

Objectives

9.21 The key objectives for the site drainage will be:

- Implementation of a sustainable drainage scheme in accordance with current national and local policy together with principles of good practice design.
- Control of peak discharges from the site to a rate commensurate with the baseline conditions.
- Development of storm water management proposals that maintain water quality and biodiversity of the site.
- Implementation of the storm water management system prior to first use of the site.

10 SuDS Management

Water Quality

- 10.1** Impermeable surfaces collect pollutants from a wide variety of sources including cleaning activities, wear from car tyres, vehicle oil and exhaust leaks and general atmospheric deposition (source: CIRIA C609). The implementation of SuDS in development drainage provides a significant benefit in removal of pollutant from development run-off.
- 10.2** The SuDS Manual C753 describes a 'Simple Index Approach' for assessing the pollution risk of surface run-off to the receiving environment using indices for likely pollution levels for different land uses and SuDS performance capabilities.
- 10.3** CIRIA document C753 Table 26.2, as shown in **Table 10-1** below, indicates the minimum treatment indices appropriate for contributing pollution hazards for different land use classifications. To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index.

Land Use	Pollution Hazard Level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4

Table 10-1: CIRIA 753 Table 26.2 Pollution Hazard Indices

- 10.4** For a residential type development, roof water requires a very low treatment of 0.2 for total suspended solids, 0.2 for heavy metals and 0.05 for hydrocarbons, and run-off from low traffic roads such as cul-de-sacs and individual property driveways requires low treatment of 0.5 for total suspended solids, 0.4 for heavy metals and 0.4 for hydrocarbons.
- 10.5** To provide the correct level of treatment, an assessment needs to be made of the mitigation provided by each SuDS feature. Tables 26.3 and 26.4 of The SuDS Manual CIRIA document C753 shown as **Table 10-2** for discharges to surface waters and groundwater respectively indicate the treatment mitigation indices provided by each SuDS feature.

Type of SuDS component	Total suspended solids (TSS)	Metals	Hydro-carbons
Swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the one in 1-year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 10-2: CIRIA 753 Table 26.3 SuDS Mitigation Indices for discharges to surface waters.

- 10.6** Where more than one mitigation feature is to be used, CIRIA guidance states that the total mitigation index shall be calculated as follows:

$$\text{Total SuDS mitigation index} = \text{Mitigation Index 1} + 0.5 \times \text{Mitigation Index 2}$$

- 10.7** At present, the site and surrounding area does not benefit from any additional measures of stormwater treatment.
- 10.8** Due to the need to provide wider sustainability benefits and view the development at a strategic level, SuDS will be implemented to passively treat run off from the development so as to have a positive impact on the surrounding natural environment.
- 10.9** The site will employ SuDS features, such as detention basins. These are widely accepted to be of high pollutant removal efficiency (CIRIA 609). This provides for at least one stage of treatment onsite. A petrol interceptor can be provided at the inflow of the basin in order to provide another source of treatment to surface water.
- 10.10** Coupled with this however, the unknown watercourse should also be seen as an additional stage of treatment as the sedimentation process is not limited to artificial drainage systems but is taken from the natural processes observed within the water cycle.
- 10.11** As the site is not presently served by any means of storm water treatment mechanisms, by providing the afore mentioned SuDS within the proposed development it will be possible to maintain present water quality in the area and thus the development can be seen to be having no significant environmental impact in relation to water.

Exceedance Flows

- 10.12** Careful regard has to be made in respect of potential exceedance flows, being events that are more extreme than current design criteria. Various national guidance has been published on the matter of exceedance flows and measures that should be incorporated into a development to ensure the safety of occupiers and those using the infrastructure.
- 10.13** The principal aim is to direct any exceedance flows away from properties and along defined corridors. At a local level, this may mean water being conveyed along a length of highway, as long as the predicted flow

depths and velocities are acceptable. More strategically, the implementation of conveyance corridors is important in avoiding deep and high velocity flows that present a high risk. The drainage system being promoted for Pagham provides a good opportunity to incorporate exceedance flow routes into the design.

- 10.14** Clearly, many of the measures for dealing with exceedance flows must be dealt with at the detailed design stage. However, the strategic layout for proposed development at Pagham provides the framework of a network that can effectively deal with any future exceedance problems.

Implementation Proposals

- 10.15** The conceptual drainage proposals have been developed in a manner that will allow the site wide system to be designed to encourage passive treatment of discharged flows and to improve the water quality by removing the low-level silts, oils which could be attributed to track/parking area run off of this nature. Final design will provide for appropriate geometry and planting to maximise this benefit.

- 10.16** The storm water management features will be constructed and operational prior to the first use of the site.

- 10.17** It has previously been the case that the functionality of the storm water management system would be ensured by ongoing maintenance, completed by the Local Authority, Drainage Authority, or a private maintenance company as appropriate. It is proposed that, for this development, a private maintenance company will be appointed to carry out the maintenance regime below in **Table 10-3**.

- 10.18** It is usual for the following maintenance regime to be implemented:

Frequency	Operation
Post major storm events	Inspection and removal of debris.
Every two months	Grass mowing (growing season) & litter removal.
Annual	Weeding & vegetation maintenance. Minor swale clearance. Sweeping of
2 years	Tree pruning.
5-10 years	Desilting of channels. Remove silt around inlet and outlet structures.
15-20 years	Major vegetation maintenance and watercourse channel works.

Table 10-3: Framework maintenance of detention / retention system

- 10.19** The conceptual drainage masterplan proposals outlined in this report will be used for final drainage design and detailing. The storm water management system will be constructed and operational in full prior to first use of the relevant phase of development.

11 Foul Drainage

Background

- 11.1** A copy of the Southern Water sewerage network records has been obtained which confirms the presence of a rising main crossing through the development site. Foul and surface water sewers are located within Pagham Road which bounds the west of the site.
- 11.2** The proposed development area lies approximately 500m east from the treatment works believed to be serving the site.

Design Criteria / Network Requirements

- 11.3** Peak design discharges have been calculated based on the current development criteria as described in Section 2 of this report and for the following:

<i>Domestic peak (peak)</i>	=	<i>4,000 litres / dwelling / day</i>
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- 11.4** Assessed in accordance with the Design and Construction Guidance for Foul and Surface Water Sewers requirements, the development will have a design peak discharge of approximately 5.5l/s.
- 11.5** A review of the Chichester Local Plan Website, includes for a note prepared by CDC in August 2021 noted that the Pagham Wastewater Treatment Works has an estimated remaining capacity for approximately 734 dwellings. This has been combined by CDC from Environment Agency and Southern Water data. Therefore, there is indicatively enough headroom in the Wastewater Treatment Works for the proposed development of Land at Pagham Road.
- 11.6** Furthermore, the *Statement of Common Ground between Chichester District Council, Environment Agency and Southern Water – Waste Water Treatment in Chichester Plan Area* document produced on the 24th November 2021, confirmed:
- The improvement schemes at Pagham WWTW, which include a growth design horizon up to 2035 are due for completion by 2025 – more information about the options and capacity is expected to be available by the end of 2021*
- Combined growth and quality improvement schemes for Pagham WWTW due for completion by 2025 will provide additional capacity there.*
- 11.7** Therefore, the document provides confirmation that capacity will be available for the proposed development Site.

Network Requirements / Options

- 11.8** SW has been contacted to provide a pre-development enquiry for the Site. SW has confirmed a connection from the proposed development to the 150mm sewer along Pagham Road, to the south-east of the Site currently has inadequate capacity to supply the proposed development. Therefore, additional off-site

sewers/improvements to the existing sewer will be required to provide sufficient capacity. With the Ofwat instigated changes in April 2018, SW has confirmed that they have a duty to provide network capacity from the practicable Point of Connection, funded through the New Infrastructure Charges.

- 11.9** SW have provided confirmation the nearest Point of Connection with sufficient capacity for 120 dwellings would be the Pagham Wastewater Treatment Works (WTW), situated approximately 600m west of the Site. Rights are not issued to a direct connection to the WTW and therefore the connection would need to be agreed with Southern Water, prior to the works being carried out.

Treatment Requirements

- 11.10** Water companies have a statutory obligation through the Water Industry Act 1991, 2003 et al., to provide capital investment in strategic treatment infrastructure to meet development growth. This investment planning is managed and regulated by OFWAT through the Asset Management Plan (AMP) process. The five yearly cyclical process requires that water companies allocate finances to a range of strategic projects to meet their statutory obligations.

- 11.11** Where development programming requirements necessitate the reinforcement of facilities ahead of allocation in an AMP period, mechanisms are available to ensure the infrastructure can be delivered in a timely fashion, to meet the development programme.

Implementation Proposals

- 11.12** The proposed drainage network across the site will be designed to current Design and Construction Guidance for Foul and Surface Water Sewers standards, employing a point of connection agreed with Southern Water. The system will be offered for the adoption of Southern Water under S104 of the Water Industry Act 1991.

Summary

- 11.13** A site drainage strategy has been developed that meets with current regulatory requirements by discharging drainage to a sewerage network with capacity to accommodate the flows.
- 11.14** Once development is complete, the network conveying flows from the site will be adopted by Southern Water and be maintained as part of their statutory duties.

Objectives

- 11.15** The key development objectives required for the site drainage scheme are:
- Implementation of a drainage scheme to convey water to the local Southern Water network which is designed and maintained to an appropriate standard.

12 Summary

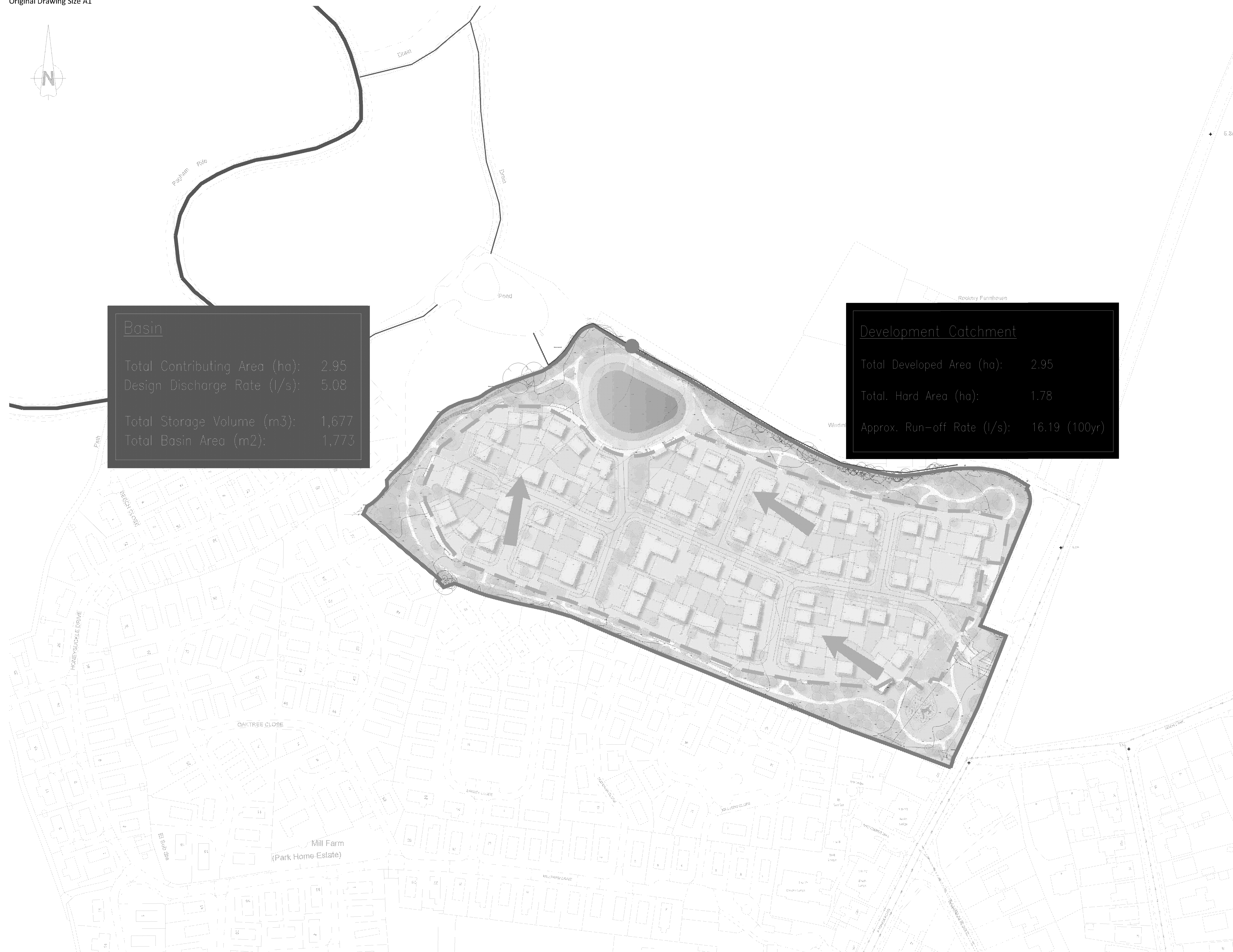
- 12.1** This FRA has identified no prohibitive engineering constraints in developing the proposed site for the proposed developments.
- 12.2** The site is fully able to comply with NPPF guidance together with associated local and national policy and guidance.
- 12.3** In regards to policy W DM2 Flood Risk, the proposed SuDS will discharge to QBAR, reducing the flood risk further downstream. The detention basins has been designed to accommodate the 1 in 100 year + 40% storm event, with a 300mm freeboard.
- 12.4** And to policy W DM3 Sustainable Urban Drainage Systems, a full SI investigation will be completed at reserved matters. Until the SI has been completed the proposed strategy has not assumed any infiltration SuDS. The SuDS will provide at least 1 level of treatment before discharging surface water into the existing drainage network.
- 12.5** Assessment of fluvial flood risk shows the land to lie within Flood Zone 1 and hence be a preferable location for residential development when considered in the context of the NPPF Sequential Test. Assessment of other potential flooding mechanisms shows the land to have a low probability of flooding from overland flow, ground water and sewer flooding.
- 12.6** Storm water discharged from development will be disposed of by way of SuDS measures to the existing ditch within the site. A detention basin located at the lowest point of the site has been proposed to detention and discharge surface water to a rate of QBAR.
- 12.7** Means to discharge foul water drainage have been established that comply with current guidance and requirements of Southern Water.

13 Limitations

- 13.1** The conclusions and recommendations contained herein are limited to those given the general availability of background information and the planned usage of the site.
- 13.2** Third party information has been used in the preparation of this report, which Brookbanks, by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Brookbanks accepts no liability for same.
- 13.3** The benefits of this report are provided solely to Hallam Land Management Ltd for the proposed development Land West of Pagham Road only.
- 13.4** Brookbanks excludes third party rights for the information contained in the report.



Appendix A - Drainage Plan



1. Do not scale from this drawing.
2. All dimensions are in metres unless otherwise stated.
3. Brookbanks Consulting Ltd has prepared this drawing for the sole use of the client. The drawing may not be relied upon by any other party without the express agreement of the client and Brookbanks Consulting Ltd. Where any data supplied by the client or from other sources has been used, it has been assumed that the information is correct. No responsibility can be accepted by Brookbanks Consulting Ltd for inaccuracies in the data supplied by any other party. The drawing has been produced based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.
4. No part of this drawing may be copied or duplicated without the express permission of Brookbanks Consulting Ltd.

	Red Line Site Boundary
	Existing Watercourse and Drainage Network
	Catchment Boundary
	Flow Direction Arrows
	SuDS Basin
	Indicative Pipe Network
	Surface Water Outfall
	Foul Water Main (Southern Water)
	Surface Water Main (Southern Water)

A	Updated Masterplan	KM	LW	LW	03.12.21
-	First Issue	KM	LW	LW	01.11.21



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Hallam Land Management

Land at Paghham II

Illustrative Surface Water Drainage Strategy

Status		Status Date
Draft		DEC 2021
Drawn	Checked	Date
KM	LW	01.11.21
Scale	Number	Rev
1:1000	10821-DR-01	A

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT HIS OWN RISK.

 Appendix B - 10H Greenfield Runoff Rates

Calculated by: Alejandro Ortiz

Site name: Pagham II

Site location:

Site Details

Latitude: 50.78329° N

Longitude: 0.73661° W

Reference: 3315680026

Date: Nov 01 2021 09:16

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 4.9

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	694	694
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	13.94	13.94
1 in 1 year (l/s):	11.85	11.85
1 in 30 years (l/s):	32.05	32.05
1 in 100 year (l/s):	44.45	44.45
1 in 200 years (l/s):	52.12	52.12

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

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 Appendix C - WinDES Detention Calculations

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Brookbanks Consulting					Page 2
6150 Knights Court Solihull Parkway Birmingham, B37 7WY			Catchment		
Date 03/12/2021 12:21			Designed by Brookbanks		
File Catchment (December 202...			Checked by		
Innovyze			Source Control 2019.1		
Summary of Results for 30 year Return Period					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.347	0.347	5.1	417.6	O K
120 min Winter	0.423	0.423	5.1	516.2	O K
180 min Winter	0.473	0.473	5.1	581.1	O K
240 min Winter	0.509	0.509	5.1	629.9	O K
360 min Winter	0.562	0.562	5.1	701.3	O K
480 min Winter	0.600	0.600	5.1	752.6	O K
600 min Winter	0.628	0.628	5.1	791.8	O K
720 min Winter	0.651	0.651	5.1	822.9	O K
960 min Winter	0.645	0.645	5.1	815.3	O K
1440 min Winter	0.619	0.619	5.1	778.7	O K
2160 min Winter	0.573	0.573	5.1	715.8	O K
2880 min Winter	0.530	0.530	5.1	657.3	O K
4320 min Winter	0.478	0.478	5.1	588.0	O K
5760 min Winter	0.422	0.422	5.1	514.0	O K
7200 min Winter	0.367	0.367	5.1	443.8	O K
8640 min Winter	0.318	0.318	5.1	380.8	O K
10080 min Winter	0.274	0.274	5.0	326.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	28.828	0.0	411.0	70	
120 min Winter	18.132	0.0	517.3	128	
180 min Winter	13.824	0.0	589.9	186	
240 min Winter	11.404	0.0	645.9	244	
360 min Winter	8.694	0.0	727.6	360	
480 min Winter	7.172	0.0	779.1	476	
600 min Winter	6.178	0.0	800.9	592	
720 min Winter	5.458	0.0	800.2	708	
960 min Winter	4.288	0.0	786.7	934	
1440 min Winter	3.044	0.0	755.0	1360	
2160 min Winter	2.161	0.0	1142.6	1672	
2880 min Winter	1.695	0.0	1190.8	2112	
4320 min Winter	1.261	0.0	1303.3	2992	
5760 min Winter	1.023	0.0	1461.0	3856	
7200 min Winter	0.869	0.0	1551.3	4616	
8640 min Winter	0.761	0.0	1627.7	5368	
10080 min Winter	0.680	0.0	1691.4	6064	
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Brookbanks Consulting		Page 3																																																						
6150 Knights Court Solihull Parkway Birmingham, B37 7WY	Catchment																																																							
Date 03/12/2021 12:21 File Catchment (December 202...	Designed by Brookbanks Checked by																																																							
Innovyze Source Control 2019.1																																																								
Rainfall Details <table><tr><td>Rainfall Model</td><td>FEH</td><td>D2 (1km)</td><td>0.243</td><td>Cv (Summer)</td><td>0.750</td></tr><tr><td>Return Period (years)</td><td>30</td><td>D3 (1km)</td><td>0.359</td><td>Cv (Winter)</td><td>0.840</td></tr><tr><td>FEH Rainfall Version</td><td>1999</td><td>E (1km)</td><td>0.308</td><td>Shortest Storm (mins)</td><td>15</td></tr><tr><td>Site Location</td><td></td><td>F (1km)</td><td>2.319</td><td>Longest Storm (mins)</td><td>10080</td></tr><tr><td>C (1km)</td><td>-0.026</td><td>Summer Storms</td><td>Yes</td><td>Climate Change %</td><td>+0</td></tr><tr><td>D1 (1km)</td><td>0.419</td><td>Winter Storms</td><td>Yes</td><td></td><td></td></tr></table> Time Area Diagram Total Area (ha) 1.780 <table><tr><th>Time (mins)</th><th>Area</th><th>Time (mins)</th><th>Area</th><th>Time (mins)</th><th>Area</th></tr><tr><th>From: To:</th><th>(ha)</th><th>From: To:</th><th>(ha)</th><th>From: To:</th><th>(ha)</th></tr><tr><td>0 4</td><td>0.593</td><td>4 8</td><td>0.593</td><td>8 12</td><td>0.593</td></tr></table>			Rainfall Model	FEH	D2 (1km)	0.243	Cv (Summer)	0.750	Return Period (years)	30	D3 (1km)	0.359	Cv (Winter)	0.840	FEH Rainfall Version	1999	E (1km)	0.308	Shortest Storm (mins)	15	Site Location		F (1km)	2.319	Longest Storm (mins)	10080	C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+0	D1 (1km)	0.419	Winter Storms	Yes			Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	0 4	0.593	4 8	0.593	8 12	0.593
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6150 Knights Court Solihull Parkway Birmingham, B37 7WY	Catchment	
Date 03/12/2021 12:21	Designed by Brookbanks	
File Catchment (December 202...	Checked by	
Innovyze	Source Control 2019.1	

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1138.0	1.500	1773.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0104-5100-1200-5100
Design Head (m)	1.200
Design Flow (l/s)	5.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.1
Flush-Flo™	0.358	5.1
Kick-Flo®	0.749	4.1
Mean Flow over Head Range	-	4.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.8	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.1	1.600	5.8	4.000	9.0	8.000	12.5
0.400	5.1	1.800	6.2	4.500	9.5	8.500	12.8
0.500	5.0	2.000	6.5	5.000	10.0	9.000	13.2
0.600	4.8	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.0	6.000	10.9		
1.000	4.7	2.600	7.3	6.500	11.3		

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6150 Knights Court Solihull Parkway Birmingham, B37 7WY			Catchment																																																																																																																																							
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<table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>155.021</td><td>0.0</td><td>410.4</td><td>27</td></tr><tr><td>30 min Summer</td><td>95.387</td><td>0.0</td><td>429.3</td><td>41</td></tr><tr><td>60 min Summer</td><td>58.693</td><td>0.0</td><td>734.8</td><td>72</td></tr><tr><td>120 min Summer</td><td>36.115</td><td>0.0</td><td>825.7</td><td>130</td></tr><tr><td>180 min Summer</td><td>27.184</td><td>0.0</td><td>808.8</td><td>190</td></tr><tr><td>240 min Summer</td><td>22.222</td><td>0.0</td><td>790.3</td><td>250</td></tr><tr><td>360 min Summer</td><td>16.727</td><td>0.0</td><td>766.0</td><td>370</td></tr><tr><td>480 min Summer</td><td>13.673</td><td>0.0</td><td>753.6</td><td>488</td></tr><tr><td>600 min Summer</td><td>11.694</td><td>0.0</td><td>748.9</td><td>608</td></tr><tr><td>720 min Summer</td><td>10.292</td><td>0.0</td><td>750.3</td><td>728</td></tr><tr><td>960 min Summer</td><td>7.998</td><td>0.0</td><td>747.2</td><td>966</td></tr><tr><td>1440 min Summer</td><td>5.606</td><td>0.0</td><td>737.6</td><td>1444</td></tr><tr><td>2160 min Summer</td><td>3.929</td><td>0.0</td><td>1514.4</td><td>2144</td></tr><tr><td>2880 min Summer</td><td>3.053</td><td>0.0</td><td>1459.9</td><td>2448</td></tr><tr><td>4320 min Summer</td><td>2.243</td><td>0.0</td><td>1352.9</td><td>3204</td></tr><tr><td>5760 min Summer</td><td>1.802</td><td>0.0</td><td>2295.0</td><td>4032</td></tr><tr><td>7200 min Summer</td><td>1.521</td><td>0.0</td><td>2414.2</td><td>4840</td></tr><tr><td>8640 min Summer</td><td>1.324</td><td>0.0</td><td>2504.7</td><td>5704</td></tr><tr><td>10080 min Summer</td><td>1.177</td><td>0.0</td><td>2526.2</td><td>6552</td></tr><tr><td>15 min Winter</td><td>155.021</td><td>0.0</td><td>425.4</td><td>27</td></tr><tr><td>30 min Winter</td><td>95.387</td><td>0.0</td><td>431.0</td><td>41</td></tr></table>							Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	155.021	0.0	410.4	27	30 min Summer	95.387	0.0	429.3	41	60 min Summer	58.693	0.0	734.8	72	120 min Summer	36.115	0.0	825.7	130	180 min Summer	27.184	0.0	808.8	190	240 min Summer	22.222	0.0	790.3	250	360 min Summer	16.727	0.0	766.0	370	480 min Summer	13.673	0.0	753.6	488	600 min Summer	11.694	0.0	748.9	608	720 min Summer	10.292	0.0	750.3	728	960 min Summer	7.998	0.0	747.2	966	1440 min Summer	5.606	0.0	737.6	1444	2160 min Summer	3.929	0.0	1514.4	2144	2880 min Summer	3.053	0.0	1459.9	2448	4320 min Summer	2.243	0.0	1352.9	3204	5760 min Summer	1.802	0.0	2295.0	4032	7200 min Summer	1.521	0.0	2414.2	4840	8640 min Summer	1.324	0.0	2504.7	5704	10080 min Summer	1.177	0.0	2526.2	6552	15 min Winter	155.021	0.0	425.4	27	30 min Winter	95.387	0.0	431.0	41																						
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Brookbanks Consulting					Page 2
6150 Knights Court Solihull Parkway Birmingham, B37 7WY			Catchment		
Date 03/12/2021 12:20 File Catchment (December 202...			Designed by Brookbanks Checked by		
Innovyze			Source Control 2019.1		
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.679	0.679	5.1	862.7	O K
120 min Winter	0.811	0.811	5.1	1052.5	O K
180 min Winter	0.896	0.896	5.1	1178.3	O K
240 min Winter	0.959	0.959	5.1	1273.7	O K
360 min Winter	1.051	1.051	5.1	1415.7	O K
480 min Winter	1.117	1.117	5.1	1520.4	O K
600 min Winter	1.168	1.168	5.1	1602.6	O K
720 min Winter	1.209	1.209	5.1	1669.4	Flood Risk
960 min Winter	1.214	1.214	5.1	1677.8	Flood Risk
1440 min Winter	1.202	1.202	5.1	1658.8	Flood Risk
2160 min Winter	1.162	1.162	5.1	1593.7	O K
2880 min Winter	1.111	1.111	5.1	1511.1	O K
4320 min Winter	1.070	1.070	5.1	1446.7	O K
5760 min Winter	1.026	1.026	5.1	1376.9	O K
7200 min Winter	0.976	0.976	5.1	1300.3	O K
8640 min Winter	0.924	0.924	5.1	1220.5	O K
10080 min Winter	0.869	0.869	5.1	1138.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	58.693	0.0	801.0	70	
120 min Winter	36.115	0.0	813.3	130	
180 min Winter	27.184	0.0	789.3	188	
240 min Winter	22.222	0.0	773.8	246	
360 min Winter	16.727	0.0	760.2	364	
480 min Winter	13.673	0.0	761.2	482	
600 min Winter	11.694	0.0	773.1	598	
720 min Winter	10.292	0.0	786.2	716	
960 min Winter	7.998	0.0	785.3	948	
1440 min Winter	5.606	0.0	773.7	1406	
2160 min Winter	3.929	0.0	1528.0	2076	
2880 min Winter	3.053	0.0	1482.4	2708	
4320 min Winter	2.243	0.0	1420.4	3376	
5760 min Winter	1.802	0.0	2566.6	4328	
7200 min Winter	1.521	0.0	2692.1	5264	
8640 min Winter	1.324	0.0	2736.9	6152	
10080 min Winter	1.177	0.0	2624.3	7064	
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Brookbanks Consulting		Page 3
6150 Knights Court Solihull Parkway Birmingham, B37 7WY	Catchment	
Date 03/12/2021 12:20 File Catchment (December 202...	Designed by Brookbanks Checked by	
Innovyze Source Control 2019.1		

Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.243	Cv (Summer)	0.750
Return Period (years)	100	D3 (1km)	0.359	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.308	Shortest Storm (mins)	15
Site Location		F (1km)	2.319	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.419	Winter Storms	Yes		

Time Area Diagram

Total Area (ha) 1.780

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.593	4 8	0.593	8 12	0.593

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Brookbanks Consulting		Page 4
6150 Knights Court Solihull Parkway Birmingham, B37 7WY	Catchment	
Date 03/12/2021 12:20	Designed by Brookbanks	
File Catchment (December 202...	Checked by	
Innovyze	Source Control 2019.1	

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1138.0	1.500	1773.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0104-5100-1200-5100
Design Head (m)	1.200
Design Flow (l/s)	5.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.1
Flush-Flo™	0.358	5.1
Kick-Flo®	0.749	4.1
Mean Flow over Head Range	-	4.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.8	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.1	1.600	5.8	4.000	9.0	8.000	12.5
0.400	5.1	1.800	6.2	4.500	9.5	8.500	12.8
0.500	5.0	2.000	6.5	5.000	10.0	9.000	13.2
0.600	4.8	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.0	6.000	10.9		
1.000	4.7	2.600	7.3	6.500	11.3		

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 Appendix D – Southern Water Sewer Records



0m 250m

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Date: 13/10/21

Scale: 1:1250

Map Centre: 499366.99044

Data updated: 20/09/21

Our Ref: 673132 - 2

Wastewater Plan A0

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2021. Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other use of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

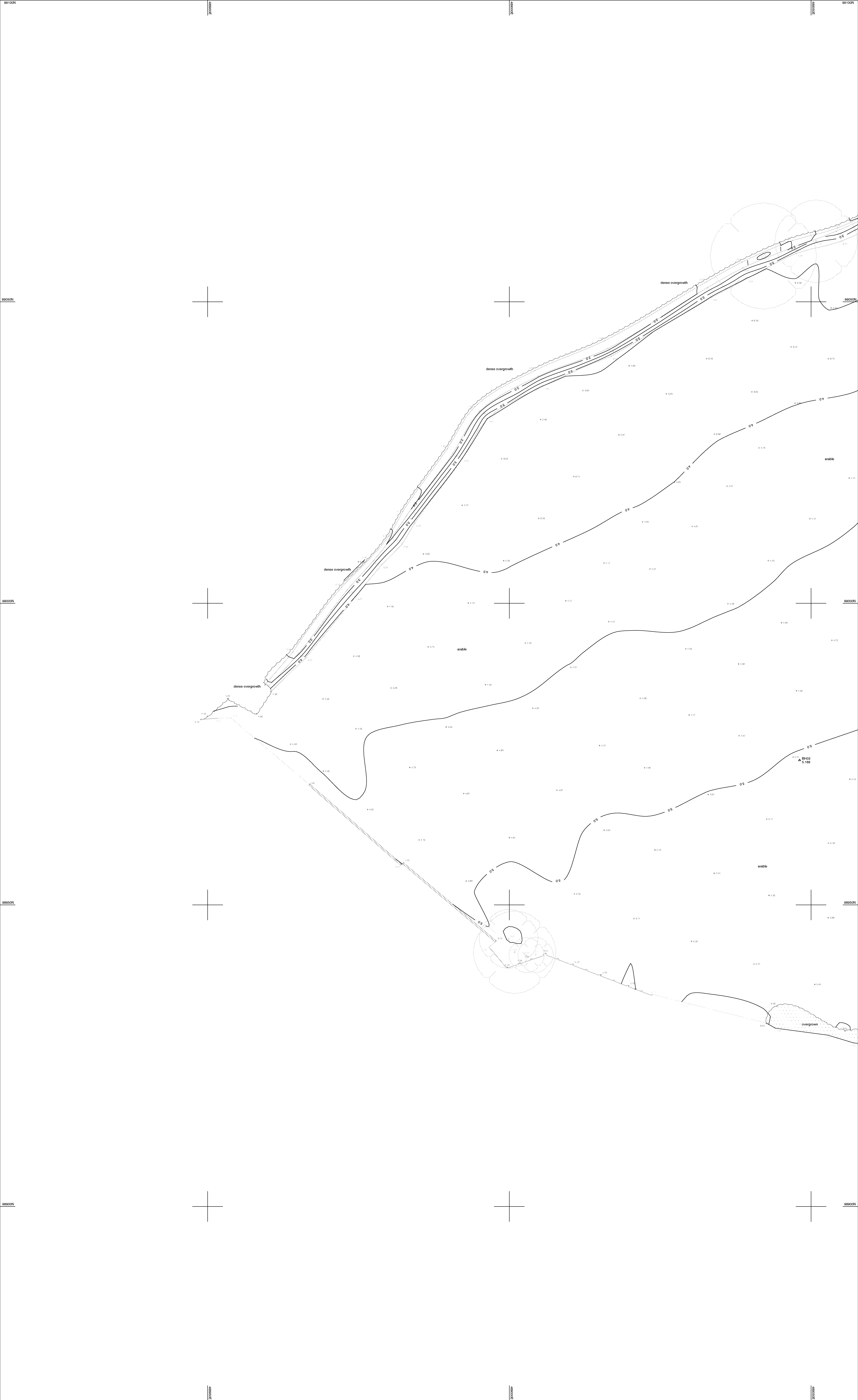
WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

acam.mela@brookbanks.com

Pagham



 Appendix E – Topographic Survey



Symbol & Abbreviation Key			
	BARBED WIRE FENCE		KERB
	POST & RAIL FENCE		DROPPED KERB
	CLOSE BOARD FENCE		GULLY CHANNEL
	RAILINGS		TOP - BOTTOM OF BANK
	CHAIN LINK FENCE		FOLIAGE
	OTHER FENCE		DITCH
	KERB		VENGE
	DROPPED KERB		OVERHEAD CABLES
	GULLY CHANNEL		GATE
	TOP - BOTTOM OF BANK		HEDGE
	FOLIAGE		TREE - BROAD LEAVED
	DITCH		TREE - CONIFEROUS
	VENGE		BUSH
	OVERHEAD CABLES		BUILDINGS
	GATE		BOREHOLE
	HEDGE		SURVEY STATION
	TREE - BROAD LEAVED		ORDNANCE SURVEY BENCH MARK
	TREE - CONIFEROUS		
	BUSH		
	BUILDINGS		
	BOREHOLE		
	SURVEY STATION		
	ORDNANCE SURVEY BENCH MARK		
A/C	AIR CONDITIONING UNIT	KO	KERB OFF/LET
AV	AIR VALVE	LC	LIGHTING COLUMN
BOL	BOLLARD	LP	LAMP POST
BO	BORERHOLE	NP	NAME PLATE
BL	BED LEVEL	NB	NOTICE BOARD
BM	BENCH MARK	PS	Pipe RISER
BT	BRITISH TELECOM	RP	RODGING POINT
CL	CABLE LEVEL	RS	ROAD SIGN
CTV	CABLE TV	SP	SIGN POST
CL	COVER LEVEL	SV	STOP VALVE
OR	CABLE RISER	TL	TRAFFIC LIGHT
DP	DOWN PIPE	TP	TELEGRAPH POLE
ER	EARTH ROD	TOF	TOP OF FENCE
EP	ELECTRICITY POLE	TOH	TOP OF HEDGE
EM	ELECTRICITY MARKER	TOW	TOP OF WALL
FB	FUSE BOX	TOR	TOP OF RAILINGS
FH	FIRE HYDRANT	TOS	SOURCE LEVEL
FP	FENCE POST	U/L	UNABLE TO LEFT
FL	FLOOR LEVEL	VM	VALVE MARKER
GV	GAS VALVE	VP	VENT PIPE
GM	GAS MARKER	WL	WATER LEVEL
GU	GULLY	WM	WATER MARKER
HM	HYDRANT MARKER	WO	WASH OUT
L	INVERT LEVEL		

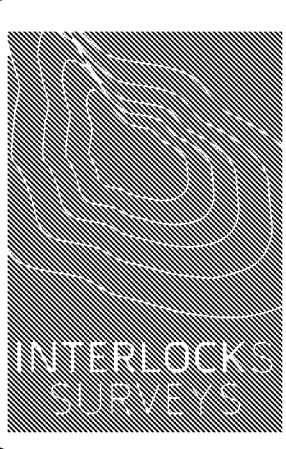
General.
This survey has been prepared with a scaling accuracy for a plot at a scale of 1:200.
All tree heights and spreads are approximate. We have tried to identify tree types, however if tree species are critical specialist advice should be gained.
Drainage pipe sizes have been measured from the surface. Chamber access has not been planned for safety reasons, therefore sizes should be regarded as approximate.
Some detail may have been omitted due to parked vehicles.

Notes.
Coordinates related to previous survey, drawing number 210841.
Levels related to previous survey, drawing number 210841.



Rev	Details of Revision	Drawn	Date

Surveyed	Drawn	Date	Checked	Date	Approved	Date
BM	BM	16/10/21	GD	18/10/21	GD	18/10/21



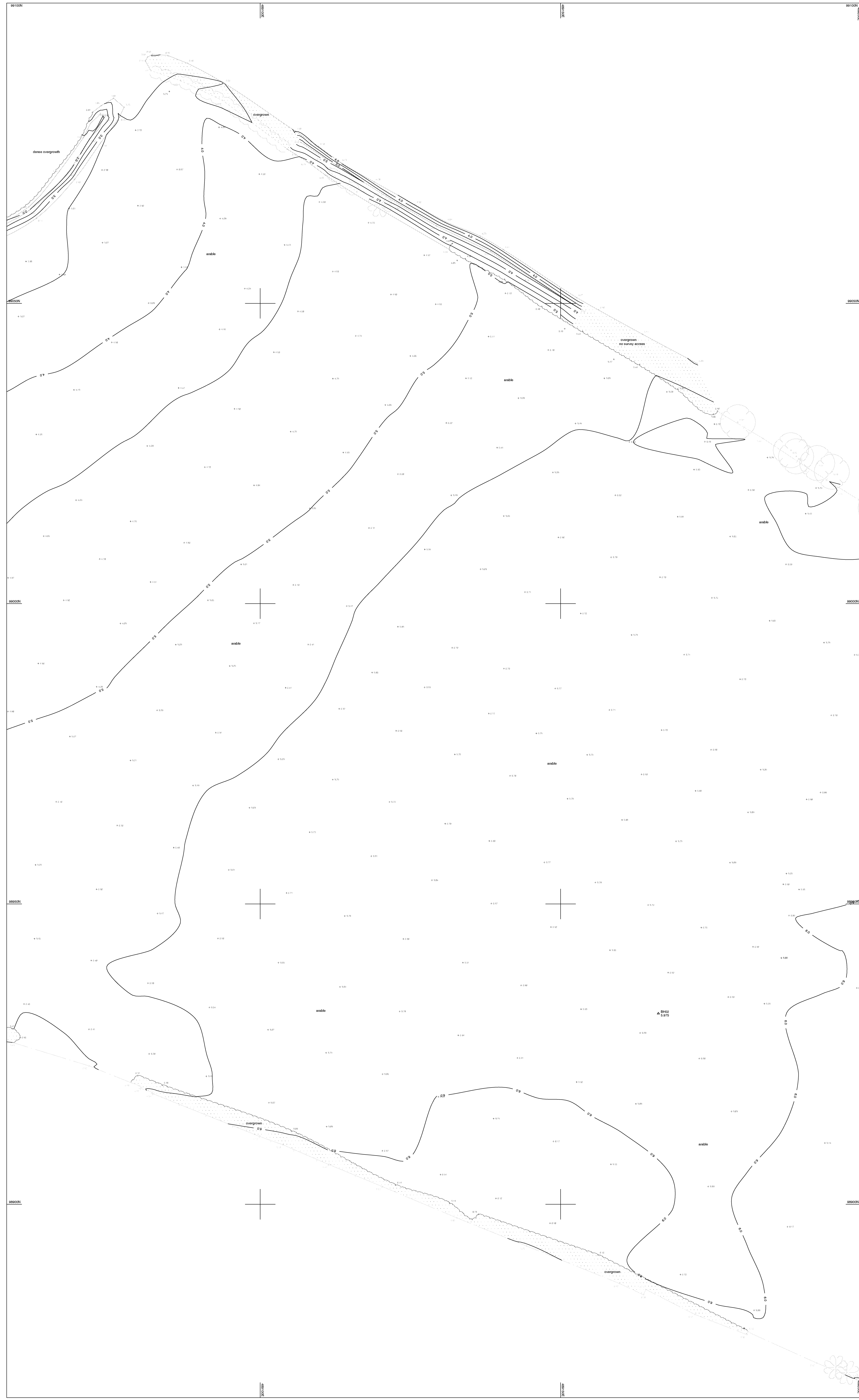
Interlocks Surveys Limited
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Client.
HALLAM LAND MANAGEMENT SOUTH EAST EAST
3RD FLOOR
43 PORTLAND ROAD
LONDON
W1B 1QH

Title.
TOPOGRAPHICAL SURVEY
LAND WEST OF PAGHAM ROAD
PAGHAM
WEST SUSSEX
(PAGHAM II)

Dwg No. **210841** Sheet **1 of 3**
Scale 1:200 A0 Sheet Rev. -



Symbol & Abbreviation Key	
	BARBED WIRE FENCE
	POST & RAIL FENCE
	CLOSE BOARD FENCE
	RAILINGS
	CHAIN LINK FENCE
	OTHER FENCE
	KERB
	DROPPED KERB
	GULLY CHANNEL
	TOP / BOTTOM OF BANK
	FOLIAGE
	DITCH
	VENGE
	OVERHEAD CABLES
	GATE
	HEDGE
	TREE - BROAD LEAVED
	TREE - CONIFEROUS
	BUSH
	BUILDINGS
	BOREHOLE
	SURVEY STATION
	ORDNANCE SURVEY BENCH MARK
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BL	BED LEVEL
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CTV	CABLE TV
CL	COVER LEVEL
CR	CABLE RISER
DP	DOWN PIPE
ER	EARTH ROD
EP	ELECTRICITY POLE
EM	ELECTRICITY MARKER
FB	FUSE BOX
FH	FIRE HYDRANT
FP	FENCE POST
FL	FLOOR LEVEL
GV	GAS VALVE
GM	GAS MARKER
GU	GULLY
HM	HYDRANT MARKER
L	INVERT LEVEL
KO	KERB OFFLET
LC	LIGHTING COLUMN
LP	LAMP POST
NP	NAME PLATE
NB	NOTICE BOARD
PS	Pipe RISER
RP	ROOFTOP POINT
RS	ROAD SIGN
SP	SEWER POST
SV	STOP VALVE
TL	TRAFFIC LIGHT
TP	TELEGRAPH POLE
TOF	TOP OF FENCE
TOH	TOP OF HEDGE
TOW	TOP OF WALL
TOS	TOP OF RAILINGS
TOV	TOP OF VALVE
UML	UNABLE TO LIFT
VM	VALVE MARKER
VP	VENT PIPE
WL	WATER LEVEL
WM	WATER MARKER
WO	WASH OUT

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Notes.
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Levels related to previous survey, drawing number 210841.

Rev	Details of Revision	Drawn	Date

Surveyed	Drawn	Date	Checked	Date	Approved	Date
BH	BH	16/10/21	GD	18/10/21	GD	18/10/21

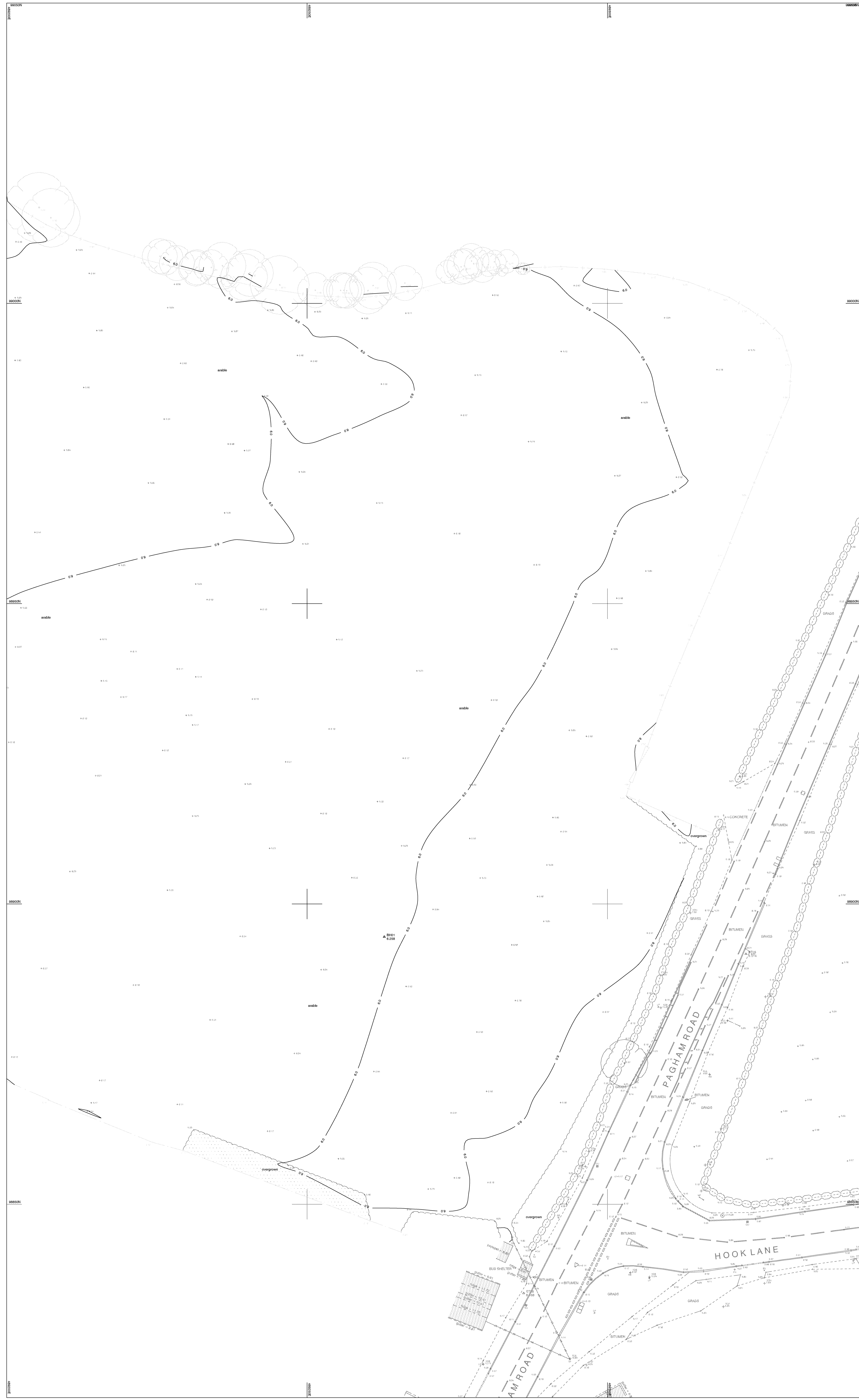
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Client.
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3RD FLOOR
43 PORTLAND ROAD
LONDON
W1B 1QH

Title.
TOPOGRAPHICAL SURVEY
LAND WEST OF PAGHAM ROAD
PAGHAM
WEST SUSSEX
(PAGHAM II)

Dwg No **210841** Sheet **2 of 3**
Scale 1:200 A0 Sheet Rev. -



Symbol & Abbreviation Key	
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	CLOSE BOARD FENCE
	RAILINGS
	CHAIN LINK FENCE
	OTHER FENCE
	KERB
	DROPPED KERB
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TOW	TOP OF WALL
TOS	TOP OF RAILINGS
TOV	TOP OF VALVE
U/L	UNABLE TO LIFT
VM	VALVE MARKER
VP	VENT PIPE
WL	WATER LEVEL
WM	WATER MARKER
WO	WASH OUT

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Surveyed	Drawn	Date	Checked	Date	Approved	Date
BH	BH	16/10/21	GD	16/10/21	GD	16/10/21

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Title.

TOPOGRAPHICAL SURVEY
LAND WEST OF PAGHAM ROAD
PAGHAM
WEST SUSSEX
(PAGHAM II)

Dwg No. **210841** Sheet **3 of 3**

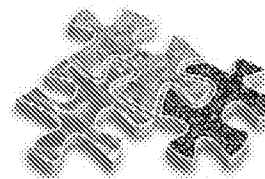
Scale 1:200 A0 Sheet Rev. -



Appendix F – GEG Groundwater Monitoring

GEG | Geo Environmental Group
Geotechnical, Environmental & Ecological Consultants

GEG House, 17 Graham Road, Malvern, WR14 2HR



***GROUNDWATER & INITIAL GAS MONITORING
FACTUAL REPORT***



***'PAGHAM PHASE II'
LAND WEST OF PAGHAM ROAD
PAGHAM, WEST SUSSEX
PO21 3PY***

APRIL 2021

Prepared for:



**Hallam Land
Management**



BROOKBANKS

Registered Company - GEG Ltd
Registered in England No 6469985
Registered Office: Granta Lodge, 71 Graham Rd, Malvern, WR14 2JS



REPORT TITLE:

**GROUNDWATER
& INITIAL GAS
MONITORING
FACTUAL REPORT**

Site Address:

‘Pagham Phase II’
Land West of Pagham Road
Pagham
West Sussex
PO21 3PY

Performed By:
Geo Environmental Group
GEG House
17 Graham Road
Malvern
WR14 2HR

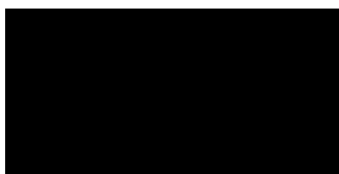
On Behalf Of:
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1. INTRODUCTION

1.1 General

Geo Environmental Group (GEG) were commissioned by Brookbanks on behalf of Hallam Land Management (HLM) (the Client) to undertake groundwater monitoring at a site known as 'Land at Pagham Phase II, West Sussex'.

The aim of the investigation was to:

- Undertake the installation of groundwater monitoring boreholes with subsequent groundwater over the winter months.
- Produce a factual report detailing the work undertaken.

A Phase I Review & Phase II Geo-Environmental Assessment was previously undertaken on a site adjacent to the north east known as 'Land at Pagham, West Sussex' by GEG on behalf of Brookbanks/HLM (Ref. GEG-19-623/PI_PII, dated 30th January 2020).

1.2 Available Information

The following drawings were supplied by Brookbanks:

- 'Pagham Phase II - Groundwater Monitoring Location Plan Request,' Brookbanks on behalf of HLM, Drawing No. 10461-SI-02, dated 10th December 2020.
- Various utility company service drawings.

GEG also purchased additional utility company service drawings of the site.

1.3 Proposed Site Development

It is understood that the site is proposed for residential development; no further information is available at this stage.

1.4 Scope

The works performed by GEG included:

- Preliminary ground investigation for the installation of standpipes for subsequent groundwater monitoring.

Limitations to the scope of the report are outlined in Section 6.



2. SITE SETTING

2.1 Site Location

The site is located in Pagham (approximately 4.5 km west of the centre of Bognor Regis) in West Sussex, at the approximate National Grid Reference 489149E, 98972N. It lies on the western side of Pagham Road south of Rookery Farm and covers an area of approximately 4.6 ha.

A section of the 1:25,000 Ordnance Survey (OS) map identifying the site location is shown in Figure 1 of Appendix A. The site layout plan is presented in Figure 2 (Appendix A) and a photographic record is provided in Appendix B.

2.2 Site Description

The site comprised a relatively level arable agricultural field bounded by mature hedgerow with occasional deciduous trees.

Topographically, the site was relatively level at an elevation of approximately 5m AOD.

2.3 Adjacent Land Uses

A summary of surrounding land-use in the immediate vicinity of the site is provided below.

North East	Small drain followed by Rockery Farm.
South East	Pagham Road followed by an agricultural field.
South West	Residential development.
North West	Residential development and agricultural fields.

3. GEOLOGY, HYDROLOGY, HYDROGEOLOGY

3.1 Published Geology

Reference to the 1:50,000 scale British Geological Survey digital mapping of the area (solid and drift) indicates that the solid geology beneath the site comprises the London Clay Formation of the Palaeogene period. It is described as poorly laminated, blue grey or grey brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand.

The solid geology is conjectured to be overlain by superficial deposits of River Terrace Deposits (RTD) across the majority of the site, described generically as sand and gravel, locally with lenses of silt, clay or peat. The westernmost section of the site is conjectured to be overlain by Raised Beach Deposits 1, generically described as shingle, sand, silt and clay. Raised Marine Deposits (clay, silt, sand and gravel) are also indicated to overlie the central part of the western boundary.



No faults are conjectured to intersect the site at the surface.

3.2 Hydrogeology

3.2.1 Groundwater Designation

The database search report indicates that the solid geology directly beneath the site is designated as Unproductive Strata.

Unproductive Strata - are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The superficial deposits of the River Terrace Deposits are characterised as a Secondary A Aquifer and the Raised Beach and Marine Deposits as a Secondary Undifferentiated Aquifer.

Secondary A Aquifers are defined as permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Secondary (Undifferentiated) Aquifers are assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

3.2.2 Groundwater Source Protection Zone

The site does not lie within a currently defined Groundwater Source Protection Zone (GWSPZ).

3.3 Hydrology

3.3.1 Nearest Watercourse

The nearest surface water feature is a drain adjacent to the north of the site flowing westwards (via a pond approximately 25m west of the site) towards the Pagham Rife approximately 225m west of the site.

3.3.2 Surface Water Flooding

According to the Environment Agency online 'Flood Map for Planning', the majority of the site lies within Flood Zone 1, being land that lies outside the 1 in 1000 year (0.1%AEP) flood risk area and hence has a low probability of flooding.

However, Flood Zones 2 and 3 marginally extend over the north western boundary of the site.

Flood Zone 2: This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.



Flood Zone 3: This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

3.4 Ordnance

According to regional unexploded bomb risks maps provided by Zetica, the site falls within an area of low bomb risk and therefore no further action is required.

4. INTRUSIVE INVESTIGATION

4.1 Site Works Overview

The following section outlines the scope of the intrusive investigation carried out by GEG in accordance with the Brookbanks specification and details the ground conditions encountered and the chemical testing undertaken.

All work was undertaken in general accordance with British Standard guidance (BS:5930:2015 and BS:10175) and the ICE UK Specification for Ground Investigation (2nd Edition 2012) guidelines.

Prior to commencement of the works, service plans were viewed in order to investigate the location of all major services and each exploratory hole location screened with a cable avoidance tool.

The exploratory holes were logged and sampled by an experienced geo-environmental engineer from GEG. The ground conditions encountered were recorded on the exploratory hole logs (Appendix C). Where the sample is disturbed but some guidance as to the in-situ consistency can be sensibly given, the consistency term is given in brackets, in accordance with BS:5930:2015.

The locations of the exploratory holes are shown on Figure 2 presented in Appendix A.

4.1.1 Limitations of Intrusive Investigation

There were no limitations to access across the site for the duration of the intrusive investigation.

4.1.2 Reinstatement

All boreholes were installed with 50mm diameter gas and groundwater monitoring standpipes and lockable flush cover. The surface covers were removed following completion of the groundwater monitoring to allow crop rotation.

4.2 Site Works

4.2.1 General

The intrusive investigation was undertaken on 21st and 22nd January 2021 and comprised window sample boreholes.



4.2.2 Window Sample Holes

7 No. window sample boreholes (WS01-WS07) were drilled using a Competitor Dart dynamic sampling rig to a maximum depth of 5.00m. Each window sample hole was preceded by concrete coring and a hand excavated service avoidance pit to a maximum depth of 1.20m below ground level (BGL).

All boreholes were installed with 50mm diameter standpipes to depths detailed on the exploratory hole logs for subsequent groundwater monitoring. Although, boreholes typically refused on dense SAND prior to reaching 5.00m depth, all standpipes were installed below the groundwater level encountered during drilling.

4.2.3 Rationale for Exploratory Holes

The rationale for the exploratory locations, which was undertaken in accordance with the Brookbanks' specification, is given in Table 1 below. A plan showing the location of the exploratory holes is included as Figure 2.

Table 1. Rationale for Exploratory Holes

Exploratory Hole	Rationale
WS01-WS07	General coverage

4.2.4 Initial Gas Monitoring

Initial gas monitoring was undertaken on 26th February and 26th March 2021. The standpipes were monitored for methane, carbon dioxide, oxygen, hydrogen sulphide and the borehole flow rate using a GA2000 gas analyser. Atmospheric pressure and trend was also recorded.

Table 2. Gas Monitoring Results

Borehole	Date	Atmospheric Pressure (mb)	Atmospheric Pressure Trend	Methane (% Vol.)	Carbon Dioxide (% Vol.)	Oxygen (% Vol.)	Hydrogen Sulphide (ppm)	Borehole Flow (l/hr)
WS01	26/02/21	Borehole location flooded at surface						
	26/03/21	1008	Falling	0.0	0.3	18.8	0	0.0
WS02	26/02/21	1035	Rising	0.0	0.2	19.6	0	0.5
	26/03/21	1008	Falling	0.0	0.5	16.5	0	0.0
WS03	26/02/21	1033	Rising	0.0	0.0	20.3	0	0.7
	26/03/21		Falling	0.0	0.0	21.1	0	0.0
WS04	26/02/21	Borehole location flooded at surface						
	26/03/21	1007	Falling	0.0	0.1	20.5	0	0.0
WS05	26/02/21	1035	Rising	0.0	0.1	21.1	0	0.3



Borehole	Date	Atmospheric Pressure (mb)	Atmospheric Pressure Trend	Methane (% Vol.)	Carbon Dioxide (% Vol.)	Oxygen (% Vol.)	Hydrogen Sulphide (ppm)	Borehole Flow (l/hr)
	26/03/21	1008	Falling	0.0	0.1	20.8	0	0.0
WS06	26/02/21	1033	Rising	0.0	0.6	20.1	0	1.0
	26/03/21	1007	Falling	0.0	0.9	19.4	0	0.1
WS07	26/02/21	1035	Rising	0.0	0.0	21.2	0	0.2
	26/03/21	1007	Falling	0.0	0.3	20.7	0	0.1

The gas monitoring results recorded low methane concentrations of 0.0% and low carbon dioxide concentrations of 0.0% to 0.9% with a maximum borehole flow rate 1.0 l/hr.

The water levels were monitored using a dip meter; results are presented in Section 4.3.6.

4.3 Ground Conditions Encountered

The ground conditions encountered are described below and broadly confirmed the published geology.

4.3.1 Made Ground

No Made Ground was encountered in the exploratory holes.

4.3.2 Topsoil

Typically soft CLAY topsoil was encountered across site to depths of 0.30m to 0.40m.

4.3.3 River Terrace Deposits

River Terrace Deposits were encountered underlying the topsoil to depths of >2.50m to >4.00m and typically comprised horizons of variably gravelly firm CLAY and medium dense to dense SAND. Soft to firm CLAY was encountered from 1.60m to 2.30m in WS05.

4.3.4 Raised Beach / Marine Deposits

Raised Beach / Marine Deposits were not encountered in the exploratory holes. However, as these deposits are potentially similar in composition to the River Terrace Deposits, differentiation between the strata is sometimes problematic.

4.3.5 London Clay Formation

The London Clay Formation was encountered underlying the River Terrace Deposits in 1 No. location (WS02) from a depth of 3.00m to the base the exploratory hole. It comprised stiff CLAY.



4.3.6 Groundwater

Groundwater was encountered in all of the exploratory holes during the investigation, as detailed in Table 3A.

Table 3A. Groundwater Inflows Recorded During the Investigation

Exploratory Hole	Groundwater Depth (m)	Stratum
WS01	1.00	River Terrace Deposits
WS02	0.83	
WS03	0.78	
WS04	0.30	
WS05	0.90	
WS06	0.79	
WS07	0.38	

Groundwater levels recorded in the boreholes during the subsequent monitoring visits are summarised in Table 3B.

Table 3B. Groundwater Levels Recorded During the Monitoring Visits

Borehole	Date	Depth of Installation (m)	Groundwater Depth (m)
WS01	26.02.21	2.50	Flooded at Surface
	26.03.21		0.74
WS02	26.02.21	4.00	0.88
	26.03.21		1.08
WS03	26.02.21	2.00	0.77
	26.03.21		0.85
WS04	26.02.21	2.00	0.44
	26.03.21		0.81
WS05	26.02.21	2.00	0.86
	26.03.21		1.08
WS06	26.02.21	2.50	1.15
	26.03.21		1.38
WS07	26.02.21	1.50	0.76
	26.03.21		0.99

It should be noted that groundwater levels may vary due to seasonal and other effects.

5. REFERENCES

1. British Standard Institute (1990) BS: 1377 Parts 1-9. Methods of Tests for Soils for Civil Engineering Purposes.
2. British Standard Institute (2015) BS: 5930 Code of Practice for Site Investigations. BSI, London.
3. British Standard Institute (2015+A1:2019) BS: 8485 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.



4. British Standard Institute (2011) BS: 10175 Code of Practice for Investigation of Potentially Contaminated Sites. BSI, London.
5. BRE Report 414 (2001). Protective measures for housing on gas-contaminated land. BRE Press, Berkshire.
6. BRE Digest 412 (February 1996). Desiccation in clay soils.
7. ICE Publishing (2012) UK Specification for Ground Investigation – Second Edition. Site Investigation Steering Group.
8. Wilson, S. & Card, G. CIRIA/Environmental Protection UK Ground Gas Seminar – 22nd June 2011 and 13th September 2011. A pragmatic approach to ground gas risk assessment for the 21st Century.

6. LIMITATIONS

As with all intrusive site investigations, there is a possibility that localised contamination ‘hotspots’/geotechnical features remain undetected on the site. Therefore, as with standard practices, this report does not provide a warranty to cover limited localised contamination ‘hotspots’/geotechnical features or any post-investigation importation of contamination.

The conclusions and recommendations stated herein are based on information available at the time of production. These may not necessarily apply if the site is to be utilised for a more or less sensitive purpose in the future, or if operational procedures or management alter over time.

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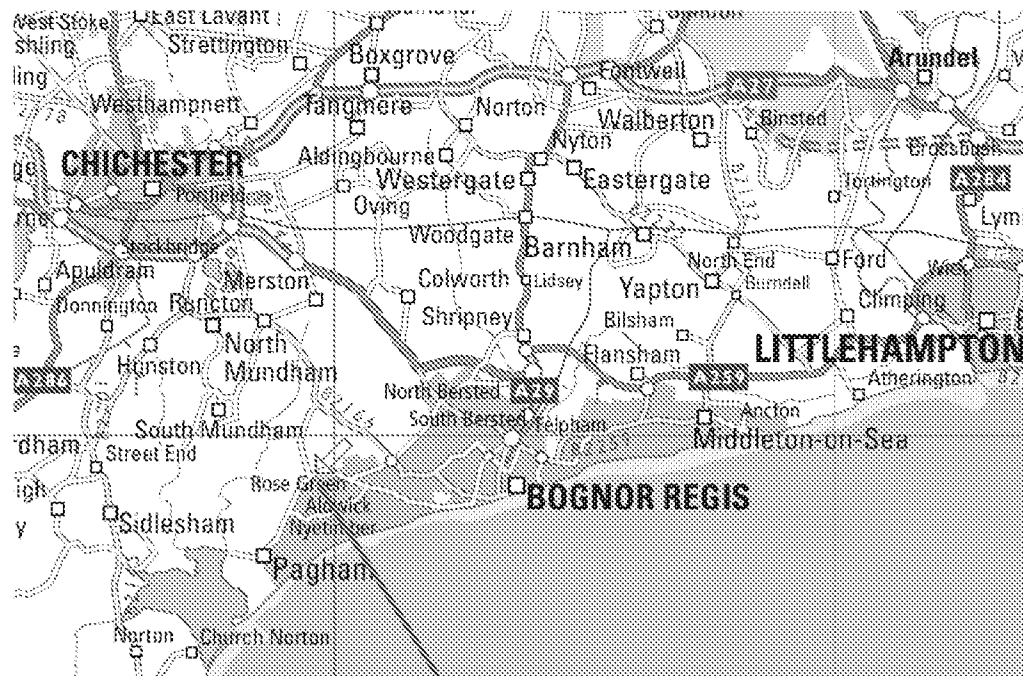
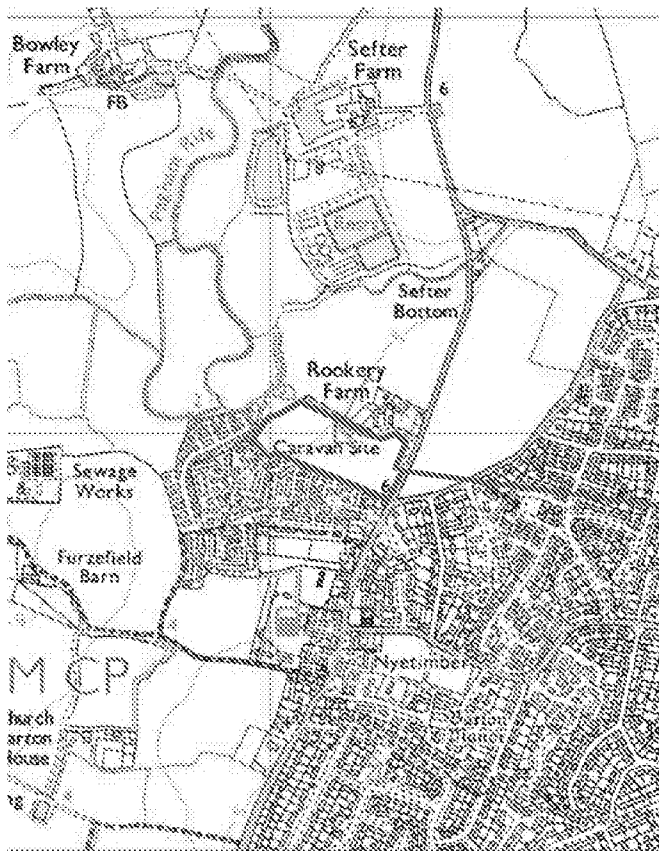
It should be noted that any warranty or liability offered or incurred by GEG, related to this report commences from the date of first issue of this report and is not altered by subsequent report revisions.

Whilst GEG may identify the presence of potential invasive plant species during the standard geo-environmental walkover and/or investigations, the Client should be aware that ecological issues including an invasive species surveys etc. are beyond the scope of the works and as such no associated liability is accepted by GEG.



APPENDIX A

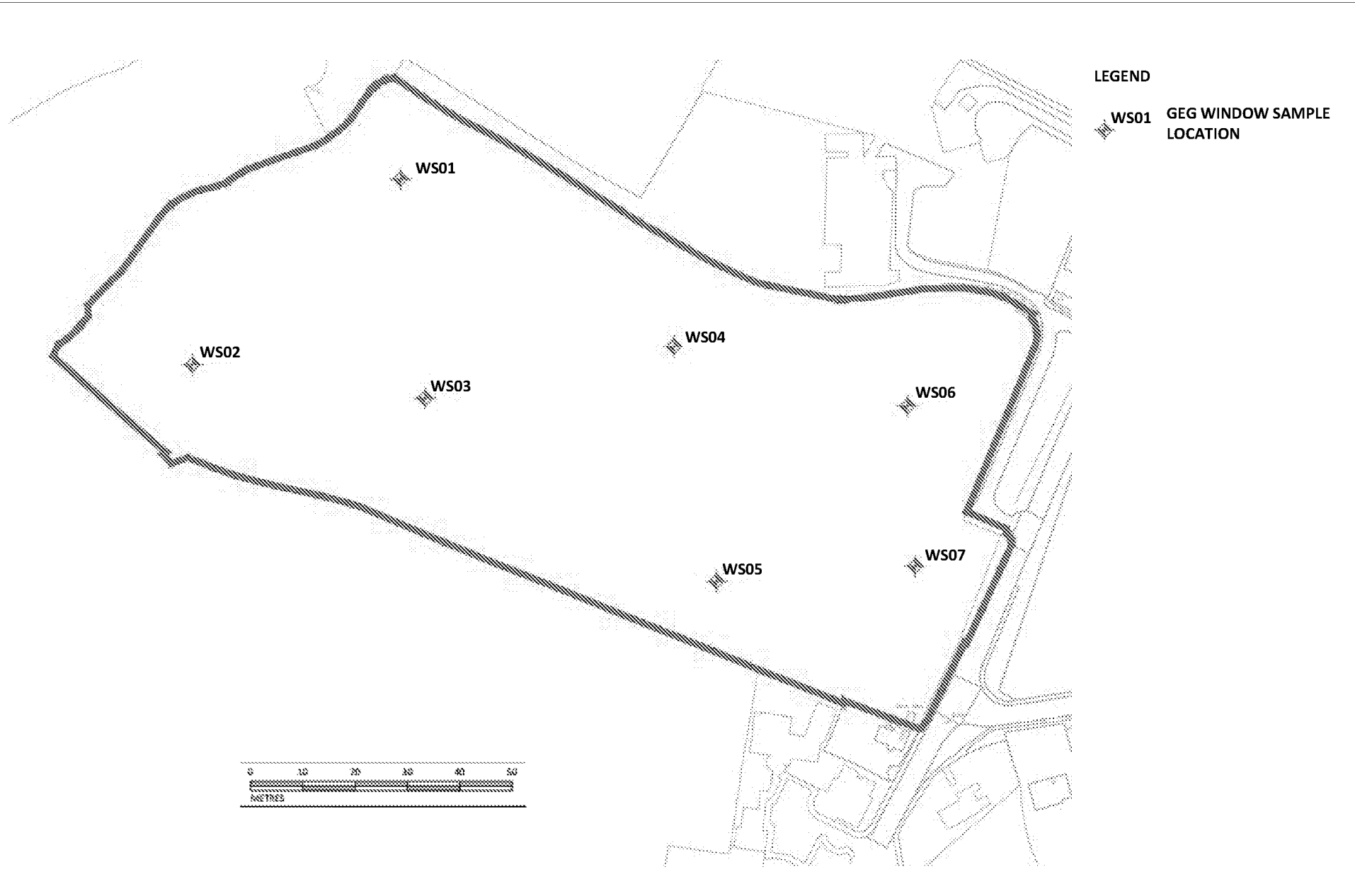
FIGURES AND PLANS



SITE LOCATION

Ordnance Survey © Crown Copyright 2021 All rights reserved. License number 100048258

TITLE: FIGURE 1: SITE LOCATION PLAN		CLIENT: BROOKBANKS / HLM		DRAWN/CHECKED: MP / MR		GEG House, 17 Graham Road Malvern, WR14 2HR Tel. 01684 212526 Fax 01684 576917 admin@g-eg.co.uk, www.g-eg.co.uk	Geo Environmental Group	
SITE: PAGHAM PHASE II, WEST SUSSEX	PROJECT No.: GEG-20-666	SCALE: NTS	DATE: 03/02/21	REVISION: A				



TITLE: FIGURE 2: EXPLORATORY HOLE LOCATION PLAN		CLIENT: BROOKBANKS / HLM		DRAWN/CHECKED: JM / MP		GEG House, 17 Graham Road Malvern, WR14 2HR Tel. 01684 212526 Fax 01684 576917 admin@g-eg.co.uk, www.g-eg.co.uk	Geo Environmental Group	
SITE: PAGHAM PHASE II, WEST SUSSEX		PROJECT No.: GEG-20-666	SCALE: AS SHOWN	DATE: 15/03/21	REVISION: A			



APPENDIX B

PHOTOGRAPHIC RECORD



Photo 1: View west across the northern boundary of the site.



Photo 2: View south across the eastern section of the site.



Photo 3: View south west across the site.



Photo 4: View west across the site.

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Client: Brookbanks / HLM

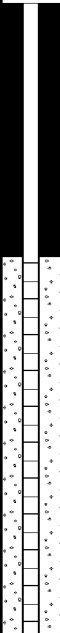
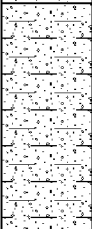
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Sussex

Project No.: GEG-20-666

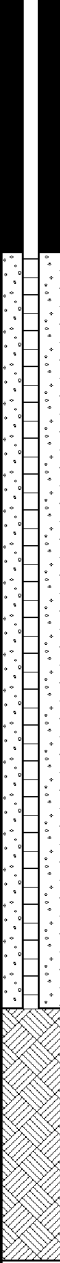
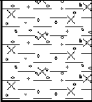
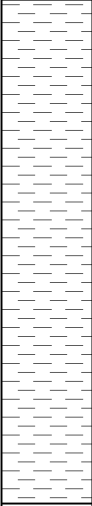


APPENDIX C

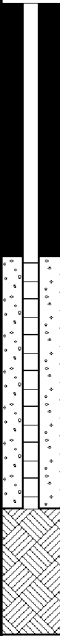
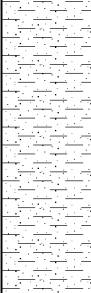
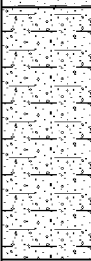
EXPLORATORY HOLE LOGS

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Project Name: Pagham II				Project No. GEG-20-666		Co-ords:		Hole Type WS	
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD						Level:		Scale 1:31	
Client: Brookbanks / HLM						Dates: 21/01/2021		Logged By AT	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.00			Soft brown slightly gravelly silty CLAY. Gravel is fine to medium mixed lithologies. (TOPSOIL)	
					0.30			Firm light brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)	0.5
					1.60			Medium dense light brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse sub-rounded to sub-angular flint. (RIVER TERRACE DEPOSITS)	1.0 1.5 2.0
					2.50			End of Borehole at 2.500m	2.5
Remarks 1. Service pit to 1.20m. 2. Groundwater encountered at 1.00m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.50m, response zone 2.50-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.									

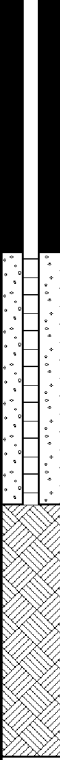
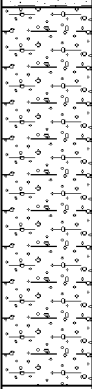


				Borehole Log				Borehole No. WS02 Sheet 1 of 1	
Project Name: Pagham II				Project No. GEG-20-666		Co-ords:		Hole Type WS	
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD						Level:		Scale 1:31	
Client: Brookbanks / HLM						Dates: 22/01/2021		Logged By AT	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.00		 Soft brown slightly gravelly silty CLAY. Gravel is fine to coarse sub-angular flint. (TOPSOIL)		
					0.40		 Firm brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)	0.5	
					0.70		 Firm brown sandy gravelly CLAY. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)		
					1.00		 Firm light brown sandy CLAY. (RIVER TERRACE DEPOSITS)	1.0	
					3.00		 Stiff grey CLAY. (LONDON CLAY FORMATION)	3.0	
					5.00		End of Borehole at 5.000m	5.0	
Remarks 1. Service pit to 1.20m. 2. Groundwater encountered at 0.83m. 3. 50mm standpipe installed 4.00m, response zone 4.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 4. Equipment used: Dando Terrier Window Sampling Rig.									

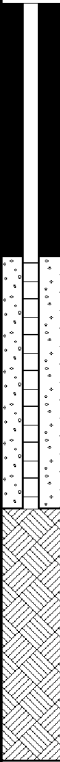


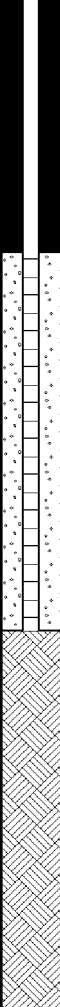
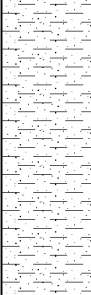
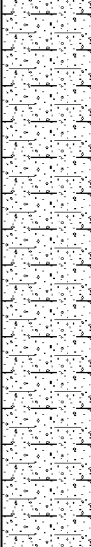
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Client: Brookbanks / HLM						Dates: 22/01/2021		Logged By AT	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.00		 Soft brown silty CLAY. (TOPSOIL)		
					0.30		 Firm light brown sandy CLAY. (RIVER TERRACE DEPOSITS)		0.5
					1.50		 Medium dense light brown clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)		1.5
					2.50		 End of Borehole at 2.500m		2.5
Remarks 1. Service pit to 1.20m. 2. Groundwater encountered at 0.78m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.00m, response zone 2.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.									



				Borehole Log				Borehole No. WS04 Sheet 1 of 1	
Project Name: Pagham II				Project No. GEG-20-666		Co-ords:		Hole Type WS	
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD						Level:		Scale 1:31	
Client: Brookbanks / HLM						Dates: 21/01/2021		Logged By AT	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.00			Soft brown slightly gravelly silty CLAY. Gravel is fine to medium sub-angular to sub-rounded mixed lithologies. (TOPSOIL)	
					0.30			Firm light brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)	0.5
					1.50			Medium dense orangish brown slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)	1.5
					3.00			End of Borehole at 3.000m	3.0
Remarks 1. Service pit to 1.20m. 2. Groundwater encountered at 0.30m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.00m, response zone 2.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.									



				Borehole Log				Borehole No. WS05 Sheet 1 of 1	
Project Name: Pagham II				Project No. GEG-20-666		Co-ords:		Hole Type WS	
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD						Level:		Scale 1:31	
Client: Brookbanks / HLM						Dates: 22/01/2021		Logged By AT	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.00		 Soft brown silty CLAY. (TOPSOIL)		
					0.30		 Firm brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)		0.5
					1.60		 Soft to firm light brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular flint. (RIVER TERRACE DEPOSITS)		1.0
					2.30		 Dense light brown slightly gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)		1.5
					3.00		End of Borehole at 3.000m		2.0
Remarks 1. Service pit to 1.20m. 2. Groundwater encountered at 0.90m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.00m, response zone 2.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.									

				Borehole Log				Borehole No. WS06 Sheet 1 of 1	
Project Name: Pagham II				Project No. GEG-20-666		Co-ords:		Hole Type WS	
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD						Level:		Scale 1:31	
Client: Brookbanks / HLM						Dates: 21/01/2021		Logged By AT	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.00		 Soft brown slightly gravelly silty CLAY. Gravel is fine to medium sub-angular to sub-rounded mixed lithologies. (TOPSOIL)		
					0.30		 Firm light brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)	0.5	
					1.80		 Medium dense light brown slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)	1.0 1.5 2.0	
					4.00		 End of Borehole at 4.000m	2.5 3.0 3.5 4.0	
Remarks 1. Service pit to 1.20m. 2. Groundwater encountered at 0.79m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.50m, response zone 2.50-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.									



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APPENDIX O: Exceedance Flow Plan



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KEY

— SITE BOUNDARY

→ OVERLAND EXCEEDANCE FLOW ROUTE

NOTES:

- This drawing is based on the proposed layout undertaken by Thrive Architects, drawing number: BARG230419_SL.01, REV. K, received 04/04/2025.
- The contributing areas delineated on this plan are based on the proposed layout and may be subject to adjustment based on modifications.
- Exceedance Flow arrows to be considered during development of levels design.
- Proposed layout is indicative and subject to detailed design.

**FOR INFORMATION
NOT FOR CONSTRUCTION**

P3	Updated Site Layout. (FA)	SL	04/04/2025
P2	Updated Layout. (GB)	SL	18/03/2025
P1	Initial Issue. (BB)	SL	29/09/2024

rev.	amendment	checked	date

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client	BARGATE HOMES LTD				
project	LAND WEST OF PAGHAM ROAD, PAGHAM				
scale	1:500	drawn by	JB	checked by	SL
date	OCTOBER 2024	cad file	FLOW EXCEEDANCE PLAN		
title	OVERLAND EXCEEDANCE FLOW PLAN				
Mayer Brown Limited jobcode	SL/BHPAGHAM.10	suitability	-	revision	P3
drawing number	SL/BHPAGHAM.10/14				

