















# **Appendix C Existing Catchment Plan and On site Drainage Arrangements**





	*TOTAL OF CATCHMENT AREA (ha)	APPROXIMATE MEASUREMENT OF TOTAL IMPERMEABLE AREA OF CATCHMENT AREA (ha)	**TOTAL STORAGE REQUIRED (IN 100+30% EVENT)	***TOTAL STORAGE PROVIDED BY EXISTING DRAINAGE STRUCTURE
CATCHMENT AREA DRAINING DIRECTLY TO SOUTH-WEST LAKE	30.65 ha	10.00 ha	5,177m <sup>3</sup>	8,500m <sup>3</sup>
CATCHMENT AREA UNDEVELOPED	8.50ha	0ha	N/A	N/A
CATCHMENT AREA DRAINING TO PUBLIC SEWER ON MADINGLEY ROAD	13.00ha	11.00ha	N/A	N/A
CATCHMENT AREA DRAINING TO COTON BROOK POND (VIA GEO-CELLULAR STORAGE STRUCTURES)	16.00ha	13.60ha	704m <sup>3</sup>	EXISTING COTON BROOK POND VOLUME = 450m <sup>3</sup> (THE TOTAL VOLUME OF STORAGE FROM THE EXISTING GEOCELLULAR STORAGE GRATES IS UNKNOWN)

**TABLE NOTES**

- \*AS MEASURED FROM LATEST TOPOGRAPHICAL SURVEY
- \*\*THE TOTAL AMOUNT OF STORAGE REQUIRED HAS BEEN CALCULATED INDICATIVELY IN MICRODRAINAGE AND WILL BE SUBJECT TO DETAILED DESIGN (THE GREENFIELD RUNOFF RATES USED FOR THIS CALCULATION ARE SHOWN IN THIS DRAWING)
- \*\*\*STORAGE VOLUMES SHOWN ARE INDICATIVE AND SUBJECT TO FULL MODELLING WORKS

**EXISTING GREEN FIELD RUNOFF RATES**

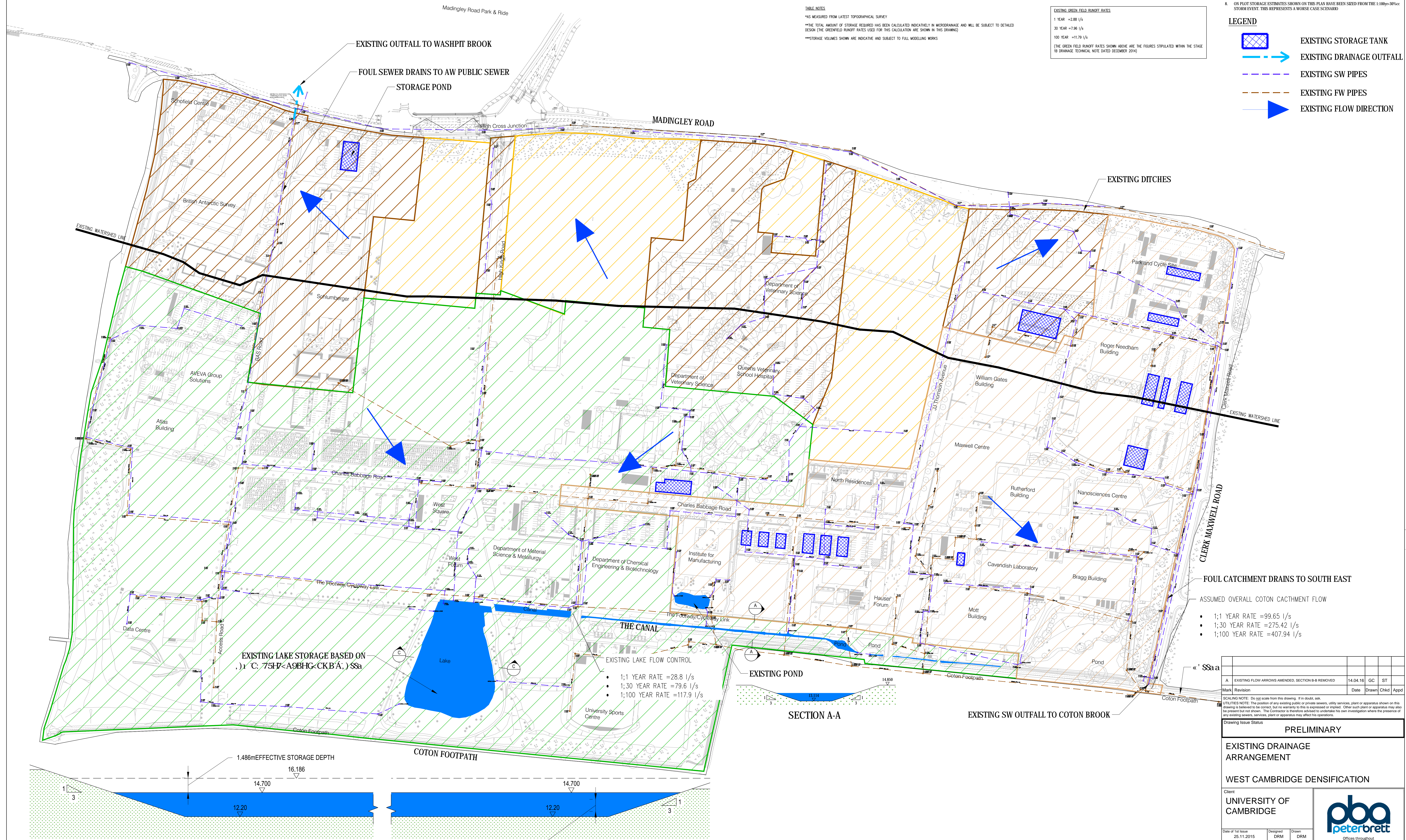
- 1 YEAR = 2.88 l/s
  - 30 YEAR = 7.96 l/s
  - 100 YEAR = 11.79 l/s
- (THE GREEN FIELD RUNOFF RATES SHOWN ABOVE ARE THE FIGURES STIPULATED WITHIN THE STAGE 1B DRAINAGE TECHNICAL NOTE DATED DECEMBER 2014)

**NOTES**

- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
- ALL LEVELS ARE IN METRES RELATIVE TO ORDNANCE DATUM NEWLYN UNLESS NOTED OTHERWISE.
- ALL COORDINATES ARE IN METRES RELATIVE TO ORDNANCE SURVEY NATIONAL GRID.
- THE CONTRACTOR IS TO VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING WORK OR PREPARING SHOP DRAWINGS.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS AND ARCHITECTS DRAWINGS AND SPECIFICATIONS.
- THIS STORAGE VOLUMES SHOWN ON THIS PLAN ARE APPROXIMATE AND SUBJECT TO DETAILED DESIGN.
- FOR FURTHER INFORMATION ON PROPOSED STORAGE PROVISIONS PLEASE REFER TO PBA DRAWING 31500-2006-116
- ON PLOT STORAGE ESTIMATES SHOWN ON THIS PLAN HAVE BEEN SIZED FROM THE 1:100yr-30%ce STORM EVENT. THIS REPRESENTS A WORSE CASE SCENARIO

**LEGEND**

- EXISTING STORAGE TANK
- EXISTING DRAINAGE OUTFALL
- EXISTING SW PIPES
- EXISTING FW PIPES
- EXISTING FLOW DIRECTION

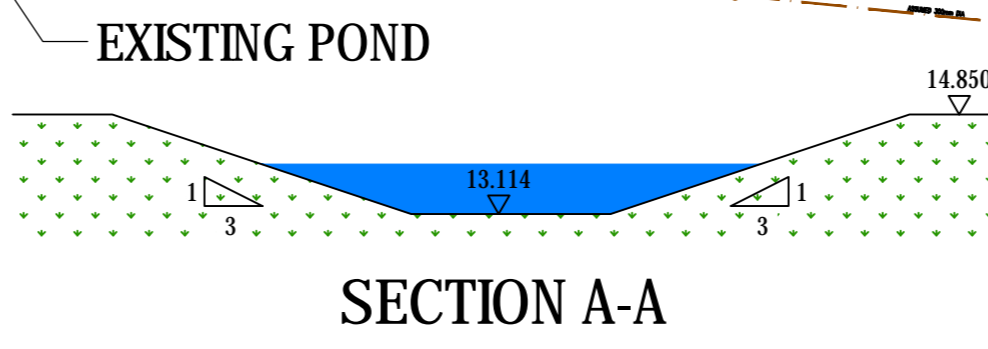
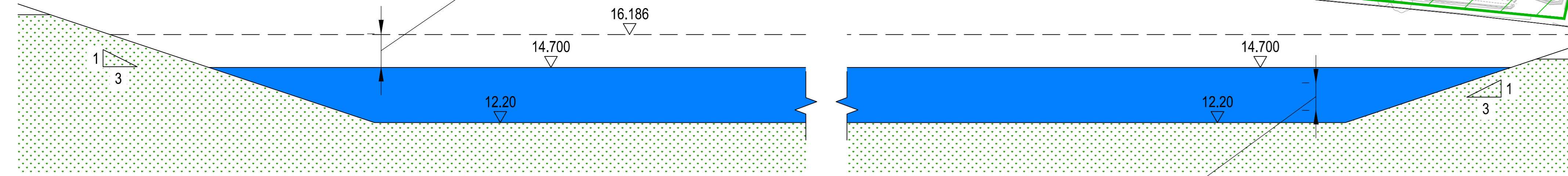


EXISTING LAKE STORAGE BASED ON  
(1) C: 75HF-A9BHG-CKB'A, )SSa

- EXISTING LAKE FLOW CONTROL
- 1;1 YEAR RATE = 28.8 l/s
  - 1;30 YEAR RATE = 79.6 l/s
  - 1;100 YEAR RATE = 117.9 l/s

- FOUL CATCHMENT DRAINS TO SOUTH EAST
- ASSUMED OVERALL COTON CATCHMENT FLOW
- 1;1 YEAR RATE = 99.65 l/s
  - 1;30 YEAR RATE = 275.42 l/s
  - 1;100 YEAR RATE = 407.94 l/s

1.486m EFFECTIVE STORAGE DEPTH



Mark	Revision	Date	Drawn	Chkd	Appd
A	EXISTING FLOW ARROWS AMENDED, SECTION B-B REMOVED	14.04.16	GC	ST	

SCALING NOTE: Do not scale from this drawing. If in doubt, ask.  
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake his own investigation where the presence of any existing sewers, services, plant or apparatus may affect his operations.

Drawing Issue Status: **PRELIMINARY**

EXISTING DRAINAGE ARRANGEMENT

WEST CAMBRIDGE DENSIFICATION

Client: UNIVERSITY OF CAMBRIDGE

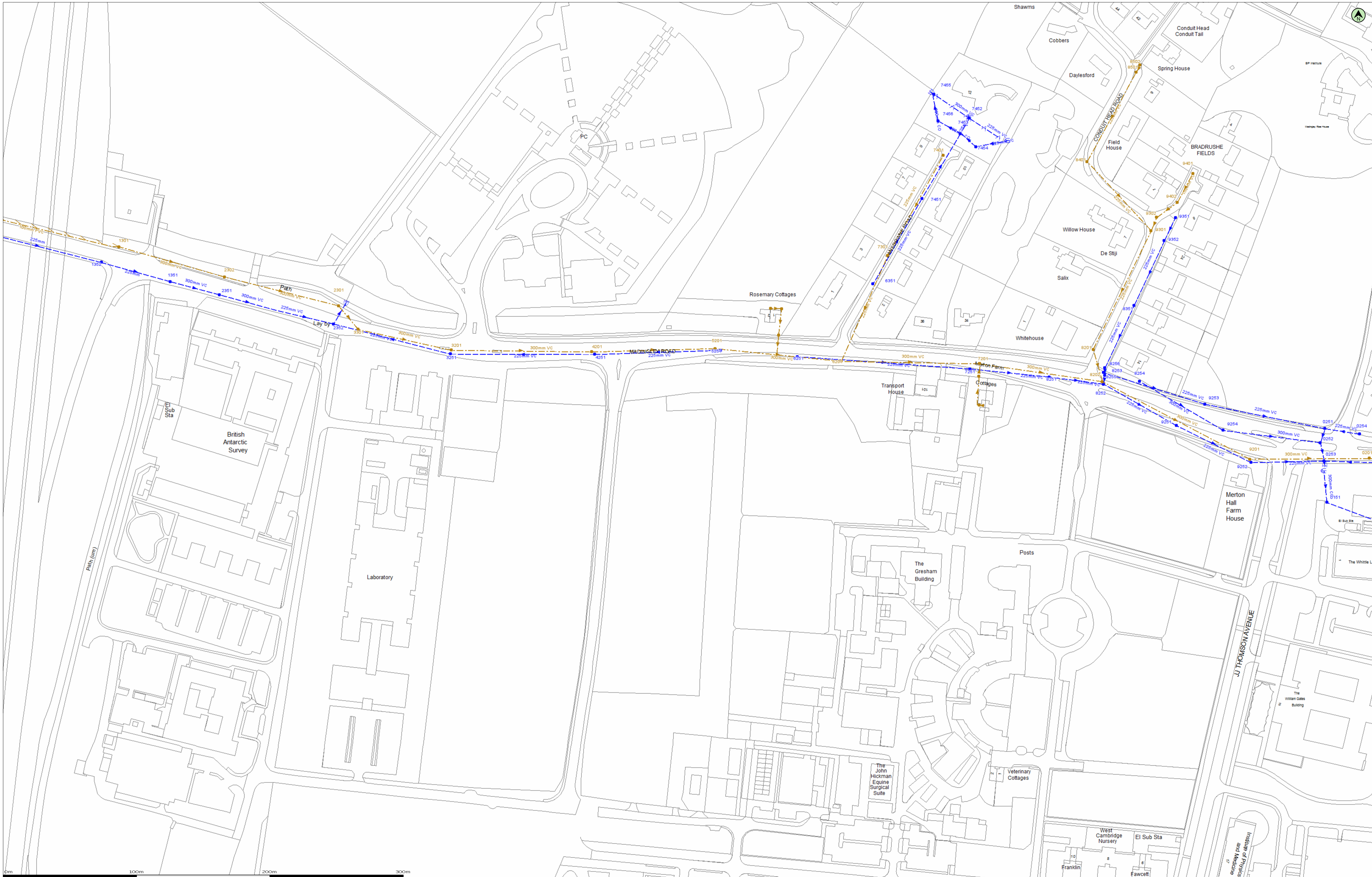
Date of 1st Issue: 25.11.2015	Designed: DRM	Drawn: DRM
As Scale: 1:1250@A0	Checked: ST	Approved: -

Drawing Number: 31500/2001/149

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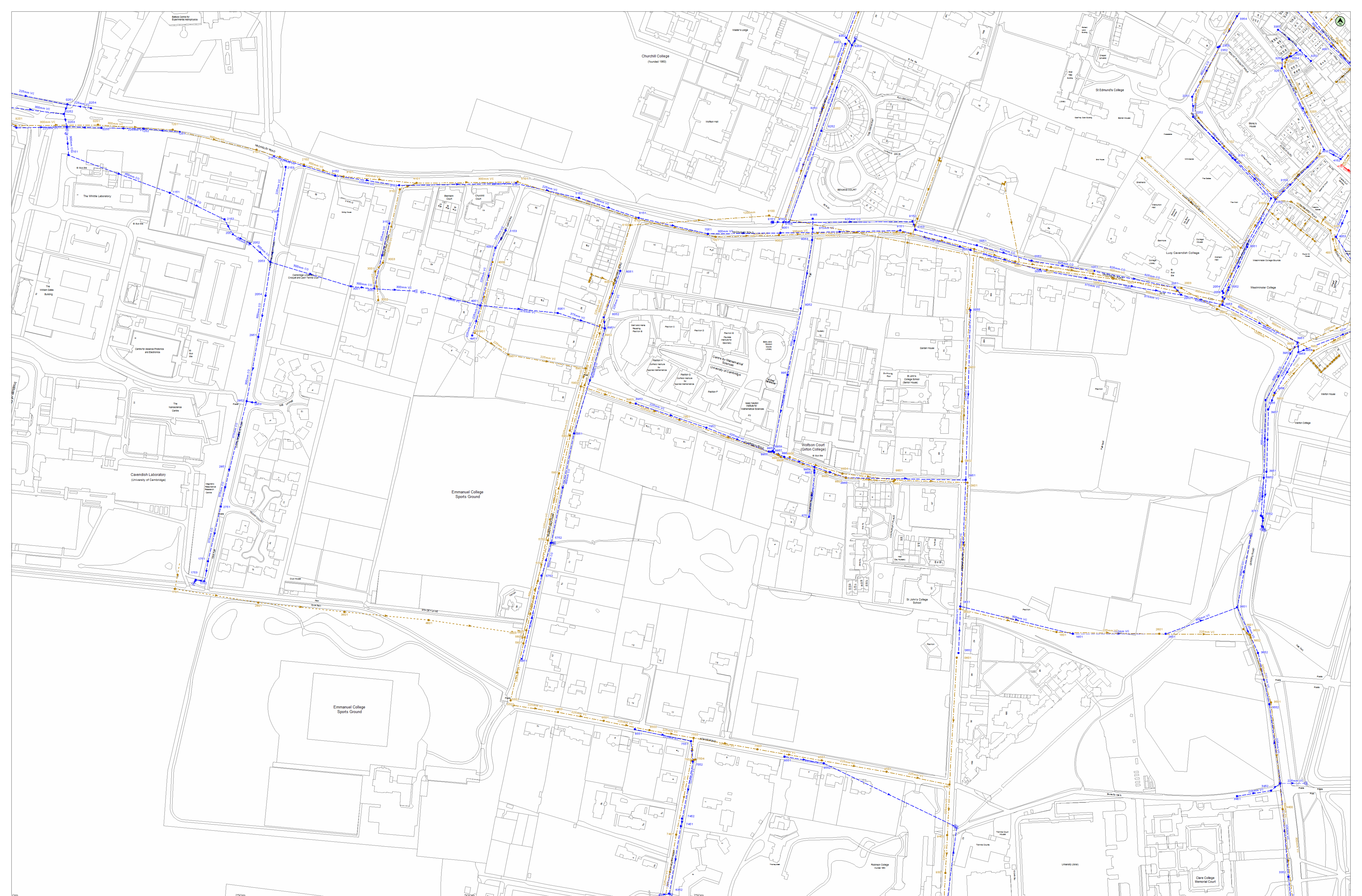
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Foul Sewer		Outfall	
Surface Sewer		Inlet	
Combined Sewer		Manhole	
Final Effluent		Sewage Treatment Works	
Rising Main		Pumping Station	
Private Sewer			
Decommissioned Sewer			

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	West Cambridge 1







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<b>Foul Sewer</b>		<b>Outfall</b>	
<b>Surface Sewer</b>		<b>Inlet</b>	
<b>Combined Sewer</b>		<b>Manhole</b>	
<b>Final Effluent</b>		<b>Storage/Treatment Works</b>	
<b>Rising Main</b>		<b>Pumping Station</b>	
<b>Private Sewer</b>			
<b>Disconnection Sewer</b>			

West Cambridge 2



Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
4103	544427	259171	C	16.38	14.12	2.26
41001	544426	259180	F	11.43	9.32	2.11
0002	544071	259066	F	11.33	9.02	2.31
0201	543070	259215	F	18.19	13.08	5.11
0601	544007	258634	F	9.3	8.25	1.05
0602	544011	258687	F	9.06	6.57	2.49
0801	544019	258825	F	11.98	6.93	5.05
0802	544013	258848	F	12.24	10.52	1.72
0901	544017	259590	F	11.84	9.84	2
1001	544110	259060	F	11.28	8.92	2.36
1002	544156	259053	F	11.08	8.81	2.27
1003	544199	259044	F	10.86	8.43	2.43
1004	544105	259057	F	10.95	-1.048	11.643
15201	543152	259210	F	18.43	13.01	5.42
1601	544116	258662	F	-	-	-
1701	543154	258709	F	-	-	-
2001	544297	259023	F	10.12	8.27	1.85
2002	544291	259014	F	9.87	9	0.87
2003	544252	259037	F	10.95	-1.048	11.643
2101	544243	259186	F	18.38	12.86	5.52
2101	544209	259179	F	14.18	12.31	1.87
2102	543295	259172	F	18.08	12.48	5.6
2102	544299	259192	F	15.73	13	2.73
2202	544273	259262	F	17.93	13.02	4.91
2601	543245	258694	F	-	-	-
2601	544228	258660	F	-	-	-
3001	543373	259055	F	14.18	12.91	1.27
3001	544317	259081	F	11.57	9.36	2.21
3002	543376	259024	F	13.97	12.99	0.98
3003	543381	259065	F	14.34	12.88	1.46
3101	544355	259136	F	14.15	11.67	2.48
3101	543338	259159	F	17.65	12.35	5.3
3102	543399	259145	F	16.49	12.8	3.69
3103	544347	259129	F	13.6	12.72	0.88
3201	544365	259279	F	20.86	18.87	1.99
3203	544389	259229	F	19.07	17.59	1.48
3204	544372	259293	F	-	-	-
3205	544367	259286	F	-	-	-
3304	544394	259238	F	21.13	16.27	4.86
3400	544363	258469	F	-	-	-
3501	544350	258585	F	7.85	4.86	2.99
3601	543339	258684	F	-	-	-
3601	544320	258665	F	-	-	-
3602	544328	258656	F	8.23	5.74	2.49
3603	544327	258659	F	-	-	-
3901	544353	258920	F	9.46	6.6	2.86
3902	544397	258969	F	9.05	6.53	2.52
3903	544371	258970	F	8.88	-1.28	10.261
4000	543501	259065	F	13.426	11.521	1.905
4001	544420	259079	F	12.42	9.06	3.36
4101	544415	259100	F	13.17	10.1	3.07
4101	543418	259152	F	16.12	12.1	4.02
4107	544403	259184	F	16.66	14.71	1.95
4209	544421	259262	F	-	-	-
4210	544436	259275	F	-	-	-
4302	544418	259302	F	20.93	13.46	7.47
4601	543431	258675	F	-	-	-
4901	543481	258688	F	13.512	10.961	2.551
5101	543528	259153	F	14.7	11.79	2.91
5501	543520	258587	F	13.868	10.496	3.372
5502	543524	258582	F	13.908	11.814	2.094
5503	543572	258575	F	13.454	-	-
5601	543534	258650	F	12.646	10.428	2.218
5602	543538	258654	F	12.335	9.68	2.655
5603	543522	258662	F	-	-	-
5604	543533	258656	F	10.963	1.663	9.3
5701	543554	258736	F	11.18	9.39	1.79
5702	543561	258762	F	11.449	1.308	10.141
5801	543573	258835	F	11.23	9.02	2.21
5802	543585	258876	F	11.076	0.915	11.161
5901	543518	258864	F	12.6	10.708	1.892
5902	543597	258930	F	11.732	8.797	2.935
6001	543633	259042	F	12.323	10.659	1.664
6101	543657	259113	F	13.71	11.2	2.51
6102	543651	259106	F	12.721	-0.243	12.964
6501	543622	258955	F	13.115	10.766	2.349
6502	543672	258955	F	12.743	10.247	2.496
6901	543602	258950	F	11.884	10.095	1.789
6902	543616	258988	F	13.321	0.985	12.336
6903	543651	258912	F	11.043	8.251	2.792
7001	543744	259093	F	13.24	10.74	2.5
7401	543701	258441	F	10.26	8.53	1.73
7501	543717	258522	F	11.762	9.891	1.771
7502	543720	258546	F	12.36	9.821	2.539
7503	543790	258534	F	11.707	9.25	2.457
7504	543722	258523	F	-	-	-
7801	543705	258893	F	10.717	7.809	2.908
8001	543855	259097	F	12.34	10.18	2.16
8002	543813	259095	F	12.63	10.42	2.21
8100	543802	259116	F	11.169	-0.849	12.018
8201	543880	259284	F	14.12	11.64	2.48
8202	543862	259234	F	13.03	11.1	1.93
8501	543860	258522	F	10.927	8.793	2.134
8801	543811	258856	F	10.63	7.72	2.91
8802	543864	258836	F	10.33	7.641	3.289
8804	543882	258835	F	11.09	7.52	3.57
8805	543825	258853	F	10.69	7.71	2.98
8806	543815	258853	F	10.59	7.73	2.86
8807	543886	258830	F	11.24	7.5	3.74
9002	543942	259099	F	11.82	9.98	1.84
9003	543957	259097	F	11.7	9.78	1.92
9201	543980	259215	F	17.6	13.43	4.37
9301	543995	258399	F	9.17	6.63	2.54
9401	543999	258495	F	9.24	7.46	1.78
9402	543997	258440	F	9.07	6.87	2.2
9501	543931	258509	F	9.997	8.221	1.776
9801	543940	258828	F	12.15	7.28	4.87
9802	543938	258826	F	-	-	-
0051	544029	259084	S	11.44	8.55	2.89
0052	544089	259067	S	11.29	8.18	3.11
0053	544022	259079	S	11.41	9.75	1.66
0054	544098	259057	S	11.21	9.21	2
0055	544022	259013	S	11.22	9.7	1.52
0151	543038	259182	S	16.44	14.6	1.84
0251	543037	259238	S	17.82	15.54	2.28
0252	543033	259227	S	18.05	15.44	2.61
0253	543036	259213	S	18	-	-
0254	543063	259234	S	18.26	15.79	2.47
0255	543074	259212	S	18.28	15.74	2.54
0851	544011	258690	S	9.63	7.42	2.21
0852	544009	258639	S	-	-	-
0851	544017	258828	S	11.99	7.93	4.06
1051	544157	259056	S	10.97	7.82	3.15
1052	544198	259039	S	10.81	8.67	2.14
1151	543148	259141	S	15.39	13.97	1.42
1251	543159	259207	S	18.45	16.64	1.81
1252	543120	259211	S	18.4	16.08	2.32
1651	544134	258660	S	-	-	-
1751	543190	258739	S	13.41	12.08	1.33
1752	543186	258717	S	13.29	12	1.29
1753	543177	258719	S	13.46	11.79	1.67
2051	543217	259096	S	14.56	13.52	1.04
2051	544245	259038	S	10.58	7.32	3.26
2052	543236	259086	S	14.76	13.52	1.24
2052	544252	259030	S	10.52	7.26	3.26
2053	543258	259066	S	14.91	13.32	1.59
2053	544297	259019	S	10.14	6.93	3.21
2054	543253	259029	S	14.62	13.33	1.29
2054	544297	259024	S	10.26	9	1.26
2056	544298	259032	S	10.15	8.92	1.23
2151	543282	259181	S	18.38	-	-
2152	543208	259112	S	15.18	13.69	1.49
2153	543275	259169	S	17.98	16.24	1.74
2154	543267	259121	S	16.43	14.71	1.72
2251	544284	259246	S	17.42	12.91	4.51
2252	544285	259224	S	16.55	11.93	4.62
2352	544292	259300	S	20.06	14.24	5.82
2353	544294	259301	S	20.09	13.37	6.72
2651	544235	258660	S	-	-	-
2751	543204	258799	S	13.89	-	-

Manhole Reference	Easting	Northing	Liquid Type	Cover Level	Invert Level	Depth to Invert
2851	543213	258839	S	14.2	12.48	1.72
2951	543245	258984	S	14.82	13.13	1.69
2952	543232	258914	S	14.79	12.77	2.02
2953	543242	258912	S	14.62	12.95	1.67
3051	543346	259039	S	13.99	12.53	1.46
3051	544324	259082	S	11.74	9.39	2.35
3052	543371	259037	S	14.03	12.61	1.42
3052	544304	259036	S	10.43	7.18	3.25
3151	543388	259108	S	15.12	-	-
3151	544311	259177	S	15	12.26	2.74
3152	544355	259134	S	14.01	10.4	3.61
3152	543329	259160	S	17.79	15.45	2.34
3153	543399	259149	S	16.46	14.52	1.94
3153	544350	259135	S	13.84	12.25	1.59
3154	544371	259150	S	15.11	11.06	4.05
3251	544362	259277	S	20.89	18.44	2.45
3252	544393	259285	S	-	-	-
3253	544382	259297	S	-	-	-
3254	544372	259290	S	-	-	-
3255	544362	259287	S	-	-	-
3352	544369	259305	S	8.5	6.32	2.18
3354	544313	259334	S	20.91	13.37	7.54
3357	544358	259319	S	-	-	-
3451	544313	258483	S	-	-	-
3452	544350	258489	S	8.5	6.47	2.03
3453	544360	258497	S	7.9	5.74	2.16
3552	544348	258683	S	7.77	6.37	1.4
3651	544313	258689	S	7.38	6.31	1.07
3652	544336	258639	S	7.87	6.35	1.52
3751	544339	258789	S	7.25	5.9	1.35
375						



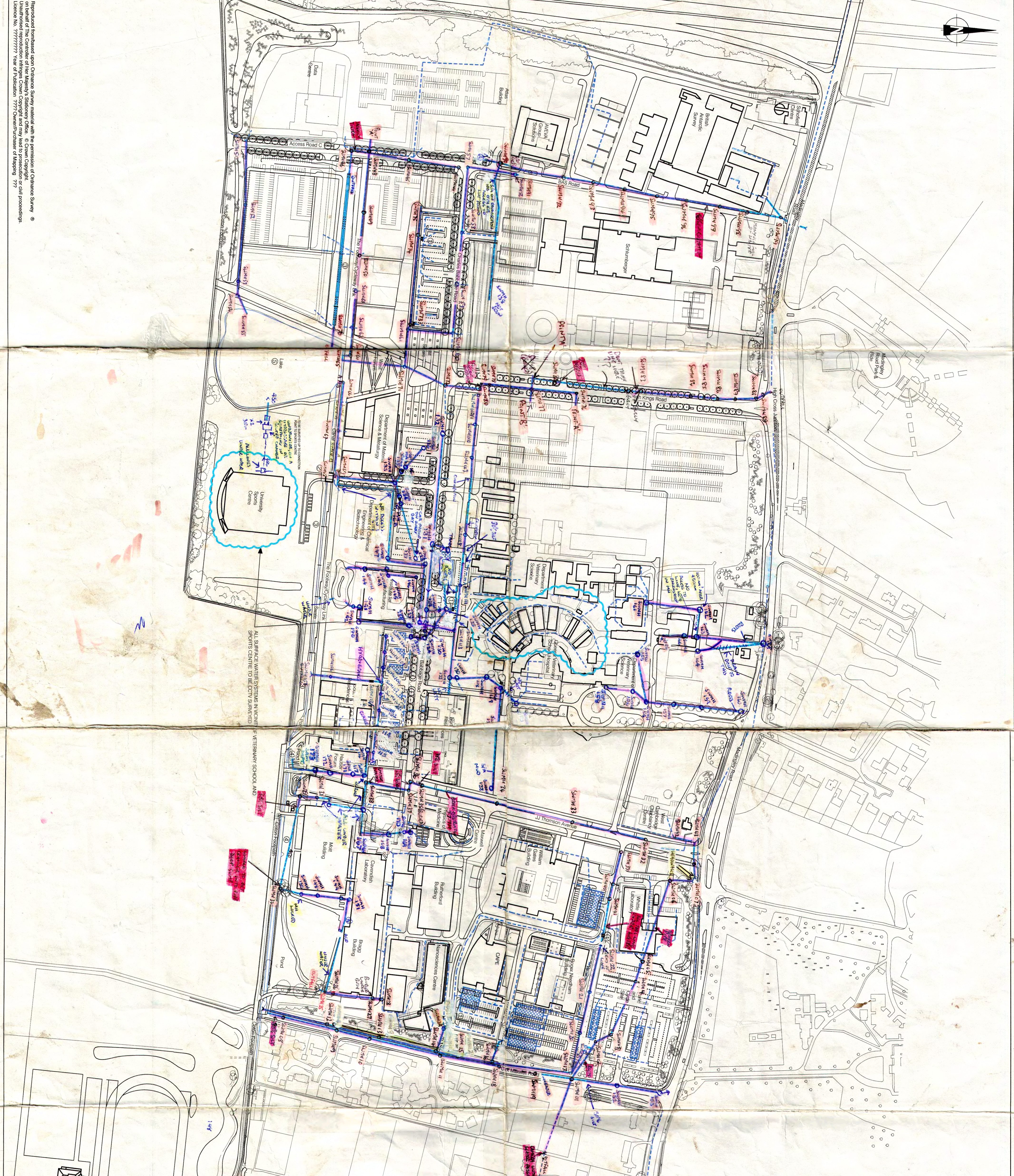
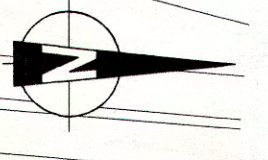
## **Appendix E Extracts from CCTV Surface/Foul Water Drainage Investigation**



**Appendix – Surface water drains with greater than 20% cross-sectional area loss recorded (CCTV survey, 2014)**

<b>Surface Water Manhole (MH) No.</b>	<b>Distance between Manholes (m)</b>	<b>Area loss recorded (%)</b>
MH 02 – MH 01	48.00	35% - 70%
MH 02 – MH 03	17.00	25%
MH 06 to MH 05	99.00	30%
MH 07 to MH 06	26.20	25% - 40%
MH 09 to MH 08	60.00	25% - 35%
MH 08 to OUTFALL	24.00	30%
MH 19 to MH 18	46.70	30%
MH 29 to MH 30	105.00	30%
MH 33 to MH 34	89.80	25% – 40%
MH 34 to MH 35	100.00	40%
MH 35 to MH 36	12.00	35%
MH 36 to MH 37	9.60	25%
MH 45 to MH 46	65.10	25%
MH 67A to MH 66A	53.00	50%
MH 74 to MH 75	33.70	40%
Point 'A' to MH 76	12.30	40%
MH 76 to MH 77	50.00	25%
MH 79 to MH 80	5.00	50%
MH 80 to MH 72	38.80	25%
MH 83 to MH 82	10.00	70%
MH 92 to MH 93	33.50	25% - 50%
MH 96 to MH 97	36.10	50%
MH 108 to MH 111	55.40	30%
MH 109 to MH 108	87.00	25%

MH 111 to MH 112	37.20	55%
MH 114 to MH 102	4.10	40%
MH 116 to MH 117	24.00	50%
MH 123 to MH 121	60.00	25%
MH 130 to MH 129	28.00	30%
MH 131 to MH 129	53.00	30%
MH 132 to MH 131	74.50	25%
MH 135 to MH 133	11.00	70%
MH 146 to OUTFALL	25.00	70%
LATT A to MH 90	4.20	40%
HEADER to MH 152	80.00	30%
MH 155 to MH 154	24.20	30%
MH 157 to MH 159	21.70	25% - 50%
MH 159 to MH 160	45.00	30%
MH 163 to MH 165	68.00	70%
D/PIPE to MH 166	27.10	30%



**NOTES**

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3. ALL COORDINATES ARE IN METRES RELATIVE TO ORDNANCE SURVEY NATIONAL GRID. PREPARING SHOP DRAWINGS.
4. THE CONTRACTOR IS TO VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING WORK OR THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL ENGINEERS AND ARCHITECTS DRAWINGS AND SPECIFICATIONS.
5. ALL MAN-HOLE COVERS TO BE LIFTED AND DEPTH TO CHAMBER INVERTS CONFIRMED.

**KEY**

1	OIL SEPARATOR
2	MAIN BALANCING LAKE CONTROL STRUCTURE
3	SWALE
4	COTTON DITCH
5	PERMANENT LAKE
6	EXISTING SURFACE WATER DRAIN
7	EXISTING SURFACE WATER DRAIN TO BE SURVEYED
8	EXISTING UNDERGROUND SURFACE WATER ATTENUATION TANK

**INFORMATION**

**WEST CAMBRIDGE DENSIFICATION SCHEME**  
**EXISTING SURFACE WATER INFRASTRUCTURE CCTV SURVEY PLAN**

**UNIVERSITY OF CAMBRIDGE**

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# West Cambridge Masterplan Stage 1b Review

Ground Conditions and Land Quality

On behalf of **University of Cambridge**

Project Ref: 31500 | Stage 1b | October 2014

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Revision	Date	Description	Prepared	Reviewed	Approved

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# 1 Introduction

## 1.1 Background

- 1.1.1 This report presents the findings of the information gathering and data review exercise of ground conditions and land quality for the West Cambridge site.
- 1.1.2 The report provides additional data to and updates the stage 1a review from October 2014 which involved, reviewing and assessing ground and land quality opportunities and constraints, gaps in data, and requirements for further work necessary to support and inform the master planning, EIA and planning application stages.
- 1.1.3 The brief for this element of work included:
- Collation of available records to provide a summary of ground conditions and land quality aspects.
  - Consider potential for minerals extraction on the site.
  - Provide a gap analysis of ground investigation and land quality data.
  - Provide general strategic level advice relating to substructure, infrastructure and earthworks design.
  - Provide strategic level advice on ground related and land quality constraints and opportunities.
  - Set out requirements for additional data gathering including ground investigations.

## 1.2 Legislation and Policy

- 1.2.1 The likely ground conditions and environmental setting which might have associated environmental liabilities or which may affect redevelopment are a material consideration in planning applications and the minimum requirements are stipulated by Clauses 120, 121 and 122 and Glossary Page 56 of the National Planning Policy Framework (March 2012), for land potentially affected by contamination.
- 1.2.2 The basic requirements of a Phase 1 study are set out in the Model Procedures for the Management of Contaminated Land (CLR 11), Annex A of BS 5930 and Section 6.2 of BS 10175. Guidance on assessment are also detailed in the Environment Agency's "Guidance on Requirements for Land Contamination Reports" and Cambridge City Council document Contaminated Land in Cambridge Developers Guide April 2009.
- 1.2.3 Potential for minerals sterilisation will be a consideration in planning and checks on Minerals Safeguarding Areas will be required as part of the planning submission process.
- 1.2.4 All the above have been taken into consideration in the data gathering exercise undertaken as part of this Stage 1b study.

## 2 Overview of Existing Information

### 2.1 Introduction

2.1.1 Data gathering for the site has focused on four principal source areas as these were considered to offer the most comprehensive source of information for the site:

- Reports, surveys, drawings and studies held by Hannah Reed/PBA based on their historical association with and work on the site since the 1990s.
- Reports, surveys, drawings and studies from existing developments on the site held by Cambridge City Council.
- Data obtained from the British Geological Survey and Cambridgeshire County Council on geology and minerals.
- Ground investigation reports and information from the original planning application and EIA for the site held by the University.

2.1.2 The information provided by the various sources is listed below and areas covered by the various reports presented in Figure 1.

### 2.2 Data Sources

#### Desk Studies

2.2.1 The information provided by the various sources includes desk studies, and similar information, that have been carried out for particular areas of the site as those areas as have been considered for development. The desk studies and other information gathered comprise:

- Cape Annex – Geoenvironmental Desk Study. Prepared by Ramboll for University of Cambridge dated August 2013.
- Maxwell Centre – Geoenvironmental Desk Study. Prepared by Ramboll for University of Cambridge dated March 2013.
- University of Cambridge Data Centre – Geotechnical and Contamination Desk Study. Prepared by Ove Arup for Lynxvale Ltd dated 14 June 2012.
- University of Cambridge, Chemical Engineering and Biotechnology – Geoenvironmental Desk Study. Prepared by Ramboll for University of Cambridge Estate Management dated February 2012.
- Cambridge University Sports Centre – Technical Note on Review of ground contamination potential. Prepared by Arup dated 18 July 2011.
- High Cross, Madingley Road, Cambridge – Environmental Study. Prepared by WS Atkins dated December 1996.

#### Ground Investigations

2.2.2 Records of several ground investigations on the site have also been gathered. Details of these ground investigations are summarised in the following tables. The approximate locations of exploratory holes carried as part of these investigations, or the location of zones of investigation for the smaller sites, are presented in Figure 1 at the rear of this report.

CAPE Annexe, University of Cambridge. Engineers: Ramboll. Contractor: Fugro. Date: November 2013					
Scope: Ground investigation for a proposed extension to CAPE building					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
4 no. TP	0.5-4.0m	MG: 0.4-0.5m GC: 19.5+m (via CPT interpretation)	<u>Laboratory:</u> 19 no. MC/PI 2 no. PSD 16 no. pH/SO <sub>4</sub>	<u>Laboratory:</u> Soil - 5 no. general contaminant suite and asbestos screen	None
5 no. CPT	20m				

University of Cambridge Data Centre, University of Cambridge. Engineers: Ove Arup. Contractor: BAM Riches. Date: September 2012					
Scope: Ground investigation for a proposed new data centre					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
1 no. BH (CP)	30m	TS/MG: 0.5-2.7m HD: 0-2.1m GC: 16.6+m	<u>In-situ:</u> SPTs and U100s in BH (CP). <u>Laboratory:</u> 12 no. MC/PI 12 no. PSD 6 no. CBR 17 no. Triax 5 no. pH/SO <sub>4</sub>	<u>Laboratory:</u> Soil - 10 no. Metals/Inorganics/PAH/BTEX 5 No. TPH/VOC/SVOC 9 no. asbestos screen 6 no. leachate	<u>Ground gas:</u> CH <sub>4</sub> 0.3-0.7% CO <sub>2</sub> 0.0-0.1% O <sub>2</sub> 20.2-20.7% Flow 0.0l/hr
6 no. BH (WS)	3-3.2m				
9 no. TP	2-4.3m				

<b>University of Cambridge, Chemical Engineering and Biotechnology Building.                      Engineers: Ramboll. Contractor: Ground Engineering &amp; RSK. Date: January &amp; July 2012</b>					
Scope: Ground investigation (separate geoenvironmental and geotechnical phases) for a proposed chemical engineering and biotechnology building					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
6 no. TP	2.8-4.1m	MG:1.5-3.0m HD: 0.0-1.4m GC:32.0+m	<u>In-situ:</u> SPTs in BH (CP & WS)  <u>Laboratory</u> 21 no. PSD 20 no. MC/PI 21 no. pH/SO <sub>4</sub> 18 no. Triax 4 no. Consol	<u>Laboratory:</u> Soil – 12 no. Metals/Inorganics/TPH/PAH 9 no. asbestos screen 6 no. leachate	Groundwater monitoring on 4 occasions
2 no. BH (CP)	25m & 35m				
4 no. BH (WS)	0.7-5m				

<b>Cambridge University Sports Centre Phase 1 Western University Campus. Engineers: Arup. Contractor: Ground Engineering. Date October 2011</b>					
Scope: Ground investigation for proposed sports centre.					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
10 no. TP	3-3.6m	MG:0.4-2.0m HD: 0-1.9m GC: 27.5+m	<u>In-situ:</u> SPTs in BH  <u>Laboratory</u> 4 no. PSD 19 no. MC 9 no. PI 6 no. pH/SO <sub>4</sub> 4 no. Triax 6 no. Compaction	<u>In-situ:</u> PID in trial pits  <u>Laboratory:</u> Soil 8 no. general contaminant suite 6 no. asbestos screen 6 no. PCB/volatiles 6 no. leachability 5 no. gamma spec radiological analysis	None
1 no. BH (CP)	30m				
8 no. CPT	10m				

**Report on a Ground Investigation, Infrastructure Phase 3, Charles Babbage Road.  
 Engineers: Hannah Reed. Contractor: Ground Engineering. Date: June 2010**

Scope: Ground investigation for proposed car park.

Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
3 no. BH (CP)	10-20m	MG:1.0-1.7m HD:0.7m GC:18.2+m	<u>In-situ:</u> U100s <u>Laboratory:</u> 12 no. MC 3 no. PI 8 no. Consol	None	None

**Site Investigation Report at Materials Science and Metallurgy Building, University of Cambridge. Engineers: Ramboll. Contractor: ST Consult. Date: December 2009**

Scope: Factual ground investigation report at site of proposed Materials and Metallurgy Building

Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
5 no. BH (WS)	4-9.5m	MG: 0.8-2.1m HD: 0.5-1.2m GC: 30+m	<u>In-situ:</u> SPTs in BH (WS); SPTs and U100s in BH (CP). <u>Laboratory:</u> 45 no MCs 42 no PI 29 no. PSD 14 no. pH/SO <sub>4</sub> 4 no. Consol 15 no. Triax	<u>Laboratory:</u> Soil - 19 no. Metals/Inorganics/ Hydrocarbons/VOCs/ SVOCs 5 no. Leachate Groundwater – 6 no. Metals/Inorganics/PAH/ TPH/Phenols	<u>Ground gas:</u> CH <sub>4</sub> <0.1% CO <sub>2</sub> 0.0-2.9% O <sub>2</sub> 16.8-21.2% Flow <1.0l/hr <u>Groundwater:</u> Dry – 2.4m bgl
3 no. BH (CP)	15-30m				
6 no. TP	2-4m				
5 no. CBR	-				

<b>West Cambridge Development – Infrastructure Phase 3, Madingley Road, Cambridge                      Engineers: Hannah Reed. Contractor: RSA Geotechnics. Date: October 2009</b>					
Scope: Factual ground investigation report for proposed infrastructure route					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
13 no. TP	1.1-1.3m	TS: 0.3m MG: 0-0.5m HD/GC: 0.8+m	<u>Laboratory:</u> 10 no. MC/PI 10 no. PSD 10 no. pH/SO <sub>4</sub> 10 no. Compaction 10 no. CBR 10 no. MCV 10 no. Triax	None	None

<b>West Cambridge Development. Madingley Road, Cambridge - Ground Investigation Report. Engineers: Richard Jackson Plc. Date: September 2008</b>					
Scope: Ground investigation for development parcel					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
17 no. TP	2.3-3.2m	TS: 0.1-0.4m MG: 0.3-2.3m HD: 0.6-2.6m GC: 2.9+m	<u>Laboratory</u> 9 no. MC/PI 2 no. CBR 2 no. Compaction	Soil - 16 no. General contaminant suite 14 no. Additional lead tests 4 no. VOCs	None

<b>West Cambridge Development, Madingley Road, Cambridge. Engineers: Hannah Reed. Contractor: Geotechnical and Environmental Associates. Date: April 2007</b>					
Scope: Ground investigation to determine appropriate method of stabilisation for near surface soils					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
7 no. TP	1.5-2.8m	MG: 0.5-0.8m HD:0.0-1.7m GC: 1.0+m	<u>Laboratory:</u> 2 no. MC/PI/Compaction/CBR/PSD 2 no. Lime stabilisation suite using 2% lime	None	None

University of Cambridge, Institute for Manufacturing Building, Charles Babbage Road, Cambridge. Engineers: Ove Arup. Contractor: Ground Engineering. Date 2007					
Scope: Ground investigation for proposed building					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
2 no. BH (CP)	30m	MG: 0.3-2.1m HD: 0-1.0m GC: 29+m	<u>In-situ:</u> SPTs and U100s in BH (CP).  <u>Laboratory:</u> Unknown – only logs reviewed	Unknown – only exploratory hole logs available for review	
6 no. TP	4-4.1m				
9 no. CPT	10.2-13.5m				

West Cambridge Development Site. Engineers: WSP. Contractor: Fugro. Date 1998					
Scope: Geotechnical site investigation and contamination survey					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
11 no. BH (CP)	10-20m	TS: 0-0.8m MG: 0-1.4m HD: 0-1.9m GC: 17.5+m	<u>In-situ:</u> SPTs and U100s in BH (CP).  <u>Laboratory:</u> 44 no. MC 16 no. PI 2 no. PSD 19 no. Triax 6 no. Consol 6 no. CBR 18 no. pH/SO <sub>4</sub>	Soil – 36 no. general contaminant suite	None
39 no. TP	1.8-3.3m				
12 no. CPT	10-15m				



High Cross, Madingley Road, Cambridge. Engineers: WS Atkins. Date 1996					
Scope: Environmental study to investigate incident of cattle poisoning					
Exploratory Holes	Depths	Geological Summary	Geotechnical Testing	Geoenvironmental Testing	Monitoring
Surface or near surface	Surface or near surface	Not applicable	None	<u>State Veterinary Investigation Centre 1995</u> Soil - 7 no. lead <u>ADAS 1996</u> Soil (compound samples) – 46 no. lead <u>Atkins 1996</u> Soil – 131 no. lead and other metals	None

2.2.3 Some desk studies and ground investigation reports make reference to other ground investigations carried out within the site boundary; copies of these investigations have not been retrieved during this stage. These investigations comprise:

- Ground Investigation for CAPE Building carried out by Geotechnical Engineering in February 2001. The investigation comprised 3 no. boreholes and 6 no. trial pits.
- Ground Investigation for Physics of Medicine Building carried out by Ground Engineering in April 2006. The investigation comprised 5 no. boreholes and 8 no. trial pits.

Although the reports are currently not held by PBA, the zones of investigation for these sites have been gleaned from other reports and studies. The locations of these zones of ground investigation are shown on Figure 1.

### British Geological Survey

2.2.4 The British Geological Survey (BGS) on-shore historical borehole record archive has been searched to collect logs of exploratory holes located within or close to the site boundary. The locations of these records are shown on Figure 1. The exploratory hole logs relate to the following developments:

- Ground investigation for Schlumberger laboratory dated 1991, located in the western area of the site.
- Ground investigation for University of Cambridge CAD centre dated 1998, located in the western area of the site.
- Pre-construction ground investigation for Cambridge Western Bypass (now M11 Motorway) dated 1969, located on western edge of site boundary.
- Madingley Road 33kV Sub-station dated 1989, located on the northern boundary of the site.
- Unknown investigation for Cambridge City Council dated 1970, located in the north-east corner of the site.

- Ground investigation for Eaton Gate development dated 1995, located just beyond the south-east corner of the site boundary.

2.2.5 It should be noted that the positioning of these exploratory holes is based on grid references supplied by BGS for each log, but is not necessarily the actual location of the exploratory hole.

## 2.3 Site History

2.3.1 The overview of the site history has been gleaned from historical Ordnance Survey (OS) maps, and other historical information, presented in desk studies which have been collected as part of this study.

2.3.2 The site was largely comprised of agricultural fields during the late 19<sup>th</sup> and early 20<sup>th</sup> Centuries. In the early 1940s, the southern and western areas of the site were developed as a wartime industrial facility (the Shorts site). The facility was used to repair bomber aircraft (that had been dismantled at the nearby Bourn airfield) and salvage used parts from redundant bombers. Phase 1 of the Shorts site, comprising hangars, the administration block, canteen and stores were located in the western area of the site and was completed in 1941. Phase 2 of the Shorts site, comprising hangars, offices, a maintenance building and fuel compound were located in the southern area of the site and was completed in 1942.

2.3.3 After the war the site was vacated, with site buildings being used by the University, and by the Home Office for storage.

2.3.4 By the late 1960s the Phase 1 site in the western area of the site had been demolished and some laboratory buildings were shown in this area. The Phase 2 site buildings in the southern area were still present at this time. The University of Cambridge - School of Veterinary Medicine is shown in the central area of the site at this time.

2.3.5 By the early 1980s, the M11 Motorway had been constructed on the western boundary of the site. Laboratory buildings, a university Design Centre and a building labelled "British Antarctic Survey" were shown in the western area of the site. The Phase 2 site buildings in the southern area of the site were no longer shown (they were demolished in 1972). This area of the site was taken over by the University Farm and was used for grazing cattle or for grass cutting. Other laboratory buildings were shown in the south-eastern area of the site at this time.

2.3.6 The 2002 and 2008 OS maps show further university development in the eastern and western areas of the site.

## 2.4 Ground and Groundwater Conditions

2.4.1 The geological map of the area indicates that the site is completely underlain by Gault Formation (generally referred to as Gault Clay comprising pale to dark grey or blue-grey clay or mudstone). The geological map also indicates that along a very small area of the northern site boundary, the Gault Formation is overlain by Head Deposits (comprising clay, silt, sand and gravel).

2.4.2 The Gault Clay was encountered in all the ground investigations carried out at the site, generally beneath a veneer of topsoil, Made Ground and/or Head Deposits. The Gault Clay was typically described as stiff to very stiff grey/brown becoming grey clay.

2.4.3 The Gault Clay is a non-aquifer i.e. a formation generally regarded as containing insignificant quantities of groundwater.

2.4.4 Groundwater was generally not encountered during ground investigations at the site, as would be anticipated given the dominant clay geology. Minor seepages were reported in some

exploratory holes, although this was generally from Made Ground and Head Deposits horizons and was not considered to be significant.

## **2.5 Land Quality**

- 2.5.1 In general terms, the ground investigation reports that have been reviewed, that have included geoenvironmental testing, have not identified gross or widespread contamination.
- 2.5.2 An incident of lead poisoning of cattle in the southern area of the site (adjacent to the former Phase 2 Shorts site) in August 1995 was investigated by the Ministry of Agriculture Fisheries and Food (MAFF) State Veterinary Service's Veterinary Investigation Centre in 1995 and subsequently by ADAS and WS Atkins in 1996. It was concluded that the animals had died from the ingestion of a grey material (possibly lead paint) located in the hedge of one of the fields. The grey material was found to contain up to 27% lead.
- 2.5.3 The soils in the area of the former Phase 2 Shorts site in the southern area of the site have been subject to contamination testing, as have soils at sites bordering this area. In general, elevated concentrations of contaminants have not been encountered in this area, or in neighbouring areas.
- 2.5.4 The majority of the site was largely greenfield prior to development during the latter part of the 20<sup>th</sup> Century. As such, the potential for widespread contamination in the remaining undeveloped areas of the site is considered to be low.

## **2.6 Unexploded Ordnance**

- 2.6.1 No specific study of unexploded ordnance (UXO) has been carried out for the whole site. Cambridge was bombed during the Second World War and the Shorts site could be deemed a potential bomb target.
- 2.6.2 Spent ammunition from aircraft guns may have been deposited in the area west of the road between the Phase 1 and 2 areas of the Shorts site.
- 2.6.3 The desk study undertaken by Arup for the University of Cambridge Data Centre (neighbouring the former War Depot area) included a preliminary UXO risk assessment. This assessment indicates that the nearest record of bombs landing west of Cambridge City Centre are located approximately 2km south-east of the site. Based on the assessment, Arup concluded that their site was unlikely to have been bombed during the Second World War.
- 2.6.4 Other preliminary UXO assessments carried out on different areas within the site boundary report the risk of unexploded ordnance as low/moderate based on high level bomb map information supplied by Zetica.
- 2.6.1 No evidence for UXO or other munitions were encountered during previous investigations or during redevelopment of the site areas to date.

## **2.7 Minerals**

- 2.7.1 The site does not fall within a Minerals Safeguarding Area as set out in the Cambridgeshire and Peterborough Minerals and Waste Development Plan-Core Strategy adopted in July 2011.
- 2.7.2 The nature of the ground conditions is such that the potential for mineral extraction at the site would be extremely limited.

## **2.8 Site Levels, Earthworks and Existing Development**

- 2.8.1 The northern site boundary with Madingley Road falls from approximately 19.50-16.80 m OD west to east and the southern site boundary of the site falls from approximately 17.50m to 12.70m OD west to east.
- 2.8.2 Within the site area there is a west to east running ridge that also falls in elevation eastwards from about 19.70m to 14.70m OD broadly through the middle to upper third of the site. The highest areas seem to be along Charles Babbage Road and the Plaza area which has been built up.
- 2.8.3 The large attenuation pond in the southern area was excavated below existing ground level and spoil from this excavation was stabilised with lime and used to construct the Plaza area such that this is the area of highest elevation at the site
- 2.8.4 The site has been subject to various phases of development such that foundations, slabs, road construction and areas of engineered fill including locally lime stabilised soil will be present in the areas of proposed buildings.

## 3 Geotechnical Considerations

### 3.1 Introduction

- 3.1.1 This section is intended to give general geotechnical guidance for masterplanning at the site. A number of geotechnical factors and constraints will need to be considered in the design of foundations, earthworks, and infrastructure for the civil engineering and building work during future development. Large areas of the site are 'green field' and would be unaffected by past industrial development. The following sections outline the geotechnical factors that should be taken into account during master planning.
- 3.1.2 The geology of the site consists of Gault Clay variously covered with Superficial Deposits (mainly Head Deposits). Head Deposits may include deposits of glacially re-worked Gault Clay which may be indistinguishable from weathered Gault Clay.

### 3.2 Foundation Conditions

#### Made Ground

- 3.2.1 Made Ground has been identified in some of the ground investigations carried out at the site. The Made Ground encountered has been of variable thickness and composition. Local pockets of Made Ground may be found in others areas of the site even where there is no apparent history of industrial development.
- 3.2.2 Due to the inherent variability in composition, thickness and strength, structures and infrastructure constructed on Made Ground may be at risk from high total and/or differential settlements.
- 3.2.3 The potential presence of buried former foundations, structures or other obstructions should not be overlooked as these may cause differential settlements or prevent penetration of piles.

#### Head Deposits

- 3.2.4 Based on the information obtained it is likely that the Head Deposits, when present, will not exceed 3m in thickness and consist of firm to stiff sandy gravelly clay. Conventional foundations bearing on to Head Deposits are expected to be suitable for lightly loaded structures, but the depth, thickness and composition of the Head Deposits may be highly variable. Foundations that span different or variable soil types may need to be stepped or lightly reinforced.
- 3.2.5 More heavily loaded foundations may need to be extended down to the underlying more competent and consistent Gault Clay stratum, either by using trench fill foundation or by piling.

#### Gault Clay

- 3.2.6 Traditional shallow spread or strip foundations are likely to be suitable for some developments on the Gault Clay. However, the Gault Clay is susceptible to weathering and softening which could affect the allowable bearing pressure and, consequently the depth of the weathering and foundation design parameters should be established on a site specific basis. Gault Clay is also susceptible to ground movements, shrinkage and swelling, due to seasonal and long term moisture changes. All clay soils consolidate to a varying degree under applied loading, and the allowable bearing pressure will be determined to ensure total and differential settlements remain within structural tolerances.
- 3.2.7 Heavily loaded foundations for major structures may exceed settlement tolerances and in such cases piled foundations will be required. Consequently large span buildings, high rise

structures or buildings that are very sensitive to settlement may need piled foundations at this site, even if situated on undisturbed natural ground.

- 3.2.8 Piled foundations will be required where buildings are to be constructed with undercrofts.

### **3.3 Shrinkage and Swelling of Clay Soils**

- 3.3.1 Previous ground investigations at the site have shown that the Gault Clay is of high to very high plasticity and is therefore particularly susceptible to volume change.

- 3.3.2 Seasonal changes in moisture content can affect the near surface soils and foundations in clay soils adopt a minimum depth to avoid such movements. Vegetation such as trees and dense hedgerows can desiccate clay soils to considerable depth and the shrinkage or swelling caused by the planting or removal of trees and hedgerows on clay soils is a common cause of structural damage. New trees planted near foundations cause shrinkage, while the ground below trees and hedgerows that have been removed and built over can take many years to resaturate. In doing so, the ground can swell, causing heave and structural damage.

### **3.4 Slope Stability**

- 3.4.1 In general, the gently sloping topography of the site would not be expected to give rise to significant slope stability issues. However, the presence of Head Deposits at the surface increases the risk of slope instability. Relict slip surfaces roughly parallel to the ground surface and often covering large areas may be present within the Head Deposits themselves, and also in the underlying periglacially weathered clay.

- 3.4.2 Excavations through these relict slip surfaces, e.g. to create level platforms for development, may lead to reactivation and ground instability. Head Deposits may have already been disturbed by earthwork operations in some areas

### **3.5 Roads**

- 3.5.1 Roads constructed in areas where natural soft materials are present at formation level, may require capping layers, or alternatively stabilisation with lime or cement to minimise consumption of granular resources. Roads in areas of Made Ground will require investigation prior to construction to determine the nature and thickness of the fill material and its properties, and mitigating measures designed accordingly.

- 3.5.2 CBR tests carried out for the Phase 3 infrastructure ground investigation recorded CBR values of approximately 6% (unsoaked) for near surface samples collected from the Head Deposits/weathered Gault Clay.

### **3.6 General Excavations**

- 3.6.1 Excavations in natural ground, such as for services, should not present any problems specific to the site area. Clay soils predominate and consequently groundwater inflows are likely to be slight and easily controlled. Excavations will require side support wherever man entry is required and in soft or loose material side support should also be provided wherever there is a risk of collapse.

### **3.7 Aggressive Ground Conditions**

- 3.7.1 The Gault Clay is known to contain sulphate minerals which in the presence of groundwater and air can give rise to aggressive conditions for buried concrete. Previous investigations have reported the sulphate conditions to be DS-3, according to BS 8500-1:2005, and concrete

for foundations specified accordingly. A check on conditions should be made prior to construction.

### **3.8 Infiltration Drainage**

- 3.8.1 The Gault Clay is practicably impermeable so there is no scope for the use of infiltration drainage for the attenuation of runoff from buildings and paved areas. Surface water systems should be designed in accordance with the principles of sustainable urban drainage, SUDS.

### **3.9 Re-use of Materials**

- 3.9.1 From the overview of earthworks testing carried out as part of previous on-site ground investigations, the re-use of site won natural materials for earthworks is likely to be practicable. The Gault Clay and Head Deposit materials are considered to be suitable for most applications although moisture conditioning may be required to achieve optimum conditions for some applications.
- 3.9.2 Successful lime stabilisation tests have been carried out on samples of Gault Clay recovered from the southern area of the site as part of an earlier ground investigation.

### **3.10 Existing Buildings and Infrastructure**

- 3.10.1 There is existing infrastructure and drainage in areas of proposed buildings which will either require diverting or being built over which may necessitate use of piled foundations.
- 3.10.2 Foundations and slabs to existing structures could clash with proposed foundations, there are potential areas of disturbed ground due to previous building work and there may be limits on foundation techniques such as piling due to vibration.
- 3.10.3 Lime stabilised soils will probably require a piled foundation solution to support structures unless this material is excavated and levels reduced.

## 4 Land Quality Considerations

### 4.1 Introduction

- 4.1.1 The site was largely used as agricultural fields up until the Second World War when parts of the southern and western areas of the site were developed for an industrial war-time use. Since then, these industrial buildings have been demolished and the site has been developed primarily for university buildings and laboratories.
- 4.1.2 The site is situated in a relatively low sensitivity geoenvironmental setting for the following reasons:
- The solid geology underlying the site is the low permeability Gault Clay – a non-aquifer.
  - There are no significant groundwater abstractions within the site boundary.
  - There are no Source Protection Zones (SPZs) on or overlapping the site.
  - There are no significant European designated environmental receptors on the site such as Ramsar sites or Special Protection Areas (SPAs).
- 4.1.3 The overall potential for land contamination issues on the site is low.

### 4.2 Contamination

- 4.2.1 The main currently undeveloped areas of the site are largely “greenfield” land and these areas of the site are considered relatively low risk with respect to potential land quality constraints.
- 4.2.2 Potential sources of contamination have been identified from desk studies carried out within the site boundary: area of the Phase 2 Shorts site (aircraft maintenance facility) present in the southern area between 1942 and 1972, areas of Made Ground, areas of the site where construction materials have been deposited or stored, electrical substations and areas of waste storage associated with on-site laboratories.
- 4.2.3 From the findings of ground investigations carried out at the site, the site history and the natural ground conditions, it is considered unlikely that soil contamination will represent a significant risk to future development at the site but may be present locally around point sources or related to specific site activities.
- 4.2.4 There may be locally elevated levels of ground gas and carbon dioxide in particular associated with deeper areas of made ground that may require some form of gas mitigation for buildings.

### 4.3 Re-use of Soil

- 4.3.1 The potential for cut and fill and on site reuse of arisings will be limited by site levels, existing development and density of future development. Off-site disposal of soil is therefore possible and soil chemistry and the level of contamination will have an impact on the cost of disposal particularly where Made Ground is excavated.



## 5 Potential Development Constraints and Opportunities

### 5.1 Geotechnical Constraints

There are no major geotechnical constraints to site development but PBA's geotechnical appraisal has identified the potential for the following issues, some local and others widespread that will need to be taken into consideration in terms of building form and layout and which will impact on the cost of development.

Areas of potential geotechnical constraints are presented in Figure 2.

- The presence of Made Ground with variable physical properties potentially requiring the deepening of shallow foundations or necessitating piled foundations.
- The potential of reactivating relict slip surfaces during excavation;
- The potential for shrinkage and swelling in the natural strata requiring the deepening of shallow foundations or necessitating piled foundations;
- The possible presence of naturally elevated sulphate in the Gault Clay strata requiring specific buried concrete design;
- The limited potential for infiltration drainage;
- The presence of clay sub-grades which are susceptible to softening and trafficking requiring the importation of capping material or requiring soil stabilisation;
- Existing area of lime stabilised fill – buildings piled.
- The locations of existing development foundations to new buildings or necessitates specific foundation types.

### 5.2 Land Quality Constraints

5.2.1 There are no major land quality constraints that will impact on future development, but PBA have identified a number of issues that will need to be taken into consideration.

- The potential for localised areas of Made Ground that are gassing;
- The potential for localised hot spots of contamination around point sources that require treatment/removal;
- The classification of waste materials for off-site disposal;
- The potential presence of unexploded ordnance (UXO).

### 5.3 Geotechnical Opportunities

The anticipated ground conditions at the site will offer relatively straightforward conditions for future development because:

- Generally the site is level with limited earthworks or site re-profiling required.

- Site soils are generally suitable for shallow foundations for lightly loaded structures.
- Overall the sub-grade conditions at the site are favourable.
- There is potential for re-using site won natural materials in earthworks for future development.

#### **5.4 Land Quality Opportunities**

Land quality is not a major issue due to the largely greenfield nature of the site.

- The site will not be classed as “Contaminated Land”;
- No site wide remediation will be required;
- There are no major sensitive environmental receptors on or off-site;
- Volumes of materials requiring off-site disposal will be limited.

## 6 Data Gaps

### 6.1 Site History

- 6.1.1 To date, the history of the site has been pieced together from available information presented in desk studies focussed on small areas of the site. A complete overview of the history of the site, including those areas yet to be developed, would be beneficial moving forward to support the future Environment Statement and planning applications.

### 6.2 Ground and Groundwater Conditions

- 6.2.1 Various ground investigations have been carried out at the site over the last 20 years. However, there are still some areas of the site, particularly in the north-central area and also in the eastern area (east of the School of Veterinary Medicine) which have not been subject to ground investigation.
- 6.2.2 The ground conditions in these areas are unlikely to be significantly different to other investigated areas of the site, although confirmatory investigation would be required for future development in these areas.
- 6.2.3 Where piled foundations may be required deep boreholes will be necessary.

### 6.3 Existing Buildings and Infrastructure

- 6.3.1 The nature and extent of existing building foundations and slabs will be required given the proposed density of the development where building foundations and slabs could clash and where there may be restrictions on for example piling due to vibration or impact on adjoining structures.

### 6.4 Land Quality

- 6.4.1 No site wide investigation or assessment of land quality has been undertaken for the site. Assessment has been on a project by project basis and therefore there are data gaps in information.
- 6.4.2 Previous locations of historical buildings and both historical and current activities that could have given rise to potential contamination such as the aircraft maintenance facility will require targeted investigation.

### 6.5 UXO

- 6.5.1 The presence of hangars and aircraft maintenance facility on the site which may have been targeted during WWII will require further study to determine the overall risk rating from UXO. At this stage, there is insufficient information to assess the risks of UXO at the site.

### 6.6 Archaeology

- 6.6.1 Although the site has been developed over the last few decades with buildings and infrastructure, the potential for archaeological remains will need to be taken into account in masterplanning.

## **6.7 Existing Processes and Activities**

- 6.7.1 Information on existing processes and activities that take place in each building, particularly in relation to emissions and discharges, storage and waste management, will be required to fully assess potential for contamination and pollution.
- 6.7.2 Existing surface water quality information will similarly be required from attenuation ponds and other existing on-site drainage.

## 7 Recommendations

### 7.1 Recommended Activities

7.1.1 The further work recommended to ensure a comprehensive understanding of all ground related aspects of the site that will contribute to site master planning and Environmental Statement preparation is detailed in Appendix A and summarised below. Proposed exploratory hole locations are presented in Figure 3.

- A comprehensive Phase 1 desk study suitable for planning and for EIA for the site to include:
  - i. An up to date Envirocheck report, including historical OS maps, covering the whole of the site area.
  - ii. Liaison and consultation with Cambridge City Council and University of Cambridge Estates to collect ground condition data they hold for the site.
  - iii. Review of the original EIA and development specific information that was not obtained or was unavailable in time for Stage 1b.
  - iv. A detailed review and summary of exploratory hole logs and geoenvironmental and geotechnical laboratory testing on soil samples retrieved from the site during previous ground investigations.
  - v. A preliminary UXO assessment for the site.
  - vi. Review of existing processes and activities including discharges, emissions, surface water quality, storage and waste disposal.
- A Phase 2 intrusive investigation to include:
  - i. Investigation in areas where there is currently a gap in data.
  - ii. Investigation targeted at specific areas where either land quality or ground conditions are of potential concern or where detailed design is required for specific land parcels.
  - iii. Classification of soils in terms of waste disposal.

## Figures

1. Plan of Previous Ground Investigations
2. Geotechnical Constraints
3. Proposed Exploratory Hole Location Plan

## Appendix A

### Scope of Additional Work

#### 1. Phase 1 Ground condition Assessment

The objective of the Phase 1 is to identify the likely ground conditions and environmental setting which might have associated environmental liabilities or which may affect development in those areas which are currently undeveloped. A combined ground condition assessment including geotechnical information will also appraise the likely foundation requirements and geological or geotechnical constraints at the site.

A Phase 1 Ground Condition Assessment is the minimum requirement under the National Planning Policy Framework (NPPF) definition of “site investigation information” for sites where development is proposed.

The Phase 1 would comprise a desk study to collect relevant information in the public domain, a detailed review of information collated from previous desk studies and ground investigations, a site walkover and a Tier 1 Preliminary Risk Assessment (qualitative). UK policy and legislation promote the use of a staged risk based approach to the assessment of ground quality/conditions. The underlying principle is the evaluation of *pollutant linkages* in order to assess whether the presence of a source of contamination could potentially lead to harmful consequences.

The basic requirements of a Phase 1 are set out in the Model Procedures for the Management of Contaminated Land (CLR 11), Annex A of BS 5930 and Section 6.2 of BS 10175. The assessment also considers the requirements detailed in the Environment Agency’s “Guidance on Requirements for Land Contamination Reports”.

Given the former wartime use of parts of the site, it is also recommended that a preliminary unexploded ordnance (UXO) survey is carried out as part of the Phase 1 Ground Condition Assessment to assess the risk of UXO to be present on the site.

#### 2. Phase 2 Ground Condition Assessment

An intrusive ground investigation (Phase 2) will provide information on the ground conditions and geotechnical parameters for the design of the geotechnical aspects of proposed development in those areas currently undeveloped. In addition, information on land contamination is obtained at the same time to verify the findings of the Phase 1 assessment and confirm the assessed contamination risk associated with proposed development.

Based on the extent of previous ground investigations at the site, and the known historical uses of the site (particularly the former Shorts site), the proposed scope of intrusive work to fill in the gaps of areas currently un/under investigated at the site could comprise:

- i) The sinking of seven boreholes to a depth of about 15 m using cable percussion techniques with standard penetration testing and recovery of soil samples.
- ii) The excavation of twenty-six trial pits to examine the near surface ground conditions including the recovery of samples of the soils encountered.
- iii) The construction of groundwater and ground gas monitoring wells in selected boreholes together with the monitoring of groundwater and ground gas levels.
- iv) Geotechnical testing of selected soil samples to determine general geotechnical parameters.

- v) Chemical analysis of soil samples for a range of potential contaminants (the exact testing suite would depend on the outcome of Phase 1).
- vi) Waste acceptance criteria testing

The need for any further work beyond the Phase 1 and 2 assessments, for example detailed plot specific ground investigations to assist in design of building foundations, remediation strategies, verification reports etc., will depend on the findings of the Phase 1 and Phase 2 assessments and it is recommended that the proposals for any further work are addressed on completion of these assessments.

### **3. ES Chapter**

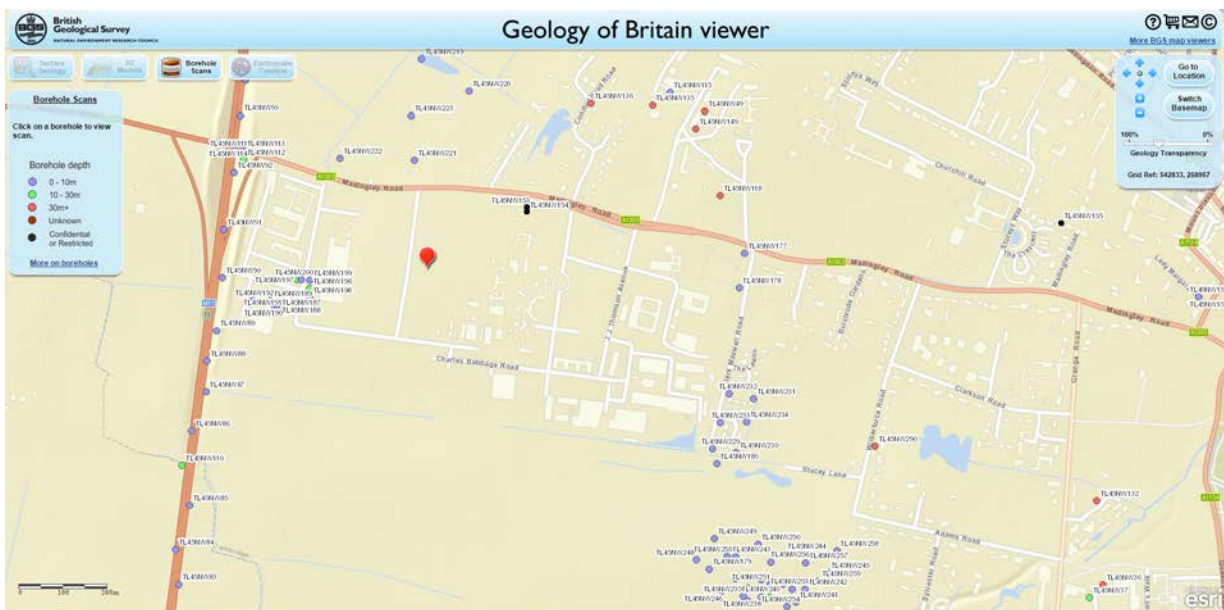
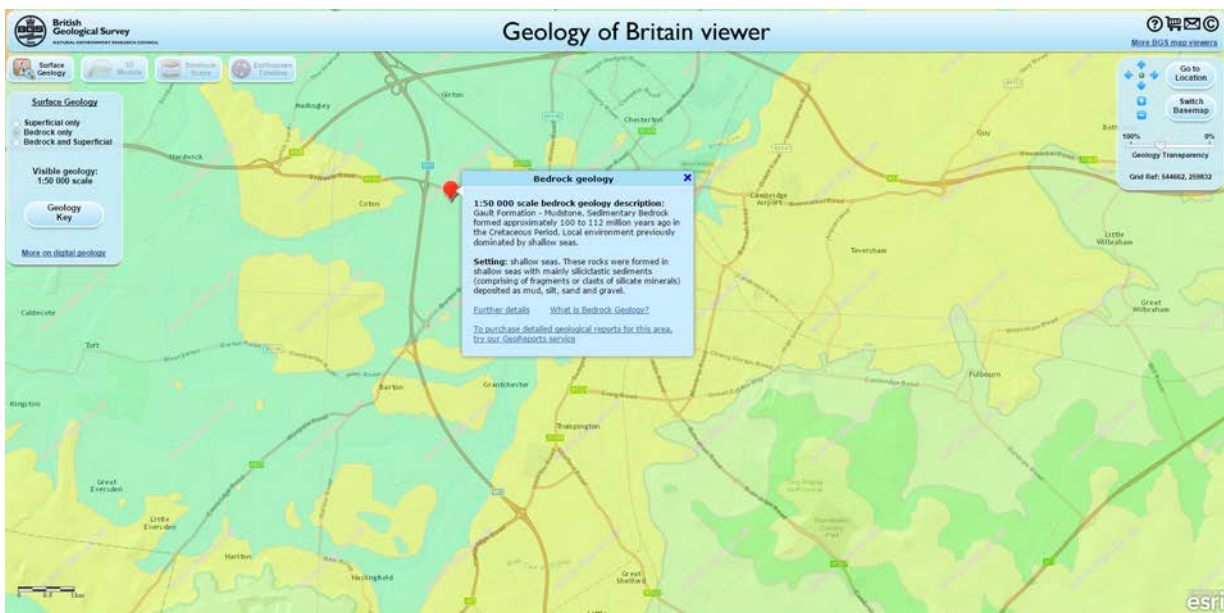
Following completion of the ground condition assessment studies, a chapter on Ground Conditions and Land Contamination which will present an assessment of the likely impact of the proposed development on aspects of the land and water environment will be required for inclusion in the Environmental Statement.

Consultation with the regulators at an early stage is recommended as this promotes stakeholder engagement and assists in the appropriate scoping of works for key milestone deliverables.



## **Appendix G Extracts from British Geological Survey (BGS) Borehole Logs**

BGS maps – Accessed on 29/9/2015



Cranfield Soil and Agrifood Institute  
**Soilscapes**

Cranfield UNIVERSITY

Soilscapes map | Soil descriptions | Help | Search | Contact | About | LandIS

Legend

Search

Get my current location

Coordinates: ?

Lat:

Lon:

OS grid reference: ?

East:

North:

Place/Postcode:

Place name:

Search results:

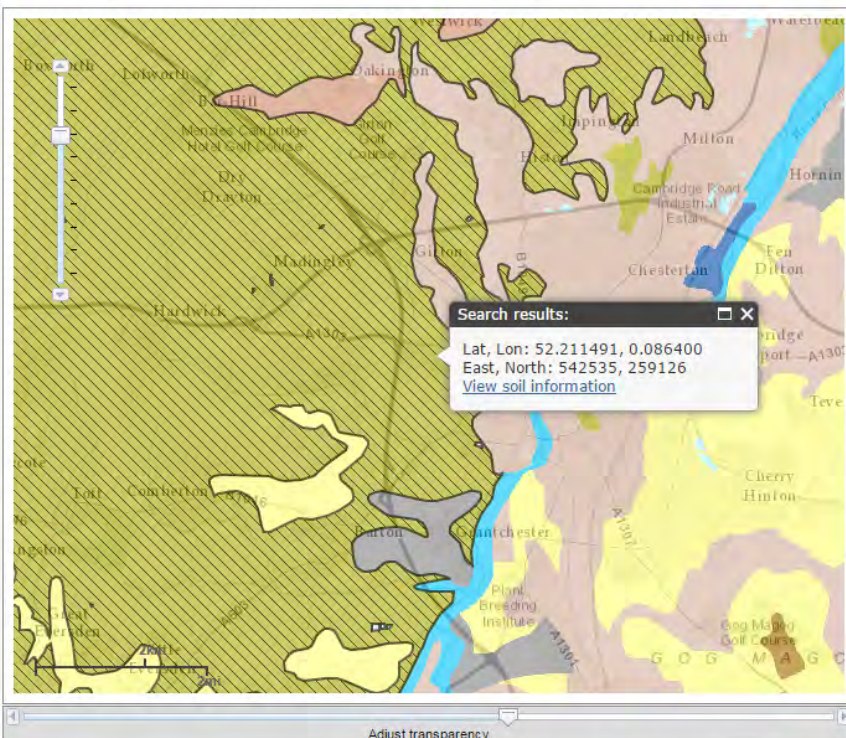
Soil information

Search results:

Lat, Lon: 52.211491, 0.086400  
East, North: 542535, 259126  
[View soil information](#)

Adjust transparency

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For more detailed soil information visit [Soil Site Reporter](#) For soils education visit [soil-net.com](#)



Legend

Search

Soil information

**Drainage:** Slightly impeded drainage

**Fertility:** High

**Habitats:** Base-rich pastures and classic chalky boulder clay ancient woodlands; some wetter areas and lime-rich flush vegetation

**Landcover:** Arable some grassland

**Carbon:** Low

**Drains to:** Stream network

**Water protection:** Land is drained and nitrate vulnerable; potential for rapid pollutant transport; surface capping can trigger sheet erosion of fine sediment to stream network

**General cropping:** Suited to autumn sown crops and grass but shortage of soil moisture can restrict yield, and timeliness with field work is important to avoid structural damage particularly in spring

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 For more detailed soil information visit [Soil Site Reporter](#) For soils education visit [soil-net.com](#)



Descriptions of the full range of soilscapes are available below. For a full soils guide, including detailed descriptions of soil types and associations, please visit the [LandIS Soils Guide](#).

- ID Description**
- 1 Saltmarsh soils
  - 2 Shallow very acid peaty soils over rock
  - 3 Shallow lime-rich soils over chalk or limestone
  - 4 Sand dune soils
  - 5 Freely draining lime-rich loamy soils
  - 6 Freely draining slightly acid loamy soils
  - 7 Freely draining slightly acid but base-rich soils
  - 8 Slightly acid loamy and clayey soils with impeded drainage
  - 9 Lime-rich loamy and clayey soils with impeded drainage
  - 10 Freely draining slightly acid sandy soils
  - 11 Freely draining sandy Breckland soils
  - 12 Freely draining floodplain soils
  - 13 Freely draining acid loamy soils over rock
  - 14 Freely draining very acid sandy and loamy soils
  - 15 Naturally wet very acid sandy and loamy soils
  - 16 Very acid loamy upland soils with a wet peaty surface
  - 17 Slowly permeable seasonally wet acid loamy and clayey soils
  - 18 Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
  - 19 Slowly permeable wet very acid upland soils with a peaty surface
  - 20 Loamy and clayey floodplain soils with naturally high groundwater
  - 21 Loamy and clayey soils of coastal flats with naturally high groundwater
  - 22 Loamy soils with naturally high groundwater
  - 23 Loamy and sandy soils with naturally high groundwater and a peaty surface
  - 24 Restored soils mostly from quarry and opencast spoil
  - 25 Blanket bog peat soils
  - 26 Raised bog peat soils
  - 27 Fen peat soils

**Soilscape description:** Lime-rich loamy and clayey soils with impeded drainage

**Texture:** Clayey, some loamy

**Coverage:** England: 5.3% Wales: 0% England & Wales: 4.5%

**Drainage:** Slightly impeded drainage

**Fertility:** High

**Habitats:** Base-rich pastures and classic chalky boulder clay ancient woodlands; some wetter areas and lime-rich flush vegetation

**Landcover:** Arable some grassland

**Carbon:** Low

**Drains to:** Stream network

**Water protection:** Land is drained and nitrate vulnerable; potential for rapid pollutant transport; surface capping can trigger sheet erosion of fine sediment to stream network

**General cropping:** Suited to autumn sown crops and grass but shortage of soil moisture can restrict yield, and timeliness with field work is important to avoid structural damage particularly in spring

Developed by Cranfield University and sponsored by DEFRA  
 For more detailed soil information visit [Soil Site Reporter](#) For soils education visit [soil-net.com](#)

# Norwest Holst Soil Engineering Ltd.

Borehole No.

**1**

 Contract No. F9081  
 Location Schlumberger, Cambridge  
 Client Buro Happold  
 Method of Boring Cable Percussion  
 Diameter of Borehole 150mm

## BOREHOLE LOG

 4227  
 5906

 TUSNW 1910  
 Sheet 1 of 2  
 Chainage.....  
 Ground Level 21.27 m.A.O.D.  
 Date 27/2/91

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/R.O.D. %	Daily Progress
Firm yellowish-brown silty CLAY with a little fine rounded gravel.		0.30	20.97		0.00-0.10 0.30-0.40 0.50-0.70 (55)		
Soft to firm dark grey silty CLAY with a little fine to medium sub-rounded to rounded gravel.		0.70	20.57		0.70-0.80 1.00-1.10		
Firm to stiff light brown mottled grey white sandy CLAY with some fine rounded gravel.		1.00	20.27		1.50-1.95	"8"	
Soft to firm orange brown very sandy CLAY with much fine to medium rounded and a little coarse sub-angular to sub-rounded gravel.		1.60	19.67		2.50-2.80 (85) 2.80-2.90		
Stiff blue grey fissured silty CLAY.					3.50-3.95	"14"	
					4.50-4.90 (90) 4.90-5.00		
					6.00-6.45	"18"	
					7.10-7.20 7.50-7.90 (90) 7.90-8.00		
					9.00-9.45	"28"	

Type of Sample

Is S.P.T. Undisturbed

Ic C.P.T. Vane

O Jar Water

Bulk Piezometer

 Remarks (Observations of Ground Water etc.) ( ) U100 Blows  
 Groundwater: Not encountered during drilling.

Water levels are subject to seasonal or tidal variations and should not be taken as constant

# Norwest Holst Soil Engineering Ltd.

Borehole No.

**2**

 Contract No. F9081  
 Location Schlumberger Cambridge  
 Client Buro Happold  
 Method of Boring Cable Percussion  
 Diameter of Borehole 150mm

## BOREHOLE LOG

 Sheet 1 of 2

Chainage

 Ground Level 21.16 m.A.O.D.

 Date 28/2/91

4224

S908

Description of Strata	Legend	Depth Below G.L. (m)	O.D. Level (m)	Casing Depth at Sampling	Sampling and Coring	"N"/R.Q.D.%	Daily Progress
Firm brownish grey silty CLAY with a little fine rounded gravel.		0.30	20.86		0.00-0.10 0.30-0.40		
Firm to stiff grey brown silty slightly sandy CLAY with a little fine to coarse sub-angular to sub-rounded gravel.		1.20 1.40	19.96 19.76		1.00-1.20 (60) 1.20-1.30 1.40-1.50 1.50-1.95	"8"	
Soft to firm orange brown very sandy CLAY with much fine to medium subrounded to rounded gravel.		2.10	19.06				
Firm blue grey mottled light grey sandy CLAY with a little subangular gravel of chalk.					2.50-2.80 (75) 2.80-2.90		
Stiff blue grey fissured silty CLAY					3.50-3.95	"17"	
					4.50-4.90 (80) 4.90-5.00		
					6.00-6.45	"17"	
					7.50-7.80 (85) 7.80-7.90		
					9.00-9.45	"26"	

Type of Sample

Is S.P.T. Undisturbed

Ic C.P.T. Vane

O Jar Water

Bulk Piezometer

Remarks (Observations of Ground Water etc.) ( ) U100 Blows.

Water levels are subject to seasonal or tidal variations and should not be taken as constant

TLHSNW 198

Trial Pit No.

5

# Norwest Holst Soil Engineering Ltd.

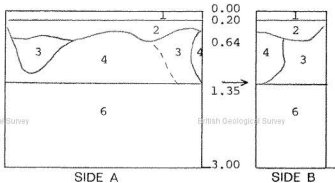
Contract No. P9081  
 Location Schlumberger, Cambridge  
 Client Buro Hapold  
 Excavation Plant JCB 3CX, Site Master  
 Dimensions (l x b x h) 2.00 x 1.00 x 3.00m

## TRIAL PIT LOG

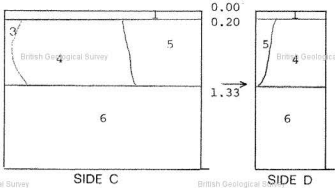
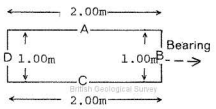
4227  
 5904

Chainage  
 Ground Level 21.10 m.A.O.D.  
 Date 8/3/91

### ELEVATIONS:—



### PLAN (Not to scale)



### SAMPLES

No. & Type	Depth m.
D1	0.50
B1	0.85
D2	0.70
W1	1.09
B2	2.20

No.	Depth m.	STRATA DESCRIPTION	Cv/Cp kN/m <sup>2</sup>
1	0.00 0.20	Topsoil.	0.46m 13.2 13.5
2	0.20 0.64	Soft light brown slightly sandy CLAY with a little fine to coarse angular gravel of flint.	10.1 14.4
3	0.64 1.35	Soft light grey CLAY with a little, locally same, fine, predominantly medium, rounded gravel of chalk and with some rootlets and rootways.	0.77m 13.5 12.8 19.5
4	0.64 1.35	Compact light orangish brown clayey fine to coarse SAND and fine to coarse angular to rounded GRAVEL of flint, and quartzite.	0.63m 9.16 13.5
5	0.20 1.35	Firm orangish brown sandy CLAY, with a little fine to coarse angular to rounded gravel of flint, quartzite and iron deposits.	10.3
6	1.35 3.00	Firm to stiff grey and grey brown mottled CLAY. 1.35-1.70m ... with a little fine to medium gravel sized rounded gravel of chalk. From 1.70m...becoming dark grey, closely fissured CLAY with occasional root systems on fissures.	

NOTES Cv/Cp: Approximate value of undrained shear strength from hand vane/penetrometer  
 Groundwater: Slight seepage from sand and gravel pockets / lenses at 1.09m  
 Pumping: Not required.  
 Supports/Stability: Spalling from sand and gravel lenses / shoring absent.

# Norwest Holst Soil Engineering Ltd.

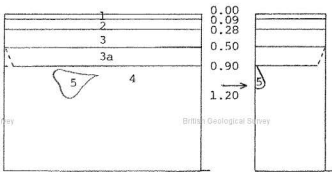
Contract No. **F9081**  
 Location **Schlumberger Cambridge**  
 Client **Buro Hapold**  
 Excavation Plant **JCB 3CX Sitcmaster**  
 Dimensions (l x b x h) **2.00 x 1.00 x 3.00m**

## TRIAL PIT LOG

4227  
 5908

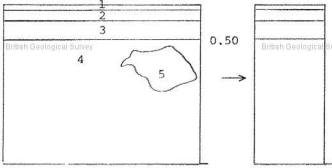
Chainage .....  
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 Date **.....11/3/91.....**

### ELEVATIONS



SIDE A

SIDE B

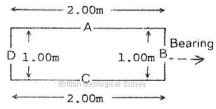


SIDE C

SIDE D

Sheet 1 of 2

### PLAN (Not to scale)



### SAMPLES

No. & Type	Depth m.
B1, D1	0.50
B2, D2	1.00
D3	1.00*
B3	1.20
B4, D4	2.00
B5, D5	3.00
W1	1.20

No.	Depth m.	STRATA DESCRIPTION	Cv/Cp kN/m <sup>2</sup>
1	0.00-0.09	Topsoil.	1.00m 78 86
2	0.09-0.28	MADE GROUND: Red and brown fine to coarse sand with much fine to coarse gravel sized brick fragments, concrete and felt-like geomembrane.	57 67 88 71
3	0.28-0.50	Firm to stiff brown sandy CLAY with some fine to coarse angular gravel of flint, quartzite and iron deposits.	2.50m 98
3a	0.50-0.90	Soft to firm brown slightly sandy CLAY with some fine to coarse angular gravel of flint and iron deposits.	113 97 93
4	0.50-3.00	Stiff, grey, occasionally light brown mottled CLAY. 0.50-1.70m ... with a little fine gravel sized chalk fragments closely fissured. from 1.70m ... with occasional dark reddish brown root systems along fissures and with occasional up to coarse gravel sized pockets of soft orange brown clay.	3.00m 98 113 108 93

NOTES Cv/Cp Approximate value of undrained shear strength from hand vane/penetrometer  
 Groundwater: Slight seepages from gravel horizons i.e. strata (5)  
 Pumping: Absent  
 Supports/Stability: Spalling of pit sides from gravel lenses.



TL45NW 200

# Norwest Holst Soil Engineering Ltd.

Trial Pit No.  
**7**

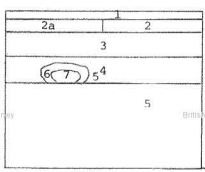
Contract No. F9081  
 Location Schlumberger Cambridge  
 Client Buro Hapold  
 Excavation Plant JCB 3CX, Sitemaster  
 Dimensions (l x b x h) 2.00 x 1.00 x 3.00m

## TRIAL PIT LOG

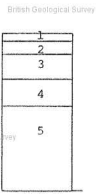
4225  
5908

Chainage  
 Ground Level ..21.08.. m A.O.D.  
 Date 11/3/91

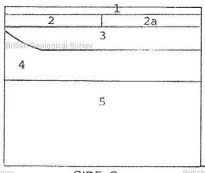
### ELEVATIONS



SIDE A



SIDE B



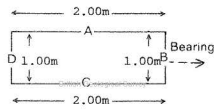
SIDE C



SIDE D

Sheet 1 of 2

PLAN (Not to scale)



### SAMPLES

No. & Type	Depth m.
B1, D1	0.70
B2	1.00
B3, D2	2.00
B4	3.00

No.	Depth m.
(1)	0.00-0.12
(2)	0.12-0.34
(3)	0.12-0.34
(3)	0.34-0.70
(4)	0.70-1.30
(6)	0.70-1.30
(7)	0.80-1.30

### STRATA DESCRIPTION

Topsoil.

MADE GROUND: Compact reddish brown clayey very sandy fine to coarse gravel of brick fragments, concrete.

MADE GROUND: Firm brown clay with a little fine to coarse angular gravel of brick fragments.

Firm to stiff orangish brown slightly sandy CLAY with a little fine to coarse angular gravel of flint.

Firm to stiff brownish grey CLAY with a little fine to coarse angular gravel of flint.

Firm orangish brown slightly sandy to sandy much fine to coarse angular to rounded gravel of flint quartzite and chalk.

Compact orangish brown clayey very sandy fine to coarse angular to rounded GRAVEL.

Cv/Cp kN/m <sup>2</sup>
0.70m strata 3
72
72
67
72
1.30m
88
88
88
88
93
93
2.00m
93
95
93
88
93
93
2.50m
98
95
93
93
95




NOTES Cv/Cp Approximate value of undrained shear strength from hand vane/penetrometer  
 Groundwater: Very slight seepage from sand and gravel lenses  
 Pumping: Not required  
 Supports/Stability: Spalling from sand and gravel lenses.



TL 45 NW

4270, 5902

188

<b>IGES</b> 19 Talisman Square, KENILWORTH, CV8 1JB. Tel: 01926 851113 Fax: 01926 851394		Job No. <b>6769</b>	Site : CADCENTRE, CAMBRIDGE. Client : YORKON LIMITED. Engineer :	<b>BOREHOLE LOG</b> <b>BH 2</b> Sheet 1 of 1 Scale 1:25							
Method <b>Endrive Hand System.</b>		Date <b>27/04/98</b>	Drilling Crew <b>Banetre Drilling.</b>	Logged By <b>BW</b>							
Dia (mm) <b>100</b>		Coord		Ground Level m.							
Date & Casing Depth	Depth m.	Sample Type	Water Level	SPT N or Cu	M/C %	Depth m.	Description of Strata	Legend			
	0.60	P		110		0.20	Turf over TOPSOIL.				
	0.70 0.80	P D		125		0.60	Pea Gravel (French Drain). MADE GROUND.  Stiff grey brown silty CLAY with occasional fine chalk and flint gravel.				
	1.10	D&P		150		1.00	Very stiff grey mottled brown quickly becoming grey silty CLAY.				
	1.50	P		150							
	1.75	D									
	2.00	P		160		2.00					
27/04/98											
Remarks							<b>GROUNDWATER</b>				
							Struck	Cased	20 mins	Scaled	Remarks
							0.50				water from French Drain.

TL 45 NW

4218 5903

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<b>IGES</b> 19 Talisman Square, KENILWORTH, CV8 1JB. Tel: 01926 851113 Fax: 01926 851394		Job No. <b>6769</b>	Site : <b>CADCENTRE, CAMBRIDGE.</b> Client : <b>YORKON LIMITED.</b> Engineer :	<b>BOREHOLE LOG</b> <b>BH 3</b> Sheet 1 of 1 Scale 1:25							
Method <b>Endrive Hand System.</b>		Date <b>27/04/98</b>		Drilling Crew <b>Danetre Drilling.</b>	Logged By <b>BW</b>						
Dia (mm) <b>100</b>		Coord		Ground Level m.							
Date & Casing Depth	Depth m.	Sample Type	Water Level	SPT N or Cu	M/C %	Depth m.	Description of Strata	Legend			
	0.20						Turf over TOPSOIL.				
	0.50	P		75		0.50	Firm to stiff grey brown silty CLAY with rare fine chalk and flint gravel and occasional rootlets.				
	0.70	D		110			Stiff grey mottled brown silty CLAY with occasional rootlets in upper surface.				
	0.75	P		125							
	0.90	P		150			- becoming dark grey and very stiff from 1.00m bgl.				
	1.00	P									
	1.25	D									
	1.50	P		125							
	1.75	D									
	2.00	P		160							
	2.50	D&P		150							
27/04/98	3.00	P		175		3.00					
Remarks 1/ Groundwater was not encountered.							<b>GROUNDWATER</b>				
							Struck	Cased	20 mins	Sealed	Remarks