Surface Water Drainage Strategy
for the Proposed Residential Development at
Station Yard, High Street, Meldreth

Contents

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1951 – DS – Rev B – Jan 18

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Surface Water Drainage Strategy

for the Proposed Residential Development at

Station Yard, High Street, Meldreth

1 Introduction

1.1 MTC Engineering (Cambridge) Limited has been asked to provide a Surface Water Drainage Strategy in respect to the proposed residential development on land at Station Yard, High Street, Meldreth, on behalf of Station Yard Meldreth Ltd.

1.2 This Drainage Strategy is based on the following information:-

1.2.1 Site Layout supplied by John Dickie Associates;

1.2.2 Ordnance Site Survey by Associated Surveying Consultants;

1.2.3 Cambridge County Council SuDS Guidance;

1.2.4 British Geological Survey mapping;

1.2.5 Ground Investigation Report by AF Howlands Associates.

1.3 The comments and opinions contained in this report including any conclusions are based on the information available to MTC Engineering (Cambridge) Ltd. during our investigations. The conclusions drawn could therefore differ if the information is found to be inaccurate, incomplete or misleading. MTC Engineering (Cambridge) Ltd. accept no liability should this prove to be the case, nor if additional information exists or becomes available with respect to this site.

1.4 MTC Engineering (Cambridge) Ltd. makes no representation whatsoever concerning the legal significance of its findings or any other matters referred to in the following report. Except as otherwise requested by the client, MTC Engineering (Cambridge) Ltd. are not obliged and disclaim any obligation to update the report for events taking place after the Assessment was undertaken.

1.5 This report is a Flood Risk Assessment of flooding issues associated with the proposed development. The information presented and conclusions drawn are based on statistical data and are for guidance purposes only. This report provides no guarantee against flooding of the study site or elsewhere, nor as to the absolute accuracy of water levels, flow rates and associated probabilities quoted

2 Site Description

2.1 The site is located on the western side of Station Road, and south of High Street, Meldreth and occupies an area of approximately 0.55Ha as shown on the site location plan provided in Appendix 1.

2.2 To the west the site is bound by Station Road which runs in a northeasterly direction then becomes High Street at the sites most northwestern corner. Past this, further west is a mixture of industrial and residential development. Past High Street to the northwest of the site is residential development.

2.3 The northeastern boundary of the site is with a derelict building then Meldreth Train Station and car park, with residential development onto High Street to the west of this.

2.4 The southern and eastern boundary of the site is with Meldreth train line running in a northeasterly direction beneath Station Road, then a mixture of open agricultural land and industrial development.

2.5 The site is currently completely impermeable and the southern section of the site is occupied by a factory/offices, whilst a concrete access and hard standing areas form the northern section of the site.

2.6 Levels on a site are relatively flat with a slight fall in a northwesterly direction from levels of just below 23.0m above Ordnance Datum (AOD) at the sites southern corner to levels of approximately 22.5m AOD at the sites northwestern corner.

2.7 British Geological Survey Mapping indicates that the bedrock geology underlying the site is the West Melbury Marly Chalk Formation, with no superficial geology present.

2.8 Infiltration testing has been undertaken at three locations on site, with three tests being carried out at trial pits 1 and 2 and two tests being carried out at trial pit 3, a copy of the infiltration test results are provided in Appendix 2.

2.9 The trial pits were dug to 2m deep and logs confirmed geology across the site as being between 250mm to 600mm of course sand and sandy clays underlain by chalky clay and structureless chalk. Tests results indicate the lowest infiltration rate achieved at trial hole 1 to be $2.45x10^{-5}$ m/s, whilst trial pit two and trial pit three achieved infiltration rates of $1.43x10^{-5}$ m/s and $4.01x10^{-6}$ m/s respectively.

3 The Proposed Development and Indicative Drainage Areas

3.1 The proposal involves a Full Planning Application for the development of 10 residential dwellings and 2 apartment blocks with associated access, parking and landscaped areas, a copy of the site layout is provided in Appendix 3.

3.2 There are no significant flood risks to the site, which lies entirely in Flood Zone 1 thus at a low risk of flooding from fluvial or tidal sources it is not indicated as at significant risk of surface water flooding by mapping and is not considered to be at significant risk of flooding from any other sources.

3.3 General good practice will be followed during the detailed design phase with finished floor levels designed to ensure that flow paths are available between buildings with finished floor levels set sufficiently above adjacent ground levels in order that water will not pond in the vicinity of access points or enter the building under any circumstance.

3.4 Drainage areas are based on the final layout and are shown on the impermeable area plan provided in Appendix 4 and are as follows;

- Dwelling/garage roof areas: 1,220m^2
- Shared drive/parking areas: 1,450m^2

3.5 To deal with surface water runoff from these areas the Surface Water Drainage Strategy detailed in Section 5 has been developed in compliance with current relevant local and national guidance.

4 Sustainable Drainage Strategy

4.1 To ensure the proposed layout can be drained using SuDS systems in accordance with all relevant local and national guidance, consideration has been given to key areas including potential discharge points, attenuation volumes required, achieving sufficient treatment of pollution and the suitable of various SuDs systems for use at the site. These are considered in further detail in the following sections.

4.2 Point of Discharge

4.2.1 In line with the surface water run off hierarchy, the preferable means of disposal for surface water is via infiltration. The site is underlain by a bedrock geology of the West Melbury Marly Chalk Formation. Infiltration testing carried out at the site in accordance with BRE365 indicate the geology is sufficiently permeable and that infiltration can be used as a means of drainage.

4.2.2 Infiltration testing has taken place at the site, with tests undertaken at three separate locations as detailed in Appendix 2. Three tests were undertaken at two of the pits (TP01 and TP03) with the lowest rate achieved being 2.45×10^{-5} m/s (0.088 m/hr) and 1.43×10^{-5} m/s (0.051 m/hr) respectively.

4.2.3 Trial pit 3 (TP03) is located within the central area of the site, with the lowest infiltration coefficient recorded at this pit during testing being 4.01×10^{-6} m/s (0.014 m/hr). To ensure that calculations provided are conservative, the lowest rate achieved during testing of 4.01×10^{-6} m/s (0.014 m/hr) has been used for all calculations undertaken at the current stage.

4.3 If during the detailed design phase further infiltration testing is carried out and confirms rates which exceed 0.014m/hr then attenuation volumes can be reduced accordingly.

4.4 SuDS Systems Proposed at the Development and Attenuation volumes

4.4.1 Permeable paving is a SuDS feature that is appropriate to use at most developments including the proposed development and provides a flood reduction benefit due to the attenuation volume in the base and a pollution reduction benefit due to the filtration of water as it passes through the permeable surfacing.

4.4.2 Permeable paving will therefore be used on all private drive and parking areas to be provided at the development whilst surface water from all roof areas will be to the base of the permeably paved areas as shown on the indicative drainage layout provided in Appendix 5.

4.4.3 Water re use systems such as rainwater harvesting and water butts that would allow rainwater to be reused for purposes such as irrigation may also be provided at the development, however will be considered as part of the detailed design phase once full planning permission be granted.

4.4.4 Should such systems be provided any storage volume provided in such systems (which would overflow to the main surface water drainage network or base of permeable paving) will not be counted towards that required to accommodate the design rainfall event as such systems may be full at the time the rainfall event occurs.

4.4.5 Large diameter pipe, tank and storm cell systems are considered to be the least sustainable/preferable SuDS system given that they solely provide a flood reduction system without providing either pollution reduction or landscape and wildlife benefits, and will therefore only be used when absolutely necessary such as for conveyance beneath access area.

4.5 Proposed Infiltration Attenuation Volumes

4.6 Based on the recorded worst case infiltration rate of 0.014m/hr from testing carried out on site, Micro Drainage Calculations (Appendix 6) indicate that 135.5m^3 is required to

sufficiently attenuate discharge from an impermeable area of 0.267Ha during a 1 in 100 year plus 40% climate change event whilst infiltration takes place.

4.7 Assuming a base thickness of 350mm and 30% void space the permeable paving will provide 0.105m^3 of storage per m^2, thus based on the area of private parking and driveways being 1,450m^2 approximately 152m^3 of attenuation can be provided in the base of permeably paved areas, which exceeds the 135.5m^3 Micro Drainage calculations indicate is required to successfully attenuate a 1 in 100 year plus 40% climate change event whilst infiltration takes place.

4.8 In the unlikely event that additional attenuation is required at the detailed design phase the base thickness of parking areas could be increased or cellular storage systems can be introduced beneath the permeably paved areas.

4.9 **SuDS Treatment Stages**

4.9.1 Run off from all areas of the proposed development will receive appropriate treatment as part of the proposed drainage system. Drainage from all private access and parking areas will initially be through permeable paving which provides a filtration system removing pollutants such as hydro carbons. This provides one treatment stage for drainage from these trafficked areas.

4.9.2 Filtering discharge through a membrane such as Terram upon exiting storage beneath the permeably paved areas will provided a second stage of treatment and ensure that requirements are met for lightly trafficked areas draining through permeable surfacing.

4.9.3 Roof drainage (which is considered clean discharge) from all dwellings will be to the base of the permeably paved access and driveways, thus will be filtered through the membrane such as Terram prior to discharge providing one treatment stage as necessary for discharge from such areas.

4.9.4 Appropriate treatment will therefore be provided to all surface water discharge from the proposed development.

4.10 **Future Maintenance of Drainage Systems**

4.10.1 Drainage systems and permeable paving serving single dwellings only will be the responsibility of the dwelling owner to maintain. Maintenance of shared systems will be the responsibility of all owners to maintain with a legal duty placed upon the owner or management company set up to maintain communal area of the development.

4.10.2 Further details of maintenance responsibilities along with provision of a maintenance plans for the various SuDS features at the development will be provided during the detailed design phase once conditional planning permission has been granted.

4.11 The final design will be based upon this drainage strategy, which clearly demonstrates that the proposed development can be drained in accordance with all national and local requirements with all drainage to be via infiltration systems during all rainfall events up to and including a 1 in 100 year plus 40% climate change rainfall event.

5 Conclusion

5.1 The proposal involves the development of 10 residential dwellings and 2 apartment blocks, with associated access, parking and landscaped areas on land at Station Yard, High Street, Meldreth.

5.2 Infiltration testing has been carried out on site in accordance with BRE 365/CIRIA 156, with all rates obtained being suitable for infiltration systems to be used as a means of surface water discharge at the site.

5.3 Micro Drainage Calculations based upon the worst-case infiltration rate achieved on site indicate the proposed surface water system will successfully drain a 1 in 100 year plus 40% climate change event solely by infiltration as detailed in Section 4.

5.4 Adequate pollution treatment will be provided to all surface water drainage prior to discharge.

5.5 A detailed maintenance plan will be provided for all drainage systems as part of the detailed design phase.

5.6 Surface water drainage from the site will be via a new SuDS system that will include:

- Permeable paving that will provide a pollution treatment system by filtration of water from trafficked areas of the proposed development whilst providing a further attenuation volume of approximately 152m^3.
- This total attenuation volume of 152m^3 therefore exceeds the 135.5m^3 volume Micro Drainage Calculations indicate is required during all events up to and including a 1 in 100 year plus 40% climate change event whilst infiltration takes place.

5.7 Appropriate consideration has been given to pollution treatment and the future maintenance of SuDS systems at this stage of the proposal with more detailed information to be provide at the detailed application stage.

5.8 The Sustainable Drainage Strategy provided is fully in line with all current local and national policy and there are no flood risk or drainage related grounds on which to object to the proposed residential development on land at Station Yard, Meldreth.

APPENDIX 1

SITE LOCATION PLAN

N

REV	DATE	BY	REVISION NOTES
-	-	-	-

Suite 2, Clare Hall,
St Ives Business Park,
Parsons Green,
St Ives,
Cambs, PE27 4WY

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Web: www.planningandarchitecture.co.uk

PARTNERS in PLANNING and ARCHITECTURE

PROJECT
Former GoCold Building,
Station Yard,
Meldreth,
Cambs,
SG8 6JR

CLIENT
Station Yard Meldreth Ltd

DRAWING TITLE
Location Plan

DRAWN BY	SCALE	
SJW	1:1250 @ A3 (10m 20 30 40 50 60)	
DATE	DWG. No.	REV.
21/04/17	2016/63/100	-

APPENDIX 2

INFILTRATION TEST RESULTS

A REPORT ON A GROUND INVESTIGATION AT MELDRETH STATION, MELDRETH, SG8 6JR (FACTUAL)

CLIENT: Station Yard Meldreth Limited

ENGINEER: MTC Engineering (Cambridge) Limited

Date: 25 July 2017

Reference: ADB/17.265

A F Howland Associates
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A F Howland Associates

CONTENTS

CLIENT: Station Yard Meldreth Limited

ENGINEER: MTC Engineering (Cambridge) Limited

A REPORT ON A GROUND INVESTIGATION AT MELDRETH STATION, MELDRETH, SG8 6JR (FACTUAL)

Reference: ADB/17.265

Date: 25 July 2017

1. INTRODUCTION

It is proposed to carry out residential development at a site off Station Road, Meldreth, SG8 6JR (drawing 17.265/1).

At the instruction of the Client, an investigation has been undertaken to provide an assessment of the ground conditions and the infiltration characteristics of the shallow soil to aid the drainage design for the proposed development.

This report provides the factual details of the fieldwork undertaken during the investigation.

2. FIELDWORK

The fieldwork was carried out on 19 and 20 July 2017, and comprised three machine excavated trial pits with subsequent soakage testing referenced TP01 to TP03.

The locations of the positions were set out in general accordance with the requirements of the Client, as indicated on drawing 17.265/2.

A cable avoidance tool (CAT) was used to sweep the location of each position and the immediate surrounding area to locate any potential services, and the positions adjusted as necessary.

Soils were described in general accordance with BS EN 1997-2:2007 Eurocode 7 and its UK National Annex supported by BS 5930:2015.

The trial pits were excavated by a wheeled JCB 3CX excavator and taken to a depth of 2.00 m using a 0.45 m wide bucket. The initial hardstanding was broken out using a hydraulic breaker attachment to the excavator. No groundwater was encountered during excavation of the trial pits.

To facilitate soakage testing and maintain the test section, the trial pits were filled with 20 mm diameter gravel between 1.00 and 2.00 m depth with temporary monitoring pipes also installed. The tests were carried out in accordance with Building Research Establishment report 365 (BRE, 2016) by filling the test section with water and recording the time taken for it to drain away. In addition to manual dipping, data loggers were installed to record the level of the water outside normal working hours.

The trial pit records and infiltration test results are appended to this report.

Details of the strata encountered, the sampling and *in situ* testing are shown on records appended to this report.

[redacted]
BSc (Hons) FGS

[redacted]
MSc PhD DIC CEng FIMMM CGeol FGS

A F HOWLAND ASSOCIATES
25 July 2017

APPENDIX A: REFERENCES

BUILDING RESEARCH ESTABLISHMENT. 2016. BRE Digest 365: Soakaway design. Building Research Establishment, London.

BRITISH STANDARDS INSTITUTION. 2015. BS 5930:2015 Code of practice for ground investigations. British Standards Institution. London.

BRITISH STANDARDS INSTITUTION. 2007. Eurocode 7 – Geotechnical Design. Part 2: Ground investigation and testing. British Standards Institution. London.

APPENDIX B: TRIAL PIT AND SOAKAGE TEST RECORDS

D Small disturbed sample

All depths and measurements are given in metres, except as noted

Strata descriptions compiled by visual examination of samples obtained after BS 5930:2015 and modified in accordance with laboratory test results where applicable

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Geotechnical Engineers

Site Meldreth Station, Station Rd, Meldreth, SG8 6JR			**Trial Pit Number** TP01
Excavation Method JCB 3CX Wheeled Excavator	**Dimensions** 1.80 m L x 0.45 m W x 2.00 m D	**Ground Level (mOD)**	**Client** Station Yard Meldreth Limited	**Job Number** 17.265
	Location	**Dates** 19/07/2017-20/07/2017	**Engineer** MTC Engineering (Cambridge) Limited	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	D1				(0.50)	Tarmac/Concrete over Made Ground (dark grey gravelly sand with many fragments of tarmac and concrete)		
0.50-0.75	D2				0.50 (0.25)	Made Ground (soft to firm grey sandy chalky slightly gravelly clay. Gravel is fine to medium chalk)		
0.75-1.10	D3				0.75 (0.35)	Soft to firm dark greyish brown sandy slightly gravelly CLAY. Gravel is subangular fine to medium chalk		
1.10-2.00	D4				1.10 (0.90)	Structureless CHALK, recovered as silt size matrix with gravel size fragments of very weak chalk		
					2.00	Complete at 2.00m		

No Image available

Remarks

1. Location CAT scanned prior to excavation.
2. Plastic 150 mm diameter pipe broken at 0.60 m depth. Client informed and confirmed it was redundant.
3. No groundwater encountered
4. Trial Pit remained open and sidewalls stable during excavation
5. Pit backfilled with gravel to 1.0 m and then arisings to surface
6. Soakage test performed between 1.0 m and 2.0 m

Scale (approx)	Logged By	Figure No.
1:25	ADB	17.265.TP01

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Geotechnical Engineers

Soakage Test (BRE Digest 365)

Site : Meldreth Station, Station Rd, Meldreth, SG8 6JR

Client : Station Yard Meldreth Limited

Engineer: MTC Engineering (Cambridge) Limited

Job Number 17.265

Sheet 1 / 1

Location	Date	Level	Location
TP01	19/07/2017		

Pit Width (m)	0.45
Pit Depth (m)	2.00
Pit Length (m)	1.80

Soil type at test level	Dark greyish brown sandy slightly gravelly CLAY over structureless CHALK
Groundwater	Not encountered
Drain discharge depth	Not known
Sidewall stability	Stable
Stone filled or open pit	Stone Filled

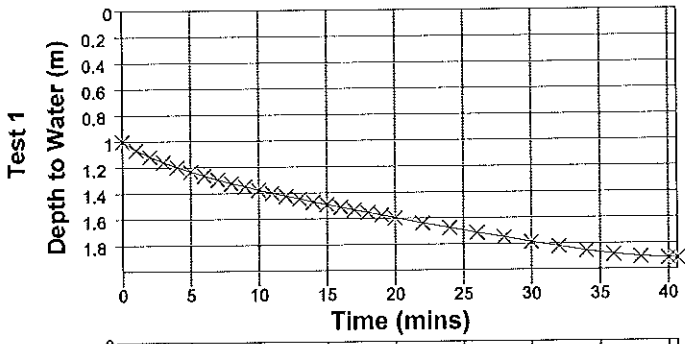
	1	2	3
Effective depth (m)	1.00	0.99	1.02
Volume outflowing between 75% & 25% (m3)*	0.12	0.12	0.12
Mean surface area through which outflow occurs (m2)	3.06	3.04	3.11
Time for outflow between 75% & 25% (min)	22.48	23.87	27.09
SOIL INFILTRATION RATE (ms-1), f	2.94E-5	2.76E-5	2.45E-5

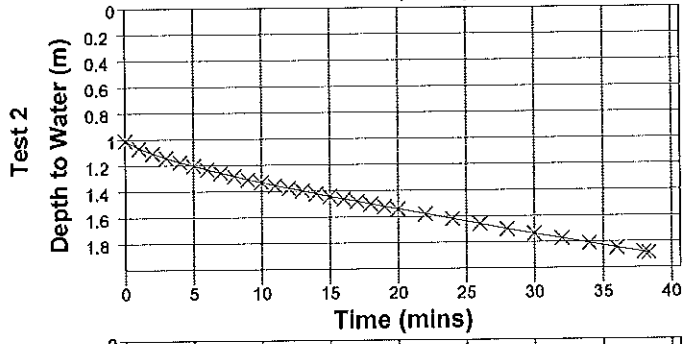
Remarks

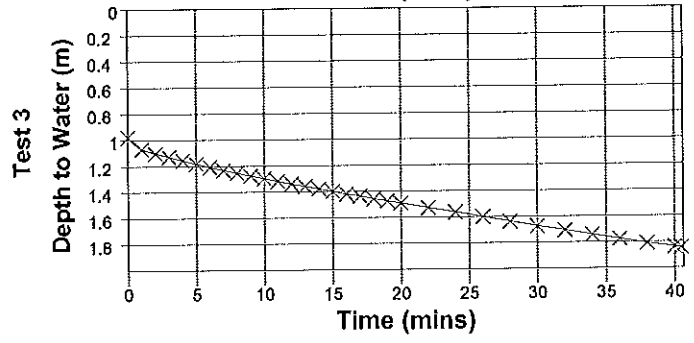
1. Soakage test undertaken between 1.0 m and 2.0 m
2. No groundwater encountered
3. Datalogger serial no. 10226020
4. Test 1 and 2 undertaken on 19/07/17 whilst test 3 undertaken on 20/07/17

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (mins)	Depth to Water Test 1	Depth to Water Test 2	Depth to Water Test 3
0	1.003	1.013	0.979
1	1.068	1.07	1.072
2	1.119	1.11	1.104
3	1.161	1.144	1.131
4	1.20	1.177	1.159
5	1.235	1.206	1.184
6	1.266	1.234	1.21
7	1.297	1.261	1.234
8	1.326	1.288	1.255
9	1.351	1.312	1.277
10	1.378	1.335	1.299
11	1.402	1.358	1.32
12	1.426	1.379	1.342
13	1.447	1.40	1.36
14	1.473	1.422	1.38
15	1.492	1.444	1.40
16	1.513	1.464	1.421
17	1.535	1.484	1.437
18	1.555	1.504	1.459
19	1.576	1.525	1.476
20	1.598	1.544	1.493
22	1.639	1.583	1.53
24	1.675	1.621	1.564
26	1.715	1.66	1.601
28	1.75	1.701	1.638
30	1.788	1.738	1.675
32	1.823	1.775	1.709
34	1.856	1.812	1.743
36	1.885	1.849	1.777
38	1.905	1.883	1.811
38.333		1.889	
40	1.915		1.84
40.5			1.845
40.667	1.918		







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Geotechnical Engineers

Site Meldreth Station, Station Rd, Meldreth, SG8 6JR			**Trial Pit Number** TP02
Excavation Method JCB 3CX Wheeled Excavator	**Dimensions** 1.80 m L x 0.45 m W x 2.00 m D	**Ground Level (mOD)**	**Client** Station Yard Meldreth Limited	**Job Number** 17.265
	Location	**Dates** 19/07/2017-20/07/2017	**Engineer** MTC Engineering (Cambridge) Limited	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	D1				(0.50)	Tarmac/Concrete over Made Ground (dark grey gravelly sand with many fragments of tarmac and concrete)		
0.50-0.75	D2				0.50 (0.25)	Dark grey slightly gravelly fine to coarse SAND. Gravel is subangular to subrounded flint		
0.75-2.00	D3				0.75 (1.25)	Grey mottled brown structureless CHALK, recovered as very weak gravel size fragments of chalk in a silt size matrix		
					2.00	Complete at 2.00m		

No image available

Remarks

1. Location CAT scanned prior to excavation.
2. No groundwater encountered
3. Trial Pit remained open and sidewalls stable during excavation
4. Pit backfilled with gravel to 1.0 m and then arisings to surface
5. Soakage test performed between 1.0 m and 2.0 m

Scale (approx)	Logged By	Figure No.
1:25	ADB	17.265.TP02

A F Howland Associates
Geotechnical Engineers

Soakage Test (BRE Digest 365)

Site : Meldreth Station, Station Rd, Meldreth, SG8 6JR

Client : Station Yard Meldreth Limited

Engineer: MTC Engineering (Cambridge) Limited

Job Number 17.265

Sheet 1 / 1

Location	Date	Level	Location
TP02	19/07/2017		

Pit Width (m)	0.45
Pit Depth (m)	2.00
Pit Length (m)	1.80

Soil type at test level	Structureless CHALK
Groundwater	Not encountered
Drain discharge depth	Not known
Sidewall stability	Stable
Stone filled or open pit	Stone Filled

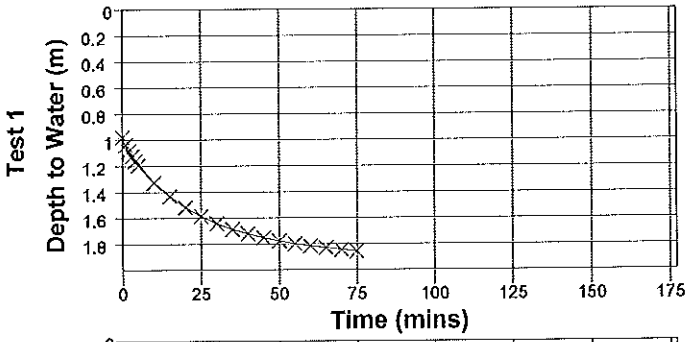
	1	2	3
Effective depth (m)	1.02	1.04	1.03
Volume outflowing between 75% & 25% (m3)*	0.12	0.13	0.13
Mean surface area through which outflow occurs (m2)	3.11	3.15	3.13
Time for outflow between 75% & 25% (min)	37.22	44.46	46.48
SOIL INFILTRATION RATE (ms-1), f	1.78E-5	1.50E-5	1.43E-5

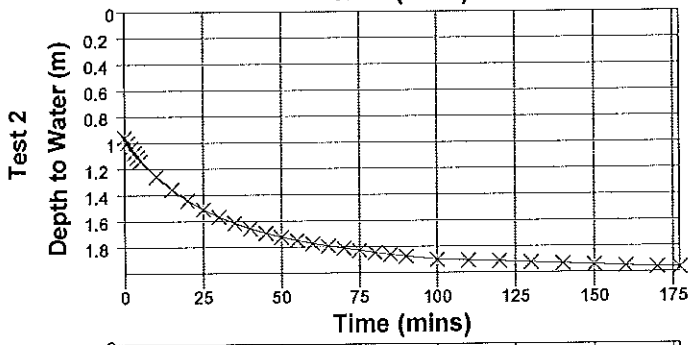
Remarks

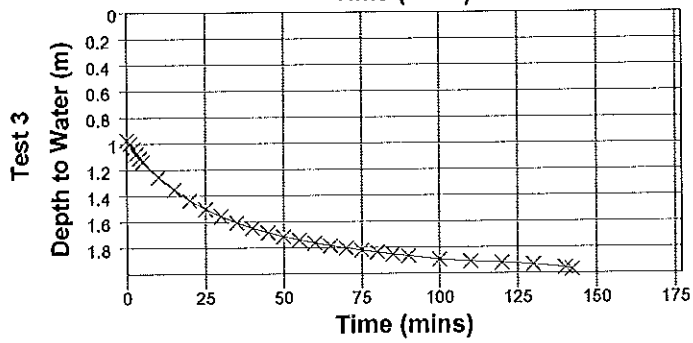
1. Soakage test undertaken between 1.0 m and 2.0 m
2. No groundwater encountered
3. Datalogger serial no. 11186010
4. Tests 1 and 2 undertaken on 19/07/17 whilst test 3 undertaken on 20/07/17

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

Elapsed time (mins)	Depth to Water Test 1	Depth to Water Test 2	Depth to Water Test 3
0	0.98	0.961	0.973
1	1.037	1.001	1.00
2	1.085	1.041	1.041
3	1.126	1.076	1.078
4	1.163	1.11	1.113
5	1.195	1.14	1.141
10	1.329	1.259	1.258
15	1.434	1.359	1.354
20	1.519	1.443	1.436
25	1.587	1.511	1.503
30	1.643	1.57	1.558
35	1.688	1.618	1.608
40	1.722	1.66	1.65
45	1.753	1.695	1.685
50	1.778	1.726	1.716
55	1.80	1.751	1.742
60	1.817	1.775	1.765
65	1.831	1.795	1.787
70	1.846	1.813	1.805
74.833	1.858		
75		1.829	1.821
80		1.846	1.836
85		1.86	1.852
90		1.875	1.866
100		1.901	1.894
110		1.909	1.91
120		1.914	1.92
130		1.925	1.933
140		1.934	1.956
142.167			1.97
150		1.943	
160		1.954	
170		1.962	
177.167		1.968	







A F Howland Associates
Geotechnical Engineers

Excavation Method JCB 3CX Wheeled Excavator	**Dimensions** 1.80 m L x 0.45 m W x 2.00 m D	**Ground Level (mOD)**	**Site** Meldreth Station, Station Rd, Meldreth, SG8 6JR
	Location	**Dates** 19/07/2017-20/07/2017	**Client** Station Yard Meldreth Limited
			Engineer MTC Engineering (Cambridge) Limited

Trial Pit Number: TP03

Job Number: 17.265

Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	D1				(0.50)	Tarmac/Concrete over Made Ground (dark grey gravelly sand with many fragments of tarmac and concrete)		
0.50-1.10	D2				0.50 (0.60)	Made Ground (soft to firm dark grey mottled brown slightly sandy chalky clay)		
1.10-2.00	D3				1.10 (0.90)	Soft to firm grey chalky gravelly CLAY. Gravel is subangular to subrounded fine to medium chalk		
					2.00	Complete at 2.00m		

No Image available

Remarks

1. Location CAT scanned prior to excavation.
2. No groundwater encountered
3. Trial Pit remained open and sidewalls stable during excavation
4. Pit backfilled with gravel to 1.0 m and then arisings to surface
5. Soakage test performed between 1.0 m and 2.0 m

Scale (approx)	Logged By	Figure No.
1:25	ADB	17.265.TP03

A F Howland Associates
Geotechnical Engineers

Soakage Test (BRE Digest 365)

Site : Meldreth Station, Station Rd, Meldreth, SG8 6JR

Client : Station Yard Meldreth Limited

Engineer: MTC Engineering (Cambridge) Limited

Job Number: 17.265

Sheet: 1 / 1

Location	Date	Level	Location
TP03	19/07/2017		

Pit Width (m)	0.45
Pit Depth (m)	2.00
Pit Length (m)	1.80

Soil type at test level	MADE GROUND over chalky gravelly CLAY
Groundwater	Not encountered
Drain discharge depth	Not known
Sidewall stability	Stable
Stone filled or open pit	Stone Filled

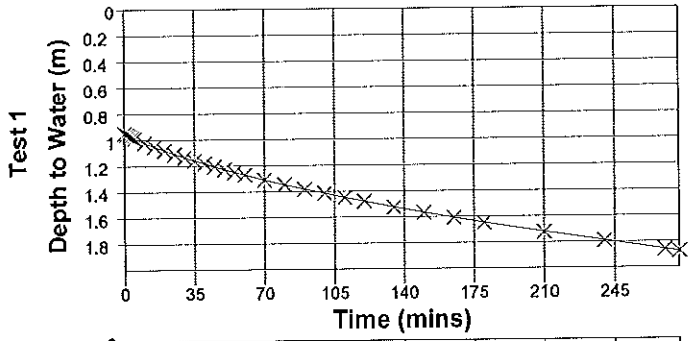
	1	2
Effective depth (m)	1.05	1.01
Volume outflowing between 75% & 25% (m3)*	0.13	0.12
Mean surface area through which outflow occurs (m2)	3.17	3.08
Time for outflow between 75% & 25% (min)	170.05	165.50
SOIL INFILTRATION RATE (ms-1), f	3.94E-6	4.01E-6

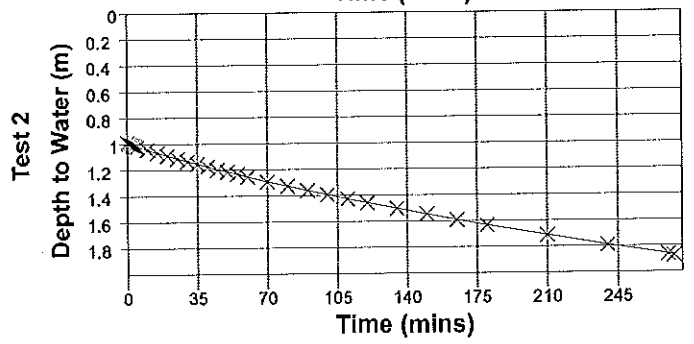
Remarks

1. Soakage test undertaken between 1.0 m and 2.0 m
2. No groundwater encountered
3. Datalogger serial no. 12816060
4. Test 1 undertaken on 19/07/17 whilst test 2 undertaken on 20/07/17
5. Test 3 not undertaken due to time constraints in agreement with the Client

* Volume outflowing reduced to account for granular backfill used during testing (30 % of free volume assumed).

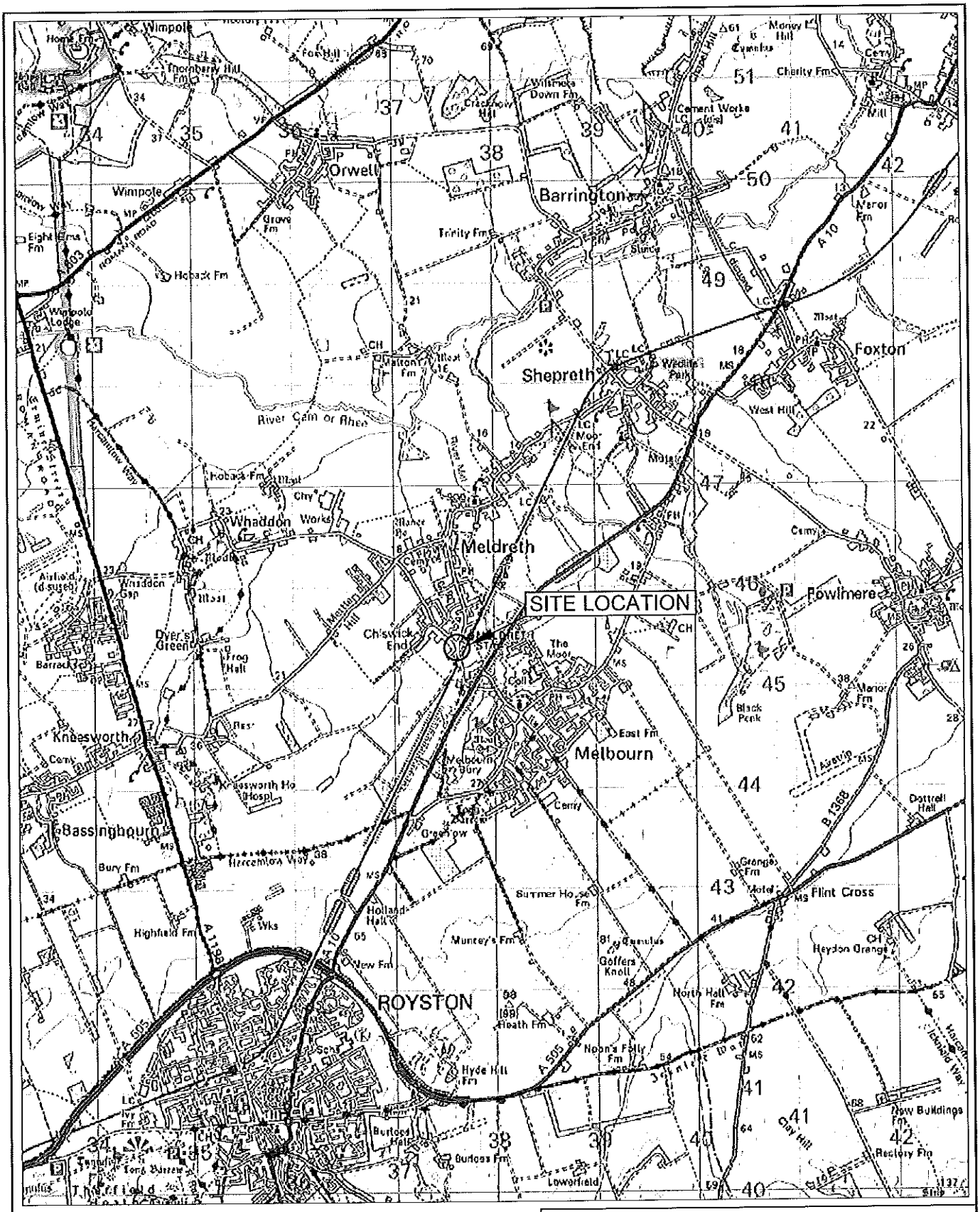
Elapsed time (mins)	Depth to Water Test 1	Depth to Water Test 2
0	0.95	0.991
1	0.961	0.998
2	0.969	1.004
3	0.974	1.009
4	0.982	1.015
5	0.989	1.02
10	1.024	1.045
15	1.054	1.069
20	1.082	1.092
25	1.11	1.113
30	1.138	1.135
35	1.16	1.155
40	1.183	1.177
45	1.207	1.20
50	1.229	1.217
55	1.251	1.234
60	1.271	1.256
70	1.312	1.295
80	1.349	1.328
90	1.384	1.363
100	1.415	1.395
110	1.451	1.43
120	1.48	1.46
135	1.528	1.505
150	1.568	1.549
165	1.609	1.594
180	1.649	1.638
210	1.723	1.715
240	1.792	1.793
270	1.861	1.865
272.633		1.876
277.167	1.876	





APPENDIX C: DRAWINGS

Drawing 17.265/1	Site Location Plan
Drawing 17.265/2	Exploratory Hole Location Plan



North

Circle indicates approximate location of site

Scale 1: 50,000 @ A4

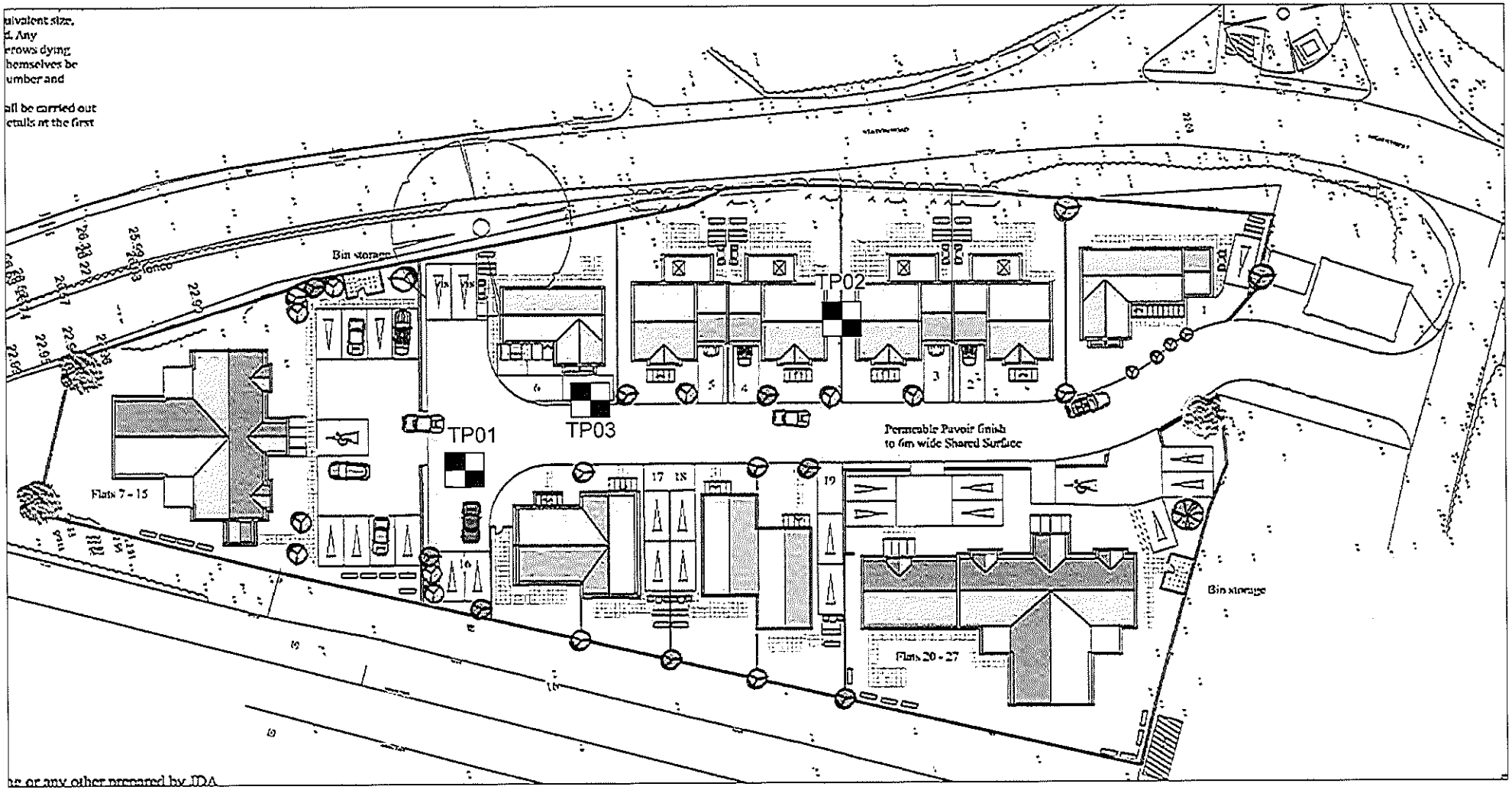
A F Howland Associates
Geotechnical Engineers

Site: Meldreth Station, Meldreth, SG8 6JR

SITE LOCATION PLAN

Client : Station Yard Meldreth Limited

Date : July 2017 **Dwg :** 17.265/1



Scale Not to Scale at A4

A F Howland Associates
Geotechnical Engineers

Site: Meldreth Station, Meldreth, SG8 6JR

EXPLORATORY HOLE LOCATION PLAN

Client : Station Yard Meldreth Limited

Date : July 2017 **Dwg :** 17.265/2

A F Howland Associates
The Old Exchange
Newmarket Road
Cringleford
Norwich
NR4 6UF

Tel: 01603 250754
Fax: 01603 250749
Email: admin@howland.co.uk
www: http://www.howland.co.uk

APPENDIX 3

DEVELOPMENT LAYOUT

PLANNING APPLICATION DRAWING

PLANNING CONSENT COMPLIANCE
The soft landscaping scheme shall be carried out as approved no later than the first planting season following the occupation of the dwelling to which it relates or the completion of development, whichever is the earlier. The management plan shall be implemented in accordance with the details contained therein.
Any trees, shrubs or hedges forming part of the approved landscaping that die, are removed, become diseased or unfit for purpose [in the opinion of the LPA] within five years of the implementation of the landscaping scheme shall be replaced during the next available planting season by the Developers, or their successors in title with an equivalent size, number and species being replaced. Any replacement trees, shrubs or hedgerows dying within five years of planting shall themselves be replaced with an equivalent size, number and species.
Thereafter the planting scheme shall be carried out in accordance with the approved details at the first available planting season.

NOTES
Do NOT scale from this drawing or any other prepared by JDA in connection with this project
This drawing is copyright and may not be altered, traced, copied, photographed or used for any purpose other than for which it has been issued without written permission of the copyright holder.
The Contractor is to check all dimensions on site and report any discrepencies PRIOR TO commencing work.
All details shown on this drawing are based upon typical site conditions related to the area. No resposibility can be accepted for abnormal conditions unless they have been reported in detail so that design amendments may be considered.
All works and materials are to be in full accordance with current British Standards, Building Regulations, Agrement Certificates and Manufacturers printed instructions.
All Building Regulations inspections are to be carried out at the appropriate stages of work.

0m 10 20 30 40 50m

1.8 x 1.2m timber boarded shed
Wheelie Bins
Air Source Heat Pumps
Lawned areas
Natural Sandstone Paving 600 x 900mm (Terraces and pathways
2m high close boarded fencing
1 8m high brick walling

John Dickie Associates
Chartered Building Engineers
5, Victor Way, Cherry Holt Road,
Bourne, Lincs PE10 9PT
Tel 07778 297733 jda@ndirect.co.uk

Proposed Residential Development at Meldreth Station, Meldreth, Cambs SG8 6JR

Drawing :
Proposed Site Layout

Client : Station Yard Meldreth Limited
March 2017
Scale 1 To 500
Drawing No JDA/2016/785/SITE.001B
Rev A May 2017 Title revised
Rev B June 2017 Various scheme revisions

APPENDIX 4

IMPERMEABLE AREA PLAN

North Arrow

DWELLING/GARAGE ROOF AREAS: 1,220m²

SHARED ACCESS AND PARKING AREAS: 1,450m²

REV	DATE	DESCRIPTION/REASON FOR ISSUE	APPR

MTC ENGINEERING

MTC Engineering (Cambridge) Ltd.
Ground Floor, 24 High Street
Whittlesford, Cambridgeshire, CB22 4LT
Tel (01223) 837270, fax (01223) 835648
E-mail office@mtcengineering.co.uk

TITLE

RESIDENTIAL DEVELOPMENT AT STATION YARD, HIGH STREET, MELDRETH
IMPERMEABLE AREA PLAN

ORIG	DATE
S.E.C	30.08.17
CHKD	SCALE 1:200@A1
APPR	DRAWING NO 1951-02 REV -

APPENDIX 5

INDICATIVE DRAINAGE LAYOUT

Private Drainage Key

- Storm Inspection Chamber (Depth <0.6m [1 side connection])
- Storm Inspection Chamber (Depth <1.2m [2 side connections])
- Storm BR manhole PCC Ring (1.2-1.5m)
- Storm BR manhole PCC Ring (1.50-2.7m)
- Backdrop on SW Chamber

Surface Water Attenuation

Permeable Block Paving
Load Category 5 permeable paving (infiltration) on subgrade assumed 2% CBR. 80mm Permeable Block, 50mm laying course material comprising mostly passing 6.3mm sieve and mostly retained on a 3mm sieve. 300mm crushed rock on permeable Geomembrane. 175mm Type 1 capping layer.

North Arrow

N
W E
S

NOTES

1. The contractor shall check all tie-ins for line and level with existing before commencing any works. The Engineer shall be notified immediately, in writing, should any errors be found.
2. Any discrepancies, of whatever nature, must be reported to the Engineer prior to the commencement or continuance of any further works.
3. All private drainage works to be in accordance with the requirements of Building Regulations 2010, Part H, "Drainage and waste disposal", (01st October 2015).
4. All pipes to be bedded and backfilled in accordance with Part H, Diagram 10. Shallow pipes shall be protected in accordance with Part H, Diagram 11.
5. Unless otherwise stated, all private drainage to be 100mm diameter. Gradients have been shown where there are pipe capacity issues and these should be regarded as minimums. Unless there are constraints dictating otherwise, gradients shall generally be 1 in 60. 100mm diameter pipes shall not be laid flatter than 1 in 80, 150mm diameter pipes shall not be laid flatter than 1 in 150.
6. All pipes, chambers and fittings to be installed strictly in accordance with the manufacturers instructions.
7. Pipes which run adjacent to buildings shall be installed in strict accordance with Part H, Clauses 2.23 to 2.25 and Diagram 8.
8. All private manholes, inspection chambers and drainage channels to comply with BS EN124. Cover strengths to be:
   Class D400 in heavy trafficked areas (access roads, service yards etc.)
   Class C250 in lightly trafficked areas (car parks, driveways etc)
   Class B125 in Non trafficked areas
   Class A15 in landscaping areas
9. All drains in the vicinity of existing or proposed trees to be constructed in accordance with the requirements of NHBC Practice Note 3.
10. Private drainage frames must be tied to manhole risers by use of manufacturers ties (e.g. Polypipe ref. FRK500 fixing kit and FRK501 black ties.) The ground works contractor will be held fully responsible for any accidents due to incorrect fitting or failure to use the correct manufacturers fixing equipment.
11. All existing land drains encountered on site during construction to be re-connected.
12. Should any departure from the slab level be considered, agreement shall be sought from the Engineer immediately and prior to commencement or continuance of any works, and should take full account of all restrictions to the slab level.
13. Garage slabs relate to the finished level of the concrete at the front entrance of the garage.
14. Where a drive slopes towards a garage there is to be a 75mm ramp up to the garage slab.
15. Maximum gradients of gardens to be 1 in 6 (unless stated otherwise), except for designed banking works.
16. All dimensions in metres unless otherwise stated.
17. As underlying ground conditions may be variable across the site the Contractor shall undertake onsite porosity tests at the location and depth of each soakaway. Tests should be undertaken in accordance with BRE365 and results forwarded to the Engineers to allow verification of designs.
18. All existing services, sewers and drains indicated on this drawing and any other related drawings are shown only indicatively, and shall have their positions and level confirmed on site by the Contractor.
19. The invert levels of all existing sewers, drains, ditches, banks or other features and apparatus where a new connection is to be made shall have their precise position and level confirmed on site by the Contractor prior to commencement of any construction work. The results of the investigations shall be confirmed to MTC Engineering (Cambridge) Ltd so that the design can be verified.

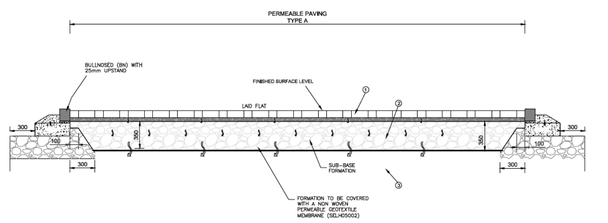
STORM WATER

20. All run-off from domestic roofs shall drain via a series of surface drainage systems with outfall to the base of permeable paving. The permeable paved areas and drainage systems are to remain private and have been designed to accommodate all storms up to and including the 100yr + 40% event.
21. All private driveways and shared accesses shall drain via permeable paving. The paving shall be designed based on CBR results and to accommodate the required loading.
22. The design of infiltration systems has been undertaken on the basis of infiltration rates established on site by BRE 365 testing. The rate used in design is 0.051 m/hr.

SOAKAWAY PROTECTION:
Please ensure that during the construction phase all soakaways, gullies and gully laterals are protected from the ingress of silt or grit from the site. Placing a fine heavy duty geotextile under the gully grating, between it and the frame should suffice.

NOTE:
At the location of the proposed lateral connection the contractor shall establish the position and depth of any existing services to prevent any clash in level and abortive costs.

TYPICAL CROSS SECTION THROUGH PRIVATE DRIVES AND ACCESS CONSTRUCTED IN PERMEABLE BLOCK PAVING



CONSTRUCTION SPECIFICATION
(CIRIA C753 TABLE 20.5
CATEGORY 4 LOADING (CBR >4)

Driveway Construction:

1. Surface Course - 80mm Priora Concrete Block (or similar approved) laid on 50mm of 6mm clean gravel
2. Sub-Base - 350mm of open graded crushed rock (SudsAgg) (Type 3) 30% voids with aggregates compacted in layers not exceeding 150mm. laid on a permeable geotextile (SELH05002)
3. Capping - assuming a substrate CBR of 5%, 150mm of (SudsAgg) (Type 3) 30% voids with aggregates compacted in layers not exceeding 150mm

NOTES:
1. AN IMPERMEABLE MEMBRANE IS REQUIRED BETWEEN THE INTERFACE OF THE PERMEABLE SUBBASE AND THE NON-PERMEABLE TYPE 1 SUB-BASE. THE MEMBRANE IS TO BE HIGH DENSITY POLYETHYLENE (HDPE), ETHYLENE PROPYLENE (SELH05001) DIENE MONOMER (M-CLASS) RUBBER (EPDM) OR POLYPROPYLENE AND BE RESISTANT TO PUNCTURE, POLLUTANTS AND GROUNDWATER ATTACK. REFER TO DETAIL FOR TREATMENT AT PENETRATIONS.
2. FLEXIBLE PIPE COUPLINGS TO BE USED TO JOIN THE DIFFERENT PIPE TYPES.
3. GEOTEXTILES TO BE INSTALLED AS PER MANUFACTURERS GUIDANCE AND ENSURE THE CORRECT OVERLAPPING AND JOINTING PROCESSES ARE ADHERED TOO.

REV	DATE	DESCRIPTION/REASON FOR ISSUE	APPR
B	04.01.18	UPDATED DETAIL	SEC
A	31.08.17	Updated Notes	SEC

MTC ENGINEERING
MTC Engineering (Cambridge) Ltd.
Ground Floor, 24 High Street
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E-mail office@mtcengineering.co.uk

TITLE
RESIDENTIAL DEVELOPMENT AT STATION YARD, HIGH STREET, MELDRETH
INDICATIVE DRAINAGE PLAN

ORIG S.E.C	DATE 30.08.17
CHKD	SCALE 1:200@A1
APPR	DRAWING NO 1951-03 REV B

APPENDIX 6

MICRO DRAINAGE CALCULATIONS: INFILTRATION ATTENUATION REQUIREMENTS

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 400 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	22.344	0.144	2.9	62.8	Flood Risk
30 min Summer	22.388	0.188	2.9	81.7	Flood Risk
60 min Summer	22.427	0.227	2.9	98.8	Flood Risk
120 min Summer	22.458	0.258	2.9	112.1	Flood Risk
180 min Summer	22.468	0.268	2.9	116.6	Flood Risk
240 min Summer	22.470	0.270	2.9	117.4	Flood Risk
360 min Summer	22.463	0.263	2.9	114.6	Flood Risk
480 min Summer	22.456	0.256	2.9	111.4	Flood Risk
600 min Summer	22.449	0.249	2.9	108.1	Flood Risk
720 min Summer	22.440	0.240	2.9	104.6	Flood Risk
960 min Summer	22.424	0.224	2.9	97.4	Flood Risk
1440 min Summer	22.392	0.192	2.9	83.4	Flood Risk
2160 min Summer	22.349	0.149	2.9	64.9	Flood Risk
2880 min Summer	22.314	0.114	2.9	49.8	Flood Risk
4320 min Summer	22.268	0.068	2.9	29.4	O K
5760 min Summer	22.248	0.048	2.8	20.9	O K
7200 min Summer	22.241	0.041	2.4	17.7	O K
8640 min Summer	22.235	0.035	2.0	15.4	O K
10080 min Summer	22.231	0.031	1.8	13.6	O K
15 min Winter	22.364	0.164	2.9	71.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	143.954	0.0	19
30 min Summer	92.629	0.0	33
60 min Summer	56.713	0.0	62
120 min Summer	33.583	0.0	122
180 min Summer	24.424	0.0	182
240 min Summer	19.389	0.0	240
360 min Summer	13.924	0.0	318
480 min Summer	11.018	0.0	378
600 min Summer	9.182	0.0	438
720 min Summer	7.908	0.0	504
960 min Summer	6.245	0.0	638
1440 min Summer	4.471	0.0	908
2160 min Summer	3.197	0.0	1296
2880 min Summer	2.518	0.0	1648
4320 min Summer	1.796	0.0	2332
5760 min Summer	1.413	0.0	2952
7200 min Summer	1.172	0.0	3680
8640 min Summer	1.006	0.0	4408
10080 min Summer	0.884	0.0	5144
15 min Winter	143.954	0.0	18

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	22.413	0.213	2.9	92.7	Flood Risk
60 min Winter	22.458	0.258	2.9	112.2	Flood Risk
120 min Winter	22.494	0.294	2.9	127.9	Flood Risk
180 min Winter	22.507	0.307	2.9	133.7	Flood Risk
240 min Winter	22.511	0.311	2.9	135.5	Flood Risk
360 min Winter	22.507	0.307	2.9	133.4	Flood Risk
480 min Winter	22.496	0.296	2.9	128.8	Flood Risk
600 min Winter	22.486	0.286	2.9	124.2	Flood Risk
720 min Winter	22.475	0.275	2.9	119.5	Flood Risk
960 min Winter	22.451	0.251	2.9	109.4	Flood Risk
1440 min Winter	22.404	0.204	2.9	88.7	Flood Risk
2160 min Winter	22.340	0.140	2.9	61.0	Flood Risk
2880 min Winter	22.291	0.091	2.9	39.4	O K
4320 min Winter	22.246	0.046	2.7	20.2	O K
5760 min Winter	22.237	0.037	2.1	16.0	O K
7200 min Winter	22.231	0.031	1.8	13.3	O K
8640 min Winter	22.226	0.026	1.5	11.4	O K
10080 min Winter	22.223	0.023	1.3	10.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	92.629	0.0	33
60 min Winter	56.713	0.0	62
120 min Winter	33.583	0.0	120
180 min Winter	24.424	0.0	178
240 min Winter	19.389	0.0	234
360 min Winter	13.924	0.0	344
480 min Winter	11.018	0.0	440
600 min Winter	9.182	0.0	472
720 min Winter	7.908	0.0	548
960 min Winter	6.245	0.0	696
1440 min Winter	4.471	0.0	982
2160 min Winter	3.197	0.0	1380
2880 min Winter	2.518	0.0	1704
4320 min Winter	1.796	0.0	2288
5760 min Winter	1.413	0.0	3000
7200 min Winter	1.172	0.0	3680
8640 min Winter	1.006	0.0	4408
10080 min Winter	0.884	0.0	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.450	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.267

Time (mins) From:	To:	Area (ha)
0	4	0.267

Model Details

Storage is Online Cover Level (m) 22.600

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.01440	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	290.0
Max Percolation (l/s)	402.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	22.200	Cap Volume Depth (m)	0.000