

# **EXPLORATION AND MINING DIVISION IRELAND**

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## **THE BHP AIRBORNE TEM AND MAGNETIC SURVEY (1998) OVER THE LIMERICK, GORT AND NEWBRIDGE SOUTH AREAS**

**July 2002**



Department of Communications, Marine  
and Natural Resources

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## INTRODUCTION

In the period January to March 1998, BHP Minerals International Inc. flew a 4227 line km magnetic and electromagnetic survey over two areas encompassing approximately 1238 km<sup>2</sup> (Figure 1).

| <b>Block</b>           | <b>Line km</b> | <b>Approx. Area (km<sup>2</sup>)</b> | <b>Prospecting Licences covered / partially covered by Survey Areas</b>  |
|------------------------|----------------|--------------------------------------|--|
| <b>Gort</b>            | 390            | 118                                  | 1983, 2687, 2689, 2848, 3043, 3479, 3692, X11  |
| <b>Limerick</b>        | 3022           | 878                                  | 72, 449, 635, 636, 786, 1302, 1303, 1583, 1584, 1942, 2471, 2529, 2531, 2579, 2638, 2696, 2756, 2762, 2835, 2844, 2845, 2872, 2927, 3267, 3344, 3366, 3367, 3368, 3369, 3431, 3488, 3489, 3501, 3504, 3509, 3544, 3545, 3550, 3608, 3654, 3806, 3807, 3824, 3858, 3859, 3908 |
| <b>Newbridge South</b> | 815            | 242                                  | 600, 1607, 1632, 2516, 2822, 2823, 3547, 3610, 3649, 3684, 3795, 3796, 3797, 3846, 3866  |

This survey was acquired over four years ago and is available to the general public in fulfilment of the 'Open Skies' policy of the Exploration and Mining Division (EMD). The Division acknowledges the cooperation of BHP and the assistance of PGW Europe Ltd.

At this time EMD is primarily concerned with prompt data release and no attempt was made to reprocess or correct survey data. Data is released as submitted and no liability is accepted on the part of the EMD for data quality or accuracy. However, to facilitate ease of use, several grids are provided with an Ordnance Survey base map for ease of geographical reference.

Geoterrex conducted the survey using a towed bird magnetometer and the GEOTEM<sup>®</sup>III electromagnetic system. This consists of 3 receiver coils, the x-coil and y-coil axes along and perpendicular to the flight direction and a vertical z-coil axis.

Time domain electromagnetic (TDEM), magnetic, radar altimeter and navigation data was acquired during the survey. All processing was carried out by Geoterrex, which is now part of Fugro Airborne Surveys.

The survey specifications, and data acquisition and processing procedures used are outlined in the Geoterrex report. The survey results are discussed in the Ireland Zinc Program Geophysics report by BHP. A listing of all digital and hardcopy data (databases, grids, maps and company reports) lodged with the Exploration and Mining Division is included in this publication and outlined below in the data listings section.

## SURVEY EQUIPMENT AND SPECIFICATIONS

|                                   |  |
|-----------------------------------|--|
| <b>Flight Line Spacing</b>        | 300m   |
| <b>Flight Line Direction</b>      | Limerick: 10° (NW-SE)<br>Gort: 120°<br>Newbridge South: 144°   |
| <b>Tie Line Spacing</b>           | Limerick: 2500m-2700m<br>Gort: 1900m<br>Newbridge South: 2500m |
| <b>Mean Terrain Clearance</b>     | 120 m  |
| <b>Nominal Survey Speed</b>       | 120 knots ( 62 m/s )   |
| <b>Total Survey Area</b>          | 1238 km <sup>2</sup>   |
| <b>Total Line Km</b>              | 4227 line km   |
| <b>Magnetometer</b>               | CS-2 Cesium Vapour   |
| <b>Sensitivity</b>                | 0.01 nT  |
| <b>Sample Rate</b>                | 10 samples /sec  |
| <b>Mounting</b>                   | Towed Bird   |
| <b>Sensor Height above ground</b> | 73 m   |
| <b>TEM Receiver</b>               | Horizontal & vertical coils                                    |
| <b>TEM Transmitter</b>            | Vertical axis loop   |
| <b>Cycle rate</b>                 | 75 Hz  |
| <b>Pulse width</b>                | 2.082 msec   |
| <b>Pulse Delay</b>                | 0.104 msec   |
| <b>Off-Time</b>                   | 4.480 msec   |
| <b>Sample Rate</b>                | 4 samples/sec  |
| <b>Mounting</b>                   | Towed Bird   |
| <b>Sensor Height above ground</b> | 70 m   |

Below are the window mean delay times (in milliseconds), from the end of the transmitter pulse, for a 75 Hz base frequency as listed in the Geoterrex reports and readme files.

|             |        |             |       |
|-------------|--------|-------------|-------|
| <b>em1</b>  | -1.953 | <b>em11</b> | 1.146 |
| <b>em2</b>  | -1.562 | <b>em12</b> | 1.407 |
| <b>em3</b>  | -0.989 | <b>em13</b> | 1.693 |
| <b>em4</b>  | -0.416 | <b>em14</b> | 2.005 |
| <b>em5</b>  | 0.163  | <b>em15</b> | 2.344 |
| <b>em6</b>  | 0.235  | <b>em16</b> | 2.709 |
| <b>em7</b>  | 0.365  | <b>em17</b> | 3.073 |
| <b>em8</b>  | 0.521  | <b>em18</b> | 3.464 |
| <b>em9</b>  | 0.703  | <b>em19</b> | 3.880 |
| <b>em10</b> | 0.912  | <b>em20</b> | 4.297 |

# **PROCESSING OVERVIEW AND MAP GENERATION**

The information provided in this section was taken from the Geoterrex reports and readme files for the survey (included on CD) and from examination of the data.

## **Magnetics Processing Sequence**

A system lag correction of 3.6 seconds was applied followed by noise editing (de-spiking) and filtering. Appendix A of the Geoterrex report outlines the field processing sequence in more detail. The long wavelength component (greater than 40 seconds) of the diurnal field was removed from the data. The regional magnetic field (IGRF) was also removed and the data was leveled and then microlevelled. The data was re-sampled to 5 samples per second for inclusion in the final database. The final data channels were de-cultured using an automatic routine.

## **Electromagnetics Processing Sequence**

A system lag correction of 4.5 secs was applied followed by drift corrections to the off-time channels 5 to 20 and on-time channel 1. Each EM transient decay curve was de-spiked and the data was then noise filtered and smoothed. Appendix A of the Geoterrex report outlines the field processing sequence in more detail. The data was re-sampled to 5 samples per second for inclusion in the final database. No corrections for flight direction asymmetry (de-herringboning) were applied.

### **EM Decay Constant Calculation**

The early time decay constant was calculated from the z-coil data by fitting channels 8 to 14 (0.521 – 2.005 msec) to a single exponential function. The late time decay constant was also calculated from the z-coil data by fitting channels 12 to 18 (1.407 – 3.464 msec). A slow rate of decay gives a high decay constant which indicates a better conductor.

### **EM Anomaly Selection & Apparent Conductivity Calculation**

EM anomalies were located by an automatic anomaly picking routine, using channel 12 (mean delay time 1.407 msec) as a reference. X coil channels 9 to 20 were then fitted to the vertical plate model to extract conductance and depth information. Appendix E of the Geoterrex report lists anomalies for all the areas surveyed. The BHP Ireland Zinc Program Geophysics report also highlights describes 11 anomalies and some borehole and TEM ground follow-up. Hardcopy maps with anomaly picks were provided and scanned in EMD. No apparent conductivity data was submitted with the survey.

## Grid and Map Generation

No grids were submitted by BHP with the survey data. Grids were generated in EMD from the final magnetic channel and TEM decay constant channels using a minimum curvature interpolation. The grid cell size is 75m and the grids are in Geosoft grd format. These grids were then used to generate the EMD decay constant and TMI maps on an Ordnance Survey base.

All digital and hardcopy products are in the Irish National Grid (ING) coordinate system:

|                    |                           |
|--------------------|---------------------------|
| Datum:             | TM65 / Airy Modified 1849 |
| Ellipsoid:         | Airy Modified 1849        |
|                    | Major axis: 6377340.189   |
|                    | Eccentricity: 0.081673374 |
|                    | 1/f: 299.3249646          |
| Projection         | Transverse Mercator       |
| Central Meridian   | -8.00.00.000              |
| Latitude of origin | 53.30.00.000              |
| False Northing:    | 250,000 m                 |
| False Easting:     | 200,000 m                 |
| Scale factor:      | 1.000035                  |

## DATA LISTING

### Geosoft polygon files of survey boundaries

Geosoft polygon files (\*.ply) for each survey area are included on the CD. The files are in ASCII format and can be opened in any text editor to view survey boundary coordinates (in ING).

### Databases

The data was supplied in ASCII format and imported into Geosoft database format (GDB) by EMD. Geoterrex readme files with channel listings are included on the CD (summarised on page 8).

### Processed GEOTEM and Magnetic Data (Geosoft GDB)

| Block           | Database       | Number of Channels | Approx. Size (Mb) | File Name (.gdb) |
|-----------------|----------------|--------------------|-------------------|------------------|
| Limerick        | Magnetics & EM | 137                | 95.4              | bhp981_lim       |
| Gort            |                | 137                | 14.7              | bhp981_gort      |
| Newbridge South |                | 137                | 26.5              | bhp981_newbs     |

## Grids

No grids for this survey were submitted by BHP. The following grids in Geosoft grid format (grd) were produced in EMD. All grids have a cell spacing of 75 m.

| Block           | Grid  | Grid Name       |
|-----------------|---|-----------------|
| Limerick        | Total magnetic intensity                    | lim_tmi_emd     |
|                 | Early decay constant (z-coil channels 8-14) | lim_etauz_emd   |
|                 | Late decay constant (z-coil channels 12-18) | lim_ltauz_emd   |
| Gort            | Total magnetic intensity                    | gort_tmi_emd    |
|                 | Early decay constant (z-coil channels 8-14) | gort_etauz_emd  |
|                 | Late decay constant (z-coil channels 12-18) | gort_ltauz_emd  |
| Newbridge South | Total magnetic intensity                    | newbs_tmi_emd   |
|                 | Early decay constant (z-coil channels 8-14) | newbs_etauz_emd |
|                 | Late decay constant (z-coil channels 12-18) | newbs_ltauz_emd |

## Maps

All hardcopy maps submitted by BHP for this release were scanned and stored in a compressed TIFF format, to keep file sizes manageable. Compression was carried out using Imaging for Windows, which is available under the Accessories menu in Windows. Colour images were compressed using LZW compression, which can be opened in most standard packages. *LZW compressed TIFF images can only be viewed in Geosoft when they are imported as a GeoTIFF file.* Maps produced in EMD, on an Ordnance Survey 1:50,000 base, are available on the release CD as uncompressed images in JPEG format, or in hardcopy format on request.

## Supplied by BHP

| Block    | Map Title  | Filename  | Scale    |
|----------|--|-----------|----------|
| Limerick | GEOTEM Electromagnetic Anomaly Map (X-coil) with Flight Path   | bhp10.1.1 | 1:50,000 |
|          | Total Magnetic Intensity Contour Map (I.G.R.F. removed)        | bhp10.1.2 |          |
|          | EM Mid-Late Time Decay Constant Contour Map (Z-coil, Ch 12-18) | bhp10.1.3 |          |
|          | TMI Residual Drapes with North Sun                             | bhp10.1.4 |          |
|          | TMI Residual Drapes with North Sun & XCHO8 Drapes              | bhp10.1.5 |          |
|          | Limerick Area Geology Map                                      | bhp10.1.6 |          |

|                 |  |           |
|-----------------|--|-----------|
|                 | EM and Magnetic Interpretation XCH08 drape on TMI with N sun angle   | bhp10.1.7 |
|                 | Geology including amendments from GEOTEM interpretation              | bhp10.1.8 |
| Gort            | GEOTEM Electromagnetic Anomaly Map (X-coil) with Flight Path         | bhp10.2.1 |
|                 | Total Magnetic Intensity Contour Map (I.G.R.F. removed)              | bhp10.2.2 |
|                 | EM Mid-Late Time Decay Constant Contour Map (Z-coil, Ch 12-18)       | bhp10.2.3 |
|                 | TMI Residual Drape with NW Sun & XCH08 Drape                         | bhp10.2.4 |
|                 | TMI Residual Drape with NW Sun angle                                 | bhp10.2.5 |
|                 | Geology Map  | bhp10.2.6 |
|                 | EM and Magnetic Interpretation XCH08 draped on TMI with NW sun angle | bhp10.2.7 |
| Newbridge South | Geology including amendments from GEOTEM interpretation              | bhp10.3.1 |
|                 | GEOTEM Electromagnetic Anomaly Map (X-coil) with Flight Path         | bhp10.3.2 |
|                 | Total Magnetic Intensity Contour Map (I.G.R.F. removed)              | bhp10.3.3 |
|                 | EM Mid-Late Time Decay Constant Contour Map (Z-coil, Ch 12-18)       | bhp10.3.4 |
|                 | TMI Residual Drape with North Sun & XCH08 Drape                      | bhp10.3.5 |
|                 | TMI Residual Drape with North Sun angle                              | bhp10.3.6 |
|                 | EM and Magnetic Interpretation XCH08 draped on TMI with NW sun angle | bhp10.3.7 |

**Supplied by EMD on Ordnance Survey base**

| Block           | Map   | Filename        | Scale    |
|-----------------|---|-----------------|----------|
| Limerick        | Processed total magnetic intensity            | lim_tmi_emd     | 1:50,000 |
| Gort            |   | gort_tmi_emd    | 1:50,000 |
| Newbridge South |   | newbs_tmi_emd   | 1:50,000 |
| Limerick        | Early decay constant<br>(z-coil channel 8-14) | lim_etauz_emd   | 1:50,000 |
| Gort            |   | gort_etauz_emd  | 1:50,000 |
| Newbridge South |   | newbs_etauz_emd | 1:50,000 |
| Limerick        | Late decay constant<br>(z-coil channel 12-18) | lim_ltauz_emd   | 1:50,000 |
| Gort            |   | gort_ltauz_emd  | 1:50,000 |
| Newbridge South |   | newbs_ltauz_emd | 1:50,000 |

These maps are available, on an Ordnance Survey 1:50,000 base, as scanned images (jpeg format) or in hardcopy format.

## Company reports

The Geoterrex logistics and processing report and the BHP Ireland Zinc Program Geophysics Report are both included on the release CD.

| <b>Report Title</b>   | <b>Filename (.pdf)</b> | <b>No. of pages</b> |
|---|------------------------|---------------------|
| Logistics and Processing Report Airborne Magnetic & GEOTEM<br>Electromagnetic Multi-coil Survey over the Limerick, Newbridge and Gort<br>Blocks | bhpr10_1               | 110                 |
| Ireland Zinc Program Geophysics Report GEOTEM Surveys over Gort,<br>Limerick, Newbridge South   | bhpr10_2               | 34                  |

# GEOSOFTE DATABASE CHANNEL LISTING

## Limerick, Gort and Newbridge South Magnetics and EM Database

| CHANNEL NAME      | DESCRIPTION  | UNITS             |
|-------------------|--|-------------------|
| FLT               | Flight Number  |                   |
| FID               | Fiducial   | seconds           |
| X                 | Easting  | metres            |
| Y                 | Northing   | metres            |
| RAW_MAG           | Total field magnetics (raw)  | nT x 100          |
| DIURNAL           | Diurnal magnetics  | nT x 100          |
| TF_MAG            | Total field magnetics (processed)  | nT x 100          |
| PRO_MAG           | Final magnetics (IGRF removed)   | nT x 100          |
| MAG_COMP          | Final magnetic micro-leveling values<br>= difference before and after micro-leveling | nT x 100          |
| IGRF              | IGRF   | nT x 100          |
| GRADIENT_MAG      | RF vertical gradient   | nT/km x 100       |
| RAD               | Radar altimeter  | metres            |
| GPS               | GPS elevation  | metres            |
| EARLY_DC_Z        | Early decay constant from z-coil channels 8-14                                       | µsec              |
| LATE_DC_Z         | Late decay constant from z-coil channels 12-18                                       | µsec              |
| PRIMARY_FIELD     | Em primary field   | uv                |
| POWERLINE_MONITOR | Powerline monitor  | uv                |
| RAW_X1 to RAW_X20 | Raw EM channel X1 to X20   | PV/m <sup>2</sup> |
| RAW_Y1 to RAW_Y20 | Raw EM channel Y1 to Y20   | PV/m <sup>2</sup> |
| RAW_Z1 to RAW_Z20 | Raw EM channel Z1 to Z20   | PV/m <sup>2</sup> |
| X1 to X20         | Processed EM channel X1 to X20   | ppm               |
| Y1 to Y20         | Processed EM channel Y1 to Y20   | PV/m <sup>2</sup> |
| Z1 to Z20         | Processed EM channel Z1 to Z20   | ppm               |

# SURVEY LOCATION

## THE BHP AIRBORNE TEM AND MAGNETIC SURVEY (1998) LIMERICK, GORT AND NEWBRIDGE SOUTH AREAS

9.1 Limerick  
2 Gort  
3 Newbridge South

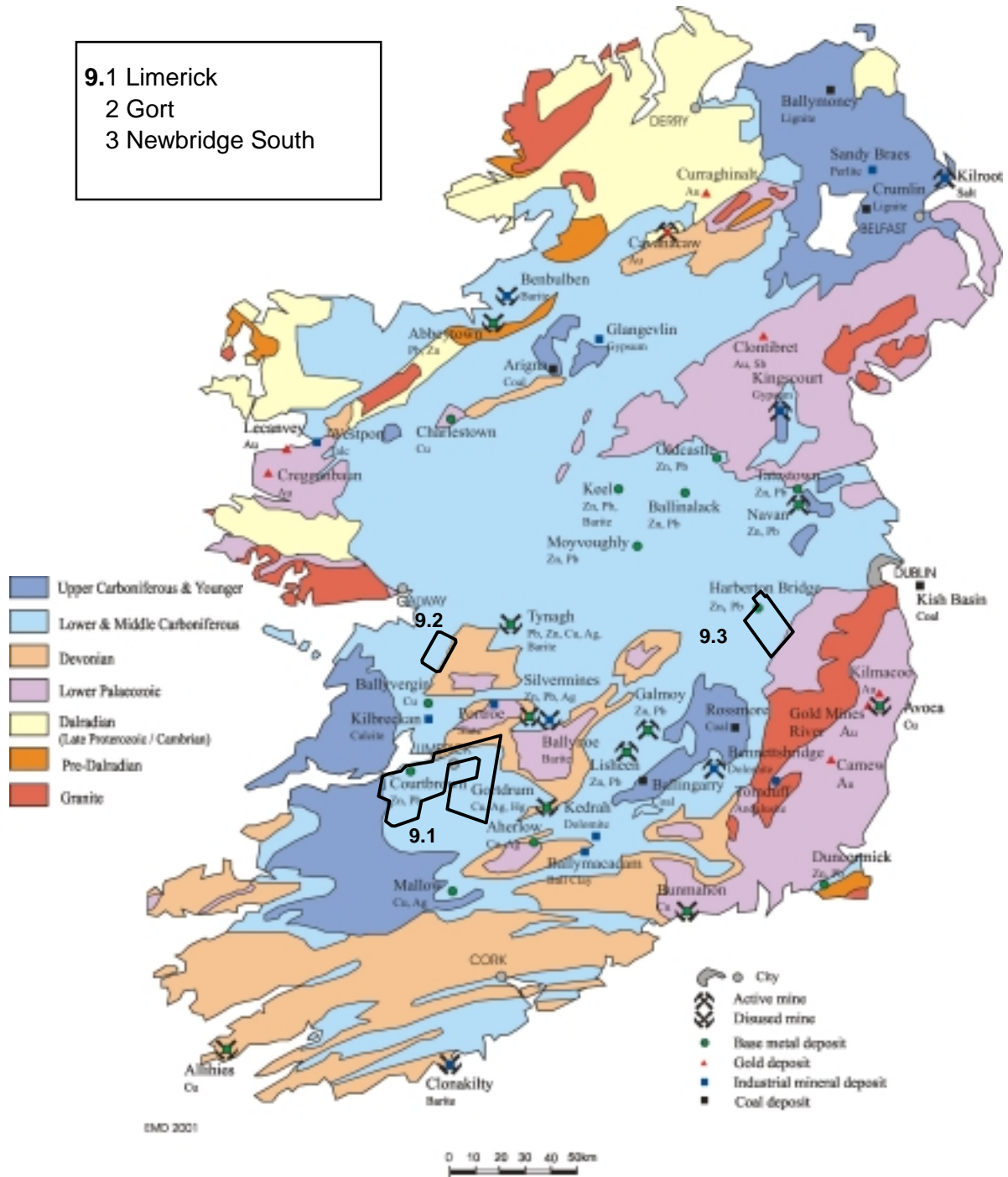


Figure 1. Location of the survey areas on a simplified geology map of Ireland.

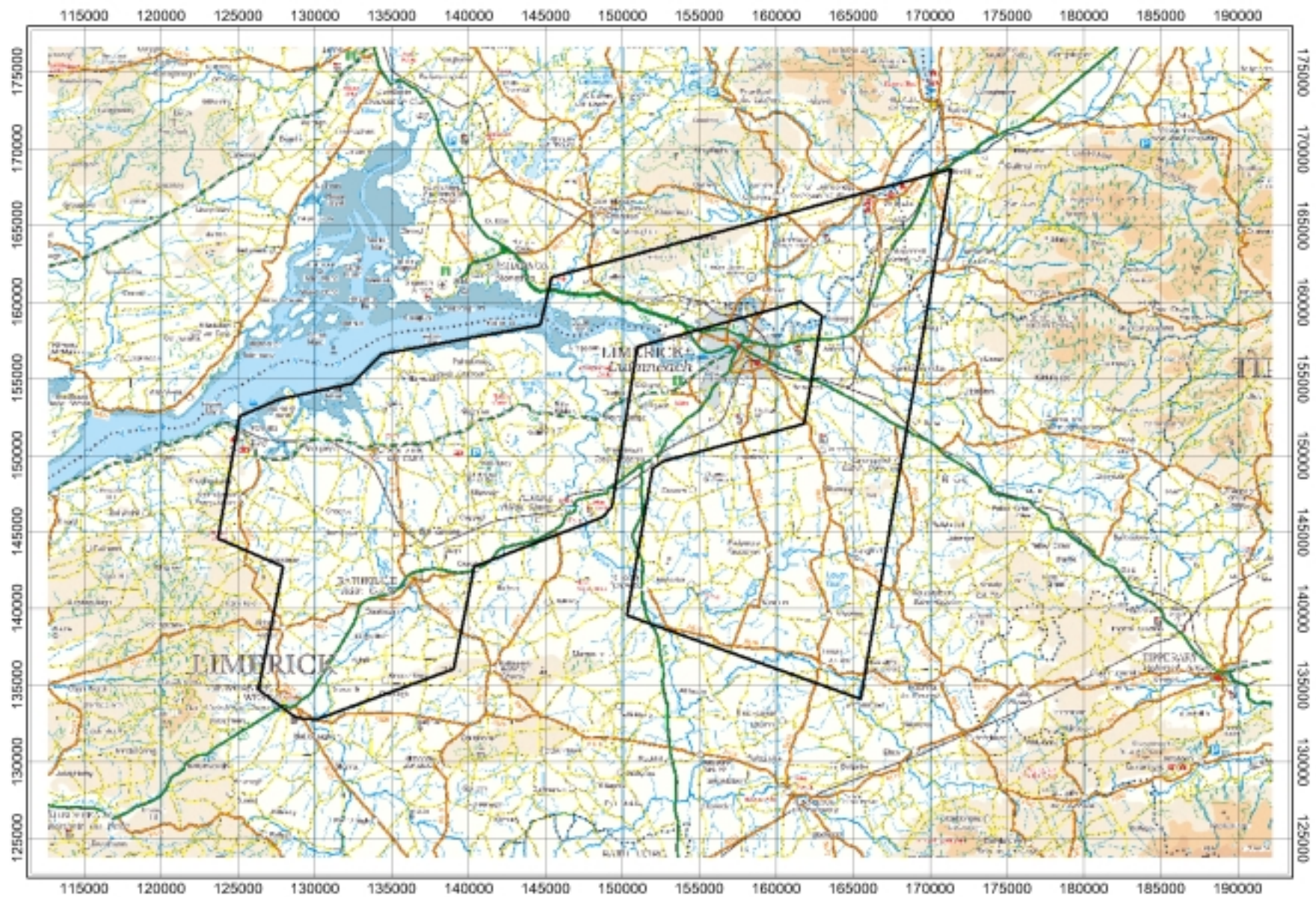


Figure 2. The Limerick survey area on a 1:250,000 Ordnance Survey base.



Figure 3. The Gort survey area on a 1:250,000 Ordnance Survey base.

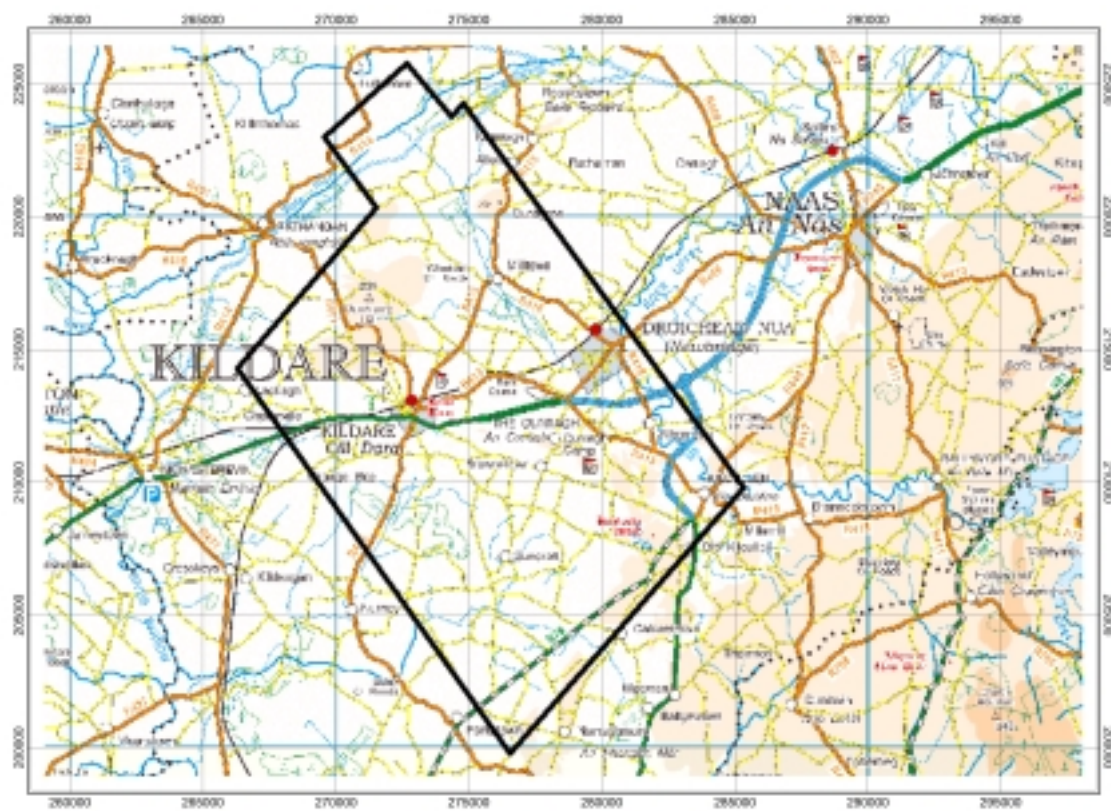


Figure 4. The Newbridge South survey area on a 1:250,000 Ordnance Survey base.