

**BEFORE THE INDEPENDENT HEARINGS COMMISSIONER
APPOINTED BY THE INVERCARGILL CITY COUNCIL**

UNDER	the Resource Management Act 1991
IN THE MATTER	of Part 8 of the Act
BY	SPACE OPERATIONS NEW ZEALAND LIMITED
	Requestor

SUMMARY STATEMENT OF ARASARATNAM SATHYENDRAN

Dated: 29 September 2026

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Introduction

- [1] My name is A Sathyendran. I am a spectrum policy and radiocommunications engineering consultant, and I practise through AnS Consulting Limited. I hold Approved Radio Engineer status.
- [2] I was engaged by the Invercargill City Council as an independent technical reviewer. I prepared a peer review report dated June 2026, which is referred to in the Commissioner's Minute #4 as the Peer Review.
- [3] I have since reviewed the evidence of Mr Robin McNeill dated 14 September 2026, Mr Graham Hulston dated 15 September 20026, and the evidence of Mr Craig Morley for Stewart Family Assets Limited dated 21 September 2026.
- [4] This summary first sets out the regulatory framework. I do so because a number of the differences between the experts turn on distinctions within that framework, and those distinctions are not always apparent from the evidence. I then address the issues in turn.
- [5] My expertise is in radiocommunications and electromagnetic matters. I do not comment on the horizon mask as a planning instrument, on whether the designation is reasonably necessary, or on the workability of the approval pathway. Those are matters for other witnesses.

Part A — The regulatory framework

Two kinds of interference

- [6] The word "interference" is used in this hearing to describe two physically different matters. I use the word in its general sense in what follows.
- [7] The first is electromagnetic interference: unwanted radio or electromagnetic energy arriving at the receiver and competing with the wanted signal from the spacecraft.

- [8] The second is physical obstruction: a solid object standing in the path; a building, a mast, a turbine or a stand of trees, which blocks or disturbs the signal before it reaches the antenna.
- [9] These have different causes, different remedies and, importantly for this hearing, different regulators. The Radiocommunications Act 1989 and the Radiocommunications Regulations 2001 address only the first. They say nothing about a physical object standing in a radio path. That was the point I made in my report at paragraphs [86] to [93].

Two sources of electromagnetic emission

- [10] Within the electromagnetic side there is a second distinction which matters equally.
- [11] The first category is equipment designed to transmit, the purpose of which is to send a signal. Examples include cellular base stations, microwave links, radio telemetry systems, broadcasting transmitters and radar. I have referred to these as transmitting devices; Mr Morley refers to them as intentional radiators.
- [12] The second category is equipment which is not designed to transmit at all, but which radiates energy as a by-product of its operation. I have referred to these as non-transmitting devices; Mr Morley refers to them as unintentional radiators. Examples include power supplies, solar inverters, wind turbine converters, electric vehicle chargers, computers and virtual fencing units.
- [13] Any equipment which switches electrical current rapidly will radiate some energy. That is a matter of physics rather than a defect in the equipment.

The two categories are regulated separately

- [14] The law treats these two categories very differently.
- [15] Transmitting devices are licensed. A licence is required in order to operate one, and an Approved Radio Engineer certifies the licence. For completeness, the New Zealand regime also permits certain equipment to operate without a licence provided prescribed conditions are met; wifi equipment is an example.

- [16] One feature of the licensing process is relevant here. The certifying engineer considers the effect of the new licence on existing licences. There is no requirement to consider the total accumulated effect of everything already operating. I have addressed this in my report.
- [17] Non transmitting devices are not licensed at all. No application is made. They fall under a separate regime, the electromagnetic compatibility or EMC regime, which prescribes classes of equipment and refers to external standards such as CISPR and IEC standards.
- [18] That regime operates by self-certification. The supplier tests the equipment, usually through an accredited laboratory, and signs a declaration of conformity.

The two regimes are not linked

- [19] This is the point I would particularly ask the Commissioner to note. The two regimes are not connected to one another.
- [20] The EMC standards are generic. They are set to protect radio services in general, at ordinary separation distances, from equipment of a given class. They are not calibrated to any particular receiver.
- [21] Some history assists. The Radiocommunications Act 1989 was enacted to address the changing nature of radiocommunications. At that time consumer radio equipment and consumer electronics were far less pervasive than they later became, and electromagnetic compatibility was not a significant problem.
- [22] By the late 1990s consumer radio equipment and consumer electronics were widespread, and consumer electronics are the single largest source of unintentional radiation. Provisions were accordingly introduced in the 2001 Regulations to address it.
- [23] Those provisions were designed for equipment operating in ordinary circumstances. They were not framed with a satellite earth station in mind, which receives signals well below its own background noise.

[24] That is not a criticism of the regime. It is a statement of what the regime was designed to do.

[25] The consequence is that a declaration of conformity establishes that a product may lawfully be supplied and used. It does not establish, and does not attempt to establish, what that particular device contributes at a particular receiver. Those are two different questions, and satisfying the first does not answer the second.

Relevance to this hearing

[26] Three consequences follow.

- (a) The RSM decision of November 2020 is the source of both the 2 km area and the –154 dBW/MHz limit. Understanding what that decision protects requires knowing which of the two regimes it sits within.
- (b) That decision addresses terrestrial services, being licensed transmitters providing a radiocommunication service. It does not address non transmitting devices.
- (c) The matters raised by submitters, such as inverters, solar installations, wind turbine converters, virtual fencing and distribution lines, fall almost entirely within the non-transmitting category. They therefore sit outside the RSM decision, and the question of what protection exists in respect of them must be answered elsewhere.

Part B — The issues

Issue one: whether the 2 km area and the –154 dBW/MHz limit are justified

[27] In my opinion they are.

[28] Section 3.3.2 of the RSM November 2020 decision establishes three protection areas, at Warkworth, Awarua and Mahia, each of 2 km radius. The protected frequency range is 2200–2290 MHz, and interference from terrestrial services within the area is to remain below –154 dBW/MHz.

- [29] That is a decision of the regulator made under the Act, and it is in force. I was not involved in making it and cannot speak to the reasoning behind the 2 km figure. It binds regardless of that reasoning.
- [30] The -154 dBW/MHz figure has been challenged Mr Morley. As I was not involved in setting it, I can only work backwards from the number and explain it rather than defend it. Working backwards, it rests on conventional principles.
- [31] The starting point is the noise floor. Every radio receiver generates a certain amount of noise simply by reason of being at a temperature above absolute zero. That noise is unavoidable and sets the level below which no signal can be distinguished.
- [32] Thermal noise power is calculated as the product of Boltzmann's constant, temperature and bandwidth.
- [33] The temperature used is 290 kelvin. That is not an arbitrary figure. 290 kelvin is the standard reference temperature used throughout the ITU and IEEE for noise calculations, corresponding to approximately ordinary ambient temperature, or about 17 degrees Celsius. It is the conventional reference for an uncooled receiver.
- [34] Using 290 kelvin, the noise floor in a 1 MHz bandwidth is -144 dBW/MHz. The protection limit of -154 dBW/MHz therefore sits 10 dB below that noise floor.
- [35] Different criteria are applied to determine how much interference is acceptable. For terrestrial services, the usual criterion is a 1 dB rise in the noise floor.
- [36] Space services apply a more stringent criterion: a 10 per cent rise in the receiver's system noise temperature. Expressed as a rise in the noise floor, that corresponds to approximately 0.4 dB.
- [37] That more stringent criterion is consistent with -154 dBW/MHz. A 10 per cent rise requires the interference to sit 10 dB below the noise floor, and 10 dB below -144 dBW/MHz is -154 dBW/MHz.
- [38] The reason space services apply the tighter criterion is that satellite link margins are thin. A link is designed with a finite margin, and that margin is already

committed to rain, atmospheric absorption, pointing error, polarisation mismatch and the longer path length at low elevation. A rise of 0.4 dB is small enough to be absorbed without redesigning the link.

[39] In my opinion there is a sound basis for the –154 dBW/MHz figure.

Issue two: whether that provides absolute protection

[40] It does not. This is the substance of my report. There are four limits on the protection.

- (a) It applies only to terrestrial services. The operative word is “services”. An emission which is merely a by-product is not a service.
- (b) It applies only to services which came into operation after November 2020. A regulatory decision does not operate retrospectively, and the cellular sites around Awarua were in operation well before that date.
- (c) Interference can originate outside the 2 km area. Distance attenuates a signal; it does not eliminate it.
- (d) There is no protection against cumulative interference. The Act addresses interferers individually. Where several sources are each below the limit but together exceed it, there is no remedy. The licensing process reinforces this, because a new licence is assessed against existing licences rather than against the accumulated total.

[41] In practical terms, the protected band is not heavily used in New Zealand. I reviewed the licences within 100 km of Awarua. Within that radius there are no fixed service licences in the band. The only licences identified were eight held by Dawn Aerospace, whose receive locations are more than 100 km distant.

[42] Transmission directly on the protected frequencies is therefore not the principal risk, because there is very little such use.

[43] The realistic concern is spill-over from the adjacent bands. A transmitter does not cease emitting precisely at the edge of its own band. There is always some spill-

over into neighbouring bands. That is a matter of physics, and the standards set emission limits so that adjacent systems can coexist.

- [44] The adjacent bands here are cellular: 2110–2170 MHz below and 2300 MHz above. Cellular equipment operating in those bands emits a small amount of energy outside its own band, some of which can fall within the protected range.
- [45] The local geography assists propagation. The surrounding country is flat, and the path from Bluff crosses salt water, which propagates radio signals further than land. The Bluff Hill site is at an elevation of approximately 251 m, against a ground station elevation of approximately 10 m.
- [46] The cellular sites predate November 2020. There is accordingly no protection against them, and no mechanism to address their combined effect.
- [47] In my opinion that existing exposure is the more significant issue. I should be clear, however, that I do not have sufficient information to say whether those emissions in fact exceed the -154 dBW/MHz threshold.

Issue three: non transmitting devices

- [48] The -154 dBW/MHz protection does not extend to equipment whose emissions are a by-product.
- [49] Such equipment is not licensed or regulated by RSM in the manner that transmitters are. It is not licensed at all, and falls under the self-certification regime described above.
- [50] The question is whether that self-certification regime is adequate in the present circumstances.
- [51] In ordinary circumstances it works well. Emissions from most equipment are low, and the standards are set so that at normal separation distances a conforming device will not trouble a normal receiver. That is the purpose of the regime, and it achieves it. Operating a laptop beside a mobile telephone is not, in ordinary experience, a problem.

- [52] This receiver, however, is more sensitive, and the margins are thinner. That is where the assumption underlying the standards breaks down. They were not derived with a receiver of this kind in contemplation.
- [53] Compliance therefore establishes that the equipment may lawfully be supplied. It does not establish whether that equipment contributes anything at this site.
- [54] At paragraph 65 of my report I said that a device which complies with the EMC standards, but which nonetheless causes harmful interference, would still be caught by the general interference provisions of the Act. I maintain that view. Those provisions are not confined to licensed transmitters.
- [55] I wish to be clear, however, about what that protection amounts to, because it is narrower than it may appear. It operates after the event: a party must be suffering interference, and that interference must be traced to a particular source and quantified. In practice that is demanding. The only quantified benchmark available for this receiver is the -154 dBW/MHz figure in the RSM decision, and that figure was set for terrestrial services rather than for equipment of this kind. There is no mechanism by which a device is assessed before it is installed. And it addresses one source at a time. There is no mechanism anywhere for the combined effect of several.
- [56] Finally on this issue, I do not have emission data for the proposed wind turbine generators and their converters, or for the other equipment raised in submissions. Without that data I am unable to say whether any of it would contribute materially at the Awarua receiver, in either direction.

Issue four: Fresnel zones and physical obstruction

- [57] I address this briefly, because much of it falls outside my scope.
- [58] The Act, the Regulations and the RSM November 2020 decision do not address physical obstruction. I was unable to identify how the horizon mask envelope had been derived from any of those instruments, and I raised that question. The evidence has now addressed it in part.

- [59] As to the technical material, the first Fresnel zone formula relied on in the evidence is the standard one. For an earth–space path, the first Fresnel radius close to the ground station reduces to the square root of the wavelength multiplied by the distance, and a clearance of 0.6 of that radius is the usual rule of thumb for terrestrial links.
- [60] I have not carried out my own calculations and I express no opinion on the numerical results of either party.
- [61] Whether the horizon mask is justified as a planning instrument, and whether the approval pathway is workable, are outside my field.

Issue five: assumptions and uncertainties

- [62] The Commissioner directed at paragraph 6 of Minute #4 that experts be explicit about assumptions and uncertainties. Mine are as follows.
- (a) I have not carried out Fresnel zone or obstruction calculations, and I express no view on any party's numbers.
 - (b) I was unable to estimate the cellular site contributions precisely, because I did not have the site details, including antenna type and orientation. The figures in my report at paragraphs [44] and [46] are estimates and are identified as such.
 - (c) My list of cellular sites operating before November 2020 may not be complete. I included only sites I could confirm were operating before that date. Sites since renamed may not appear.
 - (d) I have no emission data for the equipment raised in submissions.
 - (e) My report was prepared in June 2026, before the applicant's evidence. Some of the questions I raised have since been addressed, at least in part.
 - (f) I have corrected paragraph 35 of my report.

- (g) On the derivation of the -154 dBW/MHz figure, I have worked backwards from the number rather than from the decision record, which I did not have. The reasoning set out above is the conventional basis for a limit of that kind, and the figure is consistent with it. I cannot say from my own knowledge that it is the reasoning RSM in fact applied.
- (h) I am not a planner and express no view on the Resource Management Act questions.

A Sathyendran

28 September 2026