

1. Survey Summary

Address of Transmitter Site Surveyed:	Hill of Howth, Co. Dublin
Site Type:	GSM, UMTS, PMR, FWALA
Survey Date:	12/03/2009


Measurement Location: (at point of maximum non-ionising radiation near site)	On the access road to the site. See sketch on page 4.
---	--

Measurement Location Coordinates:		deg	min	sec	
	Latitude:	N	53	22	16.2
	Longitude:	W	6	04	07.4

Purpose and Conduct of Survey:
Non-ionising electromagnetic radiation levels were measured at the point of highest emissions which was determined near the site, in order to assess compliance with the international ICNIRP Limits for general public exposure to non-ionising radiation.
Compliance with the ICNIRP Limits is a condition of various wireless transmission licences issued by the Commission for Communications Regulation (ComReg) .

Overall Conclusions of the Survey	
Frequency Selective Measurements: (Individual emissions measured at specific frequencies)	Below ICNIRP Public Limits (Compliant)
Total Exposure Quotient: (Assessment of cumulative emissions from multiple transmitters)	Below ICNIRP Public Limits (Compliant)

2. Surveyors

Survey conducted on behalf of ComReg by:
 Vilicom Engineering Ltd, 14 Joyce Way, Park West Business Park, D12

Survey Engineer(s):	Report Writer:	Report Reviewer:
John Ryan, BSc	John Ryan, BSc	Sean Keating, BEng

3. Survey Location Details

Transmitter Site Photo



Survey Weather Conditions

Sky:

Mixed

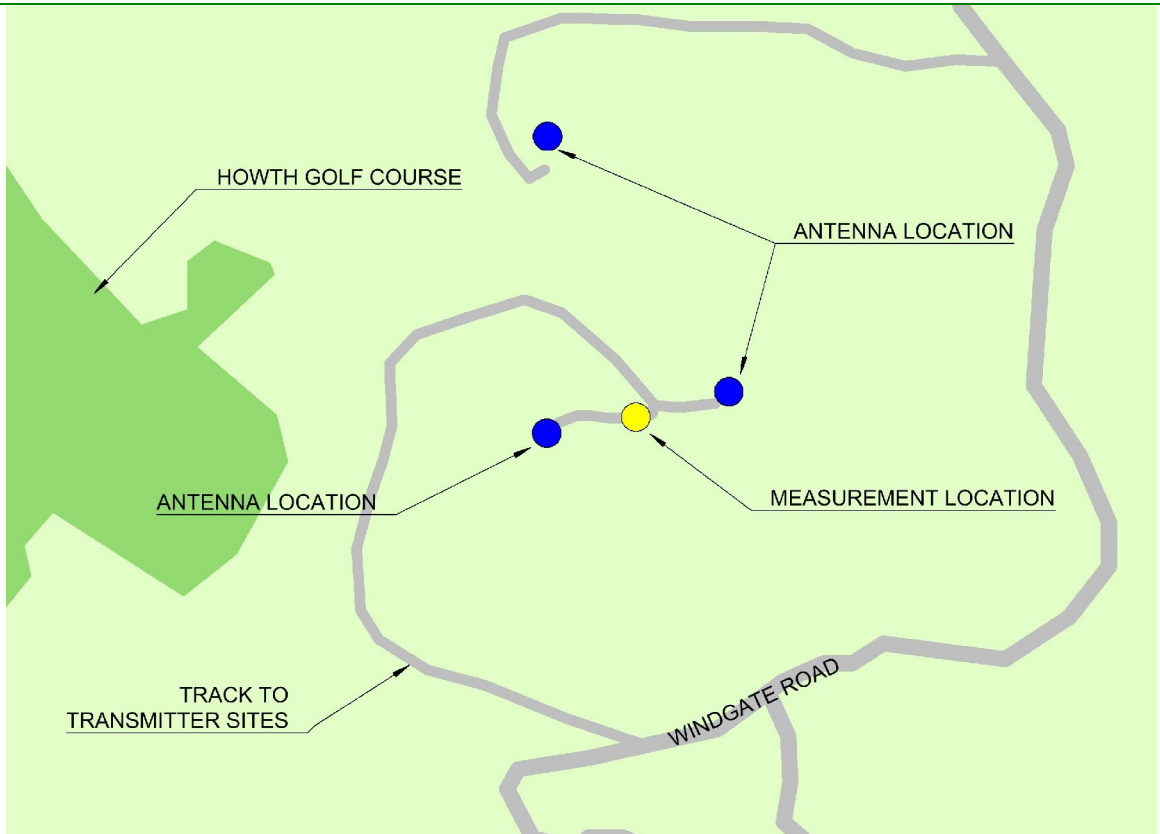
Temperature:

9° C

Relative Humidity:

64%

Map of Transmitter Site and Measurement Location



4. Introductory Note

Purpose of Survey

The survey of the designated transmitter site was commissioned by the Commission for Communications Regulation (ComReg) as part of its Programme of Measurement of Non-Ionising Radiation Emissions. The purpose of the survey was to assess whether non-ionising electromagnetic radiation emissions from the site were compliant with the limits specified in the guidelines¹ published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Compliance with the ICNIRP limits is a condition of various Wireless Telegraphy licences (e.g. GSM and UMTS Mobile telephony, wireless broadband, broadcasting etc.) issued by ComReg.

Survey Methodology

Measurements of the non-ionising radiation emissions from the site were conducted in accordance with the methodology outlined in document ComReg 08/51², which incorporates many of the measurement methods and procedures outlined in ECC Recommendation (02)04³.

Note re this Report Version

If you have downloaded this report from www.siteviewer.ie or from www.comreg.ie, you are reading an abbreviated version. In addition to sections 1 to 8, the full extended technical version of this report contains a comprehensive technical record of the measurements and any calculations performed, a list of equipment used, as well as a technical appendix. A copy of the extended report is available on request from ComReg.

¹ “Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)”, International Commission on Non-Ionizing Radiation Protection, Published in ‘Health Physics’, April 1998, Volume 74, Number 4. www.icnirp.de

² <http://www.comreg.ie/fileupload/publications/ComReg0851.pdf>

³ ECC REC (02)04 (revised Bratislava 2003, Helsinki 2007), “Measuring Non-Ionising Electromagnetic Radiation (9 kHz – 300 GHz), published by the European Communications Committee on www.ero.dk.

5. Survey Overview

Survey Stages

In accordance with the methodology outlined in document ComReg 08/51, the survey was conducted in three stages as follows:

- 1 **Initial Site Survey**
- 2 **Full Survey – Broadband Measurements**
- 3 **Full Survey – Frequency Selective Measurements**

Brief outlines of each stage, along with results and conclusions of the measurements are presented in the three sections which follow.

Measurement of Electromagnetic Fields

Electromagnetic fields can be sub-divided into two components:

- (1) Electric field **E** [measured in Volts per metre or V/m]
- (2) Magnetic field **H** [measured in Amperes per metre or A/m]

The E-field and the H-field are mathematically interdependent⁴ in the **far-field** which is the region⁵ where the distance from the radiating antenna exceeds the wavelength of the radiated electromagnetic field. The measurement locations for most transmitter installations lie well within the far-field, as the wavelengths of the transmitted signals are relatively short and the antennas are typically located many metres from any public area. The following table shows wavelengths for commonly transmitted signals:

Transmitter Type	Frequency	Wavelength
PMR Low Band VHF	68 MHz	4.41 m
UHF TV	470 MHz	0.64 m
GSM 900 (mobile phone base)	925 MHz	0.32 m
GSM 1800 (mobile phone base)	1805 MHz	0.17 m
UMTS (mobile phone base)	2110 MHz	0.14 m

In the far-field only one component needs to be measured, as the other component can be easily derived from it. Normally it is only the electric field which is measured in this region.

In the case of transmitters of very long wavelength signals, such as long wave radio (1.19 km wavelength), the H-field and E-field must be measured separately as the point of measurement will most likely lie within the **reactive near-field** region. This is the region located less than one wavelength from the radiating antenna. Here, the relationship between E and H becomes very complex and there is no direct correlation between both components of the electromagnetic field.

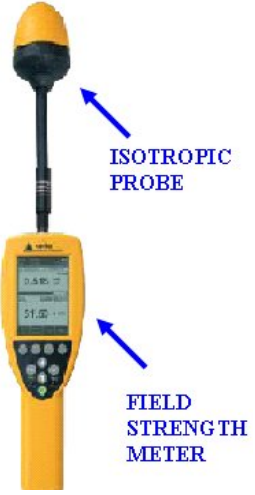


⁴ $E = H \times Z_0$ where Z_0 (characteristic impedance of free space) $\approx 377 \Omega$

⁵ Beyond a distance of $\lambda + 2D^2/\lambda$ where λ is the wavelength and D is the antenna's largest dimension

Measurement Equipment

The measurement of electromagnetic fields is a complex process which involves the use of various meters, spectrum analysers, probes and antennas, which are appropriate to the frequencies of the emissions being measured.

The table below shows examples of equipment typically used to measure electromagnetic fields in non-ionising radiation surveys.

Initial Site Survey and Broadband Measurements	Frequency Selective Measurements	
 <p>Used to measure the overall electric or magnetic field present over a range of frequencies. (e.g. 100kHz to 3GHz)</p>	<p>SPECTRUM ANALYSER WITH TRIPOD MOUNTED ANTENNA CONNECTED</p> 	<p>PORTABLE SPECTRUM ANALYSER WITH ANTENNA DIRECTLY CONNECTED</p>  <p>Spectrum analysers are used to measure individual emissions at specific frequencies. The individual emissions contribute to the overall electromagnetic field. Examples of individual emissions are a TV signal and a mobile phone signal for a particular mobile operator. There may be a number of emissions from different transmitters contributing to the overall electromagnetic field at a particular location.</p>

6. Initial Site Survey

An initial survey was carried out in the area around the designated transmitter site in order to determine the point of maximum non-ionising radiation (NIR). This is the location at which the overall electrical field strength level measured was somewhat higher than that measured in all other areas around the site and represents the highest level of exposure to which a member of the general public might be subjected in the vicinity of the transmitter.

For this initial survey a calibrated **field strength meter** fitted with an **18 GHz isotropic probe** was used. The meter and probe were used to measure the sum of all electrical fields present at **all frequencies from 3 MHz up to 18 GHz**.

Once the point of maximum NIR was determined, broadband and frequency selective measurements were conducted at that location (see following two sections).

For the duration of those measurements, the various instruments, antennas and probes used were mounted on non-metallic supports.

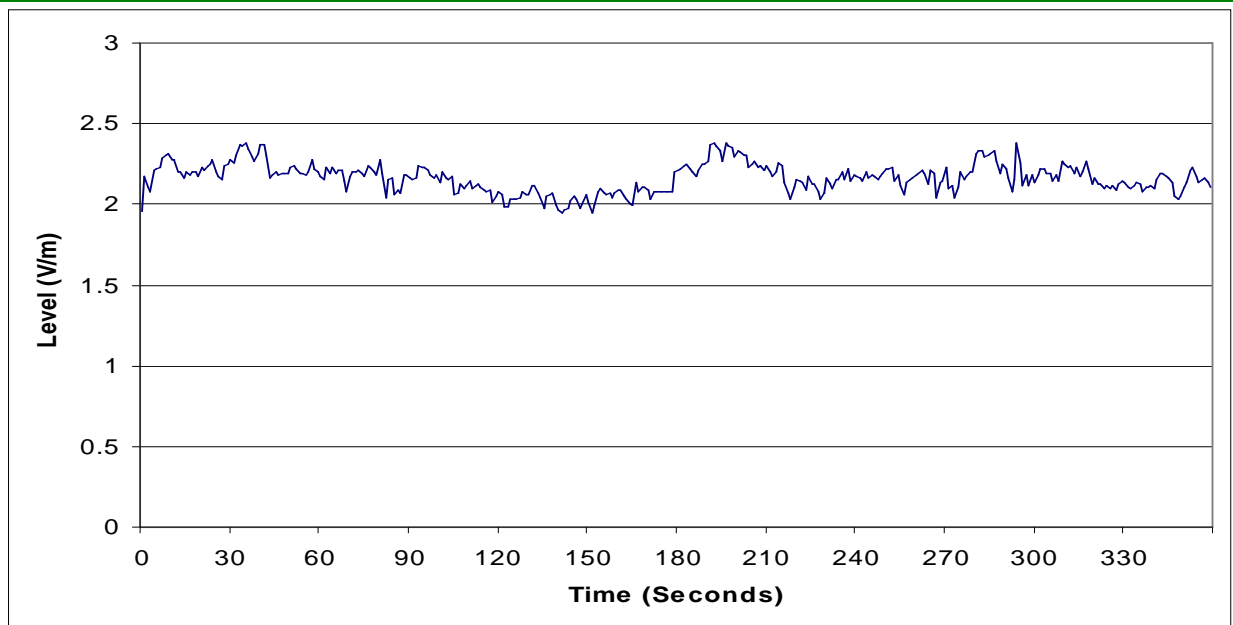
7. Full Survey – Broadband Measurements

The purpose of these measurements was to get an overview of the intensity of the electromagnetic field present at the point of maximum NIR near the site. There, the field strength meter and probe combination were mounted on a tripod and were set to record, over a six minute period, simultaneous measurements of the sum of all received signals within the frequency range of the probe.

The broadband measurement results presented in the graph and table below show the levels in Volts per metre (V/m) recorded in the course of the six minute measurement. The average and maximum levels can be compared to the lowest maximum ICNIRP general public guideline limit which is 28 V/m.

If a broadband measurement is higher than 28 V/m, it does not necessarily follow that the ICNIRP Limits have been exceeded, as the limits are frequency dependent. For example, if the emissions are in the 2100 MHz UMTS mobile phone frequency band, then the limit which applies is higher at 61 V/m. A more detailed investigation involving frequency selective measurement is necessary to assess compliance with the ICNIRP Limits (see next section).

Electric field strengths recorded over 6 min period using 18 GHz probe at point of max NIR:



Acquisition Mode: 1 Sec. Sampling

Mean Measurement:	2.16 V/m	Peak Measurement:	2.38 V/m
Date:	12/03/2009	Start Time:	15:13
Meter:	Narda NBM 550	Probe:	EF 1891 (3 MHz - 18 GHz)

Conclusion of the Broadband Measurements

The mean and peak measurements were below the lowest ICNIRP guideline limit of 28 V/m.

8. Full Survey – Frequency Selective Measurements

Basic Measurement Procedure

A more detailed survey was performed at the point of maximum NIR near the site in order to identify the individual transmit frequencies and field strengths of each type of emission (e.g. mobile telephone GSM and UMTS, wireless broadband, TV, radio signals etc) and their contribution to the total electromagnetic field. The measurements were performed using spectrum analyser equipment and a range of antennas to match the frequency bands in which emissions were measured.

Table of Measurement Results

A list of the measurements made is presented in the table on the next page. For each emission measured, the table shows:

- **Signal Type** (e.g. GSM or UMTS mobile phone, TV etc)
- Transmission **frequency** of the signal
- **Measured Level** (in Volts per metre, V/m)
- **Adjusted Level** if applicable (to account for the characteristics of certain signal types or to compensate for limitations of measurement equipment or to estimate emissions for max call or data traffic)
- **ICNIRP Limit** for Public Exposure

For further details of Adjusted Levels and ICNIRP Limits, please see the explanatory notes which follow the table of measurement results.

Assessment of ICNIRP Compliance of Individual Emissions

The levels for each emission measured, which have been adjusted where necessary, are compared to the relevant ICNIRP general public guideline limit which applies at the particular frequency of the emission. It should be noted that the ICNIRP guideline limits vary according to frequency. The limits for the different measurements presented in the tables will vary as the measurements have been performed at different frequencies.

Assessment of ICNIRP Compliance of Cumulative Emissions

The levels measured for individual emissions are used to calculate two **Total Exposure Quotients** in order to assess the cumulative effect of emissions from multiple transmitters. For further details of the quotients, please see the explanatory notes which follow the tables of measurement results.

The calculated values of the quotients must be ≤ 1 in order for the aggregate of NIR emissions to satisfy the criteria of the ICNIRP Guidelines.

Table of Frequency Selective Measurement Results

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of adjusted values)
PMR	Not disclosed	0.204409	0.204409	28.0	137
PMR	Not disclosed	0.085408	0.085408	28.0	328
PMR	Not disclosed	0.197925	0.197925	28.0	141
PMR	Not disclosed	0.149108	0.149108	28.0	188
PMR	Not disclosed	0.142069	0.142069	28.0	197
PMR	Not disclosed	0.122180	0.122180	28.0	229
PMR	Not disclosed	0.120365	0.120365	28.0	233
PMR	Not disclosed	0.107523	0.107523	28.0	260
FM Radio	87.500	0.040411	0.040411	28.0	693
FM Radio	101.850	0.015867	0.015867	28.0	1765
FM Radio	104.447	0.015049	0.015049	28.0	1861
FM Radio	106.018	0.013599	0.013599	28.0	2059
PMR	Not disclosed	0.179061	0.179061	28.0	156
PMR	Not disclosed	0.147571	0.147571	28.0	190
PMR	Not disclosed	0.128825	0.128825	28.0	217
PMR	Not disclosed	0.104232	0.104232	28.0	269
PMR	Not disclosed	0.053580	0.053580	28.0	523
TV PAL	183.120	0.029957	0.037963	28.0	738
TV PAL	207.280	0.028184	0.035716	28.0	784
TV PAL	189.200	0.022439	0.028436	28.0	985
TV PAL	213.200	0.019838	0.025140	28.0	1114
T-DAB	227.653	0.006776	0.008008	28.0	3497
TETRA	Not disclosed	0.202768	0.351205	28.0	80
TETRA	Not disclosed	0.149108	0.258262	28.0	108
TETRA	Not disclosed	0.144877	0.250935	28.0	112
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	11693
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	14175
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	257
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	882
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	6397
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	190
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	193
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	217
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	381
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	390
PMR	Not disclosed	Not disclosed	Not disclosed	Not disclosed	424

Continued below...

Signal Type	Frequency (MHz)	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below limit (of adjusted values)
TV PAL	535.333	0.019454	0.024653	31.8	1290
TV PAL	567.347	0.018728	0.023734	32.8	1380
TV PAL	583.680	0.011350	0.014383	33.2	2310
TV PAL	775.760	0.036644	0.046437	38.3	825
TV PAL	799.280	0.034914	0.044245	38.9	879
TV PAL	831.947	0.020630	0.026144	39.7	1517
TV PAL	719.573	0.017885	0.022665	36.9	1627
TV PAL	751.587	0.016788	0.021275	37.7	1772
TV PAL	847.627	0.013521	0.017134	40.0	2336
TV DVB-T	740.480	0.008521	0.022413	37.4	1669
GSM 900	952.883	2.330773	4.661546	42.4	9
GSM 900	940.750	0.956093	1.912185	42.2	22
GSM 900	948.333	0.699842	1.399684	42.3	30
GSM 1800	1856.750	0.945148	1.890297	59.2	31
UMTS	1910.800	0.017338	0.112121	60.1	536
UMTS	1905.800	0.011682	0.075542	60.0	795
UMTS	2147.600	0.015311	0.099012	61.0	616
UMTS	2113.300	0.013305	0.086037	61.0	709
UMTS	2167.200	0.009311	0.060212	61.0	1013
UMTS	2132.200	0.008790	0.056844	61.0	1073
UMTS	2127.800	0.008790	0.056844	61.0	1073
FWALA	3543.300	0.002497	0.006300	61.0	9682
FWALA	3552.000	0.001122	0.004105	61.0	14859
FWALA	3558.900	0.001122	0.003796	61.0	16069
FWALA	3528.600	0.001122	0.002795	61.0	21826
FWALA	3563.400	0.001122	0.002814	61.0	21676
FWALA	3580.200	0.001122	0.002390	61.0	25526
FWALA	3765.500	0.007595	0.019158	61.0	3184
FWALA	3761.600	0.001122	0.018128	61.0	3365
FWALA	3770.900	0.001122	0.009383	61.0	6501
FWALA	3750.500	0.001122	0.011691	61.0	5218
WiFi	5640.000	0.001488	0.005772	61.0	10568

Total Exposure Quotients (calculated from Adjusted Levels)

Quotient	Frequency Range	Calculated Quotient Value	Limit
Electrical Stimulation Effects	1 Hz to 10 MHz	n/a	1
Thermal Effects	100 kHz and above	0.017015	1

Conclusions of Frequency Selective Measurements

Frequency Selective Measurements:

(Individual emissions measured at specific frequencies)

Below ICNIRP Public Limits (Compliant)

Total Exposure Quotient:

(Assessment of cumulative emissions from multiple transmitters)

Below ICNIRP Public Limits (Compliant)

Explanatory Notes

Adjusted Levels⁶

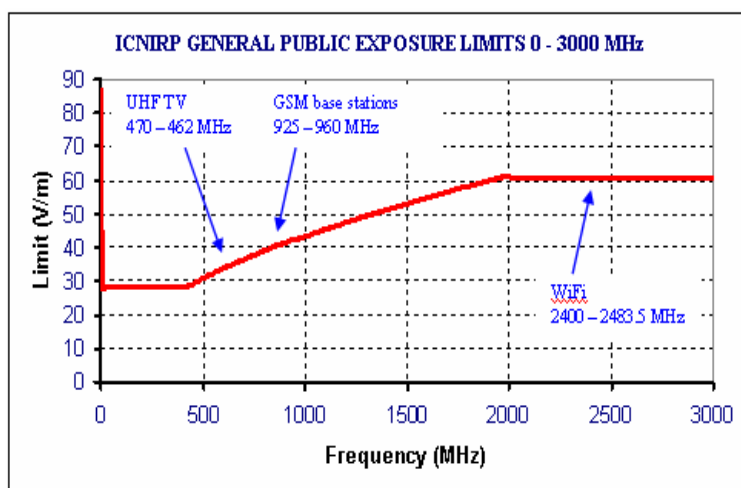
For some emissions an adjusted level has been calculated from the measured level for any or all of the following reasons:

- to compensate for the limited measurement resolution of the spectrum analyser. For example, a measurement of a digital television signal performed with at a resolution of 5 MHz needs to be adjusted upwards using a correction factor in order to account for the energy present within the full 7.6 MHz bandwidth of the signal.
- to extrapolate to an estimate of the level under maximum traffic from the transmitter. For example, the base stations of mobile telephone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day.
- to account for the characteristics of certain complex signal types (e.g. analogue PAL TV)..

The ICNIRP Public Exposure Limit

The ICNIRP Limits vary according to the frequency of the emissions, as illustrated here.

It can be seen that the limits applicable to GSM 900 mobile phone transmissions are higher than those applicable to UHF TV transmissions.



Total Exposure Quotients

The Total Exposure Quotients (which must be ≤ 1) are calculated, in accordance with mathematical formulas specified in the ICNIRP Guidelines, in order to assess the cumulative effect of emissions from multiple transmitters. The quotients in this report are calculated from the Adjusted Levels rather than from the Measured Levels, in order to account for total potential public exposure under maximum traffic conditions. The two quotients are as follows:

Quotient for Electrical Stimulation Effects (1 Hz to 10 MHz)

This quotient is calculated only in a small number of cases where strong emissions in the frequency range between 1 Hz and 10 MHz are present at the survey location (e.g. near a long wave radio transmitter site).

Quotient for Thermal Effects (100 kHz and above)

The measurements of any emissions above 100 kHz are used to calculate a Quotient to assess any thermal (heat) effects.

⁶ See appendices to the extended technical version of this report for further details re calculation of adjusted levels.