pit Photography Sheet

TP3008

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**12.44**	**24/01/2019**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**
Homes England	**540620.69**	**265533.97**	**24/01/2019**

[TP3008 2.80 m bgl]

[TP3008 Arisings]

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used
JCB 3CX

Logged By
MT

Checked By
SH

ARCADIS Trial Pit Log

TP3009

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	10019646	12.50	24/01/2019	1:25
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	540691.19	265543.20	24/01/2019	Sheet 1 of 1

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
0.00 - 0.10	ES1	0.00	PID	<1ppm		TOPSOIL: Grass over greyish brown sandy silty CLAY. Frequent rootlets.		(0.10) 0.10	12.40	
0.10 - 0.20	ES2	0.10	PID	<1ppm		MADE GROUND: Soft to firm orangish brown sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse of siltstone and flint. Rare clinker.		(0.17) 0.27	12.23	
0.27 - 0.35	ES3	0.27	PID	<1ppm		Stiff bluish grey and orangish brown slightly sandy gravelly CLAY. Low cobble content. Cobbles are subrounded square siltstone, quartz and sandstone. Gravel is subrounded to rounded fine to coarse of siltstone. Occasional 100mm pockets of brown fine to medium sand. [RIVER TERRACE DEPOSITS] Land drain.		(2.53) 2.80	9.70	
2.80 - 2.90	ES4	2.80	PID	<1ppm		Light grey and light brown very sandy GRAVEL. Gravel is subrounded to rounded fine of siltstone. [RIVER TERRACE DEPOSITES]		(0.10) 2.90	9.60	

PLAN DETAILS

2.8

0.5

Long Axis Orientation: 135

Shoring / Support: None

Stability: Unstable at base

Groundwater (description): Fast flow

Remarks

Trial pit terminated due to unstable ground at base of pit at 2.90m bgl.

Termination Depth: 2.90m

Trial Pit Photography Sheet

Project	Job No	Ground Level (mAOD)	Start Date	
Northstowe Phase 3	**10019646**	**12.50**	**24/01/2019**	**TP3009**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540691.19**	**265543.20**	**24/01/2019**	

[TP3009 2.90 m bgl]

[TP3009 Arisings]

Arcadis Cymru House
St Mellons Business Park
Cardiff
CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
JCB 3CX	**MT**	**SH**

ARCADIS Trial Pit Log

TP3010

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**12.55**	**24/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540553.06**	**265610.01**	**24/01/2019**	**Sheet 1 of 1**

SAMPLES Depth	SAMPLES Type/ No.	TESTS Depth	TESTS Type/ No.	TESTS Results	Water Strikes	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES1	0.00	PID	<1ppm		TOPSOIL: Grass over dark greyish brown very silty fine to coarse SAND. With frequent rootlets.		(0.15) 0.15	12.40	
0.15 - 0.25	ES2	0.15	PID	<1ppm		MADE GROUND: Firm brownish grey sandy slightly gravelly CLAY. Low cobble content. Cobbles are subangular brick and concrete. Gravel is angular to subangular fine to coarse of concrete and brick. Rare plastic sheet.		(0.25) 0.40	12.15	
0.40 - 0.50	ES3	0.40	PID	<1ppm		Firm orangish brown sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of siltstone and flint. With 10mm pockets of stiff grey silt. Rare lignite. [KIMMERIDGE CLAY FORMATION]		(1.00) 1.40	11.15	
1.40 - 1.50	ES4	1.40	PID	<1ppm	▼	Soft yellowish brown and grey sandy slightly gravelly CLAY. Gravel is subrounded to rounded fine to coarse of siltstone. Occasional 200mm bands of brown fine to medium sand. [KIMMERIDGE CLAY FORMATION] frequent angular square siltstone cobbles. becoming stiff.		(1.00) 2.40	10.15	
2.40 - 2.50	ES5	2.40	PID	<1ppm		Stiff dark grey and grey slightly sandy slightly gravelly CLAY. Low boulder and cobble content. Boulders and cobbles are subrounded siltstone. Gravel is subangular to subrounded fine to medium of siltstone and flint. Occasional lignite. Rare rootlets. [KIMMERIDGE CLAY FORMATION]		(0.90) 3.30	9.25	

PLAN DETAILS

3.1

0.5

Long Axis Orientation:

130

Shoring / Support: None

Stability: Stable

Groundwater (description): Fast flow

Remarks

Trial pit terminated after reaching scheduled depth at 3.30m bgl.

Termination Depth:

3.30m

AGS Arcadis Cymru House St Mellons Business Park Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
JCB 3CX	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Trial Pit Photography Sheet

Project	Job No	Ground Level (mAOD)	Start Date	
Northstowe Phase 3	**10019646**	**12.55**	**24/01/2019**	**TP3010**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540553.06**	**265610.01**	**24/01/2019**	

[TP3010 3.30 m bgl]

[TP3010 Arisings]

AGS

Arcadis Cymru House
St Mellons Business Park
Cardiff
CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
JCB 3CX	**MT**	**SH**

ARCADIS Trial Pit Log

TP3011

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**13.29**	**24/01/2019**	**1:25**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540496.26**	**265620.71**	**24/01/2019**	**Sheet 1 of 1**

SAMPLES		TESTS			Water Strikes	STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Description	Legend	Depth (Thickness)	Level	Install/ Backfill
0.00 - 0.10	ES1	0.00	PID	<1ppm		TOPSOIL: Grass over dark grey sandy SILT. Frequent rootlets.		(0.10) 0.10	13.19	
0.10 - 0.20	ES2	0.10	PID	<1ppm		MADE GROUND: Soft to firm greyish brown sandy slightly gravelly CLAY. Low boulder and cobble content. Boulders and cobbles are subangular brick and concrete. Gravel is angular to subangular fine to coarse of concrete brick and bitumen bound macadam. Occasional rootlets. Rare clay pipe fragments and clinker.		(0.85) 0.95	12.34	
0.95 - 1.05	ES3	0.95	PID	<1ppm		Orangish brown and white clayey very gravelly fine to coarse SAND. Low cobble content. Cobbles are subangular to subrounded siltstone and flint. Gravel is subangular to subrounded fine to coarse of siltstone. [RIVER TERRACE DEPOSITES]		(1.25) 2.20	11.09	
2.20 - 2.30	ES4	2.20	PID	<1ppm	▼	Orangish brown clayey gravelly fine to medium SAND. Gravel is subangular to subrounded fine to coarse of flint. [RIVER TERRACE DEPOSITES]		(0.80) 3.00	10.29	

PLAN DETAILS

2.8

0.5

Long Axis Orientation:

135

Shoring / Support: None

Stability: Stable

Groundwater (description): Fast flow

Remarks

Trial pit terminated after reaching scheduled depth at 3.00m bgl.

Termination Depth:

3.00m

AGS

Arcadis Cymru House
St Mellons Business Park
Cardiff, CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
JCB 3CX	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Trial Pit Photography Sheet

TP3011

Project	Job No	Ground Level (mAOD)	Start Date
Northstowe Phase 3	**10019646**	**12.55**	**24/01/2019**
Client	Easting (OS mE)	Northing (OS mN)	End Date
Homes England	**540553.06**	**265610.01**	**24/01/2019**

[TP3011 3.00 m bgl]

[TP3011 Arisings]

Arcadis Cymru House
St Mellons Business Park
Cardiff
CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Logged By	Checked By
JCB 3CX	**MT**	**SH**

APPENDIX D

CERTIFICATION OF FIELD APPARATUS

Allied Exploration & Geotechnics Ltd.

Unit 25 Stella Gill Industrial Estate
Pelton Fell
Chester-le-Street
DH2 2RG

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

SPT Hammer Ref:	DEL1
Test Date:	01/03/2018
Report Date:	02/03/2018
File Name:	DEL1.spt
Test Operator:	GW

UKAS TESTING 1367

Instrumented Rod Data

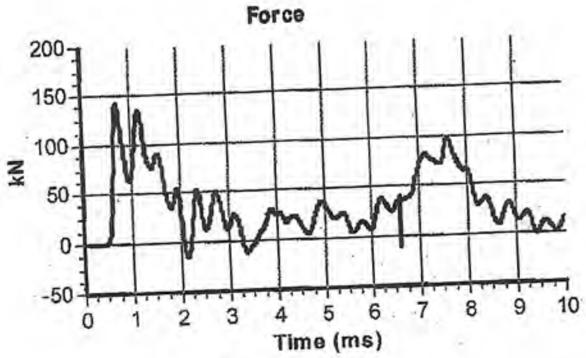
Diameter d_r (mm):	67
Wall Thickness t_r (mm):	8.4
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	6469
Accelerometer No.2:	11406

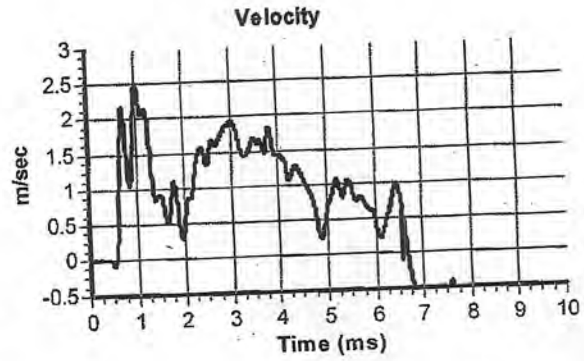
SPT Hammer Information

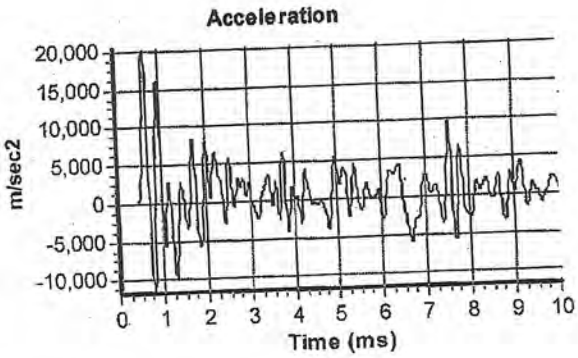
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	13.6

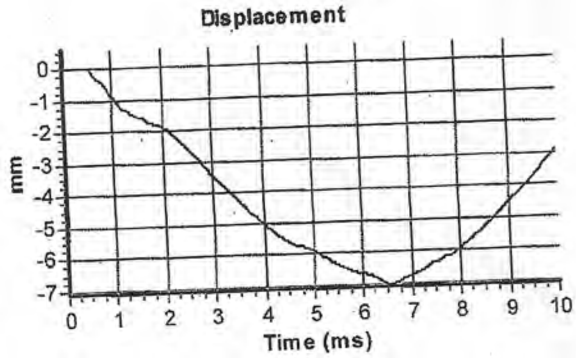
Comments / Location

Mass and Height supplied by client









Calculations

Area of Rod A (mm2):	1546
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	287

Energy Ratio E_r (%): 61

Reg 13(1)

Signed [redacted]
Title: [redacted]

The recommended calibration interval is 6 months

APPENDIX E

MONITORING DATA

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH1
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	2.38	**Pre-Sampling Water Level (m):**	**1.51**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	10
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	15:30	1.51	10						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	15:45	2.0-2.3							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty brownish orange	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty brownish orange
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	2.1		

Comments:
Unable to purge any more water, sample taken from purge water. Water level 8.2.19 1.42m

ARCADIS

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH1
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	9.61	**Pre-Sampling Water Level (m):**	**1.84**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	14:00	1.84	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	15:00	8.5-9.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge
Depth to Water Post-Sampling (m)	8.56		

Comments:
Water level 8.2.19 1.63m

ARCADIS

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH2
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	3.68	**Pre-Sampling Water Level (m):**	**1.47**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	12:00	1.47	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	13:00	1.5-2.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty brownish orange	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty brownish orange
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Fast recharge
Depth to Water Post-Sampling (m)	1.57		

Comments:
Water level 8.2.19 1.55m

ARCADIS

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH2
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	10.01	**Pre-Sampling Water Level (m):**	**1.47**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35	
Single Purge Volume (l):				

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	12:00	1.47	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	12:45	8.5-9.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	8.57		

Comments:
Unable to purge any more water. Sample taken from purge water. Bailer lost down hole. Water level 8.2.19 1.55m

ARCADIS

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH3
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	4.61	**Pre-Sampling Water Level (m):**	Dry	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	N/A	
Single Purge Volume (l):				

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	16:00	Dry	N/A						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	N/A								

Purging Method:		**Pumped:**		**Bailed:**	N/A
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	N/A	**Water Description During/After Purging (Colour, Clarity, Odour)**	N/A
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	N/A
Depth to Water Post-Sampling (m)	Dry		

Comments:
Water level 8.2.19, Dry.

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH3
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	9.87	**Pre-Sampling Water Level (m):**	**9.52**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	0.5	
Single Purge Volume (l):				

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	16:00	9.52	0.5						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	N/A								

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	9.7		

Comments:
Unable to purge any more water, no sample taken, not enough water. Water level 8.2.19, 6.71m most likely from water add on 7.2.19 for falling head test (24l).

ARCADIS Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH4
Project No:	10019646	**Sample Ref:**	8.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	8.2.19		

Borehole Depth:	5.53	**Pre-Sampling Water Level (m):**	**1.02**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	50
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	09:30	1.02	50						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	10:00	1.0-1.5							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and orangish brown.	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and orangish brown.
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Fast recharge
Depth to Water Post-Sampling (m)	1.04		

Comments:

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH4
Project No:	10019646	**Sample Ref:**	8.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	8.2.19		

Borehole Depth:	9.5	**Pre-Sampling Water Level (m):**	**2.02**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	08:00	2.02	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	09:00	8.5-9.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	sSow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	9		

Comments:
Unable to purge any more water. Sample taken from purge water.

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH5
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	3.62	**Pre-Sampling Water Level (m):**	**1.47**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	45
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	10:45	1.47	45						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	11:45	2.00-2.50							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty and brownish orange	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and brownish orange
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Fast recharge.
Depth to Water Post-Sampling (m)	1.48		

Comments:
Water level 8.2.19 1.47m.

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH5
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	9.23	**Pre-Sampling Water Level (m):**	**1.47**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	09:30	1.47	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	10:30	8.00-8.50							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and brownish grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and brownish grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	8.81		

Comments:
Could not purge more water from hole as recharge too slow. Took sample from purge water. Water level 8.2.19 - 8.34m.

V1

ARCADIS

Project:	Northstowe Phase 3		
Job Number:	10019646	Date:	22/02/2019

Weather:	Sunny
Engineer:	IT

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
BH1 Shallow	11:30	1034	11	Peak: -005.96	Peak: -00.7	Initial	0.0	0.0	0.0	20.2	0.0	0.0			0.0	1.22	2.47	BAL 81.2%
						30	0.0	0.0	0.7	18.2	0.0	0.0			0.0			
						60	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
						90	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
				Steady: -005.96	Steady: -00.7	120	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
						150	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
						180	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
BH1 Deep	11:33	1034	11	Peak: -005.96	Peak: -00.7	Initial	0.0	0.0	0.7	18.1	0.0	0.0			0.0	1.22	9.56	BAL 79.9%
						30	0.0	0.0	1.3	18.8	0.0	0.0			0.0			
						60	0.0	0.0	1.3	18.8	0.0	0.0			0.0			
						90	0.0	0.0	1.3	18.8	0.0	0.0			0.0			
				Steady: -005.96	Steady: -00.7	120	0.0	0.0	1.3	18.8	0.0	0.0			0.0			
						150	0.0	0.0	1.2	18.8	0.0	0.0			0.0			
						180	0.0	0.0	1.1	18.7	0.0	0.0			0.0			
BH2 Shallow	10:58	1034	11	Peak: -006.91	Peak: -00.5	Initial	0.0	0.0	0.0	19.9	0.0	0.0			0.1	1.325	2.92	BAL 80.9%
						30	0.0	0.0	0.3	18.9	0.0	0.0			0.0			
						60	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
						90	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
				Steady: -006.91	Steady: -00.5	120	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
						150	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
						180	0.0	0.0	0.4	18.8	0.0	0.0			0.0			
BH2 Deep	11:05	1034	11	Peak: -006.91	Peak: -00.6	Initial	0.0	0.0	0.8	18.1	0.0	0.0			1.5	1.325	9.06	BAL 79.7%
						30	0.0	0.0	0.1	20.0	0.0	0.0			0.0			
						60	0.0	0.0	0.1	20.2	0.0	0.0			0.0			
						90	0.0	0.0	0.1	20.2	0.0	0.0			0.0			
				Steady: -006.91	Steady: -00.6	120	0.0	0.0	0.0	20.3	0.0	0.0			0.0			
						150	0.0	0.0	0.0	20.3	0.0	0.0			0.0			
						180	0.0	0.0	0.0	20.3	0.0	0.0			0.0			

Notes:

Ambient Concentration	
CH4	0.0
CO2	0.0
O2	20.1
H2S	0.0
CO	0.0

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser	GA12507	**GA2000**
PID	110-009173	**PID 28**
Dip meter/ interface probe	DIP-30	**DIP-GWE-7-030**

Project:	Northstowe Phase 3
Job Number:	10019646

Date: 22/02/2019

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: -005.95	Peak: -00.8	Initial	0.0	0.0	0.0	20.1	0.0	0.0			0.0			
						30	0.0	0.0	0.2	18.6	0.0	0.0			0.0			
						60	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
BH3 Shallow	11:58	1035	12			90	0.0	0.0	0.3	18.6	0.0	0.0			0.0	3.1	4.54	BAL 81.2%
				Steady: -005.95	Steady: -0.08	120	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
						150	0.0	0.0	0.3	18.5	0.0	0.0			0.0			
						180	0.0	0.0	0.3	18.5	0.0	0.0			0.0			
				Peak: -005.89	Peak: -00.9	Initial	0.0	0.0	0.3	18.5	0.0	0.0			0.0			
						30	0.0	0.0	0.5	17.5	0.0	0.0			0.0			
						60	0.0	0.0	0.4	18.1	0.0	0.0			0.0			
BH3 Deep	12:05	1035	12			90	0.0	0.0	0.3	18.5	0.0	0.0			0.0	3.1	9.76	BAL 81.9%
				Steady: -005.89	Steady: -0.08	120	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
						150	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
						180	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
				Peak: -005.89	Peak: -00.8	Initial	0.0	0.0	0.2	20.4	0.0	0.0			0.0			
						30	0.0	0.0	0.1	20.5	0.0	0.0			0.0			
						60	0.0	0.0	0.0	20.6	0.0	0.0			0.0			
BH4 Shallow	12:30	1035	12			90	0.0	0.0	0.0	20.6	0.0	0.0			0.0	0.92	9.45	BAL 79.3%
				Steady: -005.89	Steady: -0.08	120	0.0	0.0	0.0	20.7	0.0	0.0			0.0			
						150	0.0	0.0	0.0	20.7	0.0	0.0			0.0			
						180	0.0	0.0	0.0	20.7	0.0	0.0			0.0			
				Peak: -005.91	Peak: -00.8	Initial	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
						30	0.0	0.0	1.2	19.6	0.0	0.0			0.0			
						60	0.0	0.0	1.1	19.8	0.0	0.0			0.0			
BH4 Deep	12:26	1035	12			90	0.0	0.0	0.9	19.9	0.0	0.0			0.0	0.92	5.72	BAL 79.4%
				Steady: -005.91	Steady: -0.08	120	0.0	0.0	0.7	20.1	0.0	0.0			0.0			
						150	0.0	0.0	0.5	20.2	0.0	0.0			0.0			
						180	0.0	0.0	0.3	20.3	0.0	0.0			0.0			
				Peak: -005.94	Peak: -0.00	Initial	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						30	0.0	0.0	0.1	20.2	0.0	0.0			0.0			
						60	0.0	0.0	0.1	20.0	0.0	0.0			0.0			
BH5 Shallow	12:56	1035	12			90	0.0	0.0	0.2	19.8	0.0	0.0			0.0	1.43	2.865	BAL 80.0%
				Steady: -005.94	Steady: -0.00	120	0.0	0.0	0.2	19.8	0.0	0.0			0.0			
						150	0.0	0.0	0.2	19.8	0.0	0.0			0.0			
						180	0.0	0.0	0.2	19.8	0.0	0.0			0.0			

Notes:

Project:	Northstowe Phase 3		
Job Number:	10019646	Date:	22/02/2019

Weather:	Sunny
Engineer:	IT

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
BH5 Deep	12:50	1035	12	Peak: -005.94	Peak: -0.00	Initial	0.0	0.0	0.0	20.5	0.0	0.0			0.0	5.93	9.23	BAL 79.6%
						30	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						60	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						90	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
				Steady: -005.94	Steady: -0.00	120	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						150	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						180	0.0	0.0	0.0	20.4	0.0	0.0			0.0			

Notes:

Ambient Concentration	
CH4	0.0
CO2	0.0
O2	20.1
H2S	0.0
CO	0.0

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser	GA12507	**GA2000**
PID	110-009173	**PID 28**
Dip meter/ interface probe	DIP-30	**DIP-GWE-7-030**

APPENDIX F

GEOTECHNICAL LABORATORY TEST DATA

Laboratory Report

UKAS TESTING 2788

GSTL

GEO Site & Testing Services Ltd

Contract Number: 42783

Client Ref: **10019646**

Report Date: **25-02-2019**

Client PO: **PO 14021570**

Client **Arcadis**
Fortran Rd
St Mellons
Cardiff
CF3 0EY

Contract Title: **Northstowe Phase 3**
For the attention of: **Marcus Toms**

Date Received: **07-02-2019**
Date Commenced: **07-02-2019**
Date Completed: **25-02-2019**

Test Description	Qty
Moisture Content BS 1377:1990 - Part 2 : 3.2 - * UKAS	17
4 Point Liquid & Plastic Limit BS 1377:1990 - Part 2 : 4.3 & 5.3 - * UKAS	5
PSD Wet Sieve method BS 1377:1990 - Part 2 : 9.2 - * UKAS	2
BRE Full Suite **includes pH, water & acid soluble sulphate, total sulphur, magnesium, chloride and nitrate** BRE - BR279 - @ Non Accredited Test	3
Organic Matter Content-dichromate method BS 1377:1990 - Part 3 : 3 - @ Non Accredited Test	2
Dry Den/MC (4.5kg Rammer Method 1 Litre Mould) BS 1377:1990 - Part 4 : 3.5 - * UKAS	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:

Reg 13(1) [redacted]

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

Laboratory Report

GSTL

GEO Site & Testing Services Ltd

UKAS TESTING 2788

Contract Number: 42783

Test Description	Qty
CBR: Remoulded Specimen and tested at top only BS 1377:1990 - Part 4 : 7 - * UKAS	2
One-dimensional Consolidation 75mm or 50mm diameter specimens (5 days) BS 1377:1990 - Part 5 : 3 - * UKAS	1
Quick Undrained Triaxial Compression Test - Multi-stage Loading of a single specimen (100mm diameter) BS 1377:1990 - Part 7 : 9 - * UKAS	4
Dry Den/MC (2.5kg Rammer Method 1 Litre Mould) BS 1377:1990 - Part 4 : 3.3 - * UKAS	1
Disposal of samples for job	1

Notes: **Observations and Interpretations are outside the UKAS Accreditation**
*** - denotes test included in laboratory scope of accreditation**
 # - denotes test carried out by approved contractor
@ - denotes non accredited tests

Approved Signatories:
Reg 13(1) [redacted]

GEO Site & Testing Services Ltd
Unit 3-4, Heol Aur, Dafen Ind Estate, Dafen, Llanelli, Carmarthenshire SA14 8QN
Tel: 01554 784040 Fax: 01554 784041 info@gstl.co.uk gstl.co.uk

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5) DESCRIPTIONS	
Contract Number	**42783**	
Site Name	**Northstowe Phase 3**	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Descriptions
BH1	2	D	0.30	-	0.30	Brown fine to coarse gravelly silty CLAY with rootlets.
BH1	1	UT	4.50	-	4.88	Reddish grey silty CLAY.
BH1	7	B	5.50	-	5.50	Grey silty CLAY.
BH1	9	B	8.50	-	8.50	Grey fine gravelly silty CLAY.
BH2	2	B	0.30	-	0.30	Brown fine to medium gravelly sandy silty CLAY.
BH2	10	B	5.70	-	5.70	Grey fine gravelly silty CLAY.
BH2	13	B	10.00	-	10.50	Grey silty CLAY.
BH3	1	UT	1.50	-	1.88	Grey fine gravelly silty CLAY.
BH3	2	UT	3.50	-	3.79	Grey silty CLAY.
BH3	7	B	8.50	-	9.00	Grey silty CLAY.
BH4	2	D	0.40	-	0.40	Brown fine to medium gravelly silty CLAY with rootlets.
BH4	9	B	6.10	-	6.10	Grey fine gravelly silty CLAY.
BH4	13	D	9.00	-	9.00	Grey fine gravelly silty CLAY.
BH5	1	B	0.20	-	0.20	Brown fine to medium gravelly sandy silty CLAY.
BH5	11	D	10.38	-	10.43	Grey fine gravelly silty CLAY.
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		
				-		

Operators	Checked	25/02/2019	Reg 13(1)
** Please Select Operator **	Approved	25/02/2019	Reg 13(1)

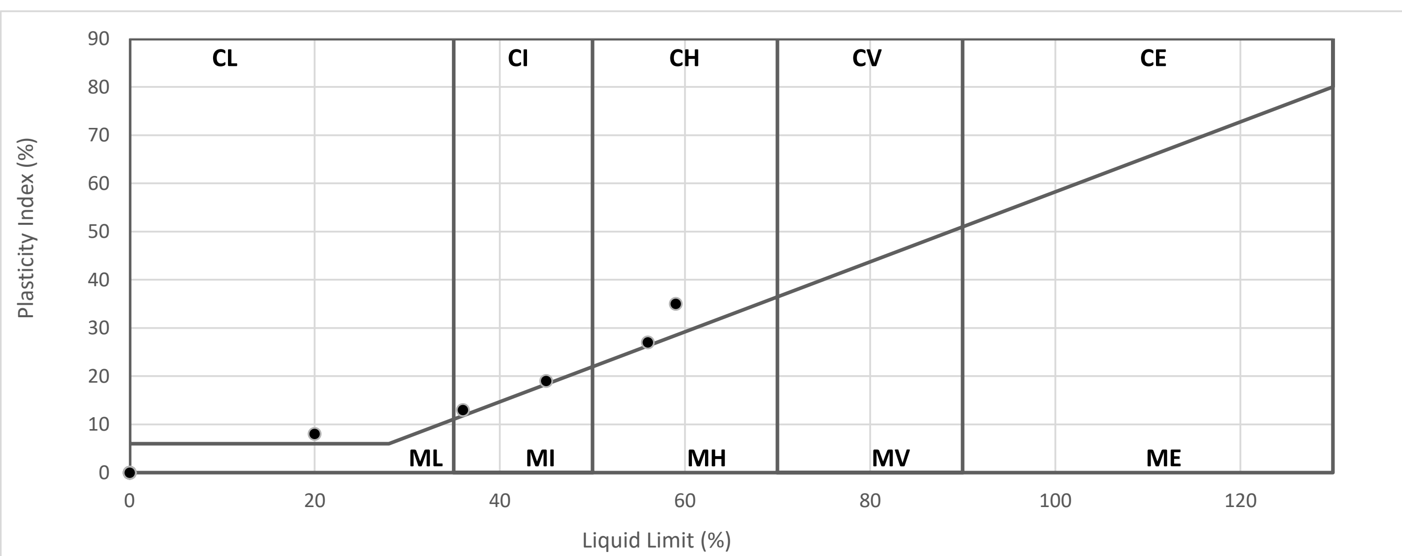
UKAS TESTING 2788

GSTL	LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX (BS 1377 : Part 2 : 1990 Method 5)	
Contract Number	**42783**	
Site Name	**Northstowe Phase 3**	

Sample/Hole Reference	Sample Number	Sample Type	Depth (m)			Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity index %	Passing 0.425mm %	Remarks
BH1	2	D	0.30	-	0.30	33	56	29	27	80	CH High Plasticity
BH1	1	UT	4.50	-	4.88	26				100	
BH1	7	B	5.50	-	5.50	34					
BH1	9	B	8.50	-	8.50	36					
BH2	2	B	0.30	-	0.30	24	20	12	8	71	CL Low Plasticity
BH2	10	B	5.70	-	5.70	43					
BH2	13	B	10.00	-	10.50	39					
BH3	1	UT	1.50	-	1.88	23	59	24	35	78	CH High Plasticity
BH3	2	UT	3.50	-	3.79	39					
BH3	7	B	8.50	-	9.00	31					
BH4	2	D	0.40	-	0.40	29	45	26	19	74	CI Intermediate Plasticity
BH4	9	B	6.10	-	6.10	30					
BH4	13	D	9.00	-	9.00	26					
BH5	1	B	0.20	-	0.20	25	36	23	13	71	CI Intermediate Plasticity
BH5	11	D	10.38	-	10.43	28					
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							
				-							

Symbols: NP : Non Plastic # : Liquid Limit and Plastic Limit Wet Sieved

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION
BS 5930:1999+A2:2010



Operators	Checked	25/02/2019	Reg 13(1) [redacted])
** Please Select Operator **	Approved	25/02/2019	Reg 13(1) [redacted]

UKAS TESTING 2788

GSTL	Certificate of Chemical Analysis (BRE BR 279)	Contract Number	42783
		Client Reference	10019646
Client	Arcadis	**Date Received**	
Site Name	Northstowe Phase 3	**Date Started**	18/02/2019
		Date Completed	25/02/2019
		No. of Samples	3

Hole Number	Sample Number	Sample Type	Depth (m)			Acid Soluble Sulphate	Aqueous Extract Sulphate	Chloride Content	Ph Value	Total Sulphur	Magnesium	Nitrate
BH1	5	B	3.50	-	3.50	0.33	0.04	NCP	7.44	0.14	<1	10-25
BH2	4	B	0.70	-	0.70	0.29	0.03	NCP	7.11	0.13	<1	25-50
BH3	4	D	2.00	-	2.00	0.27	0.03	NCP	7.69	0.12	<1	10-25
				-								
				-								
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Key	Reported As
Acid Soluble Sulphate	% SO_4
Aqueous Extract Sulphate	g/l SO_4
Chloride Content (Semi)	mg Cl/l
PH Value	@ 25°
Total Sulphur	% S
Magnesium	g/l SO_4
Nitrate	NO_3 mg/l

Remarks

NCP = No Chloride Present

Test Operator	Checked and Authorised by			
Reg 13(1) [redacted]	Date	25/02/2019	Reg [redacted]	Reg 13(1) [redacted]

GSTL	**Certificate of Chemical Analysis** **BS1377 Part 3 1990**	**Contract Number**	42783
		Client Reference	10019646
Client	Arcadis	**Date Received**	
Site Name	Northstowe Phase 3	**Date Started**	18/02/2019
		Date Completed	25/02/2019
		No. of Samples	2

Hole Number	Sample Number	Sample Type	Depth (m)			Acid Soluble Sulphate	Aqueous Extract Sulphate	Water Soluble Chloride	PH Value	Organic Matter Content	Acid Soluble Chloride	Loss On Ignition
BH2	1	B	0.10	-	0.10					4.1		
BH5	1	B	0.20	-	0.20					3.3		
				-								
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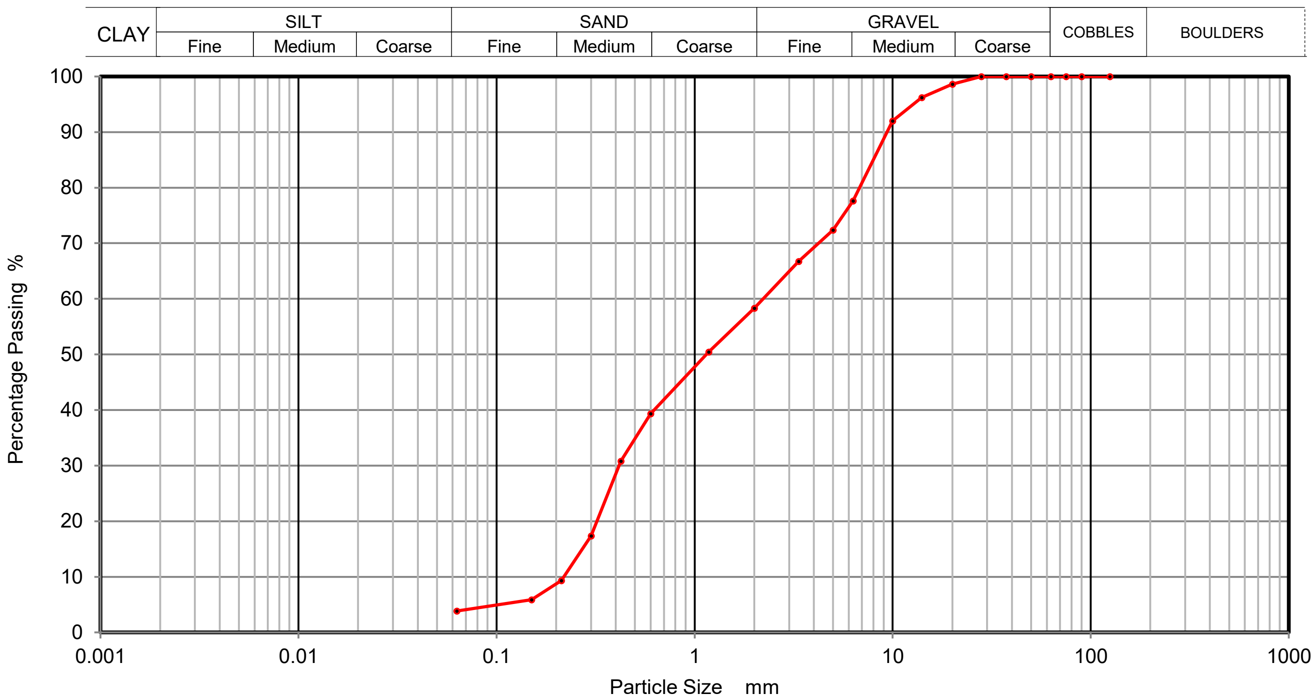
Key	Reported As	Clause
Acid Soluble Sulphate	% SO_3	Clause 5.2 & 5.5
Aqueous Extract Sulphate	g/l SO_3	Clause 5.3 & 5.5
Water Soluble Chloride	%	Clause 7.2
PH Value	@ 25°	Clause 9.5
Organic	%	Clause 3
Acid Soluble Chloride	%	Clause 7.3
LOI	%	Clause 4

Remarks

NCP = No Chloride Present

Test Operator	Checked and Authorised by			
Reg 13(1) [redacted]	Date	25/02/2019	Reg [redacted]	Reg 13(1) [redacted]

GSTL	**PARTICLE SIZE DISTRIBUTION** **BS 1377 Part 2:1990** **Wet Sieve, Clause 9.2**	Contract Number	**42783**
		Borehole/Pit No.	**BH2**
Site Name	**Northstowe Phase 3**	Sample No.	**5**
Soil Description	Brown silty fine to coarse gravelly fine to coarse SAND.	Depth Top	**1.50**
		Depth Base	**2.00**
		Sample Type	**B**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	99		
14	96		
10	92		
6.3	78		
5	72		
3.35	67		
2	58		
1.18	50		
0.6	39		
0.425	31		
0.3	17		
0.212	9		
0.15	6		
0.063	4		

Sample Proportions	% dry mass
Cobbles	0
Gravel	42
Sand	54
Silt and Clay	4

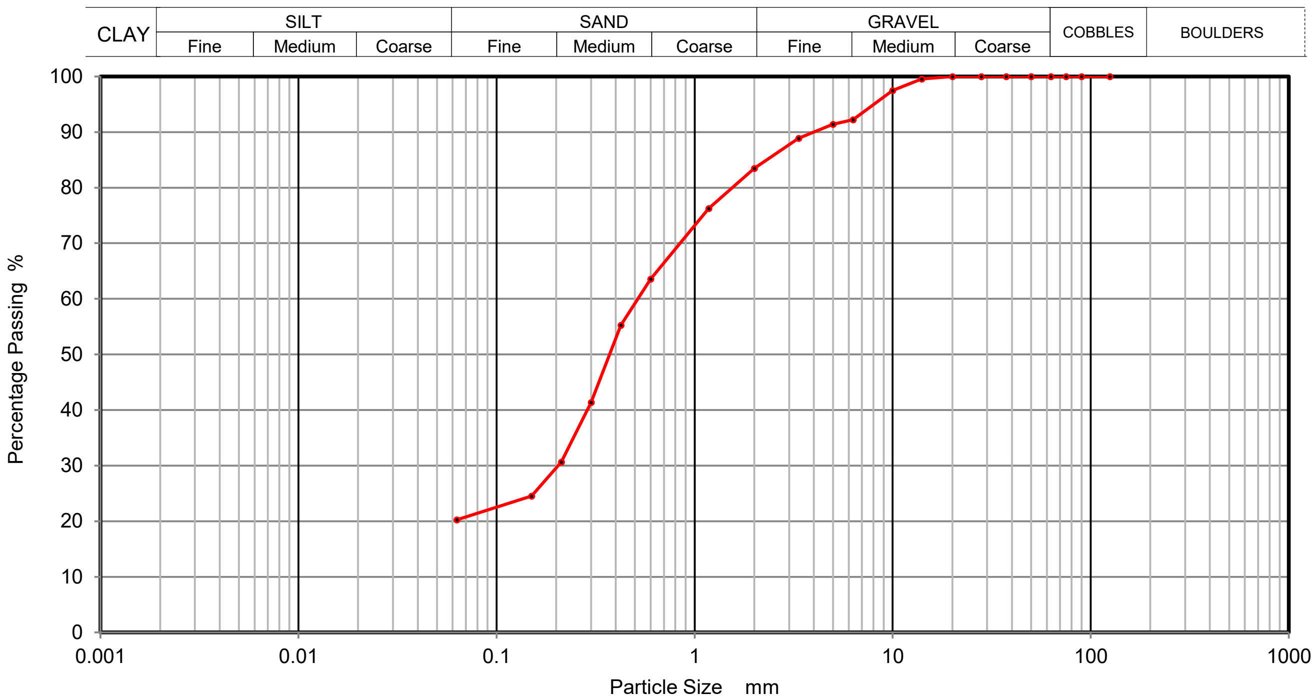
Remarks

Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	24/02/2019	Reg	Reg 13(1)
Reg	Approved	25/02/2019	Reg	

UKAS TESTING 2788

GSTL	PARTICLE SIZE DISTRIBUTION BS 1377 Part 2:1990 Wet Sieve, Clause 9.2	Contract Number	42783
		Borehole/Pit No.	BH4
Site Name	Northstowe Phase 3	Sample No.	5
Soil Description	Brown fine to coarse gravelly silty clayey fine to coarse SAND.	Depth Top	3.10
		Depth Base	3.50
		Sample Type	B



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	97		
6.3	92		
5	91		
3.35	89		
2	83		
1.18	76		
0.6	64		
0.425	55		
0.3	41		
0.212	31		
0.15	25		
0.063	20		

Sample Proportions	% dry mass
Cobbles	0
Gravel	17
Sand	63
Silt and Clay	20

Remarks

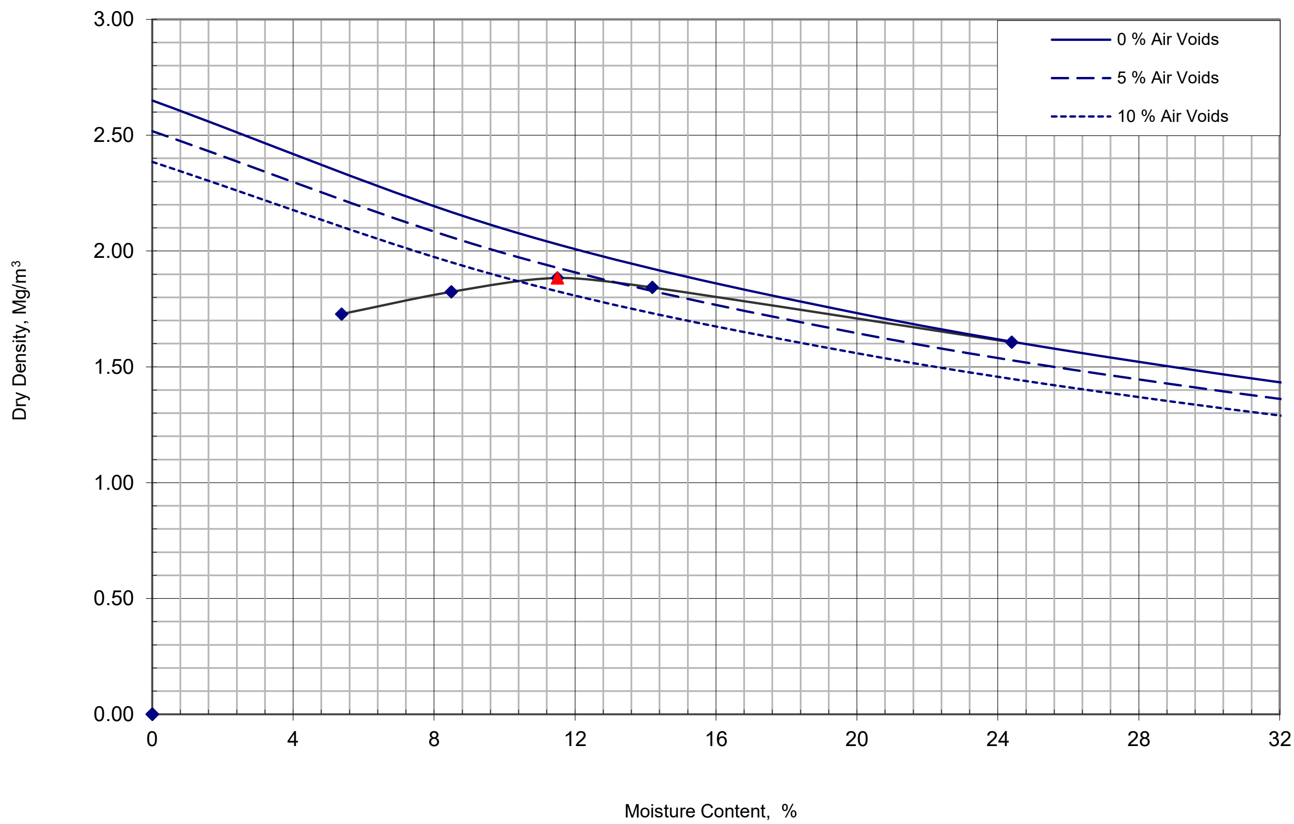
Preparation and testing in accordance with BS1377 unless noted below

Operators	Checked	24/02/2019	Reg [redacted]
Reg [redacted]	Approved	25/02/2019	Reg [redacted]

Reg 13(1) [redacted]

UKAS TESTING 2788

GSTL	Dry Density / Moisture Content Relationship BS 1377:Part 4:1990	Contract Number	42783
		Borehole / Pit No	BH1
Site Name	**Northstowe Phase 3**	Sample No	**2**
Soil Description	**Light brown fine to coarse gravelly silty CLAY.**	Depth Top	**0.50**
Compaction Method	**2.5 Kg Rammer**	Depth Base	**0.50**
Compaction Clause	**BS1377:Part 4:1990, Clause 3.3**	Sample Type	**B**



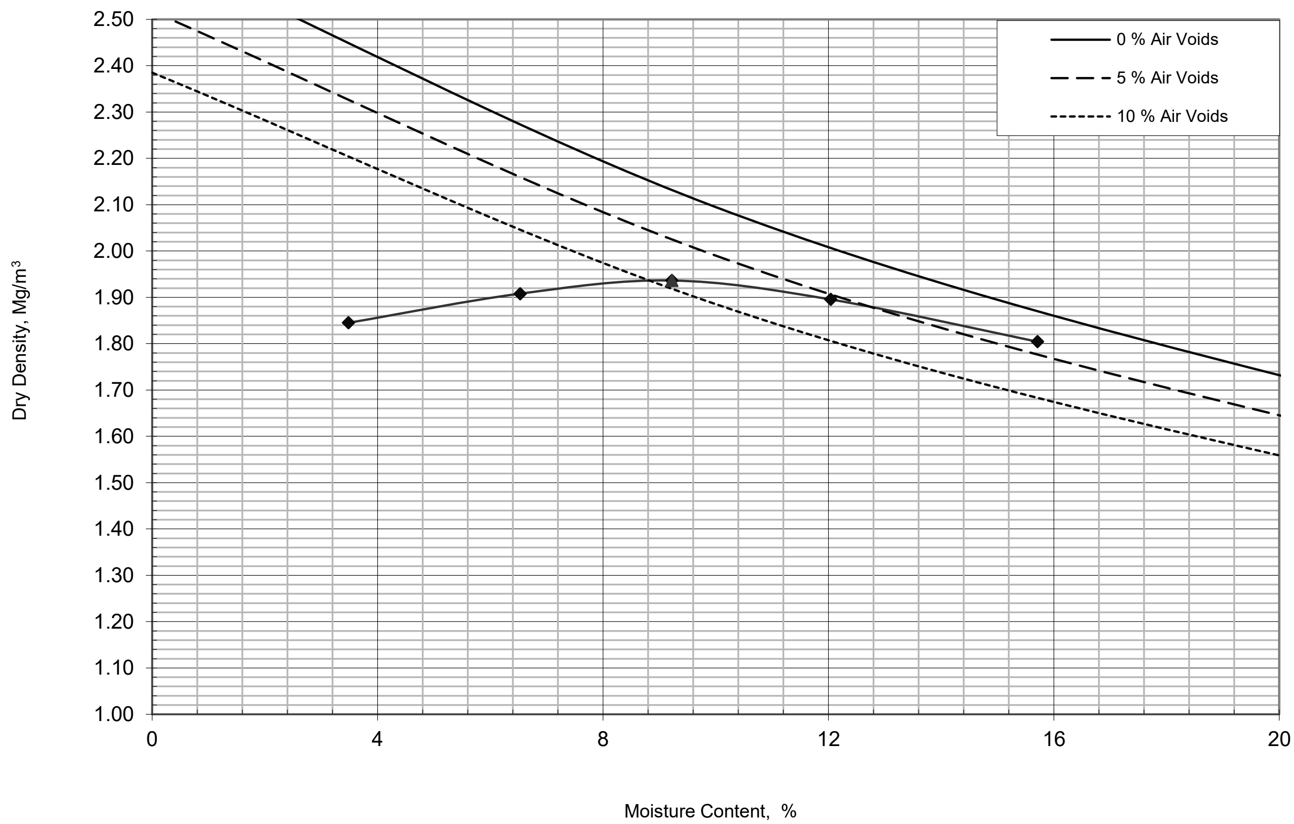
Compaction Point	1	2	3	4	5							
Moisture Content	5.4	8.5	12	14	24							
Bulk Density	1.82	1.98	2.10	2.10	2.00							
Dry Density	1.73	1.82	1.88	1.84	1.61							

Initial Moisture Content	24	%
Maximum Dry Density	1.88	Mg/m3
Optimum Moisture Content	12	%
Particle Density	2.65 Assumed	Mg/m3
Material Retained 37.5mm		%
Material Retained 20mm	12.47	%

Operators	Checked	25/02/2019	Reg [redacted]	Reg 13(1) [redacted]
R [redacted]	Approved	26/02/2019	Reg [redacted]	

UKAS TESTING 2788

GSTL	Dry Density / Moisture Content Relationship BS 1377:Part 4:1990	Contract Number	42783
		Borehole / Pit No	BH5
Site Name	**Northstowe Phase 3**	Sample No	**3**
Soil Description	**Brown fine to medium gravelly silty SAND.**	Depth Top	**1.00**
Compaction Method	**4.5 Kg Rammer**	Depth Base	**1.00**
Compaction Clause	**BS1377:Part 4:1990, Clause 3.5**	Sample Type	**B**



Compaction Point	1	2	3	4	5							
Moisture Content	3.5	6.5	9.2	12	16							
Bulk Density	1.91	2.03	2.11	2.12	2.09							
Dry Density	1.84	1.91	1.94	1.90	1.80							

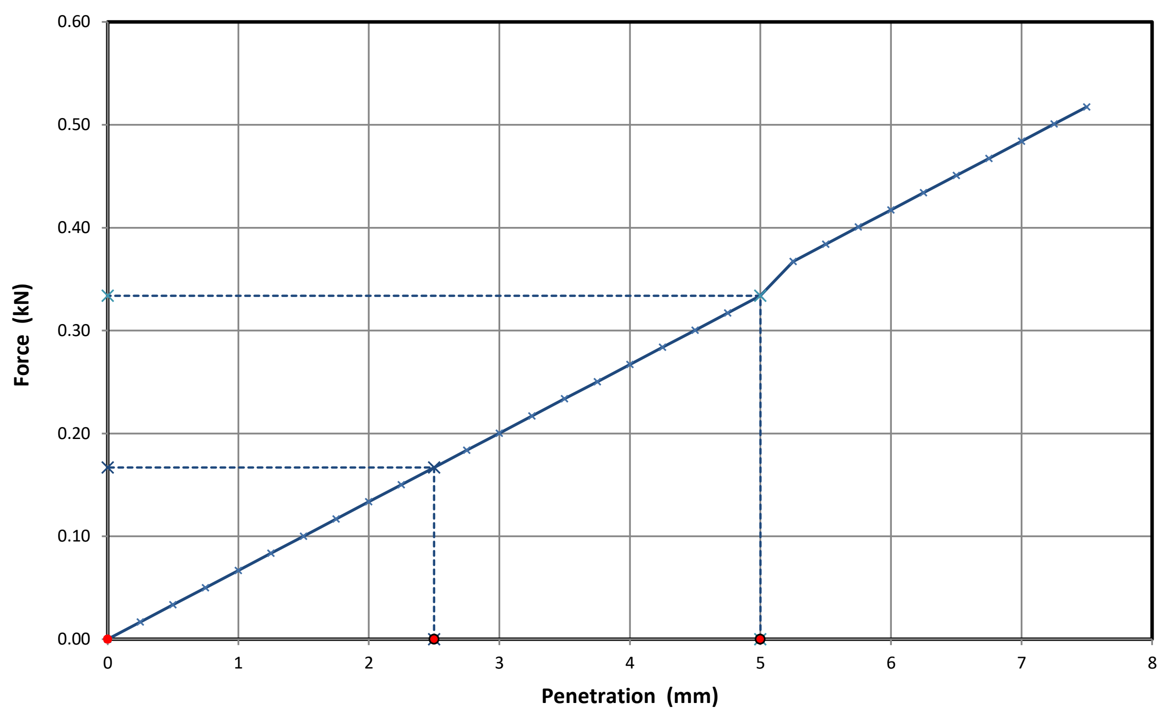
Initial Moisture Content	12	%
Maximum Dry Density	1.94	Mg/m3
Optimum Moisture Content	9	%
Particle Density	2.65 Assumed	Mg/m3
Material Retained 37.5mm	0	%
Material Retained 20mm	0	%

Operators	Checked	24/02/2019	Reg
R	Approved	25/02/2019	Reg

Reg 13(1)

UKAS TESTING 2788

GSTL	California Bearing Ratio BS 1377: Part 4: 1990 Clause 7	Contract Number	42783
		Borehole/Pit No.	BH1
Site Name	Northstowe Phase 3	Sample No.	2
Soil Description	Light brown fine to coarse gravelly silty CLAY.	Depth Top	0.50
Compaction Method	2.5 Kg Rammer	Depth Base	0.50
Retained 20mm	12.47 %	Sample Type	B



Initial Sample Conditions	
Moisture Content (%)	24
Moisture Top (%)	
Moisture Bottom (%)	
Bulk Density (Mg/m3)	2.00
Dry Density (Mg/m3)	1.60

Specified Testing Parameters	
Surcharge (Kg)	2
Soaking Time (hours)	N/A
Swelling (mm)	N/A
Remarks	

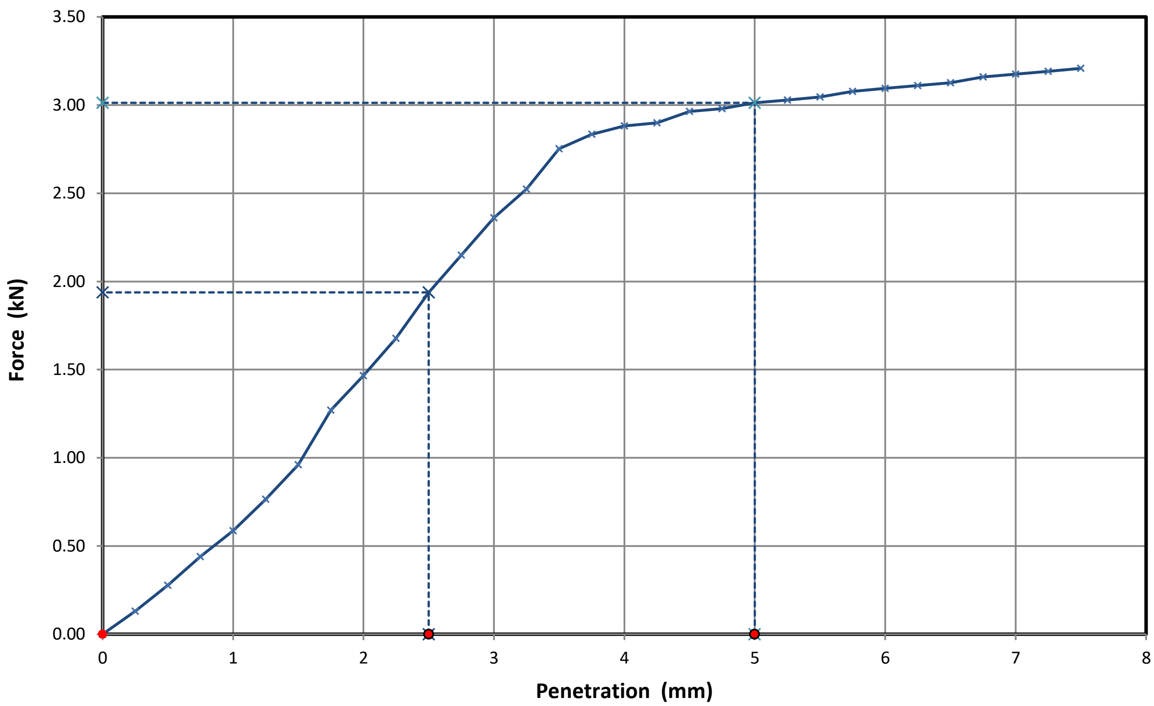
CBR Test Values			
2.5mm Top	1.3	2.5mm Bottom	
5mm Top	1.7	5mm Bottom	
CBR Value %	**1.7**	**CBR Value %**	

Operators	Checked	25/02/2019	Reg [redacted]
Reg [redacted]	Approved	26/02/2019	Reg [redacted]

Reg 13(1) [redacted]

UKAS TESTING 2788

GSTL	California Bearing Ratio BS 1377: Part 4: 1990 Clause 7	Contract Number	42783
		Borehole/Pit No.	BH5
Site Name	Northstowe Phase 3	Sample No.	3
Soil Description	Brown fine to medium gravelly silty SAND.	Depth Top	1.00
Compaction Method	2.5 Kg Rammer	Depth Base	1.00
Retained 20mm	10 %	Sample Type	B



Initial Sample Conditions	
Moisture Content (%)	12
Moisture Top (%)	
Moisture Bottom (%)	
Bulk Density (Mg/m3)	2.12
Dry Density (Mg/m3)	1.89

Specified Testing Parameters	
Surcharge (Kg)	2
Soaking Time (hours)	N/A
Swelling (mm)	N/A
Remarks	

CBR Test Values

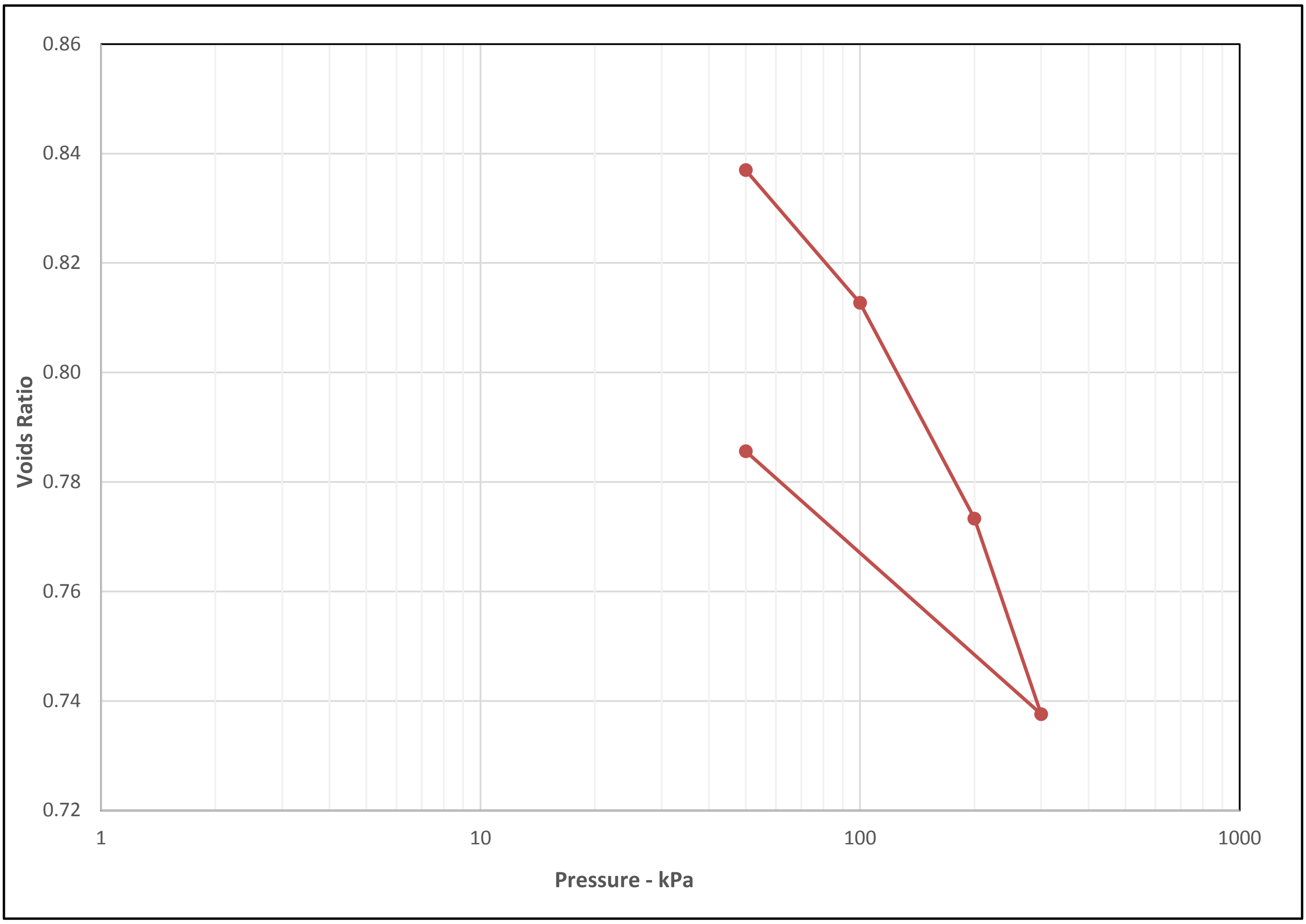
2.5mm Top	14.7	2.5mm Bottom	
5mm Top	15.1	5mm Bottom	
CBR Value %	**15.1**	**CBR Value %**	

Operators	Checked	24/02/2019	Reg
Reg	Approved	25/02/2019	Reg

Reg 13(1) [redacted]

UKAS
TESTING
2788

GSTL	ONE DIMENSIONAL CONSOLIDATION TEST BS1377:Part 5:1990, clause 3	Contract Number	42783
		Borehole/Trialpit No.	BH3
Site Name	Northstowe Phase 3	Sample No.	3
Soil Description	Grey silty stiff CLAY	Depth Top (m)	5.50
		Depth Base (m)	5.95
Lab Temperature	20°c	Sample Location	Middle
Remarks	Cv Calculated Using T90	Sample Type	UT



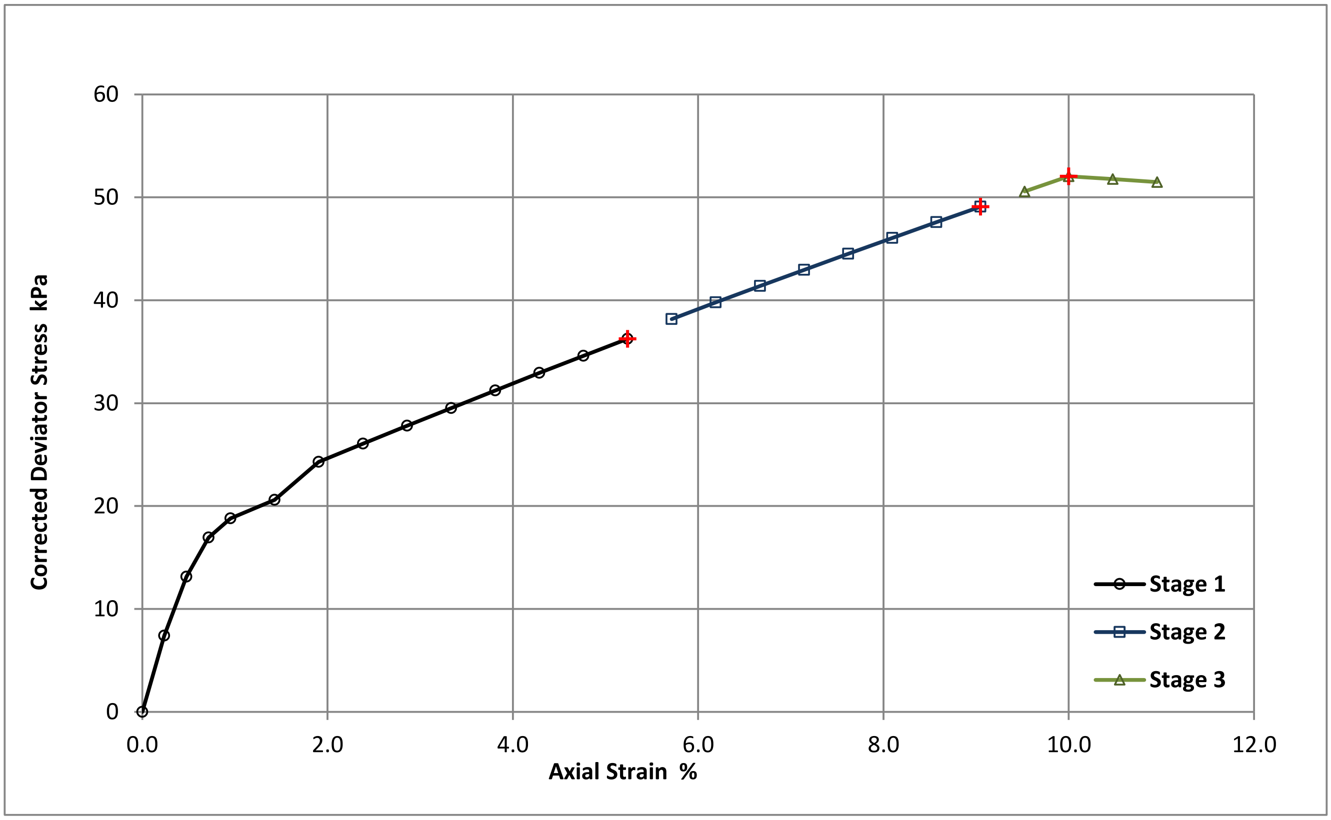
Initial Sample Conditions		Pressure Range			Mv m2/MN	Cv m2/yr	Pressure Range			Mv m2/MN	Cv m2/yr
Moisture Content (%)	31	0	-	50	Swell	Stage		-			
Bulk Density (Mg/m3)	1.89	50	-	100	0.26	6.6		-			
Dry Density (Mg/m3)	1.44	100	-	200	0.22	6.7		-			
Voids Ratio	0.8436	200	-	300	0.200	1.7		-			
Degree of saturation	98.4	300	-	50	0.11	2.5		-			
Height (mm)	19.92		-					-			
Diameter (mm)	49.99		-					-			
Particle Density (Mg/m3)	2.65		-					-			

Operators	Checked	17/02/2019	Reg 13(1)
R	Approved	18/02/2019	Reg

Reg 13(1) [redacted]

UKAS TESTING 2788

	Multi Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 9	Contract Number	42783
		Borehole/Pit No.	BH2
Site Name	Northstowe Phase 3	Sample No.	1
Soil Description	Grey silty CLAY.	Depth Top	8.50
		Depth Base	9.00
		Sample Type	UT



Moisture Content (%)	45		
Bulk Density (Mg/m^3)	1.89		
Dry Density (Mg/m^3)	1.30		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	105		
Cell Pressures (kPa)	85	170	225
Deviator Stress (kPa)	36	49	52
Undrained Shear Strength (kPa)	18	25	26
Failure Strain (%)	5.2	9.0	10
Mode Of Failure	Plastic		
Mrmbrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

Specimen Post Test

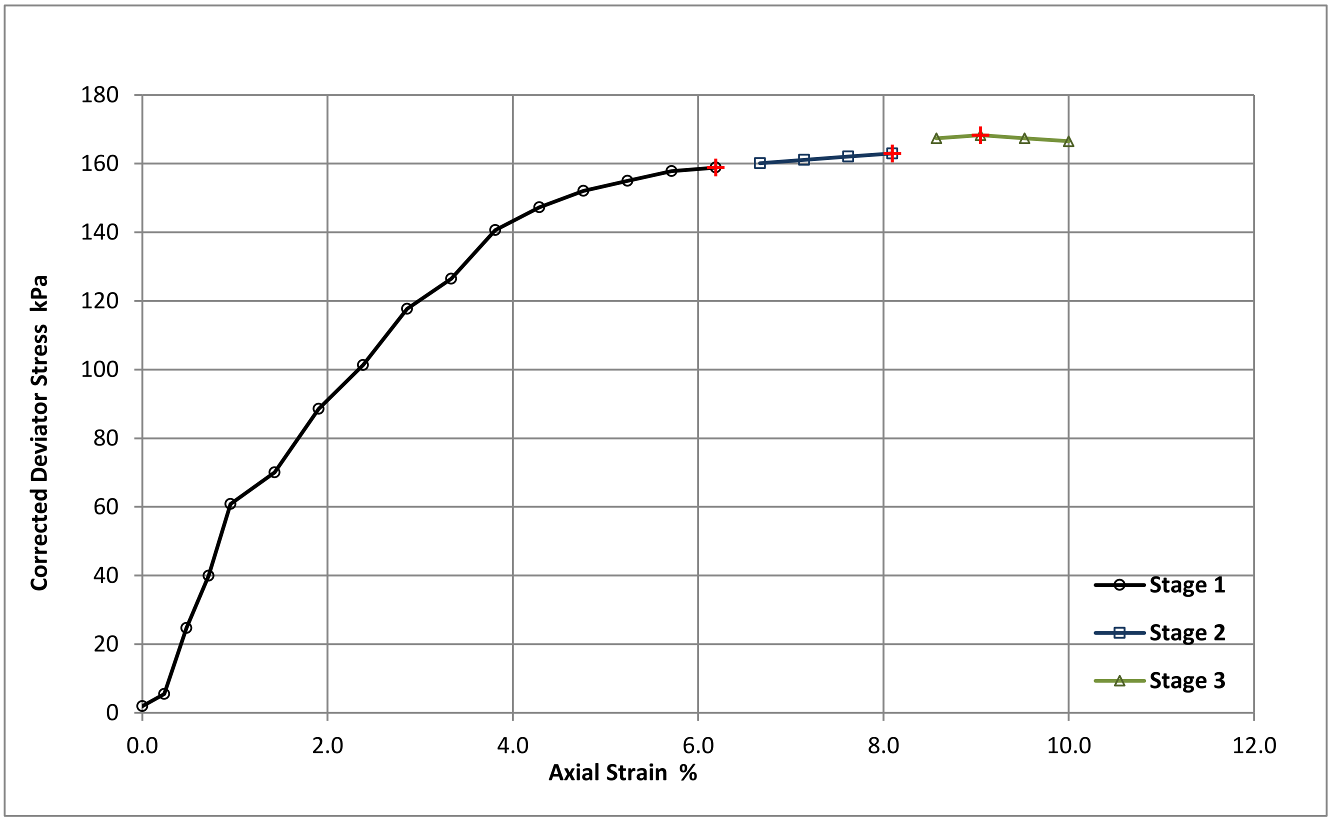
Sample Split

Checked	24/02/2019	Reg [redacted]
Approved	25/02/2019	Reg [redacted]

Reg 13(1) [redacted]

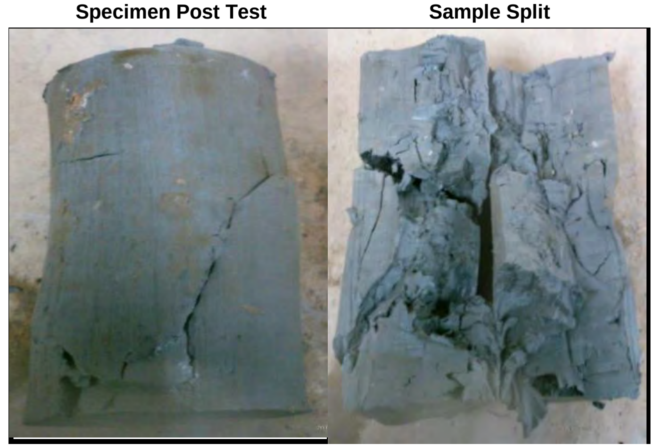
UKAS TESTING 2788

GSTL	Multi Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 9	Contract Number	42783
		Borehole/Pit No.	BH3
Site Name	Northstowe Phase 3	Sample No.	1
Soil Description	Grey silty CLAY.	Depth Top	1.50
		Depth Base	1.88
		Sample Type	UT



Moisture Content (%)	23		
Bulk Density (Mg/m^3)	1.93		
Dry Density (Mg/m^3)	1.57		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	105		
Cell Pressures (kPa)	15	30	45
Deviator Stress (kPa)	159	163	168
Undrained Shear Strength (kPa)	79	81	84
Failure Strain (%)	6.2	8.1	9
Mode Of Failure	Plastic		
Mrmbrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

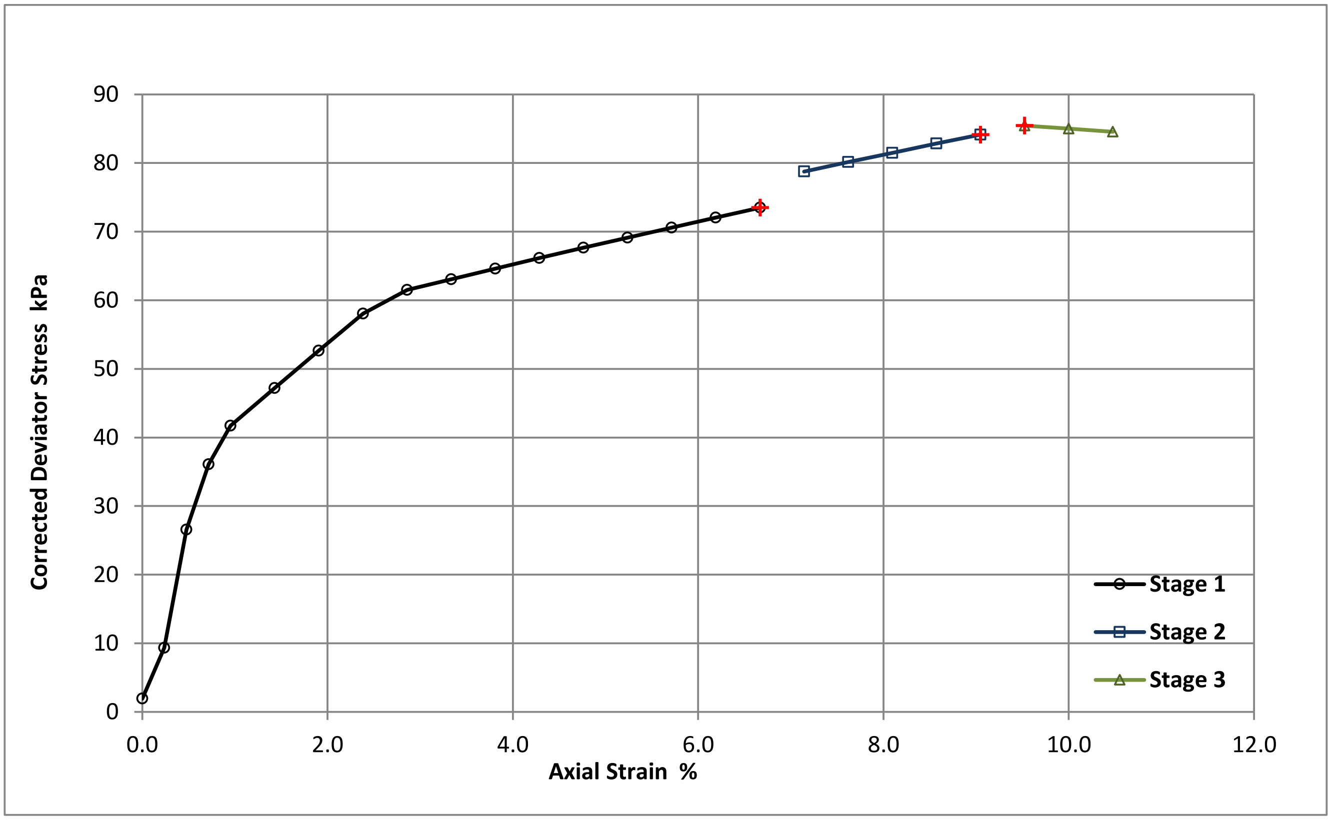
Specimen Post Test **Sample Split**



Checked	24/02/2019	Reg [redacted]	Reg 13(1) [redacted]
Approved	25/02/2019	Reg [redacted]	

UKAS TESTING 2788

GSTL	Multi Stage Unconsolidated-Undrained Triaxial Test BS 1377 : 1990 Part 7 : 9	Contract Number	42783
		Borehole/Pit No.	BH5
Site Name	Northstowe Phase 3	Sample No.	1
Soil Description	Brown silty CLAY.	Depth Top	7.00
		Depth Base	7.38
		Sample Type	UT



Moisture Content (%)	25		
Bulk Density (Mg/m^3)	1.88		
Dry Density (Mg/m^3)	1.50		
Specimen Length (mm)	210		
Specimen Diamteter (mm)	105		
Cell Pressures (kPa)	70	140	210
Deviator Stress (kPa)	73	84	85
Undrained Shear Strength (kPa)	37	42	43
Failure Strain (%)	6.7	9.0	10
Mode Of Failure	Plastic		
Mrmbrane Used/Thickness	Rubber/0.3mm		
Rate of Strain (%/min)	3.00		

Specimen Post Test

Sample Split

Checked	24/02/2019	Reg
Approved	25/02/2019	Reg

Reg 13(1)

UKAS TESTING 2788

APPENDIX G

GEO-ENVIRONMENTAL LABORATORY TEST DATA

[redacted]
Arcadis Consulting (UK) Ltd
10 Medawar Road
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Guildford
Surrey
GU2 7AR

t: [redacted]
f: [redacted]
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i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 19-26662

Project / Site name:	Northstowe Phase 3	**Samples received on:**	24/01/2019
Your job number:	10019646	**Samples instructed on:**	28/01/2019
Your order number:		**Analysis completed by:**	06/02/2019
Report Issue Number:	1	**Report issued on:**	06/02/2019
Samples Analysed:	1 soil sample		

Signed: [redacted]

[redacted]
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 19-26662

Project / Site name: Northstowe Phase 3

Lab Sample Number				1142600				
Sample Reference				BH4				
Sample Number				82				
Depth (m)				0.40				
Date Sampled				Deviating				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	14				
Total mass of sample received	kg	0.001	NONE	1.7				
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected				
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.3				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Free Cyanide	mg/kg	1	MCERTS	< 1				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.035				
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05				
Fluorene	mg/kg	0.05	MCERTS	< 0.05				
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05				
Anthracene	mg/kg	0.05	MCERTS	< 0.05				
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Pyrene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Chrysene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80				
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.9				
Boron (water soluble)	mg/kg	0.2	MCERTS	2.3				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2				
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	17				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	12				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	9.5				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	12				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	29				

Analytical Report Number: 19-26662

Project / Site name: Northstowe Phase 3

Lab Sample Number				1142600				
Sample Reference				BH4				
Sample Number				82				
Depth (m)				0.40				
Date Sampled				Deviating				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	ug/kg	1	MCERTS	< 1.0				
Toluene	µg/kg	1	MCERTS	< 1.0				
Ethylbenzene	µg/kg	1	MCERTS	< 1.0				
p & m-xylene	µg/kg	1	MCERTS	< 1.0				
o-xylene	µg/kg	1	MCERTS	< 1.0				
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0				
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0				
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0				
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0				
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0				
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10				
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001				
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0				
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0				
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10				
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10				
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10				

Analytical Report Number : 19-26662

Project / Site name: Northstowe Phase 3

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1142600	BH4	82	0.40	Light brown sandy clay with gravel and vegetation.

Analytical Report Number : 19-26662

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH4	82	S	19-26662	1142600	a			

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

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Analytical Report Number : 19-26818

Replaces Analytical Report Number : 19-26818, issue no. 1

Project / Site name:	Northstowe Phase 3	**Samples received on:**	23/01/2019
Your job number:	10019646	**Samples instructed on:**	29/01/2019
Your order number:		**Analysis completed by:**	04/03/2019
Report Issue Number:	2	**Report issued on:**	04/03/2019
Samples Analysed:	6 soil samples		

Signed: [redacted]

[redacted]
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 19-26818

Project / Site name: Northstowe Phase 3

Lab Sample Number				1143556	1143557	1143558	1143559	1143560
Sample Reference				HDP1	HDP2	HDP3	HDP4	HDP5
Sample Number				202	201	202	201	201
Depth (m)				0.00-0.35	0.00-0.10	0.20-0.30	0.00-0.10	0.00-0.10
Date Sampled				22/01/2019	22/01/2019	22/01/2019	22/01/2019	22/01/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	11	23	13	13	20
Total mass of sample received	kg	0.001	NONE	1.2	1.2	1.6	1.2	1.3
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.6	6.9	7.4	8.0	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.011	0.014	0.011	0.012	0.037
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	< 0.80	< 0.80
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.8	12	14	11	15
Boron (water soluble)	mg/kg	0.2	MCERTS	1.3	2.5	2.3	2.2	3.0
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	30	22	22	30
Copper (aqua regia extractable)	mg/kg	1	MCERTS	23	34	41	17	81
Lead (aqua regia extractable)	mg/kg	1	MCERTS	15	20	16	20	19
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	21	18	18	26
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	74	63	100	46	69

Analytical Report Number: 19-26818

Project / Site name: Northstowe Phase 3

Lab Sample Number				1143561				
Sample Reference				HDP6				
Sample Number				201				
Depth (m)				0.00-0.10				
Date Sampled				22/01/2019				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	15				
Total mass of sample received	kg	0.001	NONE	0.35				
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected				
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.7				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Free Cyanide	mg/kg	1	MCERTS	< 1				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.024				
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05				
Fluorene	mg/kg	0.05	MCERTS	< 0.05				
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05				
Anthracene	mg/kg	0.05	MCERTS	< 0.05				
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Pyrene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Chrysene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80				
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16				
Boron (water soluble)	mg/kg	0.2	MCERTS	1.9				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2				
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	25				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	30				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	21				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	65				

Analytical Report Number : 19-26818

Project / Site name: Northstowe Phase 3

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation.
The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1143556	HDP1	202	0.00-0.35	Brown clay and sand with gravel and vegetation.
1143557	HDP2	201	0.00-0.10	Brown clay and loam with vegetation and gravel
1143558	HDP3	202	0.20-0.30	Brown loam and clay with vegetation and gravel
1143559	HDP4	201	0.00-0.10	Brown loam and clay with vegetation and gravel
1143560	HDP5	201	0.00-0.10	Light brown clay and loam with vegetation and gravel.
1143561	HDP6	201	0.00-0.10	Brown loam and clay with vegetation and gravel

Light brown clay and loam with vegetation and gravel.

Analytical Report Number : 19-26818

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
HDP1	202	S	19-26818	1143556	c	Free cyanide in soil	L080-PL	c
HDP1	202	S	19-26818	1143556	c	Total cyanide in soil	L080-PL	c
HDP2	201	S	19-26818	1143557	c	Free cyanide in soil	L080-PL	c
HDP2	201	S	19-26818	1143557	c	Total cyanide in soil	L080-PL	c
HDP3	202	S	19-26818	1143558	c	Free cyanide in soil	L080-PL	c
HDP3	202	S	19-26818	1143558	c	Total cyanide in soil	L080-PL	c
HDP4	201	S	19-26818	1143559	c	Free cyanide in soil	L080-PL	c
HDP4	201	S	19-26818	1143559	c	Total cyanide in soil	L080-PL	c
HDP5	201	S	19-26818	1143560	c	Free cyanide in soil	L080-PL	c
HDP5	201	S	19-26818	1143560	c	Total cyanide in soil	L080-PL	c
HDP6	201	S	19-26818	1143561	c	Free cyanide in soil	L080-PL	c
HDP6	201	S	19-26818	1143561	c	Total cyanide in soil	L080-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

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Analytical Report Number : 19-26919

Replaces Analytical Report Number : 19-26919, issue no. 2

Project / Site name:	Northstowe Phase 3	**Samples received on:**	28/01/2019
Your job number:	10019646	**Samples instructed on:**	30/01/2019
Your order number:		**Analysis completed by:**	04/03/2019
Report Issue Number:	3	**Report issued on:**	04/03/2019
Samples Analysed:	3 soil samples		

Signed: [redacted]

[redacted]
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 19-26919

Project / Site name: Northstowe Phase 3

Lab Sample Number				1144051	1144052	1144053		
Sample Reference				TP3002	TP3004	TP3005		
Sample Number				201	202	202		
Depth (m)				0.00-0.10	0.17-0.25	0.45-0.55		
Date Sampled				25/01/2019	25/01/2019	25/01/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	16	13	10		
Total mass of sample received	kg	0.001	NONE	1.3	1.9	1.9		
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected		
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.5	7.9	8.0		
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1		
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1		
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.023	0.016	0.0087		
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Phenanthrene	mg/kg	0.05	MCERTS	0.47	< 0.05	< 0.05		
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Fluoranthene	mg/kg	0.05	MCERTS	1.4	0.52	< 0.05		
Pyrene	mg/kg	0.05	MCERTS	1.1	0.39	< 0.05		
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.58	< 0.05	< 0.05		
Chrysene	mg/kg	0.05	MCERTS	0.97	< 0.05	< 0.05		
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.1	< 0.05	< 0.05		
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.45	< 0.05	< 0.05		
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.66	< 0.05	< 0.05		
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.33	< 0.05	< 0.05		
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05		
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.42	< 0.05	< 0.05		
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	7.41	0.91	< 0.80		
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	15	12	13		
Boron (water soluble)	mg/kg	0.2	MCERTS	1.1	0.8	0.6		
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2		
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0		
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	27	26	25		
Copper (aqua regia extractable)	mg/kg	1	MCERTS	11	13	14		
Lead (aqua regia extractable)	mg/kg	1	MCERTS	14	11	9.1		
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3		
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	19	19	21		
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0		
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	49	46	50		

Analytical Report Number : 19-26919

Project / Site name: Northstowe Phase 3

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1144051	TP3002	201	0.00-0.10	Brown loam and clay with vegetation.
1144052	TP3004	202	0.17-0.25	Brown loam and clay with vegetation.
1144053	TP3005	202	0.45-0.55	Brown loam and clay with vegetation and gravel

Analytical Report Number : 19-26919

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 19-26926

Replaces Analytical Report Number : 19-26926, issue no. 1

Project / Site name:	Northstowe Phase 3	**Samples received on:**	28/01/2019
Your job number:	10019646	**Samples instructed on:**	30/01/2019
Your order number:		**Analysis completed by:**	04/03/2019
Report Issue Number:	2	**Report issued on:**	04/03/2019
Samples Analysed:	5 soil samples		

Signed: [redacted]

[redacted]
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 19-26926

Project / Site name: Northstowe Phase 3

Lab Sample Number				1144065	1144066	1144067	1144068	1144069
Sample Reference				TP3003	TP3008	TP3009	TP3010	TP3011
Sample Number				2	1	2	2	2
Depth (m)				0.13-0.20	0.00-0.08	0.10-0.20	0.15-0.25	0.10-0.20
Date Sampled				22/01/2019	22/01/2019	22/01/2019	22/01/2019	22/01/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	18	16	15	12	15
Total mass of sample received	kg	0.001	NONE	1.2	1.3	1.1	1.2	1.3
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.8	7.9	8.1	8.2	8.2
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.036	0.019	0.016	0.022	0.020
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	1.1	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	2.3	< 0.05	< 0.05	< 0.05	2.1
Fluorene	mg/kg	0.05	MCERTS	0.96	< 0.05	< 0.05	< 0.05	1.3
Phenanthrene	mg/kg	0.05	MCERTS	16	1.2	< 0.05	3.5	19
Anthracene	mg/kg	0.05	MCERTS	3.9	< 0.05	< 0.05	0.65	4.2
Fluoranthene	mg/kg	0.05	MCERTS	32	3.0	0.34	8.2	27
Pyrene	mg/kg	0.05	MCERTS	28	2.5	0.32	6.9	22
Benzo(a)anthracene	mg/kg	0.05	MCERTS	12	1.2	< 0.05	3.0	12
Chrysene	mg/kg	0.05	MCERTS	9.5	1.2	< 0.05	3.4	7.7
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	16	1.7	< 0.05	5.3	12
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	3.9	0.66	< 0.05	1.2	5.1
Benzo(a)pyrene	mg/kg	0.05	MCERTS	11	1.1	< 0.05	3.2	8.6
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	4.9	0.58	< 0.05	1.6	4.6
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	1.4	< 0.05	< 0.05	0.53	1.4
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	5.5	0.74	< 0.05	1.9	5.4
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	148	13.8	< 0.80	39.3	132

Analytical Report Number: 19-26926

Project / Site name: Northstowe Phase 3

Lab Sample Number				1144065	1144066	1144067	1144068	1144069
Sample Reference				TP3003	TP3008	TP3009	TP3010	TP3011
Sample Number				2	1	2	2	2
Depth (m)				0.13-0.20	0.00-0.08	0.10-0.20	0.15-0.25	0.10-0.20
Date Sampled				22/01/2019	22/01/2019	22/01/2019	22/01/2019	22/01/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	21	21	28	16	20
Boron (water soluble)	mg/kg	0.2	MCERTS	1.7	1.1	2.0	1.9	1.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.4	< 0.2	0.4	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	25	30	26	21
Copper (aqua regia extractable)	mg/kg	1	MCERTS	17	16	13	13	15
Lead (aqua regia extractable)	mg/kg	1	MCERTS	35	30	15	29	18
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23	23	28	21	25
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	66	87	74	80	70
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	1.4	1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	-	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	-	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	13	-	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	15	-	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	-	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	-	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	2.6	-	< 2.0	< 2.0	2.6
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	23	-	< 10	< 10	30
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	< 10	-	< 10	< 10	12
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	33	-	< 10	15	44

Analytical Report Number : 19-26926

Project / Site name: Northstowe Phase 3

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation.
The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1144065	TP3003	2	0.13-0.20	Brown clay and loam with vegetation and gravel
1144066	TP3008	1	0.00-0.08	Brown loam and clay with vegetation.
1144067	TP3009	2	0.10-0.20	Brown loam and clay with vegetation and gravel
1144068	TP3010	2	0.15-0.25	Brown loam and clay with vegetation and gravel
1144069	TP3011	2	0.10-0.20	Brown loam and clay with vegetation and gravel

Analytical Report Number : 19-26926

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP3003	2	S	19-26926	1144065	c	Free cyanide in soil	L080-PL	c
TP3003	2	S	19-26926	1144065	c	Total cyanide in soil	L080-PL	c
TP3008	1	S	19-26926	1144066	c	Free cyanide in soil	L080-PL	c
TP3008	1	S	19-26926	1144066	c	Total cyanide in soil	L080-PL	c
TP3009	2	S	19-26926	1144067	c	Free cyanide in soil	L080-PL	c
TP3009	2	S	19-26926	1144067	c	Total cyanide in soil	L080-PL	c
TP3010	2	S	19-26926	1144068	c	Free cyanide in soil	L080-PL	c
TP3010	2	S	19-26926	1144068	c	Total cyanide in soil	L080-PL	c
TP3011	2	S	19-26926	1144069	c	Free cyanide in soil	L080-PL	c
TP3011	2	S	19-26926	1144069	c	Total cyanide in soil	L080-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

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Analytical Report Number : 19-27413

Project / Site name:	Northstowe Phase 3	**Samples received on:**	23/01/2019
Your job number:	10019646	**Samples instructed on:**	04/02/2019
Your order number:		**Analysis completed by:**	20/02/2019
Report Issue Number:	1	**Report issued on:**	20/02/2019
Samples Analysed:	3 soil samples		

Signed: [redacted]

[redacted]
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 19-27413

Project / Site name: Northstowe Phase 3

Lab Sample Number				1147004	1147005	1147006		
Sample Reference				HDP1	HDP3	HDP4		
Sample Number				201	201	201		
Depth (m)				0.00-0.10	0.00-0.10	0.00-0.10		
Date Sampled				22/01/2019	22/01/2019	22/01/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1		
Moisture Content	%	N/A	NONE	12	15	12		
Total mass of sample received	kg	0.001	NONE	1.2	1.2	1.2		

Organochlorine Pesticides (OCP)

Aldrin	ug/kg	10	NONE	< 10	< 10	< 10		
BHC-alpha (benzene hexachloride)	ug/kg	10	NONE	< 10	< 10	< 10		
BHC-beta	ug/kg	10	NONE	< 10	< 10	< 10		
BHC-delta	ug/kg	10	NONE	< 10	< 10	< 10		
BHC-gamma (Lindane, gamma HCH)	ug/kg	10	NONE	< 10	< 10	< 10		
Chlordane-cis	ug/kg	10	NONE	< 10	< 10	< 10		
Chlordane-trans	ug/kg	10	NONE	< 10	< 10	< 10		
Chlorothalonil	ug/kg	10	NONE	< 10	< 10	< 10		
DDD-o,p'	ug/kg	1	NONE	< 1.0	< 1.0	< 1.0		
DDD-p,p'	ug/kg	1	NONE	< 1.0	< 1.0	< 1.0		
DDE-o, p'	ug/kg	1	NONE	< 1.0	< 1.0	< 1.0		
DDE-p,p'	ug/kg	1	NONE	< 1.0	< 1.0	< 1.0		
DDT-o,p'	ug/kg	1	NONE	< 1.0	< 1.0	< 1.0		
DDT-p,p'	ug/kg	1	NONE	< 1.0	< 1.0	< 1.0		
Dichlorobenzonitrile, 2,6-	ug/kg	10	NONE	< 10	< 10	< 10		
Dieldrin	ug/kg	10	NONE	< 10	< 10	< 10		
Endosulfan I (alpha isomer)	ug/kg	10	NONE	< 10	< 10	< 10		
Endosulfan II (beta isomer)	ug/kg	10	NONE	< 10	< 10	< 10		
Endosulfan sulfate	ug/kg	10	NONE	< 10	< 10	< 10		
Endrin	ug/kg	10	NONE	< 10	< 10	< 10		
Endrin aldehyde	ug/kg	10	NONE	< 10	< 10	< 10		
Endrin ketone	ug/kg	10	NONE	< 10	< 10	< 10		
Heptachlor	ug/kg	10	NONE	< 10	< 10	< 10		
Heptachlor exo-epoxide	ug/kg	10	NONE	< 10	< 10	< 10		
Hexachlorobenzene	ug/kg	10	NONE	< 10	< 10	< 10		
Hexachlorobutadiene	ug/kg	10	NONE	< 10	< 10	< 10		
Isodrin	ug/kg	10	NONE	< 10	< 10	< 10		
Methoxychlor, p,p'-	ug/kg	10	NONE	< 10	< 10	< 10		
Pentachlorobenzene	ug/kg	10	NONE	< 10	< 10	< 10		
Tecnazene	ug/kg	10	NONE	< 10	< 10	< 10		
Tetrachlorobenzene, 1,2,4,5-	ug/kg	10	NONE	< 10	< 10	< 10		
Trichlorobenzene, 1,2,3-	ug/kg	10	NONE	< 10	< 10	< 10		
Trichlorobenzene, 1,3,5-	ug/kg	10	NONE	< 10	< 10	< 10		
Trifluralin	ug/kg	10	NONE	< 10	< 10	< 10		

Analytical Report Number: 19-27413

Project / Site name: Northstowe Phase 3

Lab Sample Number				1147004	1147005	1147006		
Sample Reference				HDP1	HDP3	HDP4		
Sample Number				201	201	201		
Depth (m)				0.00-0.10	0.00-0.10	0.00-0.10		
Date Sampled				22/01/2019	22/01/2019	22/01/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Organophosphorus Pesticides (OPP)								
Azinphos-ethyl	ug/kg	10	NONE	< 10	< 10	< 10		
Azinphos-methyl	ug/kg	10	NONE	< 10	< 10	< 10		
Carbophenothion	ug/kg	10	NONE	< 10	< 10	< 10		
Chlorfenvinphos (mixture of z and e isomers)	ug/kg	10	NONE	< 10	< 10	< 10		
Chlorpyrifos	ug/kg	10	NONE	< 10	< 10	< 10		
Demeton-O	ug/kg	10	NONE	< 10	< 10	< 10		
Demeton-S	ug/kg	10	NONE	< 10	< 10	< 10		
Diazinon	ug/kg	10	NONE	< 10	< 10	< 10		
Dichlorvos	ug/kg	10	NONE	< 10	< 10	< 10		
Dimethoate	ug/kg	10	NONE	< 10	< 10	< 10		
Dimethylvinphos	ug/kg	10	NONE	< 10	< 10	< 10		
Ethion	ug/kg	10	NONE	< 10	< 10	< 10		
Etrimfos	ug/kg	10	NONE	< 10	< 10	< 10		
Fenitrothion	ug/kg	10	NONE	< 10	< 10	< 10		
Fenthion	ug/kg	10	NONE	< 10	< 10	< 10		
Malathion	ug/kg	10	NONE	< 10	< 10	< 10		
Methacrifos	ug/kg	10	NONE	< 10	< 10	< 10		
Mevinphos , E-	ug/kg	10	NONE	< 10	< 10	< 10		
Mevinphos, Z-	ug/kg	10	NONE	< 10	< 10	< 10		
Parathion	ug/kg	10	NONE	< 10	< 10	< 10		
Parathion-methyl	ug/kg	10	NONE	< 10	< 10	< 10		
Phorate	ug/kg	10	NONE	< 10	< 10	< 10		
Phosalone	ug/kg	10	NONE	< 10	< 10	< 10		
Phosphamidon I	ug/kg	10	NONE	< 10	< 10	< 10		
Pirimiphos-ethyl	ug/kg	10	NONE	< 10	< 10	< 10		
Pirimiphos-methyl	ug/kg	10	NONE	< 10	< 10	< 10		
Propetamphos	ug/kg	10	NONE	< 10	< 10	< 10		
Triazophos	ug/kg	10	NONE	< 10	< 10	< 10		
Organonitrogen Pesticides (ONP)								
Pendimethalin	ug/kg	10	NONE	12	38	< 10		
Propyzamide	ug/kg	10	NONE	< 10	< 10	< 10		
Triadimefon	ug/kg	10	NONE	< 10	< 10	< 10		

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Project / Site name: Northstowe Phase 3

Lab Sample Number				1147004	1147005	1147006		
Sample Reference				HDP1	HDP3	HDP4		
Sample Number				201	201	201		
Depth (m)				0.00-0.10	0.00-0.10	0.00-0.10		
Date Sampled				22/01/2019	22/01/2019	22/01/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					

Organotins

Tributyl Tin	µg/kg	10	NONE	< 10	< 10	< 10		
Dibutyl Tin	µg/kg	10	NONE	< 10	< 10	< 10		
Tetrabutyl Tin	µg/kg	10	NONE	< 10	< 10	< 10		
Triphenyl Tin	µg/kg	10	NONE	< 10	< 10	< 10		

Environmental Forensics

Triazine Herbicides

Atrazine	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		
Simazine	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		
Prometryn	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		
Propazine	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		
Terbuthylazine	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		
Terbutryn	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		
Trietazine	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		
Cyanazine	mg/kg	0.1	NONE	< 0.10	< 0.10	< 0.10		

Acid Herbicides

2,4,5-T	ug/kg	20	NONE	< 20	< 20	< 20		
2,4,5-TP	ug/kg	20	NONE	< 20	< 20	< 20		
2,4-D	ug/kg	20	NONE	< 20	< 20	< 20		
2,4-DB	ug/kg	20	NONE	< 20	< 20	< 20		
Dicamba	ug/kg	20	NONE	< 20	< 20	< 20		
Dichlorprop	ug/kg	20	NONE	< 20	< 20	< 20		
Dinoseb	ug/kg	20	NONE	< 20	< 20	< 20		
MCPA	ug/kg	20	NONE	< 20	< 20	< 20		
MCPB	ug/kg	20	NONE	< 20	< 20	< 20		
MCPP (Mecoprop)	ug/kg	20	NONE	< 20	< 20	< 20		
Picloram	ug/kg	20	NONE	< 20	< 20	< 20		

Phenylurea herbicides

Isoproturon	ug/kg	10	NONE	< 10	< 10	< 10		
Chlortoluron	ug/kg	10	NONE	< 10	< 10	< 10		
Linuron	ug/kg	10	NONE	< 10	< 10	< 10		
Diuron	ug/kg	10	NONE	< 10	< 10	< 10		
Diflubenzuron	ug/kg	10	NONE	< 10	< 10	< 10		
Flumeturon	ug/kg	10	NONE	< 10	< 10	< 10		
Siduron	ug/kg	10	NONE	< 10	< 10	< 10		
Terbuthiuron	ug/kg	10	NONE	< 10	< 10	< 10		
Thidiazuron	ug/kg	10	NONE	< 10	< 10	< 10		

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* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1147004	HDP1	201	0.00-0.10	Brown loam and sand with gravel and vegetation.
1147005	HDP3	201	0.00-0.10	Brown loam and sand with vegetation and gravel.
1147006	HDP4	201	0.00-0.10	Brown loam and clay with vegetation and gravel

Analytical Report Number : 19-27413

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
EF - Organotins by GC-MS/MS in soil	Organotins by GC-MS/MS	In-house method	UK	W	NONE
EF - Phenylurea herbicides in soil by LC-MS/MS	Phenylurea herbicides by LC-MS/MS	In-house method	UK	W	NONE
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Organochlorine Pesticides in soil by GC MS/MS	Detemination of Pesticides in soil by GC MS/MS	Organochlorine Pesticides in soil by GC MS/MS	L055B-PL	D	NONE
Organonitrogen Pesticides in soil by GC MS/MS	Detemination of Pesticides in soil by GC MS/MS	Organonitrogen Pesticides in soil by GC MS/MS	L055B-PL	D	NONE
Organophosphorus Pesticides in soil by GC MS/MS	Detemination of Pesticides in soil by GC MS/MS	Organophosphorus Pesticides in soil by GC MS/MS	L055B-PL	D	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
TO - Acid Herbicides in soil by LC-MS/MS	Determination of Acid herbicides in waters by LC-MS/MS	In-house method		W	NONE
TO - Triazine pesticides in soil	Determination of Triazines by LC-MS(/MS).	In-house method based on USEPA method 615.		W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 19-27437

Project / Site name:	Northstowe Phase 3	**Samples received on:**	04/02/2019
Your job number:	10019646	**Samples instructed on:**	04/02/2019
Your order number:		**Analysis completed by:**	13/02/2019
Report Issue Number:	1	**Report issued on:**	13/02/2019
Samples Analysed:	6 soil samples		

[redacted]

Signed: [redacted]

[redacted]
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 19-27437

Project / Site name: Northstowe Phase 3

Lab Sample Number				1147106	1147107	1147108	1147109	1147110
Sample Reference				TP3003	TP3007	TP3008	TP3009	TP3010
Sample Number				3	3	2	3	3
Depth (m)				0.58-0.65	0.50-0.60	0.08-0.20	0.27-0.35	0.40-0.50
Date Sampled				22/01/2019	22/01/2019	22/01/2019	22/01/2019	22/01/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	17	16	13	15	14
Total mass of sample received	kg	0.001	NONE	0.92	0.75	1.1	1.0	1.1
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.5	7.5	8.0	8.3	8.3
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.28	0.055	0.016	0.039	0.020
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.23	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.8	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.60	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	5.4	< 0.05	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	4.6	< 0.05	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.4	< 0.05	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.1	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.6	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.1	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.0	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.0	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.20	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.1	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	26.1	< 0.80	< 0.80
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	33	16	22	39	17
Boron (water soluble)	mg/kg	0.2	MCERTS	1.8	2.3	2.5	1.4	1.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	41	32	28	39	26
Copper (aqua regia extractable)	mg/kg	1	MCERTS	8.2	11	15	16	12
Lead (aqua regia extractable)	mg/kg	1	MCERTS	13	9.2	23	13	14
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	73	23	23	34	22
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	39	71	83	54

Analytical Report Number: 19-27437

Project / Site name: Northstowe Phase 3

Lab Sample Number				1150579				
Sample Reference				TP3011				
Sample Number				3				
Depth (m)				0.95-1.05				
Date Sampled				24/01/2019				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	13				
Total mass of sample received	kg	0.001	NONE	1.3				
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected				
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.1				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Free Cyanide	mg/kg	1	MCERTS	< 1				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.018				
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05				
Fluorene	mg/kg	0.05	MCERTS	< 0.05				
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05				
Anthracene	mg/kg	0.05	MCERTS	< 0.05				
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Pyrene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Chrysene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80				
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	42				
Boron (water soluble)	mg/kg	0.2	MCERTS	1.5				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2				
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	28				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	16				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	17				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	34				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	120				

Analytical Report Number : 19-27437

Project / Site name: Northstowe Phase 3

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1147106	TP3003	3	0.58-0.65	Brown clay and sand with gravel.
1147107	TP3007	3	0.50-0.60	Brown clay and sand with gravel.
1147108	TP3008	2	0.08-0.20	Brown loam and sand with vegetation and gravel.
1147109	TP3009	3	0.27-0.35	Brown clay and sand with gravel.
1147110	TP3010	3	0.40-0.50	Brown loam and sand with gravel.
1150579	TP3011	3	0.95-1.05	Brown clay and loam with gravel.

Analytical Report Number : 19-27437

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
TP3003	3	S	19-27437	1147106	c	Free cyanide in soil	L080-PL	c
TP3003	3	S	19-27437	1147106	c	Total cyanide in soil	L080-PL	c
TP3007	3	S	19-27437	1147107	c	Free cyanide in soil	L080-PL	c
TP3007	3	S	19-27437	1147107	c	Total cyanide in soil	L080-PL	c
TP3008	2	S	19-27437	1147108	c	Free cyanide in soil	L080-PL	c
TP3008	2	S	19-27437	1147108	c	Total cyanide in soil	L080-PL	c
TP3009	3	S	19-27437	1147109	c	Free cyanide in soil	L080-PL	c
TP3009	3	S	19-27437	1147109	c	Total cyanide in soil	L080-PL	c
TP3010	3	S	19-27437	1147110	c	Free cyanide in soil	L080-PL	c
TP3010	3	S	19-27437	1147110	c	Total cyanide in soil	L080-PL	c
TP3011	3	S	19-27437	1150579	c	Free cyanide in soil	L080-PL	c
TP3011	3	S	19-27437	1150579	c	Total cyanide in soil	L080-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

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Analytical Report Number : 19-27494

Project / Site name:	Northstowe Phase 3	**Samples received on:**	28/01/2019
Your job number:	10019646	**Samples instructed on:**	04/02/2019
Your order number:		**Analysis completed by:**	12/02/2019
Report Issue Number:	1	**Report issued on:**	12/02/2019
Samples Analysed:	6 soil samples		

Signed: [redacted]

[redacted]

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 19-27494

Project / Site name: Northstowe Phase 3

Lab Sample Number				1147345	1147346	1147347	1147348	1147349
Sample Reference				BH1	BH2	BH3	BH5	TP3001
Sample Number				1	1	80	2	201
Depth (m)				0.10-0.20	0.10-0.10	0.10-0.10	0.30-0.30	0.00-0.10
Date Sampled				25/01/2019	25/01/2019	25/01/2019	25/01/2019	25/01/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	18	20	24	13	21
Total mass of sample received	kg	0.001	NONE	0.97	1.1	1.3	1.5	1.3
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Not-detected
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	8.2	8.0	8.0	8.2	7.0
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Free Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.011	0.032	0.016	0.014	0.024
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.38
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.79
Pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.68
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.38
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.41
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.44
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.25
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.37
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.22
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	0.27
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	< 0.80	< 0.80	< 0.80	4.19

Analytical Report Number: 19-27494

Project / Site name: Northstowe Phase 3

Lab Sample Number				1147345	1147346	1147347	1147348	1147349
Sample Reference				BH1	BH2	BH3	BH5	TP3001
Sample Number				1	1	80	2	201
Depth (m)				0.10-0.20	0.10-0.10	0.10-0.10	0.30-0.30	0.00-0.10
Date Sampled				25/01/2019	25/01/2019	25/01/2019	25/01/2019	25/01/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	18	24	12	12	14
Boron (water soluble)	mg/kg	0.2	MCERTS	2.5	2.4	3.8	0.3	1.8
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.4	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	31	30	44	14	22
Copper (aqua regia extractable)	mg/kg	1	MCERTS	25	29	27	7.7	14
Lead (aqua regia extractable)	mg/kg	1	MCERTS	20	21	18	6.2	18
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	34	35	25	13	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	120	120	86	23	41

Analytical Report Number: 19-27494

Project / Site name: Northstowe Phase 3

Lab Sample Number				1147350				
Sample Reference				TP3006				
Sample Number				201				
Depth (m)				0.00-0.10				
Date Sampled				25/01/2019				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	15				
Total mass of sample received	kg	0.001	NONE	1.1				
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected				
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	6.7				
Total Cyanide	mg/kg	1	MCERTS	< 1				
Free Cyanide	mg/kg	1	MCERTS	< 1				
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.046				
Total Phenols								
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05				
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05				
Fluorene	mg/kg	0.05	MCERTS	< 0.05				
Phenanthrene	mg/kg	0.05	MCERTS	0.45				
Anthracene	mg/kg	0.05	MCERTS	< 0.05				
Fluoranthene	mg/kg	0.05	MCERTS	0.90				
Pyrene	mg/kg	0.05	MCERTS	0.83				
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.45				
Chrysene	mg/kg	0.05	MCERTS	0.48				
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.51				
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.30				
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.48				
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.27				
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.30				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	4.97				

Analytical Report Number: 19-27494

Project / Site name: Northstowe Phase 3

Lab Sample Number				1147350				
Sample Reference				TP3006				
Sample Number				201				
Depth (m)				0.00-0.10				
Date Sampled				25/01/2019				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12				
Boron (water soluble)	mg/kg	0.2	MCERTS	1.2				
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2				
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0				
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	21				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	13				
Lead (aqua regia extractable)	mg/kg	1	MCERTS	21				
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3				
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	15				
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0				
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	47				

Analytical Report Number : 19-27494

Project / Site name: Northstowe Phase 3

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1147345	BH1	1	0.10-0.20	Brown loam and clay with vegetation and gravel
1147346	BH2	1	0.10-0.10	Brown loam and clay with vegetation and gravel
1147347	BH3	80	0.10-0.10	Brown clay and loam with vegetation.
1147348	BH5	2	0.30-0.30	Light brown sand with gravel.
1147349	TP3001	201	0.00-0.10	Brown loam and sand with vegetation.
1147350	TP3006	201	0.00-0.10	Brown loam and sand with vegetation.

Analytical Report Number : 19-27494

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH1	1	S	19-27494	1147345	c	Free cyanide in soil	L080-PL	c
BH1	1	S	19-27494	1147345	c	Total cyanide in soil	L080-PL	c
BH2	1	S	19-27494	1147346	c	Free cyanide in soil	L080-PL	c
BH2	1	S	19-27494	1147346	c	Total cyanide in soil	L080-PL	c
BH3	80	S	19-27494	1147347	c	Free cyanide in soil	L080-PL	c
BH3	80	S	19-27494	1147347	c	Total cyanide in soil	L080-PL	c
BH5	2	S	19-27494	1147348	c	Free cyanide in soil	L080-PL	c
BH5	2	S	19-27494	1147348	c	Total cyanide in soil	L080-PL	c
TP3001	201	S	19-27494	1147349	c	Free cyanide in soil	L080-PL	c
TP3001	201	S	19-27494	1147349	c	Total cyanide in soil	L080-PL	c
TP3006	201	S	19-27494	1147350	c	Free cyanide in soil	L080-PL	c
TP3006	201	S	19-27494	1147350	c	Total cyanide in soil	L080-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

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Analytical Report Number : 19-28354

Project / Site name:	Northstowe Phase 3	**Samples received on:**	11/02/2019
Your job number:	10019646	**Samples instructed on:**	12/02/2019
Your order number:		**Analysis completed by:**	20/02/2019
Report Issue Number:	1	**Report issued on:**	20/02/2019
Samples Analysed:	8 water samples		

Signed: [redacted]

[redacted]
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Analytical Report Number: 19-28354

Project / Site name: Northstowe Phase 3

Lab Sample Number				1152216	1152217	1152218	1152219	1152220
Sample Reference				BH4	BH4	BH5	BH5	BH2
Sample Number				8.2.19EW1	8.2.19EW2	7.2.19EW2	7.2.19EW1	7.2.19EW1
Depth (m)				1.00-1.50	8.50-9.00	8.00-8.50	2.00-2.50	1.50-2.00
Date Sampled				08/02/2019	08/02/2019	07/02/2019	07/02/2019	07/02/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH	pH Units	N/A	ISO 17025	7.2	7.4	7.3	7.2	7.5
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Sulphate as SO_4	µg/l	45	ISO 17025	106000	192000	195000	104000	32400
Sulphate as SO_4	mg/l	0.045	ISO 17025	106	192	195	104	32.4
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	5.26	-	5.56	-	-
Alkalinity	mgCaCO3/l	3	ISO 17025	450	400	380	380	180
Phenols by HPLC								
Catechol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Resorcinol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Ethylphenol & Dimethylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cresols	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Naphthols	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Isopropylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Phenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trimethylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Total Phenols								
Total Phenols (HPLC)	µg/l	3.5	NONE	< 3.5	< 3.5	< 3.5	< 3.5	< 3.5
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total PAH								
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16

Analytical Report Number: 19-28354

Project / Site name: Northstowe Phase 3

Lab Sample Number				1152216	1152217	1152218	1152219	1152220
Sample Reference				BH4	BH4	BH5	BH5	BH2
Sample Number				8.2.19EW1	8.2.19EW2	7.2.19EW2	7.2.19EW1	7.2.19EW1
Depth (m)				1.00-1.50	8.50-9.00	8.00-8.50	2.00-2.50	1.50-2.00
Date Sampled				08/02/2019	08/02/2019	07/02/2019	07/02/2019	07/02/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.28	0.84	0.59	0.39	0.22
Boron (dissolved)	µg/l	10	ISO 17025	130	770	600	85	150
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.02	0.02	< 0.02	< 0.02
Calcium (dissolved)	mg/l	0.012	ISO 17025	180	-	140	-	-
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	0.2	< 0.2
Copper (dissolved)	µg/l	0.5	ISO 17025	2.3	1.0	2.0	1.1	1.5
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	1.0	6.0	12	3.2	1.2
Selenium (dissolved)	µg/l	0.6	ISO 17025	2.7	9.5	11	2.2	1.6
Zinc (dissolved)	µg/l	0.5	ISO 17025	1.6	14	13	0.6	3.4
Monoaromatics & Oxygenates								
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	130
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	230
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	90
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	450
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 19-28354

Project / Site name: Northstowe Phase 3

Lab Sample Number				1152221	1152222	1152223		
Sample Reference				BH2	BH1	BH1		
Sample Number				7.2.19EW2	7.2.19EW1	7.2.19EW2		
Depth (m)				8.50-9.00	2.00-2.30	8.50-9.00		
Date Sampled				07/02/2019	07/02/2019	07/02/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
pH	pH Units	N/A	ISO 17025	7.5	7.5	7.5		
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10		
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10		
Sulphate as SO_4	µg/l	45	ISO 17025	166000	452000	1250000		
Sulphate as SO_4	mg/l	0.045	ISO 17025	166	452	1250		
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	4.76	3.93	-		
Alkalinity	mgCaCO3/l	3	ISO 17025	320	490	540		
Phenols by HPLC								
Catechol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Resorcinol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Ethylphenol & Dimethylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Cresols	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Naphthols	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Isopropylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Phenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Trimethylphenol	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5		
Total Phenols								
Total Phenols (HPLC)	µg/l	3.5	NONE	< 3.5	< 3.5	< 3.5		
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Total PAH								
Total EPA-16 PAHs	µg/l	0.16	ISO 17025	< 0.16	< 0.16	< 0.16		

Analytical Report Number: 19-28354

Project / Site name: Northstowe Phase 3

Lab Sample Number				1152221	1152222	1152223		
Sample Reference				BH2	BH1	BH1		
Sample Number				7.2.19EW2	7.2.19EW1	7.2.19EW2		
Depth (m)				8.50-9.00	2.00-2.30	8.50-9.00		
Date Sampled				07/02/2019	07/02/2019	07/02/2019		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.81	0.35	0.58		
Boron (dissolved)	µg/l	10	ISO 17025	1200	95	1100		
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.02	0.05		
Calcium (dissolved)	mg/l	0.012	ISO 17025	77	200	-		
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0		
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.2	< 0.2		
Copper (dissolved)	µg/l	0.5	ISO 17025	2.7	1.0	1.3		
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2		
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05		
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.7	2.9	5.0		
Selenium (dissolved)	µg/l	0.6	ISO 17025	16	11	6.0		
Zinc (dissolved)	µg/l	0.5	ISO 17025	13	1.5	2.9		
Monoaromatics & Oxygenates								
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		

U/S = Unsuitable Sample   I/S = Insufficient Sample

Analytical Report Number : 19-28354

Project / Site name: Northstowe Phase 3

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Alkalinity in Water (by discreet analyser)	Determination of Alkalinity by discreet analyser (colorimetry). Accredited matrices: SW, PW, GW.	In house method based on MEWAM & USEPA Method 310.2.	L082-PL	W	ISO 17025
Boron in water	Determination of boron in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW	In-house method based on MEWAM	L039-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE
Free cyanide in water	Determination of free cyanide by distillation followed by colorimetry.Accredited matrices SW, GW, PW.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 "for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	W	ISO 17025
Phenols, speciated, in water, by HPLC	Determination of speciated phenols by HPLC.	In house method based on Blue Book Method.	L030-PL	W	NONE
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES. Accredited matrices: SW PW GW, PrW.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Sample ID	Other_ID	Sample Type	Job	Sample Number	Sample Deviation Code	test_name	test_ref	Test Deviation code
BH1	7.2.19EW1	W	19-28354	1152222	c	pH at 20oC in water (automated)	L099-PL	c
BH1	7.2.19EW2	W	19-28354	1152223	c	pH at 20oC in water (automated)	L099-PL	c
BH2	7.2.19EW1	W	19-28354	1152220	c	pH at 20oC in water (automated)	L099-PL	c
BH2	7.2.19EW2	W	19-28354	1152221	c	pH at 20oC in water (automated)	L099-PL	c
BH4	8.2.19EW1	W	19-28354	1152216	c	pH at 20oC in water (automated)	L099-PL	c
BH4	8.2.19EW2	W	19-28354	1152217	c	pH at 20oC in water (automated)	L099-PL	c
BH5	7.2.19EW1	W	19-28354	1152219	c	pH at 20oC in water (automated)	L099-PL	c
BH5	7.2.19EW2	W	19-28354	1152218	c	pH at 20oC in water (automated)	L099-PL	c

Key: a - No sampling date b - Incorrect container
c - Holding time d - Headspace e - Temperature

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MEMO

SUBJECT
Oakington Non-Technical Summary Report

DATE
13 June 2019

DEPARTMENT
Water Management and Resilience

COPIES TO

TO
[redacted]

OUR REF
10019646-AUK-NS-P3-RP-IE-2-1-Oakington Flood Risk Report

PROJECT NUMBER
10019646

FROM
[redacted]

Background

This memo has been produced for the residents of Oakington to describe the work carried out on behalf of the Homes and Communities Agency (HCA) to assess the current and future flood risk in the village. This assessment has been carried out as part of the Northstowe new town development work which is currently entering Phase 3a and involves construction work on lands immediately north of Oakington.

Arcadis Consulting (UK) Limited (Arcadis) was commissioned by the HCA to appraise any changes to local flood risk resulting from the development, and to assess any opportunities to reduce flood risk to the community of Oakington. As a result, Arcadis have produced this summary memo setting out the work undertaken to date.

Flood Modelling

Flood modelling is the practice of using computer software to predict where, when, and how flooding might affect a given area. A range of data is used to build up a digital picture of the area and different sizes of flood events are simulated. This is known as a 'flood model'. The flood model is then used to produce a map of predicted flood extents and depths. This can be compared with information on real floods to assess how accurate the flood model is.

In the case of Oakington and Northstowe, Arcadis took an existing Environment Agency approved flood model for the Oakington Brook, Beck Brook and Washpit Brook and added extra, more up to date information to define the local area in and around Oakington. The aim of this exercise was to make sure that the flood model gave the best possible representation of flood risk within Oakington and the surrounding area. The following specific improvements to the model were made:

- Addition of the drain and ditch network around the village, using newly collected information on the sizes and locations of the drains;
- Inclusion of information showing the location of, and ground levels along, the Cambridge Guided Busway; and
- Addition of information on the existing ground levels across the Northstowe site.

Arcadis used survey data obtained by EDI Surveys in 2015 to update the model. Eight additional watercourses were added into the model to enhance the level of detail in the Oakington area. Two drains associated with Northstowe were added, including Award Drain 171 and its culverts running parallel to Longstanton Road. The modelled watercourses and drains are shown in Figure 1.

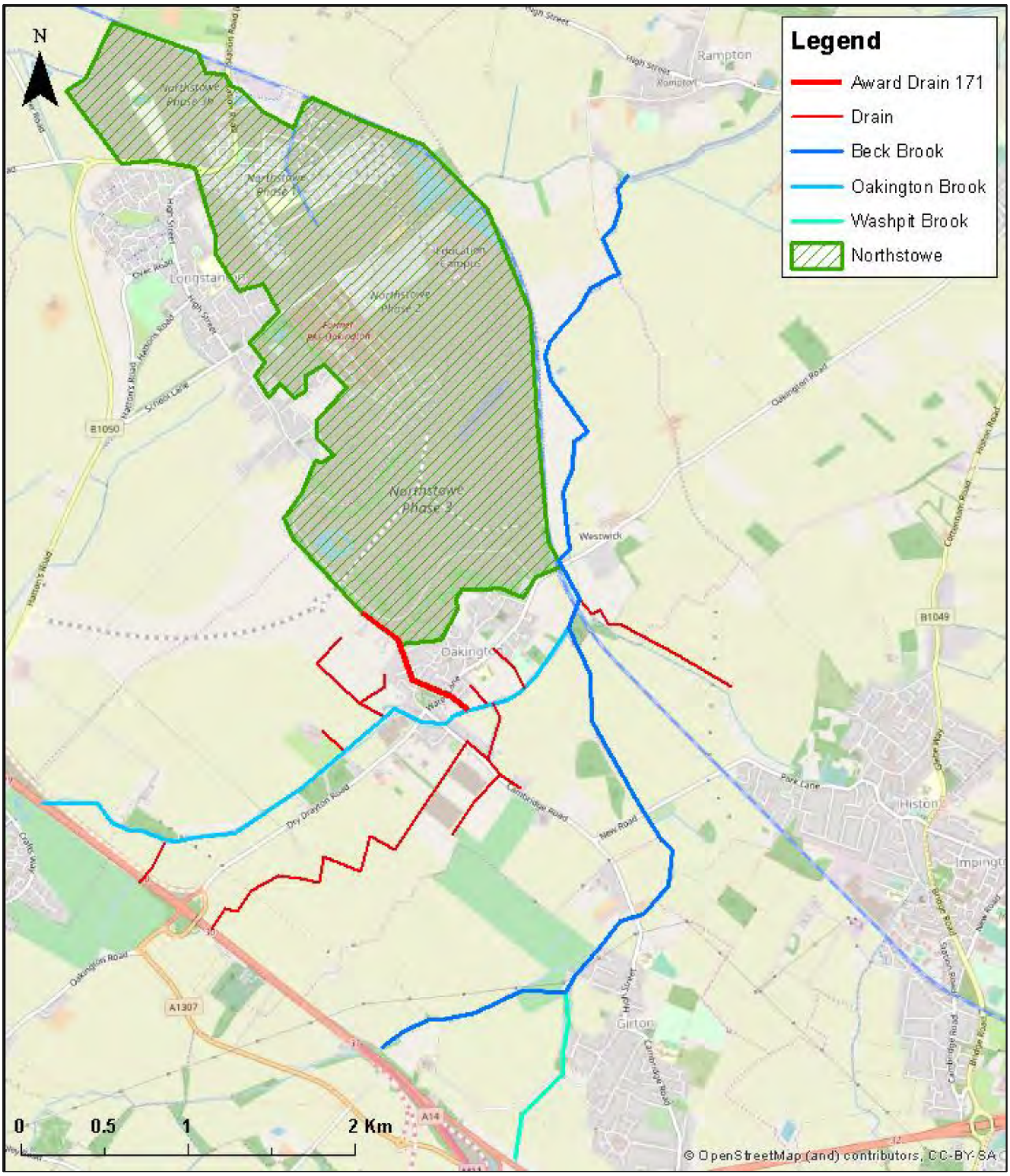

Figure 1: Watercourses and drains included in the flood model

Rain falling during the August 2014 flood event was captured by a local rain gauge 'Uttons Drove Pluvio'. Arcadis used the rainfall data for the period 8th-9th August 2014 from this gauge to reconstruct the storm conditions for this event.

Arcadis adapted the model to specifically simulate the flood conditions which affected the Oakington area in August 2014. This was achieved using industry-standard software, which analysed the August 2014 event rainfall data combined with the ground and watercourse conditions in Oakington at the time. The August 2014 event was simulated in the computer model and a map of the predicted flood extents was created. This map was compared to the actual flooding which was recorded in Oakington and, in December 2016, the Environment Agency agreed that the Arcadis model flood extents matched well with the flooding reported in the August 2014 event. A consultation meeting held with the Oakington Flood Management Group on 2nd November 2016 also confirmed the modelled flooding correlated well with the August 2014 event based on their local knowledge and records. This meant that the model could be used to assess the impacts of different storm events with confidence.

Causes of Flooding in Oakington

High water levels in the Oakington Brook which then overtop the banks are the main source of flood risk in Oakington. These high water levels are fed by water running off the surrounding areas into the Oakington Brook. In most cases, water is channelled into the Oakington Brook by the drainage ditch network. Figure 1 shows that many of these ditches flow from areas outside the Northstowe development.

The Arcadis flood model captures the flow in the drains and Oakington Brook for each of their catchments. Figure 2 shows the areas that contribute flows to the Oakington Brook as it flows through the village. The ability of the flood model to produce mapped predictions which are a close reflection of the August 2014 event are testimony to the complex interactions influencing flood risk in Oakington, of which runoff from the Northstowe development is only one factor.

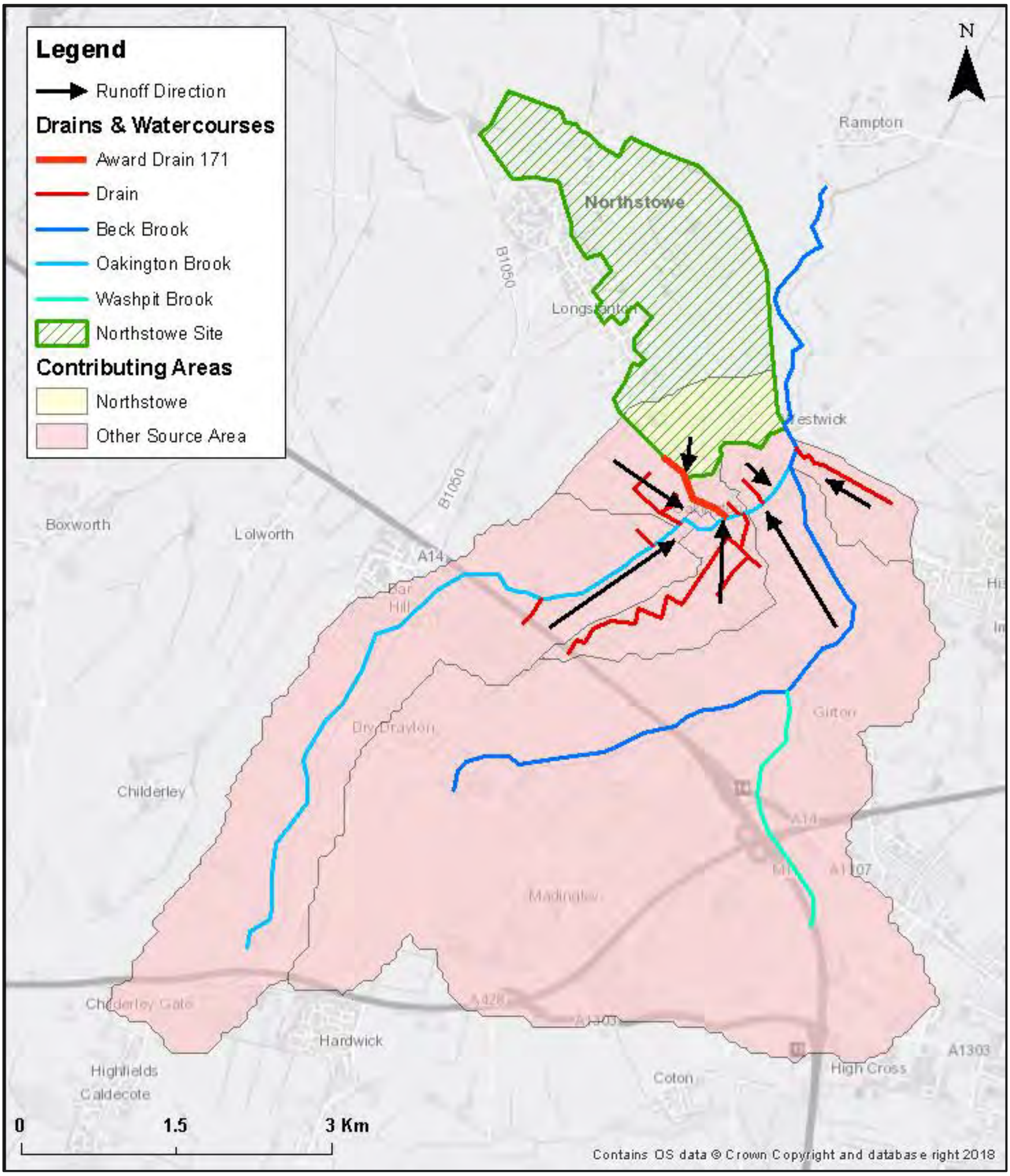

Figure 2: Areas that contribute flow to the Oakington Brook as it passes through the village

Flood events can be classified by how rare they are. For example, very large flood events such as the August 2014 event are considered to be rarer than much smaller floods which could, for example, occur on a yearly basis and would only affect smaller areas. In order to describe these events, the term ‘Annual Exceedance Probability’ (AEP) is used. This is the chance that a flood of a certain size will occur in any given year. For example, a flood which has a 1% AEP has a 1 in 100 chance of occurring in any given year.

Flow estimations suggest that the August 2014 event was rare. The estimated AEP was 0.1% or a 1 in 1000 chance of occurring in any given year.

The location and depth of flooding predicted by the model for the August 2014 event (Figure 3b) matches well with the location and depth of flooding predicted when a 0.1% AEP (1 in 1000 chance of occurring in any given year) is run through the model (Figure 3a).

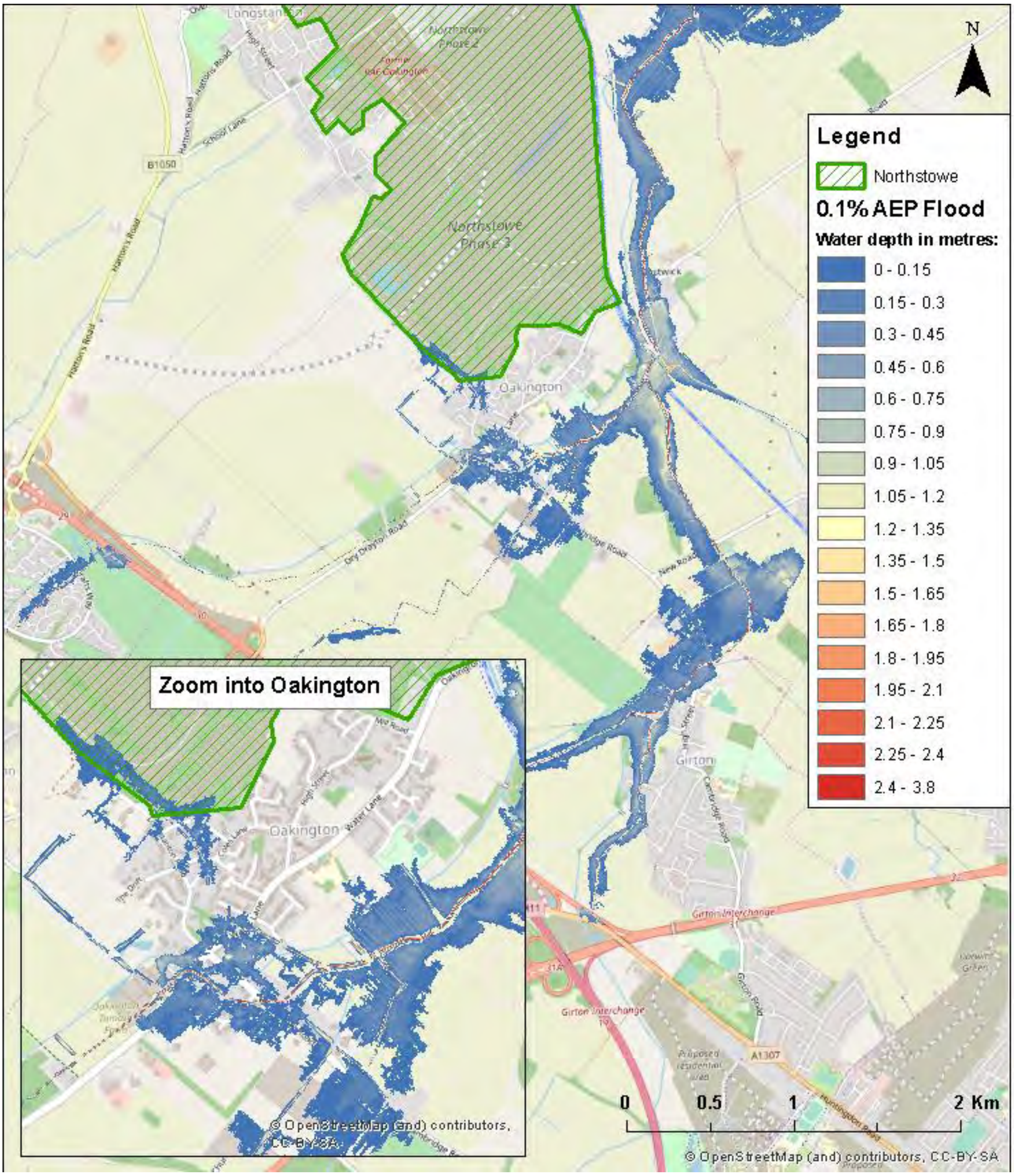

Figure 3a: 0.1% AEP predicted flood extent and depths from the Arcadis model

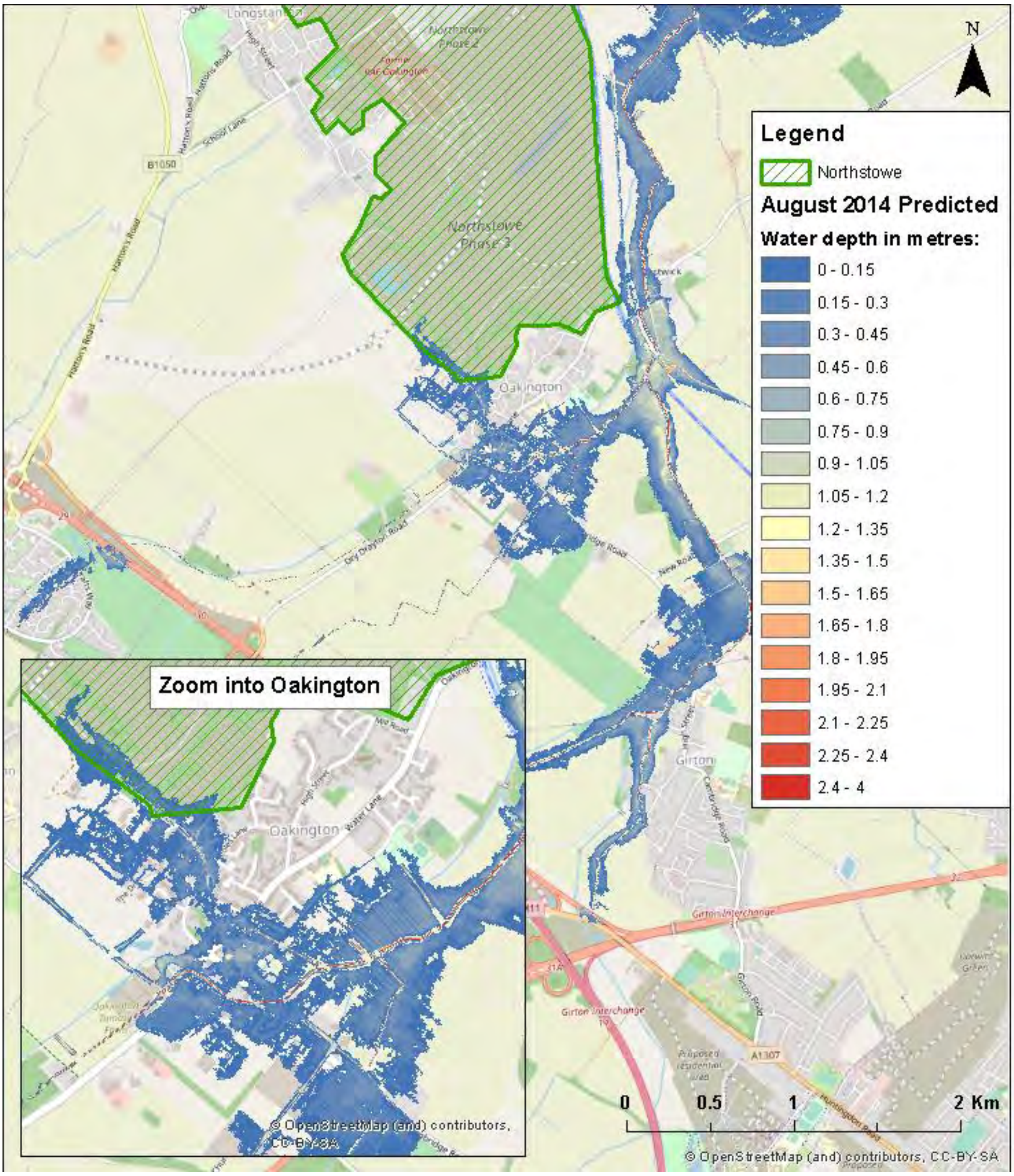

Figure 3b: August 2014 event predicted flood extent and depths from the Arcadis model

Managing Rainwater Runoff from the Northstowe Development

As a sustainable development, a range of measures will be put in place on the Northstowe development to prevent any increases in the amount of surface water running off the site into the drainage network which feeds into the Oakington Brook. Measures that will be included are:

- Retaining existing vegetation and the military lake to attenuate surface water runoff from the Northstowe site.
- Actively managing surface runoff: all design options for Phase 3a include creating ponds at Northstowe. These are designed to aid drainage and store surface water, reducing surface water runoff towards Longstanton Road and Oakington.

The measures on the Northstowe development site will ensure that any runoff from the developed site is no greater than the runoff from the existing site. These measures can only manage the risk of runoff from water originating from the Northstowe site. Where flood risk in Oakington is influenced by water sources originating from beyond the Northstowe site, risks they pose will not be reduced by measures on the Northstowe site.

NORTHSTOWE
Phase 3A
Flood Risk Assessment Addendum

January 2021

Homes England

NORTHSTOWE PHASE 3A

Flood Risk Assessment and Drainage Strategy Addendum

JANUARY 2021

VERSION CONTROL

Report Number: 10019646-ARC-XX-XX-RP-DE-0035

Version	Date	Author	Checker	Approver	Changes
01	18/12/2020	[redacted] Reg 13(1)	[redacted] Reg 13(1)	[redacted] Reg 13(1)	First Issue
02	19/01/2021	[redacted] Reg 13(1)	[redacted] Reg 13(1)	[redacted] Reg 13(1)	First Issue

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APPENDIX A

Surface Water Drainage Strategy

SuDS Typology Map - 10019646-AUK-NS-P3-DR-IE-64-0

HR Wallingford Storage estimation tool (UKSUDS.com)

1 Introduction

1.1 Overview

1.1.1 Arcadis Consulting (UK) Ltd (Arcadis) has been commissioned by Homes England to prepare a Flood Risk Assessment (FRA) and foul and surface water drainage strategy to support the Outline Planning Application for Phase 3A of Northstowe new town in Cambridgeshire.

1.1.2 This Addendum has been prepared to provide additional and supplementary information on the long-term management of the proposed SuDS features as well as the mitigation of residual risk of surface water runoff that will drain to the south, towards Oakington.

1.1.3 The Lead Local Flood Authority, Environment Agency has confirmed acceptance of the design principles as set out within the Flood Risk Assessment (FRA) and Foul and Surface Water Drainage Strategy, which will be used to inform the ongoing design for infrastructure within the site.

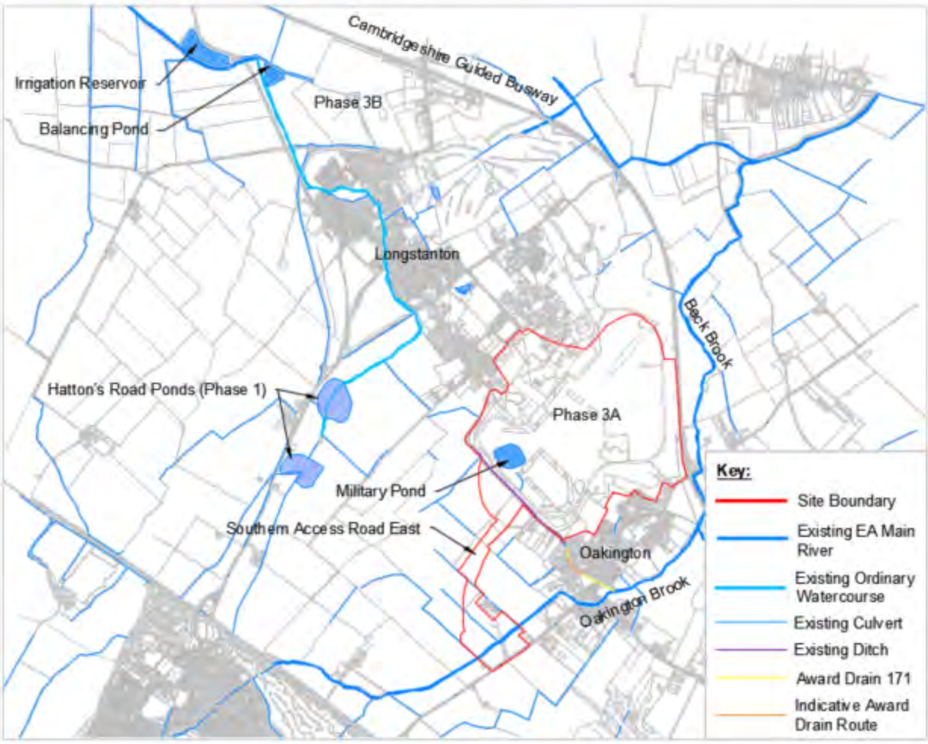
1.2 Existing Site

1.2.1 The Application Site of the proposed Development comprises approximately 210ha of land that forms the southern part of former Oakington airfield and barracks (approximately 180ha) and land to the south east providing for the Southern Access Road East, connecting Phase 3A to Dry Drayton Road near to the Oakington Business Park.

1.2.2 The land is currently occupied by the former military airfield and comprises of a mixture of open grassland, arable land and fields interspersed woodland belt, groups of trees, small watercourses and the 'Military Lake' as shown in ***Figure 1***.

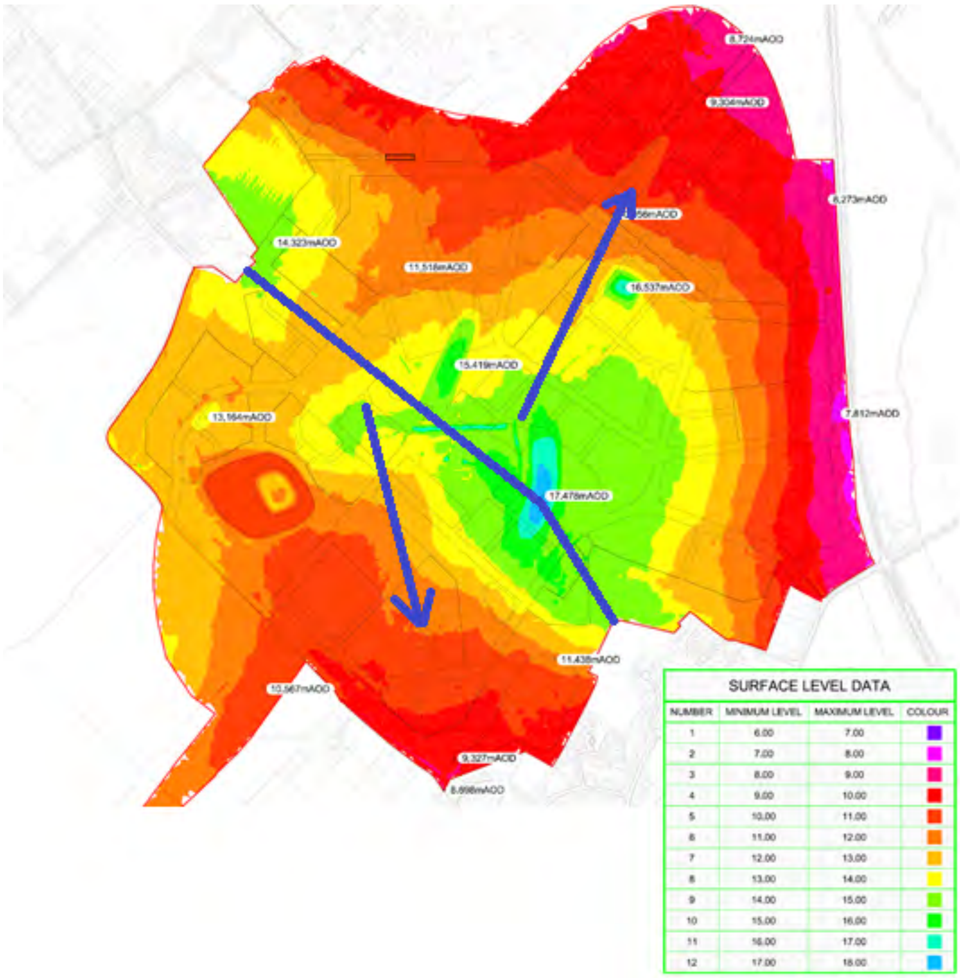
1.2.3 Longstanton Road (a restricted access road) runs through the site between Longstanton and Oakington. Award Drain 171 runs along the west side of Longstanton Road and into Oakington Brook to the south.

Figure 1: Site Location Map and Key Features



1.2.4 There is a high point in the centre of the site where levels range from 14.14m AOD to 17.47m AOD and approximately two thirds of the site slopes towards the north and east to levels of 7.7m AOD on the eastern edge of the site adjacent to the Cambridgeshire Guided Busway. This is broadly towards the existing Phase 2 Waterpark and outfall to Beck Brook.

1.2.5 As shown in ***Figure 2*** below, approximately one third of the site slopes southwards and currently runs off towards the south western corner of the site to a level of 9.4m AOD adjacent to Longstanton Road and Award Drain 171 which runs along the eastern edge of Longstanton Road at this location.



NUMBER	MINIMUM LEVEL	MAXIMUM LEVEL	COLOUR
1	6.00	7.00	
2	7.00	8.00	
3	8.00	9.00	
4	9.00	10.00	
5	10.00	11.00	
6	11.00	12.00	
7	12.00	13.00	
8	13.00	14.00	
9	14.00	15.00	
10	15.00	16.00	
11	16.00	17.00	
12	17.00	18.00	

Figure 2: Existing Topography

1.2.6 The land between Longstanton Road and Dry Drayton Road is relatively flat, with levels along Longstanton Road of 11m AOD and levels on Dry Drayton Road of 11m AOD. Levels increase along the route to circa 12m AOD and there are several field ditches that cross this area, as well as Oakington Brook with flows from west to east and is located slightly north of Dry Drayton Road.

1.3 Award Drain 171

1.3.1 As noted above approximately one third of the site currently drains uncontrolled towards this Award Drain. The Award Drain has both open sections and culverted sections, before it discharges into Oakington Brook to the South, is maintained by South Cambridgeshire District Council (SCDC). CCTV has been undertaken along this Award Drain and showed evidence of siltation. SCDC have been made aware of this. There may be an opportunity to provide a lower, but more consistent base flow along this watercourse to keep the downstream section clearer, as part of these development proposals, through limiting runoff from the site to the mean annual greenfield runoff rates.

1.4 Military Lake

1.4.1 The Military Lake sits within an area of largely unproductive strata and therefore ground water contributions are thought to be a relatively small proportion of inflow to this feature.

1.4.2 Changes in drainage regime may alter flow through this feature and therefore ongoing ground water monitoring around the site is proposed, and the opportunity for incorporating SuDS that allow groundwater recharge will be considered where feasible and appropriate. Open space will also be provided around the Military Lake to allow for runoff from these greenspaces towards the Military Lake.

1.4.3 The Military Lake is not required to form part of the proposed onsite drainage strategy for the site, but ground water recharge opportunities into this feature will be sought through use of SuDS throughout the area, wherever feasible.

1.4.4 Based in modelling undertaken to date a change in groundwater level was not predicted to occur east of the Phase 3A site perimeter drainage towards Oakington, but as noted above this will be verified through ongoing groundwater monitoring.

1.4.5 Any reduction in discharge to the Award Drain adjacent to Longstanton Road (if observed) would be offset by the positive discharge from the southern attenuation pond at the mean annual greenfield runoff rates (for up to and including the 1 in 200 year +40% climate change rainfall event).

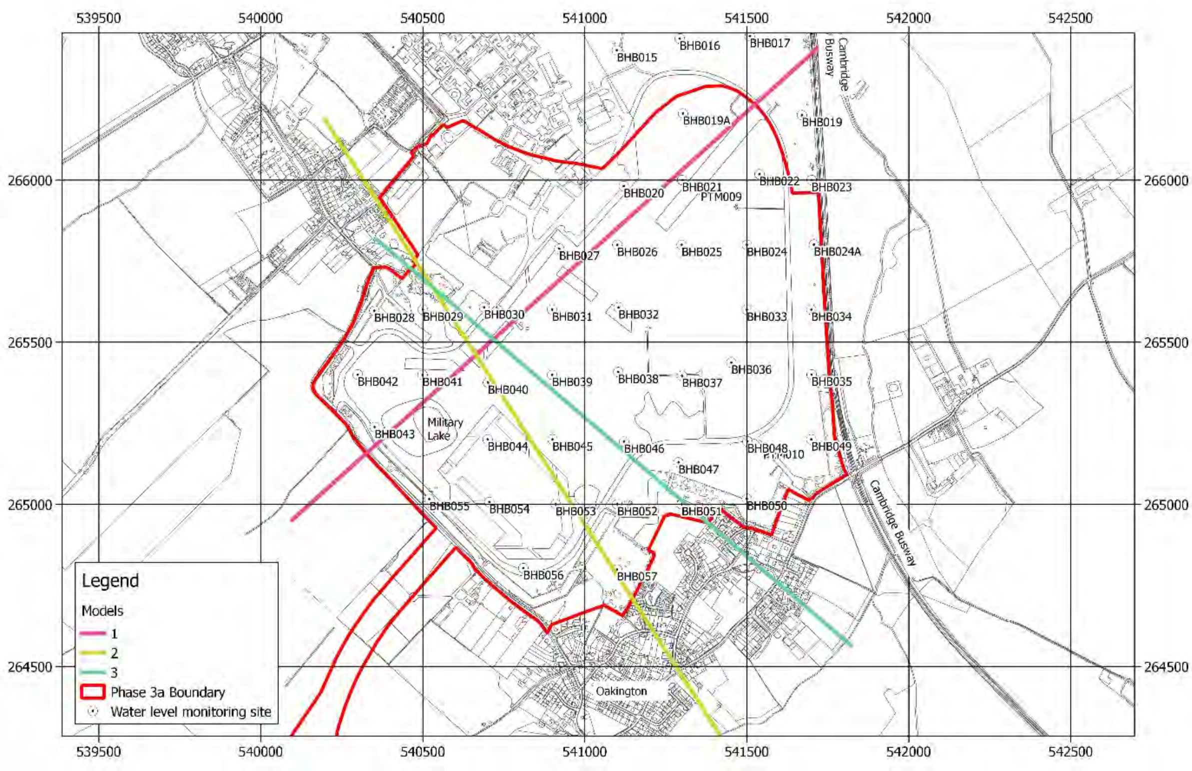


Figure 3: SEEP/W Groundwater Section Location Map

1.4.6 Section 1 shows the anticipated reduction in groundwater within the site towards the Cambridge Guided Busway. Whilst this shows a reduction in levels within the site, the topography across the site indicates that groundwater levels will remain similar on the Cambridge Guided Busway boundary and therefore will not have an impact downstream towards the Beck Brook.

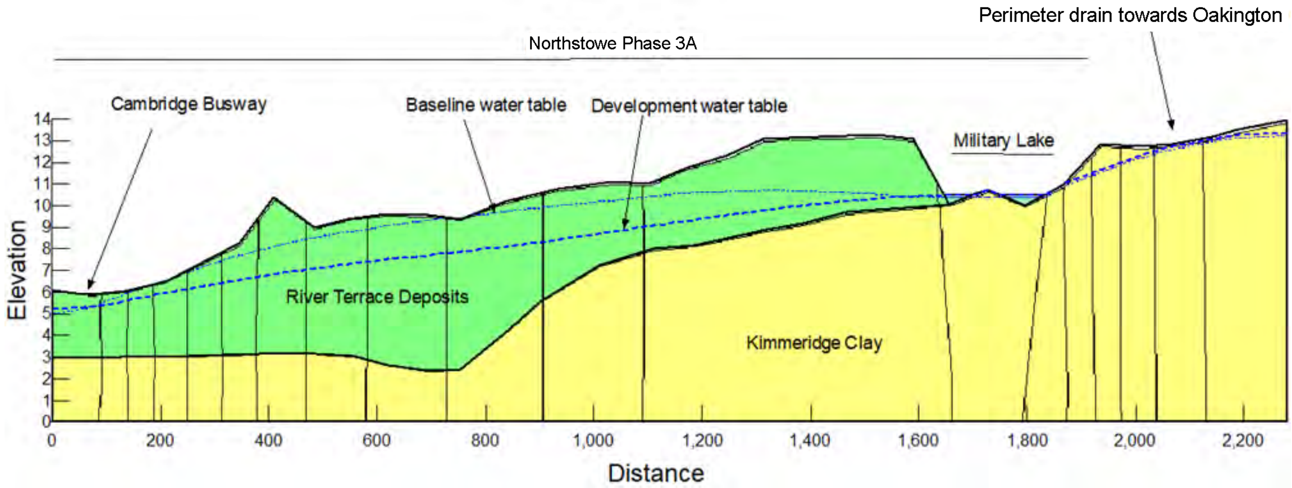


Figure 4: Phase 3A Groundwater Section 1 - Development Impact

1.4.7 Section 2 shows the anticipated reduction in groundwater within the site through the area of the site with Kimmeridge Clays. Again, whilst this shows a reduction in levels within the River Terrace Deposits; the topography across the site, the overlap with the Kimmeridge Clay and the perimeter ditch mean that the future groundwater levels within Longstanton and towards Oakington will remain similar beyond the southern boundary of the site and therefore will not have an impact downstream towards the Oakington Brook.

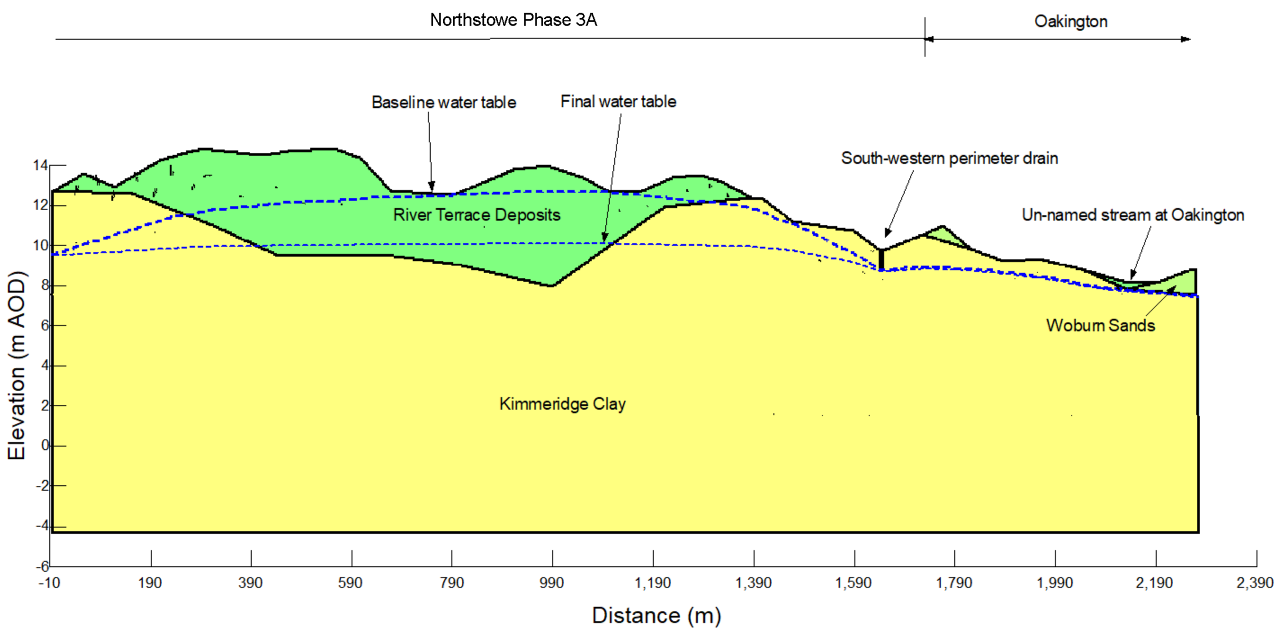


Figure 3: Phase 3A Groundwater Section 2 - Development Impact

1.4.8 Section 3 shows the anticipated reduction in groundwater within the site through the area of the site with River Terrace Deposits along the southern site boundary. Again, whilst this shows a reduction in levels within the River Terrace Deposits within the Application Site, the topography across the site, and the perimeter ditch mean that the future groundwater levels within Longstanton and towards Oakington will remain similar beyond the southern boundary of the site and therefore will not have an impact downstream towards Oakington and Oakington Brook.

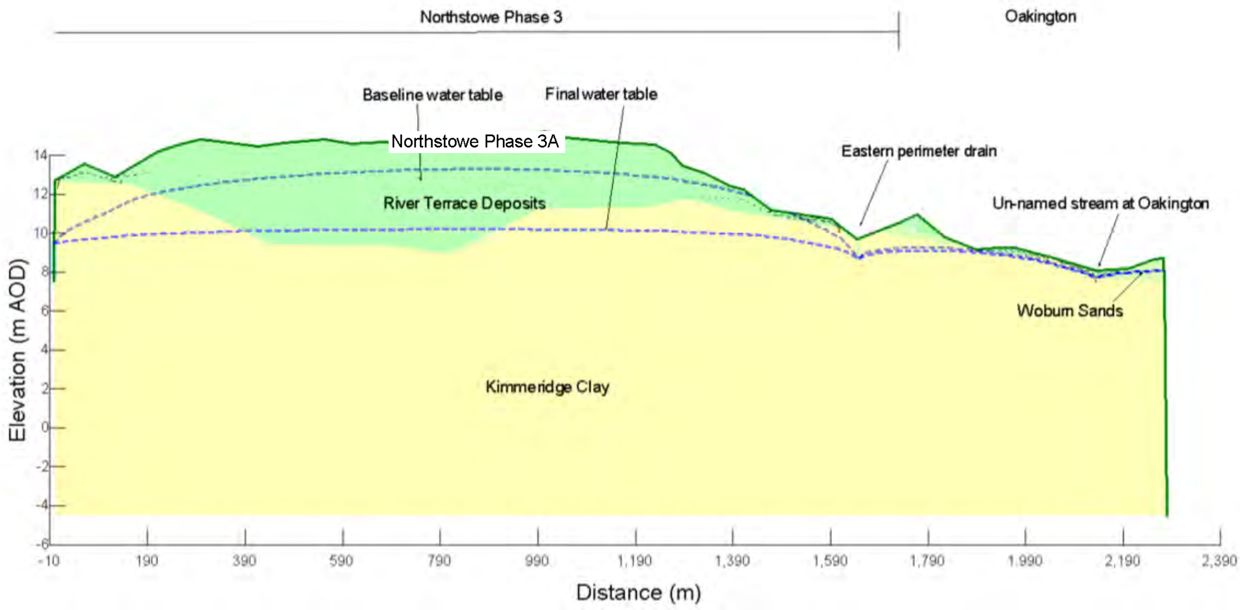


Figure 4: Phase 3A Groundwater Section 3 - Development Impact

2 Surface Water Management Strategy

2.1 Introduction

2.1.1 The NPPF recognises that flood risk and other environmental impact can be managed by minimising changes in the volume and rate of surface runoff from redeveloped sites and recommends that priority is given to the use of SuDS in new development, this being complementary to the control of development within the floodplain.

2.1.2 Collection, control and discharge of surface water runoff are a principal planning and design consideration, and this is reflected in the National Sustainable Drainage Systems Standards (2015).

2.1.3 A SuDS Strategy for the site has therefore been developed as set out below to manage and reduce the flood risk posed by the change in the surface water runoff and flow pattern from the site as a result of the proposed development.

2.1.4 This Addendum provides supplementary information, to be read in conjunction with the Flood Risk Assessment (FRA) and Foul and Surface Water Drainage Strategy regarding the proposals for SuDS Features, long term adoption and maintenance as well as consideration of exceedance events, with particular reference to the catchment area that falls to the south and towards Oakington.

2.2 Discharge of Surface Water

2.2.1 For development within the 64ha catchment currently discharging surface water runoff into the Award Drain 171 adjacent to Longstanton Road, this point of outfall will continue to be used with appropriate surface water attenuation provided on site to limit runoff into this existing watercourse to the mean annual greenfield runoff rate (3l/s/ha). This will be a significant betterment to the existing runoff rates in extreme rainfall events.

2.2.2 This discharge rate will be utilised for rainfall events up to and including the 1 in 200-year rainfall event (including a 40% allowance for climate change). The LLFA and EA have confirmed acceptance of this principle, and this discharge rate provides significant improvement on the existing greenfield peak discharge rates for more intense rainfall events (i.e. from 10 year to 200 year events) reducing the impact of runoff currently experienced from this catchment.

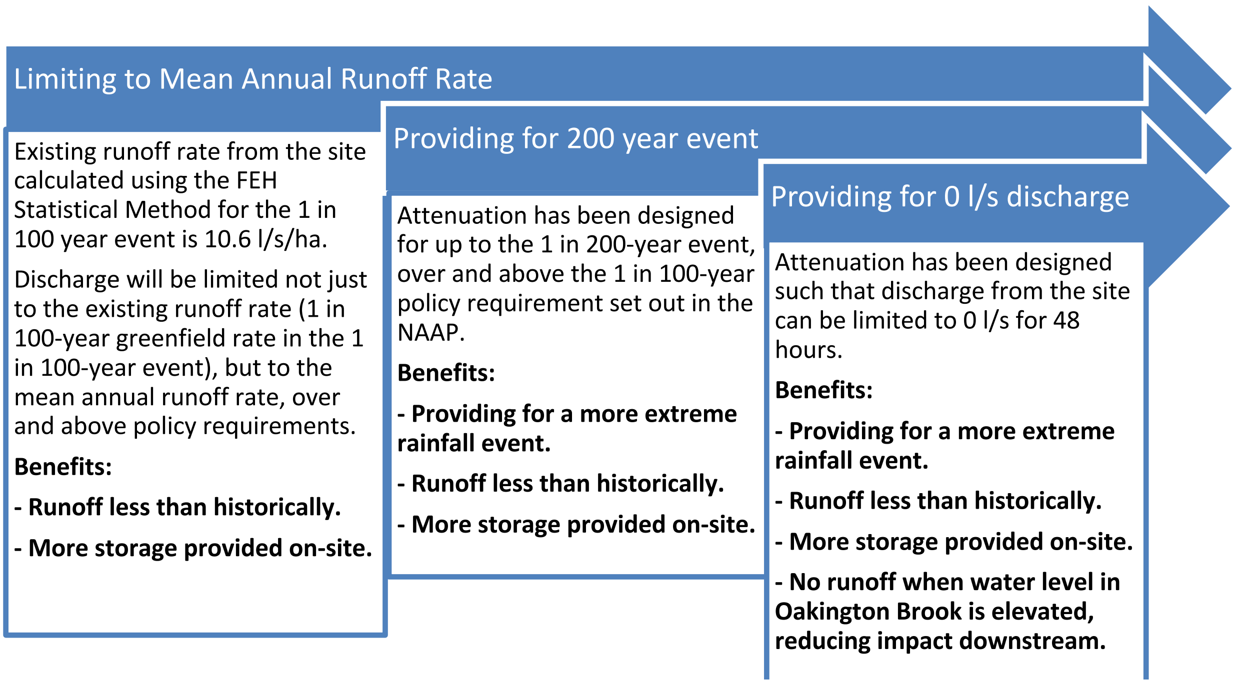


Figure 5: Betterment Provided by Design Parameters Relative to Policy Requirements

2.2.3 In addition to the above, and acknowledging the historic flood risk within Oakington, where Award Drain 171 discharges, further measures are also proposed to ensure that surface water runoff from the site can be managed in more extreme rainfall events, and if the downstream water levels in Oakington Brook become elevated, as shown in ***Figure 5*** above.

2.3 Impermeable areas and Attenuation Requirements

2.3.1 At this stage the following impermeable percentages have been applied to development areas within the site:

- Proposed primary and secondary streets and SARE – 100%
- Residential parcels – 60% impermeable (i.e., roads, houses and external areas – this allows for a 10% increase in impermeable area over time due to urban creep). The remaining 40% of the area will remain green being open space, SuDS features and gardens.
- Schools – 40% impermeable (accounting for school building and playing fields)
- Green spaces – an allowance of 20% runoff has been allowed from these areas at this stage as a conservative assumption.

2.3.2 The above assumptions on areas and runoff have been verified through comparison with calculations undertaken through the Storage estimation tool at www.uksuds.com (HR Wallingford) which are contained within ***Appendix A***. These confirm sufficient storage has been allowed for within the southern catchment for the capture and attenuation of surface water runoff from this area this area.

2.3.3 The volume of strategic attenuation required for up to and including the 1 in 200-year rainfall event (including an allowance for climate change) is given below in ***Table 1: Surface Water Storage Requirements.*** The storage allowance and provision are well in excess of policy requirements and therefore considered to be a sustainable solution that will significantly benefit the wider area and downstream catchments.

Table 1: Surface Water Storage Requirements

Site Area	Impermeable Area	Discharge Rate (3 l/s/ha)	Storage Volume (200 year + 40% CC) 3 l/s/ha	Storage Volume (200 year + 40% CC storage for 48 hours at 0 l/s)
Northern Catchment	54.6 ha	164 l/s	47,100 m^3	63,500 m^3
Southern Catchment	30.0 ha	90 l/s	26,100 m^3	34,900 m^3
SARE	4.78 ha	14 l/s	3,900 m^3	N/A

2.3.4 Space has been provided to enable provision of the attenuation as set out above.It should also be noted that the onsite surface water drainage infrastructure will also provide localised storage capacity. Therefore, it is anticipated that the design provided is conservative and that at the detailed design stage, the storage required will be refined to account for the wider drainage infrastructure storage also.

2.4 Inclusion of SuDS Features

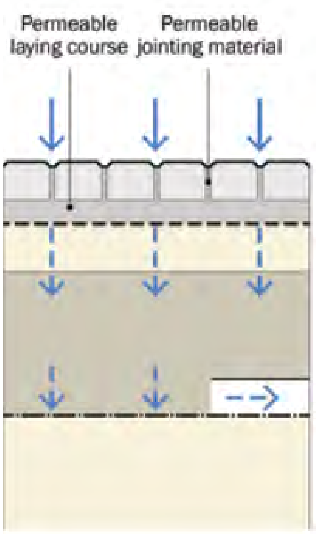
2.4.1 The principles of the SuDS strategy are shown on drawing ***10019646-AUK-NS-P3-IE-C-P02*** contained within ***Appendix A*** and include:

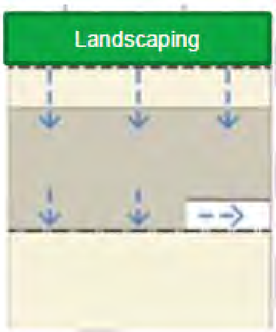
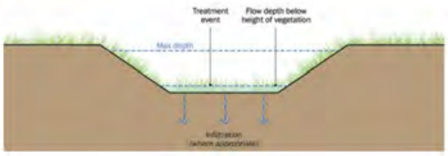
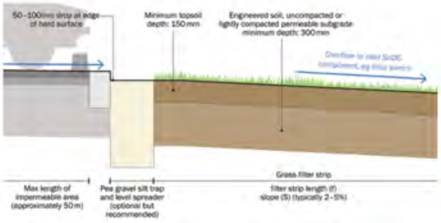
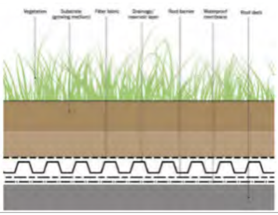
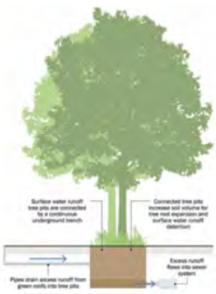
- SuDS features to be included within development parcels (i.e., have swales, tanked permeable paving, rainwater gardens etc). It is proposed that surface water runoff will be limited within the parcels to ensure management of the runoff at source in line with best practice. It is proposed therefore that runoff from residential parcels will be limited to a maximum rate of 12l/s/ha into the wider site conveyance network.
- Water quality / SuDS conveyance provided along highways where feasible to provide water quality treatment to highway runoff.
- Conveyance across site through use of piped drainage and conveyance swales.
- Strategic Attenuation (including water quality cleansing forebay areas) providing a final layer of treatment and protection in more extreme rainfall events, and to accommodate overland flows, before surface water is discharged from the site at the mean annual greenfield runoff rate (3l/s/ha). These areas have also been designed to accommodate all surface water runoff from the site in up to and including the 1 in 200-year rainfall event (including a 40% allowance for climate change) with 0l/s discharge for up to 48h hours when water levels in the receiving watercourses are elevated. This will allow for the surface water runoff from the site to be retained within the site and slowly released once the peak water levels have receded, or after 48hrs.

2.4.2 As noted within the Flood Risk Assessment (FRA) and Foul and Surface Water Drainage Strategy, and this addendum, the use of SuDS features that allow for groundwater recharge will be considered and utilised where feasible at the detailed design stage.

2.4.1 Plot Specific Use of SuDS Features

2.4.1.1 It is anticipated that a combination of the following SuDS features could be incorporated within development parcels to deliver attenuation and water quality measures as part of the wider strategy. Specific SuDS features will be designed at future Reserved Matter stage.

SUDS FEATURE	*DESCRIPTION*
TANKED PERMEABLE PAVEMENT 	• ***Roof water will be drained into pervious permeable areas using diffusers to dissipate the point inflows. Detailed design of the pavement will need to take into account the additional impermeable roof area. The storage would have a flow control device restricting the amount of discharge entering the sewer to allowable rates.*** • ***The permeable surface is designed to allow water to drain through to the sub-base at a rate greater than the rain that falls into the surface, thereby preventing any surface water running along the surface. The permeable sub-base is used to temporarily store infiltrated run-off underground and is then discharged into the drainage system.*** • ***As with all drainage systems, the permeable surface would require scheduled maintenance to ensure the system works to its optimum performance and prevent the voids within the pavement being blocked with debris.*** • ***Location and use on site:** Permeable pavement may be included in courtyard, parking and associated hard landscaping areas.*

SUDS FEATURE	***DESCRIPTION***
 ***TANKED INFILTRATION BLANKET***	• ***A tanked infiltration blanket allows surface water flows to be attenuated before being discharged off site. An infiltration blanket can be used under a landscaped area and has a suitable void ratio and depth to cater for storm volumes of up to Q100 + 30% climate change.*** • ***As with all drainage systems, the blanket would require schedules maintenance to ensure the system works to its optimum performance and prevent the voids within the pavement being blocked with debris.*** • ***Location and use on site: A tanked infiltration blanket could be included underneath hedge planting and other landscaping connected to a SuDS system such as permeable paving system to direct water to the discharge point.***
CONVEYANCE SWALES 	• ***Swales are shallow, flat-bottomed, vegetated open channels designed to convey, treat, and often attenuate surface water runoff. Swales can replace conventional pipework as a means of conveying runoff, and the use of filter strips and/or flow spreaders removed the need for kerbs and gullies.*** • ***Location and use on site: Larger conveyance swales will border the Phase 3A site, collecting water from roadside filter strips and discharging runoff into the attenuation.***
FILTER STRIPS 	• ***Filter strips are uniformly graded and gently sloping strips of grass or other dense vegetation that are designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration, and infiltration.*** • ***Location and use on site: Highways will drain via filter strips into larger conveyance swales bordering the site.***
GREEN ROOFS 	• ***Green roofs are areas of living vegetation, installed on top of buildings, for a range of reasons, including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff.*** • ***Location and use on site: Green roofs may be used on flat roof areas.***
LANDSCAPING 	• ***Soft landscaping, such as grassed areas, planted areas and treed, protect and enhance the urban environment. They also facilitate the discharge of surface water runoff to the ground and ultimately into groundwater. These devices will assist in providing water quality improvement and some attenuation of minor storm events.*** • ***Location and use on site: Soft landscaping, such as trees, gardens and grassed areas included throughout the site.*** ***All images included have been obtained from CIRIA SuDS Manual v6.***

2.4.2 Conveyance Perimeter Channels

2.4.2.1 These are proposed around the edge of the site, at low points, to convey surface water runoff from the development towards the strategic attenuation features that form the final element of the SuDS control train. These can be seen on drawing 10019646-AUK-NS-P3-IE-C-P02 contained within ***Appendix A.***

2.4.2.2 These Conveyance Perimeter Channels will provide a supplementary function of also capturing overland flows in extreme events over and above the capacity of the designed positive drainage network. These will provide additional conveyance and attenuation to capture overland flows, preventing this from affecting downstream areas.

2.4.2.3 Further details on the anticipated design and function of these features can be seen on the SuDS Typology Map included in ***Appendix A*** - 10019646-AUK-NS-P3-DR-IE-64-0.

2.4.2.4 These will be designed in accordance with the requirements of the CIRIA SuDS Manual.

2.4.3 Attenuation Ponds

2.4.3.1 The SuDS attenuation ponds will be designed in accordance with the SuDS Manual and RoSPA guidance providing for access, maintenance and including:

- Minimum 1 in 3 earthworks where access is provided (note - typically 1 in 3 allowed for at all locations)
- Min freeboard 300mm for extreme rainfall event s/ residual risk
- 3m maintenance strip allowed around features for maintenance access

2.5 Residual risk and Overland Flow Management

2.5.1 Residual risk and overland flow routing will be managed through the use of SuDS throughout the site to capture and convey overland flows in extreme events.

2.5.2 Green spaces and roads will be designed to convey surface water overland flows away from buildings and towards the strategic attenuation features.

2.5.3 Conveyance perimeter channels around the edges of the site, at low points, will be designed to manage overland flows and runoff from the site in extreme rainfall events, as shown on the SuDS Typology Map included in ***Appendix A*** - 10019646-AUK-NS-P3-DR-IE-64-0.

2.5.4 In addition, the use of SuDS within each parcel will prevent uncontrolled runoff.

2.5.5 Finished floor levels will also be set a minimum of 150mm above external ground levels.

2.6 Adoption and Maintenance

2.6.1 It is envisaged that Anglian Water will adopt and maintain the onsite Surface Water Management System and associated SuDS, similar to Phase 2. This will include the drainage function of the ponds and conveyance perimeter channels. This will be done through a S104 Agreement with Anglin Water.

2.6.2 Detailed design of the SuDs features within the development parcels will be undertaken by developers in line with the principles set out within this Drainage Strategy and will be offered for adoption by Anglian Water.

2.6.3 Therefore, all drainage features within the site are anticipated to be adopted and maintained by Anglian Water and should be designed in accordance with the Anglian Water SuDS Design Guide. This will help to ensure that appropriate measures in place.

2.6.4 In the instance that adoption does not come forward, a private maintenance company may be implemented to manage required maintenance, and this will be delivered in line with the Long-Term Management Plan contained below.

2.6.5 Highway drainage will be adopted and maintained by the Local Highway Authority (Cambridgeshire County Council).

2.6.6 The Military Lake is not required to form part of the onsite drainage, and will not be adopted or maintained as part of the drainage. It is anticipated to be maintained separately to the wider drainage infrastructure, likely as part of the open space.

2.7 Long Term Management Strategy

2.7.1 This section sets out an outline of the anticipated adoption and maintenance requirements for the Sustainable Drainage Systems on Northstowe Phase 3A, subject to the detailed design of these features.

2.7.2 On plot drainage will be designed in detail by the plot developed at a later stage and will include SuDS features to manage and limit surface water runoff as a result of the development proposals.

2.7.3 Highway drainage (conveying runoff from the highway only) will be adopted and maintained by the Local Highway Authority (Cambridgeshire County Council). This includes trapped gullies and their associated connections only at this stage.

2.7.4 All other positive drainage and SuDS features (including the Waterpark) will be offered for adoption by Anglian Water, similar to the Phase 1 and Phase 2 proposals and will be designed in accordance with Sewers for Adoption and the Anglian Water's Sustainable Drainage Systems (SUDS) Adoption Manual.

2.7.5 The SuDS features proposed as part of the surface water strategy for Phase 3A includes swales, attenuation ponds, inlets, outlets and flow control systems.

2.7.6 The specific maintenance procedures for these features are outlined below, as stated in the Anglian Water SuDS Manual.

2.7.1 Conveyance Perimeter Channels and Swales

2.7.7 These will require regular maintenance to ensure continuing operation to design performance standards. Table 2 outlines the operation and maintenance requirements of swales. The major maintenance requirement for dry swales is mowing. Mowing should ideally retain grass lengths of 75-100mm across the main 'treatment' surface, to assist in filtering pollutants and retaining sediments and to reduce the risk of flattening during runoff events. However, longer vegetation lengths, where appropriate, are not considered to pose a significant risk to functionality.

2.7.8 Occasionally sediment will need to be removed (e.g., once deposits exceed 25 mm in depth), although this can be minimised by ensuring upstream areas are stabilised and by incorporating effective pre-treatment devices. Sediments excavated from a swale that receives runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. For runoff from busy street with high vehicle traffic, sediment testing will be essential. Any damage due to sediment removal or erosion should be repaired and immediately reseeded or planted.

Table 2: Operation and Maintenance Schedule for Swales

Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for >48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, after plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required

Maintenance Schedule	Required Action	Typical Frequency
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

2.7.2 Ponds

2.7.9 Ponds will require regular maintenance and inspection to ensure continuing operation to design performance standards. The treatment performance of ponds is dependent on maintenance, and robust management plans will be required to ensure maintenance is carried out in the long term.

2.7.10 Any invasive maintenance work such as silt or vegetation removal is only required intermittently, but it should be planned to be sympathetic to the requirements of wildlife in a pond. Care should be taken to avoid disturbance to nesting birds during the breeding season and habitats of target species at critical times. Invasive silt and vegetation removal should only be carried out to limited areas at any one time of the pond area on one occasion each year to minimise the impact on biodiversity.

Table 3: Operation and Maintenance Schedule for Ponds

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Cut grass – public areas	Monthly (during growing season)
	Cut meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc. for evidence of blockage and/or physical damage	Monthly
	Inspect water body for signs of poor water quality	Monthly (May – October)
	Inspect silt accumulation rates in any forebay and main body of pond and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Check mechanical devices	Half yearly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface)	Annually
	Remove 25% of bank vegetation from water's edge to a minimum of 1m above water level	Annually

Maintenance Schedule	Required Action	Typical Frequency
	Tidy all dead growth (scrub clearance) before start of growing season. (Note: tree maintenance is usually part of overall landscape management contract)	Annually
	Remove sediment from any forebay	Every 1-5 years, or as required
	Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays.	Every 5 years, or as required.
Occasional maintenance	Remove sediment from the main body of ponds when pool volume is reduced by 20%	With effective pre-treatment, this will only be required rarely, e.g., every 25-50 years.
Remedial actions	Repair erosion or other damage	As required
	Replant where necessary	As required
	Aerate pond when signs of eutrophication are detected	As required
	Realign rip-rap or repair other damage	As required
	Repair/ rehabilitate inlets, outlets and overflows	As required

2.7.3 Inlets, Outlets and Flow Control Systems

2.7.11 Inlets and outlets are the structures or landscape features that manage the flow into and out of a SuDS component. Control structures limit the flow through the outlet and are necessary to meet the site discharge rate. Limiting the flow causes water to back up in the SuDS component, allowing the attenuation storage volume to be filled.

2.7.12 Inlets raised above any adjacent permanent water levels are recommended. All concealed infrastructure is likely to be at risk from blockage or lack of maintenance. Where high flows are unavoidable and larger diameter pipes are involved, concrete, brick or stone head walls may be required. There may also be a need for safety/security screening of pipe outfalls.

2.7.13 Float or displacement control systems make use of adjustable gates attached to a float or counterbalance. There can be problems with debris or ice affecting movement of the gate. Active systems that operate in real time require significant additional costs for both installation and operation and maintenance.

2.7.14 If not adequately protected, small, low flow orifices can easily block, preventing structural control from meeting its design purpose and potentially causing flooding and other adverse impacts. There are a number of different anti-clogging design approaches, including:

- Gravel surround
- Gabion protection
- Reverse slope outlet pipe for a pond with a permanent pool
- Orifices protected within perforated risers or T-pieces
- Debris guards
- ‘Hooded’ outlets

2.7.15 The use of trash screens and security grilles requires regular maintenance and do not reflect SuDS best practice. It is recommended that such systems are only used in exceptional circumstances.

2.8 Flood Resilience and Resistance

2.8.1 The detailed development of the layout should always consider that the site could potentially be affected by a more extreme event and as such the implementation of flood resilience and resistance methods should be considered. Relatively simple measures such as raising utility entry points, setting minimum floor levels, using first floor or ceiling down electrical circuits and sloping landscaping away from properties can be easily and economically incorporated into the development of the site.

2.9 Residual Risk

2.9.1 Residual risk associated with a severe flood event that exceeds the normal flood management design standard, such as an intense rainfall event which the drainage system cannot cope with, can be managed through the appropriate detailed design of onsite levels, providing overland flow routing within the site to the sustainable drainage infrastructure.

2.9.2 In addition, surface water attenuation within the site will be sized appropriately to manage and maintain runoff from the site in over and above policy required rainfall events.

2.9.3 Residual risk associated with the maintenance of SuDS infrastructure or blockage of a surface water conveyance system will be managed through the implementation of maintenance plans, and adoption by appropriate parties will be progressed.

2.9.4 Freeboard will also be provided within all SuDS features in line with the design guidance set out within the SuDS Manual CIRIA C753, providing additional capacity over and above the designed capacity set out within the drainage strategy below.

3 SARE

3.1.1 The Southern Access Road East will cross the Oakington Brook near to Dry Drayton Road.

3.1.2 The EA has confirmed that they would be keen to assess the opportunity to throttle flows at this location to reduce flow downstream. Therefor the exact nature and level of this crossing will be developed further at detailed design stage, in conjunction with the EA.

3.1.3 Access and egress can be provided for Northstowe phase 3 within Flood Zone 1, along the existing Southern Access Road West, and therefore resilience for the development has been provided though alternative routes for egress. Longstanton Road and other Public Rights of way are also provided, as well as the connection to the north through to Phase 1.

4 Conclusions

4.1.1 This Flood Risk Assessment (FRA) and Drainage Strategy Addendum has been prepared on behalf of Homes England in support of the planning application for the Phase 3A Northstowe development.

4.1.2 This Addendum provides supplementary information, to be read in conjunction with the Flood Risk Assessment (FRA) and Foul and Surface Water Drainage Strategy regarding the proposals for SuDS Features, long term adoption and maintenance as well as consideration of exceedance events, with particular reference to the catchment area that falls to the south and towards Oakington.

4.1.3 A review of the impact on Oakington has been undertaken and mitigation to manage surface water discharge is proposed to provide a betterment relative to limiting discharge rate and attenuation during extreme rainfall events.

4.1.4 An outline drainage strategy has been prepared for the site in line with best practice which substantially exceeds the requirements of planning policy.

4.1.5 The surface water from the site will maintain existing drainage regime (discharging to watercourses) as ground conditions indicated that infiltration will not be able to be used as a predominant solution.

4.1.6 Discharge will be limited to the mean annual greenfield runoff rate of 3l/s, for up to and including the 1 in 200-year rainfall event (including an allowance for climate change). This is substantially above the requirements set out within planning policy.

4.1.7 Discharge from the SARE will be limited to greenfield runoff rates of 3l/s and discharged to the adjacent field drains and Oakington Brook.

4.1.8 In addition to the above, appropriate attenuation will be provided limiting discharge to 0l/s for 48hrs from the main development if water levels within the adjacent watercourses are elevated, to allow time for water levels to recede before discharging surface water from the site. This will provide further betterment to receiving watercourses relative to the control of discharge during extreme rainfall events.

4.1.9 Drainage will be designed in accordance with best practice, the SUDS Manual, Sewers for Adoption, CCC design guidance or Building Regulations where applicable.

4.1.10 Adoption of the onsite features will be undertaken by:

- Anglian Water will maintain the public drainage system (foul and surface water), and SUDS features including the Conveyance Perimeter Channels and Ponds.
- CCC will adopt and maintain highway drainage.
- On plot drainage will be offered to Anglian Water for adoption. In some instances management and maintained may be transferred to a management company.

4.1.11 Residual risk will be managed through the appropriate design of onsite levels and corridors to manage overland flows sustainability, and through management of the SuDS features.

4.1.12 Finished floor level of the properties will be set a minimum of 150mm above adjacent levels.

4.1.13 Safe Access and egress can be delivered, and alternative routes are available including the Southern Access Road West and connections to Phase 1 and 2.

4.1.14 Water quality will be improved by providing a number of SuDS features including permeable paving, vegetated SuDS strips, rainwater gardens, swales, attenuation ponds and other appropriate SuDS components.

4.1.15 Adequate space has been provided with the development proposals to allow for a sustainable management of surface water runoff as a result of the development, resilient design measures and managing exceedance events.

APPENDIX A

Surface Water Drainage Strategy

SuDS Typology Map - 10019646-AUK-NS-P3-DR-IE-64-0

HR Wallingford Storage estimation tool (UKSUDS.com)

Design & Consultancy
for natural and
built assets

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arcadis.com

NORTHSTOWE

Freedom of Information Request

MARCH 2021

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Phase 2B Information

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Phase 3A and 3B Information

1 Introduction

This information has been compiled on request of Home England.

The information within this document relates to available groundwater monitoring data across the Homes England areas at Northstowe.

The information is work undertaken since the previous Freedom of Information request in 2018.

Information in this report includes the following;

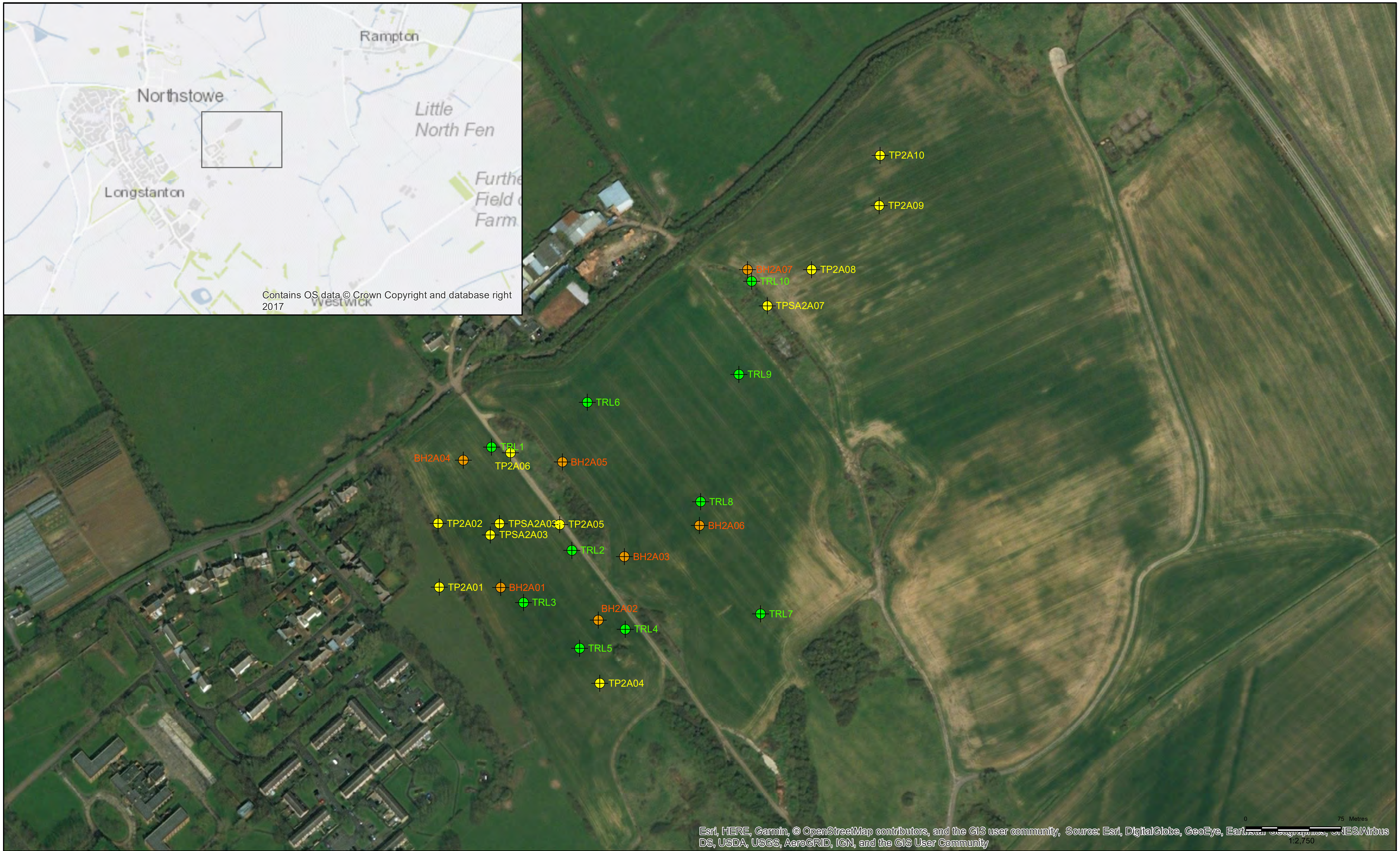
- Plans showing locations of boreholes
- Borehole records / logs
- Groundwater monitoring data

Information has been taken from the following reports;

1. Northstowe - Parcel 2A (August 2018) Ground Investigation Report (10018973-AFS-GLR-G001)
2. Northstowe - Phase 2B (October 2019) Ground Investigation Report (10018973-AUK-XX-XX-RP-GE-0002-01-Factual Report)
3. Northstowe – Phase 3 (May 2019) Ground Investigation Report (10019646-AFS-GLR-G001)

APPENDIX A

Phase 2A Information



Legend

- TRL Probe Locations
- Trial Pit Locations
- Borehole Locations

Client

Homes England

Client

Homes England
50 Victoria Street
Westminster
London
SW1H 0TL

0300 1234 500
0300 1234 500

Site

Former Oakington Airfield
Cambridge

Designed	Req	Date 17 Jul 18	Signed IT
Drawn	Req	Date 17 Jul 18	Signed IT
Checked	Req	Date 20 Jul 18	Signed SH
Approved	Req	Date 20 Jul 18	Signed GW
Scale:	1:2,750	Datum:	AOD
Original Size:	A3	Grid:	OS
Project Number:	10018973		

PROJECT:

Northstowe - Parcel 2A

TITLE:

Exploratory Hole Location Plan

ARCADIS Design & Consultancy for natural and built assets

Registered office:
Arcadis House
34 York Way
Kings Cross
London
N1 9AB

Coordinating office:
10 Medawar Road
The Surrey Research Park
Guildford
GU2 7AR

www.arcadis.com

Drawing Number: 10018973-GLR-EHP-0001

Revision: 02

50mm on Original

Print Date : 17-07-18 12:46:47

C:\Users\trujolsi2842\Desktop\Templates\Northstowe - Phase 2A.mxd

ARCADIS Percussive Borehole Log

BH2A01

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**8.73**	**31/05/2018**	**1:50**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	**540803.00**	**266850.70**	**01/06/2018**	**Sheet 1 of 2**

SAMPLES / TESTS

Sample Depth	Type/No.	Test Depth	Type/No.	Results
0.00 - 0.50	B1			
0.00 - 0.50	D20			
0.00 - 0.50	ES24			
0.50 - 1.00	B2			
0.50 - 1.00	D21			
0.50 - 1.00	ES25			
1.20 - 1.50	B3	1.20	SPT(S)	N=7 (2,1/2,1,2,2)
1.20 - 1.50	D22			
1.20 - 1.50	ES26			
1.50 - 2.00	B4			
1.50 - 2.00	D23			
1.50 - 2.00	ES27			
2.00 - 2.45	U5			
2.50 - 3.00	B6			
3.00 - 3.45	D7	3.00	SPT(S)	N=50 (3,18/24,16,7,3)
3.50 - 4.00	D8			
4.00 - 4.45	U9			
4.50 - 5.00	D10			
5.00 - 5.50	D11	5.00	SPT(S)	N=34 (5,5/7,8,9,10)
5.50 - 6.00	B12			
6.00 - 6.45	U13			
6.50 - 7.50	D14			
7.50 - 7.95	D15	7.50	SPT(S)	N=35 (5,5/7,8,9,11)
8.00 - 9.00	D16			
9.00 - 9.45	U17			
9.50 - 10.00	B18			
10.00 - 10.45	D19	10.00	SPT(S)	N=35 (5,6/7,8,9,11)

PROGRESS

Date Time	Casing	Water
01/06/2018 07:00	0.00	Dry

STRATA

Description	Depth (Thickness)	Level
Orangish brown mottled light grey clayey gravelly fine to coarse SAND. Gravel is subangular to rounded fine to coarse flint. [RIVER TERRACE DEPOSITS]	(1.00) 1.00	7.73
Firm brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular rounded fine to coarse flint. [RIVER TERRACE DEPOSITS]	(0.70) 1.70	7.03
Stiff fissured dark grey CLAY. Fissures are extremely closely spaced, randomly orientated, smooth and mat. [KIMMERAGE CLAY FORMATION] Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone. Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone.	(4.30) 6.00	2.73
Very stiff fissured dark grey CLAY with occasional light grey siltstone pockets. Fissures are extremely closely spaced, randomly orientated, smooth and mat. [KIMMERAGE CLAY FORMATION]	(4.45)	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.45	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration
3.10	3.30	00:33
4.50	4.60	00:25

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
31/05/2018 14:30	2.40	20	2.11	1.65	3.15
31/05/2018 15:30	4.60	20	4.43	3.15	

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.45	150	3.15

WATER ADDED

From	To	Volume (ltr)

Remarks

PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 10.45mbgl.

Termination Depth: 10.45m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) ltd**	**SH**	**SH**

ARCADIS Percussive Borehole Log — BH2A01

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	10018973	8.73	31/05/2018	1:50
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	540803.00	266850.70	01/06/2018	Sheet 2 of 2

SAMPLES Depth	SAMPLES Type/ No.	TESTS Depth	TESTS Type/ No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
						01/06/2018 11:00	3.15 13.84	Very stiff fissured dark grey CLAY with occasional light grey siltstone pockets. Fissures are extremely closely spaced, randomly orientated, smooth and mat. [KIMMERAGE CLAY FORMATION]		10.45	-1.72	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00	1.20	Inspection Pit	3.10	3.30	00:33	31/05/2018 14:30	2.40	20	2.11	1.65	3.15	150	10.45	150	3.15			
1.20	10.45	Cable Percussion	4.50	4.60	00:25	31/05/2018 15:30	4.60	20	4.43	3.15								

Remarks

PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 10.45mbgl.

Termination Depth: 10.45m

ARCADIS Percussive Borehole Log — BH2A02

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	10018973	8.75	04/06/2018	1:50
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	540877.00	266834.00	05/06/2018	Sheet 1 of 2

Samples

Depth	Type/No.
0.00 - 0.50	B1
0.00 - 0.50	D29
0.00 - 0.50	ES25
0.50 - 1.00	B2
0.50 - 1.00	D30
0.50 - 1.00	ES26
1.20 - 1.50	B3
1.20 - 1.50	D31
1.20 - 1.50	ES27
1.50 - 2.00	B4
1.50 - 2.00	D32
1.50 - 2.00	ES28
2.20 - 3.00	B5
2.20 - 3.00	D33
3.00 - 3.45	D6
3.50 - 4.00	D7
4.00 - 4.45	U8
4.50 - 5.00	D9
5.00 - 5.45	D10
5.50 - 6.00	B11
6.00 - 6.45	U12
6.50 - 7.50	D13
7.50 - 7.95	D14
8.00 - 9.00	D15
9.00 - 9.45	U16
9.50 - 10.50	B17

Tests

Depth	Type/No.	Results
1.20	SPT(S)	N=9 (2,2/3,2,2,2)
2.00	SPT(S)	N=7 (2,3/2,2,1,2)
3.00	SPT(S)	N=12 (1,2/2,3,3,4)
5.00	SPT(S)	N=28 (5,5/6,6,7,9)
7.50	SPT(S)	N=26 (3,5/5,6,7,8)

Progress

Date Time	Casing	Water
04/06/2018 17:00	1.20	0.77
05/06/2018 07:00	1.20	0.77

Strata

Description	Depth (Thickness)	Level
Orangish brown mottled white clayey slightly gravelly fine to coarse SAND. Gravel is angular to subrounded fine to medium flint. [RIVER TERRACE DEPOSITS] Becoming very gravelly.	(1.20) 1.20	7.55
Loose yellowish brown clayey very sandy GRAVEL. Sand is fine to coarse. Gravel is angular to subrounded fine to medium flint with occasional pockets (50 - 100mm) of sandy gravel, clayey sand and gravelly sand. [RIVER TERRACE DEPOSITS]	(1.00) 2.20	6.55
Stiff dark grey CLAY. [KIMMERAGE CLAY FORMATION] Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone. Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone.	(5.30) 7.50	1.25
Very stiff dark grey CLAY. [KIMMERAGE CLAY FORMATION]		

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.45	Cable Percussion

Chiselling

Hard Strata From	To	Duration
4.40	4.70	01:10
14.20	14.40	00:40

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
04/06/2018 16:30	0.80	20	0.77		2.60
05/06/2018 08:30	4.20	20	3.96	2.60	

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
150	15.45	150	2.60

Water Added

From	To	Volume (ltr)

Remarks

PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	Arcadis Consulting (UK) ltd	MT	SH

Percussive Borehole Log

BH2A02

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**8.75**	**04/06/2018**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540877.00**	**266834.00**	**05/06/2018**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend	Depth (Thickness)	Level	Install/ Backfill
								Very stiff dark grey CLAY. [KIMMERAGE CLAY FORMATION]				
10.50 - 10.95	D18	10.50	SPT(S)	N=31 (4,6/6,7,9,9)								
11.00 - 12.00	D19											
12.00 - 12.45	U20											
12.50 - 13.50	D21									(7.95)		
13.50 - 13.95	D22	13.50	SPT(S)	N=35 (4,5/6,8,10,11)								
14.00 - 15.00	B23							Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone.				
15.00 - 15.45	D24											
						05/06/2018 13:00	2.60 11.83			15.45	-6.70	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00	1.20	Inspection Pit	4.40	4.70	01:10	04/06/2018 16:30	0.80	20	0.77		2.60	150	15.45	150	2.60			
1.20	15.45	Cable Percussion	14.20	14.40	00:40	05/06/2018 08:30	4.20	20	3.96	2.60								

Remarks

PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (mm), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) ltd**	**MT**	**SH**

ARCADIS Percussive Borehole Log

BH2A03

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**9.10**	**30/05/2018**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540900.30**	**266874.90**	**31/05/2018**	**Sheet 1 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Depth (Thickness)	Level
0.00 - 0.20	B3	0.00	PID	<1ppm				Grass over soft to firm dark brown gravelly very sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint. [TOPSOIL]	(0.20) 0.20	8.90
0.00 - 0.20	D2									
0.00 - 0.20	ES1									
0.50 - 1.00	B6							Loose to dense orange brown clayey SAND and GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint. [RIVER TERRACE DEPOSITS]	(0.80) 1.00	8.10
0.50 - 1.00	D5									
0.50 - 1.00	ES4									
1.20 - 1.50	B9	1.20	SPT(C)	N=4 (3,1/1,1,1,1)				Very soft grey mottled orange brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint. [KIMMERAGE CLAY FORMATION]	(0.50) 1.50	7.60
1.20 - 1.50	D8									
1.20 - 1.50	ES7									
1.50 - 2.00	B12	1.50	PID	4.3ppm				Firm grey mottled orange brown slightly gravelly CLAY with siltstone bands. Gravel is subangular to subrounded fine to coarse flint. [KIMMERAGE CLAY FORMATION]	(1.50) 3.00	6.10
1.50 - 2.00	D11									
1.50 - 2.00	ES10									
2.00 - 2.45	D13	2.00	SPT(S)	N=12 (1,2/2,3,3,4)						
		2.00	PID	7.6ppm						
2.50 - 3.00	D14	2.50	PID	<1ppm						
3.00 - 3.45	UT15							Stiff grey brown CLAY with frequent 10-50mm bands of siltstone. [KIMMERAGE CLAY FORMATION]	(10.50)	
3.45 - 4.00	D16	3.45	PID	35.9ppm						
4.00 - 4.45	D17	4.00	SPT(S)	N=18 (2,3/3,4,5,6)		30/05/2018 18:30	1.65 Dry			
		4.00	PID	3.8ppm		31/05/2018 07:30	1.65 Dry			
5.00 - 5.45	UT18									
5.50 - 6.00	B19									
6.00 - 6.45	D20	6.00	SPT(S)	N=23 (3,4/4,5,6,8)						
		6.00	PID	2.6ppm						
7.50 - 8.00	B21									
		8.00	SPT(C)	N=28 (10,13/8,8,6,6)						
8.50 - 9.00	D22	8.50	PID	5.1ppm						
9.00 - 9.45	D23	9.00	SPT(S)	N=28 (3,4/5,6,8,9)						
		9.00	PID	<1ppm						
9.50 - 10.50	D24	9.50	PID	<1ppm						

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration
0.00	15.45	Cable Percussion	3.50	3.70	00:50
0.00	1.20	Inspection Pit	4.60	4.70	00:30
			13.70	13.80	00:33

WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
31/05/2018 18:00	4.70	20	4.53	1.65	

HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth
150	15.45	150	1.65

WATER ADDED From	To	Volume (ltr)

Remarks

Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) ltd**	**IT**	**SH**

Percussive Borehole Log — BH2A03

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**9.10**	**30/05/2018**	**1:50**
Client: **Homes England**	Easting (OS mE): **540900.30**	Northing (OS mN): **266874.90**	End Date: **31/05/2018**	**Sheet 2 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
								Stiff grey brown CLAY with frequent 10-50mm bands of siltstone. [KIMMERAGE CLAY FORMATION]				
10.50 - 10.95	UT25											
11.00 - 12.00	B26											
12.00 - 12.45	D27	12.00 12.00	SPT(S) PID	N=30 (3,4/5,7,8,10) 1.6ppm								
13.50 - 13.95	D28	13.50	PID	46.5ppm				Very stiff grey CLAY with occasional 10mm bands of siltstone. [KIMMERAGE CLAY FORMATION]		13.50	-4.40	
14.50 - 15.00	D29	14.50	PID	13.2ppm						(1.95)		
15.00 - 15.45	D30	15.00	PID	46.5ppm								
						31/05/2018 13:30	1.65 13.87			15.45	-6.35	

DRILLING TECHNIQUE

From	To	Type
0.00	15.45	Cable Percussion
0.00	1.20	Inspection Pit

CHISELLING

Hard Strata From	Hard Strata To	Duration
3.50	3.70	00:50
4.60	4.70	00:30
13.70	13.80	00:33

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
31/05/2018 18:00	4.70	20	4.53	1.65	

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	15.45	150	1.65

WATER ADDED

From	To	Volume (ltr)

Remarks
Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

ARCADIS Percussive Borehole Log — BH2A04

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**8.58**	**01/06/2018**	**1:50**
Client: **Homes England**	Easting (OS mE): **540773.70**	Northing (OS mN): **266950.60**	End Date: **04/06/2018**	**Sheet 1 of 2**

Samples

Depth	Type/No.
0.00 - 0.50	B1
0.00 - 0.50	D32
0.00 - 0.50	ES28
0.50 - 1.00	B2
0.50 - 1.00	D33
0.50 - 1.00	ES29
1.20 - 1.50	B4
1.20 - 1.50	D34
1.20 - 1.50	ES30
1.20 - 1.65	D3
1.50 - 2.00	B5
1.50 - 2.00	D35
1.50 - 2.00	ES31
2.00 - 2.45	U6
2.50 - 3.00	D7
3.00 - 3.45	D8
3.50 - 4.00	D9
4.00 - 4.45	U10
4.50 - 5.00	B11
5.00 - 5.45	D12
5.50 - 6.00	D13
6.00 - 6.45	U14
6.50 - 7.50	D15
7.50 - 7.95	D16
8.00 - 9.00	B17
8.50 - 9.00	D18
9.00 - 9.45	U19
9.50 - 10.50	D20

Tests

Depth	Type/No.	Results
1.20	SPT(S)	N=6 (1,1/1,1,2,2)
3.00	SPT(S)	N=19 (3,3/4,4,5,6)
5.00	SPT(S)	N=32 (5,5/6,8,8,10)
7.50	SPT(S)	N=29 (5,5/6,6,8,9)

Progress

Date Time	Casing	Water
01/06/2018 12:00	1.20	Dry
04/06/2018 07:00	1.20	Dry

Strata

Description	Depth (Thickness)	Level
MADE GROUND: Firm to stiff orangish brown mottled bluish grey and white slightly gravelly sandy CLAY with 10mm pockets of silt. Gravel is subangular to subrounded fine to medium flint. 30mm pockets of firm dark grey clay.	(0.80) 0.80	7.78
Firm bluish grey mottled orangish brown slightly sandy CLAY with pockets and bands of silt and siltstone. [KIMMERAGE CLAY FORMATION]	(2.20) 3.00	5.58
Very stiff grey slightly sandy CLAY with pockets and bands of silt and siltstone. [KIMMERAGE CLAY FORMATION] Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone. 1mm elongated light grey pockets, Possible bioturbation. Rare fossil shell fragments.	(12.45)	

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.45	Cable Percussion

Chiselling

Hard Strata From	To	Duration
4.30	4.40	00:30
4.40	4.60	00:50
14.30	14.40	00:34

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
04/06/2018 14:00	14.60	20	14.53	1.65	

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
150	15.45	150	1.65

Water Added

From	To	Volume (ltr)

Remarks
PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

AGS — Arcadis Cymru House, St Mellons Business Park, Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) ltd**	**MT**	**SH**

Percussive Borehole Log

BH2A04

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**8.58**	**01/06/2018**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540773.70**	**266950.60**	**04/06/2018**	**Sheet 2 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
								Very stiff grey slightly sandy CLAY with pockets and bands of silt and siltstone. [KIMMERAGE CLAY FORMATION]				
10.50 - 10.95	D21	10.50	SPT(S)	N=31 (5,6/6,7,8,10)								
11.00 - 12.00	D22											
12.00 - 12.45	U23											
12.50 - 13.50	B24											
13.50 - 13.95	D25	13.50	SPT(S)	N=35 (3,4/6,9,9,11)								
14.50 - 15.00	D26							Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone.				
15.00 - 15.45	D27	15.00	SPT(S)	N=45 (5,8/9,11,11,14)								
						04/06/2018 16:00	1.65 14.54			15.45	-6.87	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit	4.30	4.40	00:30	04/06/2018 14:00	14.60	20	14.53	1.65		150	15.45	150	1.65			
1.20	15.45	Cable Percussion	4.40	4.60	00:50													
			14.30	14.40	00:34													

Remarks

PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) ltd**	**MT**	**SH**

ARCADIS Percussive Borehole Log — BH2A05

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	10018973	8.91	05/06/2018	1:50
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	540851.50	266949.30	06/06/2018	Sheet 1 of 2

Samples

Depth	Type/No.
0.00 - 0.20	B1
0.00 - 0.20	D27
0.00 - 0.20	ES28
0.20 - 0.50	B2
0.20 - 0.50	D29
0.20 - 0.50	ES30
0.50 - 0.70	B3
0.50 - 0.70	D31
0.50 - 0.70	ES32
1.20 - 1.50	B4
1.20 - 1.50	D33
1.20 - 1.50	ES34
1.50 - 2.00	B5
1.50 - 2.00	D35
1.50 - 2.00	ES36
2.00 - 2.45	U6
2.50 - 3.00	D7
3.00 - 3.45	D8
3.50 - 4.00	D9
4.00 - 4.45	U10
4.50 - 5.00	B11
5.00 - 5.45	D12
5.50 - 6.00	D13
6.00 - 6.45	U14
6.50 - 7.50	D15
7.50 - 7.95	D16
8.00 - 9.00	B17
9.00 - 9.45	U18
9.50 - 10.50	D19

Tests

Depth	Type/No.	Results
1.20	SPT(S)	N=7 (1,2/1,2,2,2)
3.00	SPT(S)	N=16 (2,2/3,4,4,5)
5.00	SPT(S)	N=34 (5,4/7,7,8,12)
7.50	SPT(S)	N=26 (3,4/5,6,7,8)

Progress

Date Time	Casing	Water
05/06/2018 17:00	2.50	Dry
06/06/2018 07:00	2.50	Dry

Strata

Description	Depth (Thickness)	Level
Firm to very stiff brownish grey sandy slightly gravelly CLAY with frequent rootlets. Gravel is angular to subrounded fine to medium flint. [TOPSOIL]	(0.20) 0.20	8.71
Brownish grey mottled bluish grey clayey gravelly SAND. Gravel is subangular to subrounded fine to medium flint with rare 5mm ironstone nodules. [RIVER TERRACE DEPOSITS]	(0.30) 0.50	8.41
Firm to stiff light brown, bluish grey, white and orangish brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to rounded fine white flint. [KIMMERAGE CLAY FORMATION]	(0.70) 1.20	7.71
Soft to firm orangish brown mottled bluish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine flint. [KIMMERAGE CLAY FORMATION]	(0.60) 1.80	7.11
Firm dark grey slightly sandy CLAY with 1mm pockets of very light brown silt. [KIMMERAGE CLAY FORMATION] Occasional fossil shell fragments.	(1.20) 3.00	5.91
Stiff to very stiff bluish grey mottled grey and brown CLAY. [KIMMERAGE CLAY FORMATION] Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone.	(2.60) 5.60	3.31
Stiff dark grey CLAY. [KIMMERAGE CLAY FORMATION] Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone.		

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.45	Cable Percussion

Chiselling

Hard Strata From	Hard Strata To	Duration
4.30	4.60	01:00
5.40	5.60	00:33
7.40	7.50	00:25
14.60	14.80	00:33

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
05/06/2018 15:00	1.50	20	1.08	1.50	2.50
06/06/2018 09:00	5.60	20	14.71	2.60	8.50
06/06/2018 14:00	14.80	20	5.49	2.60	

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
150	15.45	150	2.60

Water Added

From	To	Volume (ltr)

Remarks

PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

AGS — Arcadis Cymru House, St Mellons Business Park, Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	Arcadis Consulting (UK) ltd	MT	SH

ARCADIS Percussive Borehole Log

BH2A05

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**8.91**	**05/06/2018**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540851.50**	**266949.30**	**06/06/2018**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing / Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
								Stiff dark grey CLAY. [KIMMERAGE CLAY FORMATION]				
10.50 - 10.95	D20	10.50	SPT(S)	N=32 (5,5/6,8,8,10)								
11.00 - 12.00	D21											
12.00 - 12.45	U22											
12.50 - 13.50	B23									(9.85)		
13.50 - 13.95	D24	13.50	SPT(S)	N=43 (6,7/9,10,11,13)								
14.00 - 15.00	D25											
					▼			Siltstone band recovered as light grey mottled bluish grey weak to very weak fine grained siltstone.				
15.00 - 15.45	D26	15.00	SPT(S)	N=49 (7,9/9,14,12,14)								
						06/06/2018 14:00	2.60 14.71			15.45	-6.54	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit	4.30	4.60	01:00	05/06/2018 15:00	1.50	20	1.08	1.50	2.50	150	15.45	150	2.60			
1.20	15.45	Cable Percussion	5.40	5.60	00:33	06/06/2018 09:00	5.60	20	14.71	2.60	8.50							
			7.40	7.50	00:25	06/06/2018 14:00	14.80	20	5.49	2.60								
			14.60	14.80	00:33													

Remarks

PID results not included as equipment became moisture sensitive. Exploratory hole terminated at scheduled depth of 15.45mbgl.

Termination Depth: 15.45m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) ltd**	**MT**	**SH**

ARCADIS Percussive Borehole Log

BH2A06

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**9.37**	**30/05/2018**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540959.20**	**266899.40**	**30/05/2018**	**Sheet 1 of 2**

SAMPLES / TESTS / WATER STRIKES / PROGRESS

Samples Depth	Samples Type/No.	Tests Depth	Tests Type/No.	Results	Water Strikes	Progress Date Time	Casing	Water
0.00 - 0.20	B3	0.00	PID	<1ppm		30/05/2018 08:00	0.00	Dry
0.00 - 0.20	D2	0.20	PID	2.8ppm				
0.00 - 0.20	ES1							
0.20 - 0.80	B6							
0.20 - 0.80	D5							
0.20 - 0.80	ES4							
0.80 - 1.20	B9	0.80	PID	<1ppm				
0.80 - 1.20	D8							
0.80 - 1.20	ES7							
1.20 - 1.50	B13	1.20	SPT(S)	N=5 (1,1/1,1,1,2)				
1.20 - 1.50	D12	1.20	PID	<1ppm				
1.20 - 1.50	ES11							
1.20 - 1.65	D10	1.50	PID	<1ppm				
2.00 - 2.45	UT14							
2.50 - 3.00	B16	2.50	PID	1.1ppm				
2.50 - 3.00	D15							
3.00 - 3.45	D17	3.00	SPT(S)	N=20 (2,2/3,3,5,9)				
		3.00	PID	<1ppm				
3.50 - 4.00	B19	3.50	PID	<1ppm				
3.50 - 4.00	D18							
					▼ 4.20 ▽ 4.01			
4.50 - 4.95	D20	4.50	SPT(S)	N=18 (7,6/5,4,4,5)				
4.50 - 5.00	B22	4.50	PID	1.2ppm				
4.50 - 5.00	D21							
5.00 - 6.00	B24	4.95	PID	<1ppm				
5.00 - 6.00	D23	5.00	PID	<1ppm				
6.00 - 6.45	UT25							
6.50 - 7.50	B27	6.50	PID	<1ppm				
6.50 - 7.50	D26							
7.50 - 7.95	D28	7.50	SPT(S)	N=26 (3,7/5,6,6,9)				
		7.50	PID	<1ppm				
8.00 - 9.00	B30	8.00	PID	<1ppm				
8.00 - 9.00	D29							
9.00 - 9.45	UT31							
9.50 - 10.00	B33	9.50	PID	<1ppm				
9.50 - 10.00	D32							
10.00 - 10.45	D34	10.00	SPT(S)	N=27 (3,4/5,6,7,9)				
		10.00	PID	<1ppm				

STRATA

Description	Depth (Thickness)	Level
Grass over soft dark brown slightly gravelly sandy CLAY with occasional. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint and brick. [TOPSOIL]	(0.20) 0.20	9.17
MADE GROUND: Loose brown slightly silty gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to coarse flint.	(0.60) 0.80	8.57
Loose to dense orange brown slightly clayey SAND and GRAVEL. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse flint. [RIVER TERRACE DEPOSITS]	(0.40) 1.20	8.17
Soft brown mottled grey slightly gravelly CLAY. Gravel is subangular to subrounded fine flint. [RIVER TERRACE DEPOSITS]	(0.30) 1.50	7.87
Stiff light grey brown mottled orange brown CLAY. [KIMMERAGE CLAY FORMATION]	(1.00) 2.50	6.87
Stiff light brown mottled grey CLAY with occasional gravel. Gravel is subangular to subrounded fine flint. [KIMMERAGE CLAY FORMATION]	(1.00) 3.50	5.87
Stiff grey CLAY with siltstone bands. [KIMMERAGE CLAY FORMATION]	(6.95)	

DRILLING TECHNIQUE

From	To	Type
0.00	10.45	Cable Percussion
0.00	1.20	Inspection Pit

CHISELLING

Hard Strata From	Hard Strata To	Duration
3.40	3.60	00:34
4.30	4.40	00:34

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
30/05/2018 14:30	4.20	20	4.01	1.65	

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.45	150	1.65

WATER ADDED

From	To	Volume (ltr)

Remarks

Exploratory hole terminated at scheduled depth of 10.45mbgl. Slight seepage at 4.20mbgl.

Termination Depth: 10.45m

Percussive Borehole Log

BH2A06

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**9.37**	**30/05/2018**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540959.20**	**266899.40**	**30/05/2018**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA		Depth (Thickness)	Level	Install/ Backfill
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend			
								Stiff grey CLAY with siltstone bands. [KIMMERAGE CLAY FORMATION]				
						30/05/2018 15:45	1.65 Dry			10.45	-1.08	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00	10.45	Cable Percussion	3.40	3.60	00:34	30/05/2018 14:30	4.20	20	4.01	1.65		150	10.45	150	1.65			
0.00	1.20	Inspection Pit	4.30	4.40	00:34													

Remarks

Exploratory hole terminated at scheduled depth of 10.45mbgl. Slight seepage at 4.20mbgl.

Termination Depth: 10.45m

Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) ltd**	**IT**	**SH**

ARCADIS Percussive Borehole Log — BH2A07

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**7.06**	**29/05/2018**	**1:50**
Client: **Homes England**	Easting (OS mE): **540996.80**	Northing (OS mN): **267100.20**	End Date: **29/05/2018**	**Sheet 1 of 2**

Samples

Depth	Type/No.
0.00 - 0.20	B1
0.00 - 0.20	D30
0.00 - 0.20	ES2
0.20	B3
0.20 - 0.50	D31
0.20 - 0.50	ES4
0.50 - 1.00	B5
0.50 - 1.00	D32
0.50 - 1.00	ES6
1.20 - 1.50	B8
1.20 - 1.50	D33
1.20 - 1.50	ES9
1.20 - 1.65	D7
1.50 - 2.00	B11
1.50 - 2.00	ES10
2.00 - 2.45	U12
2.50 - 3.00	B13
2.50 - 3.00	D34
2.50 - 3.00	ES14
3.00 - 3.45	D15
3.50 - 4.00	B16
3.50 - 4.00	D35
4.00 - 4.45	U17
4.50 - 5.00	B18
4.50 - 5.00	D36
5.00 - 5.45	D19
5.50 - 6.00	B20
5.50 - 6.00	D37
6.00 - 6.45	U21
6.50 - 7.00	B22
6.50 - 7.00	D38
7.00 - 7.45	D23
7.50 - 8.00	B24
7.50 - 8.00	D39
8.00 - 8.45	U25
8.50 - 9.00	B26
8.50 - 9.00	D40
9.00 - 9.45	D27
9.50 - 10.00	B28
9.50 - 10.00	D41
10.00 - 10.45	D29

Tests

Depth	Type/No.	Results
0.00	PID	<1ppm
0.20	PID	<1ppm
0.50	PID	<1ppm
1.20	SPT(S)	N=24 (1,3/8,8,4,4)
1.20	PID	<1ppm
1.20	PID	<1ppm
1.50	PID	<1ppm
2.50	PID	<1ppm
3.00	SPT(S)	N=25 (3,4/8,7,6,4)
3.00	PID	<1ppm
3.50	PID	<1ppm
4.50	PID	<1ppm
5.00	SPT(S)	N=25 (17,8/7,5,6,7)
5.00	PID	<1ppm
5.50	PID	<1ppm
6.50	PID	<1ppm
7.00	SPT(S)	N=30 (4,6/6,7,8,9)
7.00	PID	<1ppm
7.50	PID	<1ppm
8.50	PID	<1ppm
9.00	SPT(S)	N=28 (4,4/5,6,7,10)
9.00	PID	2.2ppm
9.50	PID	<1ppm
10.00	SPT(S)	N=29 (3,4/5,6,8,10)
10.00	PID	<1ppm

Progress

Date Time	Casing	Water
29/05/2018 08:00	0.00	Dry

Strata

Description	Depth (Thickness)	Level
Grass over firm to stiff brownish grey slightly gravelly slightly sandy CLAY. Gravel is angular to subrounded fine to medium flint and brick with frequent rootlets. [TOPSOIL]	(0.20) 0.20	6.86
MADE GROUND: Soft to firm light greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium flint with occasional rootlets and pockets of silty sand.	(1.20) 1.40	5.66
Firm brownish grey mottled bluish grey slightly sandy CLAY with occasional 20mm pockets of very light brown silt. Rare semi-decayed vegetation and 10mm extremely weak claystone bands. [KIMMERAGE CLAY FORMATION]	1.50 (0.50) 2.00	5.56 / 5.06
Firm light brown mottled bluish grey clayey SILT with frequent 5-10mm pockets of weak claystone recovered as bluish grey CLAY. [KIMMERAGE CLAY FORMATION]		
Stiff to very stiff bluish grey mottled orangish brown slightly sandy slightly gravelly CLAY with occasional 2mm bands of fine to medium sand. Gravel is subrounded fine to medium claystone. [KIMMERAGE CLAY FORMATION] — Containing 2mm Mica crystals.	(3.00) 5.00	2.06
Stiff to very stiff dark grey CLAY. [KIMMERAGE CLAY FORMATION] — Rare 1mm light grey bioturbated channels. — Ammonite fossil. — Rare 4mm bioturbated channels with occasional to frequent fossils (shells and 10mm ammonite).	(5.45)	

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.45	Cable Percussion

Chiselling

Hard Strata From	To	Duration
1.70	1.80	00:25
2.70	2.80	00:25
3.60	3.80	00:50

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
150	10.45	150	1.50

Water Added

From	To	Volume (ltr)

Remarks

Inspection pit excavated to 1.20mbgl. Exploratory hole terminated at required depth of 10.45mbgl. No groundwater encountered.

Termination Depth: 10.45m

AGS — Arcadis Cymru House, St Mellons Business Park, Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	Arcadis Consulting (UK) ltd	MT	SH

ARCADIS Percussive Borehole Log

BH2A07

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Parcel 2A	**10018973**	**7.06**	**29/05/2018**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540996.80**	**267100.20**	**29/05/2018**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend	Depth (Thickness)	Level	Install/ Backfill
								Stiff to very stiff dark grey CLAY. [KIMMERAGE CLAY FORMATION]				
						29/05/2018 16:00	1.50 Dry			10.45	-3.39	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00	1.20	Inspection Pit	1.70	1.80	00:25							150	10.45	150	1.50			
1.20	10.45	Cable Percussion	2.70	2.80	00:25													
			3.60	3.80	00:50													

Remarks

Inspection pit excavated to 1.20mbgl. Exploratory hole terminated at required depth of 10.45mbgl. No groundwater encountered.

Termination Depth: 10.45m

ARCADIS

Project:	**Northstowe - Parcel 2A**		
Job Number:	**10018973**	**Date:**	29/06/2018

Weather:	**Very warm / Dry**
Engineer:	**RD**

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 7	Peak:0	Initial	0	0	0	21	0	0						
						30	0	0	0.7	20.1	0	1						
						60	0	0	0.8	19.7	0	1						
						90	0	0	0.8	19.5	0	0						
				Steady: 7	Steady:0	120	0	0	0.9	19.5	0	1						
						150	0	0	0.9	19.4	0	1						
BH2A01S	29/06/2018	1025				180	0	0	0.9	19.4	0	1				0.83	2.44	Measured from Ground Level
				Peak: 5	Peak: 0	Initial	0	0	0	20.8	0	1						
						30	0	0	0.2	20.5	0	3						
						60	0	0	0.2	20.5	0	3						
						90	0	0	0.2	20.5	0	3						
				Steady: 5	Steady: 0	120	0	0	0.2	20.5	0	2						
						150	0	0	0.2	20.5	0	2						
BH2A01D	29/06/2018	1025				180	0	0	0.2	20.6	0	2				0.6	6.21	Measured from Ground Level
				Peak: 9	Peak: 0	Initial	0	0	0.1	20.7	0	0						
						30	0	0	0.2	20.5	0	0						
						60	0	0	0.2	20.5	0	1						
						90	0	0	0.3	20.5	0	1						
				Steady: 9	Steady: 0	120	0	0	0.3	20.5	0	0						
						150	0	0	0.3	20.5	0	1						
BH2A02S	29/06/2018	1025				180	0	0	0.3	20.5	0	0				0.75	2.2	Measured from Ground Level
				Peak: 3763	Peak: 6.6	Initial	0	0	0.1	20.7	0	3						
						30	0	0	0.2	20.5	0	4						
						60	0	0	0.2	20.5	0	4						
						90	0	0	0.2	20.5	0	4						
				Steady: 3763	Steady: 3.0	120	0	0	0.2	20.5	0	4						
						150	0	0	0.2	20.5	0	4						
BH2A02D	29/06/2018	1025				180	0	0	0.2	20.5	0	4				0.56	7.88	Measured from Ground Level

Notes:

PID readings have not been taken.

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Ambient Concentration	
CH4	**0**
CO2	**0.428571429**
O2	**20.43015873**
H2S	**0.095238095**
CO	**1.19047619**

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		GA5000
PID		
Dip meter/ interface probe		

ARCADIS	Project:	Northstowe - Parcel 2A
	Job Number:	10018973

Date: 29/06/2018

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 12	Peak: 0	Initial	0	0	0.1	20.8	0	0						
						30	0	0	0.2	20.8	0	2						
						60	0	0	0.2	20.8	0	2						
						90	0	0	0.2	20.8	0	2						
				Steady: 12	Steady: 0	120	0	0	0.2	20.8	0	2						
						150	0	0	0.2	20.8	0	2						
BH2A03S	29/06/2018	1025				180	0	0	0.2	20.8	0	2				1.11	3.04	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0.1	20.8	0	0						
						30	0	0	1.5	19.1	0	2						
						60	0	0	1.6	19	0	2						
						90	0	0	1.6	19	0	2						
				Steady: 0	Steady: 0	120	0	0	1.6	19	0	2						
						150	0	0	1.6	19	0	2						
BH2A03D	29/06/2018	1025				180	0	0	1.6	19	0	2				1.1	5	Measured from Ground Level
				Peak: 3	Peak: 0	Initial	0	0	0.1	20.9	0	0						
						30	0	0	0.5	20.7	1	0						
						60	0	0	0.5	20.7	1	0						
						90	0	0	0.5	20.7	1	0						
				Steady: 3	Steady: 0	120	0	0	0.5	20.7	1	0						
						150	0	0	0.5	20.7	1	0						
BH2A04S	29/06/2018	1025				180	0	0	0.5	20.7	1	0				1.32	3.14	Measured from Ground Level
				Peak: 15	Peak: 0	Initial	0	0	0.1	21	0	0						
						30	0	0	0.1	21	0	0						
						60	0	0	0.1	21	0	0						
						90	0	0	0.1	21	0	0						
				Steady: 15	Steady: 0	120	0	0	0.1	21	0	0						
						150	0	0	0.1	21	0	0						
BH2A04D	29/06/2018	1025				180	0	0	0.1	21	0	0				1.35	14.96	Measured from Ground Level
				Peak: 0	Peak: 0.1	Initial	0	0	0.1	20.9	0	0						
						30	0	0	0.5	20.7	0	0						
						60	0	0	0.5	20.6	0	0						
						90	0	0	0.5	20.6	0	0						
				Steady: 0	Steady: 0.1	120	0	0	0.5	20.6	0	0						
						150	0	0	0.5	20.6	0	0						
BH2A05S	29/06/2018	1025				180	0	0	0.5	20.6	0	0				1.3	2.94	Measured from Ground Level

Notes:

PID readings have not been taken.

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Project:	Northstowe - Parcel 2A		
Job Number:	10018973	Date:	29/06/2018

Weather:	Very warm / Dry
Engineer:	RD

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 9	Peak: 0	Initial	0	0	0.1	20.9	0	1						
						30	0	0	0.2	20.8	0	1						
						60	0	0	0.2	20.8	0	1						
						90	0	0	0.2	20.8	0	0						
				Steady: 9	Steady: 0	120	0	0	0.2	20.8	0	0						
						150	0	0	0.2	20.8	0	0						
BH2A05D	29/06/2018	1025				180	0	0	0.2	20.8	0	0				1.43	15.02	Measured from Ground Level
				Peak: 9	Peak: 0	Initial	0	0	0	20.9	0	1						
						30	0	0	1.7	20	0	0						
						60	0	0	1.7	19.9	0	0						
						90	0	0	1.6	19.9	0	0						
				Steady: 9	Steady: 0	120	0	0	1.6	19.9	0	0						
						150	0	0	1.6	19.9	0	0						
BH2A06S	29/06/2018	1025				180	0	0	1.6	19.9	0	0				1.6	2.36	Measured from Ground Level
				Peak: 10	Peak: 0	Initial	0	0	0.1	20.8	0	1						
						30	0	0	0.4	20.6	0	2						
						60	0	0	0.4	20.5	0	2						
						90	0	0	0.4	20.5	0	2						
				Steady: 10	Steady: 0	120	0	0	0.4	20.5	0	1						
						150	0	0	0.4	20.5	0	2						
BH2A06D	29/06/2018	1025				180	0	0	0.4	20.5	0	1				1.6	7.06	Measured from Ground Level
				Peak: 10	Peak: 0	Initial	0	0	0	20.8	0	0						
						30	0	0	0.1	20.8	0	0						
						60	0	0	0.1	20.7	0	0						
						90	0	0	0.1	20.7	0	0						
				Steady: 10	Steady: 0	120	0	0	0.1	20.7	0	0						
						150	0	0	0.1	20.7	0	0						
BH2A07S	29/06/2018	1025				180	0	0	0.1	20.7	0	0				0.56	2.67	Measured from Ground Level

Notes:

PID readings have not been taken.

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Ambient Concentration	
CH4	0
CO2	0.44
O2	20.53939394
H2S	0
CO	0.689655172

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		GA5000
PID		
Dip meter/ interface probe		

ARCADIS

Project:	Northstowe - Parcel 2A
Job Number:	10018973

Date:	29/06/2018

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 3	Peak: 0	Initial	0	0	0	20.7	0	0						
						30	0	0	0.2	20.6	0	2						
						60	0	0	0.2	20.6	0	2						
						90	0	0	0.2	20.6	0	2						
				Steady: 3	Steady: 0	120	0	0	0.2	20.6	0	2						
						150	0	0	0.2	20.6	0	2						
BH2A07D	29/06/2018	1025				180	0	0	0.2	20.6	0	2				0.55	10.04	Measured from Ground Level

Notes:

PID readings have not been taken.

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

ARCADIS

Project:	Northstowe - Parcel 2A			Weather:	Dry
Job Number:	10018973	Date:	06/07/2018	Engineer:	RD

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 0	Peak:0	Initial	0	0	0	20.8	0	0			0			
						30	0	0	1.5	18.3	0	0			0.5			
						60	0	0	1.5	18.2	0	0			0.5			
						90	0	0	1.5	18.2	0	0			0.5			
				Steady: 0	Steady:0	120	0	0	1.5	18.2	0	0			0.5			
						150	0	0	1.5	18.2	0	0			0.5			
BH2A01S	06/07/2018 11:15	1019				180	0	0	1.5	18.2	0	0			0.5	0.85	2.44	Measured from Ground Level
				Peak: 36	Peak: 0.2	Initial	0	0	0	20.6	0	0			0			
						30	0	0	0.3	20.2	0	4			0.4			
						60	0	0	0.2	20.3	0	4			0.4			
						90	0	0	0.2	20.3	0	3			0.4			
				Steady: 36	Steady: 0	120	0	0	0.2	20.4	0	3			0.4			
						150	0	0	0.2	20.4	0	3			0.4			
BH2A01D	06/07/2018 11:15	1019				180	0	0	0.2	20.5	0	2			0.4	0.64	6.21	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0.1	20.6	0	0			0			
						30	0	0	0.3	20.4	0	0			0.7			
						60	0	0	0.3	20.4	0	0			0.7			
						90	0	0	0.3	20.4	0	0			0.7			
				Steady: 0	Steady: 0	120	0	0	0.3	20.4	0	0			0.7			
						150	0	0	0.3	20.4	0	0			0.7			
BH2A02S	06/07/2018 11:40	1019				180	0	0	0.3	20.4	0	0			0.7	0.73	2.2	Measured from Ground Level
				Peak: 827	Peak: 5.4	Initial	0	0	0	20.7	0	0			0.5			
						30	0	0	0.4	20.1	0	6			0.7			
						60	0	0	0.4	20.1	0	8			1.1			
						90	0	0	0.4	20.1	0	8			1.1			
				Steady: 827	Steady: 1.2	120	0	0	0.4	20.1	0	8						Measured from Ground Level
						150	0	0	0.4	20.1	0	8						/ PID readings stopped at 120
BH2A02D	06/07/2018 11:40	1019				180	0	0	0.4	20.1	0	8				0.57	7.88	seconds due to a pump error.

Notes:

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Ambient Concentration	
CH4	0
CO2	0.668253968
O2	19.83333333
H2S	0
CO	1.031746032

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		GA5000
PID		
Dip meter/ interface probe		

ARCADIS

Project:	Northstowe - Parcel 2A
Job Number:	10018973

Date: 06/07/2018

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 0	Peak: 0	Initial	0	0	0.1	20.6	0	0			0.6			
						30	0	0	0.2	20.6	0	0			1.4			
						60	0	0	0.1	20.5	0	0			1.5			
						90	0	0	0.1	20.5	0	0			1.5			
				Steady: 0	Steady: 0	120	0	0	0.1	20.5	0	0			1.5			
						150	0	0	0.1	20.5	0	0			1.5			
BH2A03S	06/07/2018 09:10	1021				180	0	0	0.1	20.5	0	0			1.5	1.23	3.04	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0.1	20.5	0	0			0.7			
						30	0	0	3.4	17.3	0	0			0.8			
						60	0	0	3.6	16.9	0	0			1.3			
						90	0	0	3.7	16.8	0	0			1.3			
				Steady: 0	Steady: 0	120	0.1	0	3.7	16.8	0	0			1.3			
						150	0.1	0	3.7	16.8	0	0			1.3			
BH2A03D	06/07/2018 09:10	1021				180	0.1	0	3.7	16.8	0	0				1.22	5	Measured from Ground Level
				Peak: 3	Peak: 0	Initial	0	0	0	20.4	0	0			0			
						30	0	0	0.4	20.3	0	0			0.1			
						60	0	0	0.4	20.3	0	0			0.1			
						90	0	0	0.4	20.3	0	0			0.2			
				Steady: 3	Steady: 0	120	0	0	0.4	20.3	0	0			0.2			
						150	0	0	0.4	20.3	0	0			0.2			
BH2A04S	06/07/2018 10:50	1019				180	0	0	0.4	20.3	0	0			0.2	1.36	3.14	Measured from Ground Level
				Peak: 2	Peak: 0	Initial	0	0	0	20.5	0	0			0			
						30	0	0	0	20.4	0	0			0.1			
						60	0	0	0	20.4	0	0			0.1			
						90	0	0	0	20.4	0	0			0.1			
				Steady: 2	Steady: 0	120	0	0	0	20.4	0	0			0.1			
						150	0	0	0	20.4	0	0			0.1			
BH2A04D	06/07/2018 10:50	1019				180	0	0	0	20.4	0	0			0.1	1.34	14.96	Measured from Ground Level
				Peak: 1	Peak: 0.1	Initial	0	0	0	20.5	0	0			0.4			
						30	0	0	0.4	20.2	0	0			2.5			
						60	0	0	0.4	20.2	0	0			2			
						90	0	0	0.4	20.2	0	0			2.6			
				Steady: 1	Steady: 0.0	120	0	0	0.4	20.2	0	0			2.7			
						150	0	0	0.4	20.2	0	0			2.8			
BH2A05S	13/07/2018 10:30	1021				180	0	0	0.4	20.2	0	0			3	1.29	2.94	Measured from Ground Level

Notes:

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

ARCADIS

Project:	Northstowe - Parcel 2A		
Job Number:	10018973	Date:	06/07/2018

Weather:	Dry
Engineer:	RD

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 2	Peak: 0	Initial	0	0	0	20.5	0	1			0			
						30	0	0	0.1	20.4	0	0			0.5			
						60	0	0	0.1	20.4	0	0			2.3			
						90	0	0	0.1	20.4	0	0			2.2			
				Steady: 2	Steady: 0	120	0	0	0.1	20.4	0	0			2.5			
						150	0	0	0.1	20.4	0	0			2.7			
BH2A05D	06/07/2018 10:30	1021				180	0	0	0.1	20.4	0	0			2.8	1.41	15.02	Measured from Ground Level
				Peak: 1	Peak: 0	Initial	0	0	0.1	20.4	0	0			1.9			
						30	0	0	0.9	20	0	0			5.1			
						60	0	0	0.9	19.9	0	0			10.3			
						90	0	0	0.9	19.9	0	0			12.6			
				Steady:1	Steady: 0	120	0	0	0.9	19.9	0	0			12.7			
						150	0	0	0.9	19.9	0	0			12.5			
BH2A06S	06/07/2018 09:45	1021				180	0	0	1	19.9	0	0			12.4	1.74	2.36	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0.1	20.7	0	0			0.3			
						30	0	0	0.4	20.6	0	0			4.1			
						60	0	0	0.4	20.6	0	0			8.6			
						90	0	0	0.4	20.6	0	0			12.5			
				Steady: 0	Steady: 0	120	0	0	0.4	20.6	0	0			8.6			
						150	0	0	0.4	20.6	0	0			9.2			
BH2A06D	06/07/2018 09:45	1021				180	0	0	0.4	20.6	0	0			9.1	1.73	7.06	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0.1	20.7	0	0			0.4			
						30	0	0	0.1	20.7	0	0			0.3			
						60	0	0	0.1	20.7	0	0			0.4			
						90	0	0	0.1	20.7	0	0			0.3			
				Steady: 0	Steady: 0	120	0	0	0.1	20.7	0	0			0.4			
						150	0	0	0.1	20.7	0	0			0.4			
BH2A07S	06/07/2018 10:10	1021				180	0	0	0.1	20.7	0	0			0.4	0.59	2.67	Measured from Ground Level

Notes:

Ambient Concentration	
CH4	0
CO2	0.32
O2	20.43714286
H2S	0
CO	0.314285714

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		GA5000
PID		
Dip meter/ interface probe		

Project:	Northstowe - Parcel 2A
Job Number:	10018973

Date:	06/07/2018

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 3	Peak: 0	Initial	0	0	0.1	20.7	0	0			0.6			
						30	0	0	0.3	20.4	0	2			3.7			
						60	0	0	0.3	20.4	0	2			4.5			
						90	0	0	0.3	20.4	0	2			7.2			
				Steady: 3	Steady: 0	120	0	0	0.3	20.4	0	2			9.6			
						150	0	0	0.3	20.5	0	1			9.4			
BH2A07D	06/07/2018 10:10	1021				180	0	0	0.2	20.5	0	1			9.5	0.53	10.04	Measured from Ground Level

Notes:

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Project:	Northstowe - Parcel 2A			Weather:	Sunny / Dry
Job Number:	10018973	Date:	13/07/2018	Engineer:	RD

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 0	Peak:0	Initial	0	0	0	20.5	0	0			0			
						30	0	0	1.4	18.6	0	0			0.6			
						60	0	0	1.4	18.5	0	0			0.6			
						90	0	0	1.4	18.5	0	0			0.6			
				Steady: 0	Steady:0	120	0	0	1.4	18.5	0	0			0.6			
						150	0	0	1.4	18.4	0	0			0.6			
BH2A01S	13/07/2018	1021				180	0	0	1.4	18.4	0	0				0.91	2.44	Measured from Ground Level
				Peak: 75	Peak: 0.4	Initial	0	0	0	20.6	0	0			0			
						30	0	0	0.3	20.1	0	4			1.2			
						60	0	0	0.3	20.1	0	4			1.2			
						90	0	0	0.3	20.1	0	4			1.2			
				Steady: 75	Steady: 0	120	0	0	0.2	20.2	0	4			1.2			
						150	0	0	0.2	20.2	0	3			1.2			
BH2A01D	13/07/2018	1021				180	0	0	0.2	20.2	0	2				0.61	6.21	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0.2	20.6	0	0			0			
						30	0	0	0.2	20.1	0	0			0.3			
						60	0	0	0.2	20.1	0	0			0.3			
						90	0	0	0.2	20.1	0	0			0.3			
				Steady: 0	Steady: 0	120	0	0	0.2	20.1	0	0			0.3			
						150	0	0	0.2	20.1	0	0			0.3			
BH2A02S	13/07/2018	1021				180	0	0	0.2	20.1	0	0			0.3	0.79	2.2	Measured from Ground Level
				Peak: 437	Peak: 3.5	Initial	0	0	0	20.5	0	0			0			
						30	0	0	0.4	19.6	0	9			0.4			
						60	0	0	0.4	19.5	0	9						
						90	0	0	0.4	19.5	0	9						
				Steady: 437	Steady: 0.5	120	0	0	0.4	19.5	0	9						Measured from Ground Level
						150	0	0	0.4	19.5	0	9						/ PID readings stopped at 60
BH2A02D	13/07/2018	1021				180	0	0	0.4	19.5	0	9				0.57	7.88	seconds due to a pump error.

Notes:

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Ambient Concentration	
CH4	0
CO2	0.666666667
O2	19.82063492
H2S	0
CO	1.19047619

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		GA5000
PID		
Dip meter/ interface probe		

Project:	**Northstowe - Parcel 2A**
Job Number:	**10018973**

Date:	**13/07/2018**

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 1	Peak: 0	Initial	0	0	0.1	20.6	0	0			0			
						30	0	0	3.8	17.1	0	0			0.9			
						60	0	0	3.8	16.7	0	0			1.2			
						90	0	0	3.8	16.7	0	0			1.2			
				Steady: 1	Steady: 0	120	0	0	3.8	16.6	0	0			1.2			
						150	0	0	3.8	16.6	0	0			1.2			
BH2A03S	13/07/2018	1023				180	0	0	3.8	16.6	0	0			1.2	1.21	3.04	Measured from Ground Level
				Peak: 4	Peak: 0	Initial	0	0	0	20.7	0	0			0			
						30	0	0	0.2	20.5	0	0			1.8			
						60	0	0	0.2	20.5	0	0			2			
						90	0	0	0.2	20.5	0	0			2.2			
				Steady: 4	Steady: 0	120	0	0	0.2	20.5	0	0			2.2			
						150	0	0	0.2	20.5	0	0			2.2			
BH2A03D	13/07/2018	1023				180	0	0	0.2	20.5	0	0			2.2	1.21	5	Measured from Ground Level
				Peak:5	Peak: 0	Initial	0	0	0	20.7	0	0			0			
						30	0	0	0.4	20.5	0	0			1.2			
						60	0	0	0.4	20.5	0	0			1.2			
						90	0	0	0.4	20.5	0	0			1.2			
				Steady:5	Steady: 0	120	0	0	0.4	20.5	0	0			1.2			
						150	0	0	0.4	20.5	0	0			1.2			
BH2A04S	13/07/2018	1021				180	0	0	0.4	20.5	0	0			1.2	1.37	3.14	Measured from Ground Level
				Peak: 1	Peak: 0	Initial	0	0	0	20.8	0	0			0			
						30	0	0	0	20.8	0	0			1.3			
						60	0	0	0	20.8	0	0			1.3			
						90	0	0	0	20.8	0	0			1.3			
				Steady: 1	Steady: 0	120	0	0	0	20.8	0	0			1.3			
						150	0	0	0	20.8	0	0			1.3			
BH2A04D	13/07/2018	1021				180	0	0	0	20.8	0	0				1.38	14.96	Measured from Ground Level
				Peak: 0	Peak: 0.0	Initial	0	0	0	20.7	0	0			0			
						30	0	0	0.3	20.4	0	0			0.6			
						60	0	0	0.3	20.4	0	0			0.6			
						90	0	0	0.3	20.4	0	0			0.6			
				Steady: 0	Steady: 0.0	120	0	0	0.3	20.4	0	0			0.6			
						150	0	0	0.3	20.4	0	0			0.6			
BH2A05S	13/07/2018	1023				180	0	0	0.3	20.4	0	0			0.6	1.3	2.94	Measured from Ground Level

Notes:

Overcast / Dry

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Project:	Northstowe - Parcel 2A		
Job Number:	10018973	Date:	13/07/2018

Weather:	Sunny / Dry
Engineer:	RD

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 0	Peak: 0	Initial	0	0	0	20.5	0	0			0			
						30	0	0	0.1	20.3	0	0			1.5			
						60	0	0	0.1	20.3	0	0			2			
						90	0	0	0.1	20.3	0	0			2			
				Steady: 0	Steady: 0	120	0	0	0.1	20.3	0	0			2			
						150	0	0	0.1	20.3	0	0			2			
BH2A05D	13/07/2018	1023				180	0	0	0.1	20.3	0	0			2	1.41	15.02	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0	20.7	0	0			0			
						30	0	0	0.6	20.5	0	0			0.5			
						60	0	0	0.6	20.5	0	0			1.2			
						90	0	0	0.6	20.4	0	0			1.2			
				Steady: 0	Steady: 0	120	0	0	0.6	20.4	0	0			1.2			
						150	0	0	0.6	20.4	0	0			1.5			
BH2A06S	13/07/2018	1023				180	0	0	0.6	20.4	0	0			1.5	1.72	2.36	Measured from Ground Level
				Peak: 0	Peak: 0	Initial	0	0	0	20.5	0	0			0			
						30	0	0	0.3	20.3	0	0			3.3			
						60	0	0	0.2	20.2	0	0			3.5			
						90	0	0	0.2	20.2	0	0			3.3			
				Steady: 0	Steady: 0	120	0	0	0.2	20.2	0	0			3.3			
						150	0	0	0.2	20.2	0	0			3.3			
BH2A06D	13/07/2018	1023				180	0	0	0.2	20.2	0	0			3.3	1.65	7.06	Measured from Ground Level
				Peak: 1	Peak: 0	Initial	0	0	0	20.5	0	0			0			
						30	0	0	0.3	20.2	0	0			2.8			
						60	0	0	0.3	20.2	0	0			3.6			
						90	0	0	0.3	20.2	0	0			3.6			
				Steady: 1	Steady: 0	120	0	0	0.3	20.2	0	0			3.6			
						150	0	0	0.3	20.2	0	0						
BH2A07S	13/07/2018	1023				180	0	0	0.3	20.2	0	0				0.69	2.67	Measured from Ground Level

Notes:

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Ambient Concentration	
CH4	0
CO2	0.26
O2	20.27878788
H2S	0
CO	0

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		GA5000
PID		
Dip meter/ interface probe		

Project:	Northstowe - Parcel 2A
Job Number:	10018973

Date:	13/07/2018

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 10	Peak: 0	Initial	0	0	0	20.5	0	0			0			
						30	0	0	0.3	20.1	0	0			1.8			
						60	0	0	0.3	20.1	0	0			1.9			
						90	0	0	0.3	20.1	0	0			1.9			
				Steady: 10	Steady: 0	120	0	0	0.3	20.1	0	0			1.9			
						150	0	0	0.3	20.1	0	0			1.9			
BH2A07D	13/07/2018	1023				180	0	0	0.3	20.1	0	0			1.9	0.66	10.04	Measured from Ground Level

Notes:

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A01S
Project No:	10018973	**Sample Ref:**	EW1.5
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	2.44	**Pre-Sampling Water Level (m):**	**0.76**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.76	-	7.31	1143	15	11.7	1.17	56.1
First Purge Volume	10	0.76	2.6	7.25	1131	15.8	7.2	0.71	35.2
Second Purge Volume	15	0.76	2.6	7.25	1127	16	7.1	0.7	35
Third Purge Volume	20	0.76	2.6	7.18	1095	16.4	5	0.49	34.6
Stable Reading	25	0.76	-	7.17	1081	16.5	4.1	0.4	32.3

Water Description at Start of Purging (Colour, Clarity, Odour)	Silty	**Water Description During/After Purging (Colour, Clarity, Odour)**	Silty

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A01D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	
Date:	21/06/2018		

Borehole Depth:	6.21	**Pre-Sampling Water Level (m):**	**0.59**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.59	-	7.35	1222	13.4	6.9	0.72	10.8
First Purge Volume	10	0.59	2.6	7.36	1239	13.3	4.5	0.46	32.7
Second Purge Volume	15	0.59	2.6	7.36	1251	12.4	4.3	0.46	32.5
Third Purge Volume	20	0.59	2.6	7.39	1095	16.5	5	0.49	34.6
Stable Reading	25	0.59	-	7.4	1306	13.7	8.4	0.87	35

Water Description at Start of Purging (Colour, Clarity, Odour)	Silty	**Water Description During/After Purging (Colour, Clarity, Odour)**	Silty

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A02S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	
Date:	21/06/2018		

Borehole Depth:	2.2	**Pre-Sampling Water Level (m):**	**0.68**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.68	-	6.95	832	15.5	20	1.96	73.5
First Purge Volume	10	0.68	2.6	6.92	809	15.6	16	1.59	80.8
Second Purge Volume	15	0.68	2.6	7.02	731	16	29.2	2.87	93.2
Third Purge Volume	20	0.68	2.6	7.07	698	15.8	32	3.16	98.4
Stable Reading	25	0.68	-	7.08	697	16	33.4	3.28	100.4

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A02D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	
Date:	21/06/2018		

Borehole Depth:	7.88	**Pre-Sampling Water Level (m):**	**0.54**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.54	-	7.33	1360	13	28.7	2.98	5.6
First Purge Volume	10	0.54	2.6	7.28	1352	11.9	14.4	1.53	9.2
Second Purge Volume	15	0.54	2.6	7.21	1307	11.6	6.8	0.79	11.9
Third Purge Volume	20	0.54	2.6	7.2	1281	11.2	5.8	0.63	11.8
Stable Reading	25	0.54	-	7.2	1279	11.3	5.6	0.61	13.6

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A03S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	
Date:	21/06/2018		

Borehole Depth:	3.04	**Pre-Sampling Water Level (m):**	1
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1	-	7.17	908	13	36.8	3.87	0
First Purge Volume	10	1	2.6	7.16	902	13	37.5	3.95	0
Second Purge Volume	15	1	2.6	7.22	1338	12.2	19.6	2.09	14.1
Third Purge Volume	20	1	2.6	7.16	1296	12.2	19.6	2.1	15.3
Stable Reading	25	1	-	7.11	1128	12.3	21.7	2.31	15.5

Water Description at Start of Purging (Colour, Clarity, Odour)	Silty base	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A03D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	
Date:	21/06/2018		

Borehole Depth:	5	**Pre-Sampling Water Level (m):**	**1.03**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1.03	-	7.04	1322	14.5	15.8	1.52	55
First Purge Volume	10	1.03	2.6	7.02	1333	14.7	12.3	1.22	49.4
Second Purge Volume	15	1.03	2.6	7.01	1371	14.2	5.4	0.54	17.1
Third Purge Volume	20	1.03	2.6	7.01	1372	14.2	5.3	0.54	16.8
Stable Reading	25	1.03	-	7.01	1371	14	4.6	0.45	12.8

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A04S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	3.14	**Pre-Sampling Water Level (m):**	**1.05**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1.05	-	7.33	1135	10.9	51.5	5.67	193.3
First Purge Volume	15	1.05	2.6	7.07	1006	12.4	54.2	5.73	237.8
Second Purge Volume	20	1.05	2.6	7.15	1073	11.3	52.2	5.7	182.4
Third Purge Volume	25	1.05	2.6	7.22	1026	11.7	60.6	6.55	93.3
Stable Reading	30	1.05	-	7.22	1026	11.7	60.6	6.55	92.1

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Poor recharge, 0.8m dradown. Slow pumping.

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Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A04D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	14.96	**Pre-Sampling Water Level (m):**	**1.095**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1.095	-	7.07	1006	12.4	54.2	5.73	237.8
First Purge Volume	15	1.095	2.6	7.03	999	12.1	49.2	5.28	209
Second Purge Volume	20	1.095	2.6	7.03	988	12	49.3	5.29	181.4
Third Purge Volume	25	1.095	2.6	7.03	988	12	49.2	5.28	181.8
Stable Reading	30	1.095	-	7.04	987	11.9	45.3	4.91	186.5

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Poor recharge, 0.8m dradown. Slow pumping.

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A05S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	2.94	**Pre-Sampling Water Level (m):**	**1.19**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1.19	-	6.98	1708	14.9	45.4	4.44	89.7
First Purge Volume	15	1.19	2.6	6.88	1500	14	10.1	1.03	94
Second Purge Volume	20	1.19	2.6	6.87	1463	14	10.2	1.04	94.6
Third Purge Volume	25	1.19	2.6	6.87	1459	14.1	10.3	1.07	94.6
Stable Reading	30	1.19	-	6.87	1454	14.2	10.2	1.04	94.7

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A05D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	15.02	**Pre-Sampling Water Level (m):**	**1.22**
Standpipe Diameter (mm):	50	**Total Purge Volume (l)** (3 x Single Purge Volume)	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1.22	-	7.48	1953	12	14.5	1.48	67.8
First Purge Volume	15	1.22	2.6	7.48	2063	11.6	7.4	0.8	94.5
Second Purge Volume	20	1.22	2.6	7.42	2029	11.5	10.8	1.57	68.1
Third Purge Volume	25	1.22	2.6	7.4	2025	11.5	11.4	1.23	59.2
Stable Reading	30	1.22	-	7.39	2015	11.6	11.7	1.26	60.8

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

ARCADIS Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A06S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	2.36	**Pre-Sampling Water Level (m):**	**1.3**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start			-						
First Purge Volume	5	1.3	2.6	7.03	128	13.9	29	3	11.6
Second Purge Volume	25	1.3	2.6	7.06	792	13.5	42.3	4.38	9.8
Third Purge Volume	30	1.3	2.6	7.13	940	14.5	51.2	5.12	12.4
Stable Reading			-						

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A06D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	7.06	**Pre-Sampling Water Level (m):**	**1.32**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start			-						
First Purge Volume	5	1.32	2.6	7.1	1814	13.1	7.1	0.75	3.3
Second Purge Volume	25	1.32	2.6	7.08	1869	12	3.7	0.42	8.7
Third Purge Volume	30	1.32	2.6	7.1	1879	12.5	3.7	0.47	12
Stable Reading			-						

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A07S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	2.67	**Pre-Sampling Water Level (m):**	**0.52**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.52	-	6.96	4111	16.2	32.5	3.13	119
First Purge Volume	10	0.52	2.6	6.97	4129	16.1	31.5	3.04	119.7
Second Purge Volume	15	0.52	2.6	6.99	4136	16.2	26.5	2.57	118.9
Third Purge Volume	20	0.52	2.6	7.01	4102	16.2	25.6	2.47	117.4
Stable Reading	25	0.52	-	7.02	4093	16.2	25.4	2.45	116.8

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH2A07D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	10.04	**Pre-Sampling Water Level (m):**	**0.54**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.54	-	6.89	4396	14.6	10.5	1.05	14.6
First Purge Volume	10	0.54	2.6	6.99	4360	14.4	10	1.01	14.6
Second Purge Volume	15	0.54	2.6	6.97	4189	13.4	14.3	1.18	14.5
Third Purge Volume	20	0.54	2.6	6.97	4068	13	17	1.77	14.5
Stable Reading	25	0.54	-	6.97	4043	12.9	16.5	1.71	14.7

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH1003S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	3.64	**Pre-Sampling Water Level (m):**	**0.92**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.92	-	6.95	1074	13.7	5.5	0.57	124.3
First Purge Volume	15	0.92	2.6	6.95	1073	13.7	5.5	0.56	124.1
Second Purge Volume	20	0.92	2.6	6.96	1072	13.7	5.2	0.55	123.8
Third Purge Volume	25	0.92	2.6	6.97	1071	13.8	4.8	0.5	123
Stable Reading	30	0.92	-	6.98	1068	13.8	4.9	0.5	122.4

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH1003D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	8.92	**Pre-Sampling Water Level (m):**	**0.92**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.92	-	6.95	1075	13.6	5.6	0.58	1246
First Purge Volume	15	0.92	2.6	7.07	2327	13.6	6.7	0.68	29.1
Second Purge Volume	20	0.92	2.6	7.06	2308	13.7	6.4	0.65	48.6
Third Purge Volume	25	0.92	2.6	7.07	2313	14	6.1	0.63	50.2
Stable Reading	30	0.92	-	7.06	2308	14	6.2	0.63	75.8

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH1103D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	9.34	**Pre-Sampling Water Level (m):**	**0.54**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.54	-	7.17	710	12	77.2	7.57	21.8
First Purge Volume	10	0.54	2.6	7.16	708	12	498.3	5.95	21.5
Second Purge Volume	15	0.54	2.6	7.18	673	11.9	10.3	1.11	12.6
Third Purge Volume	20	0.54	2.6	7.2	658	11.7	9.1	0.98	4
Stable Reading	25	0.54	-	7.24	657	12.1	7.2	0.77	5.3

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH1108
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	21/06/2018		

Borehole Depth:	5.66	**Pre-Sampling Water Level (m):**	**1.35**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1.35	-	7.06	506	15.2	15.5	1.55	2.1
First Purge Volume	10	1.35	2.6	7.06	506	15.2	15.4	1.54	1.6
Second Purge Volume	15	1.35	2.6	7.08	502	14.8	17.6	1.33	7.7
Third Purge Volume	20	1.35	2.6	7.09	503	14.9	11	1.1	8.1
Stable Reading	25	1.35	-	7.08	503	14.9	10.2	1.04	7.5

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH1205S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	3.84	**Pre-Sampling Water Level (m):**	**0.67**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.67	-	5.37	2223	13.9	12.3	1.25	66
First Purge Volume	10	0.67	2.6	5.36	2227	13.9	11.8	1.13	66
Second Purge Volume	15	0.67	2.6	5.44	2268	13.8	8.9	0.91	58.2
Third Purge Volume	20	0.67	2.6	5.36	2271	13.5	11.2	1.15	56.6
Stable Reading	25	0.67	-	5.32	2273	13.4	13.2	1.37	58.9

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH1205D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	19.77	**Pre-Sampling Water Level (m):**	**0.83**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.83	-	5.93	1953	11.7	10.5	1.09	1.2
First Purge Volume	10	0.83	2.6	5.93	1953	11.7	10.3	1.12	1.2
Second Purge Volume	15	0.83	2.6	5.94	1951	11.6	9.3	1	0
Third Purge Volume	20	0.83	2.6	5.95	1928	11.4	8.9	0.96	0.3
Stable Reading	25	0.83	-	5.97	1903	11.3	9.1	0.99	1.5

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH601S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	3.59	**Pre-Sampling Water Level (m):**	**0.94**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.94	-	6.92	2832	13	54	5.61	44.1
First Purge Volume	10	0.94	2.6	6.88	3127	12.7	32.6	3.38	18.1
Second Purge Volume	15	0.94	2.6	6.84	3448	12.4	14.2	1.5	1.5
Third Purge Volume	20	0.94	2.6	6.84	3527	12.4	11.5	1.22	13.5
Stable Reading	25	0.94	-	6.84	3534	12.3	10.9	1.15	15.8

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH601D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	9.82	**Pre-Sampling Water Level (m):**	**0.92**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	0.92	-	7.18	2418	10.3	33.8	3.62	10.8
First Purge Volume	10	0.92	2.6	7.23	2371	10.9	18.7	1.98	9.6
Second Purge Volume	15	0.92	2.6	7.4	1832	10.8	10.3	1.13	33.9
Third Purge Volume	20	0.92	2.6	7.48	1438	10.6	8.6	0.96	39.5
Stable Reading	25	0.92	-	7.48	1354	10.4	8	0.89	40.9

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH604S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	2.95	**Pre-Sampling Water Level (m):**	**1.1**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8
Single Purge Volume (l):	2.6		

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	5	1.1	-	7.12	2500	15.8	15.3	1.46	3.2
First Purge Volume	10	1.1	2.6	7.12	2489	15.8	14.4	1.4	2.9
Second Purge Volume	15	1.1	2.6	7.12	2482	15.7	14.2	1.33	2.6
Third Purge Volume	20	1.1	2.6	7.1	2301	15.7	10.1	0.99	14.8
Stable Reading	25	1.1	-	7.09	2278	15.8	10	0.97	12.4

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH604D
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	7.8	**Pre-Sampling Water Level (m):**		
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	8	
Single Purge Volume (l):				

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start									
First Purge Volume	10			7.62	1934	11.4	11	1.17	14
Second Purge Volume	15			7.72	1915	11.2	8.2	0.9	37.4
Third Purge Volume	20			7.77	2010	12	27.2	2.96	28.9
Stable Reading									

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Well going dry, sampling. Depth to water unknown, well to small to dip.

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH606S
Project No:	10018973	**Sample Ref:**	EW6
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	2.08	**Pre-Sampling Water Level (m):**	**1.41**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l)** (3 x Single Purge Volume)	8	
Single Purge Volume (l):	2.6			

Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start			-						
First Purge Volume	15	1.41	2.6	7.09	735	16.5	15.4	1.53	15.1
Second Purge Volume	20	1.41	2.6	7.09	736	16.4	15.6	1.5	15.6
Third Purge Volume	25	1.41	2.6	7.1	733	16.5	15	1.48	9.8
Stable Reading	30	1.41	-	7.09	731	16.5	14.9	1.48	9.8

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

Water Sampling (Low Flow)

Project:	Northstowe - Parcel 2A	**Position No:**	BH606D
Project No:	10018973	**Sample Ref:**	EW3.5
Engineer:	RD	**Weather:**	Warm
Date:	22/06/2018		

Borehole Depth:	4.99	**Pre-Sampling Water Level (m):**	**1.29**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l)** (3 x Single Purge Volume)	8	
Single Purge Volume (l):	2.6			

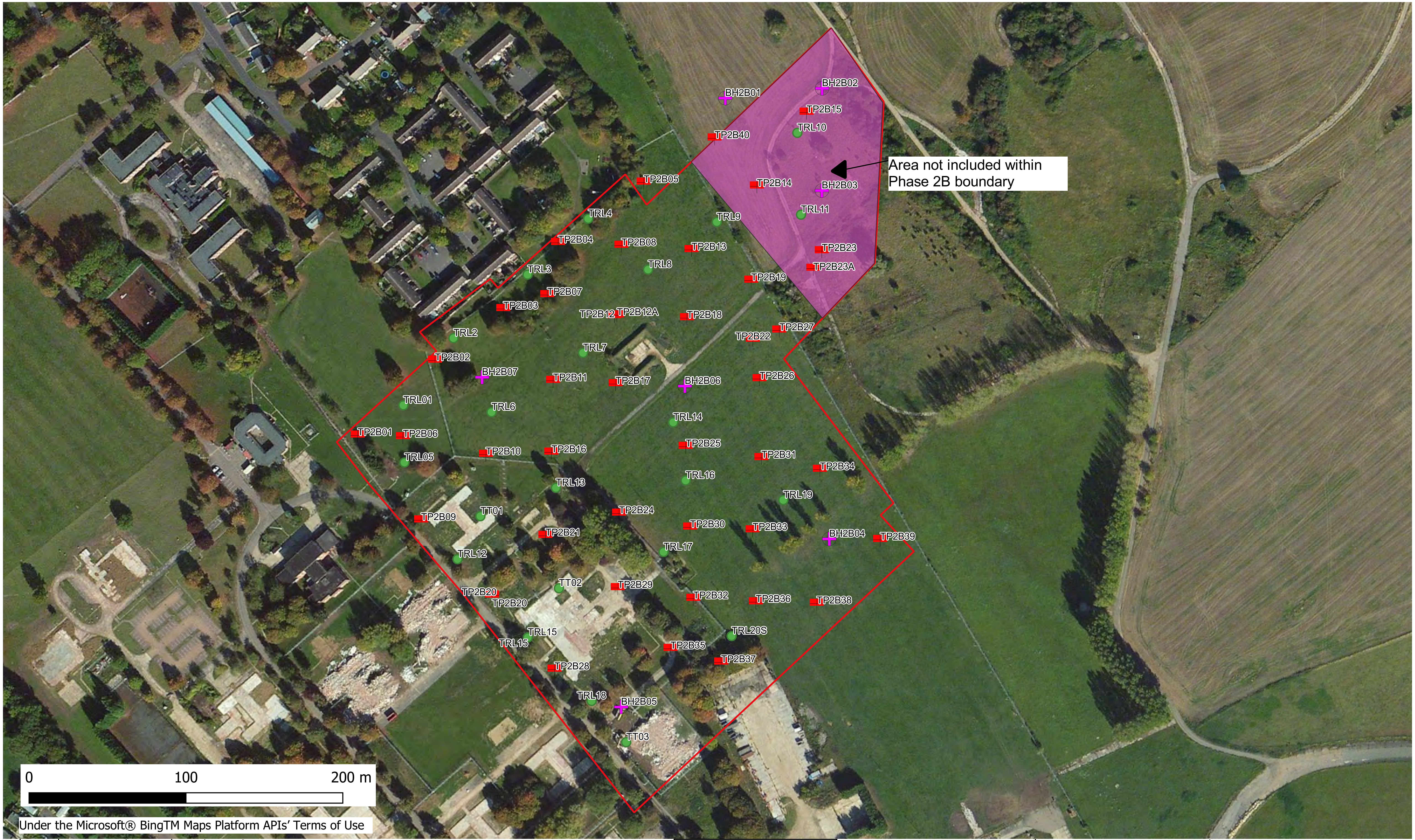
Operations	Time (min)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start			-						
First Purge Volume	15	1.29	2.6	6.95	1514	12.2	7.4	0.78	82.4
Second Purge Volume	20	1.29	2.6	6.95	1517	12.2	7.9	0.84	79.5
Third Purge Volume	25	1.29	2.6	6.96	1506	12.4	5.6	0.59	86.7
Stable Reading	30	1.29	-	6.96	1504	12.4	5.5	0.59	86.1

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear	**Water Description During/After Purging (Colour, Clarity, Odour)**	Clear

Comments:

APPENDIX B

Phase 2B Information



N

REV	Date	Description	Drawn	Check	Approved
1	19-11-2019	Groundwater Location Plan	[redacted]	[redacted]	[redacted]

Legand

Arcadis 2019

- Cable Percussive Boreholes
- Trial Pit
- TRL Probe
- 2B Red Line Boundary

Issued for Information			
Design	[redacted]	19-11-2019	
Drawn	[redacted]	19-11-2019	
Checked	[redacted]	19-11-2019	
Approved	[redacted]	19-11-2019	
Scale	1:2200	Datum:	AOD
Original Size	A3	Grid:	OS
Suitability Code:		Project Number	10018973

Client:

Homes England

Homes England

Northstowe Phase 2B

Head Office
7 Blue Lion Place
237 Long Lane
London SE1 4PU

PROJECT:

Northstowe Phase 2B

TITLE:

Exploratory Hole Location Plan

ARCADIS Design & Consultancy for natural and built assets

Registered office:

Arcadis House
34 York Way,
London
N1 9AB

Co-Ordinating office:

1st Floor, 2 Glass Wharf,
Temple Quay, Bristol
BS2 0FR

Drawing Number: 10018973-ARC-XX-XX-DR-ZZ-0001-P1-EXPLORATORY HOLE LOCATION PLAN

ARCADIS Percussive Borehole Log — BH2B01

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.46**	**15/08/2019**	**1:50**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	**540864.93**	**266749.16**	**15/08/2019**	**Sheet 1 of 2**

Samples / Tests / Progress

Sample Depth	Sample Type/No.	Test Depth	Test Type/No.	Results	Water Strikes	Date Time	Casing / Water
0.10	D1					15/08/2019 08:00	0.00 Dry
0.30	D2						
0.50	D3						
0.50 - 0.70	ES31						
1.00	D4						
1.00 - 1.20	ES32						
1.50 - 1.80	D6	1.50	SPT(S)	N=21 (2,4/5,7,6,3)			1.50 Dry
1.50 - 1.80	ES33						
1.50 - 1.95	D5						
2.00 - 2.50	B7						
2.50	U8			Ublow=15			
2.50 - 2.95	ES34						
2.50 - 2.95	UT8						
2.95 - 3.00	D9						
3.50 - 3.95	D10	3.50	SPT(S)	N=8 (1,2/2,2,2,2)			2.50 Dry
4.00	D11				▼		
4.50	UTNR			Ublow=30			
4.50 - 5.00	B12						
4.50 - 5.00	D13						
6.00	D14	6.00	SPT(S)	N=18 (2,3/3,4,5,6)			2.50 Dry
6.00 - 6.45	D15						
7.00	B16						
7.10 - 7.50	D17						
7.50 - 7.95	D18	7.50	SPT(S)	N=30 (8,9/13,8,5,4)			2.50 Damp
9.00 - 9.45	D20			Ublow=31			
9.00 - 9.45	UT19						
9.45 - 9.50	D21						

Strata

Description	Depth (Thickness)	Level
REWORKED NATURAL: Firm dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium, angular to subrounded of flint, chert and rare brick fragments.	0.90 (0.90)	8.56
Medium dense light orangish brown slightly clayey sandy GRAVEL. Gravel is fine to coarse, subangular to subrouned of flint and chert. [RIVER TERRACE DEPOSITS]	1.90 (1.00)	7.56
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY] Becoming soft	4.10 (2.20)	5.36
SILTSTONE [KIMMERIDGE CLAY]	4.20	5.26
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	4.60 (0.40)	4.86
SILTSTONE [KIMMERIDGE CLAY]	5.30 (0.70)	4.16
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	7.10 (1.80)	2.36
SILTSTONE [KIMMERIDGE CLAY]	7.70 (0.60)	1.76
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]		

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.50	Cable Percussion

Chiselling

Hard Strata From	Hard Strata To	Duration

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
15/08/2019 11:30	4.10	20	4.10	2.50	

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
200	4.00	200	2.50
150	15.50		

Water Added

From	To	Volume (ltr)

Remarks
Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

AGS

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**LC**	**SH**

ARCADIS Percussive Borehole Log

BH2B01

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.46**	**15/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540864.93**	**266749.16**	**15/08/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]				
10.50	D22	10.50	SPT(S)	N=20 (2,3/4,5,5,6)			2.50 Damp					
10.50 - 10.95	D23											
12.00 - 12.45	UT24			Ublow=34								
12.45 - 12.50	D25											
										(7.80)		
13.50	D26	13.50	SPT(S)	N=24 (2,3/5,6,6,7)			2.50 Damp					
13.50 - 13.95	D27											
14.50	D28											
15.00 - 15.45	UT29			Ublow=39								
15.45 - 15.50	D30					15/08/2019 17:00	2.50 4.00			15.50	-6.04	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit				15/08/2019 11:30	4.10	20	4.10	2.50		200	4.00	200	2.50			
1.20	15.50	Cable Percussion										150	15.50					

Remarks
Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

ARCADIS Percussive Borehole Log

BH2B02

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.31**	**16/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540926.63**	**266755.40**	**16/08/2019**	**Sheet 1 of 2**

Samples

Depth	Type/No.
0.00 - 0.20	ES2
0.10	D1
0.30	D3
0.50	D4
0.50 - 0.70	ES5
1.00	D6
1.00 - 1.20	ES7
1.20 - 1.65	D8
1.20 - 1.70	B9
1.20 - 1.70	ES10
2.00	D11
2.20 - 2.40	ES12
2.20 - 2.65	D13
2.50 - 3.00	B14
3.20 - 3.65	UT15
3.65 - 3.70	D16
4.00	D17
4.00 - 4.20	ES18
4.20 - 4.65	D19
5.00	D20
6.00	D21
6.00 - 6.45	D22
7.00	D23
7.50 - 7.95	D24
8.50	D25
9.00 - 9.45	UT26
9.45 - 9.50	D27

Tests

Depth	Type/No.	Results
1.20	SPT(S)	N=33 (1,4/6,9,9,9)
2.20	SPT(S)	N=9 (1,1/1,2,3,3)
		Ublow=16 (3.20 - 3.65)
4.20	SPT(S)	N=14 (2,2/3,3,4,4)
6.00	SPT(S)	N=25 (4,4/5,6,7,7)
7.50	SPT(S)	N=26 (4,5/6,6,7,7)
		Ublow=28 (9.00 - 9.45)

Water strike at approx. 4.00 m.

Progress

Date Time	Casing	Water
16/08/2019 08:00	0.00	Dry
	1.20	Dry
	2.20	Dry
	2.50	Dry
	2.50	Damp
	2.50	Damp

Strata

Description	Depth (Thickness)	Level
REWORKED NATURAL: Soft to firm dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse, subangular to subrounded of flint and chert.	0.50 (0.50)	8.81
REWORKED NATURAL: Light orangish brown slightly gravelly, clayey SAND. Gravel is fine and medium, subangular to subrounded of flint and chert.	1.20 (0.70)	8.11
Medium dense light orangish brown slightly clayey, gravelly SAND. Gravel is fine to coarse, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	2.20 (1.00)	7.11
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY] Becoming loose.	4.10 (1.90)	5.21
SILTSTONE [KIMMERIDGE CLAY]	4.30 (0.20)	5.01
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	5.80 (1.50)	3.51
SILTSTONE [KIMMERIDGE CLAY]	6.10 (0.30)	3.21
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	7.10 (1.00)	2.21
SILTSTONE [KIMMERIDGE CLAY]	7.70 (0.60)	1.61
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]		

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.50	Cable Percussion

Chiselling

Hard Strata From	Hard Strata To	Duration

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
16/08/2019 11:00	4.10	20	4.10	2.50	

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
200	5.00	200	2.50
150	15.50		

Water Added

From	To	Volume (ltr)

Remarks

Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

Percussive Borehole Log — BH2B02

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.31**	**16/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540926.63**	**266755.40**	**16/08/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]				
10.50	D28	10.50	SPT(S)	N=19 (2,3/4,4,5,6)			2.50 Damp					
10.50 - 10.95	D29											
11.50	D30											
12.00 - 12.45	UT31			Ublow=31								
12.45 - 12.50	D32											
										(7.80)		
13.50	D33	13.50	SPT(S)	N=26 (4,5/6,6,7,7)			2.50 Damp					
13.50 - 13.95	D34											
14.50	D35											
15.00 - 15.45	UT36			Ublow=33								
15.45 - 15.50	D37					16/08/2019 15:00	2.50 4.00			15.50	-6.19	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit				16/08/2019 11:00	4.10	20	4.10	2.50		200	5.00	200	2.50			
1.20	15.50	Cable Percussion										150	15.50					

Remarks
Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**LC**	**SH**

ARCADIS Percussive Borehole Log — BH2B03

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.92**	**14/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540926.45**	**266690.24**	**14/08/2019**	**Sheet 1 of 2**

Samples Depth	Samples Type/No.	Tests Depth	Tests Type/No.	Results	Water Strikes	Date Time	Casing Water	Strata Description	Depth (Thickness)	Level
0.10	D1					14/08/2019 08:00	0.00 Dry	REWORKED NATURAL: Dark brown slightly gravelly SAND with occasional rootlets. Gravel is fine to coarse, angular to subrounded of flint, chert. becoming clayey	(1.00)	
0.30	D2									
0.50	D3									
0.50 - 0.70	ES4									
1.00	D5								1.00	8.91
1.00 - 1.20	ES6							Medium dense light orangish brown mottled dark brown slightly clayey SAND and GRAVEL. Gravel is fine to coarse, subangulara to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]		
1.20 - 1.65	D7	1.20	SPT(S)	N=23 (1,3/5,5,6,7)			1.20 Dry			
1.40 - 1.70	B8								(0.80)	
1.80 - 2.00	B9								1.80	8.12
2.00 - 2.20	ES10							Firm to stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]		
2.20 - 2.65	D11	2.20	SPT(S)	N=10 (1,2/2,2,3,3)			2.20 Dry			
3.00	D12									
3.20	U13			Ublow=16						
3.20 - 3.65	UT13									
3.70 - 4.00	ES14									
4.00	D15								(4.20)	
4.20 - 4.65	D16	4.20	SPT(S)	N=13 (2,2/3,3,3,4)			2.50 Dry			
5.00	D17									
6.00	D18			Ublow=36				SILTSTONE [KIMMERIDGE CLAY]	6.00 (0.20)	3.92
6.00 - 6.50	UT19							Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	6.20	3.72
7.00	D20									
7.50 - 7.95	D21	7.50	SPT(S)	N=21 (4,4/4,5,6,6)			2.50 Dry			
8.00	D22									
9.00	D23			Ublow=21						
9.00 - 9.45	UT24									
9.45 - 9.50	D25									

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.50	Cable Percussion

Chiselling

Hard Strata From	Hard Strata To	Duration

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
200	4.00	200	2.50
150	15.50		

Water Added

From	To	Volume (ltr)

Remarks
Borehole terminated at scheduled depth. Slight Seepage noted at 15.00m. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

AGS — Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**LC**	**SH**

ARCADIS Percussive Borehole Log

BH2B03

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.92**	**14/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540926.45**	**266690.24**	**14/08/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]				
10.50	D26	10.50	SPT(S)	N=21 (2,3/4,5,6,6)			2.50 Dry	Rare shelly fragments				
10.50 - 10.95	D27											
11.50	D28											
12.00 - 12.45	UT29			Ublow=29								
12.45 - 12.50	D30									(9.30)		
13.50	D31	13.50	SPT(S)	N=24 (2,3/5,6,6,7)			2.50 Dry					
13.50 - 13.95	D32											
14.50	D33											
15.00 - 15.45	UT34			Ublow=34								
15.45 - 15.50	D35					14/08/2019 17:00	2.50 Damp			15.50	-5.58	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit										200	4.00	200	2.50			
1.20	15.50	Cable Percussion										150	15.50					

Remarks
Borehole terminated at scheduled depth. Slight Seepage noted at 15.00m. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

ARCADIS Percussive Borehole Log

BH2B04

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**8.27**	**13/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540931.21**	**266468.18**	**14/08/2019**	**Sheet 1 of 2**

Samples Depth	Samples Type/No.	Tests Depth	Tests Type/No.	Results	Water Strikes	Progress Date Time	Casing / Water	Strata Description	Depth (Thickness)	Level
0.10	D1					13/08/2019 15:00	0.00 Dry	MADE GROUND: Dark orangish brown slightly gravelly SAND. Gravel is fine to coarse	(0.30)	
0.30	D2								0.30	7.97
0.50	D3							Light orangish brown very gravelly SAND. Gravel is fine to coarse, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	(0.70)	
0.50 - 0.80	ES28									
1.00	D4								1.00	7.27
1.50 - 1.95	B5	1.50	SPT(C)	N=27 (2,4/6,6,7,8)			1.50 1.2	Light brown sandy GRAVEL. Gravel is fine to coarse, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	(1.25)	
1.50 - 1.95	ES29									
2.25	D6								2.25	6.02
2.50 - 2.95	B7	2.50	SPT(S)	N>50 (2,4/7,10,14,19 for 70mm)			2.50 2	Light orangish brown sandy GRAVEL. Gravel is fine and medium, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	(1.85)	
2.50 - 2.95	ES30									
3.25	D8									
3.50 - 3.95	B9	3.50	SPT(C)	N=32 (2,4/7,7,9,9)	▼		3.50 2.9			
3.50 - 3.95	ES31				▽				4.10	4.17
4.25	D10							Firm light brownish grey CLAY. [KIMMERIDGE CLAY]	(0.50)	
4.50	D11	4.50	SPT(S)	N=13 (1,2/2,3,4,4)			4.50 4		4.60	3.67
5.50	D12					13/08/2019 17:00 14/08/2019 08:00	4.50 4.00 4.50 4.00	Stiff to very stiff light grey SILT. [KIMMERIDGE CLAY]	(4.50)	
6.00 - 6.45	D13	6.00	SPT(S)	N=19 (1,2/4,4,5,6)			6.00 5			
7.00	D14									
7.50 - 7.95	D15	7.50	SPT(S)	N=19 (2,2/3,4,6,6)			7.50 6.8			
8.50	D16									
9.00 - 9.45	D17	9.00	SPT(S)	N=39 (1,7/10,12,7,10)			8.40 9		9.10	-0.83
10.00	D18							Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	(2.00)	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.45	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration
11.10	11.30	00:45

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
13/08/2019 15:00	4.10	20	3.60	4.00	

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
200	7.00	200	7.00
150	15.45	150	10.00

WATER ADDED

From	To	Volume (ltr)

Remarks

Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.45m

AGS

Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

Unless otherwise stated: Depth (mm), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**LC**	**SH**

Percussive Borehole Log — BH2B04

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**8.27**	**13/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540931.21**	**266468.18**	**14/08/2019**	**Sheet 2 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Depth (Thickness)	Level
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]		
10.50 - 10.95	UT19			Ublow=59						
10.95 - 11.00	D20									
								SILTSTONE [KIMMERIDGE CLAY]	11.10 (0.20)	-2.83
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	11.30	-3.03
11.50	D21									
12.00 - 12.45	D22	12.00	SPT(S)	N=29 (3,5/7,7,8,7)			2.50 10.00			
13.00	D23									
13.50 - 13.95	UT24			Ublow=39					(4.15)	
13.95 - 14.00	D25									
14.50	D26									
15.00 - 15.45	D27	15.00	SPT(S)	N=28 (4,4/7,6,7,8)			14.60 10.00			
						14/08/2019 14:00	14.60 10.00		15.45	-7.18

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.45	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration
11.10	11.30	00:45

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
13/08/2019 15:00	4.10	20	3.60	4.00	

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
200	7.00	200	7.00
150	15.45	150	10.00

WATER ADDED

From	To	Volume (ltr)

Remarks

Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.45m

Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**LC**	**SH**

Percussive Borehole Log — BH2B05

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.02**	**15/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540798.55**	**266361.06**	**15/08/2019**	**Sheet 1 of 2**

Samples Depth	Type/No.	Tests Depth	Type/No.	Results	Water Strikes	Date Time	Casing Water	Description	Depth (Thickness)	Level
0.10	D1					15/08/2019 08:00	0.00 Dry	MADE GROUND: Dark orangish brown slightly gravelly SAND. Gravel is fine to coarse		
0.30	D2									
0.50	D3									
0.50 - 0.70	ES29								(1.00)	
1.00	D4							Light orangish brown slightly gravelly SAND. Gravel is fine to coarse, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	1.00 (0.50)	8.02
1.50 - 1.70	ES30	1.50	SPT(C)	N=21 (3,3/4,5,5,7)			1.50 1	Multicoloured sandy GRAVEL. Gravel is fine to coarse, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS] Blowing sands.	1.50	7.52
1.50 - 1.95	B5									
2.25	D6									
2.50 - 2.95	B7	2.50	SPT(C)	N=22 (4,4/5,5,6,6)			2.50 2.1		(2.00)	
3.25	D8									
3.50 - 3.70	ES31	3.50	SPT(C)	N=11 (1,2/2,3,3,3)			3.50 1.1	Multicoloured very sandy GRAVEL. Gravel is fine to coarse, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	3.50	5.52
3.50 - 3.95	B9									
4.25	D10									
4.50 - 4.70	ES32	4.50	SPT(C)	N=13 (1,1/2,3,4,4)			4.50 2			
4.50 - 4.95	B11									
5.50	D12								(3.70)	
6.00 - 6.45	B13	6.00	SPT(C)	N=17 (2,3/4,5,4,4)			6.00 2			
7.20	D14							Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]	7.20	1.82
7.20 - 7.50	ES33									
7.50 - 7.95	D15	7.50	SPT(S)	N=14 (1,2/3,3,4,4)			7.50 7			
8.50	D16									
9.00 - 9.45	UT17			Ublow=25						
9.45 - 9.50	D18									
10.00	D19									

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.50	Cable Percussion

Chiselling

Hard Strata From	To	Duration

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
200	4.50	200	5.00
200	5.00	150	7.50

Water Added

From	To	Volume (ltr)

Remarks

Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

AGS — Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**LC**	**SH**

Percussive Borehole Log — BH2B05

ARCADIS

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.02**	**15/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540798.55**	**266361.06**	**15/08/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]				
10.50 - 10.95	D20	10.50	SPT(S)	N=24 (2,2/4,6,6,8)			7.50 7					
11.50	D21											
12.00 - 12.45	UT22			Ublow=27								
12.45 - 12.50	D23									(8.30)		
13.00	D24											
13.50 - 13.95	D25											
14.50	D26											
15.00 - 15.45	UT27			Ublow=29								
15.45 - 15.50	D28					15/08/2019 17:00	6.00 7.00			15.50	-6.48	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.50	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
200	4.50	200	5.00
200	5.00	150	7.50

WATER ADDED

From	To	Volume (ltr)

Remarks

Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

AGS — Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**LC**	**SH**

ARCADIS Percussive Borehole Log — BH2B06

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.14**	**11/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540839.16**	**266565.59**	**12/08/2019**	**Sheet 1 of 2**

SAMPLES Depth	Type/ No.	TESTS Depth	Type/ No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Depth (Thickness)	Level
0.10	D1					12/08/2019 08:00	0.00 Dry	Medium dense yellowish brown gravelly SAND. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of flint. [RIVER TERRACE DEPOSITS]		
0.20 - 0.30	ES31	0.20	PID	<1ppm						
0.30	D2									
0.50	D3									
0.80 - 1.00	ES32	0.80	PID	<1ppm						
1.00	D4							Siltstone cobble recovered as light grey subangular fone to coarse GRAVEL	(2.20)	
1.50 - 1.80	ES33	1.50	SPT(C)	N=28 (4,6/6,6,8,8)			0.00			
1.50 - 1.95	B5	1.50	PID	<1ppm			DRY			
2.20 - 2.50	ES34	2.20	PID	<1ppm					2.20	6.94
2.25	D6							Firm to stiff light grey laminated orangish brown silty sandy CLAY. Sand is fine to coarse [KIMMERIDGE CLAY]	(0.50)	
2.50 - 2.95	D7	2.50	SPT(S)	N=8 (3,2/1,2,2,3)			2.50 2			
2.70 - 3.00	ES35	2.70	PID	<1ppm					2.70	6.44
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]		
3.25	D8									
3.50	U9			Ublow=13						
3.50 - 3.95	UT9									
4.00	D10									
4.25	D11									
4.50 - 4.95	D12	4.50	SPT(S)	N=21 (2,2/4,5,6,6)			3.20 DRY			
5.50	D13									
6.00 - 6.45	UT14			Ublow=21						
6.50	D15							Occasional ouser and bivalve shell fragments.	(12.80)	
7.00	D16							Light grey silt noted on fissure surfaces		
7.50	D17	7.50	SPT(S)	N=20 (2,2/4,5,5,6)			3.20 DRY			
8.50	D18									
9.00 - 9.45	UT19			Ublow=21						
9.50	D20									
10.00	D21									

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.50	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
12/08/2019 00:00	11.00	20	11.00	3.20	

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
200	6.50	200	3.20
150	15.50		

WATER ADDED

From	To	Volume (ltr)

Remarks

Slight seepage at 2.00m. Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

Arcadis Consulting (UK) Ltd. 10 Medawar Road, The Surrey Research Park, Guildford GU2 7AR

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 2000	**Arcadis Consulting (UK) Ltd**	**SH**	**RF**

ARCADIS Percussive Borehole Log

BH2B06

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.14**	**11/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540839.16**	**266565.59**	**12/08/2019**	**Sheet 2 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]				
10.50 - 10.95	D22	10.50	SPT(S)	N=24 (2,2/4,4,8,8)			3.20 DRY	Slight polish on fissure surfaces				
					▼							
11.50	D23											
12.00 - 12.45	UT24			Ublow=24								
12.50	D25											
13.00	D26											
13.50 - 13.95	D27	13.50	SPT(S)	N=26 (3,5/5,6,7,8)			3.20 DRY					
14.50	D28											
15.00 - 15.45	UT29			Ublow=37								
15.50	D30					12/08/2019 18:00	3.20 Dry			15.50	-6.36	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00 1.20	1.20 15.50	Inspection Pit Cable Percussion				12/08/2019 00:00	11.00	20	11.00	3.20		200 150	6.50 15.50	200	3.20			

Remarks

Slight seepage at 2.00m. Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

ARCADIS Percussive Borehole Log

BH2B07

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.02**	**12/08/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**540709.92**	**266571.24**	**13/08/2019**	**Sheet 1 of 2**

Samples and Tests

Sample Depth	Type/No.	Test Depth	Type/No.	Results
0.10	D1			
0.10 - 0.50	ES31			
0.30	D2			
0.50	D3			
0.80 - 1.00	ES32			
1.00	D4			
1.50 - 1.95	D5	1.50	SPT(S)	N=46 (3,5/9,11,12,14)
1.50 - 2.00	ES33			
2.25	D6			
2.50 - 2.95	B7	2.50	SPT(C)	N=40 (3,2/3,10,18,9)
3.00 - 3.50	ES34			
3.25	D8			
3.50 - 3.95	B9	3.50	SPT(C)	N=38 (3,9/9,8,11,10)
4.25	D10			
4.40	D11			
4.50 - 4.95	D12	4.50	SPT(S)	N=14 (2,1/2,3,4,5)
4.50 - 5.00	B13			
5.00 - 5.50	ES35			
5.50	D14			
6.00 - 6.45	D15	6.00	SPT(S)	N=24 (2,2/5,6,7,6)
7.00	D16			
7.50 - 7.95	B17	7.50	SPT(C)	N=23 (1,3/5,5,6,7)
8.00 - 8.50	B18			
8.00 - 8.50	ES36			
9.00 - 9.45	UT19			Ublow=19
9.45 - 9.50	D20			

Water strikes: at about 1.70 m (▼) and 4.40 m (▽).

Progress

Date Time	Casing	Water
12/08/2019 08:00	0.00	Dry
	1.50	Dry
	2.50	1.8
	3.50	2.7
	4.50	2.8
	6.00	3.1
	7.00	2.6
12/08/2019 18:00	7.50	2.30
13/08/2019 08:00	7.50	3.10

Strata

Description	Depth (Thickness)	Level
Grass over dark brown clayey SAND with frequent rootlets. [TOPSOIL]	0.10	8.92
Dark brown slightly clayey slightly gravelly SAND with occasional rootlets. [RIVER TERRACE DEPOSITS]	(0.40) 0.50	8.52
Dense yellowish brown gravelly SAND. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of flint. [RIVER TERRACE DEPOSITS]	(2.30) 2.80	6.22
Firm grey silty CLAY band. [KIMMERIDGE CLAY]	(0.20) 3.00	6.02
Light orangish brown sandy GRAVEL. Gravel is fine to medium, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	(1.40) 4.40	4.62
Firm brownish grey silty CLAY band. [KIMMERIDGE CLAY]	(0.30) 4.70	4.32
Medium dense yellowish brown sandy GRAVEL with clay pockets. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse of flint. [RIVER TERRACE DEPOSITS]	(2.10) 6.80	2.22
Medium dense light orangish brown slightly sandy GRAVEL. Gravel is fine to coarse, subangular to subrounded of flint and chert. [RIVER TERRACE DEPOSITS]	(0.90) 7.70	1.32
Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]		

Drilling Technique

From	To	Type
0.00	1.20	Inspection Pit
1.20	15.50	Cable Percussion

Chiselling

Hard Strata From	To	Duration

Water Observations

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
12/08/2019 14:00	4.50	20	2.00	4.50	

Hole/Casing Diameter

Hole Dia.	Depth	Casing Dia.	Depth
200	9.50	200	8.20
150	15.50		

Water Added

From	To	Volume (ltr)

Remarks
Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

Percussive Borehole Log

BH2B07

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe - Phase 2B	**10018973**	**9.02**	**12/08/2019**	**1:50**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	**540709.92**	**266571.24**	**13/08/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/ Backfill
								Stiff fissured dark grey CLAY. Fissures are closely to medium spaced, sub horizontal and subvertical, smooth and matt. [KIMMERIDGE CLAY]				
10.50	D21	10.50	SPT(S)	N=24 (2,3/5,6,6,7)			8.20					
10.50 - 10.95	D22						2.3					
11.50	D23											
12.00 - 12.45	UT24			Ublow=31								
12.45 - 12.50	D25											
										(7.80)		
13.50	D26	13.50	SPT(S)	N=26 (1,2/5,7,7,7)			8.20					
13.50 - 13.95	D27						damp					
14.50	D28											
15.00 - 15.45	UT29			Ublow=39								
15.45 - 15.50	D30					13/08/2019 12:00	8.20 2.30			15.50	-6.48	

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit				12/08/2019 14:00	4.50	20	2.00	4.50		200	9.50	200	8.20			
1.20	15.50	Cable Percussion										150	15.50					

Remarks
Borehole terminated at scheduled depth. No visual or olfactory evidence of contamination.

Termination Depth: 15.50m

Project:	Northstowe - Phase 2			Weather:	Sunny
Job Number:	10018973	Date:	27/08/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
BH2B01S	13:00	1014	-	Peak: 1.14	Peak: 0.3	Initial	0.0	-	4.2	13.7	0.0	11.0			-	Dry	2.28	
						30	0.0	-	4.0	12.6	0.0	7.0			-			
						60	0.0	-	4.2	12.2	0.0	7.0			-			
						90	0.0	-	4.4	11.7	0.0	7.0			-			
				Steady: 1.14	Steady: 0.3	120	0.0	-	4.7	11.2	0.0	7.0			-			
						150	0.0	-	4.9	10.7	0.0	6.0			-			
						180	0.0	-	5.2	10.1	0.0	6.0			-			
						210	0.0	-	5.5	9.5	0.0	6.0			-			
						240	0.0	-	5.7	9.2	0.0	6.0			-			
						270	0.0	-	5.8	9.0	0.0	6.0			-			
BH2B01D	-	1014	-	Peak: 11.74	Peak: 0.3	Initial	0.0	-	2.5	15.5	0.0	10.0			-	1.97	5.75	
						30	0.0	-	2.5	15.3	0.0	8.0			-			
						60	0.0	-	2.6	15.0	0.0	7.0			-			
						90	0.0	-	2.7	14.8	0.0	7.0			-			
				Steady: 11.74	Steady: 0.3	120	0.0	-	2.7	14.7	0.0	7.0			-			
						150	0.0	-	2.9	14.3	0.0	7.0			-			
						180	0.0	-	3.1	13.6	0.0	7.0			-			
						210	0.0	-	3.5	12.6	0.0	7.0			-			
						240	0.0	-	3.8	11.7	0.0	7.0			-			
						270	0.0	-	4.0	11.1	0.0	7.0			-			
BH2B02S	-	1014	-	Peak: 1.12	Peak: 0.3	Initial	0.0	-	3.0	14.8	0.0	11.0			-	1.66	2.22	
						30	0.0	-	3.4	12.5	0.0	8.0			-			
						60	0.0	-	3.9	11.2	0.0	8.0			-			
						90	0.0	-	4.1	10.8	0.0	8.0			-			
				Steady: 1.12	Steady: 0.3	120	0.0	-	4.4	10.2	0.0	7.0			-			
						150	0.0	-	4.7	9.5	0.0	8.0			-			
						180	0.0	-	5.0	8.9	0.0	8.0			-			
						210	0.0	-	5.3	2.1	0.0	8.0			-			
						240	0.0	-	5.6	7.2	0.0	7.0			-			
						270	0.0	-	6.0	6.6	0.0	7.0			-			
BH2B02D	-	1015	-	Peak: 1.12	Peak: 0.3	Initial	0.0	-	2.8	14.0	0.0	8.0			-	1.97	6.04	
						30	0.0	-	2.9	13.7	0.0	9.0			-			
						60	0.0	-	2.9	13.5	0.0	9.0			-			
						90	0.0	-	2.9	13.4	0.0	9.0			-			
				Steady: 1.12	Steady: 0.3	120	0.0	-	3.0	13.4	0.0	9.0			-			
						150	0.0	-	3.0	13.1	0.0	8.0			-			
						180	0.0	-	3.4	12.1	0.0	8.0			-			
						210	0.0	-	4.1	10.5	0.0	8.0			-			
						240	0.0	-	4.6	9.5	0.0	8.0			-			
						270	0.0	-	4.7	9.3	0.0	7.0			-			

Notes:

First monitoring visit

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		
PID		
Dip meter/ interface probe		

ARCADIS

Project:	Northstowe - Phase 2			Weather:	Sunny
Job Number:	10018973	Date:	27/08/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 1.05	Peak: 0.3	Initial	0.0	-	2	18.4	0.0	12.0			-			
						30	0.0	-	3.4	16.6	0.0	7.0			-			
						60	0.0	-	3.9	16.2	0.0	7.0			-			
						90	0.0	-	4	16.2	0.0	7.0			-			
BH2B03S	13:50	1012	-	Steady: 1.05	Steady: 0.3	120	0.0	-	4	16.2	0.0	6.0			-	1.60	1.60	
						150	0.0	-	3.9	16.4	0.0	6.0			-			
						180	0.0	-	3.8	16.5	0.0	6.0			-			
						210	0.0	-	3.7	16.6	0.0	6.0			-			
						240	0.0	-	3.7	16.7	0.0	6.0			-			
						270	0.0	-	3.6	16.8	0.0	6.0			-			
				Peak: 8.92	Peak: 0.3	Initial	0.0	-	0.3	19.9	0.0	9.0			-			
						30	0.0	-	0	21.6	0.0	6.0			-			
						60	0.0	-	0	21.8	0.0	6.0			-			
						90	0.0	-	0	21.8	0.0	6.0			-			
BH2B03D	-	1012	-	Steady: 8.92	Steady: 0.3	120	0.0	-	0	21.8	0.0	6.0			-	4.10	6.92	
						150	0.0	-	0	21.9	0.0	5.0			-			
						180	0.0	-	0	21.9	0.0	5.0			-			
						210	0.0	-	0	21.9	0.0	5.0			-			
						240	0.0	-	0	21.9	0.0	6.0			-			
						270	0.0	-	0.0	21.9	0.0	5.0			-			
				Peak: 1.41	Peak: 0.3	Initial	0.0	-	0.7	20.1	0.0	8.0			-			
						30	0.0	-	0.7	19.8	0.0	6.0			-			
						60	0.0	-	0.7	19.8	0.0	6.0			-			
						90	0.0	-	0.7	19.8	1.0	6.0			-			
BH2B04S	-	1015	-	Steady: 1.41	Steady: 0.3	120	0.0	-	0.7	19.8	1.0	6.0			-	2.01	3.70	
						150	0.0	-	0.7	19.9	1.0	6.0			-			
						180	0.0	-	0.7	19.9	1.0	6.0			-			
						210	0.0	-	0.7	19.9	1.0	6.0			-			
						240	0.0	-	0.7	19.9	1.0	6.0			-			
						270	0.0	-	0.7	19.9	1.0	6.0			-			
				Peak: 1.31	Peak: 0.3	Initial	0.0	-	0.0	20.8	1.0	10.0			-			
						30	0.0	-	0.0	20.9	1.0	7.0			-			
						60	0.0	-	0.0	20.9	1.0	7.0			-			
						90	0.0	-	0.0	20.9	1.0	7.0			-			
BH2B04D	-	1015	-	Steady: 1.31	Steady: 0.3	120	0.0	-	0.0	20.9	1.0	7.0			-	2.02	10.14	
						150	0.0	-	0.0	20.9	1.0	7.0			-			
						180	0.0	-	0.0	20.9	1.0	7.0			-			
						210	0.0	-	0.0	20.9	1.0	7.0			-			
						240	0.0	-	0.0	20.9	1.0	7.0			-			
						270	0.0	-	0.0	20.9	1.0	7.0			-			
				Peak: N/A	Peak: N/A	Initial	0.1	-	1.8	20.0	1.0	2.0			-			
						30	0.1	-	2.1	18.9	1.0	3.0			-			

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
						60	0.1	-	2.3	18.7	1.0	3.0			-			
						90	0.1	-	2.3	18.7	1.0	3.0			-			
BH2B05S	09:20	1012	-	Steady: N/A	Steady: N/A	120	0.1	-	2.3	18.7	1.0	2.0			-	2.76	3.03	
						150	0.1	-	2.3	18.6	1.0	2.0			-			
						180	0.1	-	2.3	18.6	1.0	2.0			-			
						210	0.1	-	2.4	18.6	1.0	2.0			-			
						240	0.1	-	2.4	18.6	1.0	2.0			-			
						270	0.1	-	2.4	18.6	1.0	2.0			-			

Notes:

First monitoring visit: Phase 2 Boreholes

Previous weather conditions, Atmospheric pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

ARCADIS

Project:	Northstowe - Phase 2			Weather:	Sunny
Job Number:	10018973	Date:	27/08/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: N/A	Peak: N/A	Initial	0.1	-	0.2	19.7	1.0	3.0			-			
						30	0.1	-	0.2	20	1.0	2.0			-			
						60	0.1	-	0.1	20.1	1.0	2.0			-			
						90	0.1	-	0.1	20.1	1.0	2.0			-			
BH2B05D	10:00	1014	-	Steady: N/A	Steady: N/A	120	0.1	-	0.1	20.1	1.0	2.0			-	2.74	10.84	
						150	0.1	-	0.1	20.2	1.0	2.0			-			
						180	0.1	-	0.1	20.2	1.0	2.0			-			
						210	0.1	-	0.1	20.2	1.0	2.0			-			
						240	0.1	-	0.1	20.2	1.0	2.0			-			
						270	0.1	-	0.1	20.2	1.0	2.0			-			
				Peak: N/A	Peak: N/A	Initial	0.0	-	0.2	20.6	1.0	6.0			-			
						30	0.0	-	0.3	20.6	1.0	4.0			-			
						60	0.0	-	0.3	20.6	1.0	4.0			-			
						90	0.0	-	0.4	20.6	1.0	4.0			-			
BH2B06S	-	1014	-	Steady: N/A	Steady: N/A	120	0.0	-	0.4	20.6	1.0	4.0			-	2.02	2.18	
						150	0.0	-	0.4	20.6	1.0	4.0			-			
						180	0.0	-	0.5	20.5	1.0	4.0			-			
						210	0.0	-	0.5	20.5	1.0	4.0			-			
						240	0.0	-	0.5	20.5	1.0	4.0			-			
						270	0.0	-	0.5	20.5	1.0	4.0			-			
				Peak: N/A	Peak: N/A	Initial	0.0	-	0.0	20.2	1.0	8.0			-			
						30	0.0	-	0.0	20.3	1.0	6.0			-			
						60	0.0	-	0.0	20.4	1.0	6.0			-			
						90	0.0	-	0.0	20.4	1.0	6.0			-			
BH2B06D	-	1014	-	Steady: N/A	Steady: N/A	120	0.0	-	0.0	20.4	1.0	6.0			-	1.07	15.69	
						150	0.0	-	0.0	20.4	1.0	6.0			-			
						180	0.0	-	0.0	20.4	1.0	6.0			-			

						210	0.0	-	0.0	19.9	1.0	6.0			-			
						240	0.0	-	0.0	19.9	1.0	6.0			-			
						270	0.0	-	0.0	19.9	1.0	6.0			-			
				Peak: N/A	Peak: N/A	Initial	0.0	-	0.1	20.1	1.0	5.0			-			
						30	0.0	-	0.8	19.1	1.0	3.0			-			
						60	0.0	-	0.8	19.1	1.0	3.0			-			
						90	0.0	-	0.9	19	1.0	3.0			-			
BH2B07S	-	1014	-	Steady: N/A	Steady: N/A	120	0.0	-	0.9	18.9	1.0	3.0			-	1.84	5.47	
						150	0.0	-	0.9	18.9	1.0	3.0			-			
						180	0.0	-	1.0	18.8	1.0	3.0			-			
						210	0.0	-	1.0	18.8	1.0	3.0			-			
						240	0.0	-	1.0	18.8	1.0	3.0			-			
						270	0.0	-	0.9	18.8	1.0	3.0			-			
				Peak: N/A	Peak: N/A	Initial	0.1	-	0.2	19.5	1.0	6.0			-			
						30	0.1	-	0.2	19.8	1.0	4.0			-			
						60	0.1	-	0.1	19.8	1.0	4.0			-			
						90	0.1	-	0.1	19.8	1.0	4.0			-			
BH2B07D	-	1014	-	Steady: N/A	Steady: N/A	120	0.1	-	0.1	19.8	2.0	4.0			-	1.64	15.25	
						150	0.1	-	0.1	19.8	2.0	4.0			-			
						180	0.1	-	0.1	19.8	2.0	5.0			-			
						210	0.1	-	0.1	19.8	2.0	4.0			-			
						240	0.1	-	0.1	19.9	1.0	5.0			-			
						270	0.1	-	0.1	19.9	1.0	5.0			-			

Notes:

First monitoring visit

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Project:	Northstowe - Phase 2			Weather:	Raining / showers
Job Number:	10018973	Date:	04/09/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 0.02	Peak: 0.3	Initial	0.0	-	0.4	21	0.0	4.0			-			
						30	0.0	-	5.2	12.8	0.0	3.0			-			
						60	0.0	-	5.2	12.8	0.0	3.0			-			
						90	0.0	-	5.1	12.9	0.0	3.0			-			
BH2B01S	-	1013	-	Steady: 0.02	Steady: 0.3	120	0.0	-	5.1	13	0.0	3.0			-	Dry	1.83	
						150	0.0	-	5	13.3	0.0	3.0			-			
						180	0.0	-	4.9	13.7	0.0	3.0			-			
						210	0.0	-	4.8	14	0.0	2.0			-			
						240	0.0	-	4.7	14.3	0.0	2.0			-			
						270	0.0	-	4.7	14.5	0.0	2.0			-			
				Peak: 0.02	Peak: 0.3	Initial	0.0	-	0.1	21.9	0.0	3.0			-			
						30	0.0	-	3	16.8	0.0	3.0			-			
						60	0.0	-	3.7	15.7	0.0	3.0			-			
						90	0.0	-	3.9	15.4	0.0	2.0			-			
BH2B01D	-	1013	-	Steady: 0.02	Steady: 0.3	120	0.0	-	4	15.4	0.0	2.0			-	1.97	5.74	
						150	0.0	-	4	15.6	0.0	2.0			-			
						180	0.0	-	3.9	16	0.0	2.0			-			
						210	0.0	-	3.7	16.4	0.0	2.0			-			
						240	0.0	-	3.6	16.9	0.0	2.0			-			
						270	0.0	-	3.4	17.5	0.0	2.0			-			
				Peak: 0.02	Peak: 0.3	Initial	0.0	-	0.2	21.8	0.0	4.0			-			
						30	0.0	-	2.7	16.1	0.0	3.0			-			
						60	0.0	-	3.4	14.7	0.0	3.0			-			
						90	0.0	-	4.1	13.4	0.0	3.0			-			
BH2B02S	-	1013	-	Steady: 0.02	Steady: 0.3	120	0.0	-	4.5	12.4	0.0	3.0			-	1.70	2.24	
						150	0.0	-	5.1	11.3	0.0	3.0			-			
						180	0.0	-	5.4	10.7	0.0	3.0			-			
						210	0.0	-	5.6	10.2	0.0	3.0			-			
						240	0.0	-	5.8	9.8	0.0	3.0			-			
						270	0.0	-	6.0	9.5	0.0	2.0			-			
				Peak: 9.42	Peak: 0.0	Initial	0.0	-	0.2	18.6	0.0	4.0			-			
						30	0.0	-	1.1	19.4	0.0	5.0			-			
						60	0.0	-	1.1	19.4	0.0	5.0			-			
						90	0.0	-	1.1	19.4	0.0	5.0			-			
BH2B02D	-	1013	-	Steady: 9.42	Steady: -1.8 rising to -0.3 after 1min	120	0.0	-	1.1	19.4	0.0	5.0			-	1.95	6.05	
						150	0.0	-	1.1	19.3	0.0	5.0			-			
						180	0.0	-	1.2	19.3	0.0	6.0			-			
						210	0.0	-	1.2	19.2	0.0	5.0			-			
						240	0.0	-	1.6	18.5	0.0	5.0			-			
						270	0.0	-	2.6	16.9	0.0	4.0			-			

Notes:

Second monitoring visit

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		
PID		
Dip meter/ interface probe		

Project:	Northstowe - Phase 2			Weather:	Raining / showers
Job Number:	10018973	Date:	04/09/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: -0.02	Peak: 0.3 rising to	Initial	0.0	-	0.0	21	0.0	4.0			-			
						30	0.0	-	5.0	17.4	0.0	3.0			-			
						60	0.0	-	5.1	17.3	0.0	3.0			-			
						90	0.0	-	5.1	17.3	0.0	3.0			-			
BH2B03S	-	1012	-	Steady: -0.02	Steady: 0.3 rising to 0.4 after 40secs	120	0.0	-	5.1	17.3	0.0	3.0			-	1.60	1.60	
						150	0.0	-	5.1	17.3	0.0	3.0			-			
						180	0.0	-	5.1	17.3	0.0	3.0			-			
						210	0.0	-	5.1	17.4	0.0	3.0			-			
						240	0.0	-	5.1	17.4	0.0	2.0			-			
						270	0.0	-	5.0	17.4	0.0	2.0			-			
				Peak: 14.92	Peak: 0.3	Initial	0.0	-	0.2	22	0.0	3.0			-			
						30	0.0	-	0.4	20.6	0.0	4.0			-			
						60	0.0	-	0.3	21.2	0.0	3.0			-			
						90	0.0	-	0.2	21.5	0.0	3.0			-			
BH2B03D	-	1013	-	Steady: 14.92	Steady: 0.3	120	0.0	-	0.1	21.6	0.0	3.0			-	4.44	6.99	
						150	0.0	-	0.1	21.7	0.0	3.0			-			
						180	0.0	-	0.1	21.7	0.0	3.0			-			
						210	0.0	-	0.1	21.7	0.0	3.0			-			
						240	0.0	-	0.1	21.8	0.0	3.0			-			
						270	0.0	-	0.1	21.8	0.0	3.0			-			
				Peak: -0.05	Peak: 0.2 rising to	Initial	0.0	-	0.9	20.5	0.0	3.0			-			
						30	0.0	-	0.9	20.4	0.0	3.0			-			
						60	0.0	-	0.9	20.4	0.0	3.0			-			
						90	0.0	-	0.9	20.4	1.0	3.0			-			
BH2B04S	-	1012	-	Steady: -0.05	Steady: 0.2 rising to 0.3 after 10secs	120	0.0	-	0.9	20.4	1.0	3.0			-	2.02	3.68	
						150	0.0	-	0.9	20.4	1.0	3.0			-			
						180	0.0	-	0.9	20.4	1.0	3.0			-			
						210	0.0	-	0.9	20.4	1.0	3.0			-			
						240	0.0	-	1.0	20.4	1.0	3.0			-			
						270	0.0	-	1.0	20.4	1.0	3.0			-			
				Peak: 0.07	Peak: 0.3	Initial	0.0	-	0.2	21.0	0.0	4.0			-			
						30	0.0	-	0.1	21.2	0.0	3.0			-			
						60	0.0	-	0.1	21.2	0.0	3.0			-			
						90	0.0	-	0.1	21.2	0.0	3.0			-			
BH2B04D	-	1012	-	Steady: 0.07	Steady: 0.3	120	0.0	-	0.1	21.3	0.0	3.0			-	2.57	8.32	
						150	0.0	-	0.0	21.3	0.0	3.0			-			
						180	0.0	-	0.0	21.3	0.0	3.0			-			
						210	0.0	-	0.0	21.3	0.0	3.0			-			
						240	0.0	-	0.0	21.3	0.0	3.0			-			
						270	0.0	-	0.0	21.3	0.0	3.0			-			
				Peak: -0.07	Peak: 0.2 rising to	Initial	0.0	-	1.8	21.0	0.0	3.0			-			
						30	0.0	-	1.9	20.3	0.0	2.0			-			

						60	0.0	-	2.1	20.1	0.0	2.0			-			
						90	0.0	-	2.3	20.0	0.0	2.0			-			
BH2B05S	-	1011	-	Steady: -0.07	Steady: 0.2 rising to 0.3 after 20secs	120	0.0	-	2.4	19.9	0.0	2.0			-	2.76	3.05	
						150	0.0	-	2.5	19.8	0.0	2.0			-			
						180	0.0	-	2.6	19.7	0.0	2.0			-			
						210	0.0	-	2.6	19.7	0.0	2.0			-			
						240	0.0	-	2.6	19.7	0.0	2.0			-			
						270	0.0	-	2.6	19.6	0.0	2.0			-			

Notes:

Second monitoring visit

Previous weather conditions, Atmospheric pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Project:	Northstowe - Phase 2			Weather:	Sunny
Job Number:	10018973	Date:	27/08/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: -0.05	Peak: 0.2 rising to	Initial	0.0	-	0.3	20.6	0.0	3.0			-			
						30	0.0	-	0.2	20.7	1.0	3.0			-			
						60	0.0	-	0.2	20.8	1.0	3.0			-			
						90	0.0	-	0.1	20.7	1.0	3.0			-			
BH2B05D	-	1012	-	Steady: -0.05	Steady: 0.2 rising to 0.3 after 20secs	120	0.0	-	0.1	20.7	1.0	3.0			-	2.74	10.85	
						150	0.0	-	0.1	20.7	1.0	2.0			-			
						180	0.0	-	0.1	20.7	1.0	2.0			-			
						210	0.0	-	0.1	20.7	1.0	2.0			-			
						240	0.0	-	0.1	20.7	1.0	2.0			-			
						270	0.0	-	0.1	20.7	1.0	2.0			-			
				Peak: -0.07	Peak: 0.2 rising to	Initial	0.0	-	0.6	21.3	0.0	2.0			-			
						30	0.0	-	0.6	21.2	0.0	2.0			-			
						60	0.0	-	0.6	21.2	0.0	2.0			-			
						90	0.0	-	0.6	21.2	0.0	2.0			-			
BH2B06S	-	1012	-	Steady: -0.07	Steady: 0.2 rising to 0.3 after 20secs	120	0.0	-	0.6	21.2	0.0	2.0			-	2.03	2.18	
						150	0.0	-	0.7	21.2	0.0	2.0			-			
						180	0.0	-	0.7	21.1	0.0	2.0			-			
						210	0.0	-	0.7	21.1	0.0	2.0			-			
						240	0.0	-	0.7	21.1	0.0	2.0			-			
						270	0.0	-	0.7	21.1	0.0	2.0			-			
				Peak: -0.05	Peak: 0.2 rising to	Initial	0.0	-	0.1	21.1	0.0	5.0			-			
						30	0.0	-	0.1	21.3	0.0	3.0			-			
						60	0.0	-	0.1	21.3	0.0	3.0			-			
						90	0.0	-	0.1	21.3	0.0	3.0			-			
				Steady: -0.05	Steady: 0.2 rising to 0.3 after 15secs	120	0.0	-	0.1	21.3	0.0	3.0			-			
BH2B06D	-	1012	-			150	0.0	-	0.1	21.3	0.0	3.0			-	0.90	15.62	
						180	0.0	-	0.1	21.3	0.0	3.0			-			

						210	0.0	-	0.0	21.3	0.0	3.0			-			
						240	0.0	-	0.0	21.3	0.0	3.0			-			
						270	0.0	-	0.0	21.3	0.0	3.0			-			
				Peak: -0.09	Peak: 0.3	Initial	0.0	-	0.5	20.7	0.0	3.0			-			
						30	0.0	-	0.6	20.6	1.0	2.0			-			
						60	0.0	-	0.6	20.6	1.0	2.0			-			
						90	0.0	-	0.7	20.5	1.0	2.0			-			
BH2B07S	-	1012	-	Steady: -0.09	Steady: 0.3	120	0.0	-	0.7	20.5	1.0	2.0			-	1.89	5.35	
						150	0.0	-	0.8	20.4	1.0	2.0			-			
						180	0.0	-	1.0	20.4	1.0	2.0			-			
						210	0.0	-	1.1	20.3	1.0	2.0			-			
						240	0.0	-	1.2	20.2	1.0	2.0			-			
						270	0.0	-	1.2	20.2	1.0	3.0			-			
				Peak: -0.03	Peak: 0.2	Initial	0.0	-	0.2	21.0	0.0	3.0			-			
						30	0.0	-	0.1	21.1	0.0	3.0			-			
						60	0.0	-	0.1	21.1	0.0	3.0			-			
						90	0.0	-	0.1	21.2	0.0	3.0			-			
BH2B07D	-	1012	-	Steady: -0.03	Steady: 0.2	120	0.0	-	0.1	21.2	0.0	3.0			-	1.83	15.30	
						150	0.0	-	0.1	21.2	0.0	3.0			-			
						180	0.0	-	0.1	21.2	0.0	3.0			-			
						210	0.0	-	0.1	21.2	0.0	3.0			-			
						240	0.0	-	0.1	21.2	0.0	3.0			-			
						270	0.0	-	0.1	21.2	0.0	3.0			-			

Notes:

Second monitoring visit

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

Project:	Northstowe - Phase 2		
Job Number:	10018973	Date:	12/09/2019

Weather:	Fine
Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
BH2B01S	-	1026	-	Peak: 0.00 Steady: 0.00	Peak: 0.3 Steady: 0.3	Initial	0.0	-	0.1	21.6	0.0	5.0			-	1.75	2.24	Dry
						30	0.0	-	3.1	16.1	0.0	4.0			-			
						60	0.0	-	3.2	16	0.0	3.0			-			
						90	0.0	-	3.3	15.9	0.0	3.0			-			
						120	0.0	-	3.3	15.9	0.0	3.0			-			
						150	0.0	-	3.4	15.8	0.0	3.0			-			
						180	0.0	-	3.4	15.7	0.0	3.0			-			
						210	0.0	-	3.5	15.6	0.0	3.0			-			
						240	0.0	-	3.5	15.5	0.0	3.0			-			
						270	0.0	-	3.6	15.3	0.0	3.0			-			
BH2B01D	-	1026	-	Peak: -0.03 Steady: -0.03	Peak: 0.0 Steady: 0.0	Initial	0.0	-	0.1	21.0	0.0	4.0			-	1.94	6.06	Dry
						30	0.0	-	2.3	17.6	0.0	7.0			-			
						60	0.0	-	2.3	17.6	0.0	7.0			-			
						90	0.0	-	2.3	17.5	0.0	7.0			-			
						120	0.0	-	2.3	17.5	0.0	7.0			-			
						150	0.0	-	2.3	17.5	0.0	7.0			-			
						180	0.0	-	2.3	17.5	0.0	7.0			-			
						210	0.0	-	2.3	17.5	0.0	7.0			-			
						240	0.0	-	2.3	17.4	0.0	6.0			-			
						270	0.0	-	2.4	17.3	0.0	5.0			-			
BH2B02S	-	1026	-	Peak: 0.05 Steady: 0.05	Peak: 0.3 Steady: 0.3	Initial	0.0	-	0.4	21.0	0.0	7.0			-	-	1.81	Dry
						30	0.0	-	1.2	20.4	0.0	3.0			-			
						60	0.0	-	1.2	20.4	0.0	2.0			-			
						90	0.0	-	1.2	20.4	0.0	2.0			-			
						120	0.0	-	1.2	20.4	0.0	2.0			-			
						150	0.0	-	1.2	20.4	0.0	2.0			-			
						180	0.0	-	1.2	20.4	0.0	2.0			-			
						210	0.0	-	1.3	20.3	0.0	2.0			-			
						240	0.0	-	1.3	20.3	0.0	2.0			-			
						270	0.0	-	1.3	20.3	0.0	2.0			-			
BH2B02D	-	1025	-	Peak: 0.03 Steady: 0.03	Peak: 0.3 Steady: 0.3	Initial	0.0	-	0.2	18.6	0.0	4.0			-	1.98	5.76	Dry
						30	0.0	-	1.1	19.4	0.0	5.0			-			
						60	0.0	-	1.1	19.4	0.0	5.0			-			
						90	0.0	-	1.1	19.4	0.0	5.0			-			
						120	0.0	-	1.1	19.4	0.0	5.0			-			
						150	0.0	-	1.1	19.3	0.0	5.0			-			
						180	0.0	-	1.2	19.3	0.0	6.0			-			
						210	0.0	-	1.2	19.2	0.0	5.0			-			
						240	0.0	-	1.6	18.5	0.0	5.0			-			
						270	0.0	-	2.6	16.9	0.0	4.0			-			

Notes:

Third monitoring visit

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	Y

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser		
PID		
Dip meter/ interface probe		

ARCADIS

Project:	Northstowe - Phase 2			Weather:	Fine
Job Number:	10018973	Date:	12/09/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: 0.09	Peak: 0.3	Initial	0.0	-	0.0	21.3	0.0	7.0			-			
						30	0.0	-	4.2	17.9	0.0	4.0			-			
						60	0.0	-	4.3	17.8	0.0	3.0			-			
						90	0.0	-	4.5	17.7	0.0	3.0			-			
BH2B03S	-	1026	-	Steady: 0.09	Steady: 0.3	120	0.0	-	4.6	17.6	0.0	3.0			-	1.62	1.62	Dry
						150	0.0	-	4.7	17.5	0.0	3.0			-			
						180	0.0	-	4.9	17.4	0.0	3.0			-			
						210	0.0	-	5.0	17.3	0.0	3.0			-			
						240	0.0	-	5.2	17.2	0.0	3.0			-			
						270	0.0	-	5.3	17.2	0.0	3.0			-			
				Peak: 0.00	Peak: 0.3	Initial	0.0	-	0.1	21.4	0.0	4.0			-			
						30	0.0	-	0.7	19.8	0.0	6.0			-			
						60	0.0	-	0.4	20.5	0.0	5.0			-			
						90	0.0	-	0.3	20.9	0.0	4.0			-			
BH2B03D	-	1026	-	Steady: 0.00	Steady: 0.3	120	0.0	-	0.2	21.0	0.0	4.0			-	4.45	6.99	Dry
						150	0.0	-	0.2	21.1	0.0	4.0			-			
						180	0.0	-	0.1	21.1	0.0	4.0			-			
						210	0.0	-	0.1	21.2	0.0	3.0			-			
						240	0.0	-	0.1	21.2	0.0	3.0			-			
						270	0.0	-	0.1	21.2	0.0	3.0			-			
				Peak: 0.00	Peak: 0.3	Initial	0.0	-	0.0	20.9	0.0	6.0			-			
						30	0.0	-	0.7	20.3	0.0	3.0			-			
						60	0.0	-	0.7	20.3	0.0	3.0			-			
						90	0.0	-	0.7	20.3	0.0	3.0			-			
BH2B04S	-	1026	-	Steady: 0.00	Steady: 0.3	120	0.0	-	0.7	20.4	0.0	3.0			-	1.96	3.65	Dry
						150	0.0	-	0.7	20.4	0.0	3.0			-			
						180	0.0	-	0.7	20.4	0.0	3.0			-			
						210	0.0	-	0.7	20.4	0.0	3.0			-			
						240	0.0	-	0.7	20.4	0.0	3.0			-			
						270	0.0	-	0.7	20.4	0.0	3.0			-			
				Peak: 0.09	Peak: 0.3	Initial	0.0	-	0.0	21.1	0.0	4.0			-			
						30	0.0	-	0.1	20.9	0.0	4.0			-			
						60	0.0	-	0.1	21.0	0.0	4.0			-			
						90	0.0	-	0.1	21.0	0.0	4.0			-			
BH2B04D	-	1026	-	Steady: 0.09	Steady: 0.3	120	0.0	-	0.0	21.0	0.0	3.0			-	2.23	8.25	Dry
						150	0.0	-	0.0	21.1	0.0	3.0			-			
						180	0.0	-	0.0	21.1	0.0	3.0			-			
						210	0.0	-	0.0	21.1	0.0	3.0			-			
						240	0.0	-	0.0	21.1	0.0	3.0			-			
						270	0.0	-	0.0	21.1	0.0	3.0			-			
				Peak: 5.36	Peak: 0.2	Initial	0.0	-	0.1	21.2	0.0	3.0			-			
						30	0.0	-	2.4	20.1	0.0	2.0			-			

BH2B05S	-	1025	-	Steady: 5.36	Steady: 0.2	60	0.0	-	2.4	20.0	0.0	2.0			-	2.73	3.00	Dry
						90	0.0	-	2.4	20.0	0.0	2.0			-			
						120	0.0	-	2.4	20.0	0.0	2.0			-			
						150	0.0	-	2.4	20.0	0.0	2.0			-			
						180	0.0	-	2.3	19.9	0.0	2.0			-			
						210	0.0	-	2.3	19.9	0.0	2.0			-			
						240	0.0	-	2.3	19.9	0.0	2.0			-			
						270	0.0	-	2.3	19.9	1.0	2.0			-			

Notes:

Third monitoring visit

Previous weather conditions, Atmospheric pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

ARCADIS

Project:	Northstowe - Phase 2			Weather:	Fine
Job Number:	10018973	Date:	12/09/2019	Engineer:	ME

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
BH2B05D	-	1025	-	Peak: 5.52 Steady: 5.52	Peak: -2.9 rising to Steady: -2.9 rising to -1.1 after 60secs	Initial	0.0	-	0.1	20.5	1.0	2.0			-	2.74	10.89	Dry
						30	0.0	-	0.4	20.2	1.0	4.0			-			
						60	0.0	-	0.3	20.3	1.0	4.0			-			
						90	0.0	-	0.3	20.3	1.0	3.0			-			
						120	0.0	-	0.3	20.3	1.0	3.0			-			
						150	0.0	-	0.2	20.3	1.0	3.0			-			
						180	0.0	-	0.2	20.3	1.0	3.0			-			
						210	0.0	-	0.2	20.3	1.0	3.0			-			
						240	0.0	-	0.2	20.3	1.0	3.0			-			
						270	0.0	-	0.2	20.3	1.0	3.0			-			
BH2B06S	-	1025	-	Peak: 3.55 Steady: 3.55	Peak: 0.2 Steady: 0.2	Initial	0.0	-	0.0	21.4	0.0	5.0			-	2.05	2.18	Dry
						30	0.0	-	0.5	21.1	0.0	3.0			-			
						60	0.0	-	0.5	21.0	0.0	3.0			-			
						90	0.0	-	0.6	21.0	0.0	3.0			-			
						120	0.0	-	0.6	21.0	0.0	3.0			-			
						150	0.0	-	0.6	21.0	0.0	3.0			-			
						180	0.0	-	0.6	20.9	0.0	3.0			-			
						210	0.0	-	0.6	20.9	0.0	3.0			-			
						240	0.0	-	0.6	20.9	0.0	3.0			-			
						270	0.0	-	0.6	20.9	0.0	3.0			-			
BH2B06D	-	1026	-	Peak: 0.16 Steady: 0.16	Peak: 0.1 Steady: -4.8 rising to -1.6 after 60secs	Initial	0.0	-	0.0	20.9	1.0	5.0			-	0.87	15.64	Dry
						30	0.0	-	0.2	20.1	0.0	9.0			-			
						60	0.0	-	0.2	20.1	1.0	9.0			-			
						90	0.0	-	0.2	20.1	1.0	9.0			-			
						120	0.0	-	0.2	20.1	1.0	9.0			-			
						150	0.0	-	0.2	20.0	1.0	9.0			-			
						180	0.0	-	0.2	20.0	1.0	9.0			-			

						210	0.0	-	0.2	20.0	1.0	9.0			-			
						240	0.0	-	0.2	20.0	1.0	9.0			-			
						270	0.0	-	0.2	20.0	1.0	8.0			-			
BH2B07S	-	1025	-	Peak: 7.83	Peak: 0.3	Initial	0.0	-	0.0	20.5	1.0	3.0			-	1.90	5.32	Dry
						30	0.0	-	0.9	19.9	1.0	3.0			-			
						60	0.0	-	0.9	19.8	1.0	3.0			-			
						90	0.0	-	0.9	19.8	1.0	3.0			-			
				Steady: 7.83	Steady: 0.3	120	0.0	-	0.9	19.8	1.0	3.0			-			
						150	0.0	-	1.0	19.7	1.0	3.0			-			
						180	0.0	-	1.0	19.7	1.0	3.0			-			
						210	0.0	-	1.0	19.7	1.0	2.0			-			
						240	0.0	-	1.0	19.7	1.0	2.0			-			
						270	0.0	-	1.1	19.6	1.0	2.0			-			
BH2B07D	-	1026	-	Peak: 0.00	Peak: -0.2 rising t	Initial	0.0	-	0.1	20.4	1.0	4.0			-	1.84	15.12	Dry
						30	0.0	-	0.2	20.1	1.0	4.0			-			
						60	0.0	-	0.2	20.2	1.0	4.0			-			
						90	0.0	-	0.2	20.2	1.0	4.0			-			
				Steady: 0.00	Steady: -0.2 rising	120	0.0	-	0.2	20.2	1.0	4.0			-			
						150	0.0	-	0.2	20.2	1.0	4.0			-			
						180	0.0	-	0.2	20.2	1.0	4.0			-			
						210	0.0	-	0.2	20.2	1.0	4.0			-			
						240	0.0	-	0.2	20.3	1.0	4.0			-			
						270	0.0	-	0.2	20.3	1.0	4.0			-			

Notes:

Third monitoring visit

Previous weather conditions, Atmosphic pressure trend and rate, flooding, soil moisture, water draw in tube, wind direction/strength, condition of monitoring point, missing/open tap, datum level, vegetation stress, odours, bubbles, etc.

APPENDIX C

Phase 3A and 3B Information

1	18Feb2019		SS	SH	GW
REV	Date	Description	Drawn	Check	Approv

NOTES:

Legend

Trial Pits

Client

Homes England

Homes England

Site

Northstowe Phase 3

414-428 Midsummer Blvd,
Milton Keynes MK9 2EA, UK

Suitability Description:

Issued for Information

Designed	Req	Date 18Feb2019	Signed SH
Drawn	Req	Date 18Feb2019	Signed SS
Checked	Req	Date 18Feb2019	Signed SH
Approved	Re	Date 18Feb2019	Signed JV
Scale:	1:5,000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10019646

PROJECT:

Northstowe Phase 3A

TITLE:

Exploratory Hole Location Plan

ARCADIS Design & Consultancy for natural and built assets

Registered office:
Arcadis House
34 York Way,
London
N1 9AB

Coordinating Office:
10 Medawar Road,
The Surrey Research Park,
Guildford, Surrey GU2 7AR | UK
Office: +44 (0) 1483 803000

www.arcadis.com

Drawing Number: 10019646-GLR-EHP-0001

Revision: 01

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REV	Date	Description	Drawn	Check	Approv
1	18Apr2019		SS	SH	GW

NOTES:

Legend

- Handpits
- Cable percussive boreholes

Client

Homes England

Homes England

Site

Northstowe Phase 3

414-428 Midsummer Blvd,
Milton Keynes MK9 2EA, UK

Suitability Description: Issued for Information

Designed	Reg	Date 18Apr2019	Signed SH
Drawn	Reg	Date 18Apr2019	Signed SS
Checked	Reg	Date 18Apr2019	Signed SH
Approved	Re	Date 18Apr2019	Signed JV
Scale:	1:6,000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10019646

PROJECT:

Northstowe Phase 3B

TITLE:

Exploratory Hole Location Plan

ARCADIS Design & Consultancy for natural and built assets

Registered office:
Arcadis House
34 York Way,
London
N1 9AB

Coordinating Office:
10 Medawar Road,
The Surrey Research Park,
Guildford, Surrey GU2 7AR | UK
Office: +44 (0) 1483 803000

www.arcadis.com

Drawing Number: 10019646-GLR-EHP-0002

Revision: 01

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ARCADIS Percussive Borehole Log

BH1

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**9.44**	**25/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539181.13**	**268325.81**	**25/01/2019**	**Sheet 1 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Depth (Thickness)	Level
0.10	D1	0.10	PID	<1ppm		25/01/2019 00:00	0.00	Soft becoming firm brown mottled orange sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of flint. [AMPTHILL CLAY FORMATION]		
0.10 - 0.20	ES1									
0.20	B1									
0.30	D2	0.30	PID	<1ppm						
0.30 - 0.40	ES2									
0.50	B2	0.50	PID	<1ppm						
0.50 - 0.60	ES3									
1.00	D3	1.00	PID	<1ppm						
1.00 - 1.10	ES4									
1.50	B3	1.50	SPT(S)	N=14 (1,1/2,2,5,5)	Dry					
1.50	D4								(3.20)	
2.00	D5	2.00	PID	<1ppm						
2.00 - 2.10	ES5									
2.00 - 2.30	EW1									
2.50	D6	2.50	SPT(S)	N=14 (1,2/3,3,3,5)	Dry					
2.53	B4									
3.00 - 3.10	ES6	3.00	PID	<1ppm						
3.20	D7	3.20	PID	<1ppm				Stiff dark grey slightly sandy CLAY. [AMPTHILL CLAY FORMATION]	3.20	6.24
3.20 - 3.30	ES7									
3.50	B5	3.50	SPT(S)	N=15 (2,2/2,3,5,5)	Dry					
3.50	B6									
3.50	D8									
4.00	D9	4.00	PID	<1ppm						
4.00 - 4.10	ES8									
4.50 - 4.88	UT1			Ublow=35						
4.88	D10									
5.50	B7	5.50	SPT(S)	N=26 (2,3/5,5,7,9)	Dry					
5.50	D11									
6.00 - 6.10	ES9	6.00	PID	<1ppm						
									(7.30)	
7.00	D12									
7.50	B8			Ublow=65						
7.50	UT2									
8.00	D13	8.00	PID	<1ppm						
8.00 - 8.10	ES10									
8.50	B9	8.50	SPT(S)	N=32 (3,5/5,7,9,11)	Dry					
8.50	D14									
8.50 - 9.00	EW2									
9.00	D15									
10.00	D16									

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.50	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.50	150	3.50

WATER ADDED

From	To	Volume (ltr)

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. No groundwater encountered.

Termination Depth: 10.50m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log

BH1

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**9.44**	**25/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539181.13**	**268325.81**	**25/01/2019**	**Sheet 2 of 2**

SAMPLES Depth	SAMPLES Type/No.	TESTS Depth	TESTS Type/No.	TESTS Results	Water Strikes	PROGRESS Date Time	PROGRESS Casing Water	STRATA Description	Legend	Depth (Thickness)	Level	Install/Backfill
						25/01/2019 16:00	3.20	Stiff dark grey slightly sandy CLAY. [AMPTHILL CLAY FORMATION]		10.50	-1.06	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.50	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.50	150	3.50

WATER ADDED

From	To	Volume (ltr)

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. No groundwater encountered.

Termination Depth: 10.50m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log — BH2

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**7.91**	**29/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539668.01**	**268089.67**	**30/01/2019**	**Sheet 1 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water
0.10	B1	0.10	PID	<1ppm		29/01/2019 08:00	0.00
0.10	ES1						
0.20	D1						
0.30	B2	0.30	PID	<1ppm			
0.30	ES2						
0.50	B3	0.50	PID	<1ppm			
0.50	ES3						
0.70	B4	0.70	PID	<1ppm			
0.70	D2						
0.70	ES4						
1.00	ES5	1.00	PID	<1ppm			
1.50 - 2.00	B5	1.50	SPT(C)	N=32 (2,2/3,7,9,13)	1.3		
1.50 - 2.00	EW1						
2.00	ES6	2.00	PID	<1ppm			
2.50 - 3.00	B6	2.50	SPT(C)	N=32 (2,3/5,7,7,13)	2		
3.00	ES7	3.00	PID	<1ppm			
3.50 - 4.00	B7	3.50	SPT(C)	N=40 (3,5/5,11,11,13)	3		
4.00	ES8	4.00	PID	<1ppm			
4.50 - 5.00	B8	4.50	SPT(C)	N>50 (1,3/7,13,13,17 for 0mm)	3.8		
5.00	ES9	5.00	PID	<1ppm			
5.50 - 6.00	B9	5.50	SPT(C)	N=34 (2,5/12,12,5,5)	3.1		
5.70	B10	5.70	PID	<1ppm			
5.70	ES10						
6.00	D3						
7.00	D4	7.00	PID	<1ppm			
7.00	ES11						
7.50 - 7.95	D5	7.50	SPT(S)	N=13 (1,2/2,3,3,5)	Dry		
7.50 - 8.00	B11						
8.00	D6					29/01/2019 16:00	6.00
						30/01/2019 08:00	6.00
8.50	UT1			Ublow=65			
8.50 - 9.00	B12						
8.50 - 9.00	EW2						
9.00	D7	9.00	PID	<1ppm			
9.00	ES12						
10.00	D8	10.00	SPT(S)	N=25 (2,5/5,5,6,9)	Dry		
10.00 - 10.45	D9						

STRATA Description	Depth (Thickness)	Level
TOPSOIL: Very soft to soft brown silty slightly sandy CLAY. Sand is medium to coarse. Occasional rootlets.	(0.30) 0.30	7.61
Soft grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of flint. Sand is fine and medium. [RIVER TERRACE DEPOSITS]	(0.40) 0.70	7.21
Dense becoming very dense light greyish brown and white slightly silty very gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium flint and siltstone. [RIVER TERRACE DEPOSITS]	(5.00) 5.70	2.21
Stiff to very stiff dark grey and white slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subangular to subrounded fine to medium siltstone. [AMPTHILL CLAY FORMATION]	(4.80)	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.50	Cable Percussion

CHISELLING

Hard Strata From	To	Duration

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
29/01/2019 14:34	4.50	20	4.5		

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.50	150	6.00

WATER ADDED

From	To	Volume (ltr)
0.70	5.70	200

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl.

Termination Depth: 10.50m

AGS — Arcadis Cymru House, St Mellons Business Park, Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**MT**	**LC**

Percussive Borehole Log

BH2

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**7.91**	**29/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539668.01**	**268089.67**	**30/01/2019**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA				
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend	Depth (Thickness)	Level	Install/ Backfill
10.00 - 10.50	B13					30/01/2019 16:00	6.00	Stiff to very stiff dark grey and white slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is subangular to subrounded fine to medium siltstone. [AMPTHILL CLAY FORMATION]		10.50	-2.59	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00 1.20	1.20 10.50	Inspection Pit Cable Percussion				29/01/2019 14:34	4.50	20	4.5			150	10.50	150	6.00	0.70	5.70	200

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl.

Termination Depth: 10.50m

ARCADIS Percussive Borehole Log

BH3

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**5.85**	**24/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539195.74**	**267955.11**	**25/01/2019**	**Sheet 1 of 2**

SAMPLES / TESTS

Depth	Type/No.	Test Depth	Type/No.	Results	Water Strikes
0.10	B1	0.10	PID	<1ppm	
0.10	D1				
0.10	ES80				
0.30	B2	0.30	PID	<1ppm	
0.30	ES81	0.50	PID	<1ppm	
0.50	ES82				
1.00	ES83	1.00	PID	<1ppm	
1.20	D2				
1.50 - 1.88	UT1			Ublow=35	
1.88 - 1.93	D3				
2.00	D4	2.00	PID	<1ppm	
2.00	ES84				
2.50	B3	2.50	SPT(S)	N=10 (2,2/2,2,3,3)	Dry
2.50 - 2.95	D5				
3.00	D6	3.00	PID	<1ppm	
3.00	ES85				
3.50 - 3.79	UT2			Ublow=35	
3.79 - 3.84	D7				
3.80 - 4.00	D8				
4.00	B4	4.00	PID	<1ppm	
4.00	ES86				
4.50 - 4.95	D9	4.50	SPT(S)	N=15 (1,2/3,3,4,5)	Dry
4.50 - 5.00	B5				
5.00	D10				
5.50 - 5.93	U3			Ublow=55	
5.93 - 5.98	D11				
6.00	ES87	6.00	PID	<1ppm	
7.00	D12	7.00	SPT(S)	N=26 (3,3/5,5,7,9)	Dry
7.00 - 7.45	D13				
7.00 - 7.50	B6				
8.00	D14	8.00	PID	<1ppm	
8.00	ES88				
8.50	UT4			Ublow=85	
8.50 - 9.00	B7				
9.00	D15				
10.00	B8	10.00	SPT(S)	N=30 (3,5/5,7,7,11)	Dry
10.00	D16	10.00	PID	<1ppm	

PROGRESS

Date Time	Casing	Water
24/01/2019 08:00		0.00

STRATA

Description	Depth (Thickness)	Level
Soft brown slightly gravelly sandy CLAY. Sand is fine and medium. Gravel is subangular subrounded fine of flint. [AMPTHILL CLAY FORMATION]	(1.20) 1.20	4.65
Firm brown slightly gravelly CLAY. Gravel is subangular to subrounded fine of flint. [AMPTHILL CLAY FORMATION]	(0.80) 2.00	3.85
Firm greyish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine of flint and siltstone. [AMPTHILL CLAY FORMATION] Gravel is fine to medium siltstone. Siltstone band Becomes stiff.	(8.50)	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.45	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration
3.70	4.00	01:00

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
24/01/2019 13:00	3.70	20	3.60	3.50	4.00

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.50	150	4.20

WATER ADDED

From	To	Volume (ltr)

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. Soakaway test undertaken between 3.00m and 4.61m.

Termination Depth: 10.50m

AGS Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

Percussive Borehole Log

BH3

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**5.85**	**24/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539195.74**	**267955.11**	**25/01/2019**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA		Depth (Thickness)	Level	Install/ Backfill
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend			
10.00 10.00 - 10.45	ES89 D17					24/01/2019 16:00	4.20	Firm greyish brown slightly gravelly CLAY. Gravel is subangular to subrounded fine of flint and siltstone. [AMPTHILL CLAY FORMATION] Becoming stiff and slightly gravelly. Gravel is subrounded to subangular fine to medium siltstone.		10.50	-4.65	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00 1.20	1.20 10.45	Inspection Pit Cable Percussion	3.70	4.00	01:00	24/01/2019 13:00	3.70	20	3.60	3.50	4.00	150	10.50	150	4.20			

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.50m bgl. Soakaway test undertaken between 3.00m and 4.61m.

Termination Depth: 10.50m

Arcadis Cymru House St Mellons Business Park Cardiff CF3 0EY

Unless otherwise stated:
Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log — BH4

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**6.93**	**22/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539324.67**	**267833.26**	**24/01/2019**	**Sheet 1 of 2**

SAMPLES Depth	Type/No.	TESTS Depth	Type/No.	Results	Water Strikes	PROGRESS Date Time	Casing Water	STRATA Description	Depth (Thickness)	Level
0.10	D1	0.10	PID	<1ppm		22/01/2019 12:00		Soft to firm brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to medium of flint [TOPSOIL]	(0.35)	
0.10	ES81									
0.20 - 0.30	B1								0.35	6.58
0.40	D2	0.40	PID	<1ppm				Soft orangish brown slightly gravelly sandy CLAY. Gravel is subangular to subrounded fine to medium of flint. [Possible Glacial Deposits]		
0.40	ES82									
0.40 - 0.60	B2								(0.65)	
1.00 - 1.50	EW1								1.00	5.93
1.20	D3	1.20	PID	<1ppm				Soft becoming firm greyish brown CLAY. [Possible Glacial Deposits]		
1.20 - 1.50	B3									
1.20 - 1.60	ES83									
1.50 - 1.77	U1			Ublow=15						
1.77 - 1.82	D4									
2.00	D5	2.00	PID	<1ppm					(2.10)	
2.00	ES84									
2.50 - 2.95	D6	2.50	SPT(S)	N=8 (1,1/2,2,2,2)	Dry					
2.50 - 3.00	B4	2.50	PID	<1ppm						
2.50 - 3.00	ES85									
3.00	D7									
3.10 - 3.50	B5	3.10	PID	<1ppm				Medium dense orangish brown , gravelly clayey fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of flint. [Possible Glacial Deposits]	3.10	3.83
3.10 - 3.50	ES86									
3.50 - 4.00	B6	3.50	SPT(C)	N=12 (1,1/2,2,3,5)	2.5					
4.00	D8					22/01/2019 16:00	3.00 3.10			
4.50 - 5.00	B7	4.50	SPT(C)	N=21 (2,3/4,4,6,7)	2.3				(3.00)	
5.00	D9									
5.50 - 6.00	B8	5.50	SPT(C)	N=48 (3,7/9,9,11,19)	2.1					
5.50 - 6.00	ES87	5.50	PID	<1ppm						
6.10	B9					23/01/2019 08:00	3.00	Firm grey CLAY. [AMPTHILL CLAY FORMATION]	6.10	0.83
7.00	D10	7.00	SPT(S)	N=14 (2,2/3,3,4,4)	Dry					
7.00 - 7.45	D11									
7.00 - 7.50	B10									
8.00	D12								(4.35)	
8.50	UT2	8.50	PID	<1ppm						
8.50 - 9.00	B11			Ublow=55						
8.50 - 9.00	ES88									
8.50 - 9.00	EW2									
9.00	D13									
10.00	B12	10.00	SPT(S)	N=16 (2,3/3,4,4,5)	Dry					
10.00	D14									

DRILLING TECHNIQUE From	To	Type	CHISELLING Hard Strata From	To	Duration	WATER OBSERVATIONS Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	HOLE/CASING DIAMETER Hole Dia.	Depth	Casing Dia.	Depth	WATER ADDED From	To	Volume (ltr)
0.00	1.20	Inspection Pit	5.70	5.70	01:00	22/01/2019 14:00	3.10	20	2.50	3.00		150	10.00	150	6.10			
1.20	10.45	Cable Percussion										150	10.45					

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.45m bgl. Falling head test undertaken between 3.10m and 6.10m. Soakaway test undertaken between 8.00m and 10.00m

Termination Depth: 10.45m

AGS — Arcadis Cymru House, St Mellons Business Park, Cardiff, CF3 0EY

Unless otherwise stated: Depth (m), Diameter (mm), Time (hhmm), Thickness (m), Level (mOD).

Equipment Used	Contractor	Logged By	Checked By
Dando 150	**Arcadis Consulting (UK) Ltd**	**IT**	**LC**

ARCADIS Percussive Borehole Log — BH4

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**6.93**	**22/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539324.67**	**267833.26**	**24/01/2019**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA		Depth (Thickness)	Level	Install/ Backfill
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend			
10.00 - 10.45	D15					23/01/2019 16:00	6.10	Firm grey CLAY. [AMPTHILL CLAY FORMATION] Becomes stiff.		10.45	-3.52	

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	Hard Strata To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00	1.20	Inspection Pit	5.70	5.70	01:00	22/01/2019 14:00	3.10	20	2.50	3.00		150	10.00	150	6.10			
1.20	10.45	Cable Percussion										150	10.45					

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.45m bgl. Falling head test undertaken between 3.10m and 6.10m. Soakaway test undertaken between 8.00m and 10.00m

Termination Depth: 10.45m

ARCADIS Percussive Borehole Log — BH5

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**8.24**	**31/01/2019**	**1:50**
Client	**Easting (OS mE)**	**Northing (OS mN)**	**End Date**	
Homes England	**539703.90**	**267510.69**	**31/01/2019**	**Sheet 1 of 2**

SAMPLES

Depth	Type/No.
0.20	B1
0.20	D1
0.20	ES1
0.30	B2
0.30	ES2
0.50	D2
0.50	ES3
1.00	B3
1.00	ES4
1.50 - 2.00	B4
2.00	ES5
2.00 - 2.50	EW1
2.50 - 3.00	B5
3.00	ES6
4.50	B6
4.80	B7
4.80	ES7
5.00	D3
5.50 - 5.95	D4
5.50 - 6.00	B8
6.00	D5
6.00	ES8
7.00	D6
7.00 - 7.38	UT1
7.38 - 7.43	D7
8.00	D8
8.00	ES9
8.00 - 8.50	EW2
8.50 - 8.95	D9
8.50 - 9.00	B9
10.00	D10
10.00	ES10

TESTS

Depth	Type/No.	Results	Water Strikes
0.20	PID	<1ppm	
0.30	PID	<1ppm	
0.50	PID	<1ppm	
1.00	PID	<1ppm	
1.50	SPT(C)	N=28 (3,4/4,6,7,11)	Dry
1.50	PID	<1ppm	
2.50	SPT(C)	N=40 (3,4/7,7,11,15)	Dry
2.50	PID	<1ppm	
3.00	PID	<1ppm	
4.50	SPT(C)	N=39 (4,5/7,7,11,14)	3
4.50	PID	<1ppm	
4.80	PID	<1ppm	
5.00	PID	<1ppm	
5.50	SPT(S)	N=11 (2,2/2,3,3,3)	Dry
5.50	PID	<1ppm	
6.00	PID	<1ppm	
7.00	PID	<1ppm Ublow=55	
8.00	PID	<1ppm	
8.50	SPT(S)	N=24 (3,4/5,5,7,7)	Dry
8.50	PID	<1ppm	
10.00	PID	<1ppm	

PROGRESS

Date Time	Casing	Water
31/01/2019 08:00	0.00	

STRATA

Description	Depth (Thickness)	Level
Soft brownish grey slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is angular to subangular fine to medium flint. Frequent rootlets. [TOPSOIL]	(0.30) 0.30	7.94
Medium dense yellowish brown and white slightly silty very gravelly SAND. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of flint and siltstone. [RIVER TERRACE DEPOSITS] Becomes dense.	(4.50) 4.80	3.44
Stiff to very stiff dark grey slightly sandy CLAY. Sand is fine and medium. Occasional shell fragments. [AMPTHILL CLAY FORMATION]	(5.63)	

DRILLING TECHNIQUE

From	To	Type
0.00	1.20	Inspection Pit
1.20	10.43	Cable Percussion

CHISELLING

Hard Strata From	Hard Strata To	Duration

WATER OBSERVATIONS

Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed
31/01/2019 09:26	3.80	20	3.8		

HOLE/CASING DIAMETER

Hole Dia.	Depth	Casing Dia.	Depth
150	10.43	150	5.00

WATER ADDED

From	To	Volume (ltr)
0.30	4.70	375

Remarks

Exploratory hole terminated after reaching scheduled depth at 10.43m bgl.

Termination Depth: 10.43m

Percussive Borehole Log

BH5

Project	Project No.	Ground Level (mAOD)	Start Date	Scale
Northstowe Phase 3	**10019646**	**8.24**	**31/01/2019**	**1:50**
Client	Easting (OS mE)	Northing (OS mN)	End Date	
Homes England	**539703.90**	**267510.69**	**31/01/2019**	**Sheet 2 of 2**

SAMPLES		TESTS			Water Strikes	PROGRESS		STRATA		Depth (Thickness)	Level	Install/ Backfill
Depth	Type/ No.	Depth	Type/ No.	Results		Date Time	Casing Water	Description	Legend			
10.00 - 10.38	UT2							Stiff to very stiff dark grey slightly sandy CLAY. Sand is fine and medium. Occasional shell fragments. [AMPTHILL CLAY FORMATION]		10.43	-2.19	
10.38 - 10.43	D11					31/01/2019 16:00	5.00					

DRILLING TECHNIQUE			CHISELLING			WATER OBSERVATIONS						HOLE/CASING DIAMETER				WATER ADDED		
From	To	Type	Hard Strata From	To	Duration	Date/Time	Strike At	Time Elapsed	Rise To	Casing	Sealed	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Volume (ltr)
0.00	1.20	Inspection Pit				31/01/2019 09:26	3.80	20	3.8			150	10.43	150	5.00	0.30	4.70	375
1.20	10.43	Cable Percussion																

Remarks
Exploratory hole terminated after reaching scheduled depth at 10.43m bgl.

Termination Depth:
10.43m

ARCADIS

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH1
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	2.38	**Pre-Sampling Water Level (m):**	**1.51**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	10
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	15:30	1.51	10						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	15:45	2.0-2.3							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty brownish orange	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty brownish orange
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	2.1		

Comments:
Unable to purge any more water, sample taken from purge water. Water level 8.2.19 1.42m

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH1
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	9.61	**Pre-Sampling Water Level (m):**	**1.84**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	14:00	1.84	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	15:00	8.5-9.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge
Depth to Water Post-Sampling (m)	8.56		

Comments:
Water level 8.2.19 1.63m

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Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH2
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	3.68	**Pre-Sampling Water Level (m):**	**1.47**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	12:00	1.47	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	13:00	1.5-2.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty brownish orange	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty brownish orange
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Fast recharge
Depth to Water Post-Sampling (m)	1.57		

Comments:
Water level 8.2.19 1.55m

V1

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH2
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	10.01	**Pre-Sampling Water Level (m):**	**1.47**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35	
Single Purge Volume (l):				

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	12:00	1.47	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	12:45	8.5-9.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	8.57		

Comments:
Unable to purge any more water. Sample taken from purge water. Bailer lost down hole. Water level 8.2.19 1.55m

Water Monitoring

ARCADIS

Project:	Northstowe Phase 3	**Position No:**	BH3
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	4.61	**Pre-Sampling Water Level (m):**	Dry
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	N/A
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	16:00	Dry	N/A						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	N/A								

Purging Method:		**Pumped:**		**Bailed:**	N/A
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	N/A	**Water Description During/After Purging (Colour, Clarity, Odour)**	N/A
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	N/A
Depth to Water Post-Sampling (m)	Dry		

Comments:
Water level 8.2.19, Dry.

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Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH3
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	9.87	**Pre-Sampling Water Level (m):**	**9.52**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	0.5	
Single Purge Volume (l):				

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	16:00	9.52	0.5						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	N/A								

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	9.7		

Comments:
Unable to purge any more water, no sample taken, not enough water. Water level 8.2.19, 6.71m most likely from water add on 7.2.19 for falling head test (24l).

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Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH4
Project No:	10019646	**Sample Ref:**	8.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	8.2.19		

Borehole Depth:	5.53	**Pre-Sampling Water Level (m):**	**1.02**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	50
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	09:30	1.02	50						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	10:00	1.0-1.5							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and orangish brown.	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and orangish brown.
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Fast recharge
Depth to Water Post-Sampling (m)	1.04		

Comments:

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH4
Project No:	10019646	**Sample Ref:**	8.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	8.2.19		

Borehole Depth:	9.5	**Pre-Sampling Water Level (m):**	**2.02**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35	
Single Purge Volume (l):				

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	08:00	2.02	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	09:00	8.5-9.0							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	sSow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	9		

Comments:
Unable to purge any more water. Sample taken from purge water.

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH5
Project No:	10019646	**Sample Ref:**	7.2.19EW1
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	3.62	**Pre-Sampling Water Level (m):**	**1.47**
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	45
Single Purge Volume (l):			

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	10:45	1.47	45						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	11:45	2.00-2.50							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Very silty and brownish orange	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and brownish orange
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Fast recharge.
Depth to Water Post-Sampling (m)	1.48		

Comments:
Water level 8.2.19 1.47m.

Water Monitoring

Project:	Northstowe Phase 3	**Position No:**	BH5
Project No:	10019646	**Sample Ref:**	7.2.19EW2
Engineer:	MT	**Weather:**	overcast and windy
Date:	7.2.19		

Borehole Depth:	9.23	**Pre-Sampling Water Level (m):**	**1.47**	
Standpipe Diameter (mm):	50	**Total Purge Volume (l) (3 x Single Purge Volume)**	35	
Single Purge Volume (l):				

Operations	Time (24 hr)	Depth to Water (m)	Volume Removed (l)	pH	Cond. (µScm-1)	Temp. (°C)	DO (%)	DO (mg)	ORP (mV)
Start	09:30	1.47	35						
First Purge Volume									
Second Purge Volume									
Third Purge Volume									
Stable Reading									
Sample	10:30	8.00-8.50							

Purging Method:		**Pumped:**		**Bailed:**	Yes
Pump Type:		**Bailer Type:**			

Water Description at Start of Purging (Colour, Clarity, Odour)	Clear becoming silty and brownish grey	**Water Description During/After Purging (Colour, Clarity, Odour)**	Very silty and brownish grey
Total Volume Pumped/Time to Stability		**Comments on Recharge/Drawdown**	Slow recharge, most likely from gravel pack
Depth to Water Post-Sampling (m)	8.81		

Comments:
Could not purge more water from hole as recharge too slow. Took sample from purge water. Water level 8.2.19 - 8.34m.

ARCADIS

Project:	Northstowe Phase 3		
Job Number:	10019646	**Date:**	22/02/2019

Weather:	Sunny
Engineer:	IT

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: -005.96	Peak: -00.7	Initial	0.0	0.0	0.0	20.2	0.0	0.0			0.0			
						30	0.0	0.0	0.7	18.2	0.0	0.0			0.0			
						60	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
BH1 Shallow	11:30	1034	11			90	0.0	0.0	0.7	18.1	0.0	0.0			0.0	1.22	2.47	BAL 81.2%
				Steady: -005.96	Steady: -00.7	120	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
						150	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
						180	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
				Peak: -005.96	Peak: -00.7	Initial	0.0	0.0	0.7	18.1	0.0	0.0			0.0			
						30	0.0	0.0	1.3	18.8	0.0	0.0			0.0			
						60	0.0	0.0	1.3	18.8	0.0	0.0			0.0			
BH1 Deep	11:33	1034	11			90	0.0	0.0	1.3	18.8	0.0	0.0			0.0	1.22	9.56	BAL 79.9%
				Steady: -005.96	Steady: -00.7	120	0.0	0.0	1.3	18.8	0.0	0.0			0.0			
						150	0.0	0.0	1.2	18.8	0.0	0.0			0.0			
						180	0.0	0.0	1.1	18.7	0.0	0.0			0.0			
				Peak: -006.91	Peak: -00.5	Initial	0.0	0.0	0.0	19.9	0.0	0.0			0.1			
						30	0.0	0.0	0.3	18.9	0.0	0.0			0.0			
						60	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
BH2 Shallow	10:58	1034	11			90	0.0	0.0	0.3	18.8	0.0	0.0			0.0	1.325	2.92	BAL 80.9%
				Steady: -006.91	Steady: -00.5	120	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
						150	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
						180	0.0	0.0	0.4	18.8	0.0	0.0			0.0			
				Peak: -006.91	Peak: -00.6	Initial	0.0	0.0	0.8	18.1	0.0	0.0			1.5			
						30	0.0	0.0	0.1	20.0	0.0	0.0			0.0			
						60	0.0	0.0	0.1	20.2	0.0	0.0			0.0			
BH2 Deep	11:05	1034	11			90	0.0	0.0	0.1	20.2	0.0	0.0			0.0	1.325	9.06	BAL 79.7%
				Steady: -006.91	Steady: -00.6	120	0.0	0.0	0.0	20.3	0.0	0.0			0.0			
						150	0.0	0.0	0.0	20.3	0.0	0.0			0.0			
						180	0.0	0.0	0.0	20.3	0.0	0.0			0.0			

Notes:

Ambient Concentration	
CH4	0.0
CO2	0.0
O2	20.1
H2S	0.0
CO	0.0

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser	GA12507	**GA2000**
PID	110-009173	**PID 28**
Dip meter/ interface probe	DIP-30	**DIP-GWE-7-030**

V1

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ARCADIS

Project:	Northstowe Phase 3
Job Number:	10019646

Date: 22/02/2019

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°c)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
				Peak: -005.95	Peak: -00.8	Initial	0.0	0.0	0.0	20.1	0.0	0.0			0.0			
						30	0.0	0.0	0.2	18.6	0.0	0.0			0.0			
						60	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
BH3 Shallow	11:58	1035	12			90	0.0	0.0	0.3	18.6	0.0	0.0			0.0	3.1	4.54	BAL 81.2%
				Steady: -005.95	Steady: -0.08	120	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
						150	0.0	0.0	0.3	18.5	0.0	0.0			0.0			
						180	0.0	0.0	0.3	18.5	0.0	0.0			0.0			
				Peak: -005.89	Peak: -00.9	Initial	0.0	0.0	0.3	18.5	0.0	0.0			0.0			
						30	0.0	0.0	0.5	17.5	0.0	0.0			0.0			
						60	0.0	0.0	0.4	18.1	0.0	0.0			0.0			
BH3 Deep	12:05	1035	12			90	0.0	0.0	0.3	18.5	0.0	0.0			0.0	3.1	9.76	BAL 81.9%
				Steady: -005.89	Steady: -0.08	120	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
						150	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
						180	0.0	0.0	0.3	18.6	0.0	0.0			0.0			
				Peak: -005.89	Peak: -00.8	Initial	0.0	0.0	0.2	20.4	0.0	0.0			0.0			
						30	0.0	0.0	0.1	20.5	0.0	0.0			0.0			
						60	0.0	0.0	0.0	20.6	0.0	0.0			0.0			
BH4 Shallow	12:30	1035	12			90	0.0	0.0	0.0	20.6	0.0	0.0			0.0	0.92	9.45	BAL 79.3%
				Steady: -005.89	Steady: -0.08	120	0.0	0.0	0.0	20.7	0.0	0.0			0.0			
						150	0.0	0.0	0.0	20.7	0.0	0.0			0.0			
						180	0.0	0.0	0.0	20.7	0.0	0.0			0.0			
				Peak: -005.91	Peak: -00.8	Initial	0.0	0.0	0.3	18.8	0.0	0.0			0.0			
						30	0.0	0.0	1.2	19.6	0.0	0.0			0.0			
						60	0.0	0.0	1.1	19.8	0.0	0.0			0.0			
BH4 Deep	12:26	1035	12			90	0.0	0.0	0.9	19.9	0.0	0.0			0.0	0.92	5.72	BAL 79.4%
				Steady: -005.91	Steady: -0.08	120	0.0	0.0	0.7	20.1	0.0	0.0			0.0			
						150	0.0	0.0	0.5	20.2	0.0	0.0			0.0			
						180	0.0	0.0	0.3	20.3	0.0	0.0			0.0			
				Peak: -005.94	Peak: -0.00	Initial	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						30	0.0	0.0	0.1	20.2	0.0	0.0			0.0			
						60	0.0	0.0	0.1	20.0	0.0	0.0			0.0			
BH5 Shallow	12:56	1035	12			90	0.0	0.0	0.2	19.8	0.0	0.0			0.0	1.43	2.865	BAL 80.0%
				Steady: -005.94	Steady: -0.00	120	0.0	0.0	0.2	19.8	0.0	0.0			0.0			
						150	0.0	0.0	0.2	19.8	0.0	0.0			0.0			
						180	0.0	0.0	0.2	19.8	0.0	0.0			0.0			

Notes:

ARCADIS

Project:	Northstowe Phase 3		
Job Number:	10019646	Date:	22/02/2019

Weather:	Sunny
Engineer:	IT

Monitoring Point Reference	Date/ Time	Atmos. Pressure (mbar)	Temp. (°C)	Well Pressure (Pa)	Flow Rate (l/h)	Time (sec)	CH4 (% v/v)	LEL (%)	CO2 (% v/v)	O2 (% v/v)	H2S (ppm)	CO (ppm)	Hex. (%)	PID cf	VOC (ppm)	Depth to Water (m)	Depth to base (m)	Comments (all readings from GL, note datum height if different)
BH5 Deep	12:50	1035	12	Peak: -005.94	Peak: -0.00	Initial	0.0	0.0	0.0	20.5	0.0	0.0			0.0	5.93	9.23	BAL 79.6%
						30	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						60	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						90	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
				Steady: -005.94	Steady: -0.00	120	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						150	0.0	0.0	0.0	20.4	0.0	0.0			0.0			
						180	0.0	0.0	0.0	20.4	0.0	0.0			0.0			

Notes:

Ambient Concentration	
CH4	0.0
CO2	0.0
O2	20.1
H2S	0.0
CO	0.0

QA Checklist:	
Weather conditions logged for previous 24 hrs	N
Gas monitor calibrated	Y
All filters in place	Y
Flow reading stable and zeroed	

Instrument Details:	Serial No.	Hyder/other ref.
Landfill Gas Analyser	GA12507	**GA2000**
PID	110-009173	**PID 28**
Dip meter/ interface probe	DIP-30	**DIP-GWE-7-030**