

**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 ROBIN MCNEILL

Dated: 28 September 2026

Todd Walker

Solicitor acting
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Summary statement of Robin McNeill

Introduction

- [1] My name is Robin Gustav McNeill. I prepared evidence dated 14 September 2026.
- [2] I have since reviewed the evidence filed for Stewart Family Assets Limited (SFAL) by Mr Craig Morley (engineering and electromagnetic interference) dated 21 September 2026.
- [3] I have also reviewed the evidence filed for Stewart Family Assets Limited (SFAL) by Mr Huw Jones Morley dated 21 September 2026.
- [4] My evidence first deals with directed questions from the Commissioner before addressing other matters for clarification.

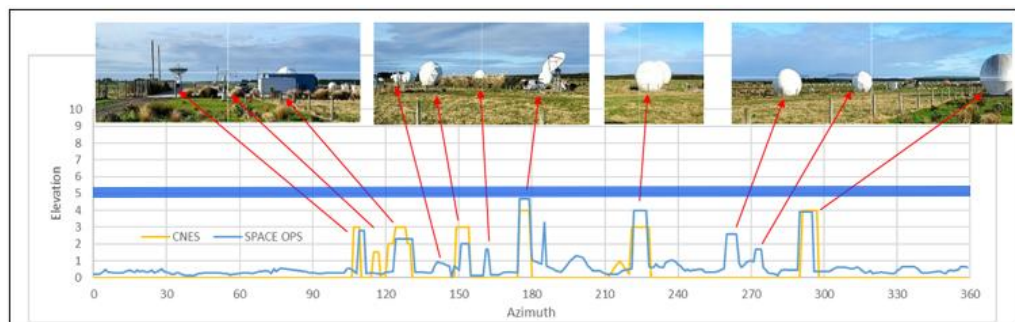
Directed Questions: Commissioner's Minute #4 dated 23 September 2026

(a) the derivation and justification of the 5° / 2 m / 3 km horizon mask parameters (McNeill; Hulston; cf. Morley at [43], [57], [64]; Peer Review at [86]–[93]);

- [5] In my 14 September statement, I have set out the justification for a 5° elevation horizon. Our operations have optimal reliability with the lowest elevation horizon. Internationally, a 5° elevation horizon is generally accepted as delivering good conditions for communication with satellites and other space vehicles craft for the short periods of time that they are passing through our view.
- [6] I understand that the international acceptance of a 5° elevation horizon largely stems from the American Federal Communications Commission's (FCC) *Code of Federal Regulations* rule §25.205 Minimum antenna elevation angle, which states that earth station antennas must not transmit at elevation angles less than five degrees in certain frequencies,
- [7] RSM's "*Replanning the 1710–2300 MHz Band – Decision, Revision (15 February 2021)*" requires earth stations to meet "*ITU Radio Regulations*" Section IV Article 21.14, and so sets the minimum transmitting elevation at 3° elevation. The ITU is the International Telecommunications Union,

the agency of the United Nations responsible for global information and communication technologies.

- [8] For pragmatic reasons, the industry standard in the international space community relaxes the 3° elevation limit to 5° elevation to reduce the risk of interference to terrestrial users.
- [9] At minimum elevations higher than 5° significant periods of capture and communications with satellites and other space vehicles are lost and the benefits of a low horizon location are diminished.
- [10] It is not clear to me how Mr Morley arrived at his assertion in his evidence paragraph 43 that there are obstructions rising to 8° elevation. The “horizon pollution Manhattan” described in paragraph 42 all occurs below 5° elevation and this is below the target maximum of 5° elevation horizon that our customers expect and we endeavour to deliver.
- [11] The horizon mask presented in my Figure 8 (copied below, with 5° elevation highlighted in blue for clarity) clearly shows that only one obstruction rises above 4° elevation and only three obstructions rising above 3°. This is not unexpected as the antennas at Awarua SGS are spaced taking into the account of the heights of other antennas to ensure that obstructions are kept below 5°.



- [12] I understand Mr Morely's paragraph 57 to assert that (to paraphrase) some buildings and structures may affect radio signals more than others. In this he is correct. The difficulty is that without prior analysis it is not possible to know which structures and buildings will affect radio signals. It is because of this uncertainty that we seek a recession plane.

[13] With respect to Mr Morley's paragraph 64 addressing paragraphs 103 – 184 of the *ICC Section 42A Recommendation Report*, 31 August, Morley would appear to support the erroneous proposition in the ICC report that "a blanket approach to the horizon mask" is unsuitable. My reading of the ICC report is that their consultant is suggesting that the horizon mask should be designed to match the locations where the spacecraft rise and set. This overlooks that satellites in low Earth orbit may rise in any direction from Awarua SGS and, governed by their orbit parameters, likewise set in any direction. A tailored horizon mask, as would appear to be proposed in the ICC report, would only work for (currently) one spacecraft in geostationary orbit and another special case at Awarua in the so-called Lagrange Point 2 orbit between Earth and the sun.

b) the magnitude and character of obstruction caused by the SFAL wind turbines (McNeill at [70]–[72], Figures 19–21; cf. Morley at [49]–[54] and Appendix 1);

[14] With respect to Mr Morley's paragraphs 49-54 and Appendix 1, that evidence only addresses blocking by signals in the 2200 – 2290 MHz band (known as "S-Band") where the radio signal wavelengths are between 13.1 cm and 13.6 cm. I agree with the analysis in his *Appendix 1: Antenna Specifications and Tower Obstruction Calculations* with respect to our and our customers' operations in S-Band.

[15] Mr Morley's evidence overlooks that all the Awarua antennas operating at S-Band (transmitting and receiving in the portions of S-Band set aside for each purpose) also receive in the 8,000 MHz to 8,400 MHz radio spectrum, known as "X-Band". These antennas are known as dual-band antennas.

[16] S-Band is mostly used for receiving telemetry data from launch vehicles (rockets), and two-way telecommunications with satellites for operational purposes. X-Band is used for downloading payload data from satellites. Simultaneous operation on both bands during a satellite pass is common and often necessary.

[17] Because the wavelengths of radio signals in X-Band are almost one quarter of those in S-Band (3.6 cm in X-Band as opposed to 13.6 cm in S-Band), the effects described in Mr Morley's analysis are different for

X-Band. I am not easily able to reproduce Mr Morley's calculations, but revised calculations would show that:

- (a) The half-power beamwidth (or -3 dB beamwidth) is approximately quartered, reducing from 2.7° in S-Band to 0.64° in X-Band for a 3.7 metre dual-band dish antenna.
- (b) To a close approximation for long radio paths, (such as for ground stations communicating with satellites), the First Fresnel diameter is given by $F_1 \approx \sqrt{\lambda d}$, where the wavelength is in metres and the distance d to a point within some kilometres from the ground station is in metres. This means that the First Fresnel diameters presented in Mr Morley's appendix for S-Band are halved at X-Band, and the First Fresnel areas reduced by a quarter.
- (c) In short, the potential blocking caused by wind turbines at X-Band would be much more severe than presented in his appendix.

[18] There is a slow migration in the space industry to using "Ka-Band", in the 27,000 MHz - 30,000 MHz radio spectrum for both operations and payload downloading. There are four antennas operating in Ka-Band at Awarua SGS. The wavelengths are in the order of 1 cm and so the First Fresnel diameter would be a little over one quarter of those presented for S-Band, meaning that blockage by wind-turbines could be significant.

[19] Also, Mr Morley's analysis with respect to potential blockage assumes that the spacecraft is stationary. In fact, depending on the pass, the spacecraft could potentially rise or descend directly behind and in line with the turbine mast, exacerbating blockage.

[20] Mr Morley correctly asserts in [52] that BPSK modulation is an exceptionally robust method of encoding information into an RF signal. However, BPSK modulation is seldom used for low Earth orbit spacecraft communicating with ground stations. Recent radio licence applications have been mainly for QPSK, OQPSK and 2GFSK modulation schemes. In practice, these modulation schemes are somewhat less robust than BPSK but allow for faster data rates.

- [21] More important than the modulation scheme itself when analysing telecommunications reliability is the rate data is conveyed and the computational techniques used to deal with any errors introduced by interference and random events. An introduction to signal analysis is well beyond the scope of this summary but suffice to say that some of the data rates used by our customers exceed 500 Mbps (about 5 times the maximum speed of a home-internet connection) and these customers rely on experiencing minimal interference.

(c) the derivation, measurability and enforceability of the -154 dBW/MHz EMI limit (Morley at [33] [35]; Peer Review at [40]–[54]; SpaceOps response to peer review);

- [22] My evidence (paragraphs [27] and [28]) directly infers that the value -154 dBW/MHz was adopted from RSM's "*Re-planning the 1710–2300 MHz Band – Decisions*" of November 2020.
- [23] Mr Morley is incorrect in asserting that the [system] noise temperature of the applicable receiving equipment is not known. As he correctly observes in his paragraph 34, at S-Band our AWA-4 antenna has a G/T of 13.5 dB/K. Antennas of this sort have an efficiency of 60 – 75%. Given this information, it is easily shown that the system noise temperature for the AWA-4 antenna must be very close to 100 Kelvin.
- [24] Consequently, it is straightforward to confirm that an antenna of this class is capable of detecting signals collected at the antenna as weak as -208.6 dBW/Hz (the equivalent of -148.6dBW spread across 1 MHz bandwidth). A signal with a signal strength of -158 dBW occupying 100 kHz bandwidth with a matched filter (a typical telemetry bandwidth) could thus be resolved.
- [25] My interpretation of the -154dBW/MHz limit is that this is the maximum average signal strength received over any 1 MHz bandwidth. This means that an interfering signal much stronger than -154dBW would be acceptable provided that it occupied correspondingly less bandwidth so that the instantaneous sum of the received signal power over the 1 MHz bandwidth occupied was weaker than -154 dBW. These signals are weak, but measurable with care.

[26] To summarise, I see no difficulty in measuring the power of an interfering signal of -154 dBW/MHz and our own antennas at Awarua SGS could measure signals at these levels.

d) the workability of the proposed approval-pathway conditions (Hulston at [28]; Morley at [13], [78]; Jones at [8], [23]).

[27] The intent of our Requirement is that obstructions would be acceptable provided that they can be demonstrated to singly or cumulatively not jeopardise SpaceOps NZ's operations.

[28] To this extent, I agree with Mr Morley's paragraph 13 that "obstructions through the horizon mask do not necessarily result in harmful interference to Space Ops' operations [emphasis mine]" and that (by inference) exceptions to the recession plane for "structural and horizon mask penetrations must be independently evaluated on a rigorous, case-by-case basis" [Morely].

[29] I similarly concur with Mr Morley's paragraph 78 and agree that any analysis must be transparent, independent, and robust.

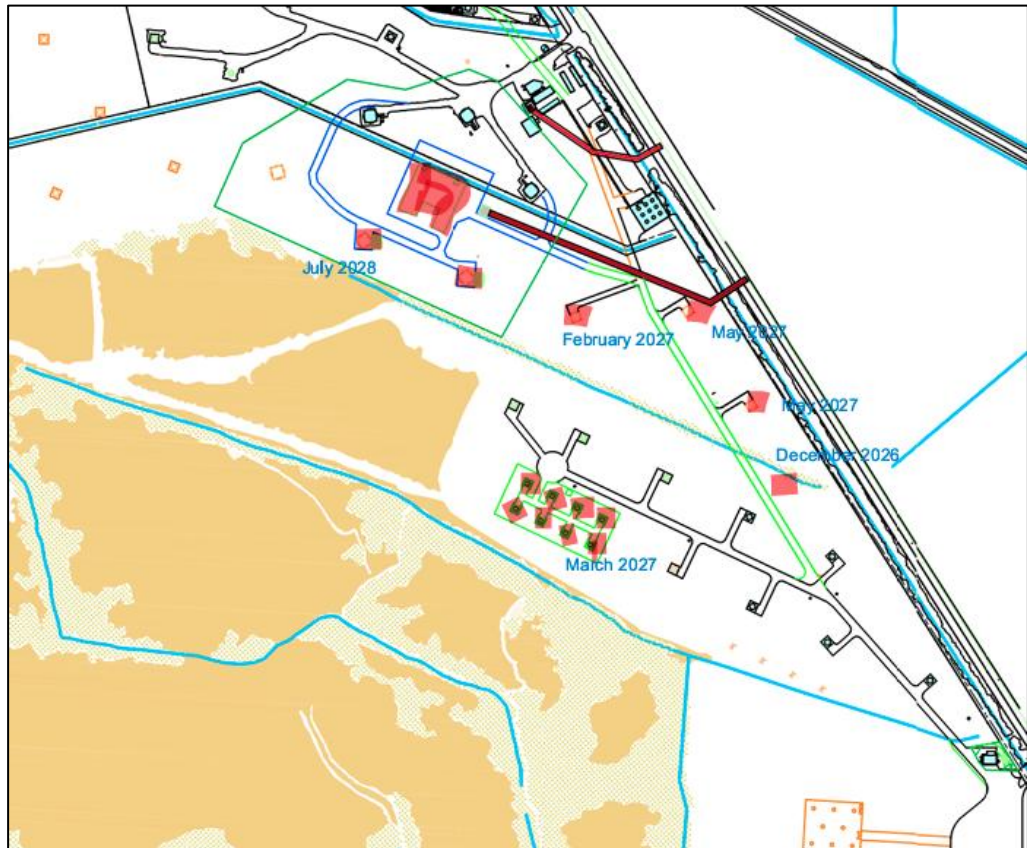
[30] I disagree with Mr Morley's paragraph 78 where he states that SFAL should not be obliged to prove the extent that any source of obstruction or interference they may propose would have on SpaceOps NZ's operation, with the inference being that this effort belongs to SpaceOps NZ. The way I read the proposed process, we would need to collaborate with the proposer of any obstruction in order to properly discharge our obligation for a rigorous assessment. That said, our NoR is clear as to the obligatory limits to be met and it should be straightforward for any proposed development to be modelled to assess its likely effects with respect to those limits. I agree that assessing the effects of wind turbines would be more challenging as Mr Morley acknowledges.

[31] Without recession plane protection as presented in the NoR, it is not clear how any proposed nearby development could be obliged to undertake prior analysis specific to potential impacts on our operations at the Ground Station.

Other Matters

Importance of Awarua SGS internationally

- [32] The geographic location of Awarua SGS is globally important to our customers. That is evident in their willingness to establish their equipment at Awarua SGS, often at higher cost than equivalent facilities around the world.
- [33] Also, our customers comment that the importance of the site's geographic location outweighs other concerns such as the high establishment costs associated with construction in peaty and wet soils at the site which, in places, extend for more than 2 metres deep requiring expensive foundations and roading, and extensive drainage.
- [34] I have appended letters from KSAT of Norway and Leaf Space of Italy that clearly show the importance of Awarua SGS to them and their operations.
- [35] Demand for antennas at Awarua SGS continues to accelerate and the map below shows confirmed orders for erecting and hosting 14 new antennas and a technology services facility related to two of those antennas between now and 30th July 2027.



Horizon Mask Parameters

[36] My evidence relating to obstructions was largely agnostic to the actual radio frequencies used by our customers at Awarua SGS. This was because our determination is for protection from objects penetrating a 5° elevation recession plane. We had believed that it would be unhelpful to complicate the recession plane

[37] We are seeking a horizon mask of 5° elevation from 2 meters height at our boundary as a pragmatic way to ensure that our customers continue to enjoy secure telecommunications with:

- (a) Low Earth orbit (LEO) satellites
- (b) Geostationary satellites
- (c) Spacecraft in deep space (specifically, a spacecraft orbiting Lagrange Point 2 in the Sun-Earth system)
- (d) Launch vehicles

(e) Satellites in launch and early operations phase (LEOP)

- [38] These uses all have different horizon mask characteristics and requirements, but a 5° elevation horizon is generally accepted as the most pragmatic approach to achieving reliable communications without unnecessary complexity within the landscape in the vicinity of a Ground Station.

Evidence of Huw Jones

- [39] The good faith engagement Mr Jones claims prior to 31 July 2025 [his paragraph 24] was not a concerted attempt by SFAL to properly understand the requirements of SpaceOps NZ. Rather, when telephoned by SFAL or a related entity I was only able to advise that without a better understanding of what was proposed, it would be difficult to establish the impact on our operations, and that I welcomed further discussions to see how we could accommodate each other.
- [40] Mr Jones overlooks in his evidence to mention that SpaceOps NZ was not advised of any aspects of SFAL's fast-track application for a proposed wind farm nor that they had sought and obtained a non-notified resource consent to establish a 100-metre-high wind measuring mast at Awarua. It was only after the mast was erected that we knew of it, or of SFAL's continued interest in establishing a wind farm.
- [41] In fact, we notified SFAL and our other neighbours in writing as to our intentions and reasons for notifying a Requirement in a letter dated 5th August 2025.

Conclusion

[42] Once certain erroneous assumptions in Mr Morley's evidence concerning frequencies and spacecraft orbits are allowed for, his evidence essentially supports SpaceOps NZ's reasons for seeking a Requirement and allowing for exceptions to the elevation plane on a case-by-case basis.

Dated: 28 September 2026

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Robin McNeill



Kongsberg Satellite Services AS
Prestvannvegen 38, 9011, Tromsø, Norway

14.09.2026

To whom it may concern,

KSAT use of Awarua Satellite Ground Station

KSAT (Kongsberg Satellite Services AS) is a world-leading satellite ground station company that provides communications, tracking, control, and data download services for satellites and space missions. It operates a global network of hundreds of antennas, including large facilities in Svalbard, Antarctica and New Zealand, enabling spacecraft operators to stay in contact with satellites almost anywhere in orbit. KSAT is considered to be one of the largest and most significant ground network operators in the world, serving government, defence, and commercial customers globally.

KSAT considers Awarua Satellite Ground Station (SGS) to be a very important station in its network. For this reason, KSAT owns and operates 11 antennas at Awarua Satellite Ground Station, ranging in size from 3.7 meters to 6 metres in diameter. The antennas are used to support missions in low Earth orbit through to Lagrange Point 1 on the Sun-Earth System. We are planning to erect two further antennas in mid-2027.

SpaceOps NZ currently holds 506 radio transmitting licences for KSAT, supporting as many spacecrafts from Awarua SGS. Using the licences, we typically undertake over 300 low Earth orbit satellite passes each day at Awarua SGS.

Our customers require as much antenna time per satellite pass as possible and for this reason a low Earth orbit satellite pass will normally begin at no more than 5° elevation and continue through the sky before finishing at 5° elevation some minutes later. It is important that there are no obstructions to the horizon mask, and the low horizon mask at Awarua SGS of less than 1.8° elevation in any direction makes it very attractive to us.

Yours faithfully,

14-Sep-2026 | 3:50 PM CEST

Signed by:

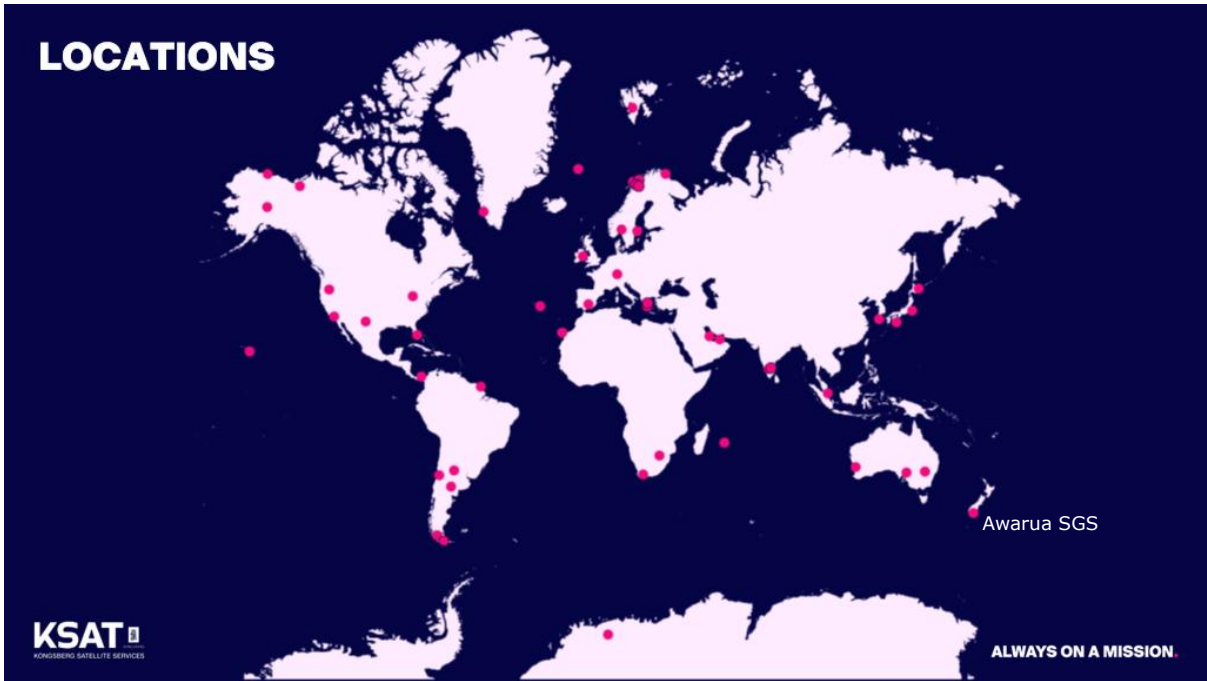
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Bettina Due

Spectrum Coordinator

Appended:

1. KSAT map of the world, showing Awarua SGS



14 September 2026

Subject: Leaf Space Use of Awarua Satellite Ground Station

To whom it may concern,

Leaf Space is an international provider of Ground Segment as a Service (GSaaS), delivering satellite communications, tracking, telemetry and command (TT&C), and mission support services through a global network of ground station assets. Through its Leaf Line network, Leaf Space enables satellite operators to communicate reliably with spacecraft in orbit and supports a wide range of commercial, institutional, and scientific missions.

Leaf Space considers Awarua Satellite Ground Station to be an important strategic location within its global ground network. The station's southern latitude, excellent radio environment, reliable infrastructure, and favourable horizon profile make it an attractive site for supporting spacecraft in low Earth orbit and beyond.

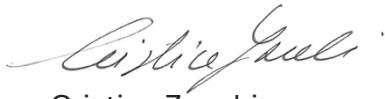
Leaf Space has four antennas at Awarua Satellite Ground Station that operate under 114 separate radio transmitting licences. Over 100 satellite passes each day are supported.

Leaf Space provides services to customers whose missions rely on maximising contact time with satellites during each orbital pass. To achieve this, low Earth orbit satellite contacts commonly commence at elevations of 5° above the horizon and continue until the spacecraft descends below 5° elevation. Consequently, maintaining clear lines of sight to the horizon is important to maximise communication opportunities and operational efficiency.

The exceptionally low horizon mask available at Awarua Satellite Ground Station, being less than approximately 1.8° elevation in all directions, is one of the key factors contributing to the site's attractiveness for satellite communications services. Any reduction in this horizon clearance has the potential to reduce satellite contact times and diminish the operational value of the site for both Leaf Space and its customers.

Given the increasing demand for ground station services from commercial and institutional satellite operators, Leaf Space regards the continued availability of unobstructed satellite visibility at Awarua Satellite Ground Station as an important factor in supporting current and future mission requirements.

Yours faithfully,



Cristina Zanchi
Chief Executive Officer
Leaf Space S.p.A.

Appendix:

Leaf Space global ground station network map showing Awarua Satellite Ground Station.