

DO NOT SCALE



KEY

	F14 CL.46.109 IL.44.300	ADOPTABLE FOUL WATER MANHOLE WITH REFERENCE NUMBER, COVER LEVEL AND INVERT LEVEL
	1000 1007.5	FOUL WATER DRAIN/SEWER WITH PIPE CODE, SIZE AND GRADIENT
	S22 CL.44.200 IL.44.733	ADOPTABLE SURFACE WATER MANHOLE WITH REFERENCE NUMBER, COVER LEVEL AND INVERT LEVEL
	400 409	SURFACE WATER DRAIN/SEWER WITH PIPE CODE, SIZE AND GRADIENT
		ADOPTABLE SURFACE WATER MANHOLE WITH FLOW CONTROL
		PROPRIETARY VEGETATED SURFACE WATER HEADWALL (E.G. ROOTLOK) TO SUIT PROPOSED SLOPES OF SURFACE WATER BASIN
		NB: DRAINAGE FEATURES TO BE ADOPTED UNDER FUTURE PHASES ARE SHOWN IN BLACK
		ADOPTABLE DRAINAGE EASEMENT
		SITE BOUNDARY

- NOTES**
- DO NOT SCALE FROM THIS DRAWING.
 - ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELATED RICHARD JACKSON LTD. ARCHITECTS & SUB-CONTRACTORS DRAWINGS. IN THE CASE OF DISCREPANCIES BETWEEN DRAWINGS REFER TO RJD FOR CLARIFICATION.
 - SURVEY UNDERTAKEN BY J.C. WHITE GEOMATICS LIMITED, REFERENCED 17/00/043, DATED SEPTEMBER 2017 AND UPDATED APRIL 2021.
 - BASED UPON ARCHITECTURAL LAYOUT UNDERTAKEN BY THE NOBLE CONSULTANCY.
 - THE CONTRACTOR SHALL, BEFORE COMMENCING THE WORKS, VERIFY ALL SITE AND SETTING OUT DIMENSIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE TRUE AND PROPER SETTING OUT OF THE WORKS AND FOR THE CORRECTNESS OF THE POSITION, LEVELS, DIMENSIONS, AND ALIGNMENT OF ALL PARTS OF THE WORKS.
 - ALL ROAD MARKINGS TO BE IN ACCORDANCE WITH THE TRAFFIC SIGNS REGULATIONS AND GENERAL DIRECTIONS 2016.
 - ALL ADOPTABLE HIGHWAY WORKS ARE TO BE TO THE FULL REQUIREMENTS AND SATISFACTION OF KENT COUNTY COUNCIL AND ARE SUBJECT TO AGREEMENT BY KENT COUNTY COUNCIL.
 - ALL ADOPTABLE DRAINAGE WORKS ARE SUBJECT TO AGREEMENT BY ICOSA WATER AND ARE TO BE IN ACCORDANCE WITH OFWAT'S SEWERAGE SECTOR GUIDANCE, DESIGN AND CONSTRUCTION GUIDE MARCH 2020 AND ANY ICOSA WATER DELETION/ADDITIONS THEREOF.
 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND PROTECTING ALL EXISTING SERVICES, EXISTING BURIED PIPES (PARTICULARLY SHALLOW PIPES) AND TREE ROOTS FROM DAMAGE IMPOSED BY LOADS AND CONSTRUCTION PLANT
 - BACKFILL TO TRENCHES OF PRIVATE DRAINAGE WHERE NOT FORMED WITH PERFORATED PIPES MAY BE SUITABLE EXCAVATED MATERIAL IN LANDSCAPED AREAS. TYPE 1 GRANULAR MATERIAL TO BE USED UNDER HARD STANDINGS AND ROADS.
 - ADOPTABLE MANHOLE COVERS WITHIN BLOCK PAVED AREAS SHALL NOT BE RECESSED.
 - ALL EXTERNAL AREAS TO BE DRAINED BY TRAPPED GULLIES.
 - MANHOLE COVER LEVELS SHOWN ON THE DRAWING ARE APPROXIMATE. EXACT LEVEL TO BE DETERMINED ON SITE TO SUIT ADJACENT FINISHED GROUND LEVELS.
 - WHERE PIPES CROSS WITH LESS THAN 300mm BETWEEN SOFFIT AND INVERT, PIPES SHALL BE SURROUNDED IN 150mm THICK GEN3 CONCRETE.
 - THE CONTRACTOR IS RESPONSIBLE FOR CHECKING AND VERIFYING THE EXISTING OUTFALL INVERT LEVELS AT THE POINT OF CONNECTION FOR ALL DRAINAGE PRIOR TO THE COMMENCEMENT OF ANY DRAINAGE CONSTRUCTION.
 - ALL PIPEWORK CONNECTING TO THE ADOPTABLE MANHOLES OR SEWERS, ARE TO BE 100mm MINIMUM DIAMETER VITRIFIED CLAY AND LAID TO CONNECT WITH LEVEL SOFFITS UNLESS NOTED OTHERWISE.
 - SETTING OUT FOR BASINS TO BE PROVIDED IN THE FORM OF CAD FILES
 - WHERE NECESSARY THE CONTRACTOR SHALL LAY SPURS FROM MANHOLES TO SUIT FUTURE PHASES TO AVOID THE NEED TO BREAK INTO CHAMBERS DURING FUTURE CONSTRUCTION. SPURS TO BE CAPPED

NOTE: THIS DRAWING SHOWS PROPOSED FOUL AND SURFACE WATER DRAINAGE FOR PHASE 1 AND FUTURE PHASES. REFER TO DRAWING H8399/CIV/-/BDW/4190 FOR EXTENT OF PROPOSED DRAINAGE TO BE CONSTRUCTED IN PHASE 1

REV	DATE	DESCRIPTION	DRAWN	CHKD
A	24.09.21	OVERALL REVIEW AND REVISIONS TO SUIT CLIENT DISCUSSIONS AND TO SUIT COMMENTS FROM ICOSA WATER	KRT	KRT

REVISIONS
This drawing is to be read in conjunction with all other Engineer's drawings and all other project information. Any discrepancy between the Engineer's drawings and other project information is to be reported to the Engineer immediately.



Project
**BROAD OAK FARM
STURRY
CANTERBURY**

Title
**SECTION 104 LAYOUT - EXTENT
OF DRAINAGE ADOPTION (FULL
SITE LAYOUT)**

Client

DAVID WILSON HOMES
WHERE QUALITY LIVES

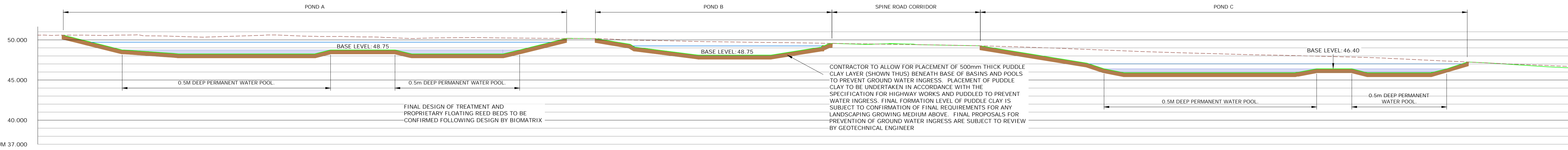
**Richard Jackson
Engineering Consultants**

847 The Crescent, Colchester, Essex CO4 9YQ Tel: 01206 228800
Unit 06C130, 6th Floor, 1 St. Katherine's Way, London, E1W 1UN Tel: 020 7448 9910
5 Quorn House, Mill Court, Great Shelford, Cambs CB22 5LD Tel: 01223 314794
4 The Old Church, St. Matthews Road, Norwich, Norfolk NR1 1SP Tel: 01603 292424
The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF Tel: 01172 020070
Email Address: mail@rj.uk.com Website: http://www.rj.uk.com

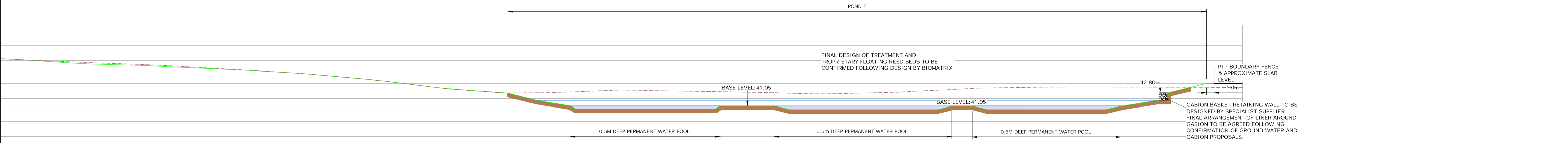
Scale	Drawn	Date			
1:2000 @ A1	KRT	JULY 2021			
Project Manager	Checked	Approved			
K. TOSH	JTT	KRT			
Status	Suitability Description	RJL Project No :			
D2	FOR TENDER	61109			
project code	discipline	phase	client	number	revision
H8398	CIV	-	BDW	4139	A



DO NOT SCALE



CHAINAGE	0.000	3.174	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000
PROPOSED GROUND LEVEL	50.596	48.875	48.250	48.250	48.250	48.750	48.250	48.770	50.056	48.369	48.100	49.520	49.268	47.750	43.458	45.900	45.900	46.400	45.900	47.147	46.535
EXISTING GROUND LEVEL	50.592	50.592	50.352	50.596	50.372	50.250	50.218	50.151	49.847	49.690	49.541	49.395	49.183	48.830	48.457	48.176	47.946	47.603	47.140	46.705	46.705



180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	290.000	300.000	310.000	320.000	330.000	336.373	340.000
47.147	46.535	46.177	45.725	45.077	44.081	43.038	41.479	39.650	39.650	40.846	40.550	40.550	40.550	40.550	41.917	43.481	43.481
47.140	46.705	46.313	45.751	45.081	44.086	43.016	42.789	43.114	42.944	42.751	42.715	43.078	43.442	43.527	43.506	43.481	43.481

REV	DATE	DESCRIPTION	DRAWN	CHKD
A	08.10.21	UPDATED SITE LAYOUT ADDED, EXTENT OF TREATMENT REMOVED PENDING DESIGN BY BIOMATRIX AND GABION BASKET ADDED TO SUIT REALIGNED PTP BOUNDARY LEVELS	KRT	JTT

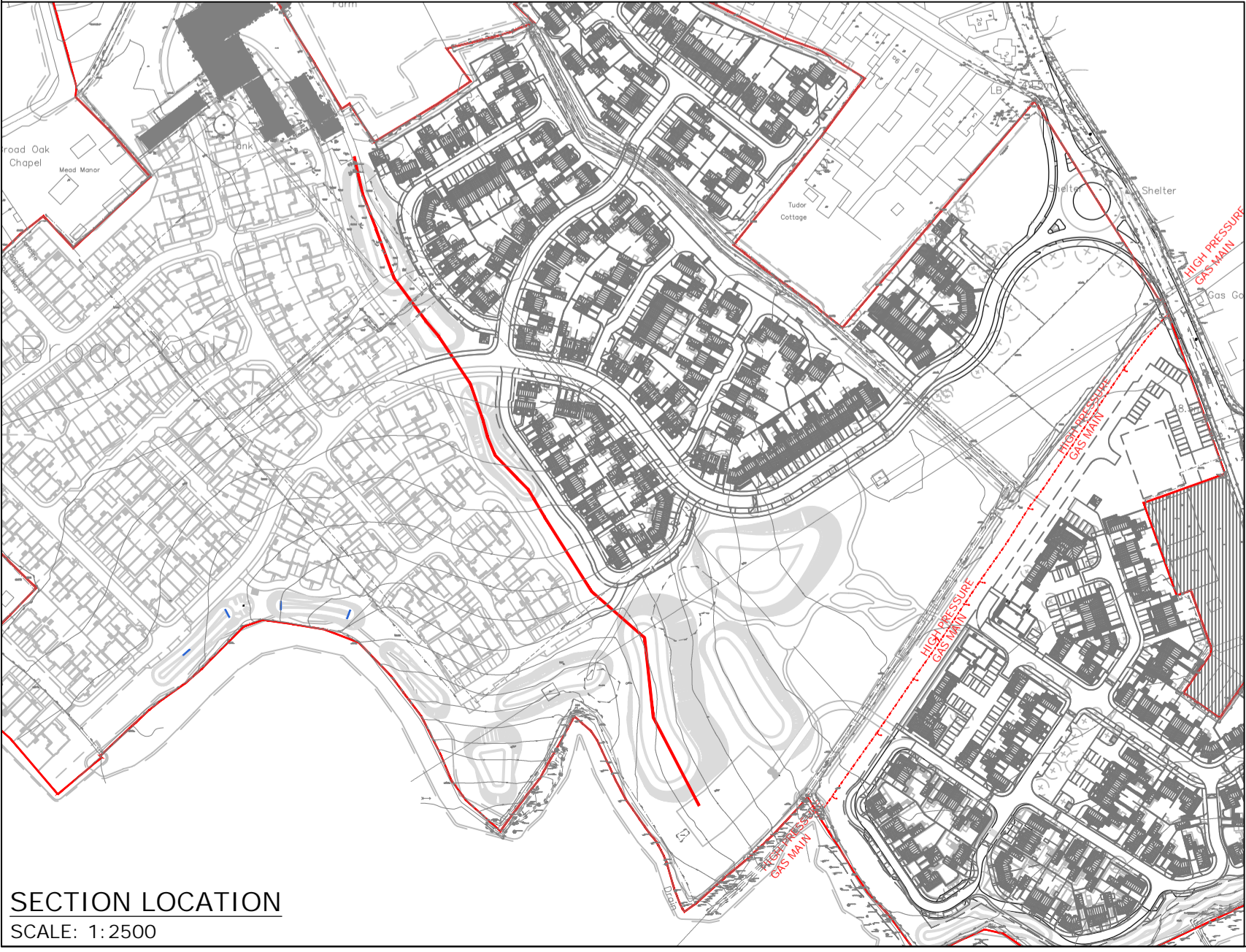
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Project
BROAD OAK FARM
STURRY
CANTERBURY

Title
SECTIONS THROUGH SURFACE
WATER ATTENUATION PONDS

Client
 **DAVID WILSON HOMES**
 WHERE QUALITY LIVES



SECTION LOCATION
 SCALE: 1:2500

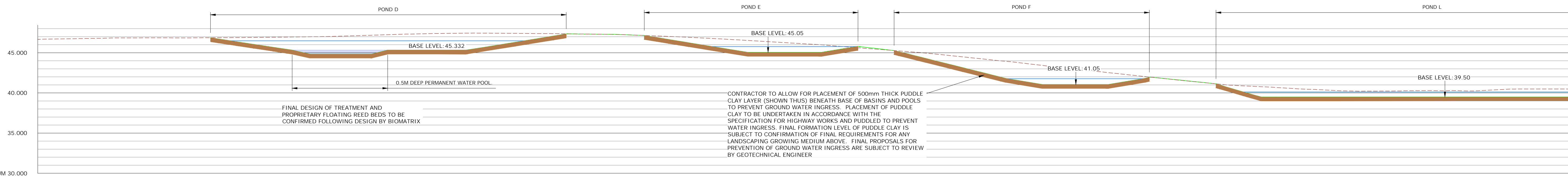
KEY	
	PROPOSED FINISHED GROUND PROFILE
	EXISTING GROUND PROFILE
	DESIGN WATER LEVEL FOR 1:100 YEAR + 40% DESIGN RAINFALL EVENT
	0.5M DEEP TREATMENT AREA WITHIN SURFACE WATER BASIN WITH FLOATING REED BEDS SUBJECT TO SPECIALIST DESIGN (BIOMATRIX GROUP)
	0.5M DEEP PERMANENT WATER AREA WITHIN SURFACE WATER BASIN
	0.5M THICK PUDDLE CLAY TO RESIST GROUND WATER INGRESS

Richard Jackson
 Engineering Consultants

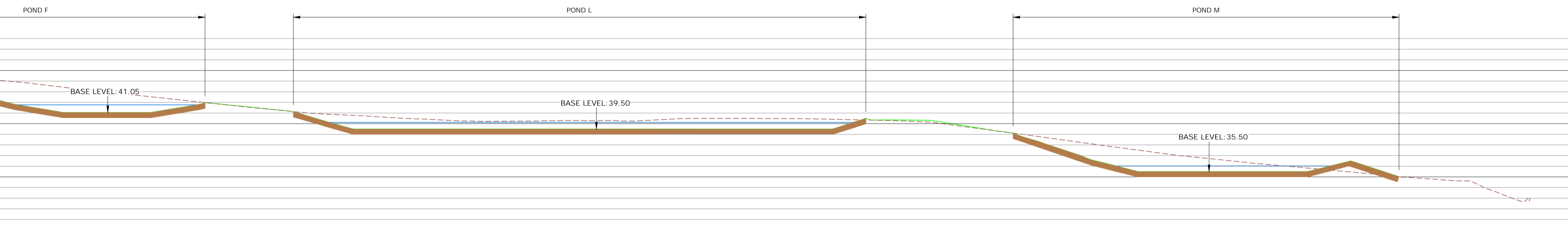
847 The Crescent, Colchester, Essex CO4 9YQ Tel: 01206 228800
 Unit 06/130, 6th Floor, 1 St. Katherine's Way, London, E1W 1UN Tel: 020 7448 9910
 5 Quern House, Mill Court, Great Shelford, Cambs CB22 5LD Tel: 01223 314794
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 The Wheelhouse, Bonds Mill, Stonehouse, Gloucestershire GL10 3RF Tel: 01172 020070
 Email Address: mail@rj.uk.com Website: http://www.rj.uk.com

Scale	Drawn	Date			
1:500 @ A1	KRT	JULY 2021			
Project Manager	Checked	Approved			
K. TOSH	JTT	KRT			
Status	Suitability Description	RJL Project No :			
D2	FOR TENDER	61109			
project code	discipline	phase	client	number	revision
H8398	CIV	X	BDW	4180	A

DO NOT SCALE



CHAINAGE	0.000	4.627	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000	120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000
PROPOSED GROUND LEVEL		47.053	47.150	46.907	45.576	44.832	45.332	46.413	47.310	46.398	45.050	45.474	44.390	41.890	41.050	41.798	40.073	39.500	39.500	39.500	39.500
EXISTING GROUND LEVEL	46.671		46.849	46.862	46.941	47.136	47.403	47.412	47.303	46.969	46.429	45.774	45.000	43.967	42.858	41.788	40.871	40.368	40.269	40.324	40.485



120.000	130.000	140.000	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	266.462
41.890	41.050	41.798	40.073	39.500	39.500	39.500	39.500	40.430	39.724	37.128	35.500	35.500	35.045	33.351	32.991
43.967	42.858	41.788	40.871	40.368	40.269	40.324	40.485	40.352	39.653	38.294	36.964	35.982	35.045	33.351	32.991

REV	DATE	DESCRIPTION	DRAWN	CHKD
A	08.10.21	UPDATED SITELAYOUT ADDED, EXTENT OF TREATMENT REMOVED PENDING DESIGN BY BIOMATRIX	KRT	JTT

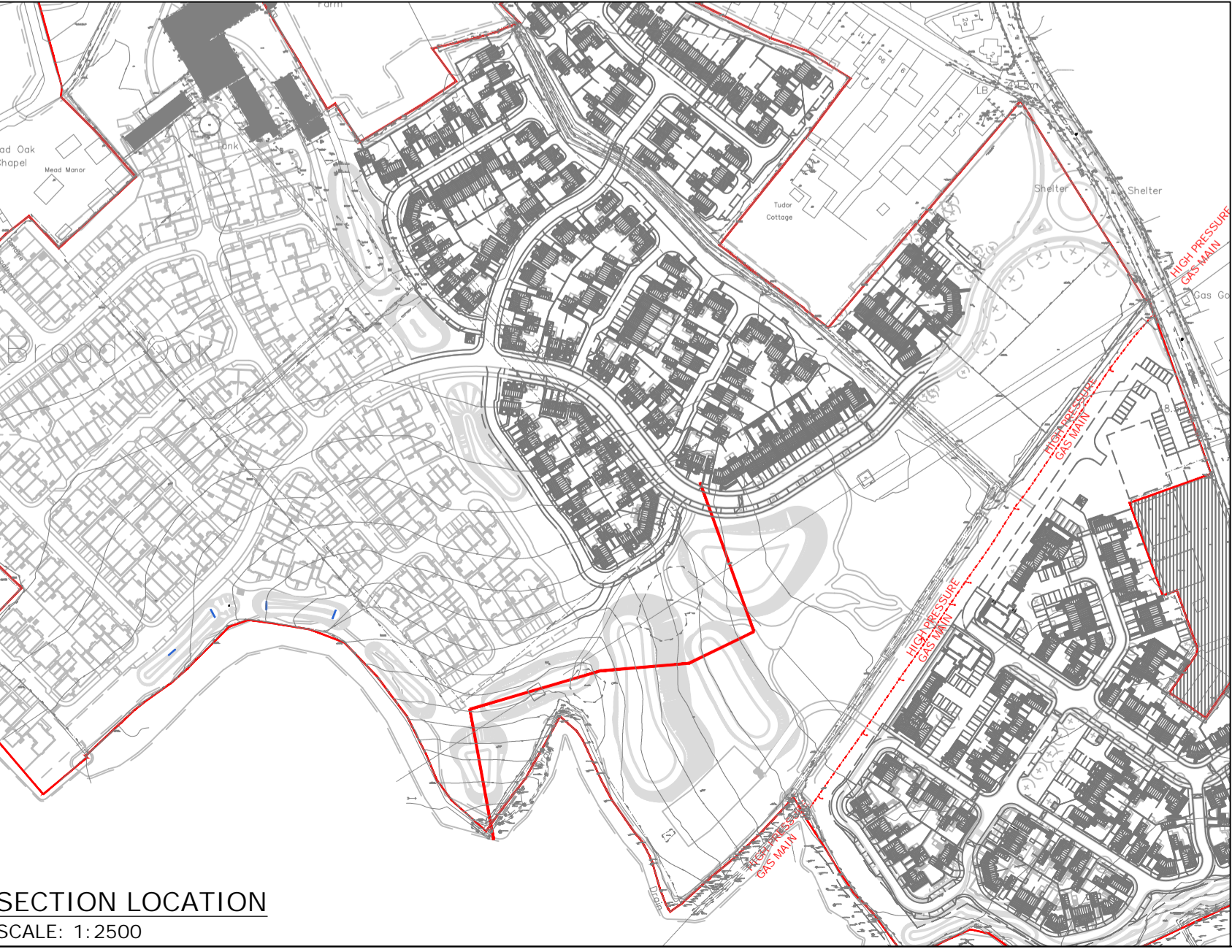
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Project
BROAD OAK FARM
STURRY
CANTERBURY

Title
SECTIONS THROUGH SURFACE
WATER ATTENUATION PONDS

Client
 **DAVID WILSON HOMES**
 WHERE QUALITY LIVES



SECTION LOCATION
 SCALE: 1:2500

KEY	
	PROPOSED FINISHED GROUND PROFILE
	EXISTING GROUND PROFILE
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Scale	Drawn	Date			
1:500 @ A1	KRT	JULY 2021			
Project Manager	Checked	Approved			
K. TOSH	JTT	KRT			
Status	Suitability Description	RJL Project No :			
D2	FOR TENDER	61109			
project code	discipline	phase	client	number	revision
H8398	CIV	X	BDW	4181	A

Trial Hole Sections

Project Id: LP2614

Project Title: Broad Oak

Location: Broad Oak, Sturry, Kent, CT2 0QX

Client: Barratt David Wilson Homes (Kent) Ltd.

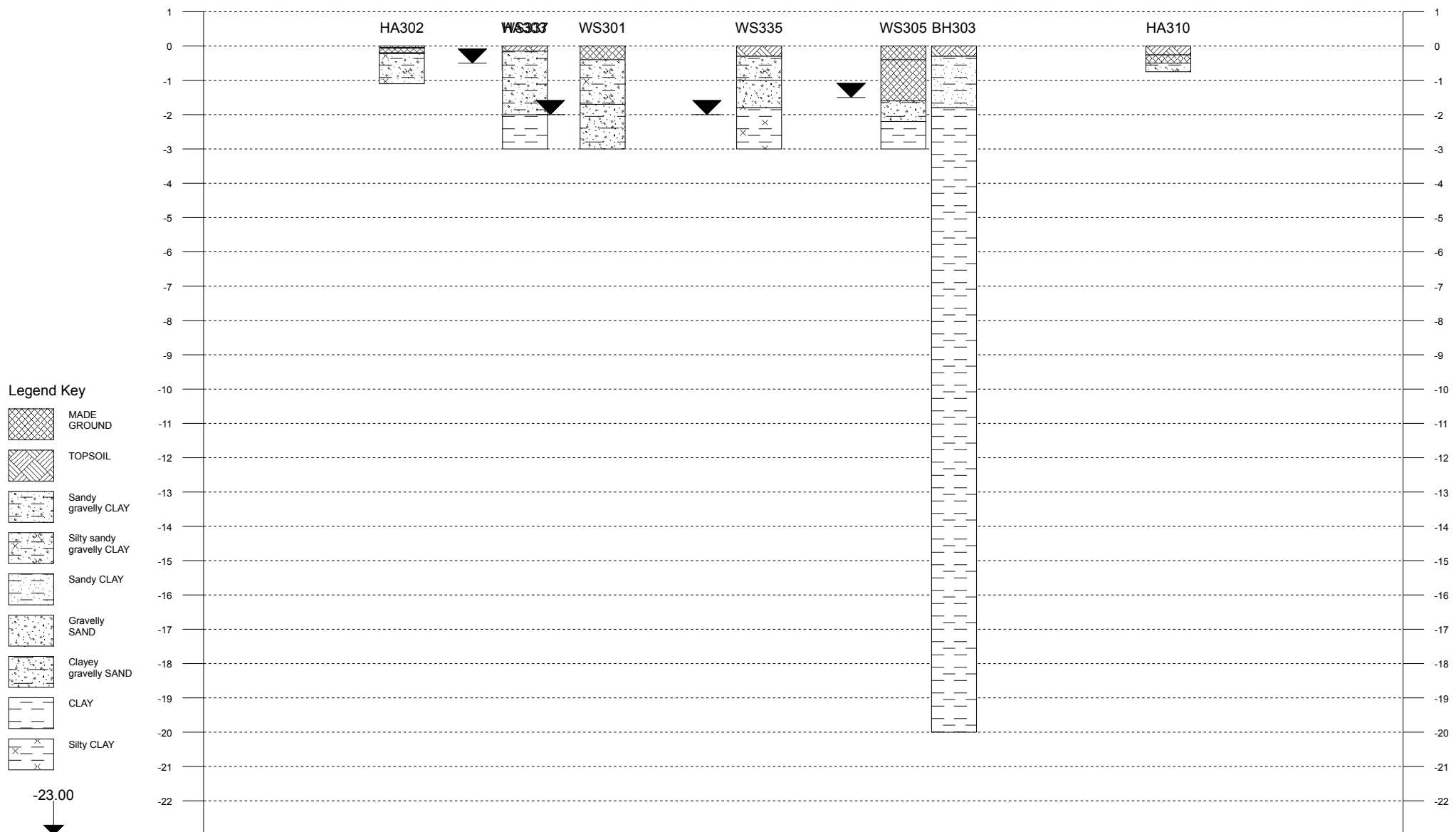
Title: Section line 1

Vertical Scale: 1:157

Horizontal Scale: 1:413

Engineer: REB

Leap Environmental Ltd
 The Atrium, Curtis Road
 Dorking, Surrey RH4 1XA
 Tel: 01306 646510
 www.leapenvironmental.com



Legend Key

- MADE GROUND
- TOPSOIL
- Sandy gravelly CLAY
- Silty sandy gravelly CLAY
- Sandy CLAY
- Gravelly SAND
- Clayey gravelly SAND
- CLAY
- Silty CLAY

-23.00

Chainage (m)	0.00	7.44	16.89	22.85	34.85	45.92	49.80	66.24	76.40
Elevation (mAOD)		-2.00	-2.00	-1.00	0.00	-2.00	-2.00	-2.00	

Project Id: LP2614

Project Title: Broad Oak

Location: Broad Oak, Sturry, Kent, CT2 0QX

Client: Barratt David Wilson Homes (Kent) Ltd.

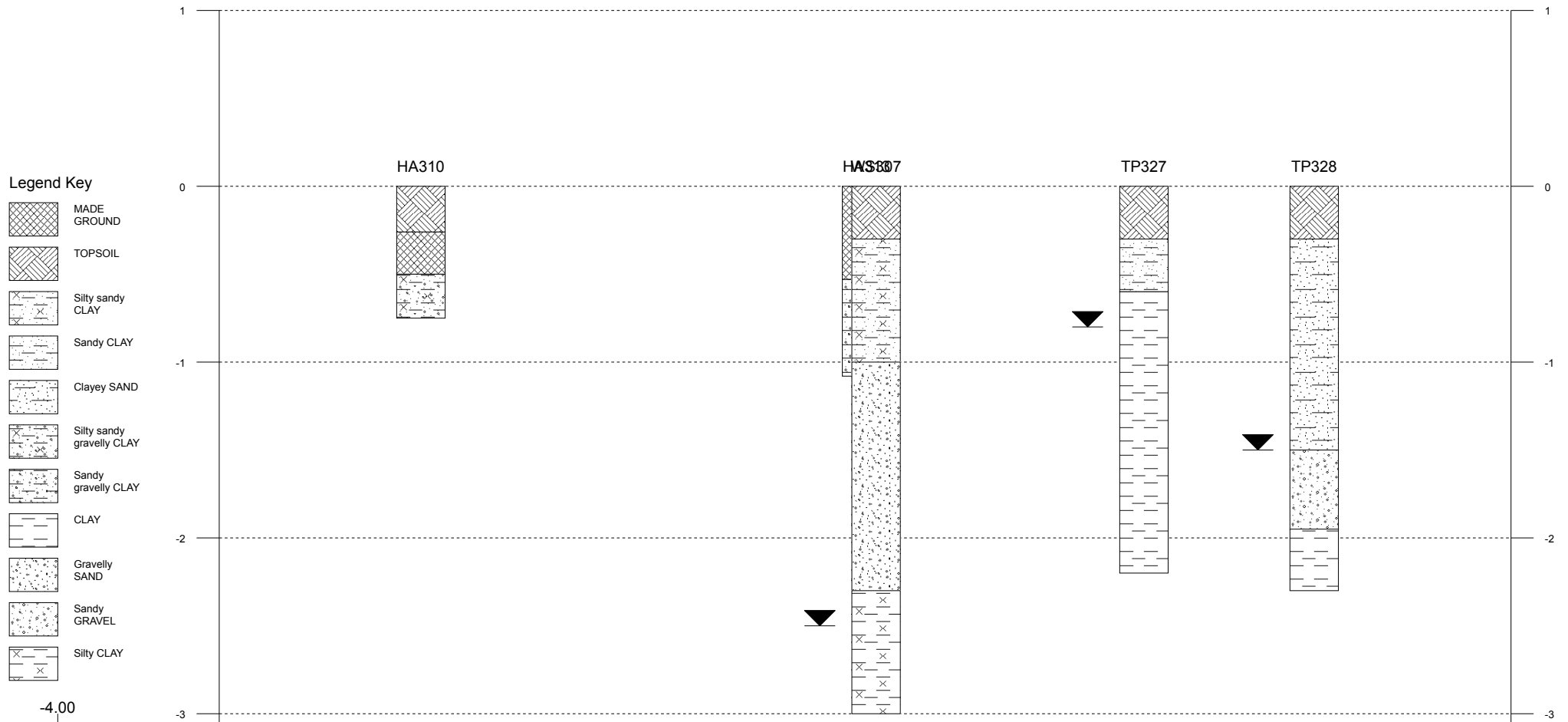
Title: Section line 2

Vertical Scale: 1:33

Horizontal Scale: 1:446

Engineer: REB

Leap Environmental Ltd
 The Atrium, Curtis Road
 Dorking, Surrey RH4 1XA
 Tel: 01306 646510
 www.leapenvironmental.com



Chainage (m)	0.00	7.13	44.214	62.74	75.84	82.58
Elevation (mAOD)		0.00	0.000	0.00	0.00	

Project Id: LP2614

Project Title: Broad Oak

Location: Broad Oak, Sturry, Kent, CT2 0QX

Client: Barratt David Wilson Homes (Kent) Ltd.

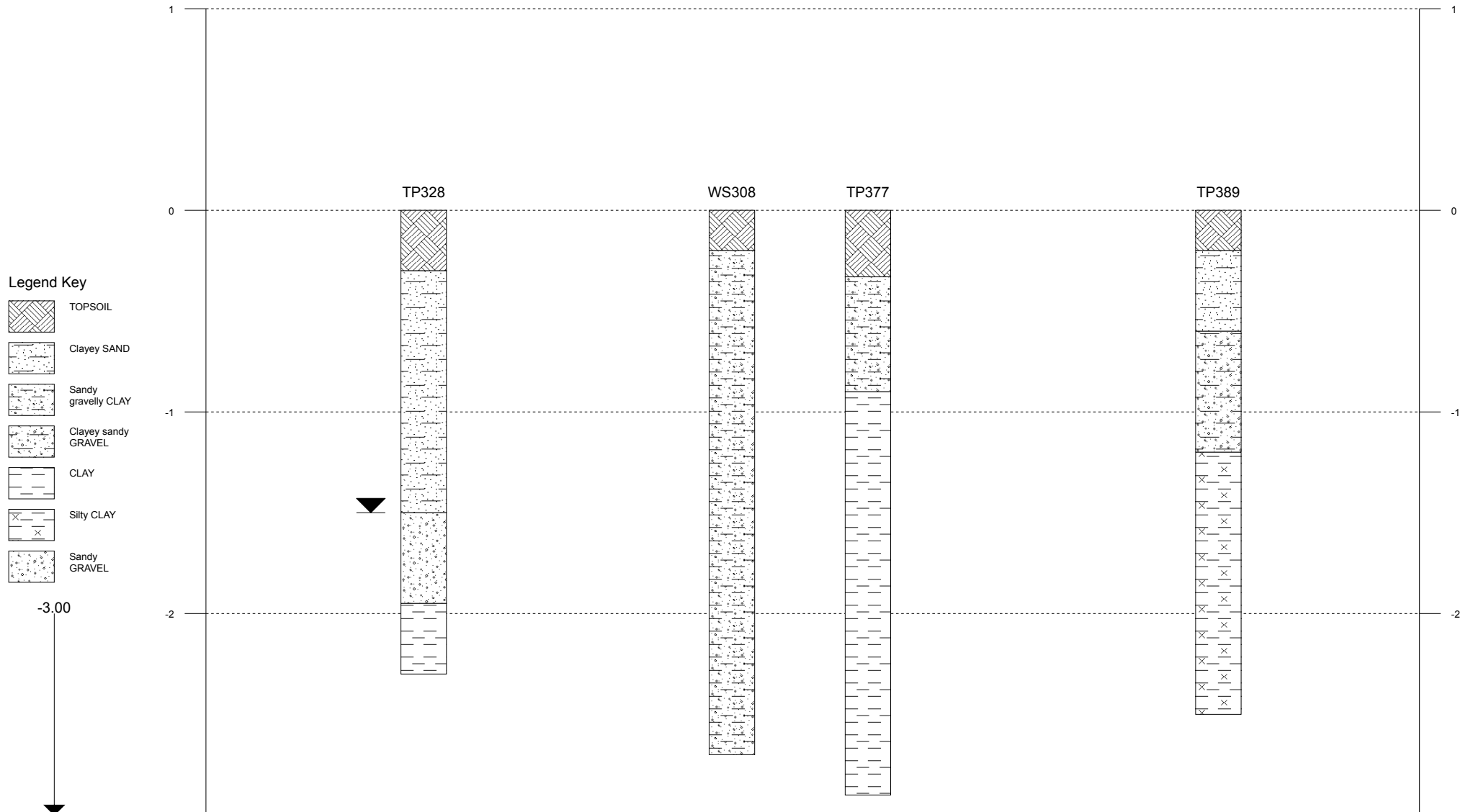
Title: Section line 3

Vertical Scale: 1:27

Horizontal Scale: 1:528

Engineer: REB

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Chainage (m)	0.00	11.18	32.96	41.06	54.24	88.21	97.70
Elevation (mAOD)		0.00	0.00	0.00	0.00	0.00	

Project Id: LP2614

Project Title: Broad Oak

Location: Broad Oak, Sturry, Kent, CT2 0QX

Client: Barratt David Wilson Homes (Kent) Ltd.

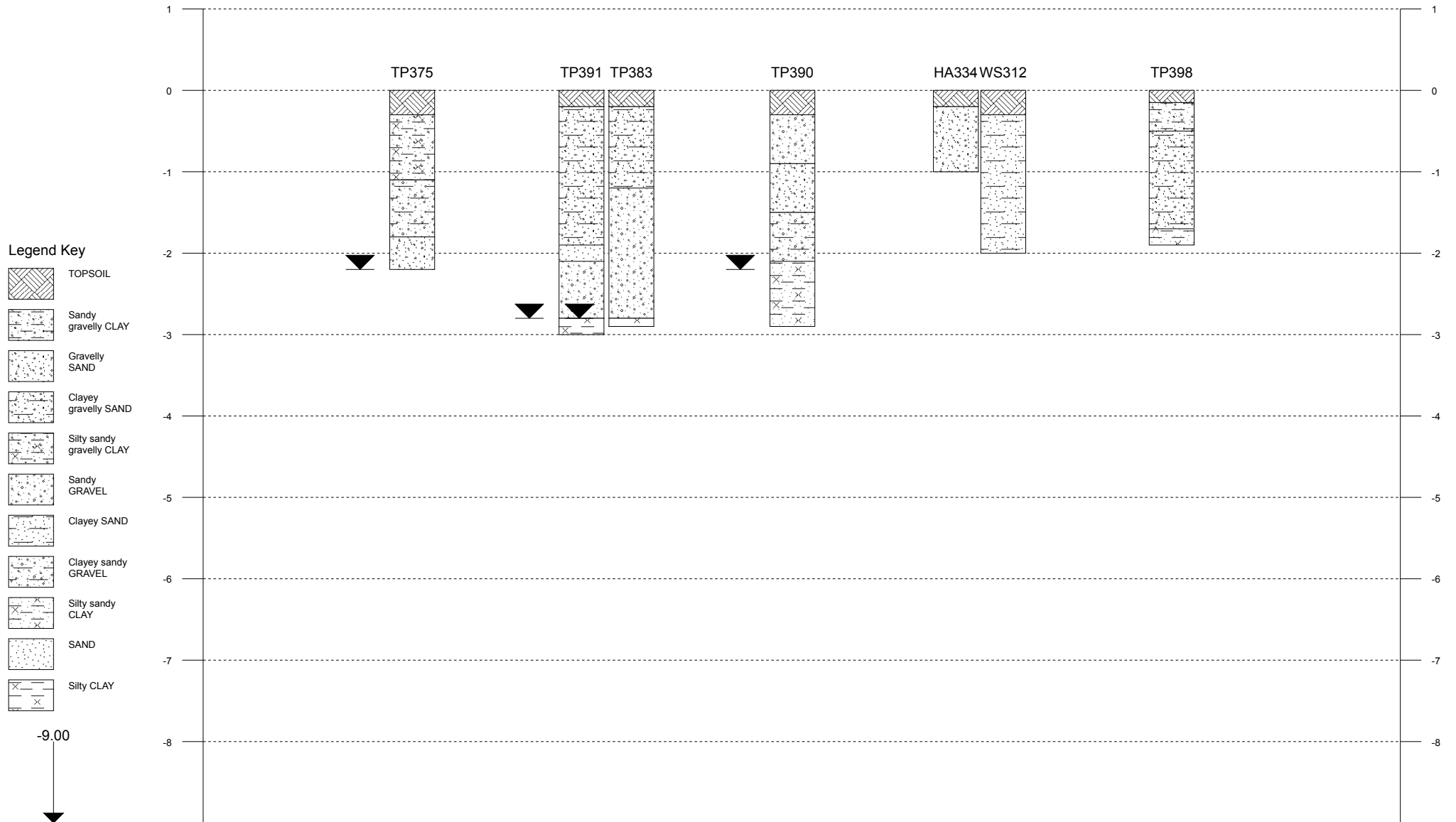
Title: Section line 4

Vertical Scale: 1:66

Horizontal Scale: 1:497

Engineer: REB

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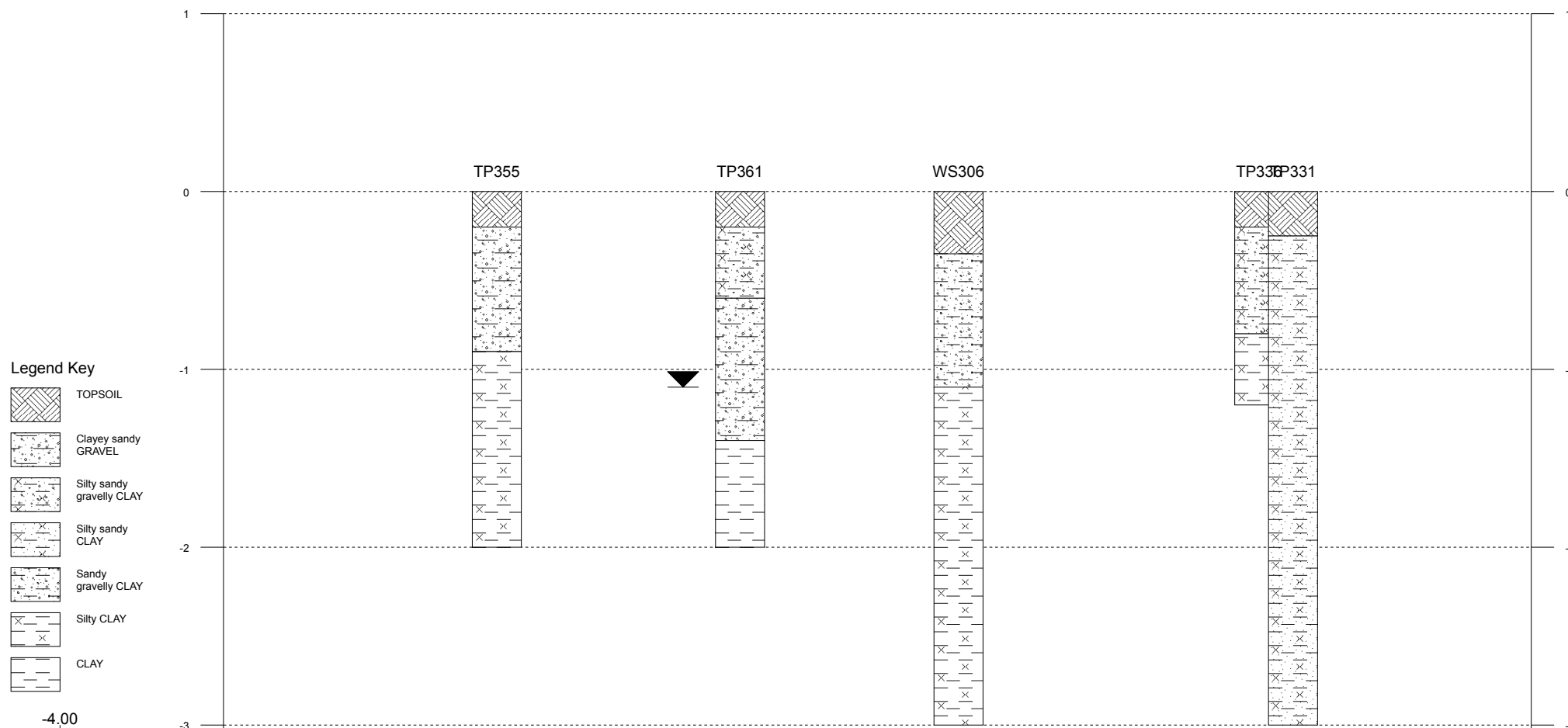


Chainage (m)	0.00	9.99	25.65	30.26	45.16	60.27	64.66	80.23	91.87
Elevation (mAOD)	0.00		0.00	0.00	0.00	0.00	-6.00	0.00	

Project Id: LP2614
 Project Title: Broad Oak
 Location: Broad Oak, Sturry, Kent, CT2 0QX
 Client: Barratt David Wilson Homes (Kent) Ltd.

Title: Section line 5
 Vertical Scale: 1:33
 Horizontal Scale: 1:399
 Engineer: REB

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 Dorking, Surrey RH4 1XA
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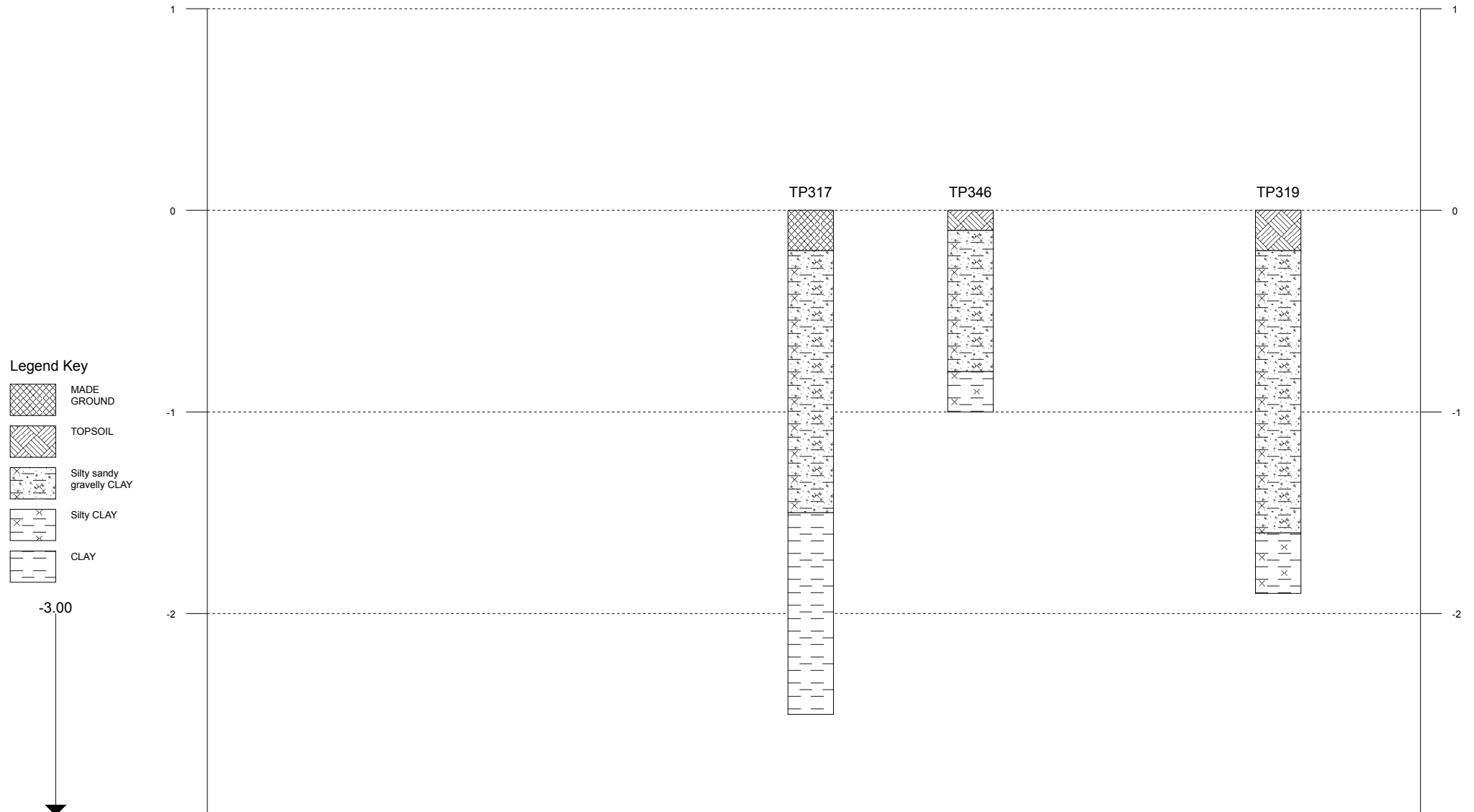







Chainage (m)	0.00	11.08	27.61	42.46	62.90	65.20	73.75
Elevation (mAOD)		0.00	0.00	0.00	0.00	0.00	

Project Id: LP2614
 Project Title: Broad Oak
 Location: Broad Oak, Sturry, Kent, CT2 0QX
 Client: Barratt David Wilson Homes (Kent) Ltd.

Title: Section line 7
 Vertical Scale: 1:27
 Horizontal Scale: 1:401
 Engineer: REB

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- Legend Key**
-  MADE GROUND
 -  TOPSOIL
 -  Silty sandy gravelly CLAY
 -  Silty CLAY
 -  CLAY

Chainage (m)	0.00	36.89	48.66	58.84	71.32	74.26	
Elevation (mAOD)		0.00	0.00	0.00	0.00		

Project Id: LP2614

Project Title: Broad Oak

Location: Broad Oak, Sturry, Kent, CT2 0QX

Client: Barratt David Wilson Homes (Kent) Ltd.

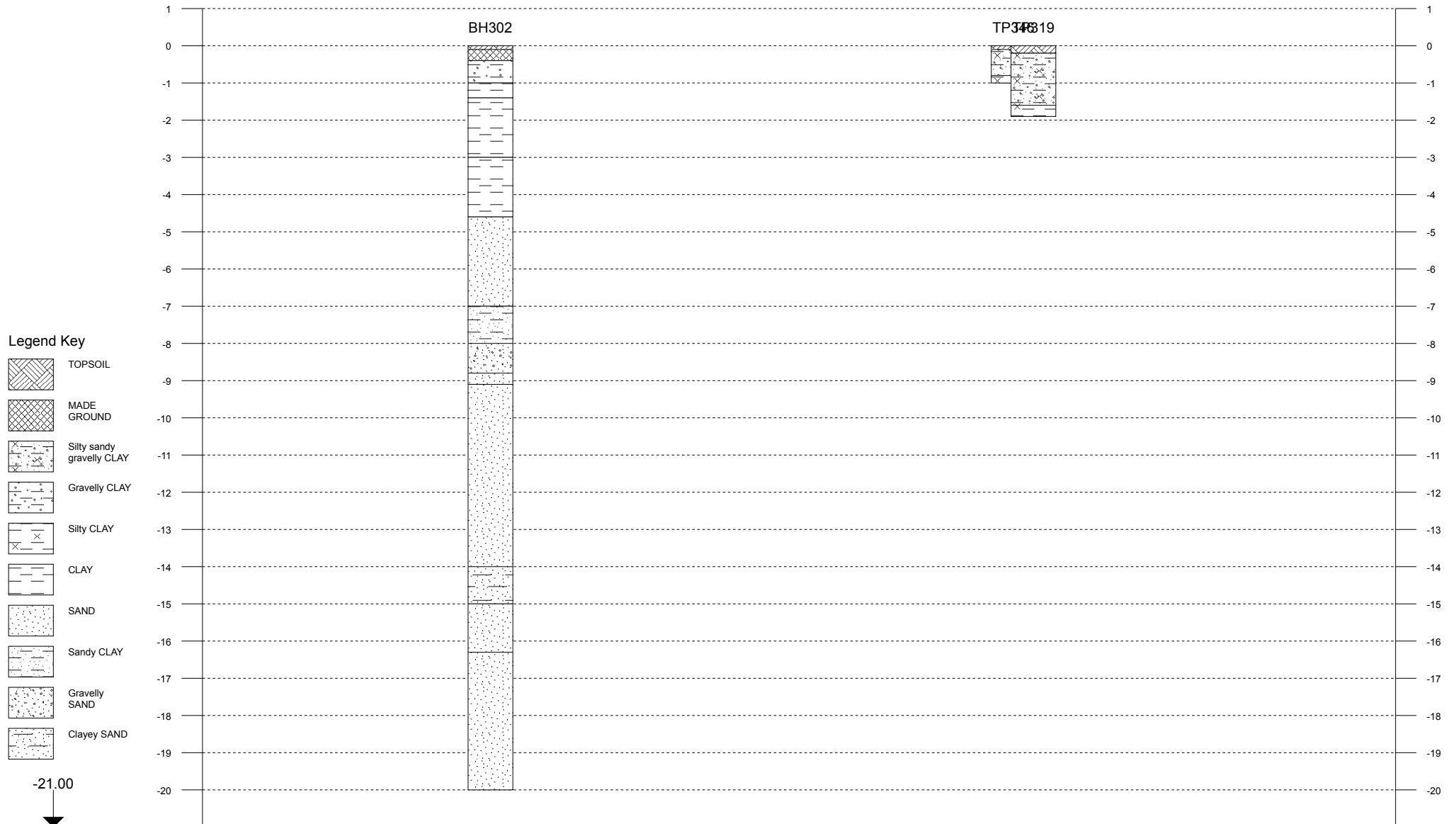
Title: Section line 8

Vertical Scale: 1:144

Horizontal Scale: 1:297

Engineer: REB

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Tel: 01306 646510
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-21.00

Chainage (m)	0.00	10.39	39.48	50.50	54.86
Elevation (mAOD)		0.00		0.00	

PUDDLE CLAY SPECIFICATION

1) General

Material to be used as puddle clay shall be naturally occurring homogeneous plastic material. It shall be free from deleterious matter such as sand, stones and organic material. The use of lime-stabilised clays shall not be allowed.

2) Properties

- a) More than 65% of the natural material shall be finer than 0.06mm and more than 40% shall be finer than 0.002mm
- b) The natural material shall be defined as firm clay in accordance with BS5930:1981 Table 8 (C_u 40-75 kPa).
- c) The natural material shall be defined as clay of intermediate to extremely high plasticity in accordance with BS5930:1981, figure 31 and the liquid limit shall not be less than 35%.
- d) The coefficient of permeability (k) of the remoulded material shall not be greater than 10^{-9} m/s.
- e) The remoulded material shall be defined as Non-dispersive (ND1) in accordance with BS1377:Part 5:1990, Table 2.

3) Identification

An indication of a material's suitability may be obtained from the following *empirical* tests, at the moisture content agreed for placement.

a) Tenacity Test

A 300mm long, 25mm diameter cylinder of clay is held vertically for 15 seconds so that at least 200mm is unsupported and in tension under its weight. If the cylinder breaks the clay will be rejected as unsuitable.

b) Pinch Test

A 75mm diameter ball of remoulded clay is squeezed into a 25mm thick flat disc. If any cracks appear the clay may be rejected as unsuitable.

c) Slaking Test

A 50mm diameter ball of remoulded clay is placed in a 600ml beaker and covered with water. If the ball disintegrates within 24 hours the clay may be rejected as unsuitable.

d) Permeability Test

A sample of remoulded clay shall be formed into a tray to hold 20 litres of water and the loss measured after 24 hours. This shall be compared with the water loss from a metal tray of the same surface area holding the same quantity of water. If the difference is greater than 1% the clay may be rejected.

4) Acceptance

- a) A representative sample of the proposed clay material, not less than 10kg in weight together with appropriate tests results shall be supplied to the Engineering Manager for his acceptance not more than two weeks after acceptance of the Tender, and at least four weeks in advance of any proposed change in source or quality of the material.
- b) Test results to BS1377 are required as follows:
 - i) Grading
 - ii) Liquid and Plastic Limits
 - iii) Natural Moisture Content
 - iv) Coefficient of Permeability of remoulded clay
 - v) Pinhole Dispersion of remoulded Clay
 - vi) Compaction (2.5kg rammer)

5) Emplacement

- a) The clay should be reworked in a stockpile on site and water added as necessary to destroy the original structure of the clay and produce a smooth plastic homogeneous puddle clay with a moisture content of a minimum of 1.3 times the plastic limit. Reworking of the clay should be carried out in such a manner as to prevent contamination.
- b) The method of placing the clay shall be agreed by the Engineering Manager before work commences. Whatever means are adopted they shall produce a continuous homogeneous plastic mass of puddle clay effectively free from voids, laminations or imperfections which could affect its water retaining properties.
- c) The clay shall be placed in horizontal layers not exceeding 150mm consolidated thickness and compacted by an approved method to an air void content not exceeding 5%.
- d) Unless agreed otherwise with the Engineering Manager, the type of compaction plant and number of passes shall conform with the requirements of Clause 608 and Tables 6/1 and 6/4 for material Class 7C (selected wet cohesive material) of the DoT specification for Highway Works Part 2.
- e) Before placing a further layer of puddle, the surface of the previous layer shall be cleansed of all slurry and surplus water and the surface prepared to ensure that the clay to be placed shall be integrated with that already placed. Preparation of surfaces between successive layers shall be formed by frequent non-continuous spade cuts into the upper surface of the clay to depth of 75mm.
- f) Where clay puddle is to be joined with existing clay puddle, the existing clay shall be cut back and stepped to form a good key between the existing and new clay puddle over a distance to be agreed by the Engineering Manager, but not less than 1000mm. All trace of junction marks shall be wholly eliminated.
- g) Precautions shall be taken to ensure any puddle clay awaiting placing, puddle clay which has been placed and any puddle clay in dry areas shall be kept continuously wet to prevent it drying out and covered by waterproof sheets to protect it from rain damage. Precautions shall be taken to prevent the material freezing.

Kevin Tosh

From: Lucy Griffiths <lg@leapenvironmental.com>
Sent: 31 January 2022 08:19
To: Kevin Tosh; Morley, Greg
Cc: Tim Howard
Subject: Re: *EXTERNAL: RE: Broad Oak, Sturry - LEAP Final Reports

Hi Kevin,

The specification looks fine to me.

Thanks and have a lovely weekend.

Kind regards,

Lucy

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From: Kevin Tosh <KevinTosh@rj.uk.com>
Sent: Friday, January 28, 2022 12:02:57 PM
To: Lucy Griffiths <lg@leapenvironmental.com>; Morley, Greg <greg.morley@bdwhomes.co.uk>
Cc: Tim Howard <th@leapenvironmental.com>
Subject: RE: *EXTERNAL: RE: Broad Oak, Sturry - LEAP Final Reports

Hi Lucy – thanks v. much. What I intend to do is include the attached specification on the drawings to ensure that the Contractor provides suitable material. Could you give the attached a quick look over to see if you agree this is sufficient?

Thanks
Kevin

Kevin Tosh BEng (Hons)
Executive Director

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From: Lucy Griffiths <lg@leapenvironmental.com>

Sent: 26 January 2022 10:32

To: Kevin Tosh <KevinTosh@rj.uk.com>; Morley, Greg <greg.morley@bdwhomes.co.uk>

Cc: Tim Howard <th@leapenvironmental.com>

Subject: RE: *EXTERNAL: RE: Broad Oak, Sturry - LEAP Final Reports

Hi Kevin/ Greg,

Assuming the material is suitable (subject to confirmatory permeability / resistance to uplift testing) and/ or constructed to manufacturers specifications, the puddle clay should be sufficient to resist the potential uplift pressures at worst case scenario. Without the aforementioned we are unable to comment further in this regard, as previously mentioned following the initial request written in italic in Kevin's response below.

Kind regards,

Lucy Griffiths BSc CGeol FGS
Senior Geotechnical Engineer

Leap Environmental Ltd

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From: Kevin Tosh <KevinTosh@rj.uk.com>

Sent: 26 January 2022 10:10

To: Lucy Griffiths <lg@leapenvironmental.com>; Morley, Greg <greg.morley@bdwhomes.co.uk>

Cc: Tim Howard <th@leapenvironmental.com>

Subject: RE: *EXTERNAL: RE: Broad Oak, Sturry - LEAP Final Reports


Hi

Prior to the 28th I had also previously noted that I would be looking for Leap to provide confirmation that the proposal for puddle clay was sufficient (extract below). If this is not something that Leap can do, @Morley, Greg, do you want me to ask our Geotech team to review?

Appendix G

SHE Form 86 Sustainable Drainage Risk Assessment

Title: DRAINAGE DESIGN STATEMENT
Project: Broad Oak Farm, Sturry
Client: BDW Kent
Project No.: 61109 - Revision C



Barratt Developments PLC SHE Form 86 Sustainable Drainage Risk Assessment

Development	Broad Oak Farm
Location	Sturry, Canterbury
Assessment by	K. Tosh (Richard Jackson Limited)
Date	07.10.2021 (revised 23.11.2021)
Description of SuDS	Attenuation basins with some areas of permanent water for ammenity and treatment purposes

Introduction

Well-designed Sustainable Drainage System (SuDS) components should include features that are no more hazardous than those found in the existing urban landscape, for example ponds in parks. SuDS design should mean that health and safety risks are considered throughout the design process. The results should be that risks are reduced to acceptable levels by designing out hazards.

This assessment will provide detail on the design considerations for SuDS and provides guidance to reduce the risk. There may be additional elements to be considered depending on the development. A drawing identifying the location and features associated with the SuDS must be attached to this assessment.

Drowning

Drowning is the principle risk and can occur in permanent bodies of water or in normally dry areas when they contain water temporarily during and after rainfall events. Drowning more frequently occurs from accidentally falling in rather than by deliberately accessing a body of water and then getting into difficulty.

The risk of drowning is also exacerbated when features such as steep banks, deep bank-side or water-edge silt and/or overhanging branches are present. Fast flowing water or areas that become inundated very quickly with a rapid rise in water level may also increase the risk of drowning.

Siting/Location

Consideration must be given to the location of a SuDS pond or similar. An open accessible situation with local roads, footpaths and homes providing a high degree of natural surveillance from surrounding properties and residents will serve to reduce risks and maximise potential benefits.

Access to the water

Edge gradient above and below the water line and the depth profile of the water is important. The key considerations are:

- Provision of a dry bench before the feature to provide a level surface for an individual to assess the surroundings
- All slopes (where people may access regardless of fencing) should be not greater than 1 in 3 (both above and below the water line) to allow unaided movement in either direction for able bodied visitors or those maintaining the location.
- A level wet bench provided at or just below the water surface line which will be both clearly wet and uncomfortable underfoot. This may dry out occasional during dry periods but should remain boggy at most times. The width of the wet bench should be a minimum of 1.5m
- Clear identification of the water edge e.g. planting or hard edging.
- Access discouraged by shallow muddy margins or reeds/shrubs that do not obstruct visibility but provide a safe deterrent/barrier.

Fencing

Where the water is accessible, the edge gradient above and below the water line, and the depth profile of the water are the critical elements. If risk is high either due to the nature of the edge, the presence of hard features such as culverts, steps etc then fencing will be deemed necessary. Where it is considered unsupervised young children can easily gain access to the water and the risk is high, then a 750mm high fence should be provided to prevent them getting to the water but allow adults entry to step across when necessary. The fence must be a vertical pale type rather than one that can be easily climbed. Where fences are provided, full responsibility for maintenance must be established and the fence erected as soon as the feature is created.

Fencing may not always be appropriate and different types of planting at the margin can be provide an element of physical protection and create a clearly identifiable border. However, if this is the chosen method of control, fencing must be erected until the planting has matured sufficiently to provide the protection.

Life Saving Equipment

Provision of Public Rescue Equipment should only be required if water conditions (flow and depth) suggest that one is needed. These should be considered the last element of a risk based approach to SuDS and only provided if all other design measures have been considered and there remains a risk. For Public Rescue Equipment to be effective the person in the water needs to be noticed if in trouble, which is therefore affected by the siting of the SuDS. Their presence can provide a false sense of security for those playing around the water or thinking or entering. If they are provided as a measure to reduce risk, arrangements must be made to regularly inspect, maintain and immediately replace if used or missing.

Warning Signs

In public areas, signs may be required to educate on the risks associated with the SuDS feature. Deep water is not recommended for SuDS designs on housing developments and therefore signs warning of this should not be needed. However, if the SuDS has the potential to have deep water or other significant hazards then signs will be required. Signs should be placed at the entrance to the location which should clearly state the site name, map of the site emergency instruction i.e. dial 999, location and postcode for emergency services and any hazard symbols and text which are relevant. Signs should also be provided along the routes adjacent to the water to reiterate the message which directly relate to the hazard with symbol based messages backed up with text.

Recommended Depths and velocities for SuDS and exceedance flow routes

Maximum velocity (m/s)	Depth (m)	Comments
0 – 0.4	<1.5	Level benches recommended: <ul style="list-style-type: none"> • At just below the water surface • At a depth of 600mm
0.5 – 0.9	<0.6	Level bench recommended <ul style="list-style-type: none"> • At or just below the water surface
1.0 - 2.0	<0.3	

Slips and Trips

Physical injuries, such as falls, slips, trips and entrapment, should be no more prevalent at SuDS components than at any other natural or amenity feature, provided that good design principles have been followed and that consideration has been given to the potentially increased likelihood of wet and slippery conditions. The steepness of the bank, freeboard, condition of the pathways and additional hazards should all be given significant consideration to ensure a trip or stumble does not result in a fall into deep or fast flowing water. This includes consideration of the perception and abilities of the very young, very old and people with disabilities, as much as lighting and the expected site activities.

Structural Integrity

All features should be structurally sound for use, taking into account the likelihood of vandalism or misuse, the durability of materials and the planned on-going maintenance regime. Any structural surfaces designed for accessibility should be suitably slip resistant, particularly those where surface water flow can be expected. The risks associated with ice formation should also be considered and managed appropriately but the same considerations as for general water safety will apply, i.e. shallow water features are preferred.

Vertical drops/steep sided structures

Good SuDS design should avoid the need for high vertical drops or deep steep sided structures. In many cases, such hazards can be avoided by sensible profiling slopes of headwalls, and/or risks reduced by locating such structures away from open water. High headwalls should not be necessary in an efficient drainage design where flows are managed in sub-catchments. If steep slopes and high vertical drops cannot be removed from the design, then consideration should be given to how the risk is managed effectively and to access arrangements for maintenance. Vehicle movements should also be given careful consideration where SuDS are close to roadways.

Level changes

Unexpected changes in level, particularly if not immediately visible, should be avoided. Slopes should be gentle at 1 in 3 or less, where accessible, and other changes in level visible and expected.

Inlet/outlet/safety grilles

Safety grilles are only required on pipes greater of 350mm or greater diameter. Grilles at inlets should slope at an angle of 45 degrees so that debris is likely to lodge against them.

ill health from untreated/polluted water

Rainwater runoff in SuDS features is no different from the water that runs across roads and car parks and stands as puddles for lengthy periods after rainfall. Many existing water features in parks and public open spaces already take highway runoff. Indeed, with good SuDS design and effective source control, accessible SuDS components should contain 'treated' runoff, and therefore any pollution levels should be very low. However, as with any natural water bodies, water in SuDS could potentially contain toxins that could potentially cause ill health, and there are management principles that should be followed to minimise potential risks.

Principal hazards to be considered as part of the assessment process

Drowning (consider ice in winter months)

Slips, trips and falls

Entry into Pipes/Confined Spaces

Water Quality – Health Risks

Design Factors	
Item	Comments
Age profile of persons in close proximity to the SuDS – Consider proximity to schools, parks, play areas, rights of way etc.	Suds will be serving a housing development of circa 450 units with a wide range of age profiles possible for the new residents. No obvious existing public access to the development site
Consider visibility and natural surveillance of the proposed SuDS feature	All of the suds basins will be overlooked by new properties
Type and nature of water edge planting – Consider time taken to mature and precautions required to protect feature during this period	Grass/Wild Flower mix - likely to be reasonably quick to establish but not likely to act as any deterrent or prevention for people accessing the basins
Gradient and extent of slopes above, at and below the water level	Majority of basins are 1:4 below and above water level. Some have been steepened to 1:3 with localised areas of some basins steepened further to 1:2 due to the constraints of the woodland buffer. In these cases there are areas of the basins with slopes at 1:3 to assist with egress. Where 1:2 is required these are typically on the woodland side of the basins and people trying to egress from the basin are more likely to be egressing on the opposite site and away from the woodland edge
Definition of water edge and nature of ground (e.g. soft/hard)	Soft landscaping up to and including the water edge
Water depth profile	Maximum 1.2m useable storage depth for the 1 in 100 + 40% for Basin D (other basins maximum of 1.0m) with additional depth beyond this of upto 800mm for the Biomatrix treatment designs which require permanent water
Water surface area	Maximum water area for 1 in 100 + 40% CC storm is approximately 8,650m ² . Permanent water area is subject to final Biomatrix design.
Underwater obstacles or traps	Subject to the design of the treatment areas by Biomatrix - otherwise, no obstacles
Potential currents, velocities	None anticipated as all basins are controlled on their outlet by the flow control which will restrict the flowrate

Potential increase in depth of water and rate of rise	Maximum depth of water as noted above. Rate of rise is generally considered to be slow with the fastest increase being for Basin C which raises the 1m storage depth in 30 minutes for the maximum design storm of 1 in 100 + 40% CC
Potential for ice formation	Yes, within permanent water this is possible. Less likely to occur in water stored above this as there will be a flow present until the basin is drained
Headwall or channel location	None of the basins have additional channels within them. All headwalls are set at the base level of the basins
Headwall height or channel depth/width	Headwalls are set to match the maximum designed water level so 1.2m for Basin D, all others 1m
Slope of headwall or channel profile	The headwalls are proposed to be of the vegetated kind with the final profile set to follow the basin slopes
Level changes	Base of each basin is flat. Areas of permanent water will add level changes to the basin base level
Inlet/outlet pipe diameter (grilles required?)	Grills will be provided to suit Icosa Water adoption requirements -
Depth of chambers - Is access possible?	Chamber depths vary across the site with all of the main drainage being designed in accordance with Adoptable Standards with normal access provision
Likely contamination of water via rat urine or dog fouling etc.	Unknown. Public open space is likely to be used for recreational dog walking
Likelihood of toxic algal blooms	Anticipated to be low when Biomatrix treatment proposals are included

Evaluation of Risk (Use the table below to evaluate the level risk associated with each risk element)

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5

Likelihood

Likelihood	
Rating 1	Rare
Rating 2	Unlikely
Rating 3	Possible
Rating 4	Probable
Rating 5	Almost Certain

Consequence	
Rating 1	No injury
Rating 2	Minor injury or health effects
Rating 3	Injury not life threatening
Rating 4	Serious injury or health effects
Rating 5	Potential of Fatality

Risk = Likelihood (L) x Consequence (C)

1-4	Acceptable - No changes required	5-10	Review if it is reasonable or practical to change design to reduce level of risk	11-25	Unacceptable risk - Design must be changed - Immediate response required
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Hazard	Factors of Harm		Risk (LxC)	Control Measures (Consider children < 5ys, children >5yrs and adults)	Residual factors		Risk (LxC)	Further controls required
	L	C			L	C		
Drowning or falling through ice in the winter	3	5	15	Fencing and signage to be provided	1	5	5	Any further measures would require a more secure fencing type to completely remove the potential for access which would be unlikely to be acceptable to BDW or planners. Additionally, such fencing has the potential to limit visibility of any person who has managed to get into the basins. BDW to consider further

Hazard	Factors of Harm		Risk (LxC)	Control Measures (Consider children < 5yrs, children >5yrs and adults)	Residual factors		Risk (LxC)	Further controls required
	L	C			L	C		
Slips/Trips	3	2	6	Earthworks and basin slopes will be landscaped - high quality landscaping preparation and maintenance will reduce the unevenness of the ground and reduce the likelihood of trips. BDW to ensure that installation of landscaping is to a high specification and that Management Company who will be responsible for maintenance undertake regular and effective maintenance	2	2	4	
Entry into Pipes/Confined Spaces	3	3	9	The design standard for all headwalls and accessible pipe work into the suds features will follow the requirements of the adopting authority (Icosa Water) as follows: Any pipes greater than 300mm diameter will require grilles, vertical where pipe enter ponds, and 45 degree trash screens where pipes leave ponds. Handrails if the drop is greater than 600mm	1	2	3	

Hazard	Factors of Harm		Risk (LxC)	Control Measures (Consider children < 5ys, children >5yrs and adults)	Residual factors		Risk (LxC)	Further controls required
	L	C			L	C		
Water Quality - Health Risks	3	2	6	With any standing water there is the potential for the water to become stagnant and for other potential sources of poor quality, such as rat urine (can be a cause of weils disease). The constructed wetland designs by Biomatrix will treat and maintain water quality with resulting health risks minimal.	2	2	4	



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