

NRL
National Radiation Laboratory

**Measurements
of exposures
around Vodafone cellsites:
summary of results
April 2010 to March 2011**

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This test report has been produced under the controls established by a quality management system that meets the requirements of AS/NZS ISO 9001:2000 which has been independently certified by Telarc SAI Limited under registration number: 2304.

This is an electronic copy of an original report signed by Martin Gledhill on 24 June 2011.

Measurements of exposures around Vodafone cellsites: summary of results April 2010 to May 2011

The National Radiation Laboratory (NRL) was commissioned by Vodafone to measure exposures to radiofrequency (RF) fields in areas around 10 of their mobile phone sites (cellsites). This report presents the results of measurements carried out between 1 April 2010 and 31 May 2011.

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 programme 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).

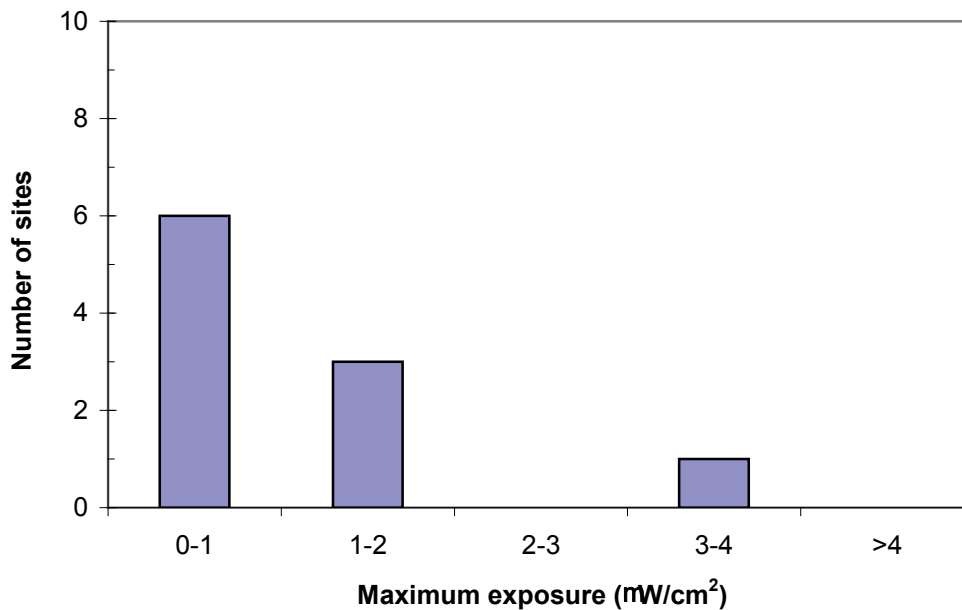
In order to preserve the transparency and validity of information provided, as well as the ongoing updating thereof, Vodafone has requested that NRL (National Radiation Laboratory - a division of the Ministry of Health) assume the programme's overall scientific management. As an independent organisation 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 ten sites.



At all of the sites tested, the maximum exposure was less than 4 microwatts per square centimetre ($\mu\text{W}/\text{cm}^2$).

Two of the sites tested were near cellsites belonging to other operators.

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 all of the sites, the maximum exposure was less than 1% 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 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 contributions from individual sources cannot be identified.

A summary of the characteristics of the instrument used is 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, September 2009 Uncertainty ± 1 dB Recommended interval: 2 years
Dates of response checks:	March 10, July 10, October 10, January 11, May 11

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. Following a review of more recent research, ICNIRP reaffirmed the validity of their exposure Guidelines in 2009.

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 (in larger cities) at 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 limit of $450 \mu\text{W}/\text{cm}^2$ applying to Vodafone equipment has been used in Appendix 3 to determine the maximum measured exposure as a percentage of the Standard. This ensures a conservative evaluation, and means that the exposure level as a percentage of the Standard will be overestimated should the site actually have transmitters operating at 1800 or 2100 MHz.

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 two to four times the minimum for sites using only GSM technology, or up to ten times the minimum for sites using UMTS (3G) technology. (A factor of twenty may apply at some more recent sites.)

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, ten or twenty as appropriate. Unless the site really was operating at the minimum standby power at the time of measurement, this approach overestimates the maximum possible exposure.

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 - Quay Street East	14/02/2011	Commercial, lamppost	3.50 $\mu\text{W}/\text{cm}^2$ (0.77)	<2.4 $\mu\text{W}/\text{cm}^2$	
Christchurch - Sumner	22/12/2010	Rooftop, residential/light commercial	1.7 $\mu\text{W}/\text{cm}^2$ (0.38)	<1.1 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Christchurch - Templeton	30/05/2011	Residential, monopole	0.7 $\mu\text{W}/\text{cm}^2$ (0.16)	<0.3 $\mu\text{W}/\text{cm}^2$	
Hamilton - Galloway Park	24/05/2011	Residential, lamppost	0.27 $\mu\text{W}/\text{cm}^2$ (0.06)	<0.1 $\mu\text{W}/\text{cm}^2$	
Manukau - Favona	09/02/2011	Industrial monopole	0.64 $\mu\text{W}/\text{cm}^2$ (0.14)	<0.4 $\mu\text{W}/\text{cm}^2$	
North Shore City - Cheltenham Beach Relocate	24/01/2011	Residential, lamppost	1.5 $\mu\text{W}/\text{cm}^2$ (0.33)	<1.0 $\mu\text{W}/\text{cm}^2$	
Opunake - Opunake	07/05/2010	Industrial monopole	0.14 $\mu\text{W}/\text{cm}^2$ (0.03)	<0.1 $\mu\text{W}/\text{cm}^2$	Telecom site nearby
Tauranga - Bethlehem	17/01/2011	Industrial monopole	0.86 $\mu\text{W}/\text{cm}^2$ (0.19)	<0.24 $\mu\text{W}/\text{cm}^2$	
Waitakere - Triangle Road	27/01/2011	Industrial monopole	1.2 $\mu\text{W}/\text{cm}^2$ (0.27)	<0.8 $\mu\text{W}/\text{cm}^2$	
Whangarei - Maunu East	01/03/2011	Residential, monopole	0.12 $\mu\text{W}/\text{cm}^2$ (0.03)	<0.06 $\mu\text{W}/\text{cm}^2$	

* Numbers in brackets represent the exposure as a percentage of the exposure limit at 900 MHz in the NZ Standard. This would overestimate the actual percentage if the site transmits at 1800 or 2100 MHz.