Assessment of exposures to radiofrequency fields near the Mainland TV radio mast at 349 Princes Drive, Nelson

EMF Services
Professional EMF measurement and advisory services

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Mainland TV
133 Waimea Road
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About EMF Services and the author of this report

EMF Services is a division of Monitoring and Advisory Services NZ Ltd (MAASNZ), and provides professional measurement and advisory services related to possible health effects of electromagnetic fields (EMFs), such as the extremely low frequency (ELF) electric and magnetic fields found around any wiring, appliances or infrastructure carrying mains electricity, and the radiofrequency (RF) fields produced by radio transmitters and some industrial equipment.

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1 Introduction and summary

This report presents estimates of exposures to radiofrequency (RF) fields from a Mainland TV transmitter mast at 349 Princes Drive, Nelson. The estimates are based on site photographs and information on equipment configurations and specifications provided by Mainland TV. It takes account of new equipment that is proposed to be installed at the site.

Exposures from the transmitters in publicly accessible areas around the site will be low. The maximum exposure produced 2 m above the ground will be equivalent to 3.4% of the limit allowed for the public in New Zealand Standard 2772.1:1999 *Radiofrequency Fields: Maximum exposure levels 3 kHz – 300 GHz*, but in most areas will be much lower than this. The region around the mast within which exposures might exceed the public limit, or 25% of the limit, does not appear to include any publicly accessible areas.

On this basis, exposures from the site comply with the requirements of subpart 7 of the National Environmental Standards for Telecommunications Facilities, and no measurements to confirm this are required. No adverse health effects are anticipated for people who live, work at or pass by near the site.

2 Site description

A number of different transmitters are installed on the mast:

Antenna type	Comments
FM radio	Transmit through various antennas on the mast. Maximum power to any antenna 21 watts, several operate at 1 watt.
UHF TV	Transmit through arrays at the top of the mast. Power to each array 12.5 watts.
Dish antennas	Point to point data links. Low transmit power (less than 1 watt), focussed beams. Note that some dish antennas are passive receive-only.
Sector antennas	WiFi service.

3 Exposure Standards

The New Zealand Ministry of Health recommends using NZS 2772.1:1999 *Radiofrequency Fields Part 1: Maximum exposure levels – 3 kHz to 300 GHz* to manage exposure to RF fields. This Standard is based closely on Guidelines published by the International Commission on Non-Ionising Radiation Protection (ICNIRP). ICNIRP is an independent scientific body recognised by the World Health Organisation for its independence and expertise in this

area. Their exposure Guidelines, which are based on a careful review of the health effects research, were first published in 1998[1], and reaffirmed in 2009[2] following a review of more recent research in this area[3], and again in 2017[4]. Research published since 2009 has been reviewed by a number of other health and scientific bodies[5], none of which has questioned the underlying basis of the limits used in New Zealand.

NZS 2772.1 sets limits for exposure to the RF fields produced by all types of transmitters, and covers both public and occupational exposures. Limits for the public are set at levels more than 50 times lower than the recognised threshold for established effects.

NZS 2772.1 sets limits for exposure to the RF fields produced by all types of transmitters, and covers both public and occupational exposures. Occupational limits should normally be applied only to people who are expected to work on RF sources (eg radio technicians and engineers, riggers, RF welder operators etc), who have received training about potential hazards and precautions which should be taken to avoid them. Their exposures to occupational levels would normally be limited to the working day and over their working lifetime. Occupational exposure limits are set at levels 10 times lower than the threshold at which adverse health effects might occur. The public limits have a safety factor of 50 to ensure protection of people of all ages and in all states of health. The limits apply to exposures of any duration.

At most of the frequencies of interest for this survey, the Standard sets fundamental limits, called *basic restrictions,* on the amount of RF power absorbed in the body. As absorption of RF power is difficult to measure, the Standard also specifies *reference levels* in terms of the more readily measured (or calculated) electric and magnetic field strengths, and plane wave equivalent power flux density. Compliance with the reference levels ensures compliance with the basic restrictions, and in many situations they can effectively be regarded as the NZS 2772.1 "exposure limits", although this term is not used as such in the Standard. If exposures exceed the reference levels, this does not necessarily mean that the basic restriction has also been exceeded. However, a more comprehensive analysis is required before compliance can be verified. At the frequencies used by the transmitters feeding dish antennas at frequencies greater than 10 GHz, the Standard sets basic restrictions on the power flux density to which someone is exposed.

The exposure limit depends on the frequency of the RF field as shown in the table below. The most restrictive limit at any frequency is a plane wave equivalent power flux density of 2 watts per square centimetre (W/m^2).

[1] http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf
[2] http://www.icnirp.org/cms/upload/publications/ICNIRPStatementEMF.pdf
[3] ICNIRP. Exposure to high frequency electromagnetic fields, biological effects and health consequences (100 kHz-300 GHz) - Review of the Scientific Evidence and Health Consequences. Munich: International Commission on Non-Ionizing Radiation Protection; 2009. ISBN 978-3-934994-10-2.
[4] http://www.icnirp.org/en/activities/news/news-article/revision-of-hf-guidelines-2017.html
[5] Links to recent reviews can be found at http://www.health.govt.nz/our-work/radiation-safety/non-ionising-radiation/research-non-ionising-radiation.

Equipment	Limit
FM radio	2 W/m^2
UHF TV	2 W/m^2*
Dish antennas	10 W/m^2
Sector antennas	10 W/m^2

*This is the minimum limit applying at frequencies used by UHF TV transmitters.

At the frequencies of interest in this assessment, the limits in the Standard are average values over six minutes. Spatial averaging, at the four corners and centre of a square whose sides vary in length between 30 cm and 4.5 cm (depending on the frequency of the signal being averaged), is also permitted.

4 Exposure estimates

AS/NZS 2772.2:2016 Part 2 includes methods to calculate the likely RF field exposure levels around proposed transmitter installations. These procedures produce conservative estimates, and have been validated by measurements made on other transmitters.

Assumptions made in deriving these estimates, and their likely effects, are tabulated in an appendix to this report. Generally, the effect of the assumptions is to over-estimate exposures.

4.1 General approach to exposure estimates

The main purpose of this report is to determine whether exposures in areas around the mast that are reasonably accessible to the public comply with the limits in NZS 2772.1:1999, and also whether they are more or less than 25% of the limits in that Standard. A two stage approach is taken:

- Estimate exposures two metres above the ground (head high for a tall person) as someone walks away from the base of the mast
- Estimate the maximum distances from the mast, at any height above two metres, at which exposures will just equal the limit (this distance will be referred to as the "compliance boundary") and 25% of the limit.

4.2 Exposures two metres above the ground

Exposures two metres above the ground have been estimated for the FM radio and UHF TV transmitters. The point to point and sector antennas would make only minor contributions to exposures two metres above the ground for several reasons:

- The beams from the dish antennas are well focussed and exposures outside main beam are very low;
- The dish antennas are used to maintain a point to point communication link, and for the link to work the beam must be aimed away from the ground or other obstructions that would interrupt the direct line of sight to an antenna at the far end of the link;
- The transmitters feeding the point to point and sector antennas operate at low power;
- The sector antennas transmit most of the power away horizontally, rather than at steep angles towards the ground.

For these reasons their contributions have not been included in the estimates. Any contribution they might make would almost certainly be less than the amount by which exposures have been overestimated due to the simplifying assumptions made in calculating exposures from the other transmitters.

Exposures two metres above the ground are plotted below as a function of distance from the base of the mast.

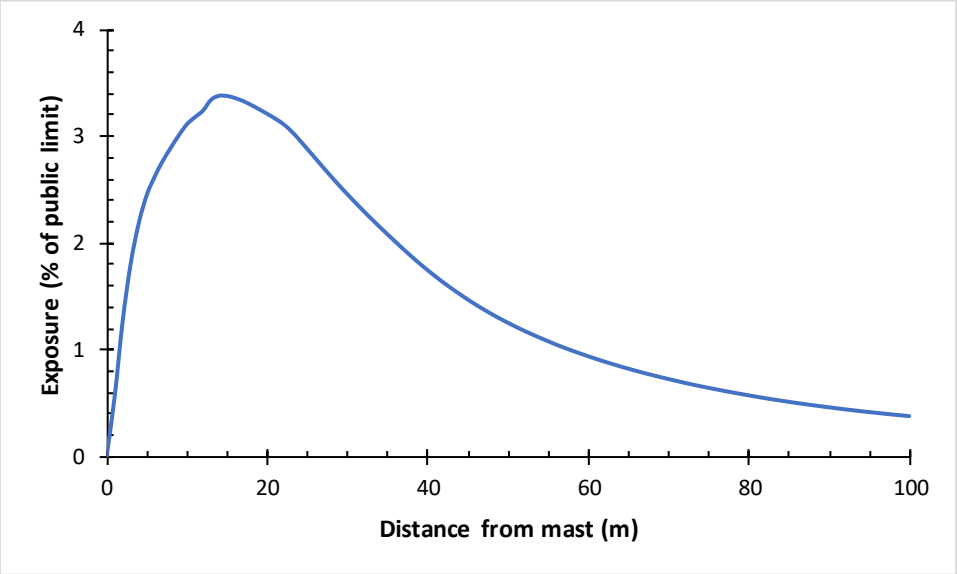

Fig 1. Exposures 2 m above the ground as a function of distance from the base of the mast

The highest exposure is estimated to be 3.4% of the public limit in NZS 2772.1, occurring about 15 metres from the base of the mast.

4.3 Distance to the compliance boundary

The distance from the mast to the compliance boundary has been calculated assuming that all the antennas are at the same height. Because the beams from the dish antennas are very directional and unlikely to overlap, only the dish antenna producing the highest exposures as a function of distance need be considered in the calculation.

Distances from the mast at which exposures are certain to be less than 100% and 25% of the limit are tabulated below.

Exposure level	Maximum distance from mast
100% of public limit (compliance boundary)	8.1 m
25% of public limit	16.2 m

4.4 Summary

The results presented in sections 4.2 and 4.3 can be summarised to show the regions around the mast beyond which exposures are certain to be less than 100% and 25% of the public limit. These are shown on the figure below.

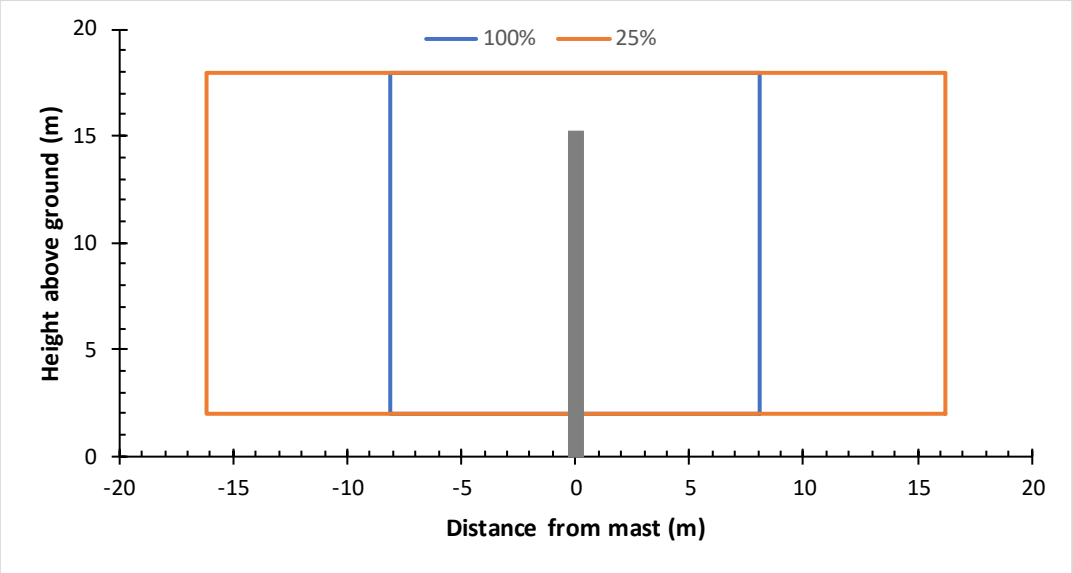

Fig 2. Regions around mast beyond which exposures are certain to be less than 100% and 25% of the public limit in NZS 2772.1:1999. The blue lines show the maximum possible extent of the region within which exposures might reach the public limit; the orange lines show the maximum extent of the region within which exposures might reach 25% of the public limit.

It should be noted that these show the maximum possible extent of the 100%/25% regions: in reality they are likely to be closer to the mast and certainly higher above the ground.

5 Conclusions

Exposures to someone on the ground near the Mainland TV mast would be less than 3.4% of the public limit in the New Zealand RF field exposure Standard.

Therefore exposures will satisfy the requirements of subpart 7 of the National Environmental Standards for Telecommunication Facilities, and no measurements to confirm this will be necessary once the site is operational.

The limits in the exposure Standard are set well below the levels at which adverse health effects may occur, so as to provide a safe and healthy working and living environment. On this basis, this site would not pose a health hazard to people who live, work or pass by close to it.

Appendix: Assumptions made in deriving exposure estimates

Assumption	Reality	Likely effect on exposure estimates
Antennas with directional characteristics all face in the same direction	Antennas with directional characteristics do not all face in the same direction.	Exposures 2 m above the ground overestimated, distance from mast to compliance boundary overestimated.
4 element yagi antennas both at the height of the lower antenna.	One is higher up.	Exposures 2 m above the ground overestimated.
No power loss in feeder cables, splitters.	Likely to be some losses.	Exposures 2 m above the ground overestimated, distance from mast to compliance boundary overestimated.
Distance to compliance boundary assumes all antennas at the same height.	Antennas are between 4 m and 15 m above the ground.	Distance from mast to compliance boundary overestimated.
Ground flat around the site.	Ground rises to the north of the site	Exposures to the north could be a little higher than shown in figure 1.
No other significant source of exposure nearby.	There are some council-owned transmitters on the nearby reservoir.	Transmitters far enough away to make little difference to these exposure estimates.
No reflections of the signal off the ground, trees or buildings.	As well as signals received directly from the antennas, there may also be an additional contribution through signals reflected off the ground, trees or buildings.	Localised increases and decreases in exposures over distances of about 1m, generally averaging out over 2 m.