**JOINT WITNESS STATEMENT OF MARTING GLEDHILL (KĀINGA ORA) AND STEVE WHITE (RADIO NEW ZEALAND)**

**Introduction**

1 This joint witness statement is prepared in response with Minute 59 of the Hearings Panel dated 7 March 2023.

2 We confirm that, on 2 March 2023 we discussed the technical assumptions and methodology Mr White used to assist RNZ's submission. On 9 March 2023 we aimed to reach agreement on matters within our respective field of expertise and record our agreement in this statement. The statement below represents our agreed joint opinion, except where otherwise noted.

3 In producing this statement, we have read and complied with the High Court Code of Conduct for Expert Witnesses.

4 Our qualifications are set out in our respective briefs of evidence. We confirm that the evidence and opinion which we give below is within our area of expertise.

**Agreed Joint witness statement**

5 Mr Gledhill has been provided with the information supporting Mr White's calculations and agrees that Mr White's calculations of the EMR field strength surrounding the RNZ facilities at Titahi Bay were appropriate and consistent with standard best practice. They provide worst-case exposure estimates based on conservative assumptions.

6 In the area around the RNZ transmitter, the NZS 2772.1:1999 General Public athermal reference levels[1] are appropriate for setting building height and provide the most restrictive constraints on exposures. In the area around the RNZ mast the general public limits are conservative because the circumstances of likely exposures are such that exposures at the athermal reference level will result in induced currents and electric fields that are well below the basic restrictions.

Mr Gledhill notes that other science-based standards, such as the IEEE-ICES 2019 C95.1 standard, find that thermal limits provide the greatest constraint at the frequencies used by the RNZ transmitters and do not set athermal limits that would apply to the RNZ transmitters at these frequencies. ICNIRP are currently revising their athermal limits at these frequencies. While the likely outcome is not known, over the years there has been greater harmonisation between the IEEE-ICES and ICNIRP Standards as they are both using the same research database.

Mr White notes that the ICNIRP 2020 Athermal General Public reference level limits are substantially the same as the NZS 2772.1:1999, and this standard may be more appropriate for determining occupational exposure limits, including where cranes are used during construction activities.

Mr White does not express any view on the approach to setting limits taken by standards setting bodies.

[1] See Table 9 and equations 3 and 4 in NZS 2772.1:1999, and Table 8 in ICNIRP 2020.

7 The circumstances producing the highest exposures would be if someone were 50 cm away from a 200 mm diameter vertical conductor that has good electrical grounding, such as a crane boom or an extended cherry-picker boom, or a vertical steel beam (for example, climbing up the outside of a crane tower to get to the operating cab.) The exposures calculated at 528 and 1057 m are shown in the table below.

| Distance from RNZ mast (m) | Height of 200 mm diameter vertical conductor (m) | Exposure to someone at the top of 200 mm diameter vertical conductor | |
|---|---|---|---|
| | | As percentage of NZS 2772.1 athermal limit | As percentage of ICNIRP 2020 athermal limit |
| 528 | 11 | 94 | 99 |
| 1057 | 22 | 96 | 100 |

8 The height at which exposures in these circumstances would be just below the athermal limits varies linearly as a function of distance from the RNZ mast. This means that the limit would be reached by the top of a 200 mm diameter vertical conductor at a height of less than 11 m at distances less than 528 m. It also means that the limit would be met at heights greater than 11 m at distances greater than 528 m.[2]

9 Similar exposures could be encountered by someone doing maintenance at these heights on the outside of a house, especially if the house has metal cladding (such as corrugated iron).

10 The circumstances described in paragraph 7 produce what are considered to be the theoretical maximum exposures that might be encountered. Differences in the shape and height of structures would affect the actual EMF levels encountered. In particular, exposures inside houses would be lower than those calculated near the 200 mm diameter vertical conductor.

**Building heights**

11 Taking account of the discussion above, it would be prudent to limit the heights of buildings up to 528 m from the RNZ mast. The calculations suggest that compliance with NZS 2772.1 is assured if maximum building heights continue to decrease linearly with distance at distances less than 528 m, from a maximum of 11 m. This appears to be observed at present, as the closest houses to the RNZ boundary are mostly single storey, and the closest 2-storey houses are about 270 m away. Depending on the type of construction, it may be a concern if higher buildings were to be built at these distances, or out to 528 m. Therefore any building in this zone taller than $11d/528$ m should be subject to an EMF safety assessment and only permitted if exposures are expected to comply with the limits in NZS 2772.1:1999 (or any replacement thereof, or equivalent recommendations from the Ministry of Health).

[2] As an approximation, the limit would be met at a height of $11d/528$, where $d$ is distance from the mast.

12 Building heights between 528 m and 1057 m could increase linearly in proportion to distance from the mast. Any building above this height should be subject to an EMF safety assessment of the type discussed in paragraph 11.

**Construction and maintenance practices**

13 At all distances, cranes and elevated work platforms present a particular risk, as these structures are usually made of conductive material and may be substantially higher than the building they are used to construct or maintain.

14 Use of any construction equipment taller than $11d/528$ m at a distance $d$ from the mast, up to a distance of 1057 m should require an EMF safety plan. Elements of the plan would include, but are not limited to:

14.1 Effective grounding of any cranes, elevated work platforms or other tall structures used during construction or maintenance.

14.2 Measures to prevent electric shocks and burns when attaching loads to hooks.

14.3 Training construction staff on EMF hazards and how to avoid or mitigate them.

Dated: 9 March 2023

Steve White (Radio New Zealand)

Martin Gledhill (Kāinga Ora)