



**NRL**

National Radiation Laboratory

# Cellsites

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## Introduction

Cellular phone networks are a recent application of radio technology, made possible by the miniaturisation of electronics. As telecommunications companies seek to improve the coverage offered by their networks, the number of cellular phone base stations, commonly known as ‘cellsites’, has grown considerably over the last few years. Each cellsite serves a limited area and must be sited close to users. As a result, many communities have at least one cellsite in their midst. As telecommunications companies look to expand services, this will become more commonplace.

In New Zealand and overseas, some people have been concerned that exposure to the radio waves transmitted by these sites may cause ill health. As a result of these concerns, many governments have undertaken detailed studies of the effect of such exposures on human health. The World Health Organization is half-way through a ten-year investigation of possible effects. To date, however, health bodies worldwide have concluded that the exposures around cellsites would not cause adverse health effects.

This booklet summarises:

- the operation of cellular phone networks and cellsites;
- the nature of radio signals;
- the status of health effects research;
- exposure standards, and exposures around cellsites in relation to them;
- findings of recent reviews;
- New Zealand initiatives.

## Operation of cellular phone networks

### *Outgoing calls*

When a call is made from a cellular phone, the phone sends the conversation by radio link to the nearest cellsite. The cellsite is connected to the main New Zealand phone network, which connects the call through to its final destination.

### *Incoming calls*

If a cellphone is switched on, the cellular phone network keeps track of which cellsite it is closest to. When a call is made to that phone, the cellular phone network directs the call through land lines to that cellsite, from which the final radio link to the phone is made.

### *Network design*

In designing their networks, telecommunications companies have to balance a number of factors: providing coverage over as much of the country as their customers require, providing sufficient capacity to handle all the calls people wish to make, and preventing radio interference between adjacent cellsites. Cellsites in rural areas are mostly designed to provide coverage over a wide area – each site may cover a radius of several tens of kilometres. In urban and suburban areas, the priority is usually to provide sufficient capacity, and each site covers a much smaller area. The area covered by each cellsite is called a “cell”. Busy cells, in which the number of calls often exceeds the capacity of the cellsite to handle them, may be split into several smaller cells, each handling a smaller area.

## Cellsites

A cellsite is a low powered radio transmitter. A site consists of two main components: an equipment shelter and antennas.

### **Equipment shelter**

This houses the electronic equipment which processes the calls being handled by the site, generates the radio signals sent to the phones and listens for calls originating from phones.

### **Antennas**

The radio signals are transmitted from specialised antennas. These may be mounted on a purpose-built tower or mast, or attached to existing structures. The antennas are designed to transmit most of the signal away horizontally, or just below the horizontal, rather than at steep angles toward the ground.

The radio transmitters used at cellsites are of much lower power than those used for commercial TV and radio transmissions. At many cellsites, especially those covering a small area, the transmitter power is similar to that in the radio-telephones used in trucks and taxis.

## Nature of radio signals

A radio signal can be thought of as a wave which spreads out from its source (the antenna). It is often referred to as an *electromagnetic wave*, which alludes to the fact that the wave is made up of linked electric and magnetic fields. Like waves on the sea, electromagnetic waves travel away from their source, and carry energy with them. The energy carried by electromagnetic waves produced by TV and radio transmitters (including cellsites) can be referred to as *radiofrequency (RF) radiation*. The electric and magnetic fields which make up the electromagnetic wave can be referred to as *radiofrequency fields*.

Radiofrequency radiation is quite different in its physical nature and in the way it interacts with the body to the *ionising radiation* produced by x-ray equipment and radioactive materials.

## Status of health effects research

The possible health effects of exposure to RF radiation have been studied for over fifty years. Several different types of study have been carried out.

### **Epidemiology**

Epidemiological studies are observational studies which look at the relationships between exposures to agents and health outcomes in the exposed group of people. For RF radiation, such studies have been carried out on people who live near TV and radio transmitters, and people who work with radio or radar equipment. There have not been any studies on people who live around cellsites, but there is currently a large study under way looking at cellphone users.

### **Cellular studies**

Cellular studies look at the effects of an agent on isolated cell or tissue culture. Many such studies have been carried using RF radiation to investigate, for example, whether RF radiation might influence the progression of cancer, or affect the way cells signal to each other.

### **Animal studies**

Long and short term animal studies have been carried out to investigate whether RF radiation affects cancer, learning and other end points.

### **Current opinion on health effects**

One clear effect of exposures to high levels of RF radiation is heating of exposed tissues. The body has effective ways to regulate its temperature, but if exposures are too intense the body no longer copes. Experiments have shown that mammals start to show signs of stress above an exposure threshold. Effects relating to heating are usually called *thermal effects*.

Exposures around cellsites are generally about five thousand times lower than the threshold required to cause any thermal effects.

Much of the debate about cellsites (and other transmitters) centres around the possibility of there being *athermal effects*, ie, effects which occur at exposures too low to cause any heating. Some experiments have suggested that there may be biological effects at athermal exposure levels, but the evidence is often contradictory or has not been independently replicated. A biological effect is not the same as a health effect, but simply a physiological response to a stimulus, which is within the range that the body can normally accommodate and is readily reversed when conditions change. For example, when moving from a bright to a dark room, the pupil dilates. The pupil contracts again on moving back into the bright room. This is a biological effect, but not a health effect.

Certainly, there are some studies which have been interpreted as suggesting that there may be adverse health effects from low exposures, and it is acknowledged that further research is needed to improve our understanding in some areas. However, when the research is viewed as a whole, there is a wide consensus that there is no persuasive evidence that such relatively weak exposures do cause short or long term health effects. Epidemiology studies, in which exposures are almost always at athermal levels, have not shown any clear, consistent evidence of health effects.

### **Exposure Standards**

There are a number of safety standards and guidelines in effect throughout the world. Of these the most widely accepted are the guidelines formulated by the International Commission on Non-Ionising Radiation Protection (ICNIRP). These were most recently reviewed in 1998. The ICNIRP is an independent body comprised of independent experts in this field of science. The ICNIRP guidelines define maximum levels to which people should be exposed, and include a safety factor of 50 for the public.

The ICNIRP guidelines have been adopted by the European Community. Other recent Standards, such as those in the USA and Canada, are similar to the ICNIRP guidelines.

The ICNIRP guidelines form the basis of the *New Zealand Standard 2772.1:1999 Radiofrequency fields Part 1: Maximum exposure levels – 3 kHz to 300 GHz*. In recognition of the fact that research into possible health effects is continuing, the level of concern about exposures to RF radiation and the impossibility of proving any agent completely safe, the NZ Standard also includes a requirement for:

“Minimising, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided that this can be achieved at modest expense.”

In other words, it is not enough that exposures comply with the Standard: transmitters should be set up so as to reduce exposures to the minimum compatible with achieving coverage requirements. Effectively, this means that if different options are available when a site is being planned, then those which result in the lowest exposures should be preferred, all other things being equal. This could be through choosing an antenna which minimises transmissions in directions not required for reaching cellphone users, and using the minimum power necessary to achieve the required coverage. It may involve a trade-off between competing objectives: for example, raising the antenna further off the ground would

decrease exposures, but may make it more visually intrusive. If two equally suitable sites are available, the one resulting in lowest exposures should be chosen.

The nature of cellular phone networks (for example, the need to minimise interference between adjacent sites) is such that cellsites must meet this exposure minimisation requirement in order to work properly.

Switzerland and Italy have recently adopted the ICNIRP guidelines, but superimposed a lower exposure level which they expect operators to meet. This lower level was chosen on the grounds that it was met by existing transmitters, and is not based on health effects research. Relaxations are possible if a new transmitter cannot meet the lower level economically.

### **Exposures around cellsites in comparison to exposure Standards**

The National Radiation Laboratory has measured exposures around many operating cellsites. Maximum exposures in publicly accessible areas around the great majority of sites are less than 1% of the public exposure limit in the Standard. Exposures are rarely more than a few percent of the limit, and none have been above 10%.

### **Findings of recent reviews**

Public concern in many countries regarding both cell phones and base stations has resulted in a number of independent expert groups being requested by governments to carry out detailed reviews of the research literature. The most recent reviews, and brief quotes from their findings are presented below.

#### ***The United Kingdom Independent Expert Group (Stewart) Report (2000)***

“The balance of evidence to date suggests that exposures to RF radiation below ICNIRP guidelines do not cause adverse health effects to the general population.”

“We conclude that the balance of evidence indicates that there is no general risk to the health of people living near to base stations on the basis that exposures are expected to be small fractions of guidelines.”

#### ***The Royal Society of Canada (1999)***

“No consistent increases in health risk due to exposure to RF radiation are evident to date.”

“It appears that exposure of the public to RF fields emitted from wireless telecommunication base stations is of sufficiently low intensity that biological or adverse health effects are not anticipated.”

#### ***The Health Council of the Netherlands (2000)***

“The chance of health problems occurring among people living and working below base stations as a result of exposure to electromagnetic fields originating from the antennae is, in the Committee’s opinion, negligible.”

### **WHO Fact Sheet**

“While RF fields around cell sites are not considered a health risk siting decisions should take into account aesthetics and public sensitivities.”

### **The Swedish Radiation Protection Institute (1998)**

“To summarize, mobile telephony base stations do not constitute any risk regarding radiation protection.”

All of these reviews consistently report that there are no credible health risks associated with cellphone sites.

### **The present position of New Zealand Government Agencies**

The issues relating to cellsites have been seen as mostly of an environmental and public health nature.

The Resource Management Act (RMA) applies to the site approval and installation process, through local authority district plans. The Ministry for the Environment considers that RF radiation is not a contaminant (as defined in the RMA) and therefore need not be considered in regional plans.

Cellsites and other radio transmitters are not covered under any specific health related legislation, however it is accepted that there are public health issues involved with these and other radio transmitters. As a result, the Ministry of Health and the NRL treat the issue very seriously. The present position of the Ministry and NRL may be summarised as follows:

- Based upon research data available to date there are no demonstrated or suspected health risks associated with cellsites;
- If future research does identify mechanisms that might indicate possible health risks, it seems likely that any such risks will be very small;
- The ICNIRP Guidelines and the New Zealand Standard are supported in all respects;
- Public concerns are recognised, therefore the policy of low or no cost avoidance of exposures is supported.

The Ministry of Health and the NRL continuously monitor and evaluate overseas research, participate in international conferences and offer financial support to the World Health Organization RF radiation programme.

The NRL makes frequent exposure audits of cellsites, on average about 40 per year.

The NRL has published information sheets on RF radiation and cell sites, and on its website maintains links to other reports and information on the topic.

Finally, the Ministry of Health and the Ministry for the Environment have recently completed an extensive consultation process aimed at developing environmental guidelines for use by local authorities. The guidelines reflect current health and environmental policy. The development process involved a significant amount of public consultation. It is expected that these guidelines will assist the public understanding of these issues and help local authorities assess resource consent applications. The guidelines: *National guidelines for managing the effects of radiofrequency transmitters* are available from the Ministry for the Environment web site:

<http://www.mfe.govt.nz/publications/rma/radio-freq-guidelines-dec00.pdf>

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