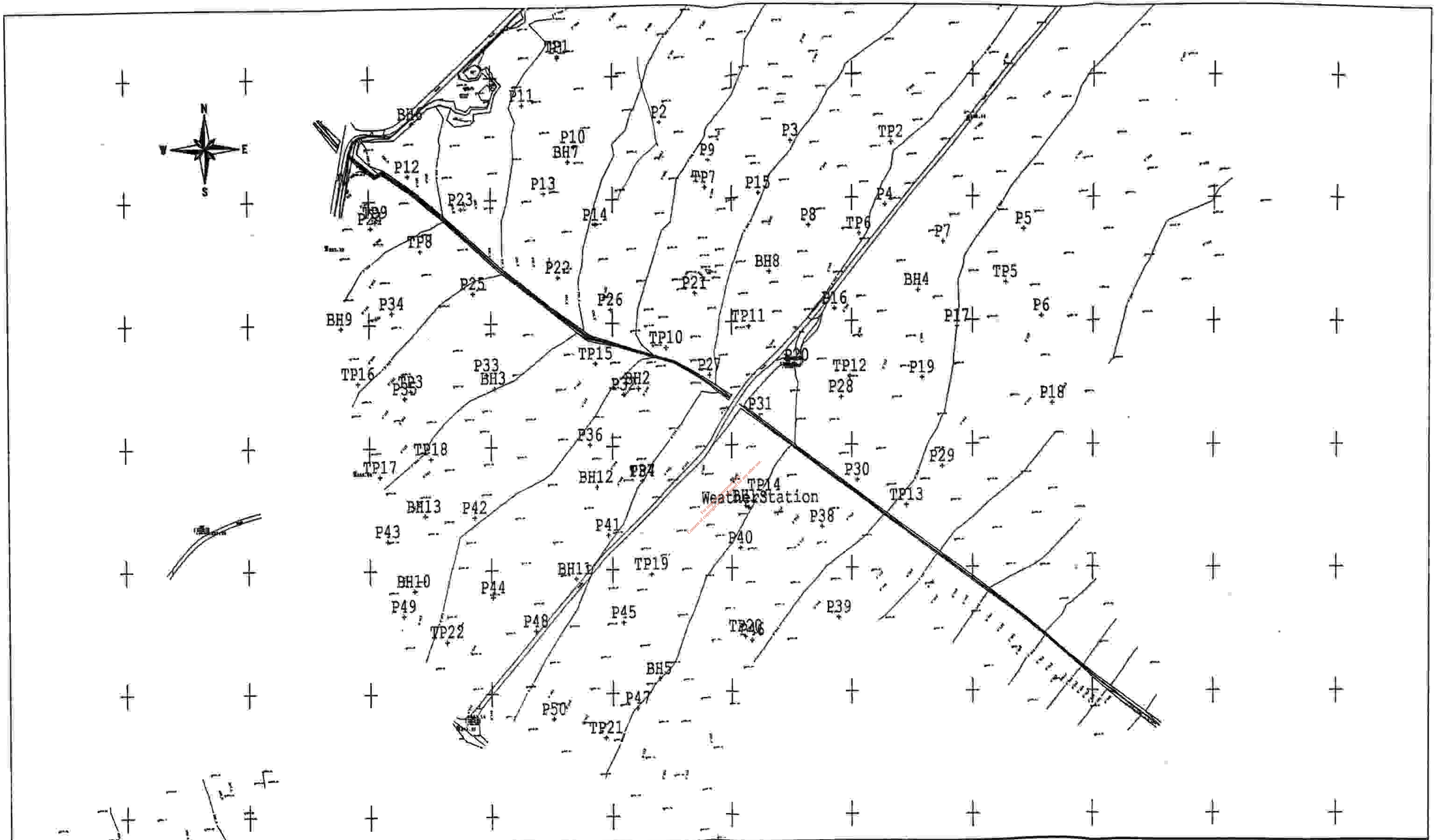
APPENDIX E

DRAWINGS

SITE LOCATION PLAN

Figure SP1



Foundation & Exploration Services
8 Kilbelin Lawns
Newbridge
Co. Kildare
Tel. (045) 448542
Fax (045) 449410
Email: fes.eddi@eddi.ie

CLIENT	Donegal County Council KIRK McCLURE MORTON
PROJECT	Meenaboll Site Investigation Co. Donegal
TITLE	Location of Boreholes, Trial Pits and Dynamic Probes

LEGEND

Scale:	1:3000
Project:	Meenaboll
Drawn:	hk
Date:	21/3/03
File:	MeenabollSI.dwg
Based on:	6613-2d

APPENDIX F

REPORTS ON GEOPHYSICAL SURVEYS

Foundation and Exploration Services
Meenaboll Site Investigation
Co. Donegal

Geophysical Survey

Report Status: Final

MEL Project Number: 1503

MEL File Ref: 1503-064

Thursday 23rd October 2003

Confidential Report To:

Foundation and Exploration Services
6 Kilbelin Lawns
Newbridge
Co. Kildare

Report submitted by :

Minerex Environmental Limited
Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Ireland
Tel.: +353-(0)1-2964435
Fax.: +353-(0)1-2964436
Email: minerex@iol.ie

Issued by :

EurGeol Hartmut Krahn M.Sc. (Geophysics) PGeo

Reviewed by :

Ben Whitfield B.Sc. (Geophysics)

Minerex
Environmental Limited

Hydrogeological, Environmental,
Geophysical Services

EXECUTIVE SUMMARY

1. Minerex Environmental Ltd. (MEL) carried out a geophysical survey in January 2003 for the preliminary site investigation for a proposed landfill development at Meenaboll, Co Donegal.

2. The geophysical survey consisted of VLF-R measurements with concurrent gouge coring, VLF-EM surveying and seismic refraction measurements.

3. The main objectives of the geophysical survey were to establish the depth of glacial till and peat deposits across the site, to produce isopachyte maps of the drift cover and to identify any major fracture zones or fault lines in the bedrock beneath the drift cover.

4. The survey showed three geological layers under the site. These are soft peat, soft to firm glacial till and strong competent bedrock. The thickness of the peat and till and the depth to the bedrock have been displayed on contour maps.

5. The bedrock resistivities and seismic velocities are high, indicating a strong compact bedrock with little weathering or fracturing.

6. The VLF-EM survey showed one medium size anomaly running from NW to SE through the site. This is interpreted as a dolerite dyke that has intruded into an older fault zone.

7. Smaller conductivity anomalies exist under the site along the trend of lower bedrock resistivities and thicker overburden.

8. The high resolution of the survey with targeted follow up drilling makes it highly unlikely that there are any unknown fault or fracture zones under the site.

9. The bedrock under the site is psammitic schist.

10. The most suitable area for proposed landfill cells according to the geophysical data on the SW of site A.

11. Further work in the main site investigation should include mapping the continuation of the dolerite dyke. Continuous 2D-Resistivity Profiles and some Seismic Refraction should be carried out under the proposed landfill cells.

CONTENTS

List of Tables, Figures and Maps in Appendices:

1. INTRODUCTION

1.1 Background

Minerex Environmental Ltd. (MEL) carried out a geophysical survey in January 2003 on behalf of Foundation & Exploration Services for the site investigation of a proposed landfill at Meenaboll, Co.Donegal. The geophysical survey consisted of VLF-R, VLF-EM and seismic refraction measurements. The draft results of the survey were used to locate rotary core boreholes over subsurface features of special interest.

1.2 Objectives

The main objectives of the geophysical survey were as follows:

- To establish the depth of glacial till and peat deposits across the sites
- To produce isopachyte maps of the drift cover
- To identify any major fracture zones or fault lines in the bedrock beneath the drift cover

Other information (bedrock type, overburden stiffness, strength of rock) about the subsurface obtained during the survey is also included in this report.

1.3 Site Description

The site consists of two areas A (26 ha) and B (4 ha). The site is located in a remote area approx. 2 km from the Letterkenny to Glenties road (Map 1). The surface cover of the site consists of peat that is overgrown with grass, rushes and small pine trees and covered with tree trunks, roots and branches from milled forestry. The elevations on the site range from 215 to 265 m.OD.

1.4 Geology

The bedrock geological map (GSI, 1997) shows that the site is underlain by the Upper Falcarragh Pelite Formation that is composed of pelitic, semi-pelitic and psammitic schists (Map2). The only outcrop of these rocks occurs in the small quarry at the road running along the NW of Site A. No other outcrop of rock has been found on the site.

To the SE of the site the Swilly Slide and its approximate SE limit of the D6 shearing is shown. The next geological formation to the NW is the Sessiagh-Clonmass formation, consisting of quartzite, dolomitic marble and schist.

The lithological boundaries and the Swilly slide are striking SW-NE, following the dominant geological trend in the region.

Tertiary Dolerite Dykes are mapped about 10 km to the NW of the site. These dykes are trending NW-SW. Dolerite sills are mapped about 3 km to the NE of the site.

The overburden geology consists of peat overlaying glacial tills. Exposures can be seen in drainage ditches and in the small quarry.

1.5 Report

This report includes the results and interpretation of the geophysical survey. Maps, figures and tables are included in the appendixes to illustrate the survey and the results. More detailed descriptions of geophysical methods and measurements can be found in Milsom (1989) and Reynolds (1997).

The client supplied a digital basemap of the site with elevation contours and spot heights. The maps and elevations were used in this report. Borehole logs and information about the peat and rock depth in the trial pits was used for the interpretation of the geophysical survey (FES, 2003).

The interpretative nature and the non-intrusive survey methods must be taken into account when considering the results of this survey and Minerex Environmental Limited while using appropriate practise to execute, interpret and present the data give no guarantees in relation to the existing subsurface.

2. GEOPHYSICAL SURVEY

2.1 Methodology

Following methods, survey parameters and quantities were carried out on Sites A and B and can be seen on the survey location map (Map 3).

1. A survey grid was set out with a Garmin 12XL GPS and marked by pink survey tape tied to trees and roots. The grid had a 50 x 50 m spacing and the grid was orientated such that the NW-SE lines were at right angles to both the geological strike and the Norwegian VLF broadcasting station Helgeland. The survey grid points are labelled numbers 1 – 136 on Map 3.

2. VLF-R measurements and Gouge Coring at all survey grid points (136 in total) was carried out to establish the bedrock resistivity, the overburden thickness and the peat thickness. The gauge coring also provided a description about the layer underlying the peat at those points where a sample could be recovered. A Geonics EM16 with a resistivity attachment and two stainless steel probes with a 10 m cable was used to determine the apparent bedrock resistivity and the phase angle. The survey was carried out using the British VLF station in Rugby (GBR 16.0 kHz).

   25 resistivity readings were taken with a Wenner electrode configuration at 10 m spacing to determine the resistivity of the overburden. The readings were taken with a MEGGER DET V meter. The overburden resistivity was used for the determination of the depth to rock from the VLF-R readings.

3. A VLF-EM survey at a 10 m station spacing along the NW to SE trending grid lines was carried out with an ABEM Wadi instrument (595 readings). The instrument measures the tilt angles between primary and secondary fields and stored the results in its memory. The survey lines are indicated on Map 3. The survey used the VLF transmitter in Helgeland (JXZ 16.4 kHz). This method indicates the location of geological features with a locally higher conductivity than in the surrounding rock layers. Such features can be faults, fracture zones and lithological boundaries where increased circulation of groundwater occurs. Other possible features indicated by this method are mineralisation and intrusions with a higher conductivity material. The survey orientation was chosen because of the regional geological trend.

4. During the VLF-R survey a geological trend striking from SE-NW was noted and it was suggested and agreed to carry out a second VLF-EM survey with an orientation from SW-NE with the GBR transmitter. 619 readings were taken at a 10 m spacing along the lines indicated on Map 3.

5. Eight Seismic Refraction Profiles with 12 geophones at a 5 m spacing and a length of 55 m each were carried out at the locations indicated on Map 3. A sledgehammer was used as the seismic source for profiles 5 and 6 that were located beside the roads and a seismograph gun was used for the other profiles in the locations with peat cover.

6. The draft results of the geophysical survey were used to locate some targeted boreholes on geological features.

2.2 Site Work

The site work was carried out between the 6th and the 16th of January 2003 and on the 21st of the same month. The weather was generally favourable and good quality and repeatable data was gathered. The only source of interference for the VLF methods was the sheep wire fence along the road to the SW of Site A.

3. RESULTS AND INTERPRETATION

The interpretation of geophysical data was carried out utilising the known response of geophysical measurements, typical physical parameters for subsurface features that may underlay the site and the experience of the authors. The contour maps provided were produced with a gridding algorithm to create contour lines between data points and reference to the data points must be made when considering the maps.

3.1 VLF-R and Gouge Coring

The gouge coring gave a detailed map of the peat thickness that is displayed on Map 4. The layers determined under the peat were soft to firm sandy to gravelly Clays (Table 1). It must be considered that the gouge corer can only recover small samples, and that it refuses on stones or boulders. The peat thickness varies between 0.2 and 4 m on the site, and the greatest thickness occurs towards the SE of the track running through the middle of the site.

The VLF-R data has been converted for a two layer case with the Grissemann and Reitmayr algorithm to yield overburden thickness and bedrock resistivities. Initially the resistivities determined by the Wenner measurements were used for the conversion, and then the depths to bedrock were optimised by using the depth from the seismic profiles, boreholes and trial pits and carrying out an optimisation.

The overburden thickness is displayed in the contour map of the rockhead (Map 6). The depth to the rock is generally shallow in the NW of the site and deepens towards the SW. The range is between 1 and 10m.

The difference between the depth to rock and the peat thickness resulted in the glacial till thickness map (Map 5). The thickness follows the trend of the peat thickness and generally increases from West to East with ranges between 1 and 8m.

The bedrock resistivities derived from the survey are displayed in Map 7. All resistivities are generally high, and the highest values occur in the centre of Site A and at the SE of Site B.

3.2 VLF-EM

The measured VLF-EM dip angle was processed using the linear filtering technique of Karous and Hjelt (1983). The resulting equivalent current density for the two transmitting stations JXZ and GBR are visualised on Fig. 2. Current density increases over an area indicate the presence of conductive subsurface features such as faults and fracture zones. The strongest values between 10 and 15 on the site are found at an NW-SE trending structure located near a small stream that passes through the middle of Area A. Smaller values between 5 and 10 can be found in areas where the bedrock resistivities are relatively small (at the East of the site) and where gradients occur in the bedrock resistivity map.

The values obtained on this site are generally small, indicating only minor conductivity anomalies. Responses measured over water-bearing fracture zones used for water wells have typically values of over 30 in Ireland.

3.3 Seismic Refraction

The seismic refraction data has been interpreted as layered earth models (Fig. 1). The following three layers have been found:

Seismic Velocity (km/s)	Thickness	Interpretation	Compaction/Strength
0.3 – 0.6	0 – 4 m	Peat	Soft
0.7 – 1.2	1 – 4 m	Till	Soft – firm
4.5 – 6.5	N/a	Rock	Strong competent

The high seismic velocities for the rock indicate very little weathering or fracturing below the rock level shown in the cross sections. If strongly weathered or fractured rock exists it would be included as a thin layer at the bottom of the glacial till.

3.4 Summary Interpretation

Map 8 shows a summary of the areas where the thickness of peat exceeds 2 m, the glacial till 3 m and the depth to bedrock is larger than 5 m. The map has been produced from all data available and has been contoured along the 50 m grid notes.

Map 9 shows the interpretation of the VLF-EM data. The main NW-SE anomaly is interpreted as a dolerite dyke intruded into an older fault zone (Site A). Dolerite has been encountered in Borehole 1, and indications for some fracturing of the rock are found in both Boreholes 1 and 2.

Smaller VLF-EM anomalies are shown as red lines on Map 9. They follow mainly the trend of bedrock with a relatively lower resistivity and thicker overburden.

The borehole data shows mainly psammitic schist for the site, with some pelites and quartzite interbedded. The bedrock resistivities allow the rock to be divided in two areas. Resistivities generally higher then 2000 Ohmm show the area of psammitic schist. This rock is interpreted to be very compact withour major fracturing and with a very small water content. Some very high resistivities towards the north of site A and East of site B could indicate a transition to quartzite.

The area shown as containing psammitic schist with a medium resistivity occurs mainly to the north of Site A. This rock is expected to show a higher schistosity than the high resistivity rock. It could also be slightly more fractured and could contain relatively more water than the higher resistivity rock, though the overall amount would be still small.

4. CONCLUSIONS AND RECOMMENDATIONS

- The thickness of peat and glacial till and the bedrock depth have been determined and displayed on maps. They can be used for vulnerability assessment and for hydrogeological and geotechnical considerations in the development of the proposed landfill.
- The rock underlying the sites is strong competent psammitic schist.
- Variations in the bedrock resistivity show that in some areas the rock has a higher schistosity and could be more fractured.
- The pattern of the bedrock resistivity shows a NW-SE trending fault running along and near the small stream on site A. An increased conductivity found in the VLF-EM data, dolerite drilled in Borehole 1 and the general geology lead to the interpretation that a tertiary dolerite dyke has intruded into an older fault zone.
- The dolerite intrusion would have contributed to the healing of the fault and to a reduction in the permeability. The combination of the river for the surface water and the fault/dolerite dyke for subsurface water will cut of any potential water flow from the south to the north of the site.
- Some smaller conductivity anomalies are linked to areas of lower bedrock resistivities and thicker overburden.
- It is highly unlikely that fault or fracture zones other than those mapped exist under the site.
- The continuation of the dolerite dyke/fault zone should be mapped in the main site investigation.
- 2D-Resistivity profiles measured along continuous lines in two orthogonal directions should be carried out under the proposed landfill cells. Seismic Refraction should be carried out in areas of interest as shown by the 2D-Resistivity.

5. REFERENCES

1. **FES, 2003.** Site Investigation Report. Meenaboll Landfill Project.

2. **GSI, 1997.** Geology of North Donegal. Bedrock Geology 1:100,000 Map Series. Geological Survey of Ireland.

3. **Milsom, 1989.** Field Geophysics. John Wiley and Sons.

4. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Sons.

Appendix A

Table 1

Table 1: Survey Data

Point	East	North	Elevation (mOD)	Peat Depth (m)	Depth to Refusal (m)	Layer below Peat	Measured VLF-Resistivity	Measured VLF-Phase	Peat Depth (m)	Till Tickness (m)	Depth to Bedrock (m)	Bedrock Resistivity (Ohmm)
1	199532	408966	238.5	1.3	1.3		450	29	1.3	3.6	4.9	1056
2	199573	408938	241.3	0.4	0.7	Brown firm gravelly Clay	1200	30	0.4	1.6	2	2466
3	199615	408910	244.3	0.7	1.1	Grey firm gravelly Clay	1000	24	0.7	3.1	3.8	3249
4	199656	408882	246.9	0.9	0.9		1100	24	0.9	3.1	4	3549
5	199697	408854	249.7	1.5	1.7	Grey soft gravelly Clay	1400	27	1.5	2.7	4.2	3517
6	199739	408827	251.9	3	3.3	Grey soft gravelly Clay	220	28	3	5	8	682
7	199780	408799	254.1	1.9	1.9		400	25	1.9	5.5	7.4	1355
8	199808	408840	255.5	2.9	2.9		300	25	2.9	6.4	9.3	1113
9	199767	408868	253.4	2.4	2.4		300	32	2.4	3.1	5.5	594
10	199725	408896	250.0	1.4	1.4		1400	25	1.4	1.6	3	4098
11	199684	408924	247.0	1.5	1.5		1500	26	1.5	1.7	3.2	4049
12	199642	408952	244.4	1.5	1.5	Grey soft gravelly Clay	900	25	1.5	3	4.5	2709
13	199601	408980	241.7	1.9	1.9		1000	26	1.9	2.1	4	2755
14	199560	409008	239.4	1.7	1.7		900	24	1.7	3	4.7	2951
15	199518	409036	236.7	0.4	0.6	Brown/grey firm gravelly Clay	1400	20	0.4	3.9	4.3	6470
16	199505	409105	232.7	0.2	0.4	Brown firm gravelly Clay	1100	29	0.2	3.3	3.5	2422
17	199546	409077	236.1	0.8	1	Brown firm gravelly Clay	1000	27	0.8	3	3.8	2551
18	199588	409049	239.6	2.1	2.4	Grey soft sandy Clay	1200	24	2.1	1.8	3.9	3848
19	199629	409021	241.8	2.6	2.9	Grey soft gravelly Clay	1000	24	2.6	1.9	4.5	3249
20	199670	408993	244.1	1.6	1.6		2200	26	1.6	2.4	4	5866
21	199712	408965	247.1	1.8	1.8		1300	25	1.8	1.8	3.6	3820
22	199753	408937	249.8	1.3	1.3		2000	29	1.3	1	2.3	4333
23	199795	408909	254.3	1.9	2.3	Grey firm gravelly Clay	400	32	1.9	3.2	5.1	765
24	199836	408881	257.0	2.8	4	Grey soft gravelly Clay	200	26	2.8	7.2	10	834
25	199864	408923	257.0	2.3	2.6	Grey soft gravelly Clay	400	24	2.3	5.5	7.8	1498
26	199823	408951	254.2	2.1	2.4	Brown/grey soft gravelly Clay	700	21	2.1	4	6.1	3170
27	199781	408979	250.6	1.2	1.3	Brown soft gravelly Clay	1600	25	1.2	2	3.2	4656
28	199740	409007	247.8	2.3	2.3		1000	24	2.3	2.1	4.4	3249
29	199698	409035	244.5	2	2		1400	29	2	0.8	2.8	3059
30	199657	409063	241.1	1.4	1.4		1100	22	1.4	3.1	4.5	4253
31	199615	409091	238.5	2.2	2.3	Grey firm sandy Clay	800	25	2.2	2.6	4.8	2433
32	199574	409119	235.6	1.5	1.5		1100	24	1.5	2.6	4.1	3549
33	199533	409147	232.2	1.1	1.3	Brown firm gravelly Clay	1400	24	1.1	3.4	4.5	4449
34	199491	409175	228.2	1.4	1.5	Brown firm gravelly Clay	300	26	1.4	4.1	5.5	1002
35	199519	409216	227.9	1.6	1.6		500	30	1.6	3.3	4.9	1077

Point	East	North	Elevation (mOD)	Peat Depth (m)	Depth to Refusal (m)	Layer below Peat	Measured VLF-Resistivity	Measured VLF-Phase	Peat Depth (m)	Till Tickness (m)	Depth to Bedrock (m)	Bedrock Resistivity (Ohmm)
36	199561	409188	231.5	1.5	1.6	Brown firm gravelly Clay	2400	26	1.5	2	3.5	6386
37	199602	409160	234.2	1.7	1.7		700	26	1.7	3.2	4.9	1983
38	199643	409132	237.3	1.9	2	Brown firm gravelly Clay	1800	22	1.9	1.5	3.4	6730
39	199685	409104	241.0	1.3	1.5	Brown firm gravelly Clay	3000	25	1.3	2.2	3.5	8568
40	199726	409076	244.9	1.3	1.4	Brown soft gravelly Clay	1700	23	1.3	3.2	4.5	5828
41	199768	409048	247.9	3.2	3.2		800	23	3.2	2	5.2	2908
42	199809	409020	250.4	2.5	2.6	Brown/grey soft gravelly Clay	900	24	2.5	2.2	4.7	2951
43	199851	408992	254.0	2	2		700	25	2	3.2	5.2	2158
44	199892	408964	257.4	1.8	2	Grey firm sandy Clay	500	21	1.8	5.2	7	2439
45	199920	409006	256.0	1.6	1.8	Grey firm gravelly Clay	1100	20	1.6	3.3	4.9	5203
46	199879	409034	253.6	2	2		900	20	2	3.5	5.5	4366
47	199837	409062	250.5	3.4	3.4		600	20	3.4	3.5	6.9	3138
48	199796	409090	248.5	2.6	2.6		600	18	2.6	4.8	7.4	4031
49	199754	409118	244.9	1.2	1.2		1700	21	1.2	2.5	3.7	7007
50	199713	409146	241.0	1.9	1.9		1200	24	1.9	2	3.9	3848
51	199671	409174	236.3	2.1	2.1		1200	25	2.1	1.7	3.8	3541
52	199630	409202	232.9	2.3	2.3		500	28	2.3	3.2	5.5	1252
53	199589	409230	230.4	1.4	1.4		1800	23	1.4	2.6	4	6154
54	199547	409257	227.1	2	2.1	Grey soft gravelly Clay	600	32	2	2.5	4.5	1116
55	199506	409285	223.1	0.8	0.8		700	39	0.8	3.7	4.5	890
56	199534	409327	222.5	1.4	1.4		1300	24	1.4	2.9	4.3	4149
58	199616	409271	230.6	1.4	1.4		800	22	1.4	4	5.4	3202
59	199658	409243	233.7	1.6	1.6		500	23	1.6	4.3	5.9	1963
60	199699	409215	237.7	1.1	1.5	Grey soft sandy Clay	800	25	1.1	3.4	4.5	2433
61	199741	409187	242.1	1.3	1.3		2000	19	1.3	1.7	3	10012
62	199782	409159	244.6	0.8	0.8		2800	19	0.8	2.2	3	13773
63	199824	409131	248.0	2.4	2.4		900	20	2.4	3.1	5.5	4366
64	199865	409103	250.7	3.9	3.9		350	24	3.9	3.6	7.5	1366
65	199907	409075	253.3	3.1	3.4	Grey soft gravelly Clay	800	25	3.1	1.7	4.8	2433
66	199948	409047	255.8	1.9	2.2	Grey soft gravelly Clay	700	25	1.9	3.3	5.2	2158
67	199990	409019	261.0	1	1.3	Brown firm gravelly Clay	600	23	1	5.2	6.2	2272
68	200017	409061	259.8	1.9	1.9		800	24	1.9	3.1	5	2653
69	199976	409089	256.0	2.2	2.2		800	26	2.2	2.4	4.6	2240
70	199935	409117	253.7	3.8	3.9	Brown soft sandy Clay	600	25	3.8	1.9	5.7	1885
71	199893	409145	251.9	3.9	3.9		500	25	3.9	2.5	6.4	1616

Meenaboll Site Investigation
Geophysical Survey

Table 1: Survey Data

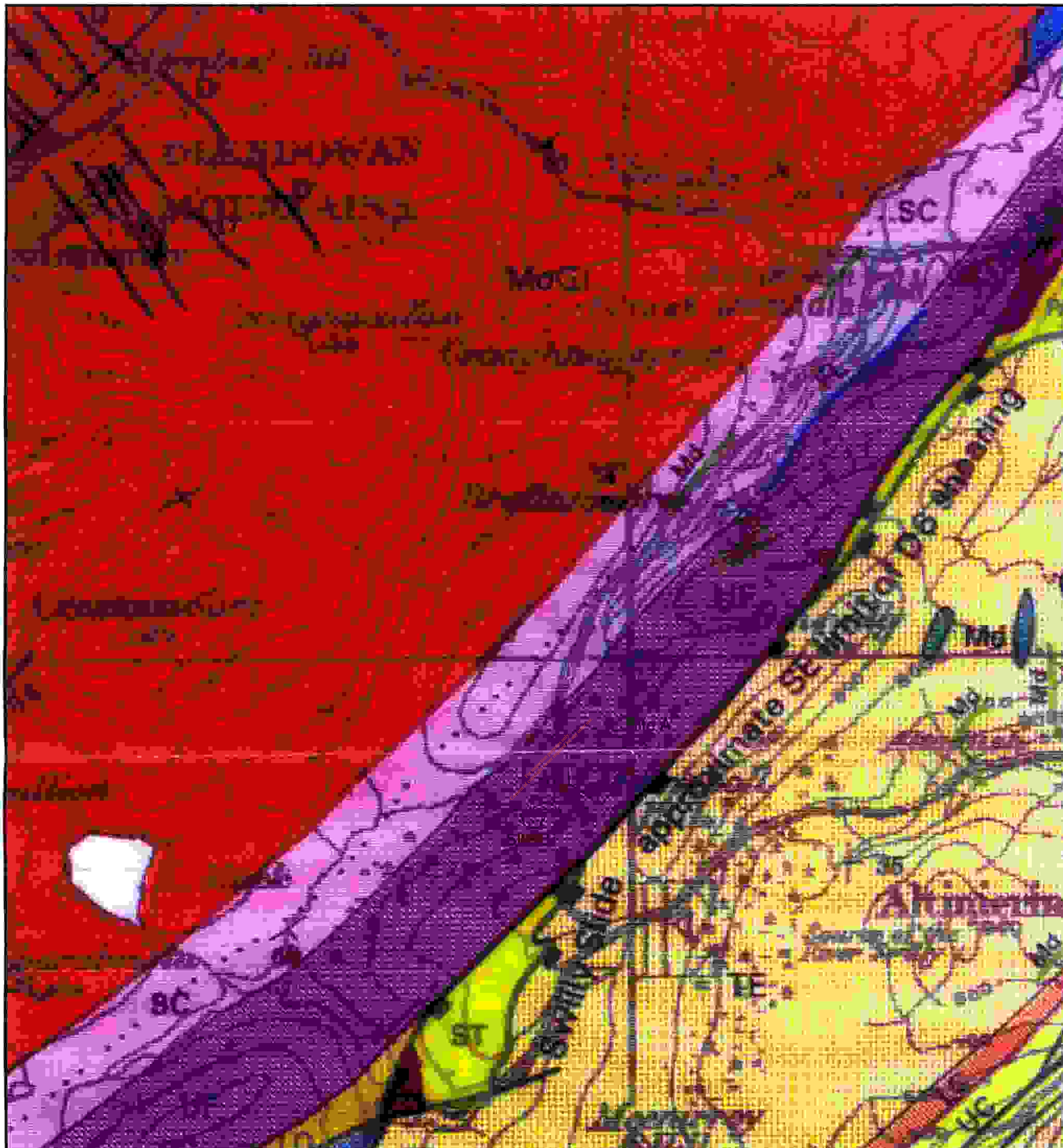
Point	East	North	Elevation (mOD)	Peat Depth (m)	Depth to Refusal (m)	Layer below Peat	Measured VLF-Resistivity	Measured VLF-Phase	Peat Depth (m)	Till Tickness (m)	Depth to Bedrock (m)	Bedrock Resistivity (Ohmm)
72	199852	409173	249.0	2.4	2.4		700	24	2.4	3	5.4	2358
73	199810	409201	246.1	1.1	1.2	Brown soft gravelly Clay	2800	29	1.1	2.9	4	6033
74	199769	409229	243.7	1.4	1.5	Grey soft sandy Clay	1500	26	1.4	2.2	3.6	4049
75	199727	409256	239.3	0.3	0.3		1200	28	0.3	3.1	3.4	2822
76	199686	409284	235.3	0.5	0.5		600	30	0.5	3.9	4.4	1274
77	199644	409312	232.0	1.4	1.4		700	28	1.4	3.1	4.5	1696
78	199603	409340	228.8	1.1	1.3	Brown firm sandy Clay	1100	29	1.1	2.5	3.6	2422
79	199562	409368	225.0	1.4	1.4		1000	28	1.4	2.7	4.1	2371
80	199608	409425	225.9	0.6	0.6		3200	28	0.6	1.9	2.5	7353
81	199631	409382	231.9	0.5	0.5		1200	33	0.5	2.5	3	2057
82	199672	409354	233.8	1.2	1.2		700	27	1.2	3	4.2	1831
83	199714	409326	236.1	0.2	0.4	Brown firm gravelly Clay	1200	35	0.2	1.7	1.9	1844
84	199755	409298	240.3	1.2	1.2		750	22	1.2	3.7	4.9	3029
85	199797	409270	244.1	0.4	0.4		5500	20	0.4	1.7	2.1	23955
86	199838	409242	246.8	1.2	1.4	Brown firm gravelly Clay	3500	20	1.2	1.4	2.6	15414
87	199880	409214	250.2	1.2	1.2		1000	22	1.2	3.6	4.8	3901
88	199921	409186	252.6	3.8	3.9	Grey soft sandy Clay	700	36	3.8	2	5.8	1030
89	199963	409158	254.3	4	4		450	25	4	2.9	6.9	1484
90	200004	409130	256.2	2	2.2	Grey soft gravelly Clay	700	24	2	3.4	5.4	2358
91	200045	409102	259.2	1.3	1.3		900	22	1.3	3.8	5.1	3551
92	200073	409144	258.9	2.4	2.6	Grey soft sandy Clay	1100	18	2.4	3.6	6	6528
93	200032	409172	256.7	3.6	3.8	Grey soft sandy Clay	900	21	3.6	4.4	8	3926
94	199991	409200	255.2	4	4		400	25	4	3.5	7.5	1355
95	199949	409228	253.4	3.3	3.6	Grey soft sandy Clay	800	23	3.3	5.2	8.5	2908
96	199908	409256	250.6	2.4	2.6	Grey soft sandy Clay	1400	23	2.4	2.1	4.5	4850
97	199866	409283	247.5	1.7	1.7		3000	22	1.7	3.3	5	10995
98	199825	409311	244.7	1.4	1.4		2400	25	1.4	1	2.4	6891
99	199783	409339	241.0	0.5	0.7	Brown firm gravelly Clay	3000	30	0.5	1.5	2	6062
100	199742	409367	236.9	1.3	1.4	Brown firm gravelly Clay	500	36	1.3	1.7	3	742
101	199700	409395	233.6	1.1	1.2	Brown firm sandy Clay	500	32	1.1	3.2	4.3	940
102	199659	409423	231.3	1.4	1.4		900	30	1.4	2.6	4	1868
103	199811	409381	241.2	0.5	0.5		2400	26	0.5	3	3.5	6386
104	199853	409353	244.8	2.2	2.2		1300	26	2.2	1.2	3.4	3530
105	199894	409325	247.9	1.2	1.4	Grey firm gravelly Clay	2800	22	1.2	1.5	2.7	10284
106	199936	409297	251.0	2.4	2.4		1100	25	2.4	1.6	4	3263

Table 1: Survey Data

Point	East	North	Elevation (mOD)	Peat Depth (m)	Depth to Refusal (m)	Layer below Peat	Measured VLF-Resistivity	Measured VLF-Phase	Peat Depth (m)	Till Tickness (m)	Depth to Bedrock (m)	Bedrock Resistivity (Ohmm)
107	199977	409269	254.2	2.4	2.6	Brown/grey soft gravelly Clay	650	28	2.4	2.3	4.7	1584
108	200018	409241	255.7	4	4.2	Brown soft gravelly Clay	600	27	4	1.2	5.2	1593
109	200060	409213	257.1	3.7	3.8	Grey soft gravelly Clay	300	25	3.7	4.3	8	1113
110	200101	409185	259.1	3.1	3.2	Grey soft gravelly Clay	1100	20	3.1	1.8	4.9	5203
111	200129	409227	259.8	3.4	3.8	Grey firm sandy Clay	800	19	3.4	2.6	6	4432
112	200088	409255	257.6	2.1	2.5	Grey firm gravelly Clay	400	26	2.1	5.1	7.2	1232
113	200046	409282	255.9	3.2	3.5	Brown firm gravelly Clay	550	29	3.2	1.7	4.9	1263
114	200005	409310	254.4	3.3	3.3		700	28	3.3	1.2	4.5	1696
115	199964	409338	251.6	2.5	2.5		1200	27	2.5	1	3.5	3033
116	200116	409296	258.1	2.5	3	Grey soft gravelly Clay	400	18	2.5	7.1	9.6	3160
117	200157	409268	260.1	4.1	4.1		400	20	4.1	4.9	9	2384
118	199362	408840	225.4	0.5	0.5		3000	30	0.5	1.2	1.7	6062
119	199403	408812	228.6	0.4	0.5	Brown soft gravelly Clay	1400	29	0.4	1.6	2	3059
120	199375	408770	223.8	0.4	0.8	Grey soft gravelly Clay	800	27	0.4	3.5	3.9	2070
121	199334	408798	222.3	0.9	0.9		1600	27	0.9	3.1	4	4001
122	199306	408757	220.2	0.4	1.1	Grey soft sandy Clay	1500	24	0.4	3.1	3.5	4750
123	199347	408729	224.8	0.7	0.7		1300	24	0.7	3.1	3.8	4149
124	199319	408687	226.7	1	1.3	Grey soft sandy Clay	550	25	1	5	6	1750
125	199278	408715	222.1	2.9	3	Grey soft sandy Clay	600	24	2.9	3.1	6	2065
126	199236	408743	219.0	1.7	1.9	Brown soft Clay	1200	22	1.7	2.6	4.3	4605
127	199167	408730	218.0	2.6	2.8	Grey soft gravelly Clay	1300	21	2.6	1.7	4.3	5461
128	199208	408702	220.7	1.8	1.9	Grey soft gravelly Clay	2300	21	1.8	2.2	4	9334
129	199250	408674	223.6	3.2	3.3	Grey soft gravelly Clay	650	25	3.2	1.8	5	2021
130	199291	408646	228.9	0.1	0.3	Brown/grey firm gravelly Clay	6000	20	0.1	2.2	2.3	26092
131	199263	408604	232.8	0.1	0.3	Brown firm Clay	5000	20	0.1	2.1	2.2	21820
132	199222	408632	225.8	1.4	1.4		1000	21	1.4	3.5	4.9	4308
133	199180	408660	221.8	1.4	1.4		1300	21	1.4	2.9	4.3	5461
134	199139	408688	218.7	1.4	1.5	Brown soft gravelly Clay	1800	18	1.4	2.6	4	10146
135	199153	408619	223.8	2.3	2.5	Grey firm sandy Clay	900	21	2.3	3	5.3	3926
136	199194	408591	227.5	1.4	1.4		2800	18	1.4	1.7	3.1	15358

Appendix B

9 Maps



LEGEND					
MdGr	Main Donegal Granite	ST	Slieve Tooey Quartzite Formation	D	Tertiary Dolerite Dyke
SC	Sessiagh-Clonmass Formation	TE	Termon Formation	Md	Metadolerite sheet, mainly sills
UF	Upper Falcarragh Pelite Formation	PA	Port Ascaig Formation		

Minerex Environmental Limited

Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey
TITLE	Map 2: Bedrock Geological Map

Scale:	NTS
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1503_Map2.dwg
Based on:	GSI-Map

Minerex
Environmental Limited
Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

CLIENT: Foundation and Exploration Services

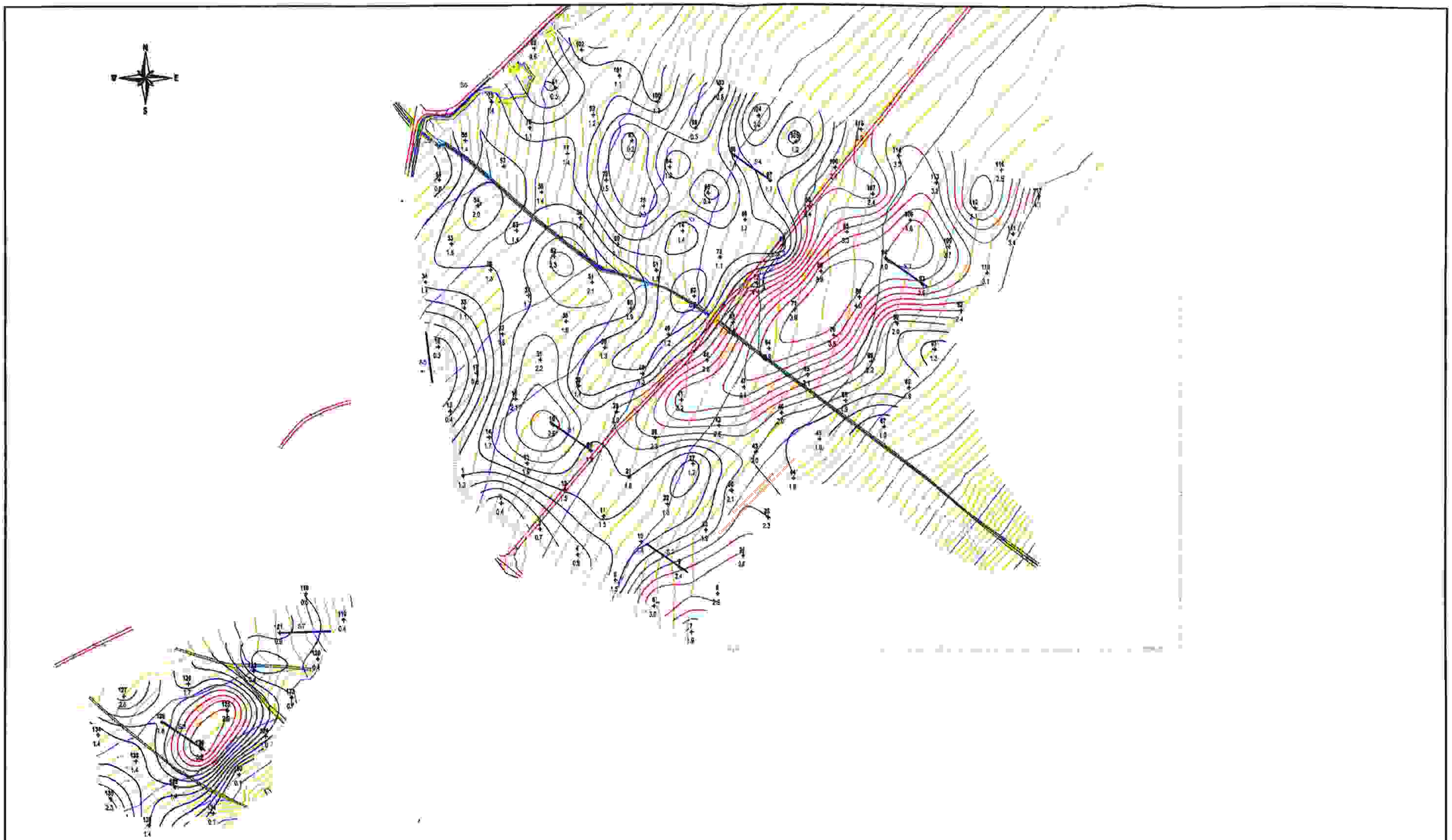
PROJECT: Meenaboll Site Investigation Geophysical Survey

TITLE: Map 3: Geophysical Survey Location Map

LEGEND

- Seismic Refraction Profile
- 11 — VLF-R and Gouge Core Station
- EM1 — VLF-EM Survey Line

Scale:	1:4000
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1503_Map3.dwg
Based on:	6613-2d



Minerex
Environmental Limited

Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey
TITLE	Map 4: Peat Thickness Contour Map

LEGEND

11
1.5
VLF-R and Gauge Core Station with Peat Thickness (m) annotated

Peat Thickness Contour Lines

Scale:	1:4000
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1504_Map4.dwg
Based on:	6613-2d

Minerex
Environmental Limited

Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

CLIENT: Foundation and Exploration Services

PROJECT: Meenaboll Site Investigation Geophysical Survey

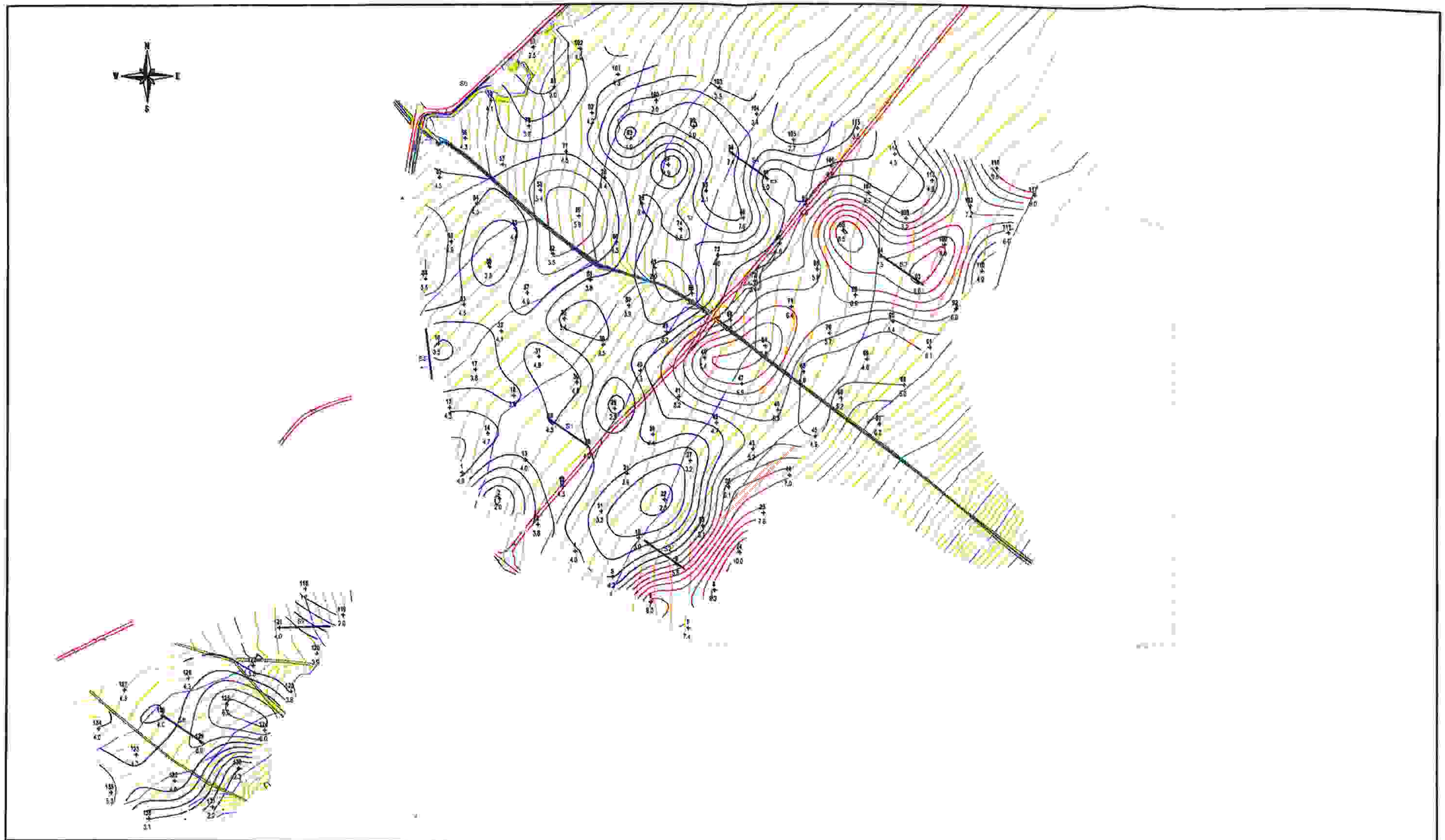
TITLE: Map 5: Glacial Till Thickness Contour Map

LEGEND

11
+
1.5 — VLF-R and Gauge Core Station with Glacial Till Thickness (m) annotated

Glacial Till Thickness Contour Lines

Scale:	1:4000
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1504_Map5.dwg
Based on:	6613-2d



Minerex Environmental Limited

Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

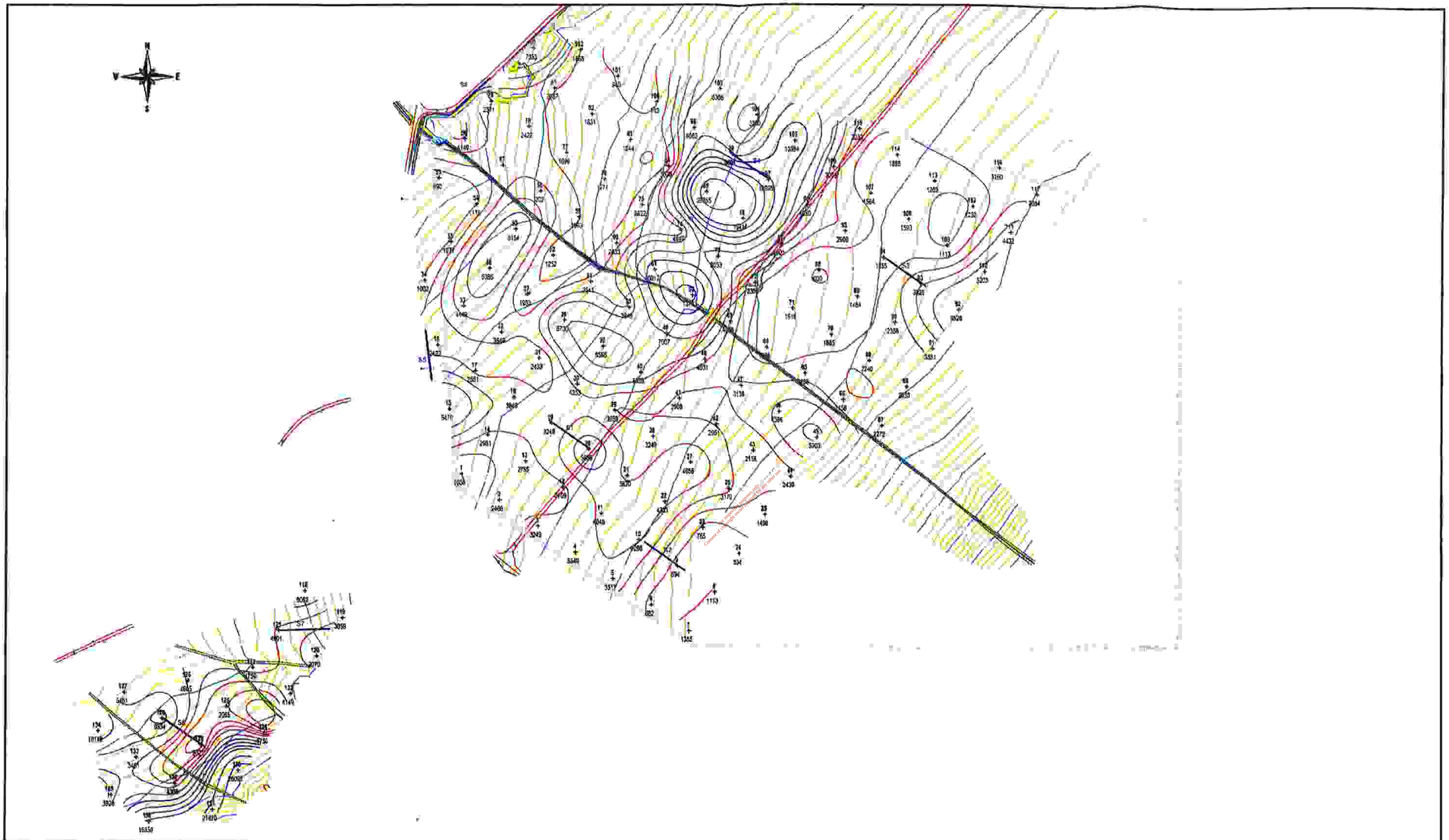
CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey
TITLE	Map 6: Rockhead Contour Map

LEGEND

11
1.5
VLF-R and Gauge Core Station with Rockhead Contour Map (Depth in m) annotated

Rockhead Depth Contour Lines

Scale:	1:4000
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1504_Map6.dwg
Based on:	6613-2d

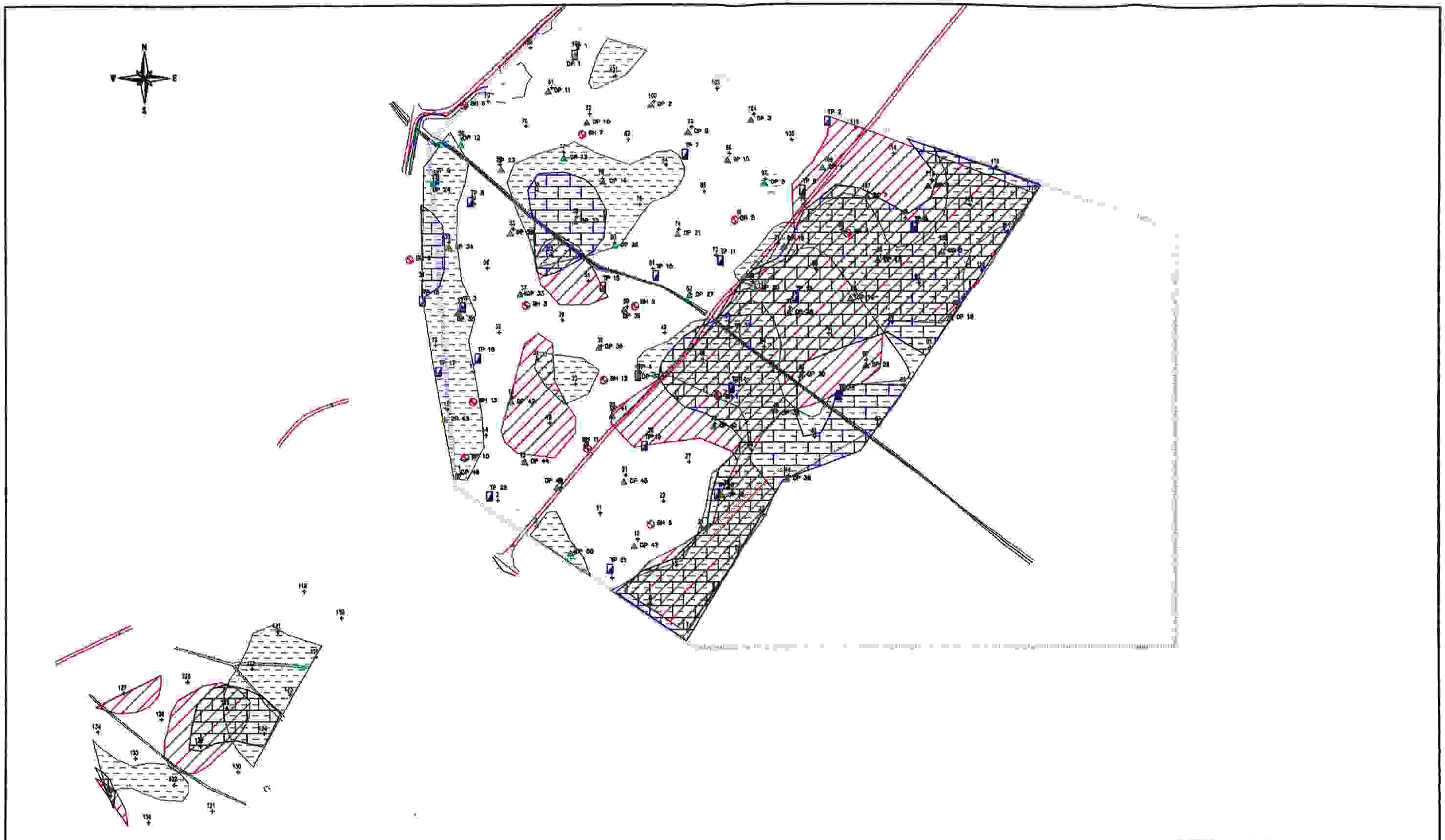


Minerex Environmental Limited	
Taney Hall, Eglinton Terrace Dundrum, Dublin 14 Tel. (01) 2964435 Fax (01) 2964436 Email: minerex@iol.ie Web: www.minerex.ie	
CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey
TITLE	Map 7: VLF-R Bedrock Resistivity Contour Map

LEGEND

11 1.5	VLF-R and Gauge Core Station with Bedrock Resistivities (Ohmm) annotated
	Bedrock Resistivity Contour Lines (non linear scale)

Scale:	1:4000
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1504_Map7.dwg
Based on:	6613-2d



Minerex
Environmental Limited

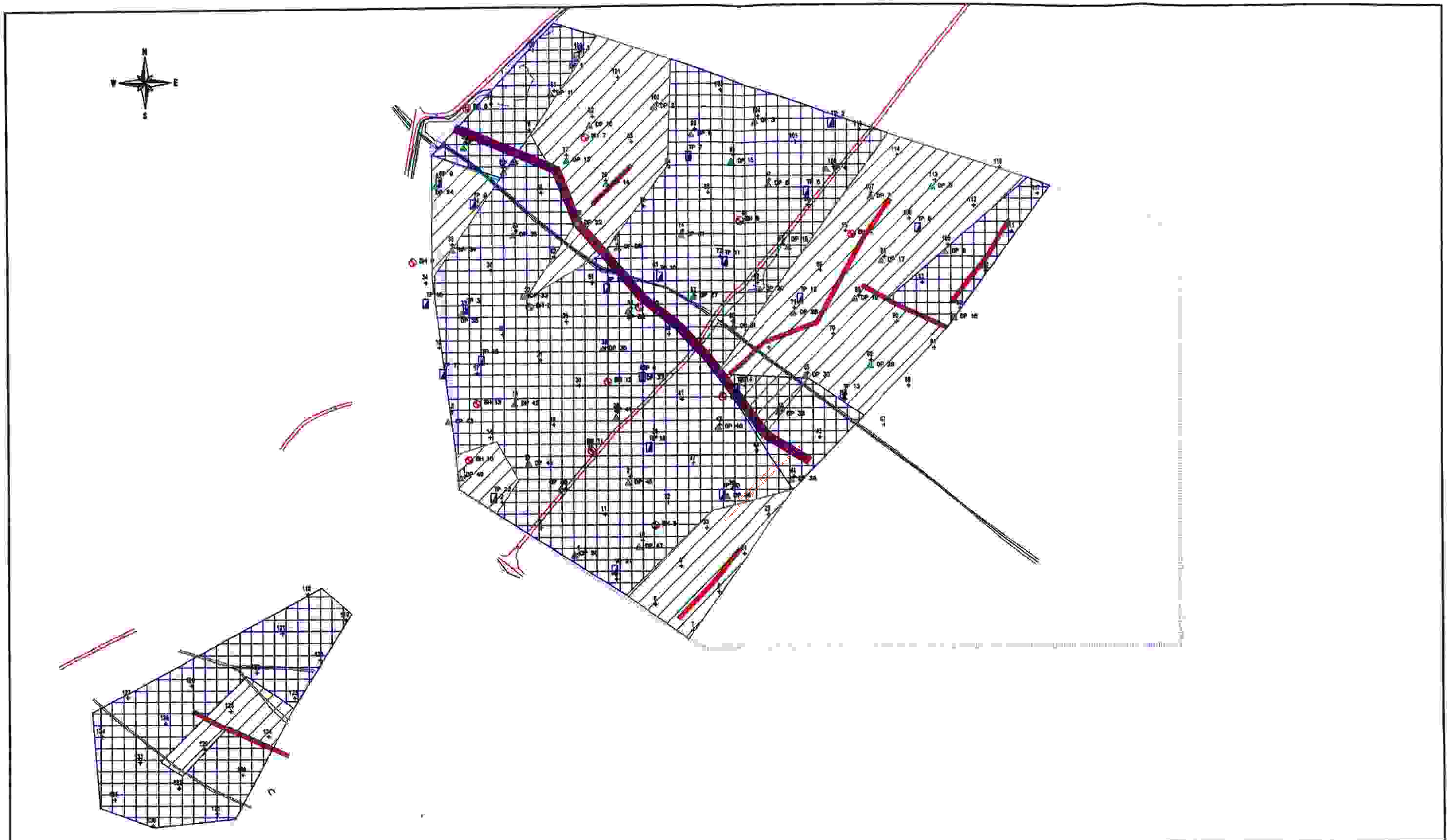
Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey
TITLE	Map 8: Interpretation Map of Layer Thickness

LEGEND

- Peat Thickness > 2 m
- Glacial Till Thickness > 3 m
- Depth to Rock > 5 m

Scale:	1:4000
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1503_Map8.dwg
Based on:	6813-2d



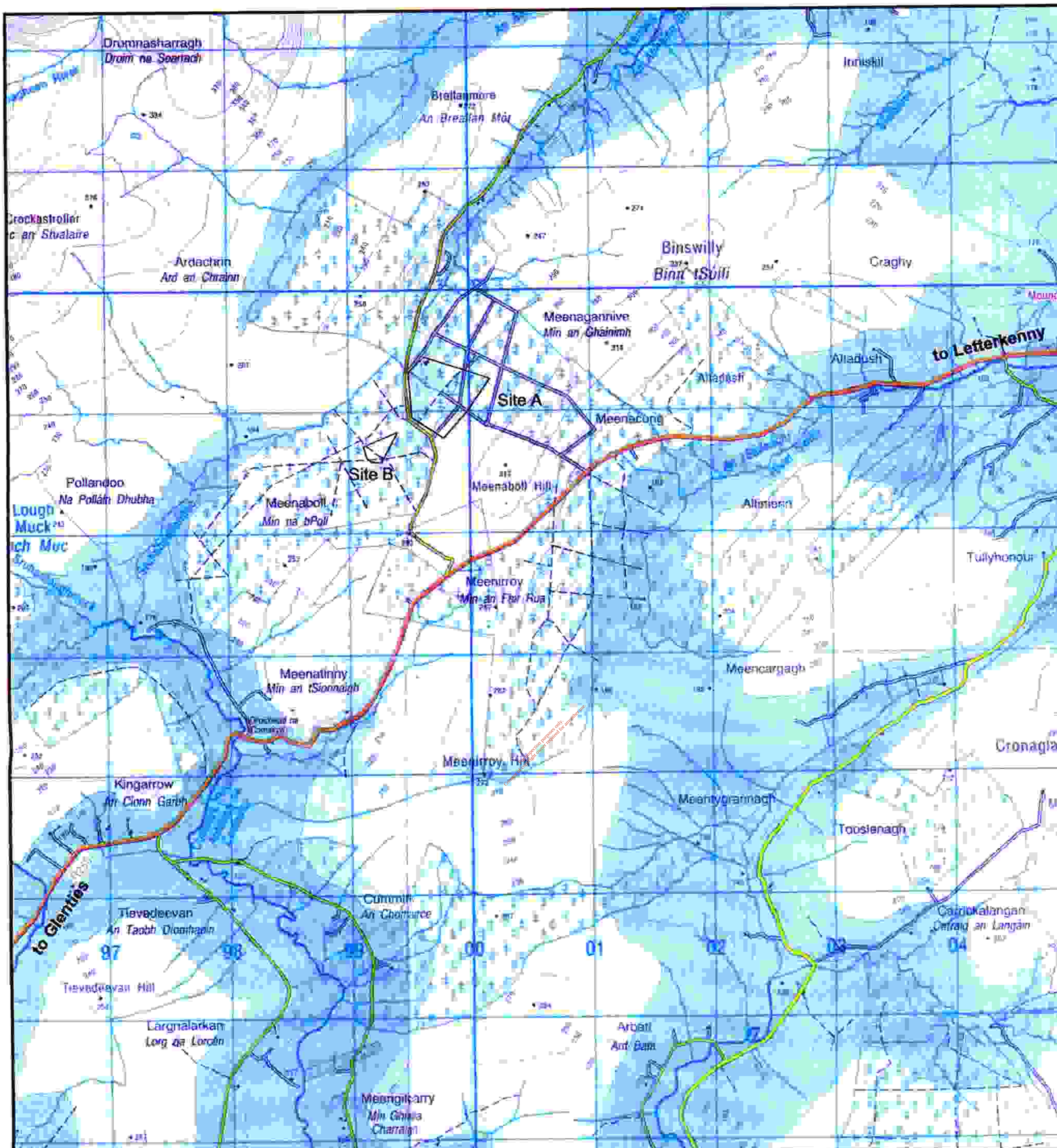
Minerex Environmental Limited
Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey
TITLE	Map 9: Interpretation Map of Bedrock Features

LEGEND

- Psammitic Schist (very high resistivity)
- Psammitic Schist (medium resistivity)
- Dolerite Dyke / Fault Zone
- Minor fault / axis of lower resistivity bedrock layer

Scale:	1:4000
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1503_Map9.dwg
Based on:	6613-2d



LEGEND

Minerex Environmental Limited
Taney Hall, Eglinton Terrace
Dundrum, Dublin 14
Tel. (01) 2964435
Fax (01) 2964436
Email: minerex@iol.ie
Web: www.minerex.ie

CLIENT	Foundation and Exploration Services
PROJECT	Meenaboll Site Investigation Geophysical Survey
TITLE	Map 1: Site Location Map

Scale:	NTS
Project:	1503
Drawn:	BW/HK
Date:	3/3/03
MEL File:	1503_Map1.dwg
Based on:	OS-Map