

**EXPLORATION
AND MINING
DIVISION
IRELAND**

ZINC • LEAD • COPPER • GOLD • SILVER • BARYTES • GYPSUM • COAL • DOLOMITE

**THE NORANDA/ BILLITON AIRBORNE TEM AND
MAGNETIC SURVEY (1997) OVER THE TULLAMORE
AREA**

June 2002



Department of Communications, Marine
and Natural Resources

**Department of Communications, Marine
and Natural Resources**

**THE NORANDA / BILLITON AIRBORNE TEM AND
MAGNETIC SURVEY (1997) OVER THE TULLAMORE
AREA**

Compiled by
Orla Dardis

**EXPLORATION AND MINING DIVISION
MINERALS PUBLICATION MP 11/02**

JUNE 2002

**© Exploration and Mining Division 2002
Published by authority of the Minister for Communications, Marine
and Natural Resources**

TABLE OF CONTENTS

INTRODUCTION	1
SURVEY EQUIPMENT AND SPECIFICATIONS	2
PROCESSING OVERVIEW AND MAP GENERATION	3
Magnetics Processing Sequence	3
Electromagnetics Processing Sequence	3
Grid and Map Generation	3
DATA LISTING	4
Geosoft polygon files of survey boundaries	4
Databases	4
Processed GEOTEM and Magnetic Data (Geosoft GDB)	4
Grids	5
Maps	5
Supplied by Noranda/Billiton	5
Supplied by EMD on Ordnance Survey base	6
Company reports	6
GEOSOFT DATABASE CHANNEL LISTING 1	7
Tullamore A,B,C,D,E and Test Areas EM Database	7
GEOSOFT DATABASE CHANNEL LISTING 2	9
Tullamore A,B,C,D,E and Test Areas Magnetics and EM Database	9
SURVEY LOCATION	10
Figure 1. Location of the survey areas on a simplified geology map of Ireland.	10
Figure 2. The Tullamore A,C,D,E survey areas on a 1:250,000 Ordnance Survey base.	11
Figure 3. The Tullamore B survey area on a 1:250,000 Ordnance Survey base.	12
Figure 4. Test areas (1 & 2) on a 1:250,000 Ordnance Survey base.	12

INTRODUCTION

In May and June 1997, Noranda Exploration Ireland Ltd. and Billiton Ireland Resources BV flew a 5689 line km joint venture magnetic and electromagnetic survey over two areas encompassing approximately 1558 km² (Figure 1).

Block	Line km	Approx. Area (km²)	Prospecting Licences covered / partially covered by Survey Areas
Tullamore A, C, D, E	4930	1370	3660, 3638, 1245, 3852, 3346, 3639, 3324, 1324, 1352, 382, 3152, 1322, 1323, 1406, 1181, 1339, 3575, 3576, 3635, 2676, 1179, 1177, 2540, 2757, 2539, 2062, 3545, 2758, 2536, 2537, 2538, 1626, 3648, 1628, 890, 2748, 1624, 3854, 3649, 2476, 3853, 1640, 3427, 1641, 3322
Tullamore B	619	188	2860, 2861, 2859, 3266, 3432, 3147, 2747
Test Area 1 (Lisheen)	140	49	2258, 3245R, 3262
Test Area 2 (Galmoy)			586R, 3245R

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 Noranda and Billiton (now BHP-Billiton) and the assistance of PGW Europe Ltd. The survey was acquired as five areas. However, in this report Tullamore block B is a separate area whilst Tullamore blocks A,C,D and E are merged together into one large block .

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[®]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 reports. No interpretation report was submitted for the survey. 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

Flight Line Spacing	300m
Flight Line Direction	135° (NW-SE)
	Lisheen test area 1: 140°
	Galmoy test area 2: 160°
Tie Line Spacing	5000m
Mean Terrain Clearance	120 m
Nominal Survey Speed	120 knots (62 m/s)
Total Survey Area	1607 km ²
Total Line Km	5689 line km
Magnetometer	CS-2 Cesium Vapour
Sensitivity	0.01 nT
Sample Rate	10 samples /sec
Mounting	Towed Bird
Sensor Height above ground	75 m
TEM Receiver	Horizontal & vertical coils
TEM Transmitter	Vertical axis loop
Cycle rate	75 Hz
Pulse width	2.127 msec
Pulse Delay	0.134 msec
Off-Time	4.480 msec
Sample Rate	4 samples/sec
Mounting	Towed Bird
Sensor Height above ground	73 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 Geotrex reports and readme files.

em1	-1.953	em11	1.146
em2	-1.562	em12	1.407
em3	-0.989	em13	1.693
em4	-0.416	em14	2.005
em5	0.163	em15	2.344
em6	0.235	em16	2.709
em7	0.365	em17	3.073
em8	0.521	em18	3.464
em9	0.703	em19	3.880
em10	0.912	em20	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 the CD's) 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 reports outline the field processing sequence in more detail. The long wavelength component (greater than 79 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. It appears that the final data channels were not de-cultured. Grids were apparently created using a minimum curvature interpolation.

Electromagnetics Processing Sequence

A system lag correction of 4.0 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 reports outline the field processing sequence in more detail. The data was re-sampled to 5 samples per second for inclusion in the final database. It appears that the final data channels were not de-cultured.

EM Decay Constant Calculation

The EM time decay constant was calculated from the x-coil data by fitting channels 8 to 20 (approx. 0.521 – 4.297 msec) to a single exponential function. A slow rate of decay gives a high decay constant which indicates a better conductor.

EM Anomaly Selection & Apparent Conductivity Calculation

No digital anomaly listings were submitted with the survey. Hardcopy maps with anomaly picks were provided and scanned in EMD. Appendix E of both submitted reports lists anomalies for all the areas surveyed. No apparent conductivity data was submitted with the survey.

Grid and Map Generation

Grids were apparently created using a minimum curvature interpolation and submitted in grid exchange format (gxf). The original submitted grids were 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 pages 7 to 9). The processed magnetics and EM data is released on CD in Geosoft format. In the magnetics databases, the north-west ends of the lines: 135 to 172 and tielines 5005 to 5008 were affected by radio tower interference and are set to the null value of -9999999. Figure 2 on page 11 of the Noranda Geoterrex report shows the area affected by interference.

Processed GEOTEM and Magnetic Data (Geosoft GDB)

Block	Database	Number of Channels	Approx. Size (Mb)	File Name (.gdb)
Tullamore A,C,D,E	Magnetics & EM	18	16	billnor97_amag
	EM	64	64	billnor97_aem
Tullamore B	Magnetics & EM	18	4.2	billnor97_bmag
	EM	64	12.3	billnor97_bem
Test area 1 & 2 (Lisheen & Galmoy)	Magnetics & EM	18	2.5	billnor97_tmag
	EM	64	4.6	billnor97_tem

Grids

The following grids in gxf format were submitted by Noranda / Billiton. All grids have a cell spacing of 50 m.

Block	Grid	Grid Name	Format
Tullamore A,C,D,E	Total magnetic intensity	mag_a	gxf
	Decay constant (x-coil channel 8-20)	tau_a	gxf
Tullamore B	Total magnetic intensity	mag_b	gxf
	Decay constant (x-coil channel 8-20)	tau_b	gxf
Test areas (Lisheen & Galmoy)	Total magnetic intensity	mag_t	gxf
	Decay constant (x-coil channel 8-20)	tau_t	gxf

Maps

All hardcopy maps submitted by Noranda/Billiton 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 Noranda/Billiton

Block	Map Title	Filename	Scale
Tullamore-Blocks A,B,C,D,E & Test Areas	Total magnetic Intensity	bill7.1.1	1:100,000
	Z-Coil Amplitude Response (Ch 12) (with Anomaly Picks)	bill7.1.2	1:100,000
	X-Coil Amplitude Response (Ch 12) (with Anomaly Picks)	bill7.1.3	1:100,000
	X-Coil Amplitude Response (Ch 10) (with Anomaly Picks)	bill7.1.4	1:100,000
	Z-Coil Amplitude Response (Ch 10) (with Anomaly Picks)	bill7.1.5	1:100,000
	X-Coil Amplitude Response (Ch 8) (with Anomaly Picks)	bill7.1.6	1:100,000
	Z-Coil Amplitude Response (Ch 8) (with Anomaly Picks)	bill7.1.7	1:100,000
	X-Coil Amplitude Response (Ch 6) (with Anomaly Picks)	bill7.1.8	1:100,000
	Z-Coil Amplitude Response (Ch 6) (with Anomaly Picks)	bill7.1.9	1:100,000
	X-Coil Decay Constant (Ch 8-20)	bill7.1.10	1:100,000

Supplied by EMD on Ordnance Survey base

Block	Map	Filename	Scale
Tullamore A,C,D,E	Processed total magnetic intensity	tulla_tmi_emd	1:100,000
Tullamore B		tullb_tmi_emd	1:50,000
Test Areas		tullt_tmi_emd	1:25,000
Tullamore A,C,D,E	Decay constant (x-coil channel 8-20)	tulla_xtau_emd	1:100,000
Tullamore B		tullb_xtau_emd	1:50,000
Test Areas		tullt_xtau_emd	1:25,000

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 reports for both areas are included on the release CD's. No interpretation report was submitted. The Geoterrex report for Noranda contains information for all areas flown (Tullamore A,B,C,D and E) whilst the Billiton report is for parts of Tullamore areas A, C,D and E and excludes area B. Both reports are virtually identical.

Report Title	Filename (.pdf)	No. of pages
Logistics and Processing Report Airborne Magnetic & GEOTEM Electromagnetic Multicoil Survey over the Tullamore Area (Noranda)	norr7_1	220
Logistics and Processing Report Airborne Magnetic & GEOTEM Electromagnetic Multicoil Survey over the Tullamore Area (Billiton)	billr7_1	181

GEOSOFTE DATABASE CHANNEL LISTING 1

Tullamore A,B,C,D,E and Test Areas EM Database

CHANNEL NAME	DESCRIPTION	UNITS
X	Easting	metres
Y	Northing	metres
FID	Fiducial	seconds
POWERLINE_MONITOR	Powerline monitor	uV
X1	Em channel X1	ppm
X5	Em channel X5	ppm
X6	Em channel X6	ppm
X7	Em channel X7	ppm
X8	Em channel X8	ppm
X9	Em channel X9	ppm
X10	Em channel X10	ppm
X11	Em channel X11	ppm
X12	Em channel X12	ppm
X13	Em channel X13	ppm
X14	Em channel X14	ppm
X15	Em channel X15	ppm
X16	Em channel X16	ppm
X17	Em channel X17	ppm
X18	Em channel X18	ppm
X19	Em channel X19	ppm
X20	Em channel X20	ppm
RAW_X2	Raw Em channel X2	ppm
RAW_X3	Raw Em channel X3	ppm
RAW_X4	Raw Em channel X4	ppm
Z1	Em channel Z1	ppm
Z5	Em channel Z5	ppm
Z6	Em channel Z6	ppm
Z7	Em channel Z7	ppm
Z8	Em channel Z8	ppm
Z9	Em channel Z9	ppm
Z10	Em channel Z10	ppm
Z11	Em channel Z11	ppm
Z12	Em channel Z12	ppm
Z13	Em channel Z13	ppm
Z14	Em channel Z14	ppm

Z15	Em channel Z15	ppm
Z16	Em channel Z16	ppm
Z17	Em channel Z17	ppm
Z18	Em channel Z18	ppm
Z19	Em channel Z19	ppm
Z20	Em channel Z20	ppm
RAW_Z2	Raw Em channel Z2	ppm
RAW_Z3	Raw Em channel Z3	ppm
RAW_Z4	Raw Em channel Z4	ppm
Y1	Em channel Y1	PV/m ²
Y5	Em channel Y5	PV/m ²
Y6	Em channel Y6	PV/m ²
Y7	Em channel Y7	PV/m ²
Y8	Em channel Y8	PV/m ²
Y9	Em channel Y9	PV/m ²
Y10	Em channel Y10	PV/m ²
Y11	Em channel Y11	PV/m ²
Y12	Em channel Y12	PV/m ²
Y13	Em channel Y13	PV/m ²
Y14	Em channel Y14	PV/m ²
Y15	Em channel Y15	PV/m ²
Y16	Em channel Y16	PV/m ²
Y17	Em channel Y17	PV/m ²
Y18	Em channel Y18	PV/m ²
Y19	Em channel Y19	PV/m ²
Y20	Em channel Y20	PV/m ²
RAW_Y2	Raw Em channel Y2	PV/m ²
RAW_Y3	Raw Em channel Y3	PV/m ²
RAW_Y4	Raw Em channel Y4	PV/m ²

GEOSOFTE DATABASE CHANNEL LISTING 2

Tullamore A,B,C,D,E and Test Areas Magnetism and EM Database

CHANNEL NAME	DESCRIPTION	UNITS
X	Easting	metres
Y	Northing	metres
FID	Fiducial	seconds
RAD	Radar altimeter	metres
BAR	Barometric altimeter	metres
GPS	GPS elevation	metres x 100
LAT	Latitude	degrees
LONG	Longitude	degrees
DIURNAL	Diurnal magnetism	nT x 100
RAW_MAG	Total field magnetism (raw)	nT x 100
FINAL_MAG	Total field magnetism (processed)	nT x 100
COMP	Final magnetic micro-leveling values (none for test areas) = difference in values before and after leveling	nT x 100
IGRF	IGRF	nT x 100
GRAD	RF vertical gradient	nT/km
XPOWERLINE_MONITOR	Powerline monitor (x-coil)	uv
PRIMARY_FIELD	Em primary field	uv
TAU	Time decay constant from x-coil channels 8-20	μsec
FLT	Flight number	

SURVEY LOCATION

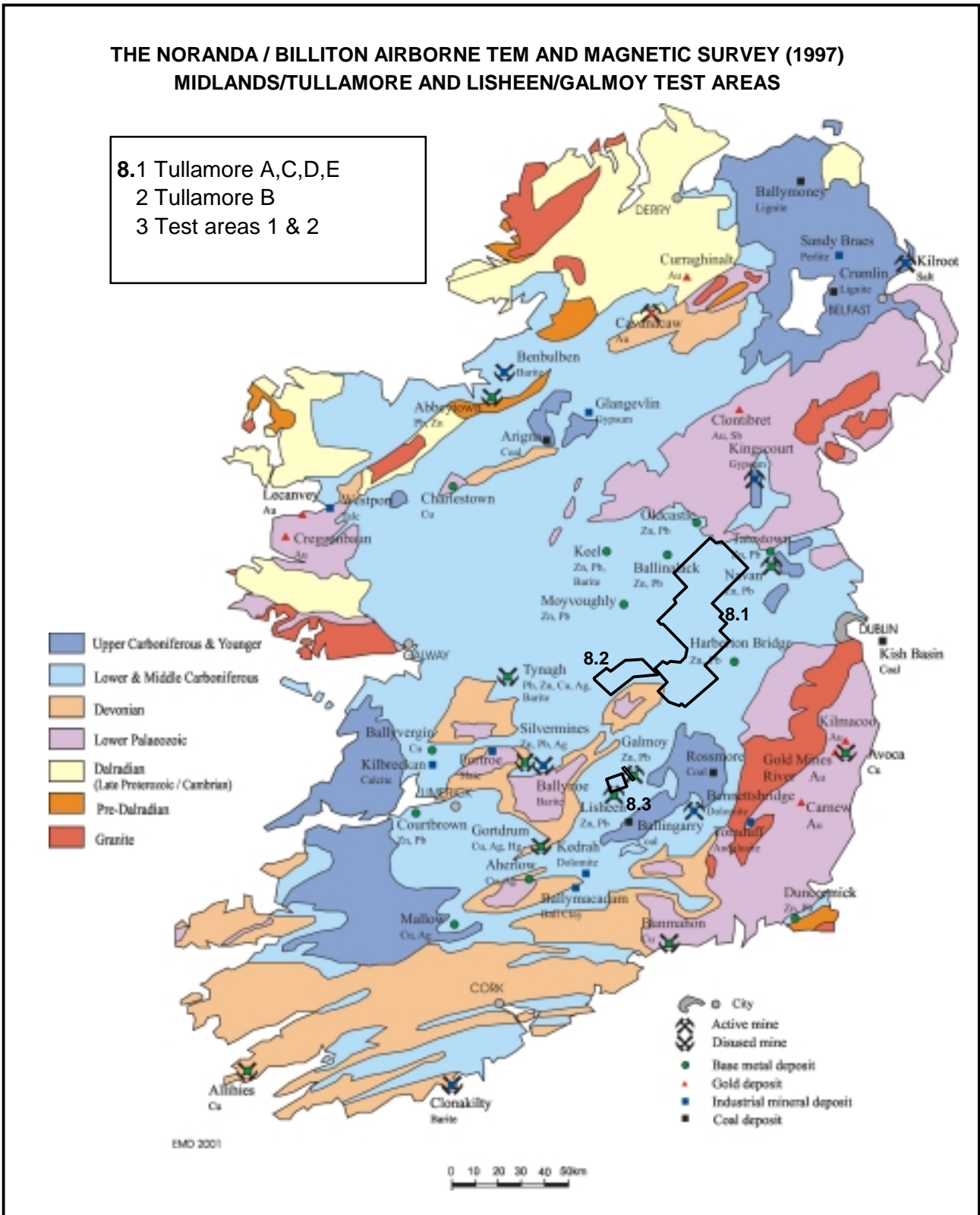


Figure 1. Location of the survey areas on a simplified geology map of Ireland.

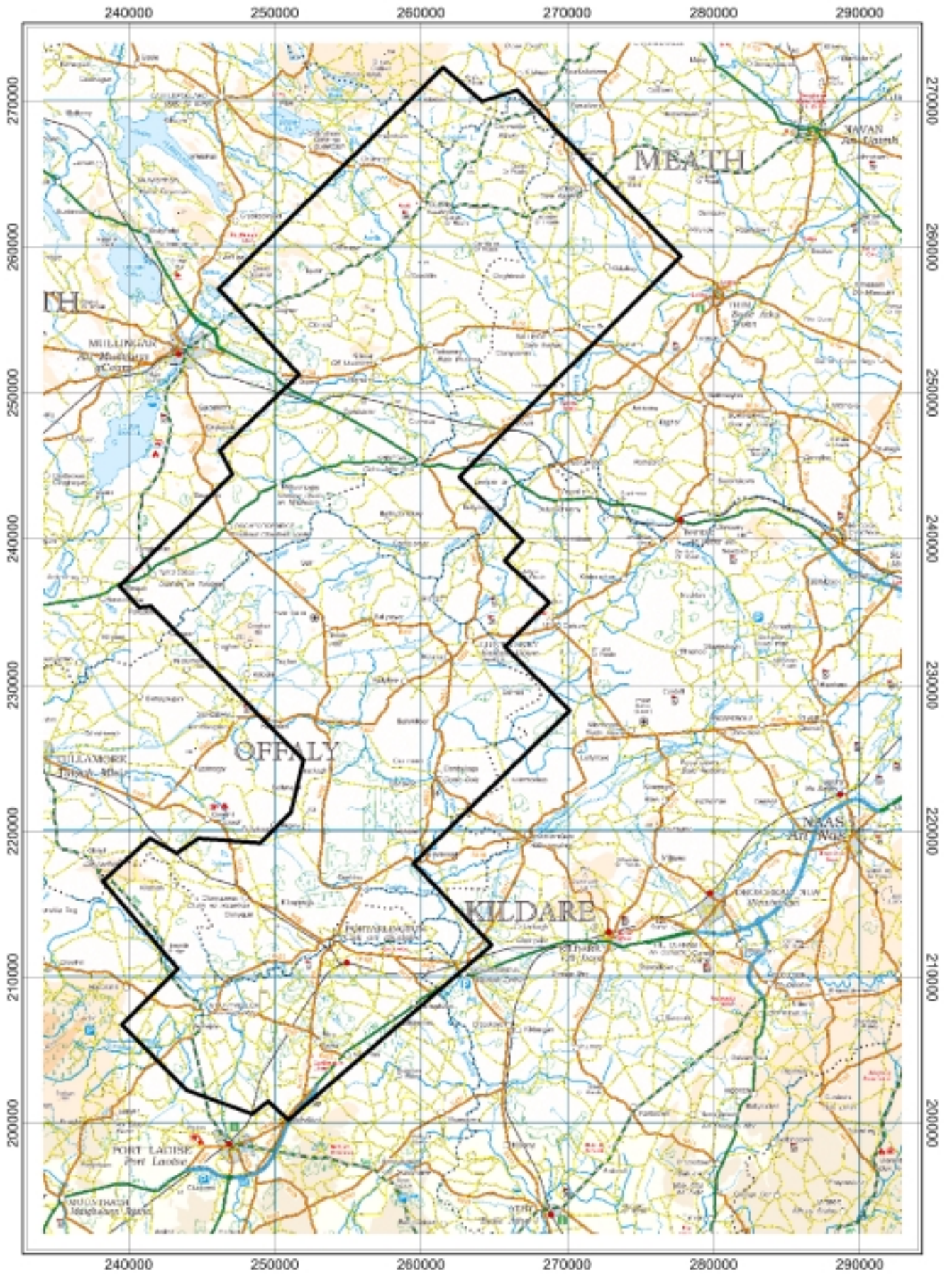


Figure 2. The Tullamore A,C,D,E survey areas on a 1:250,000 Ordnance Survey base.

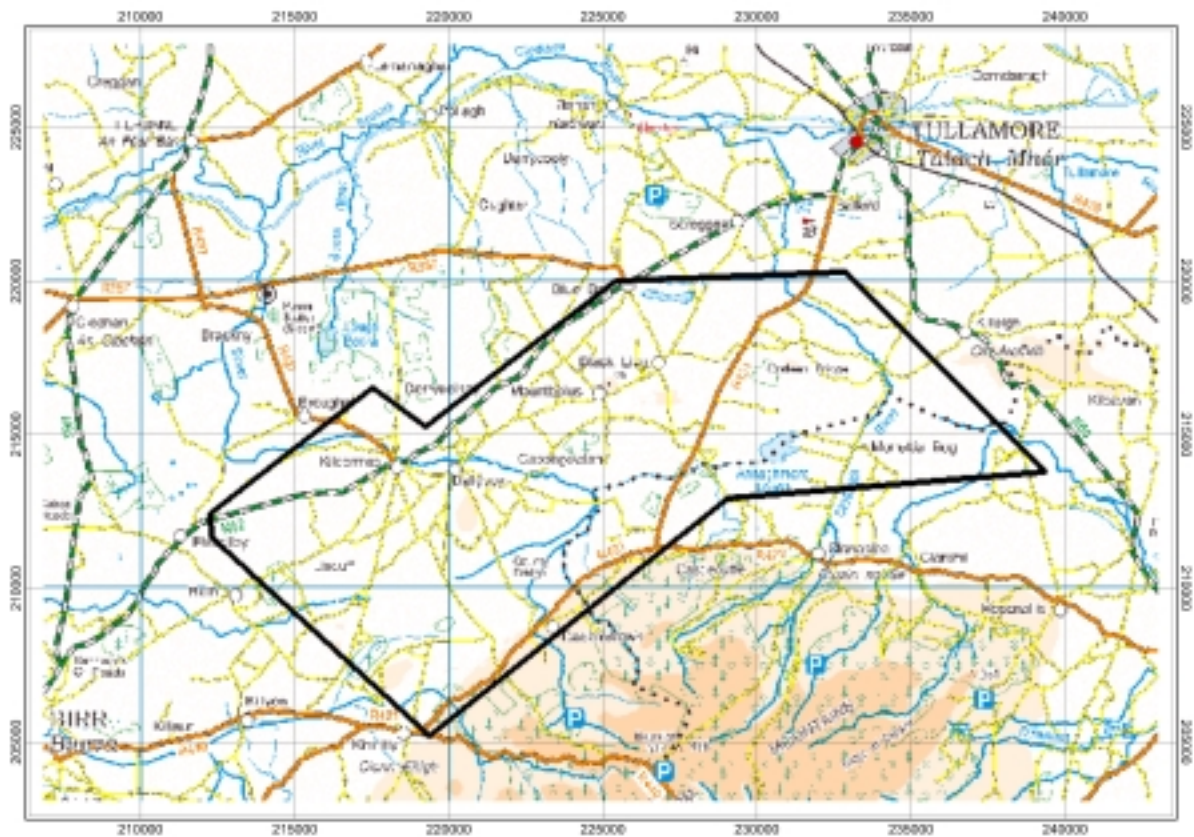


Figure 3. The Tullamore B survey area on a 1:250,000 Ordnance Survey base.

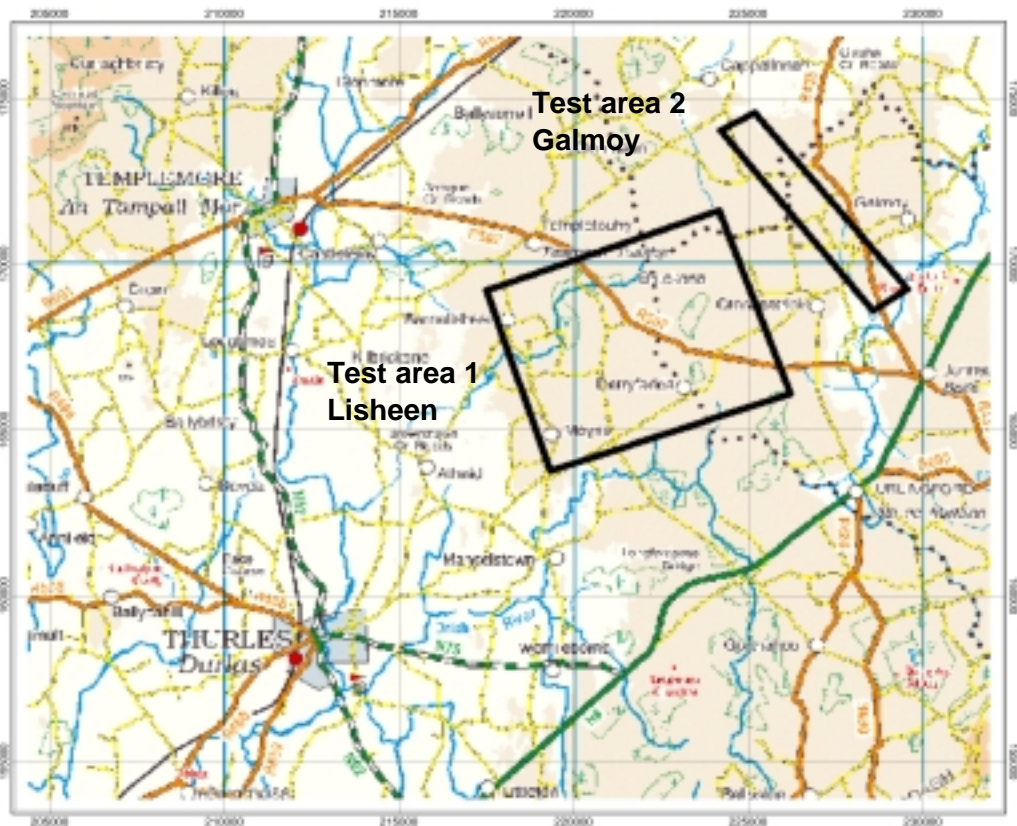


Figure 4. Test areas (1 & 2) on a 1:250,000 Ordnance Survey base.