



**SCOTTISHPOWER
RENEWABLES**

East Anglia ONE North and East Anglia TWO Offshore Windfarms

Applicants' Response to Rule 17 Questions of 13 May: Initial Infiltration Testing – Preliminary Results

Applicants: East Anglia TWO and East Anglia ONE North Limited
Document Reference: EA1N_EA2-DWF-ENV-REP-IBR-001097
SPR Reference: ExA.R17QE-2.D11.V1

Date: 21st May 2021
Revision: Version 1
Author: Royal HaskoningDHV

Applicable to East Anglia ONE North and East Anglia TWO



Revision Summary				
Rev	Date	Prepared by	Checked by	Approved by
01	21/05/2021	Paolo Pizzolla	Lesley Jamieson/ Ian MacKay	Rich Morris

Description of Revisions			
Rev	Page	Section	Description
01	n/a	n/a	Final for Submission

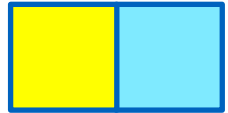


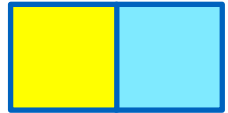
Table of Contents

1	Introduction	1
2	Initial Infiltration Testing	2
3	Initial Infiltration Testing Preliminary Results	3
4	Factor of Safety	5
5	Next Steps	6
Appendix 1 Preliminary Results of Initial Infiltration Testing		
Appendix 2 Initial Infiltration Testing Pit Location Plan		



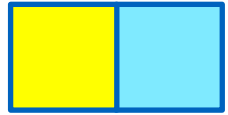
Glossary of Acronyms

DCO	Development Consent Order
EA	Environment Agency
EPR	Examination Procedure
ExA	Examination Authority
ISH	Issue Specific Hearing
LLFA	Lead Local Flood Authority
OODMP	Outline Operational Drainage Management Plan
PD	Procedural Decision
SCC	Suffolk County Council
SuDS	Sustainable Drainage System



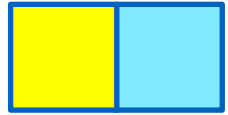
Glossary of Terminology

Applicant	East Anglia TWO Limited / East Anglia ONE North Limited
East Anglia ONE North project	The proposed project consisting of up to 67 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia ONE North windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
East Anglia TWO project	The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia TWO windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia ONE North / East Anglia TWO project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia ONE North / East Anglia TWO project Development Consent Order.
Onshore substation	The East Anglia ONE North / East Anglia TWO substation and all of the electrical equipment within the onshore substation and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia ONE North / East Anglia TWO project.



1 Introduction

1. Following the issue of questions under Rule 17 of the Infrastructure Planning (Examination Procedure) Rules 2010 (EPR) (R17QE) by the Examining Authority (ExA) on 13th May 2021 to East Anglia ONE North Limited and East Anglia TWO Limited (the Applicants), the Applicants have prepared this document in response to R17QE.2.
2. This document presents the preliminary results of the initial infiltration testing at the onshore substation and National Grid substation location for the East Anglia ONE North and East Anglia TWO Offshore Wind Farm projects (the Projects). Further infiltration tests are scheduled from 24th May 2021 as part of the main site investigation campaign.
3. The preliminary results of the initial infiltration testing have allowed a review of infiltration rates in the area of the proposed SuDS basins associated with both the National Grid substation and the Projects' onshore substations. This has enabled the Applicants to further consider the outline design of the SuDS basins including, but not limited to, size, shape, micro-siting and design parameters for the infiltration-only and hybrid schemes as presented within the **Outline Operational Drainage Management Plan** (OODMP) (REP8-064). This will allow an updated **OODMP** (REP8-064), to be submitted at Deadline 11.
4. The OODMP will provide a framework from which the final Operational Drainage Management Plan will be drafted and which must be submitted to and approved by the relevant planning authority in consultation with Suffolk County Council (SCC) (as the Lead Local Flood Authority (LLFA)) and the Environment Agency prior to the commencement of Works Nos. 30, 34, 38 or 41. This is secured through Requirement 41 of the **draft DCO** (document reference 3.1).
5. **Section 2** of this document provides a brief overview of the initial infiltration testing. **Section 3** of this document summarises the preliminary results of the initial infiltration testing, with the technical results sheets set out within **Appendix 1**. A location plan showing where infiltration testing was undertaken is set out within **Appendix 2**.
6. This document is applicable to both the East Anglia TWO and East Anglia ONE North Development Consent Order (DCO) applications, and therefore is endorsed with the yellow and blue icon used to identify materially identical documentation in accordance with the Examining Authority's procedural decisions on document management of 23rd December 2019 (PD-004). Whilst this document has been submitted to both Examinations, if it is read for one project submission there is no need to read it for the other project submission.



2 Initial Infiltration Testing

7. The Applicants commenced a significant onshore site investigation campaign in April 2021, which included the undertaking of infiltration testing at the substation site. The site investigation element of these works are being undertaken east to west, commencing at the landfall.
8. In order to obtain infiltration test results to inform representations at Issue Specific Hearing (ISH) 16 and the Applicants' Deadline 11 submissions, it was necessary to undertake initial infiltration testing out of sequence to the programmed works. Whilst it is acknowledged that the guidance adopted for undertaking infiltration testing (BRE-365 Digest: Soakaway Design (revised 2016)), recommends three infiltration tests to be undertaken per location, in order to obtain information for the Projects' Examinations, the Applicants undertook one test at five locations and two tests at two locations. This ensured a distribution of infiltration test results were obtained over the wider area of the SuDS basins.
9. The results of the initial infiltration tests are considered valid for the purpose of updating of the **OODMP** and discussion at ISH 16, given the conservative approach of adopting the lowest infiltration rate for each SuDS basin, the spatial distribution of the initial test locations and the natural variability of infiltration rates which will be experienced in the SuDS basins once constructed.
10. The Applicants will undertake the infiltration testing at the SuDS basins in full accordance with BRE-365, in line with the original onshore site investigation programme from 24th May 2021.
11. The initial infiltration testing was undertaken between 27th April and 5th May 2021 at points within the proposed SuDS basins locations which serve both the onshore substations and the National Grid substation (as shown on the location plan provided as **Figure 1, Appendix 2**).
12. Mr Matt Williams of SCC observed a portion of the initial infiltration testing on 28th April 2021.



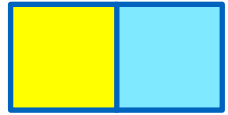
3 Initial Infiltration Testing Preliminary Results

13. **Table 1** presents a summary of the preliminary infiltration rates (rounded to the nearest whole number) determined at each location subject to initial infiltration testing.

Table 1 Summary of Preliminary Results of Initial Infiltration Testing

Test pit	SuDS Basin	Infiltration rate (mm/hr)	
		Test 1	Test 2
TP012A	National Grid Substation	63	132
TP013A	National Grid Substation	N/A	-
TP014A	National Grid Substation	152	N/A
TP015A	Onshore Substations	57	-
TP016A	Onshore Substations	82	-
TP017A	Onshore Substations	105	-
TP330A	Onshore Substations	N/A	N/A
Note: N/A results are due to rate of drop in water level being insufficient to obtain a viable result.			

14. The above preliminary results show a range of infiltration rates across the test pits excavated at seven different locations. Observations identified that the walls of three of the seven pits experienced partial collapse during testing (TP015A, TP017A, and TP330A). Whilst this could be considered to invalidate the infiltration rates calculated for those locations, it indicates that a degree of infiltration does occur (noting that heavier, impermeable soils would not collapse when filled with water). Nevertheless, the results of these test pits have been included when establishing the infiltration rates as discussed below.
15. For the National Grid substation SuDS basin (the northern basin), viable results were achieved at location TP012A and one viable result at TP014A, situated to at the north-western and south-western extent of the proposed basin location respectively. For the Projects' onshore substation SuDS basin (the southern basin), a viable result was returned for locations TP015A, TP016A and TP017A, which were located at mid-western, north-eastern and south-eastern extent of the proposed basin location respectively. Infiltration rates across these locations ranged between 57mm/hr and 152mm/hr.

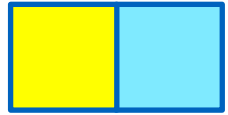


16. The Applicants have reviewed the preliminary results of the initial infiltration testing and will use the infiltration rates determined to update the drainage calculations presented within the **OODMP** (REP8-064) at Deadline 11.
17. For the National Grid substation SuDS basin, the first result of infiltration testing carried out at pit TP012A (**63mm/hr**) is considered to be a suitable preliminary infiltration rate to adopt for drainage calculations at this early stage of development.
18. For the onshore substations' basin, the test result for pit TP015A (**57mm/hr**) is considered to be a suitable preliminary infiltration rate to adopt for drainage calculations at this early stage of development.
19. The above are the lowest infiltration rates recorded which returned viable results.
20. Considered in the context of the results of all test pits, infiltration testing at TP013A, which did not experience a wall collapse during testing, returned a poor level of infiltration. The location of TP013A is on the eastern extremity of the proposed National Grid substation SuDS basin and this result is considered to potentially represent a localised area of less permeable ground.
21. During the iterative design process, the Applicants will seek to avoid locations which return less favourable infiltration rates (such as that around TP013A and TP330A) to make best use of land that has higher, and therefore more suitable, infiltration rates. However, where local variability in the infiltration rates occurs, it is considered that, given the surface area of the proposed SuDS basins, the infiltration rates across the whole of the SuDS area will vary depending on the underlying ground conditions of the SuDS basins. Post-consent, the infiltration rate of each SuDS basin will be calculated from the full BRE-365 compliant infiltration test results and will take account of the full results of all infiltration testing undertaken at that time.



4 Factor of Safety

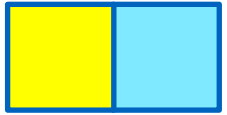
22. As that the preliminary results of the initial infiltration testing provide site specific (preliminary) infiltration rates at the proposed SuDS basin locations, the Applicants consider that the level of uncertainty regarding this aspect of the drainage calculations has reduced and propose that the precautionary application of a Factor of Safety of 10 should be reduced to 1.5 or 5.
23. However, adopting a more conservative approach, the Applicants propose to adopt a Factor of Safety of 5 within the calculations presented within the next iteration of the **OODMP** to be submitted at Deadline 11. Further justification of this Factor of Safety will also be provided in the updated **OODMP**.
24. Two versions of Drawing E are included in **Appendix 1** of the Applicants' Response to Rule 17 Questions of 13 May - Design and Layout of the Substations (document number ExA.R17QE-1.D11.V1), one showing a SuDs basin options that accommodates a Factor of Safety of 10 and another that accommodates a Factor of Safety of 5.



5 Next Steps

25. As outlined in Section 2, the Applicants will undertake further infiltration testing at the SuDS basins in full accordance with BRE-365, in line with the original onshore site investigation programme from 24th May 2021. This will comprise three tests at each location (unless a particular test satisfies the low infiltration criteria for test abandonment).
26. The Applicants have agreed with the Councils that they will submit the results of these tests to the Projects' Examinations prior to Deadline 12, with a commentary on if or how the test results affect the SuDS basin concept design as presented with the **OODMP** submitted at Deadline 11.

DRAFT



Appendix 1 Preliminary Results of Initial Infiltration Testing

DRAFT

FULL SCALE SOAKAWAY TEST

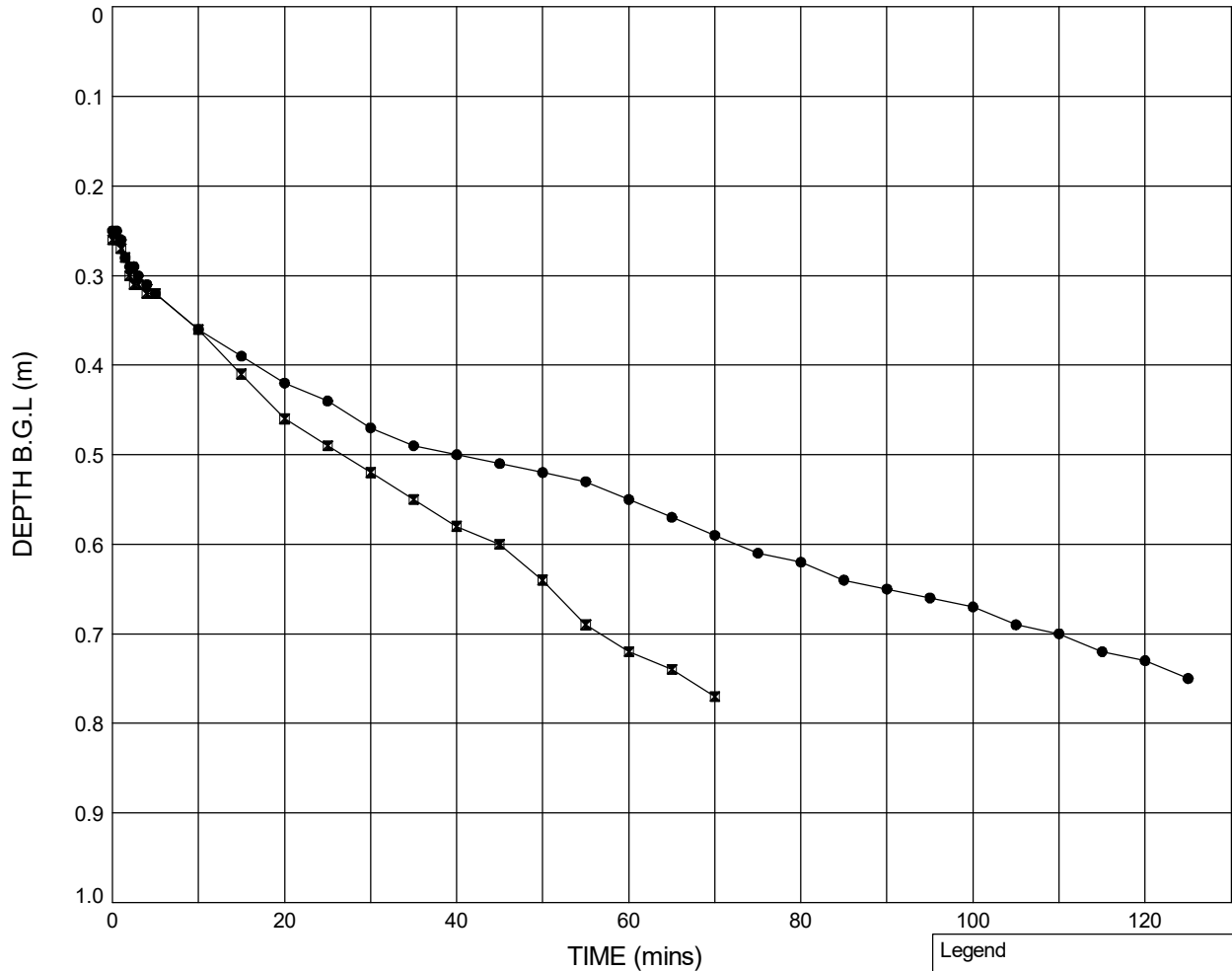
Non-standard test

Soakaway Test - Position ID : TP012A

Ground Level (m AOD): **15.00**

National Grid Co-ordinates: **E:641047.1 N:261177.1**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME

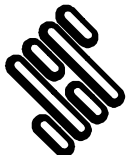


	Test 1	Test 2	
Pit start depth:	= 1.00	1.00	m
Pit final depth:	= 1.00	1.00	m
Effective depth, D_e	= 0.75	0.74	m
Effective storage volume, V_{p75-25}	= 0.4725	0.4662	m ³
Surface area, a_{p50}	= 3.2850	3.2580	m ²
Time, t_{p75-25}	= 7287	3630	secs
Infiltration rate, f	= 1.97×10^{-5}	3.94×10^{-5}	m/s

Please note test data was extrapolated to obtain $t_{p75-tp25}$. Notes: Test 1 - Duration 2 hrs 5 mins., Test 2 - Duration 1 hr 10 mins. Test 2 completed at 4.30pm. Site made safe and position backfilled.

Legend		
●	Test 1	(05.05.21)
■	Test 2	(05.05.21)

Plan (Not to scale)	
2.10	0.60
No Bearing Taken	



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By	Date	Checked By	Date
	19/05/21		
Contract		Contract Ref:	
EA HUB Onshore SI		735329	

FULL SCALE SOAKAWAY TEST

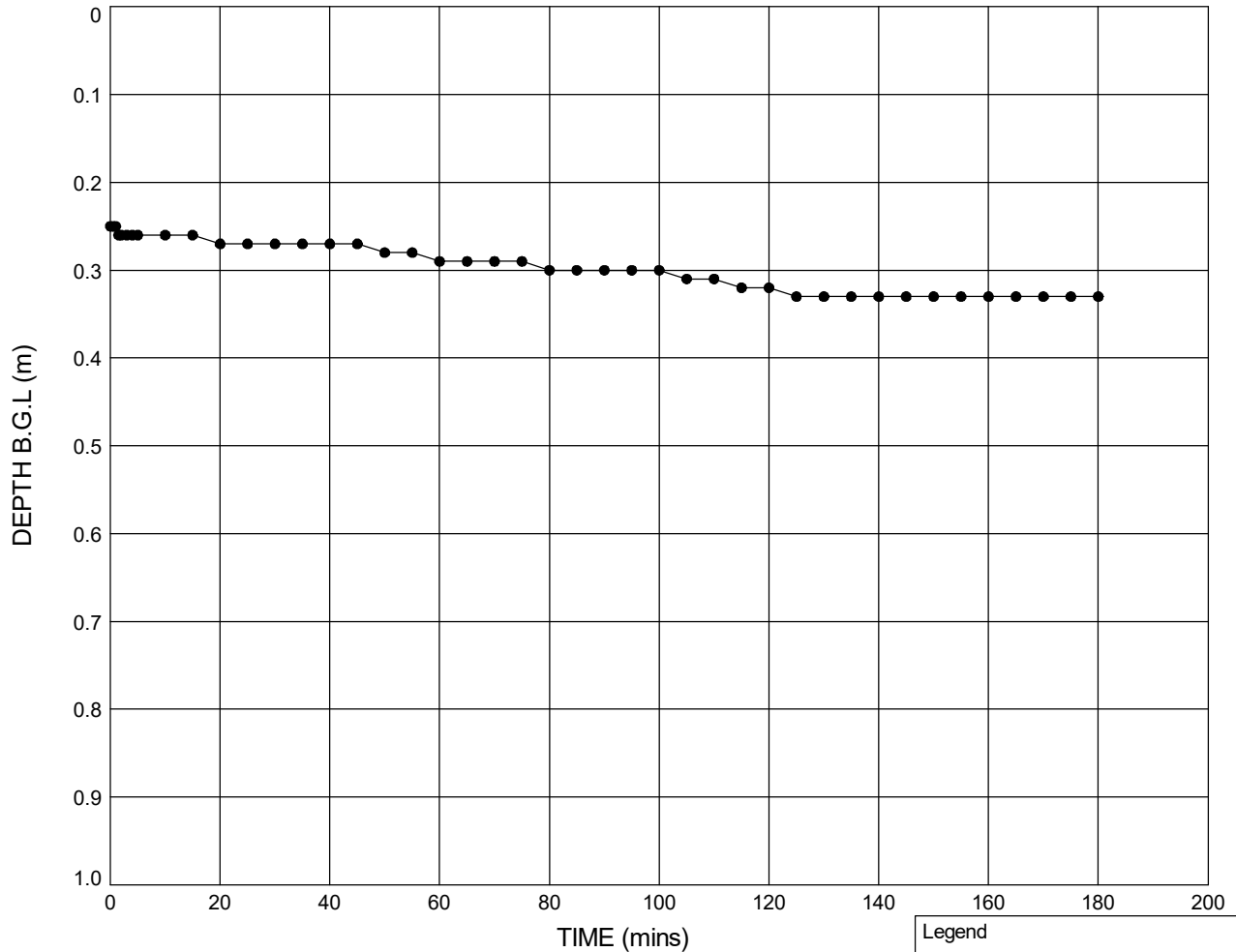
Non-standard test

Soakaway Test - Position ID : **TP013A**

Ground Level (m AOD): **16.15**

National Grid Co-ordinates: **E:641144.6 N:261171.6**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

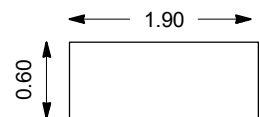
Pit start depth: = **1.00** m
Pit final depth: = **1.00** m
Effective depth, D_e = **0.75** m
Effective storage volume, V_{p75-25} = **0.4275** m³
Surface area, a_{p50} = **3.0150** m²
Time, t_{p75-25} = **NA** secs
Infiltration rate, f = **NA** m/s

Notes: Test 1 - Duration 3 hrs. An 8 cm drop in water level was recorded.
Insufficient data available to calculate infiltration rate.

Legend

● Test 1 (05.05.21)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By

Date

Checked By

Date

19/05/21

Contract

EA HUB Onshore SI

Contract Ref:

735329

FULL SCALE SOAKAWAY TEST

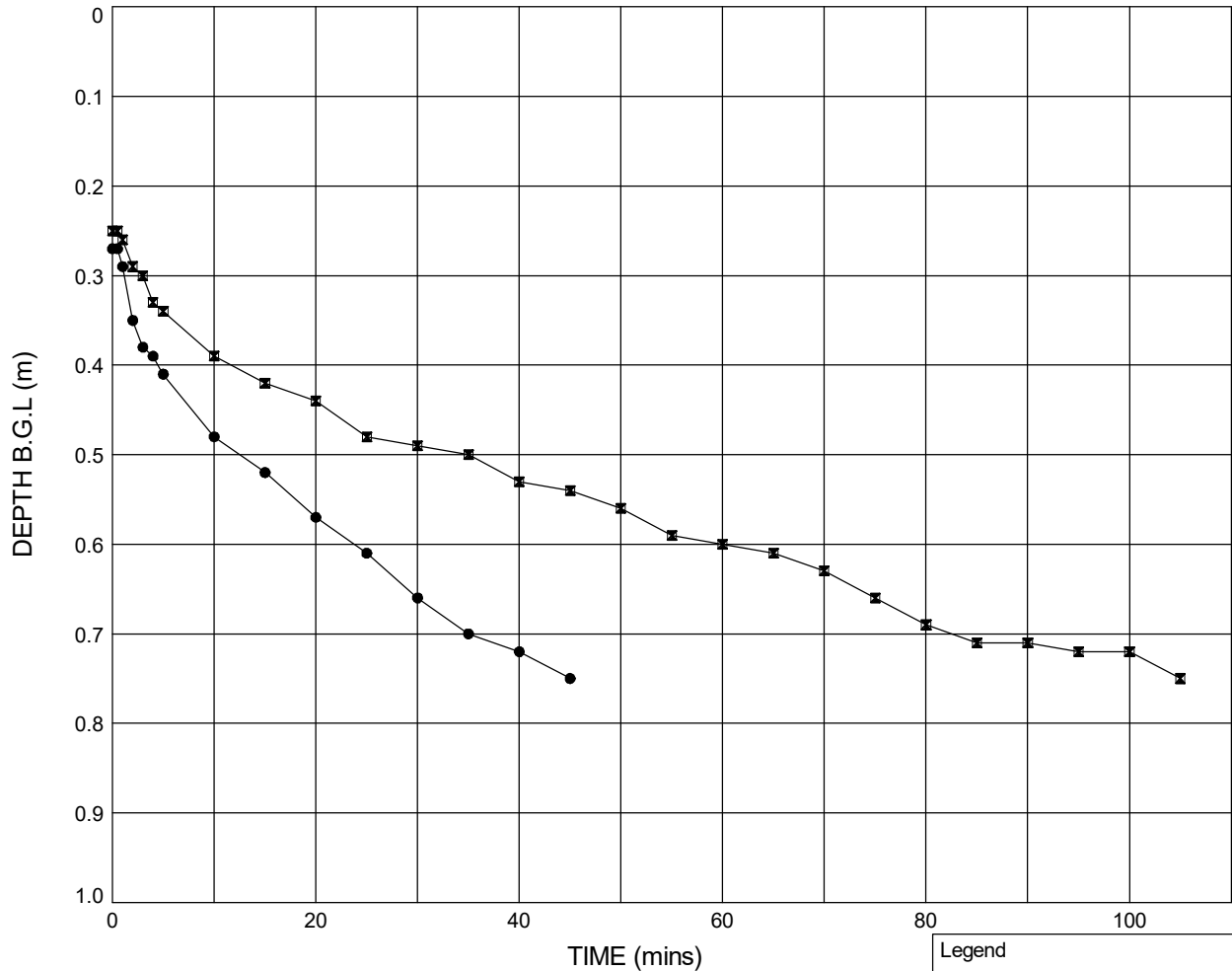
Non-standard test

Soakaway Test - Position ID : TP014A

Ground Level (m AOD): **15.62**

National Grid Co-ordinates: **E:641115.1 N:261115.3**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



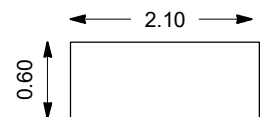
	Test 1	Test 2	
Pit start depth:	= 1.00	1.00	m
Pit final depth:	= 1.00	1.00	m
Effective depth, D_e	= 0.73	0.75	m
Effective storage volume, V_{p75-25}	= 0.4599	0.4725	m ³
Surface area, a_{p50}	= 3.2310	3.2850	m ²
Time, t_{p75-25}	= 3028	7013	secs
Infiltration rate, f	= 4.70×10^{-5}	2.05×10^{-5}	m/s

Please note test data was extrapolated to obtain $t_{p75-tp25}$. Notes: Test 1 - Duration 1 hr 15 mins., Test 2 - Duration 1 hr 45 mins. Test 2 completed at 2.55pm. Site made safe and position backfilled.

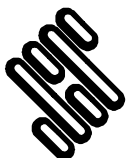
Legend

- Test 1 (04.05.21)
- Test 2 (04.05.21)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By

Date

Checked By

Date

19/05/21

Contract

EA HUB Onshore SI

Contract Ref:

735329

FULL SCALE SOAKAWAY TEST

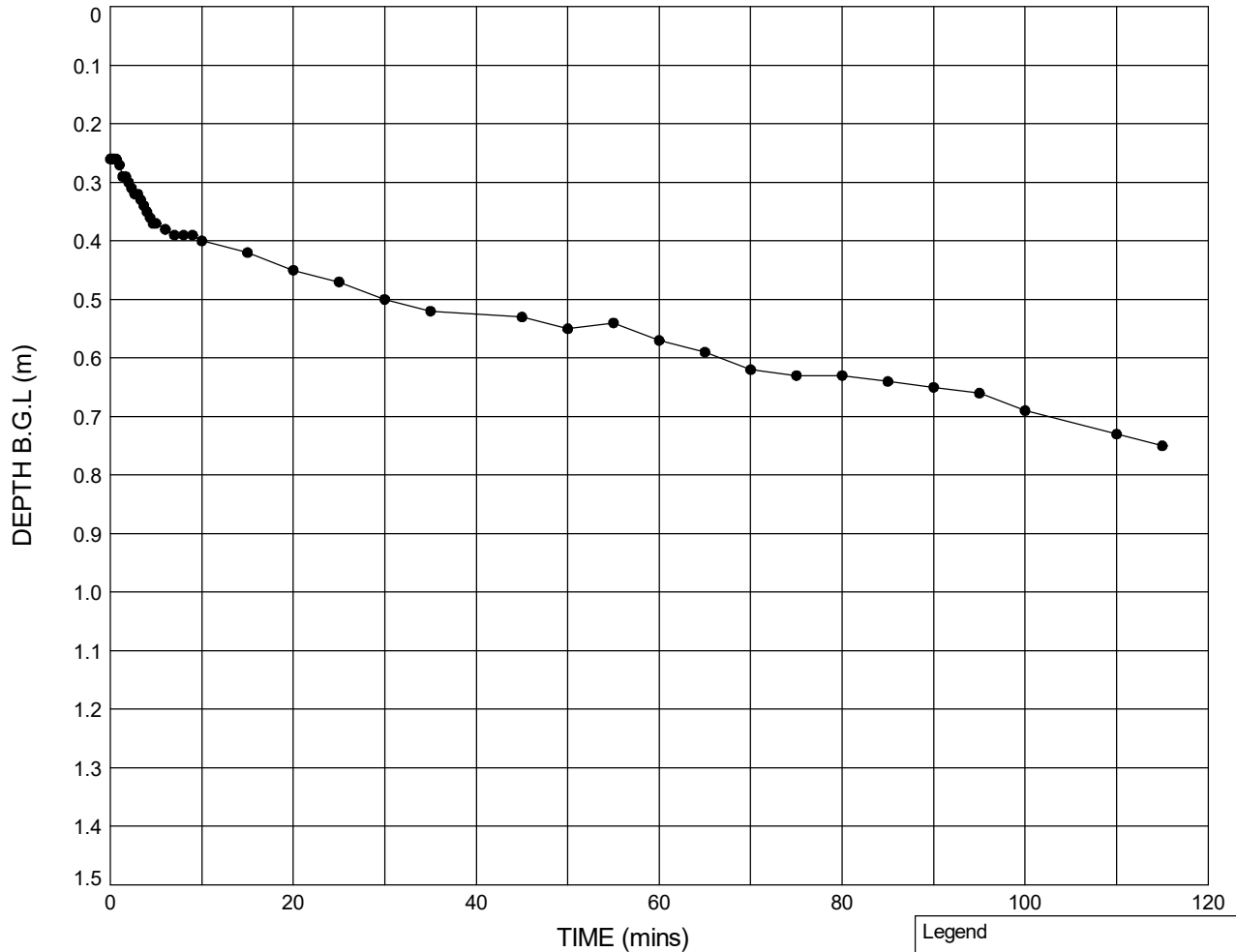
Non-standard test

Soakaway Test - Position ID : **TP015A**

Ground Level (m AOD): **14.00**

National Grid Co-ordinates: **E:641189.0 N:260887.5**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

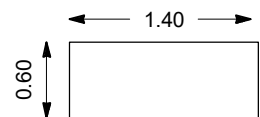
Pit start depth: = **1.50** m
Pit final depth: = **1.50** m
Effective depth, D_e = **1.24** m
Effective storage volume, V_{p75-25} = **0.5208** m³
Surface area, a_{p50} = **3.3200** m²
Time, t_{p75-25} = **9900** secs
Infiltration rate, f = **1.58×10^{-5}** m/s

Please note test data was extrapolated to obtain tp75-tp25. Notes: Test 1 - Duration 1 hr 55 mins. Test completed at 12:20am. Site Engineer notes a partial wall collapse during the test. Site made safe and position backfilled.

Legend

● Test 1 (28.04.21)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By

Date

Checked By

Date

19/05/21

Contract

EA HUB Onshore SI

Contract Ref:

735329

FULL SCALE SOAKAWAY TEST

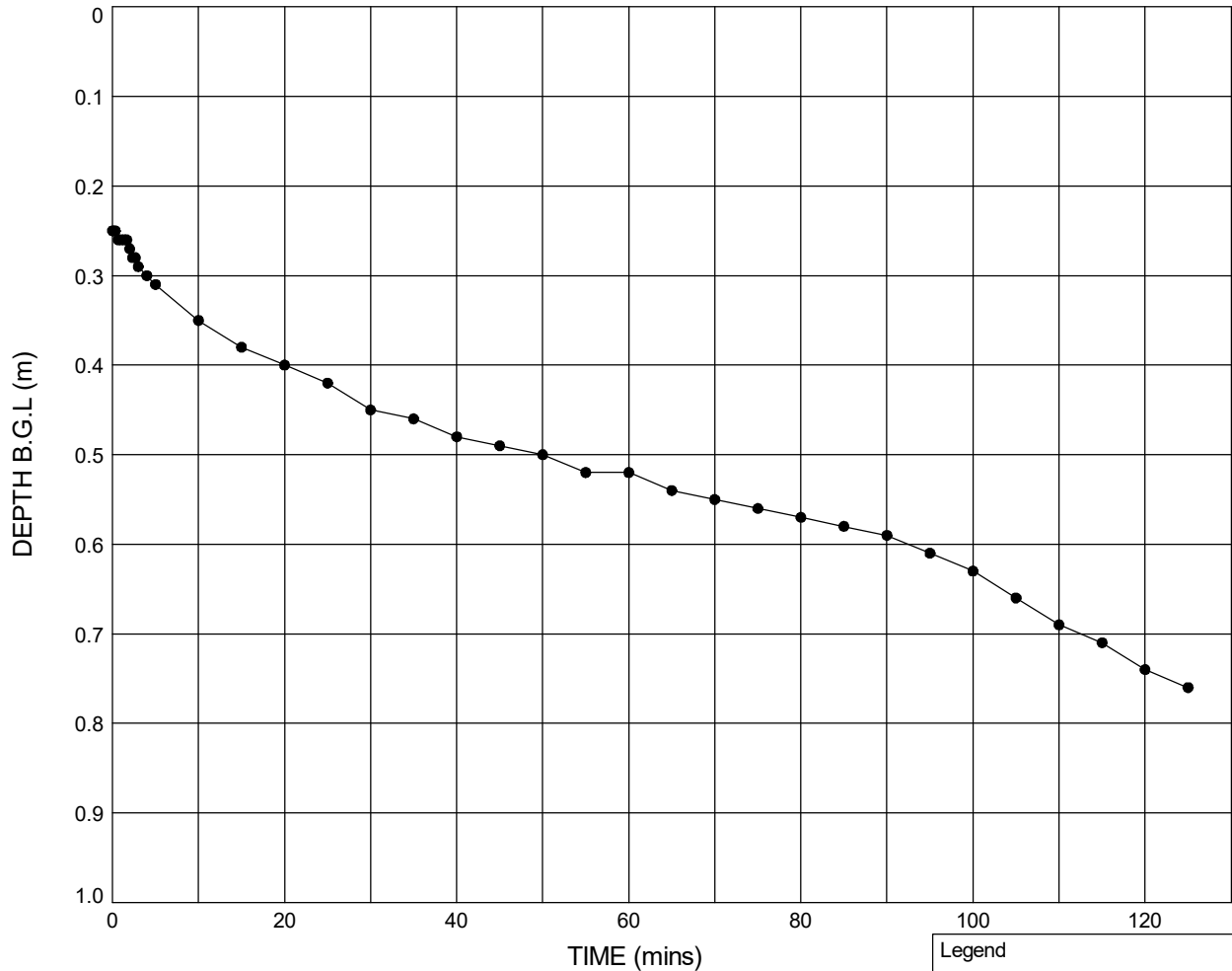
Non-standard test

Soakaway Test - Position ID : **TP016A**

Ground Level (m AOD): **15.68**

National Grid Co-ordinates: **E:641278.0 N:260939.5**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



TIME (mins)

Test 1

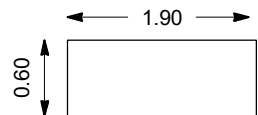
Pit start depth: = **1.00** m
Pit final depth: = **1.00** m
Effective depth, D_e = **0.75** m
Effective storage volume, V_{p75-25} = **0.4275** m³
Surface area, a_{p50} = **3.0150** m²
Time, t_{p75-25} = **6612** secs
Infiltration rate, f = **2.14×10^{-5}** m/s

Please note test data was extrapolated to obtain tp75-tp25. Notes: Test 1 - Duration 2 hrs 5 mins. Test completed at 11:15am. No repeat tests undertaken.

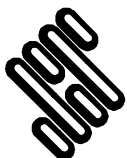
Legend

● Test 1 (30.04.21)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By

Date

Checked By

Date

19/05/21

Contract

EA HUB Onshore SI

Contract Ref:

735329

FULL SCALE SOAKAWAY TEST

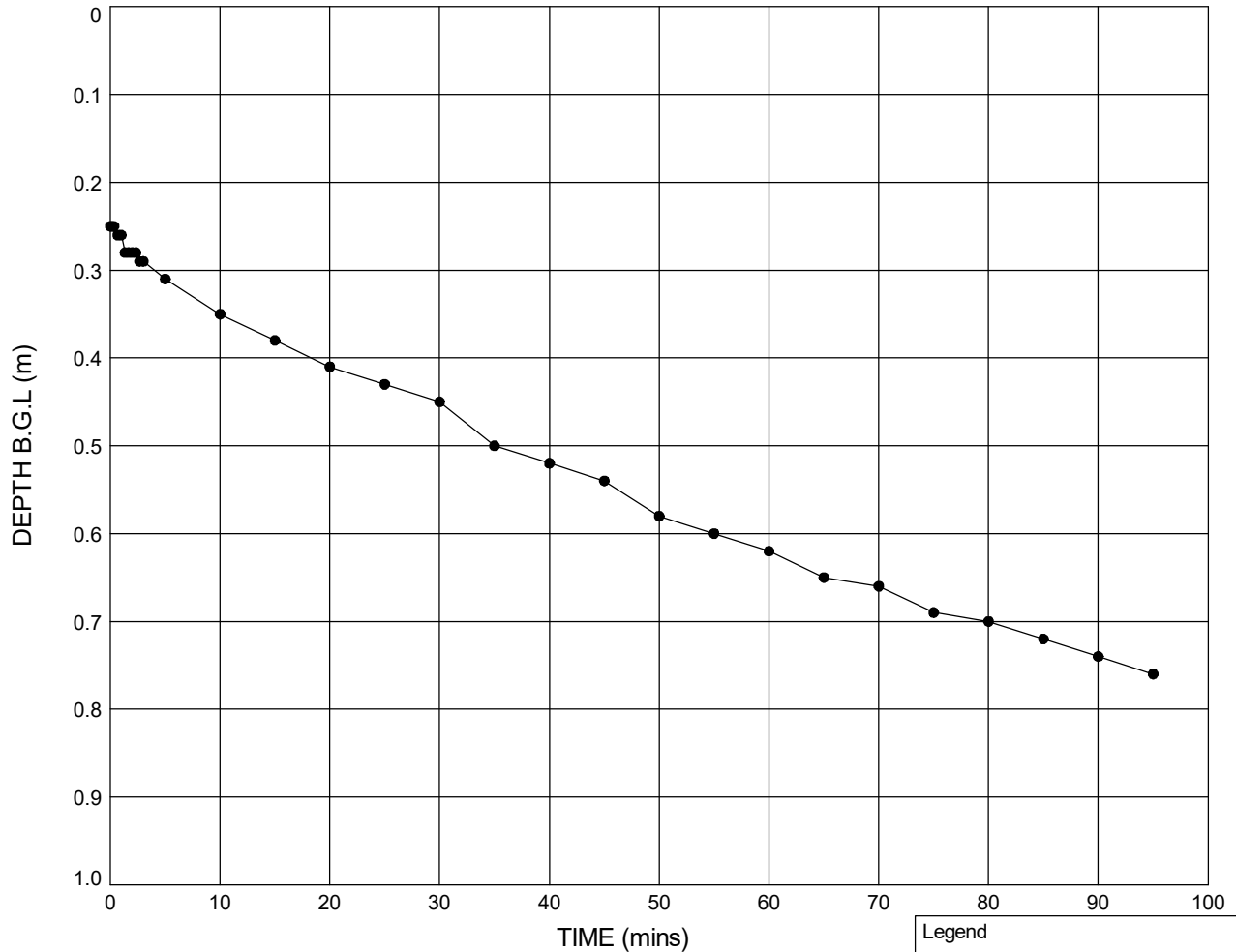
Non-standard test

Soakaway Test - Position ID : TP017A

Ground Level (m AOD): **13.92**

National Grid Co-ordinates: **E:641284.5 N:260870.4**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

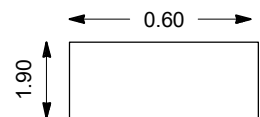
Pit start depth: = **1.00** m
Pit final depth: = **1.00** m
Effective depth, D_e = **0.75** m
Effective storage volume, V_{p75-25} = **0.4275** m³
Surface area, a_{p50} = **3.0150** m²
Time, t_{p75-25} = **4988** secs
Infiltration rate, f = **2.84×10^{-5}** m/s

Please note test data was extrapolated to obtain tp75-tp25. Notes: Test 1 - Duration 2 hrs 40 minutes. Test completed at 3.10pm. Site Engineer notes a partial wall collapse during the test. Site made safe and position backfilled.

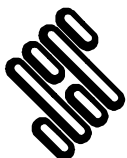
Legend

● Test 1 (29.04.21)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By

Date

Checked By

Date

19/05/21

Contract

EA HUB Onshore SI

Contract Ref:

735329

FULL SCALE SOAKAWAY TEST

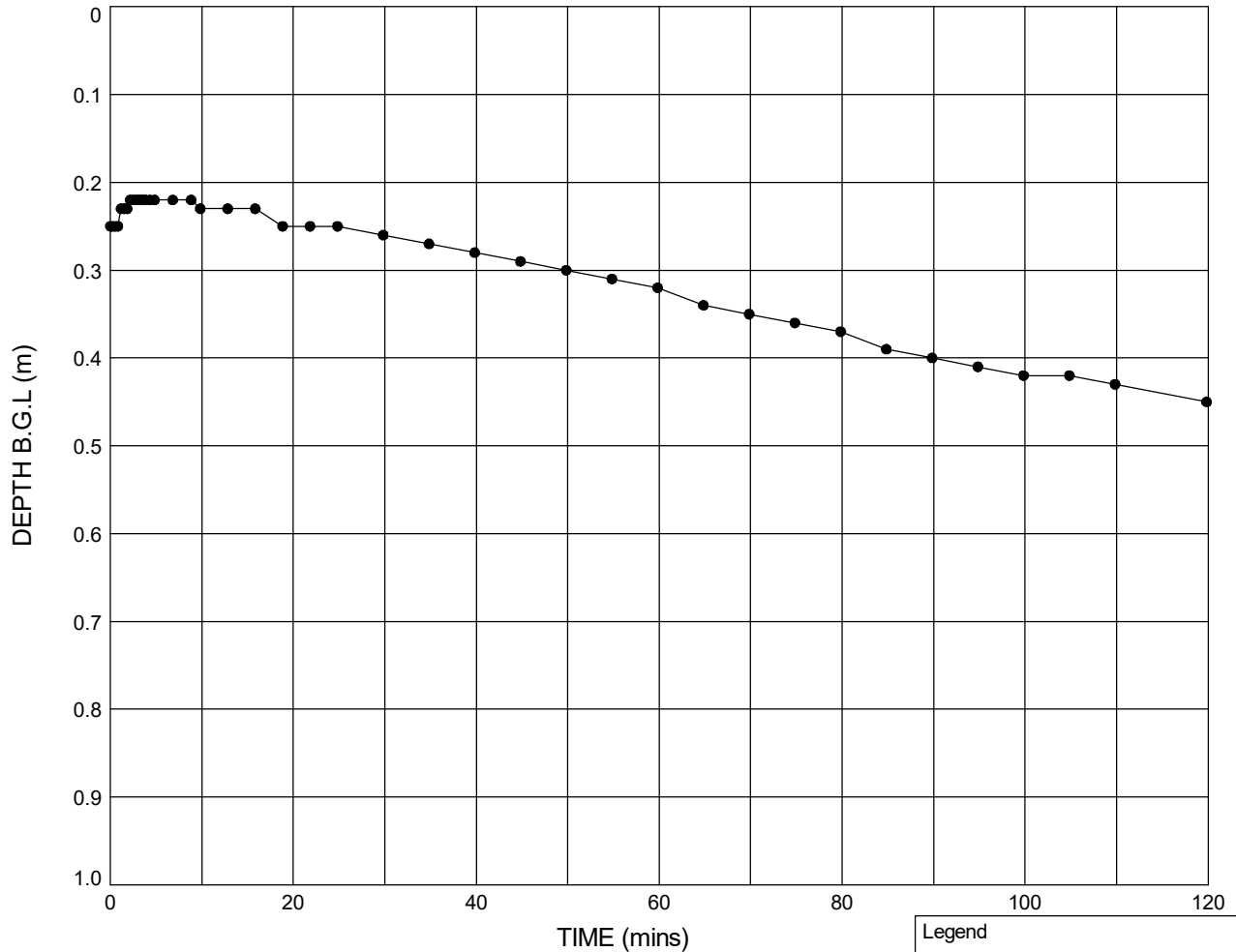
Non-standard test

Soakaway Test - Position ID : **TP330A**

Ground Level (m AOD): **13.38**

National Grid Co-ordinates: **E:641204.8 N:260845.1**

PLOT OF DEPTH OF WATER BELOW GROUND LEVEL AGAINST TIME



Test 1

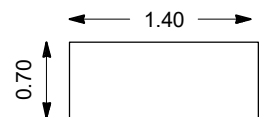
Pit start depth: = **1.00** m
Pit final depth: = **1.00** m
Effective depth, D_e = **0.75** m
Effective storage volume, V_{p75-25} = **0.3675** m³
Surface area, a_{p50} = **2.5550** m²
Time, t_{p75-25} = **NA** secs
Infiltration rate, f = **NA** m/s

Notes: Test 1 - Duration 2 hrs. Test terminated at 4.00pm with 0.45m of water in trial pit. 22 cm drop in water level recorded. Site made safe and position backfilled. Insufficient data available to calculate infiltration rate.

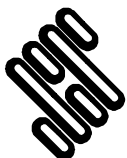
Legend

● Test 1 (27.04.21)

Plan (Not to scale)



No Bearing Taken



STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By

Date

Checked By

Date

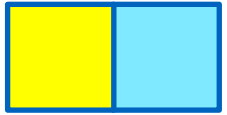
19/05/21

Contract

EA HUB Onshore SI

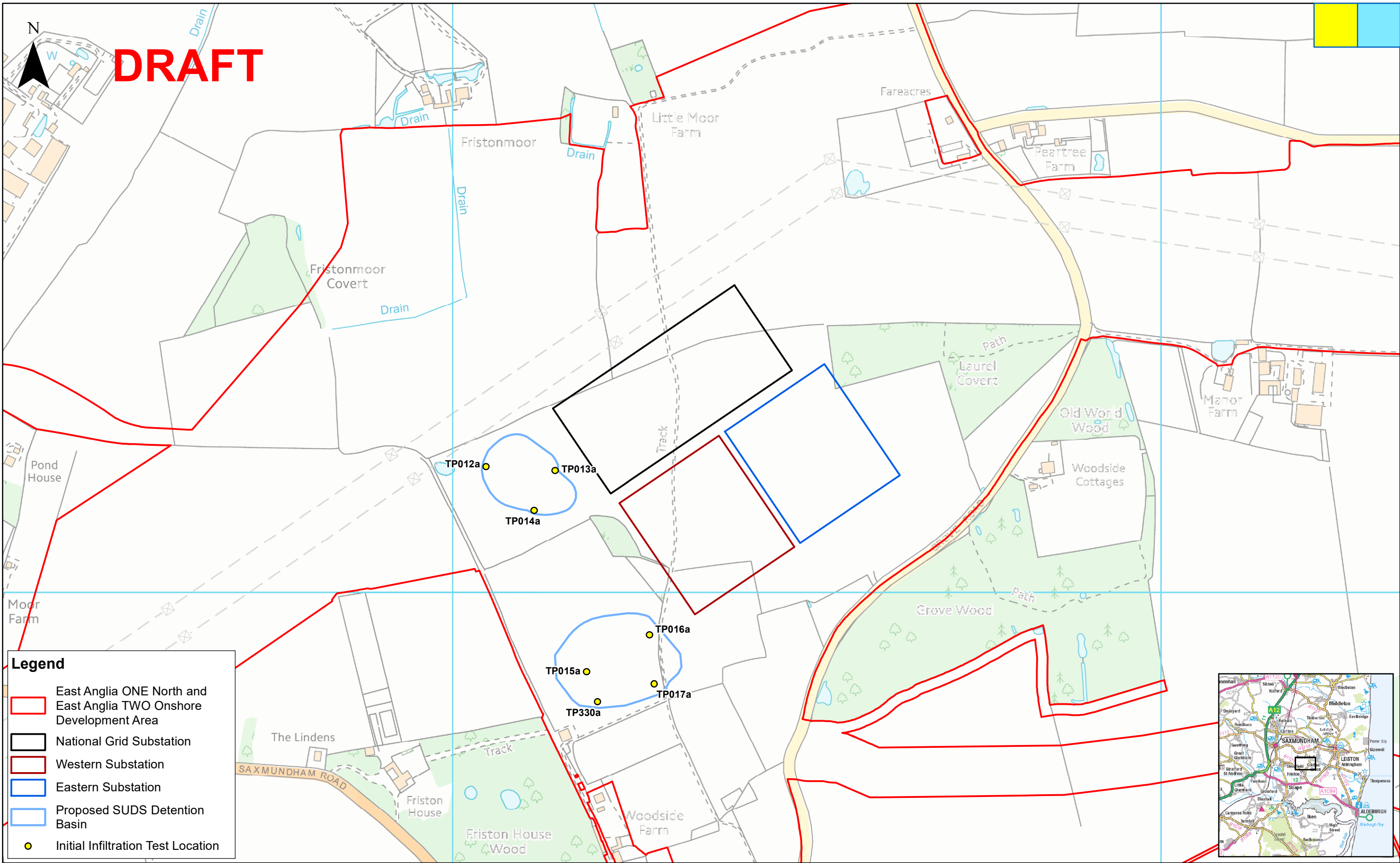
Contract Ref:



735329



Appendix 2 Initial Infiltration Testing Pit Location Plan

DRAFT



							1:5,000		East Anglia ONE North and East Anglia TWO	Drg No	EA1N-EA2-DEV-DRG-IBR-001308	
	2	20/05/2021	AB	Second Issue.	Prepared:	AB	Scale @ A3			Rev	2	Coordinate System: BNG Datum: OSGB36
	1	11/05/2021	FC	First Issue.	Checked:	BD	<small>Source: © Crown copyright and database rights 2021. Ordnance Survey 0100031673. This map has been produced to the latest known information at the time of issue, and has been produced for your information only. Please consult with the SPR Onshore GIS team to ensure the content is still current before using the information contained on this map. To the fullest extent permitted by law, we accept no responsibility or liability (whether in contract, tort (including negligence) or otherwise in respect of any errors or omissions in the information contained in the map and shall not be liable for any loss, damage or expense caused by such errors or omissions.</small>	Date		20/05/21		
	Rev	Date	By	Comment	Approved:	FM	Infiltration Testing - Initial Infiltration Test Locations	Figure		1		