Ref No.2

P5383

Sychtyn, Welshpool

Phase 2: Geotechnical Investigation

For

FRE Energy

UK Timber Frame Association

constructionline

Achilles

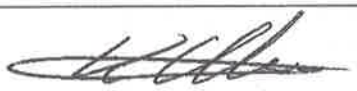
CHAS Accredited Contractor

Site Investigation

Sychtyn, Welshpool

FOR

FRE Energy Ltd

Document Reference	P5383-01
Version	1
Date Released	May 2015
Prepared by:	 Kieron Hounslow B.Eng(Hons).C.Eng.M.I.Struct.E

Contents

1.0 BRIEF. 1

2.0 LIMITATIONS. 1

3.0 SITE LOCATION AND DESCRIPTION. 2

3.1 EXPECTED GEOLOGY. 2

4.0 SITE INVESTIGATION DESIGN METHOD. 2

4.1 SITE INVESTIGATION METHOD. 2

4.2 GEOTECHNICAL TESTING. 3

5.0 GROUND CONDITIONS ENCOUNTERED. 3

5.1 TOPSOIL 3

5.2 SUBSOIL 3

5.3 GROUNDWATER. 4

5.4 MADE GROUND. 4

5.5 ALLUVIUM. 4

5.6 SOLID GEOLOGY. 4

5.7 IN-SITU GEOTECHNICAL TESTING. 4

5.8 OBSERVATIONS 4

6.0 GEOTECHNICAL ASSESSMENT 5

6.1 PROPOSED DEVELOPMENT 5

6.2 PROPOSED FOUNDATIONS 5

6.3 EXCAVATION STABILITY 5

6.4 SLOPE STABILITY 6

6.5 SOAK AWAY DRAINAGE 6

7.0 CONCLUSIONS 6

8.0 RECOMMENDATIONS 6

Appendices

A	Site Plans
B	Exploratory Trial Pit Location Plan
C	Exploratory Trial Pit Logs

Executive Summary

Site Description:	The Site comprises of a roughly rectangular piece of land, of less than 0.45Ha (1Acre) in size, located immediately to the South East of an existing Farm complex. The Farm is located in a rural area several miles West of Llanfair Caereinion. The site is centred about Ordnance Survey co-ordinates 299907E ,307349N. The site currently is largely comprised of sloping open grassland, with a gentle slope towards the South East.
Desk Study	Thomas Consulting have not been provided with a PRA report relating to the site.
Ground Investigation:	Intrusive investigations have shown that the ground is overlaid with topsoil, on soft, becoming stiff clays, over mudstone then sandstone bedrock. Hard coring within the boreholes, suggest that Bedrock was encountered at all drilling locations. Groundwater was encountered in all three of the boreholes, at teh interface between the mudstone and sandstone bedrock layers.
Contamination Assessment:	No visual evidence of contamination was observed on site.
Foundations	Reinforced concrete bases overlying engineered sub-base formation will be required to all machinery and storage tank bases, to ensure that the loadings are evenly distributed to the ground, to alleviate possible differential settlements occurring.
Recommendations	Reinforced concrete ground bearing bases should be adopted. Bases must be installed to engineered sub base, which is required to spread the loading over the soft clays.

1.0 Brief.

Thomas Consulting have been appointed by FRE Energy to undertake an intrusive geotechnical site investigation for a site located to Sychtyn Farm, several miles West of Llanfair Caereinion, which has been proposed for use an anerobic digestion plant.

The purpose of the investigation is:

1. To characterise the nature of soils beneath the site.

2. To provide recommendations for types of foundation that can be used on the digestion plant.

The digestion plant will comprise a number of separate bases for storage tanks and for mechanical plant units.

A copy of the proposed master plan for the site is included in Appendix A.

2.0 Limitations.

The investigation will include intrusive investigation of the ground conditions at three locations within the area of the site to be adopted for the plant bases. These investigations will reveal the ground conditions at the specific site of the intrusive borehole. It must be recognised that ground and groundwater conditions may vary at positions remote from any boreholes.

The results of the exploratory investigations are based upon the facts established by observation and field tests carried out at the position of the borehole.

Thomas Consulting accept no responsibility or liability for any loss arising from variation of ground or groundwater conditions between trial pit or boreholes or variations below the maximum depth of the investigation.

This report has been prepared for the specific purposes stated in the brief above and Thomas consulting do not accept responsibility or liability for any other use.

If observations relating to invasive plant species this is provided as a preliminary observation only and verification by a professional Arboriculturalist must be sought by the client.

3.0 Site Location and Description.

The site is located to the East of Sychtyn Farm. The farm is approximately 10km to the West of the village of Llanfair Caereinion. The North, East and West sides of the exploration site are bounded by the existing farm buildings and sheds. The site boundary to the South East is formed by a stream, with open fields beyond.

There is a gentle slope accroiss the site running from the farm buildings down to teh stream along teh South East boundary.

The site sits in a very remote location, within agricultural land. The site is therefore presumed to be largely undeveloped and is likely to be of natural ground.

3.1 Expected Geology.

From information published by the British Geological Society, the site is underlain by the following:

Topsoil overlying clay (Diamicton Till, formed 2 million years ago) deposits of drift material.

The solid geology is anticipated to be Nantglyn Flags Formation - Mudstone, Siltstone and Sandstone. Sedimentary Bedrock formed approximately 419 to 428 million years ago in the Silurian Period. Local environment previously dominated by deep seas.

4.0 Site Investigation Design Method.

4.1 Site Investigation Method.

Anticipated ground conditions are of shallow depths of topsoil/drift deposits overlying glacial clays and bedrock. Borehole investigation using a shell and auger rig has therefore been selected as an appropriate method of investigating the ground conditions.

Boreholes will be used to:

- Identify underlying ground conditions above bedrock (up to depths of up to 12m if necessary),
- Identify areas of potential infilling,
- Provide an indication of the stability of any excavation works into existing soils,
- To provide a profile of the underlying conditions, adoptingh two locations accross teh area of the site to be adopted for the new plant area.

4.2 Geotechnical Testing.

Site investigation testing is to be undertaken using hand shear vane testing on undisturbed samples to the top section of the boreholes, where cohesive soils are encountered. Standard penetration testing will be undertaken at every 2m within the depth of the boreholes.

Due to the nature of the proposed construction works, and with respect of the topography, soil sampling for laboratory testing was not considered to be required.

5.0 Ground Conditions Encountered.

Three shell and auger boreholes were carried out on the 29th April 2015.

The boreholes ranged in depth from 2.0m bgl (BH-2) to a maximum depth of 7.05m (BH-1).

All Site Work was carried out in accordance with BS5930[1] and accepted good practice.

5.1 Topsoil

A mixture of topsoil with cobbles and stone fill material was encountered in BH-1 (depth of 0.6m) and BH-3 (depth of 0.7m).

Topsoil of a depth of 0.15m was encountered within BH-2.

5.2 Subsoil

Beneath the topsoil layer, soft sandy clays were encountered within all boreholes. The soft clay extended to a depth of 2m in BH-1, 06m in BH-2 and 1.3m in BH-3.

Firm-Stiff clays were found to underly the soft sandy clays in all boreholes. The clays in borehole 1 were found to overly soft gravelly clay material which became increasingly stiff with depth.

Grey/Brown mudstone was encountered beneath the clays to all boreholes. Top of the mudstone is estimated to be at 6.5m (BH-1), 1.3m (BH-2) and 3.7m (BH-3). The mudstone bedrock was found to overlie Sandstone bedrock at 6.7m (BH-1), 1.9m (BH-2) and 3.7m (BH-3).

The sandstone bedrock was found to be extremely stiff. Drilling operations were halted aftyer half an hour, after further penetration was found to be unlikely.

---

[1] British Standard (2010). *Code of Practice For Site Investigations.* BS:5930:1999 + A2:2010.

5.3 Groundwater.

Groundwater was encountered as follows;

- BH-1: water strike was at a depth of 6.7m within borehole 1. The level of the water was unaltered during the inspection. The water strike was encountered at the aparant interface between mudstone and sandstone levels.
- BH-2: water strike was at a depth of 1.9m within borehole 2. The level of the water was unaltered during the inspection. The water strike was encountered at the aparant interface between mudstone and sandstone levels.
- BH-3: water strike was at a depth of 3.7m within borehole 1. The level of the water was unaltered during the inspection. The water strike was encountered at the aparant interface between mudstone and sandstone levels.

The constant water levels indicate that there is no evidence of artesian pressures within the underlying bedrock material.

5.4 Made Ground.

Made Ground was encountered within the topsoil layer to boreholes 1 and 3.

5.5 Alluvium.

Allivial materials were not encountered, despite the close proximity of the watercourse bordering the South East section of the site.

5.6 Solid Geology.

Refusal of the drill head within all boreholes indicate that competent rock head was encountered. The depth to rock head varies considerably, between 1.9m (BH-2) to 6.5m (BH-1). Based upon the borehole results that the bedrock is weak mudstone overlying dense sandstone.

5.7 In-Situ Geotechnical Testing.

Standard penetration testing of the clay soils has been undertaken at 2m vertical centres within all boreholes.

5.8 Additional Observations

None.

6.0 Geotechnical Assessment

6.1 Proposed Development

The proposed site development relates to the installation of a new anerobic digestion fascility and associated works.

The proposed plant will comprise of storage bases to two large tanks, a combined base for machinery and Hydroliser, several shallow base slabs and bases to a control building and access stair.

The proposed mixing pit will be partially sunk into the ground, by up to 3.5m. This base will need to be constructed at a location that will not undermine the foundations of the nearest farm structure building. Should the pit be 3.5m deep, the nearest part of the base slab should be no less than 7m from any building.

It Is presumed that the foundations for the various plant bases will be spread foundations. It is estimated that the maximum likely ground pressure exerted from the bases will not exceed a pressure of 60kN/sq.m

6.2 Proposed Foundations

The existing topsoil layers will require removal to all areas where new bases are to be installed.

The encountered shallow soft sandy clay soils are not competent for traditional spread foundations supporting the estimated loadings. To increase the spread of the loadings from the tanks and plant, engineered sub-base will be required to a minimum depth of 500mm.

6.3 Excavation Stability

Based upon the nature and behaviour of the material observed within the boreholes are not expected to receive additional support, however battering back to a safe angle should be considered.

Trenches must not be excavated across the face of any steep slopes without consideration of the effect on the stability of the slope.

The contractor should be advised that trench stability may be adversely affected by surface water runoff and the control of water must be given proper consideration during construction work.

It is estimated that bedrock was encountered at between 1.9 and 6.5m below formation levels. It is anticipated that construction depths will not extend to depths where the bedrock will be encountered.

Accepted good working practices and health and safety procedures must be observed during any excavation works.

6.4 Slope Stability

There is an existing gentle slope dropping to the watercourse along the South Eastern boundary of the site. The slope is not considered to be of sufficient gradient to suggest that slope instability is likely to occur as a result of the proposed plant installation works.

6.5 Soak Away Drainage

Percolation testing has not been carried out, however; as the site consists of clay soils, therefore; soakaways are considered to be unsuitable.

7.0 Conclusions

The soil profile logs indicate that ground conditions beneath the site generally consist of soft to stiff clays. The formation of the required bases, other than for the mixing pit, are likley to fall within the band of soft clays.

Bedrock is believed to have been encountered, however; this is at a depth which is unlikley to affect the proposed foundations.

There is no visual evidence of contaminated uses affecting the site.

It is considered likely that special foundations will be required, and that traditional spread foundations with an engineered sub-base should be acceptable.

Bearing capacity for the foundation design should be based upon a maximum pressure of 60kN/sq.m.

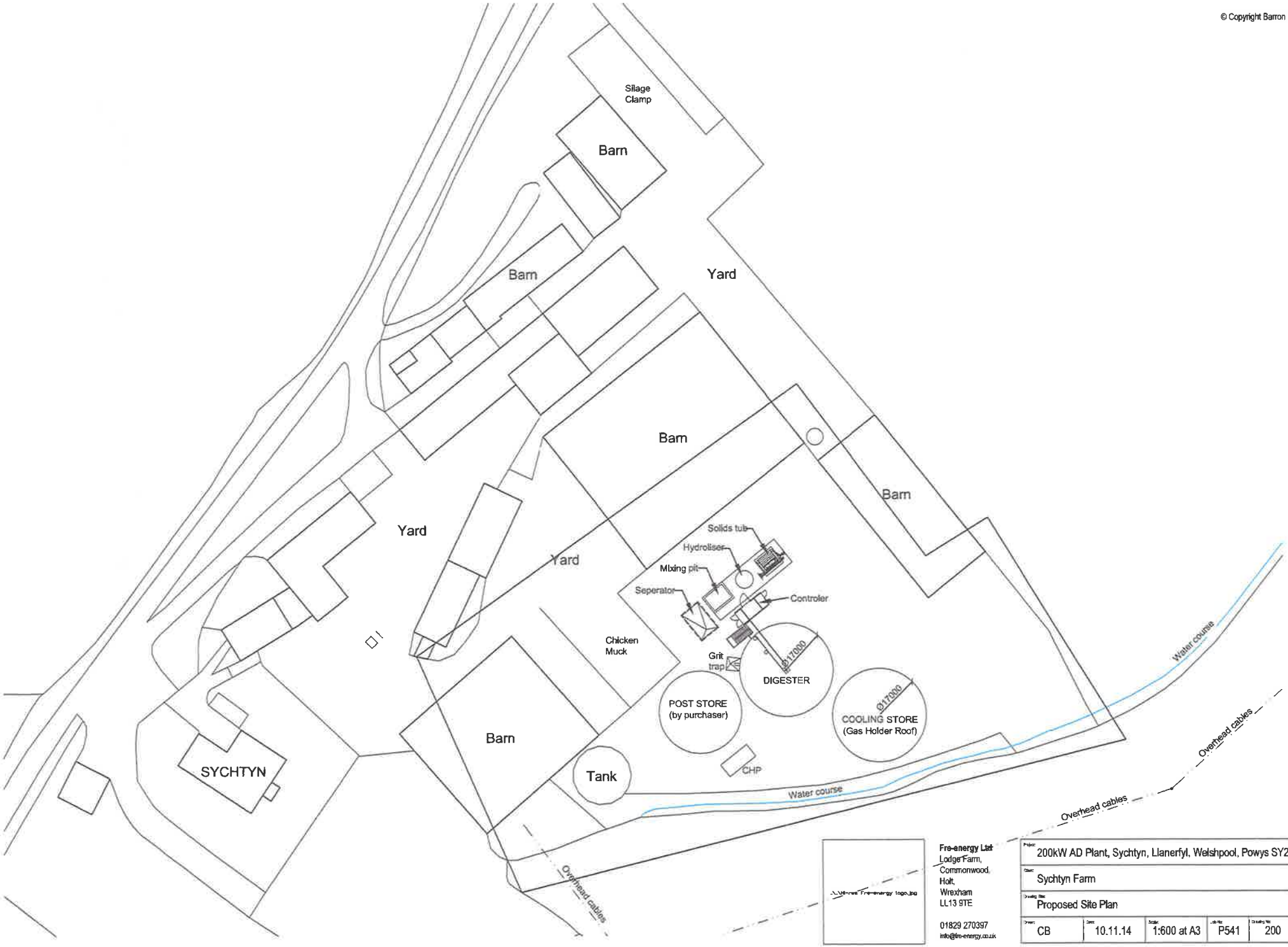
Soak-away drainage is not considered feasible on this site.

8.0 Recommendations

1. Reinforced concrete spread foundations and slabs should adopted for the substructure works to the proposed tanks and machinery bases. Bases will require well compacted sub-base of up to 500mm depth below bases. Sub base to extend a minimum of 500mm beyond footprint of reinforced concrete bases.

2. The measured strengths of the soils and guidance for foundations should be verified on site during the construction phase of the works, to ensure that potential areas of softer ground can be remediated prior to placing of foundations.

APPENDIX A SITE PLANS.

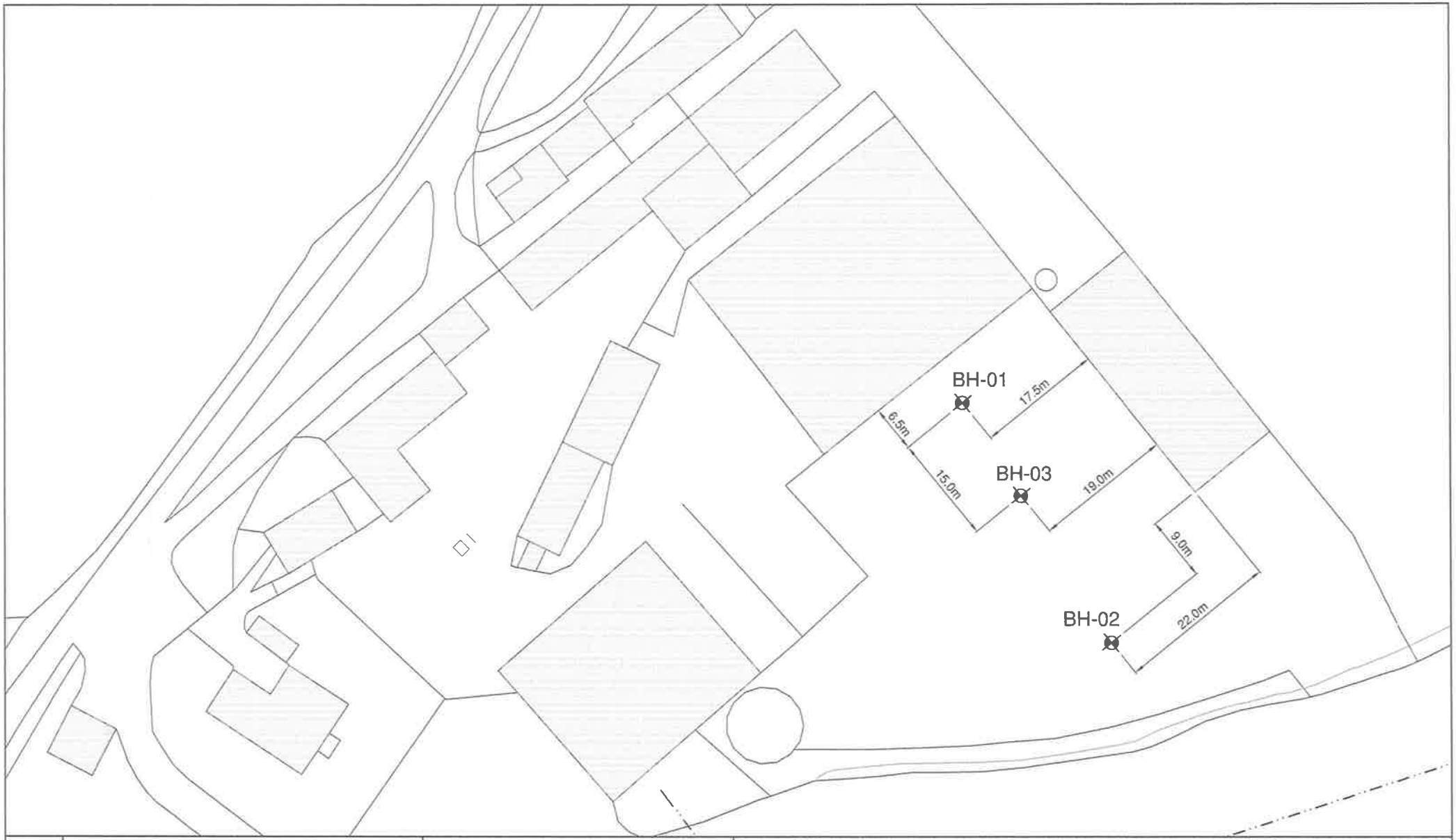


Fre-energy Ltd
Lodge Farm,
Commonwood,
Holt,
Wrexham
LL13 9TE

01829 270397
info@fre-energy.co.uk

Project: 200kW AD Plant, Sychtyn, Llanerfyl, Welshpool, Powys SY21 0JF					
Client: Sychtyn Farm					
Drawing title: Proposed Site Plan					
Drawn: CB	Date: 10.11.14	Scale: 1:600 at A3	Job No: P541	Drawing No: 200	Revision: B

APPENDIX B EXPLORATORY BOREHOLE LOCATION PLAN



SIZE A3	DO NOT SCALE THIS DRAWING

Notes

Revisions

Rev	Date	Description	Initial
A	27-04-15	Borehole 2 Location Adjusted	KDH
B	14-05-15	Borehole 3 Location Added.	NJ

Drawing Issued By

TELFORD, TEL: (01743) 237940 | CHORLEY, TEL: (01772) 299040

LANCASTER, TEL: (01524) 846022 | WORKINGTON TEL: (01900) 606480

Thomas Consulting
32 EATON AVENUE, MATRIX PARK
BUCKSHAW VILLAGE, CHORLEY. PR7 7NA.
TEL: (01772) 299040. FAX: (01772) 457860.

SKETCH - A3

Scale: 1 to 500

Contract: Sychtyn, Welshpool SY21 0JF

Drawing title: BOREHOLE LOCATION PLAN

Contract No.: TC/P5383/15

Date.: April 2015

Drawn.: K. Hounslow

Checked.: -

Drawing No: BH-01 'B'

APPENDIX C EXPLORATORY BOREHOLE LOGS

Thomas Consulting Ltd

Site: Sychtyn, Welshpool.			Reference: BH01
Excavation Method: BOREHOLE	Dimensions	Ground Level (mAOD)	Client: FRE Energy
	Location	Date: 29.04.2015	Engineer: K. Hounslow
Job No: P5383			Sheet: 1/1

Depth (m)	Sample / Test	Water Depth	Field records	Level (mAOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.60	Soil + Large Cobbles		
1.2m	1 / SPT		6			Soft Brown + Grey Clay		
					2.00	Firm Brown + Grey Clay		
					2.50	Soft Brown Gravely Silty Clay		
3.6m	2 / SPT		10		3.60	Firm Brown Gravely Clay		
					4.30	Stiff Grey Clay		
5.2m	3 / SPT		50		5.20	Very Stiff Brown + Grey Stoney Clay		
					6.50	Grey + Brown Mudstone		WL 6.70
					6.70	Grey Sandstone		
					7.05	End of Borehole		

Plan

Comments

Approx. Scale	Logged By	Fig No.
N.T.S	J. Hunt	

Thomas Consulting Ltd

Site	Reference
Sychtyn, Welshpool.	BH02

Excavation Method	Dimensions	Ground Level (mAOD)	Client	Job No
BOREHOLE			FRE Energy	P5383
	Location	Date 29.04.2015	Engineer K. Hounslow	Sheet 1/1

Depth (m)	Sample / Test	Water Depth	Field records	Level (mAOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.15	Soil		
						Soft Brown + Grey Sandy Clay		
					0.60	Stiff Brown + Grey Clay		
					1.30	Grey + Brown Mudstone		WL 1.90
					1.90	Grey Sandstone		
					2.00	End of Borehole		

Plan	Comments		
		Approx. Scale N.T.S	Logged By J. Hunt	Fig No.

Thomas Consulting Ltd

Site	Reference
Sychtyn, Welshpool.	BH03

Excavation Method	Dimensions	Ground Level (mAOD)	Client	Job No
BOREHOLE			FRE Energy	P5383
	Location	Date 29.04.2015	Engineer K. Hounslow	Sheet 1/1

Depth (m)	Sample / Test	Water Depth	Field records	Level (mAOD)	Depth (m) (Thickness)	Description	Legend	Water
					0.70	Soil, Clay + Stone Fill		
1.2m	1 / SPT		18		1.30	Soft Brown + Grey Clay		
2.4m	2 / SPT		31		2.80	Stiff Brown + Grey Clay		
					3.70	Grey + Brown Mudstone		WL 3.70
					3.95	Grey Sandstone		
						End of Borehole		

Plan

Comments

Approx. Scale	Logged By	Fig No.
N.T.S	J. Hunt	