



AIRTRICITY HOLDINGS LIMITED

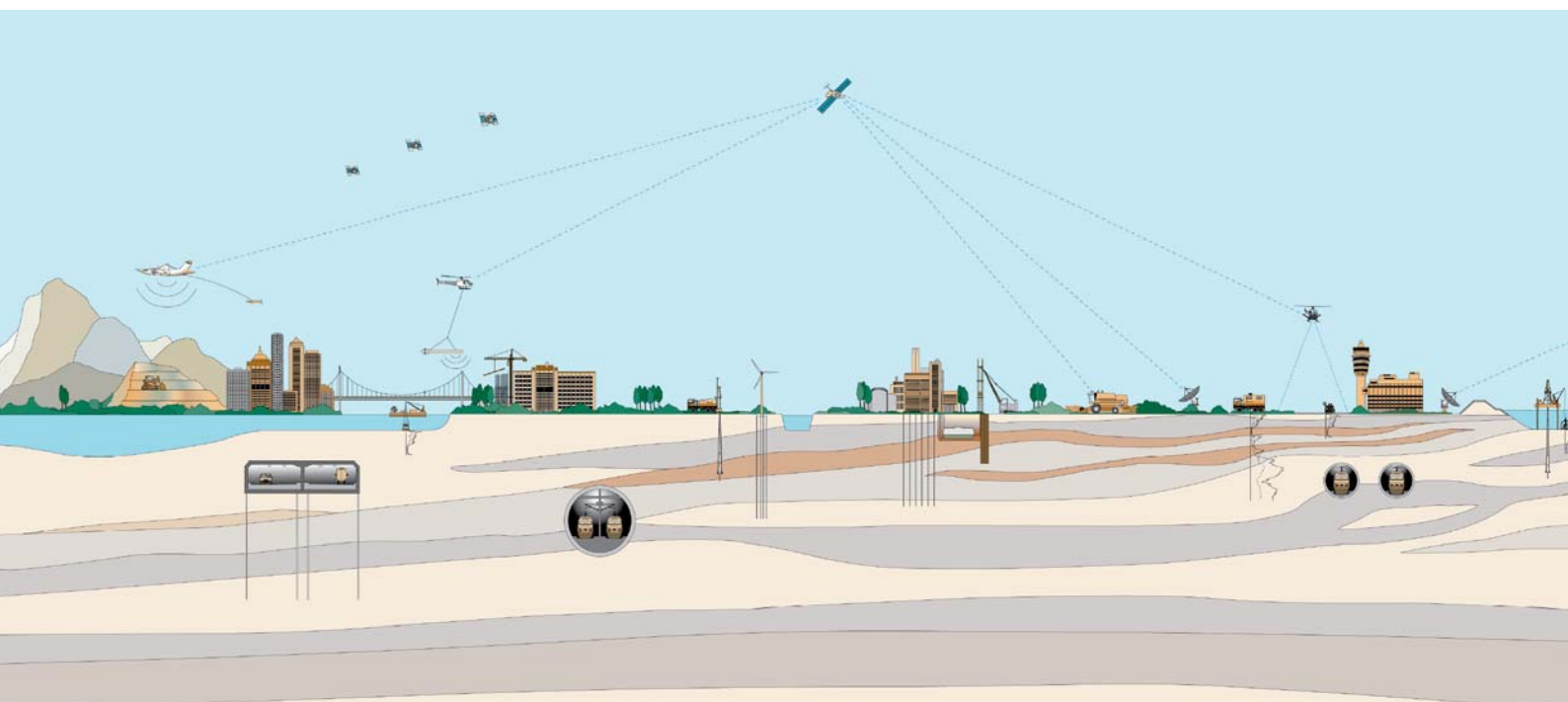
**VIKING WIND FARM
PEAT STABILITY ASSESSMENT**

**DRAFT FACTUAL REPORT ON
GROUND INVESTIGATION**

CONTRACT NO : CON083141

DATE : JANUARY 2009

CONFIDENTIAL





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VIKING WIND FARM PEAT STABILITY ASSESSMENT


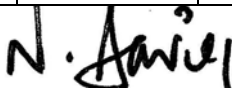
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REPORT ISSUE STATUS

Issue	Date	Description	Prepared	Checked	Approved (Printed)	Approved (Signature)
01	20/01/09	Draft Factual	BC	BC	ND	N. Davies
						
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PRINCIPAL ENGINEER			ENGINEERING MANAGER			

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1. INTRODUCTION

On the instructions of Mouchel Limited (the Engineer), acting on behalf of Airtricity Holdings Limited (the Employer), a site investigation has been carried out by Fugro Engineering Services Limited (FES) on the north mainland of Shetland on the site of the proposed Viking Wind Farm.

The objective of the investigation was to provide the Engineer with additional insitu strength properties for use in a peat stability assessment of the site. The scope of the investigation was determined by the Engineer with the agreement of the Employer.

A factual report was requested including field testing records and a site plan. The report has also been provided in .pdf format.

The site work, which comprised insitu field vane testing and peat probing at fifteen locations, was carried out between the 15th December 2008 and the 9th January 2009.

2. THE SITE AND GEOLOGY

2.1 SITE LOCATION AND DESCRIPTION

The site is located across two distinct areas on the northern mainland of Shetland. The southern area extends from Flaminster in the southeast (HU 441 559) to Weisdale in the southwest (HU 383 523) and extends to Hamarigrind Scord (HU 408 608) in the north. The northern area is centered around Duddin Hill (HU 384 669) and Easterscord (HU 420 660) and east of Meadow of Fitchin (HU 404 704).

At the time of the investigation the site comprised heather and grass moorland underlain by varying depths of peat.

2.2 GEOLOGY

The records of the British Geological Survey (GeoIndex Digital Data - 1:625,000 Superficial and Bedrock) indicate that the site is underlain by Peat over Undifferentiated Schist and Gneiss of Shetland and Upper Tyrone.

Further background research such as a desk study was not required within the terms of reference for the work.

3. METHOD OF INVESTIGATION

3.1 GENERAL

Details of the in-situ testing carried out, together with the peat thicknesses encountered, are given on the field records in Appendix A. The investigation was generally carried out in accordance with BS 5930:1999ⁱ, BS EN ISO 14688-1:2002ⁱⁱ and BS EN ISO 14689-1:2003ⁱⁱⁱ as appropriate.

3.2 FIELD TESTING

A total of eighty five field vane tests were carried out at fifteen locations as specified by the Engineer using a Farnell Field Vane. The results, with the vane and dial gauge factors, are given in Table 1 in Appendix A.

The maximum thickness of peat was also determined at each test location by hand probing. The results are given in Table 2 in Appendix A.

3.3 SURVEY

The test locations were set out using the Global Positioning System (GPS) technique with co-ordinates supplied by the Engineer. The ground levels and grid co-ordinates at the test locations were not requested.

Site plans provided by the Engineer showing the approximate positions of the test locations are presented in Figures LP1 and LP2 in Appendix B.

3.4 LIMITATIONS AND USE OF DATA

The scope of the investigation was determined by the Engineer for the particular project requirements set out in the Specification for the Contract. A factual report only was required, without interpretation of the data from the present investigation or consideration of data from other sources, except where noted. The data presented in this report reflects the site conditions encountered at the time the investigation was performed. The investigation has disclosed evidence of conditions at point locations across the site which provides information about discrete volumes of soil or rock. Accordingly, there may be ground conditions at the site which may not have been revealed by the investigation, and the passage of time may give rise to changes in the conditions encountered. Any interpolation or extrapolation of strata from the exploratory holes is subject to the interpretation of the reader. *Any cross - sections or plots are generalised by necessity and have been based on information found at the exploratory holes and depths sampled and tested.* The records should be read in conjunction with the Notes on Exploratory Hole Records in Appendix A. **Particular attention is drawn to the comments made on groundwater and interpretation which are given in these Notes.**

The investigation has been carried out by Fugro Engineering Services Limited and the report has been prepared for the sole internal use of Airtricity Holdings Limited. This report shall not be relied upon or transferred to any other parties without the express written authorisation of Fugro Engineering Services Limited. If an unauthorised third party comes into possession of this report they rely upon it at their peril and the authors owe them no duty of care and skill.

It is Fugro Engineering Services Limited's understanding that this report is to be used for the purposes as described in the Specification for the investigation and as summarised in the text of the report. Should the purpose for which the report is used or the proposed use of the site change, this report may no longer be valid. Any further use or reliance upon the report in these circumstances by Airtricity Holdings Limited without further review by and advice from Fugro Engineering Services Limited shall be at their sole and own risk.

REFERENCES

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- ⁱ BS 5930:1999, Code of practice for site investigations. British Standards Institution.
 - ⁱⁱ BS EN ISO 14688-1:2002 Geotechnical investigation and testing – Identification and classification of soil – Part 1 Identification and description. British Standards Institution.
 - ⁱⁱⁱ BS EN ISO 14689-1:2003 Geotechnical investigation and testing – Identification and classification of rock – Part 1 Identification and description. British Standards Institution.

APPENDIX A Field Test Results

Insitu Field Vane Test Results
Peat Probe Test Results

Table 1
Table 2

Table 1 In-situ Field Vane Test Results

Borehole	Hole Depth	Casing Depth	Vane Tip Depth	Water Level	Vane Size	Rod Friction	Peak Reading	Rod Friction	Remould reading	Factor	Peak Value	Remould value	Sensitivity	Vane Constant	Peak Shear kPa)	Remoulded Shear (kPa)
1	0.00	n/a	0.60	0.00	200 x 100	27	465	22	158	0.092	40.3	12.5	3.2	3.653	11.03093	3.42513
1	0.00	n/a	0.60	0.00	200 x 100	9	403	5	121	0.092	36.2	10.7	3.4	3.653	9.922803	2.9214344
1	0.00	n/a	0.60	0.00	200 x 100	2	556	10	155	0.092	51.0	13.3	3.8	3.653	13.95237	3.651793
1	0.00	n/a	1.60	0.00	200 x 100	57	411	78	218	0.092	32.6	12.9	2.5	3.653	8.915412	3.5258691
1	0.00	n/a	1.60	0.00	200 x 100	22	364	2	138	0.092	31.5	12.5	2.5	3.653	8.613195	3.42513
1	0.00	n/a	1.60	0.00	200 x 100	91	467	85	209	0.092	34.6	11.4	3.0	3.653	9.469477	3.1229127
2	0.00	n/a	0.60	0.00	200 x 100	55	925	47	251	0.092	80.0	18.8	4.3	3.653	21.91076	5.137695
2	0.00	n/a	0.60	0.00	200 x 100	41	590	48	210	0.092	50.5	14.9	3.4	3.653	13.82644	4.0799343
2	0.00	n/a	0.60	0.00	200 x 100	59	659	40	205	0.092	55.2	15.2	3.6	3.653	15.11087	4.1554886
3	0.00	n/a	0.60	0.00	200 x 100	2	320	1	19	0.092	29.3	1.7	17.7	3.653	8.00876	0.453326
3	0.00	n/a	0.60	0.00	200 x 100	42	1210	24	379	0.092	107.5	32.7	3.3	3.653	29.41582	8.9405968
3	0.00	n/a	0.60	0.00	200 x 100	78	750	61	219	0.092	61.8	14.5	4.3	3.653	16.92417	3.9791952
4	0.00	n/a	0.60	0.00	200 x 100	41	1370	42	281	0.092	122.3	22.0	5.6	3.653	33.47057	6.0191623
4	0.00	n/a	0.60	0.00	200 x 100	73	1061	68	242	0.092	90.9	16.0	5.7	3.653	24.88256	4.3821517
4	0.00	n/a	0.60	0.00	200 x 100	67	1005	64	215	0.092	86.3	13.9	6.2	3.653	23.62332	3.8029017
4	0.00	n/a	1.60	0.00	200 x 100	68	230	42	109	0.092	14.9	6.2	2.4	3.653	4.079934	1.6873802
4	0.00	n/a	1.60	0.00	200 x 100	0	130	0	122	0.092	12.0	11.2	1.1	3.653	3.274021	3.0725431
4	0.00	n/a	1.60	0.00	200 x 100	97	1043	84	365	0.092	87.0	25.9	3.4	3.653	23.8248	7.0769231
4	0.00	n/a	2.60	0.00	200 x 100	81	528	79	204	0.092	41.1	11.5	3.6	3.653	11.2576	3.1480975
4	0.00	n/a	2.60	0.00	200 x 100	79	355	70	147	0.092	25.4	7.1	3.6	3.653	6.950999	1.939228
4	0.00	n/a	2.60	0.00	200 x 100	121	494	108	225	0.092	34.3	10.8	3.2	3.653	9.393923	2.9466192
5	0.00	n/a	0.60	0.00	200 x 100	58	1042	52	262	0.092	90.5	19.3	4.7	3.653	24.78182	5.2888037
5	0.00	n/a	0.60	0.00	200 x 100	46	1242	54	362	0.092	110.0	28.3	3.9	3.653	30.121	7.7569121
5	0.00	n/a	0.60	0.00	200 x 100	35	1282	48	356	0.092	114.7	28.3	4.0	3.653	31.40542	7.7569121
5	0.00	n/a	1.60	0.00	200 x 100	97	1043	84	365	0.092	87.0	25.9	3.4	3.653	23.8248	7.0769231
5	0.00	n/a	1.60	0.00	200 x 100	148	674	127	291	0.092	48.4	15.1	3.2	3.653	13.24719	4.1303039
5	0.00	n/a	1.60	0.00	200 x 100	97	805	87	315	0.092	65.1	21.0	3.1	3.653	17.83082	5.7421298
6	0.00	n/a	0.60	0.00	200 x 100	11	348	1	59	0.092	31.0	5.3	5.8	3.653	8.487271	1.4607172
6	0.00	n/a	0.60	0.00	200 x 100	7	785	17	216	0.092	71.6	18.3	3.9	3.653	19.59376	5.0117711
6	0.00	n/a	0.60	0.00	200 x 100	14	949	26	192	0.092	86.0	15.3	5.6	3.653	23.54777	4.1806734
7	0.00	n/a	0.60	0.00	200 x 100	64	944	67	256	0.092	81.0	17.4	4.7	3.653	22.16261	4.7599234
7	0.00	n/a	0.60	0.00	200 x 100	72	879	83	327	0.092	74.2	22.4	3.3	3.653	20.32412	6.1450862
7	0.00	n/a	1.60	0.00	200 x 100	121	705	107	267	0.092	53.7	14.7	3.7	3.653	14.70791	4.0295647
7	0.00	n/a	1.60	0.00	200 x 100	138	658	96	254	0.092	47.8	14.5	3.3	3.653	13.09609	3.9791952
7	0.00	n/a	2.60	0.00	200 x 100	119	588	118	331	0.092	43.1	19.6	2.2	3.653	11.81166	5.3643581
7	0.00	n/a	2.60	0.00	200 x 100	108	611	121	344	0.092	46.3	20.5	2.3	3.653	12.66794	5.6162059
7	0.00	n/a	3.60	0.00	200 x 100	64	956	174	418	0.092	82.1	22.4	3.7	3.653	22.46482	6.1450862
7	0.00	n/a	3.60	0.00	200 x 100	72	923	186	379	0.092	78.3	17.8	4.4	3.653	21.43225	4.8606625
8	0.00	n/a	0.60	0.00	200 x 100	72	569	15	140	0.092	45.7	11.5	4.0	3.653	12.51684	3.1480975
8	0.00	n/a	0.60	0.00	200 x 100	51	505	82	214	0.092	41.8	12.1	3.4	3.653	11.43389	3.3243909
8	0.00	n/a	0.60	0.00	200 x 100	26	519	9	144	0.092	45.4	12.4	3.7	3.653	12.4161	3.3999453
8	0.00	n/a	1.20	0.00	200 x 100	45	367	15	86	0.092	29.6	6.5	4.5	3.653	8.109499	1.7881194
8	0.00	n/a	1.20	0.00	200 x 100	98	266	3	128	0.092	15.5	11.5	1.3	3.653	4.231043	3.1480975
8	0.00	n/a	1.20	0.00	200 x 100	22	342	8	84	0.092	29.4	7.0	4.2	3.653	8.059129	1.9140433

Borehole	Hole Depth	Casing Depth	Vane Tip Depth	Water Level	Vane Size	Rod Friction	Peak Reading	Rod Friction	Remould reading	Factor	Peak Value	Remould value	Sensitivity	Vane Constant	Peak Shear kPa)	Remoulded Shear (kPa)
9	0.00	n/a	0.60	0.00	200 x 100	56	452	55	130	0.092	36.4	6.9	5.3	3.653	9.973173	1.8888585
9	0.00	n/a	0.60	0.00	200 x 100	71	456	51	141	0.092	35.4	8.3	4.3	3.653	9.69614	2.2666302
9	0.00	n/a	0.60	0.00	200 x 100	59	494	59	161	0.092	40.0	9.4	4.3	3.653	10.95538	2.5688475
9	0.00	n/a	1.60	0.00	200 x 100	77	628	57	194	0.092	50.7	12.6	4.0	3.653	13.87681	3.4503148
9	0.00	n/a	1.60	0.00	200 x 100	62	736	67	259	0.092	62.0	17.7	3.5	3.653	16.97454	4.8354777
9	0.00	n/a	1.60	0.00	200 x 100	76	674	79	215	0.092	55.0	12.5	4.4	3.653	15.0605	3.42513
9	0.00	n/a	2.60	0.00	200 x 100	108	659	99	242	0.092	50.7	13.2	3.9	3.653	13.87681	3.6014235
9	0.00	n/a	2.60	0.00	200 x 100	122	707	118	159	0.092	53.8	3.8	14.3	3.653	14.7331	1.032576
9	0.00	n/a	2.60	0.00	200 x 100	101	676	92	259	0.092	52.9	15.4	3.4	3.653	14.48125	4.2058582
10	0.00	n/a	0.60	0.00	200 x 100	105	1080	97	379	0.092	89.7	25.9	3.5	3.653	24.55516	7.1021079
10	0.00	n/a	0.60	0.00	200 x 100	41	1930	2	485	0.092	173.8	44.4	3.9	3.653	47.57405	12.164249
10	0.00	n/a	0.60	0.00	200 x 100	44	1009	19	268	0.092	88.8	22.9	3.9	3.653	24.30331	6.2710101
10	0.00	n/a	1.60	0.00	200 x 100	97	658	95	295	0.092	51.6	18.4	2.8	3.653	14.12866	5.0369559
10	0.00	n/a	1.60	0.00	200 x 100	65	630	49	254	0.092	52.0	18.9	2.8	3.653	14.2294	5.1628798
10	0.00	n/a	1.60	0.00	200 x 100	49	515	38	145	0.092	42.9	9.8	4.4	3.653	11.73611	2.6947714
11	0.00	n/a	0.60	0.00	200 x 100	38	1206	2	150	0.092	107.5	13.6	7.9	3.653	29.41582	3.7273474
11	0.00	n/a	0.60	0.00	200 x 100	36	1470	58	190	0.092	131.9	12.1	10.9	3.653	36.11497	3.3243909
11	0.00	n/a	0.60	0.00	200 x 100	67	1035	43	310	0.092	89.1	24.6	3.6	3.653	24.37887	6.7243362
12	0.00	n/a	0.60	Damp	200 x 100	81	1520	28	380	0.092	132.4	32.4	4.1	3.653	36.2409	8.8650424
12	0.00	n/a	0.60	Damp	200 x 100	42	1830	34	406	0.092	164.5	34.2	4.8	3.653	45.03039	9.368738
12	0.00	n/a	0.60	Damp	200 x 100	31	1515	46	265	0.092	136.5	20.1	6.8	3.653	37.37421	5.5154667
*12	1.00	n/a	1.60	Damp	200 x 100	40	>2100			0.092				3.653	>518	
13	0.00	n/a	0.60	0.00	200 x 100	1	575	25	169	0.092	52.8	13.2	4.0	3.653	14.45606	3.6266083
13	0.00	n/a	0.60	0.00	200 x 100	31	592	42	130	0.092	51.6	8.1	6.4	3.653	14.12866	2.2162606
13	0.00	n/a	0.60	0.00	200 x 100	19	578	18	124	0.092	51.4	9.8	5.3	3.653	14.07829	2.6695866
13	0.00	n/a	1.10	0.00	200 x 100	85	582	83	204	0.092	45.7	11.1	4.1	3.653	12.51684	3.0473583
13	0.00	n/a	1.10	0.00	200 x 100	105	669	118	265	0.092	51.9	13.5	3.8	3.653	14.20422	3.7021626
13	0.00	n/a	1.10	0.00	200 x 100	96	589	102	237	0.092	45.4	12.4	3.7	3.653	12.4161	3.3999453
14	0.00	n/a	0.50	0.00	100 x 50	72	161	54	128	0.092	8.2	6.8	1.2	0.464	17.64655	14.672414
14	0.00	n/a	0.50	0.00	100 x 50	66	142	38	79	0.092	7.0	3.8	1.9	0.464	15.06897	8.1293103
14	0.00	n/a	0.50	0.00	100 x 50	74	169	48	112	0.092	8.7	5.9	1.5	0.464	18.83621	12.689655
14	0.00	n/a	0.90	0.00	100 x 50	76	258	66	129	0.092	16.7	5.8	2.9	0.464	36.08621	12.491379
14	0.00	n/a	0.90	0.00	100 x 50	51	138	47	111	0.092	8.0	5.9	1.4	0.464	17.25	12.689655
14	0.00	n/a	0.90	0.00	100 x 50	62	224	37	124	0.092	14.9	8.0	1.9	0.464	32.12069	17.25
15	0.00	n/a	0.60	0.00	200 x 100	32	880	11	232	0.092	78.0	20.3	3.8	3.653	21.35669	5.5658363
15	0.00	n/a	0.60	0.00	200 x 100	59	910	19	243	0.092	78.3	20.6	3.8	3.653	21.43225	5.6413906
15	0.00	n/a	0.60	0.00	200 x 100	39	1208	32	385	0.092	107.5	32.5	3.3	3.653	29.44101	8.8902272
15	1.00	n/a	1.60	0.00	200 x 100	90	954	94	322	0.092	79.5	21.0	3.8	3.653	21.75965	5.7421298
15	1.00	n/a	1.60	0.00	200 x 100	95	810	92	324	0.092	65.8	21.3	3.1	3.653	18.00712	5.8428689
15	1.80	n/a	2.30	0.00	100 x 50	162	424	156	206	0.092	24.1	4.6	5.2	0.464	51.94828	9.9137931
15	1.80	n/a	2.30	0.00	100 x 50	182	369	176	245	0.092	17.2	6.3	2.7	0.464	37.07759	13.681034

*Note: Test attempted on BH12 at 1.60m. Shear vane refused at 2100 divisions.

Input By: MT Checked By: BC Date: 20/01/2009

Table 2: Peat Depths

Borehole	Peat Depth (m)
1	1.8
2	1.1
3	0.8
4	3.3
5	1.9
6	1.0
7	3.8
8	1.3
9	2.7
10	2.1
11	0.7
12	2.1
13	1.2
14	1.0
15	2.4

Notes

Maximum peat thicknesses estimated by hand probing.

All probes terminated on the basis of refusal.

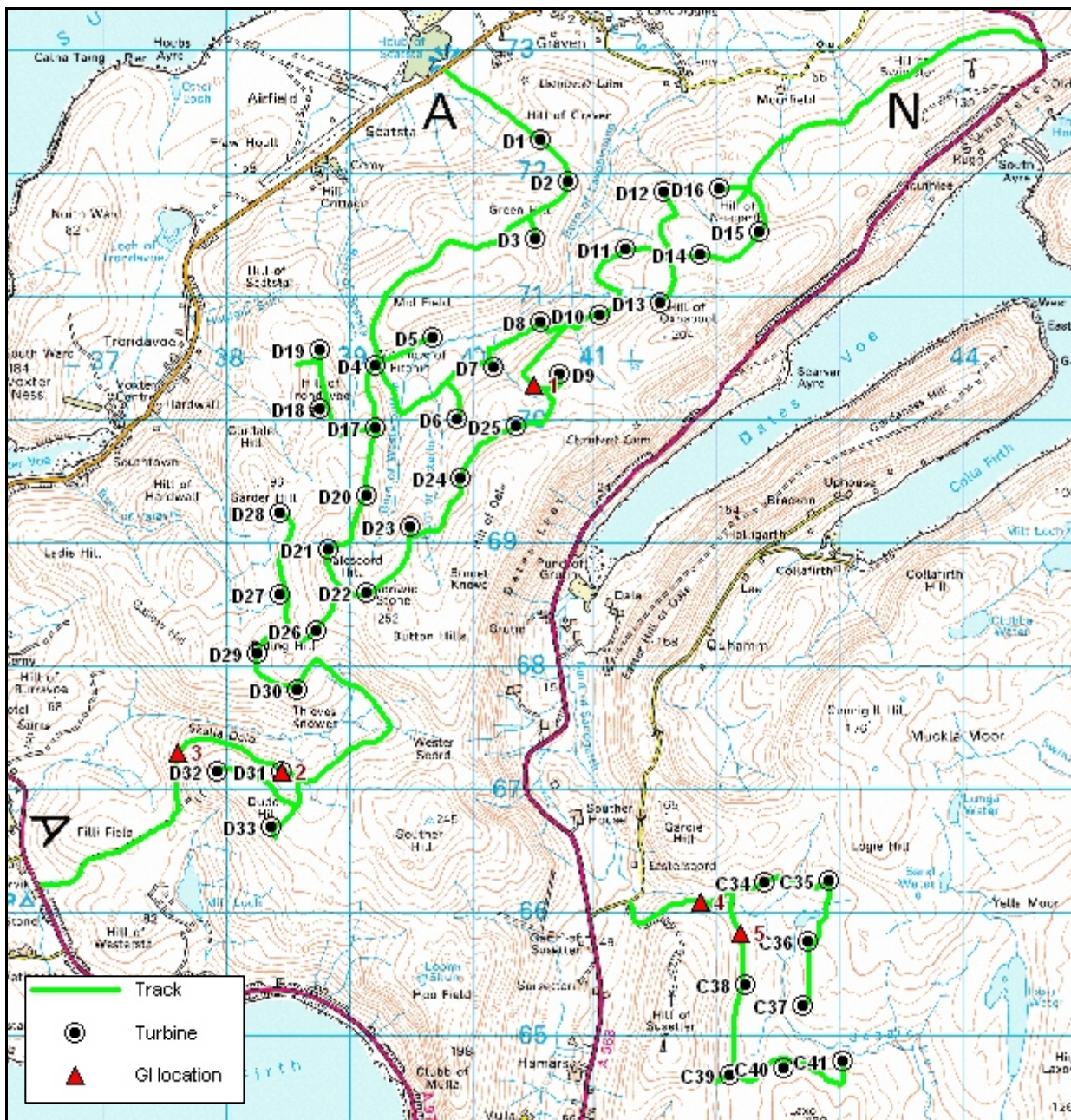
Insitu field vane test results for each position presented separately.

Input By: MT Checked By: BC Date: 20/01/09

APPENDIX B Drawings

Exploratory Hole Location Plan

Figures LP1 and LP2



Development layout and GI locations, Delting & Collafirth

Figure LP2