

NRL
National Radiation Laboratory

**Measurements
of exposures
around Vodafone cellsites:
summary of results
April 2006 to March 2007**

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This is an electronic copy of an original report signed by Martin Gledhill on 8 May 2007.

Measurements of exposures around Vodafone cellsites: summary of results April 2006 to March 2007

The National Radiation Laboratory (NRL) was commissioned by Vodafone to measure exposures to radiofrequency (RF) fields in areas around approximately 5% of their cellsites. This report presents the results of 50 measurements carried out between April 2006 and 31 March 2007.

The purpose of the survey is outlined in the following statement from Vodafone:

Vodafone is committed to providing greater transparency and access to information for all our stakeholders on the issues of mobile phones, masts and health. To proactively address these issues and to better inform and educate our customers, employees and the general public, Vodafone has established an independent field monitoring programme to measure and monitor the total electromagnetic radio-frequency (RF) field strength in the environment, from all sources (i.e., TV, radio, mobile telephony base stations etc), near our mobile base stations.

The aim of the program is to provide the public with independent, reliable and direct information on the total electromagnetic RF levels in the environment. Any interested party can easily access the measurement results from a specially developed web page by visiting the web site www.nrl.moh.govt.nz (Search: NRL Vodafone Monitoring project).

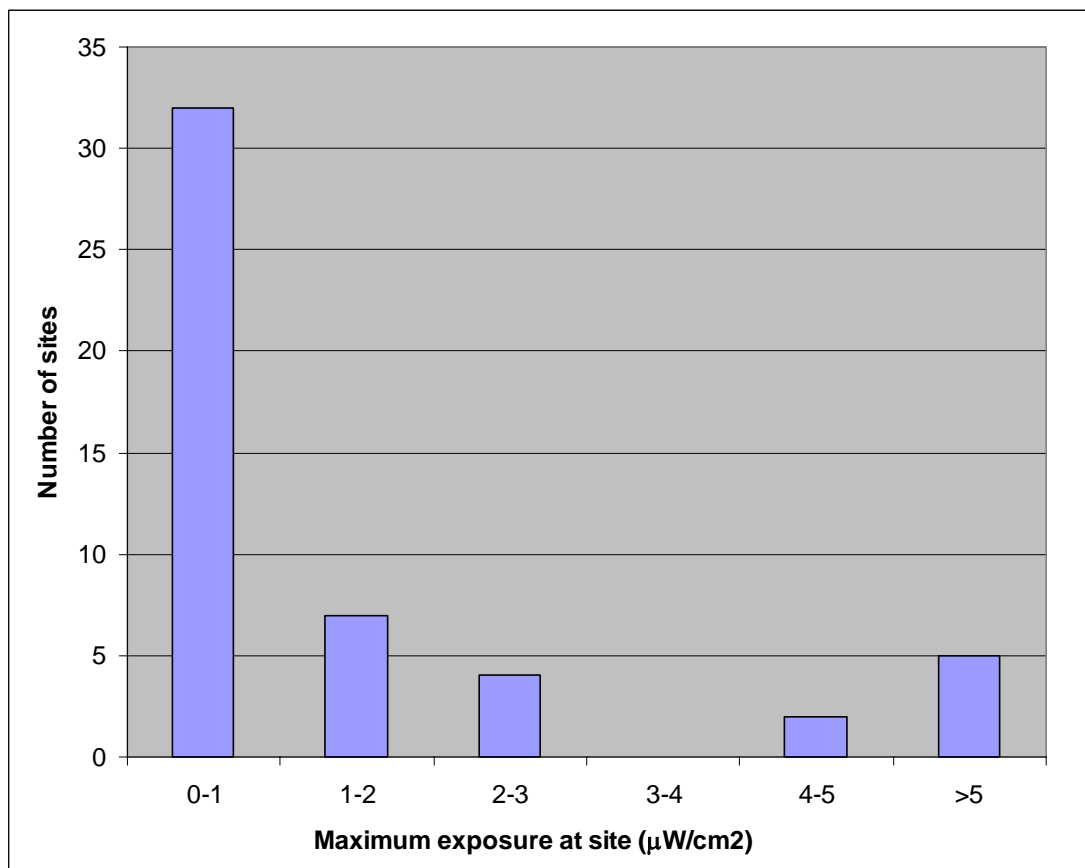
In order to preserve the transparency and validity of information provided, as well as the ongoing updating thereof, Vodafone has requested that NRL (National Radiation Laboratory - a division of the Ministry of Health) assume the programme's overall scientific management. As an independent organisation NRL selects the locations to undertake the monitoring and measurement of RF, and moreover, supervises and verifies the correctness of all information, entirely independent of Vodafone.

Vodafone had no say in the choice of sites to be tested, or when testing would be undertaken. Selection of sites and testing times was entirely at the discretion of the NRL. In general, the approach taken was to ensure:

- A good geographic spread of sites
- A range of types of sites (central city/urban/suburban, rural)
- Coverage of sites known to be of community interest

The overall intention was to obtain a spread of sites with regard to these three criteria. A greater weighting was given to monitoring sites in residential or city areas, as results from monitoring this type of site are more likely to be of interest to the public. Some weighting was also given to sites which NRL staff are aware have been of particular community interest.

The plot below presents a histogram of the maximum exposures at the fifty sites.



At most of the sites tested, the maximum exposure was less than 1 microwatt per square centimetre ($\mu\text{W}/\text{cm}^2$). Five sites had a maximum exposure greater than $5 \mu\text{W}/\text{cm}^2$; exposures at these sites were all below $17 \mu\text{W}/\text{cm}^2$.

Exposures at all sites complied with the reference levels for the public in New Zealand Standard 2772.1:1999 *Radiofrequency Fields Part 1: - Maximum exposure levels 3 kHz - 300 GHz*. At most of the sites, the maximum exposure was less than 0.2% of the reference level. On this basis, no adverse health effects are anticipated for people who live, work or pass by close to the sites.

The results are also available on the NRL website www.nrl.moh.govt.nz following the menu choices Public Advice/ELF and RF surveys/NRL Vodafone monitoring project (<http://www.nrl.moh.govt.nz/faq/nrlvodafoneproject.asp#results>). A listing of results is presented in an appendix to this report. Further appendices contain more information about the measurement technique and the New Zealand RF field exposure Standard.

Appendix A Measurement techniques

A1 Measuring equipment

Broadband electric field strength meters were used to carry out the measurements in these surveys. These instruments measure total exposure to radiofrequency (RF) fields across a wide range of frequencies, including those from cellsites, mobile radios, and TV and radio transmitters. The advantage of this approach is that the exposure recorded is that from all sources in an area, not just the site being measured. Hence, for example, if a cellsite from the Telecom network is located close to a Vodafone site, the instrument measures the total exposure from both sites. However, the contribution from individual sources cannot be identified.

Summaries of the characteristics of the instruments used are presented below.

Wandel and Goltermann EMR-300 and Type 8.2 probe

Manufacturer:	Wandel and Goltermann
Model:	EMR-300, Isotropic Broadband Field Strength Meter serial no. P-0021
Probe:	E-field probe type 8.2, high sensitivity electric field strength. Serial no. M-0086
Ranges:	0.6 to 800 V/m
Spectrum:	100 kHz to 100 MHz ± 1 dB, 100 MHz to 3 GHz ± 2.4 dB
Isotropy:	± 1 dB, $f > 1$ MHz
Calibration:	by manufacturer, July 2005 Uncertainty ± 1 dB Recommended interval: 2 years
Date response checks:	April 06, June 06, October 06, December 06, February 07

Wandel and Goltermann EMR-300 and Type 11.3 probe

Manufacturer:	Wandel and Goltermann
Model:	EMR-300, Isotropic Broadband Field Strength Meter serial no. B-0051
Probe:	E-field probe type 11.3, high sensitivity electric field strength Serial no. G-0004
Ranges:	1 V/m – 300 V/m
Spectrum:	27 MHz to 15 GHz ± 2 dB 27 MHz to 60 GHz +2 dB –4 dB
Isotropy:	± 1 dB
Calibration:	by manufacturer, July 2005 Uncertainty ± 0.5 dB Recommended interval: 2 years
Date of last response check:	April 2007

Narda SRM-3000 Meter body and 3-axis probe

Manufacturer:	Narda
Model:	Selective Radiation Meter SRM-3000 serial no. G-0010
Probe:	E-field, 3 axis, serial no. F-0039
Spectrum:	75 MHz – 3000 MHz
Isotropy:	± 0.23 dB (75 MHz - 1 GHz) ± 1.3 dB (75 MHz – 2.7 GHz) ± 2.65 dB (75 MHz - 3 GHz)
Amplitude measurement uncertainty:	± 2.6 dB – without 1.5 m co-axial cable ± 2.8 dB – with 1.5 m co-axial cable
Calibration:	by manufacturer, July 2005 Uncertainty ± 0.2 dB Recommended interval: 2 years

While the SRM-3000 is capable of frequency-selective measurements, in these surveys it was used in Safety Evaluation Mode to summarise the exposures across the whole of its range.

A2 Measurement procedures

At each site tested, the person carrying out the survey walked around the area in the vicinity of the Vodafone transmitters, recording the signal strength on the meter. In most cases, the measurements were made in areas which are reasonably accessible to the public. If it appeared likely that exposures on private land may be greater than those on publicly accessible land, then efforts were made to get access to that land. The intention was to measure the greatest exposure at the time the survey is carried out, and also gain an idea of “typical” exposures in the area around the site.

Appendix B The New Zealand RF field exposure Standard

In April 1999, New Zealand adopted NZS 2772.1:1999 *Radiofrequency Fields Part 1: Maximum exposure levels – 3 kHz to 300 GHz*. The limits in this Standard are based on guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP is an international scientific body which has been recognised by the World Health Organisation for its expertise in this area, and their guidelines have formed the basis for many other international and national exposure standards.

The New Zealand Standard sets out limits for exposure to the RF radiation produced by all types of radio transmitters, for people exposed occupationally and for the general public. The limits are based on a careful review of the research into the health effects of exposure to RF radiation, and include wide margins for safety.

The Standard sets basic restrictions on the amount of RF power absorbed in the body. As RF power absorption is difficult to measure, the Standard also prescribes reference levels in terms of the more easily measured electric and magnetic field strengths, and power flux density. Reference levels for the general public are stricter than for occupational exposures, and are set at levels more than 50 times lower than the recognised threshold for established effects. Compliance with the reference levels ensures compliance with the basic restrictions, and in most situations can be effectively regarded as “exposure limits” (although this term is not used as such in the Standard).

Most Vodafone sites operate at frequencies around 900 MHz, at which the reference level for the public is $450 \mu\text{W}/\text{cm}^2$. Some sites also operate at 1800 MHz and 2100 MHz, at which the reference levels are $900 \mu\text{W}/\text{cm}^2$ and $1000 \mu\text{W}/\text{cm}^2$ respectively. The most restrictive reference level at any frequency is $200 \mu\text{W}/\text{cm}^2$.

Appendix C Table of results

Results are presented in a table below. For each site, the following information is recorded:

Name of the site	
Date measured	
Type of site	<i>For example, whether the antennas are on a pole or a building, whether the site serves a large region or a smaller site covering a more restricted area, whether it is rural, urban/suburban, or CBD.</i>
Maximum exposure measured during survey	<i>Maximum exposure measured at any point</i>
Typical exposure around the site	<i>Upper limit for most exposures in the area immediately around the site (say up to 50-100 metres from the site).</i>
Additional comments	<i>For example, whether there are other transmitters nearby.</i>

The exposure measurements are a snapshot of the exposures at the time the measurement survey was carried out. Exposures vary over the day as more or less calls pass through the site. All Vodafone sites transmit a fixed minimum standby power, even if no calls are passing through it. Depending on the configuration of the site, the maximum output power may be 2 to 4 times the minimum.

A worst-case estimate of exposures around a site (assuming that the equipment is not changed) is obtained by assuming that the site was operating at the minimum standby power when the exposure measurements were made, and multiplying the measured exposure by four.

Town or city and name of the site	Date measured	Type of site	Maximum exposure measured during survey*	Typical exposure around the site	Additional comments
Auckland - Avondale	08/05/2006	Urban, monopole	1.17 $\mu\text{W}/\text{cm}^2$ (0.26)	<0.80 $\mu\text{W}/\text{cm}^2$	
Auckland - Sandringham	22/09/2006	Urban, rooftop	1.0 $\mu\text{W}/\text{cm}^2$ (0.22)	<1.0 $\mu\text{W}/\text{cm}^2$	
Christchurch – Bealey Ave East	12/01/2007	Urban, monopole	0.46 $\mu\text{W}/\text{cm}^2$ (0.10)	<0.07 $\mu\text{W}/\text{cm}^2$	
Christchurch – Bishopdale	11/01/2007	Urban, tower	1.23 $\mu\text{W}/\text{cm}^2$ (0.27)	<0.60 $\mu\text{W}/\text{cm}^2$	
Christchurch - Bromley	09/01/2007	Industrial, tower	1.26 $\mu\text{W}/\text{cm}^2$ (0.28)	<0.04 $\mu\text{W}/\text{cm}^2$	Shared tower, Overhead transmission lines
Christchurch – Bryndwr	11/01/2007	Urban, monopole	0.08 $\mu\text{W}/\text{cm}^2$ (0.02)	<0.07 $\mu\text{W}/\text{cm}^2$	
Christchurch – Burnside	11/01/2007	Urban, monopole	0.36 $\mu\text{W}/\text{cm}^2$ (0.08)	<0.27 $\mu\text{W}/\text{cm}^2$	
Christchurch - Opawa	09/01/2007	Urban, monopole	0.39 $\mu\text{W}/\text{cm}^2$ (0.09)	<0.20 $\mu\text{W}/\text{cm}^2$	
Christchurch – South Shore	09/01/2007	Urban, monopole	0.77 $\mu\text{W}/\text{cm}^2$ (0.17)	<0.40 $\mu\text{W}/\text{cm}^2$	
Christchurch – Strowan	11/01/2007	Urban, monopole	1.30 $\mu\text{W}/\text{cm}^2$ (0.29)	<0.60 $\mu\text{W}/\text{cm}^2$	
Dargaville - Dargaville	16/05/2006	Rural, monopole	0.1 $\mu\text{W}/\text{cm}^2$ (0.02)	<0.07 $\mu\text{W}/\text{cm}^2$	
Dunedin - Forth Street	26/10/2006	Urban, tower	1.7 $\mu\text{W}/\text{cm}^2$ (0.38)	<0.7 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Dunedin - North Dunedin	26/10/2006	Urban, building	2.1 $\mu\text{W}/\text{cm}^2$ (0.47)	<0.7 $\mu\text{W}/\text{cm}^2$	
Flaxmere	15/01/2007	Industrial, tower	0.07 $\mu\text{W}/\text{cm}^2$ (0.02)	<0.06 $\mu\text{W}/\text{cm}^2$	
Hamilton - Flagstaff	21/08/2006	Urban, monopole	0.83 $\mu\text{W}/\text{cm}^2$ (0.18)	<0.4 $\mu\text{W}/\text{cm}^2$	
Hamilton - Pukete	21/09/2006	Industrial, monopole	2.5 $\mu\text{W}/\text{cm}^2$ (0.56)	<0.45 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Hamilton - Te Rapa	21/08/2006	Industrial, monopole	0.32 $\mu\text{W}/\text{cm}^2$ (0.07)	<0.30 $\mu\text{W}/\text{cm}^2$	
Hastings - Hastings North	13/07/2006	Urban, monopole	0.17 $\mu\text{W}/\text{cm}^2$ (0.04)	<0.1 $\mu\text{W}/\text{cm}^2$	
Hastings - Hastings South	13/07/2006	Rural/urban, monopole	0.23 $\mu\text{W}/\text{cm}^2$ (0.05)	<0.1 $\mu\text{W}/\text{cm}^2$	
Havelock North – Matua Peak	15/01/2007	Roof top	0.51 $\mu\text{W}/\text{cm}^2$ (0.11)	<0.27 $\mu\text{W}/\text{cm}^2$	
Kaiteriteri	28/02/2007	Urban, monopole	2.67 $\mu\text{W}/\text{cm}^2$ (0.59)	<1.1 $\mu\text{W}/\text{cm}^2$	
Kerikeri - Kerikeri Centre	17/05/2006	Urban, rooftop	1.17 $\mu\text{W}/\text{cm}^2$ (0.26)	<0.50 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Kerikeri - Kerikeri Inlet	17/05/2006	Rural, monopole	4.68 $\mu\text{W}/\text{cm}^2$ (1.0)	<1.0 $\mu\text{W}/\text{cm}^2$	
Manukau - East Tamaki North	13/03/2007	Urban, tower	0.28 $\mu\text{W}/\text{cm}^2$ (0.06)	<0.10 $\mu\text{W}/\text{cm}^2$	
Manukau - Manukau East	16/11/2006	Urban, monopole	0.96 $\mu\text{W}/\text{cm}^2$ (0.21)	<0.6 $\mu\text{W}/\text{cm}^2$	Telecom site nearby

Manukau - Manurewa East	07/03/2007	Urban, tower	1.4 $\mu\text{W}/\text{cm}^2$ (0.31)	<1.0 $\mu\text{W}/\text{cm}^2$	
Manukau - Otara	16/11/2006	Urban, rooftop	4.6 $\mu\text{W}/\text{cm}^2$ (1.0)	<1.0 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Martinborough - Martinborough	17/04/2006	Rural, monopole	0.38 $\mu\text{W}/\text{cm}^2$ (0.08)	<0.3 $\mu\text{W}/\text{cm}^2$	
Masterton - Masterton	17/04/2006	Industrial, monopole	0.72 $\mu\text{W}/\text{cm}^2$ (0.16)	<0.56 $\mu\text{W}/\text{cm}^2$	
Masterton - Masterton Straights	17/04/2006	Urban, monopole	0.52 $\mu\text{W}/\text{cm}^2$ (0.12)	<0.20 $\mu\text{W}/\text{cm}^2$	
Napier Onekawa	13/07/2006	Industrial, monopole	0.77 $\mu\text{W}/\text{cm}^2$ (0.17)	<0.4 $\mu\text{W}/\text{cm}^2$	
Nelson - Central	28/02/2007	Urban, Rooftop	0.39 $\mu\text{W}/\text{cm}^2$ (0.09)	<0.27 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Nelson - Port	27/02/2007	Industrial, monopole	0.16 $\mu\text{W}/\text{cm}^2$ (0.04)	<0.10 $\mu\text{W}/\text{cm}^2$	
Nelson - Tahunanui	27/02/2007	Urban, monopole	0.13 $\mu\text{W}/\text{cm}^2$ (0.03)	<0.1 $\mu\text{W}/\text{cm}^2$	
North Shore City - Devonport	20/11/2006	Urban, tower	2.5 $\mu\text{W}/\text{cm}^2$ (0.56)	<2.0 $\mu\text{W}/\text{cm}^2$	Co-located with Telecom
North Shore City - Sunset Road Hub	02/05/2007	Urban, tower	0.27 $\mu\text{W}/\text{cm}^2$ (0.06)	<0.27 $\mu\text{W}/\text{cm}^2$	Microwave dishes only
Palmerston North - Takaro	28/09/2006	Rural, monopole	0.86 $\mu\text{W}/\text{cm}^2$ (0.19)	<0.6 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Paremata	21/02/2007	Urban, monopole	8.08 $\mu\text{W}/\text{cm}^2$ (1.79)	<2.0 $\mu\text{W}/\text{cm}^2$	Close to other transmitting antenna
Porirua – Elsdon	21/02/2007	Urban, monopole	0.97 $\mu\text{W}/\text{cm}^2$ (0.22)	<0.97 $\mu\text{W}/\text{cm}^2$	
Pukerua Bay	21/02/2007	Rural, wooden poles	8.17 $\mu\text{W}/\text{cm}^2$ (1.82)	<1.9 $\mu\text{W}/\text{cm}^2$	Close to several other transmitting antennas
Richmond	27/02/2007	Urban, monopole	0.09 $\mu\text{W}/\text{cm}^2$ (0.02)	<0.07 $\mu\text{W}/\text{cm}^2$	
Tawa	21/02/2007	Urban, rooftop	0.35 $\mu\text{W}/\text{cm}^2$ (0.08)	<0.10 $\mu\text{W}/\text{cm}^2$	
Titahi Bay	21/02/2007	Urban, monopole	5.37 $\mu\text{W}/\text{cm}^2$ (1.19)	<3.3 $\mu\text{W}/\text{cm}^2$	AM mast nearby
Waiheke Island - Matiatia	05/03/2007	Urban, Monopole	0.15 $\mu\text{W}/\text{cm}^2$ (0.14)	<0.10 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Waiheke Island - Onetangi	03/03/2007	Rural, tower	5.4 $\mu\text{W}/\text{cm}^2$ (1.2)	<4.0 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Waitakere - Sunnyvale	09/03/2007	Urban, monopole	0.64 $\mu\text{W}/\text{cm}^2$ (0.14)	<0.50 $\mu\text{W}/\text{cm}^2$	
Waitangirua	21/02/2007	Urban, monopole	0.60 $\mu\text{W}/\text{cm}^2$ (0.13)	<0.60 $\mu\text{W}/\text{cm}^2$	
Wanganui - Castlecliff	26/09/2006	Urban, monopole	0.6 $\mu\text{W}/\text{cm}^2$ (0.13)	<0.3 $\mu\text{W}/\text{cm}^2$	
Wellington – Cambourne	20/02/2007	Urban, monopole	16.98 $\mu\text{W}/\text{cm}^2$ (3.8)	<4.2 $\mu\text{W}/\text{cm}^2$	Telecom and other sites nearby
Wellington – Churton park	21/02/2007	Urban, monopole	0.18 $\mu\text{W}/\text{cm}^2$ (0.04)	<0.10 $\mu\text{W}/\text{cm}^2$	

* The number in brackets gives the maximum exposure presented as a percentage of the limit for public exposures recommended in New Zealand Standard NZS 2772.1:1999.