

WorldVu Development LLC
1785 Greensboro Station Place Tower 3
McLean, VA 22102

January 28, 2022

Exhibit A: Narrative Statement

By this application, WorldVu Satellites Limited (“OneWeb”) seeks authority to operate fourteen technically identical Viasat 3.7 meter antennas in Yona, Guam (the “Guam Earth Station”). The Guam Earth Station will provide gateway connectivity to OneWeb’s low earth orbit (“LEO”), non-geostationary (“NGSO”), fixed-satellite service (“FSS”) system (“the OneWeb System”), which was granted U.S. market access in June 2017.¹ OneWeb has successfully launched 394 satellites, with additional launches continuing on a regular cadence.²

The Guam Earth Station will allow OneWeb to expand its coverage and service in the United States as OneWeb prepares to begin commercial service.³ Grant of this application will serve the public interest by facilitating OneWeb’s ability to deliver ubiquitous, state-of-the-art broadband access to previously unserved and underserved populations in the United States and its territories.

I. Communications with Non-U.S.-Licensed Space Stations

OneWeb hereby incorporates by reference the *OneWeb U.S. Market Access Grant* to demonstrate compliance with the requirements of Section 25.137 of the Commission’s rules for earth station applicants proposing to communicate with non-U.S.-licensed space stations.⁴

II. Spectrum Use and Sharing

The Guam Earth Station will be mounted on fixed platforms. Although the angle at which the antennas point will change with the tracking of OneWeb’s in-orbit satellites, each platform will remain stationary. The Guam Earth Station will communicate with OneWeb’s system in the following frequency bands:

¹ See *WorldVu Satellites Limited, Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System*, Order and Declaratory Ruling, 32 FCC Rcd 5366 (2017) (“*OneWeb U.S. Market Access Grant*”) (granting OneWeb market access for its LEO NGSO FSS satellite constellation).

² See Press Release, *OneWeb Confirms Successful Launch of 36 Satellites, After Rapid Year of Progress* (Dec. 27, 2021), <https://oneweb.net/media-center/oneweb-confirms-successful-launch-of-36-satellites-after-rapid-year-of-progress>.

³ OneWeb has been granted four gateway earth station licenses in the United States. See *Satellite Communications Services, Actions Taken*, Public Notice, Report No. SES-02408 at 2-3 (rel. Oct. 13, 2021). See *Satellite Communications Services, Actions Taken*, Public Notice, Report No. SES-02296 at 4-5 (rel. Aug. 26, 2020). See *Satellite Communications Services, Actions Taken*, Public Notice, Report No. SES-02217 at 3-4 (rel. Nov. 13, 2019). OneWeb has also filed one other gateway earth station application in the United States that remains pending. See SES-LIC-20191203-01624, Call Sign E191337 (filed Dec. 3, 2019).

⁴ See 47 C.F.R. § 25.137.

- 17.8-18.6 GHz (downlink)
- 18.8-19.3 GHz (downlink)
- 27.5-29.1 GHz (uplink)
- 29.5-30.0 GHz (uplink)

As illustrated below, OneWeb’s Guam Earth Station will operate in a manner consistent with the Commission’s rules.

A. Uplink Bands

FSS is a primary or co-primary service throughout all the bands OneWeb intends to use for uplink operations from the Guam Earth Station.⁵ In the 27.5-28.35 GHz band, FSS is secondary to the Upper Microwave Flexible Use Service (“UMFUS”), except for FSS earth station operations authorized pursuant to 25.136. Appendix A of this document demonstrates compliance with the criteria set forth in 25.136(a)(4), alleviating the need for providing additional interference protection to UMFUS operations in this band.⁶

The Comsearch Coordination Report attached separately as Exhibit B to this application demonstrates that: (1) OneWeb can operate the Guam Earth Station without causing harmful interference to existing terrestrial deployments, and (2) OneWeb coordinated with existing licensees in compliance with the Commission’s rules. Similarly, NGSO systems must operate on an unprotected, non-interference basis with respect to GSO networks in the 27.5-28.35 GHz band and 29.5-30 GHz and OneWeb makes no claim of interference protection from U.S.-licensed GSO FSS systems in this band. OneWeb has demonstrated that it meets the applicable ITU EPFD_{up} limits in all frequency ranges where these limits apply and certifies its operations will be compliant with Article 22 and Resolution 76 of the ITU Radio Regulations.⁷ Accordingly, the transmissions from the Guam Earth Station will sufficiently protect GSO FSS systems.

B. Downlink

Space-to-Earth operations in the bands between 17.7-20.2 GHz must complete coordination with U.S. Federal systems in accordance with footnote US334 to the U.S. Table of Frequency Allocations. Footnote US334 lists several locations where federal earth station operations are primary, including Guam. OneWeb is actively coordinating with U.S. Federal systems regarding the Guam Earth Station and will complete this coordination prior to commencement of operations.

⁵ OneWeb notes that Guam falls under Region 3 of the International Table of Allocations. *See* 47 C.F.R. § 2.105(a), n. 3.

⁶ *See* 47 C.F.R. § 25.146(a)(4).

⁷ *See WorldVu Satellites Limited, Petition for a Declaratory Ruling Granting Access to the U.S. Market for the OneWeb NGSO FSS System*, IBFS File No. SAT-LOI-20160428-00041, Technical Narrative (“*Market Access Application Technical Narrative*”) at 33-34; A2-9 – A2-12.

In Region 3, the 17.8-18.6 and 18.8-19.3 GHz band is allocated to FSS on a primary or co-primary basis.⁸ The Commission has allocated the 17.8-18.3 GHz band to the FSS on a secondary basis. In the 18.3-18.6 GHz band, NGSO FSS is secondary to GSO and must comply with international EPFD limits. The 18.8-19.3 is allocated to NGSO FSS operations on a primary basis and GSO FSS systems are secondary.

OneWeb's downlink operations will sufficiently protect any terrestrial operations in the 17.8-18.6 and 18.8-19.3 GHz band by complying with the power-flux density limits in Article 21 of the ITU Radio Regulations and applied through Section 25.146(a) of the Commission's rules. OneWeb previously demonstrated that its downlink operations meet the ITU PFD limits.⁹ Moreover, as indicated in the Comsearch Interference Analysis Report attached as Exhibit B¹⁰ to this application, there were no objections from terrestrial licensees to OneWeb's operations.

As with its uplink operations, OneWeb's downlink operations will sufficiently protect GSO operations in the 17.8-18.6 GHz band. OneWeb has demonstrated that it meets the applicable ITU EPFD_{down} limits in all frequency ranges where these limits apply and already certified that its operations will be compliant with Article 22 of the ITU Radio Regulations.¹¹ The Commission authorized OneWeb's NGSO FSS system to transmit in this band.¹²

III. Radiation Hazard Report

Appendix B provides the radiation hazard analysis for the Guam Earth Station.

IV. FAA Notification

FAA notification is not required as the Guam Earth Station will not exceed 6.1 meters above ground.

⁸ 47 C.F.R. § 2.106.

⁹ See *Market Access Application Technical Narrative* at 23-26.

¹⁰ See *supra* note 6.

¹¹ See *Market Access Application Technical Narrative* at 33-34; A2-1 – A2-8. See also *Letter from WorldVu Satellites Limited, SAT-LOI-20160428-00041* (Mar. 14, 2019) (certifying compliance that the OneWeb System will compliance with applicable EPFD limits).

¹² *OneWeb U.S. Market Access Grant*, 32 FCC Rcd at 5366, ¶¶ 16, 23.

V. Conclusion

As explained above, grant of OneWeb's Guam Earth Station application is in the public interest and meets the requirements of the Commission's rules.

Respectfully submitted,

/s/ Alejandra Ornés

Alejandra Ornés

Vice President, Market Access

OneWeb

1785 Greensboro Station Place, Tower 3

McLean, VA 22102

Appendix A: 47 CFR § 25.136(a)(4) – UMFUS Compliance

The Commission's rules define four elements that, if met, permit an earth station licensee to operate in accordance with the terms of its authorization without providing additional interference protection to Upper Microwave Flexible Use Service ("UMFUS") stations in the 27.5-28.35 GHz band.¹³ Based on the following analysis in the sections below, the OneWeb Guam Earth Station complies with these criteria. Therefore, the Commission should authorize the OneWeb Guam Earth Station without requiring additional protection for future UMFUS licensees in Yona, Guam.

1. § 25.136(a)(4)(i)

The Guam Earth Station complies with this section of the Commission's rules because there is no other licensed earth station in the 27.5-28.35 GHz band in Yona, Guam.

2. § 25.136(a)(4)(ii)

The total population of Guam was used to determine the associated population coverage limit for Section 25.136(a)(4)(ii). According to the 2010 data from the U.S Census Bureau, the island of Guam population is 159,358 leading to the associated population limit for Section 25.136(a)(4)(ii) is therefore 450 persons. Section 25.136(a)(4)(ii) provides that, in a UMFUS license area with a population between 6,000 and 450,000 people, no more than 450 people may be within an earth station's PFD contour that is equal to or exceeds -77.6 dBm/m²/MHz to avoid having to provide interference protection to future UMFUS operators.

As demonstrated below, the Guam Earth Station's PFD contour contains fewer than 450 people. Using the ITU RR Appendix 7 Time-Variant Gain (TVG) method, each of the 14 antennas of the Guam Earth Station would track a different OneWeb satellite above a minimum elevation angle of 5 degrees.¹⁴ A composite (14 antennas) PFD contour was developed via proprietary software.¹⁵ The proprietary software assumed the UMFUS reference antenna height of

¹³ See 47 C.F.R. § 25.136(a)(4).

¹⁴ In this analysis, the population data for each census block within the Guam Earth Station PFD contour comes from the US Census data dated 2010. The propagation model implements a 1-arc second resolution SRTM Digital Terrain Elevation Data profile based on the ITU-R Recommendation P.452-15.

¹⁵ The proprietary software result for other Earth stations application have been compared with the Visualyse PRO software to ensure consistency. See SES-LIC-20180604-01082.

10 meters height above ground with a maximum threshold power of -158^{16} dBW/MHz as required by 25.136(a)(4). The UMFUS reference antenna is moved in small steps with an azimuth of $\pm 180^\circ$ around the Guam Earth station location to measure the value of the received power at each location step.

The software assumed each of the 14 antennas would track the higher elevation satellite visible down to a minimum elevation angle of 5° while maintaining a GSO arc avoidance of 6° . This composite assessed the cumulative distribution function (CDF or joint probability) of potential interference representing the EIRP towards the horizon and the propagation statistics by performing the convolution of the individual CDFs.

Table 1 below contains the Guam Earth Station parameters.

Table 1: Guam Earth Station Parameters	
ES latitude (NAD 83)	13° 25' 6.4" N
ES longitude (NAD 83)	144° 45' 6.2" E
Ground Elevation (AMSL)	111.09 m
ES antenna size	3.7 m
ES input power density (clear sky)	-18.7 dBW/MHz
ES minimum elevation angle	5°
Earth station height to the midline	2.62m
Number of active antennas at site	14
Simulation Frequency	28 GHz
Maximum Gain	58 dBi
Maximum EIRP	39.34 dBW/MHz
Clutter	P.452-16 with clutter height of 4m and distance from earth station of 100m

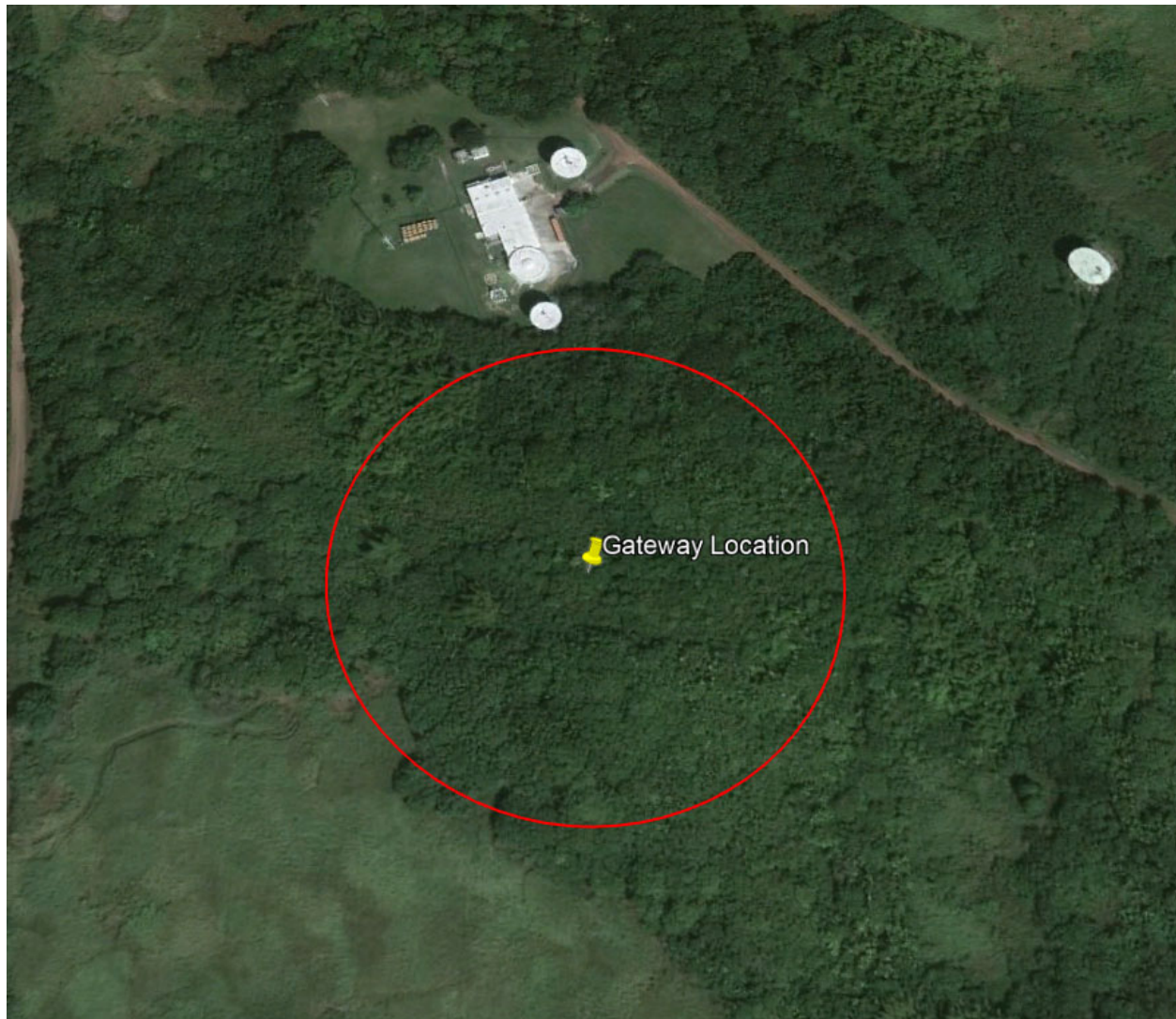
It should be noted that each antenna or SAP (Satellite Access Point) operates with a maximum 63 dBW EIRP/250 MHz in clear sky. In the event of rain fade, the EIRP of any OneWeb SAP antenna would only be increased by a maximum of 3 dB (to 66 dBW) if the rain attenuation on the uplink path to the satellite exceeds 6 dB. OneWeb notes that using the clear-sky EIRP is justified because such rain events would typically occur in the direction of one or few antenna link(s) to the satellite, but not necessarily for all 14 antennas at the site pointing in different azimuths and elevation angles. The proprietary software considers aggregate emissions

¹⁶ The -158 dBW/MHz is equivalent to the -77.6 dBm/m²/MHz value used in Section 25.136(a)(4), which was derived by converting the maximum PFD threshold to maximum input power before the antenna gain. Therefore, the antenna gain is 0 dBi. Then the PFD threshold converted to dBW/m²/MHz is -107.6 dBW/m²/MHz. If $G_{\text{ant}} = 0$ dBi, $I = \text{PFD} * A_e = -158$ dBW/MHz.

from all 14 antennas at the site where each antenna transmits continuously while tracking one NGSO satellite. Therefore, it is unlikely that all antennas would be subject to this same 6 dB or greater attenuation due to rain. Furthermore, if there is a 6 dB fade due to rain directly on the OneWeb SNP, the attenuation would also apply to the path from the earth station to UMFUS target location, thereby reducing the overall PFD at any direction around the earth station by at least 3 dB.

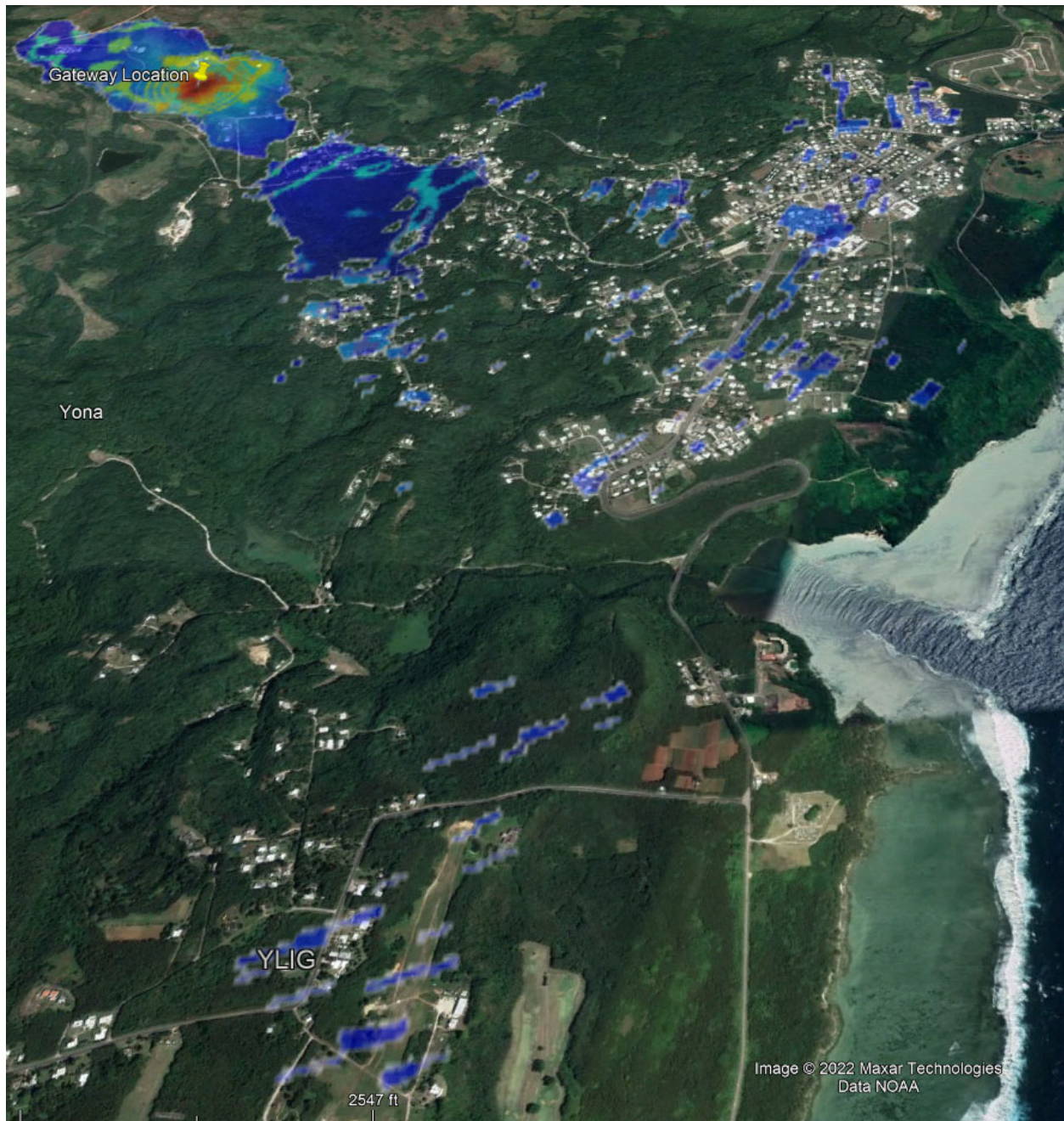
Clutter attenuation was determined using the method in Section 4.5 of Recommendation ITU-R P.452-16. Based on a survey of the site in Google Earth, a clutter height of 4m at a 100m distance was assumed to be conservative based on the low trees surrounding the site. The below figure shows the site in Google Earth with a 100 m circle drawn around it.

Figure 1. Clutter Distribution at 4m High and 100m Radius (red circle) from the Gateway Site



As a result, the TVG method calculates the area where the PFD limit could be exceeded, assuming a PFD value that is not exceeded for 99% of the time. The resulting PFD contour can be exported as a .KMZ file for viewing with a GIS mapping software. Figure 2 shows the resulting PFD contour of the analysis in Google Maps below.

Figure 2. PFD Contour for Earth Station at Guam, Docomo



The Guam Earth station's PFD contour is superimposed with U.S Census blocks 2010 Guam data to determine which census blocks overlaps partially or wholly with the PFD contour and derive the population coverage within each census block. This approach shows that only three census blocks are covered partially by the Guam PFD contour. The census blocks 9539 and 9540 are with a total population of 6480. Figure 3 below shows a view of the PFD contour as it relates to census blocks 9539 and 9549.

Figure 3. PFD Contour Superimposed with Guam Census Blocks

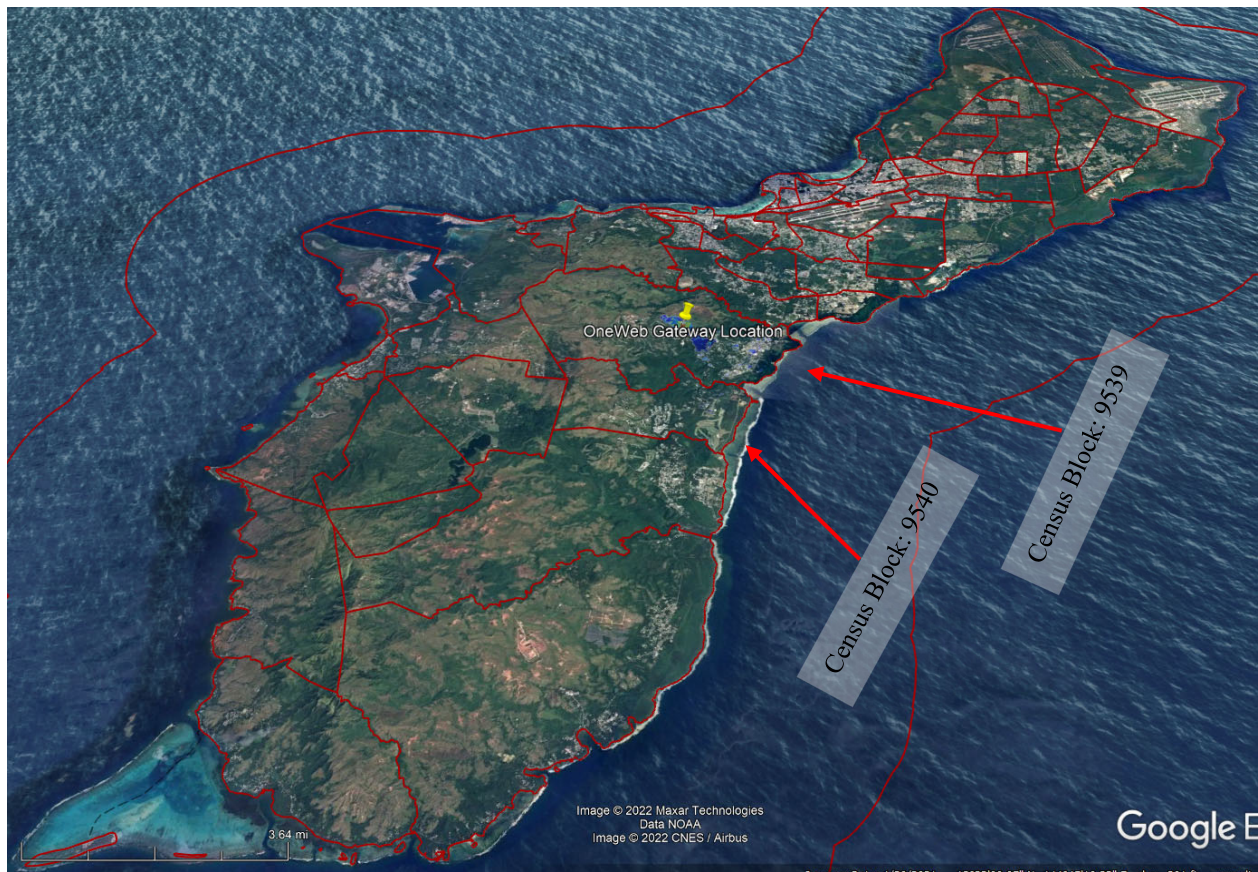


Figure 4. Wide View Showing PFD Contour Superimposed with Guam Census Block 9539

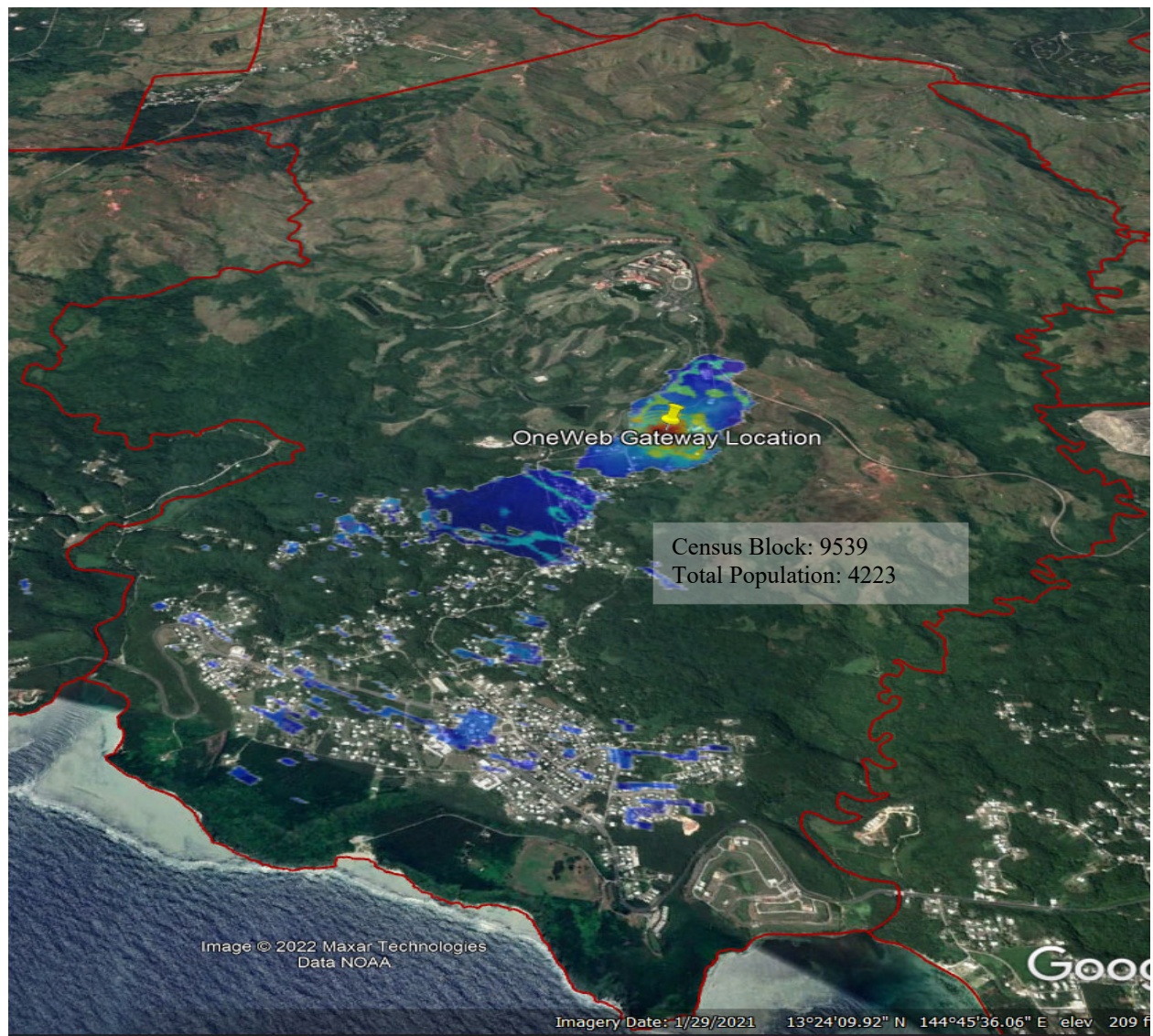


Figure 5. Wide View Showing PFD Contour Superimposed with Guam Census Block 9540



Table 2 provides the calculated population for each census block impacted by the Guam Earth Station PFD contour using the actual area method:

Table 2: Population Coverage Statistics

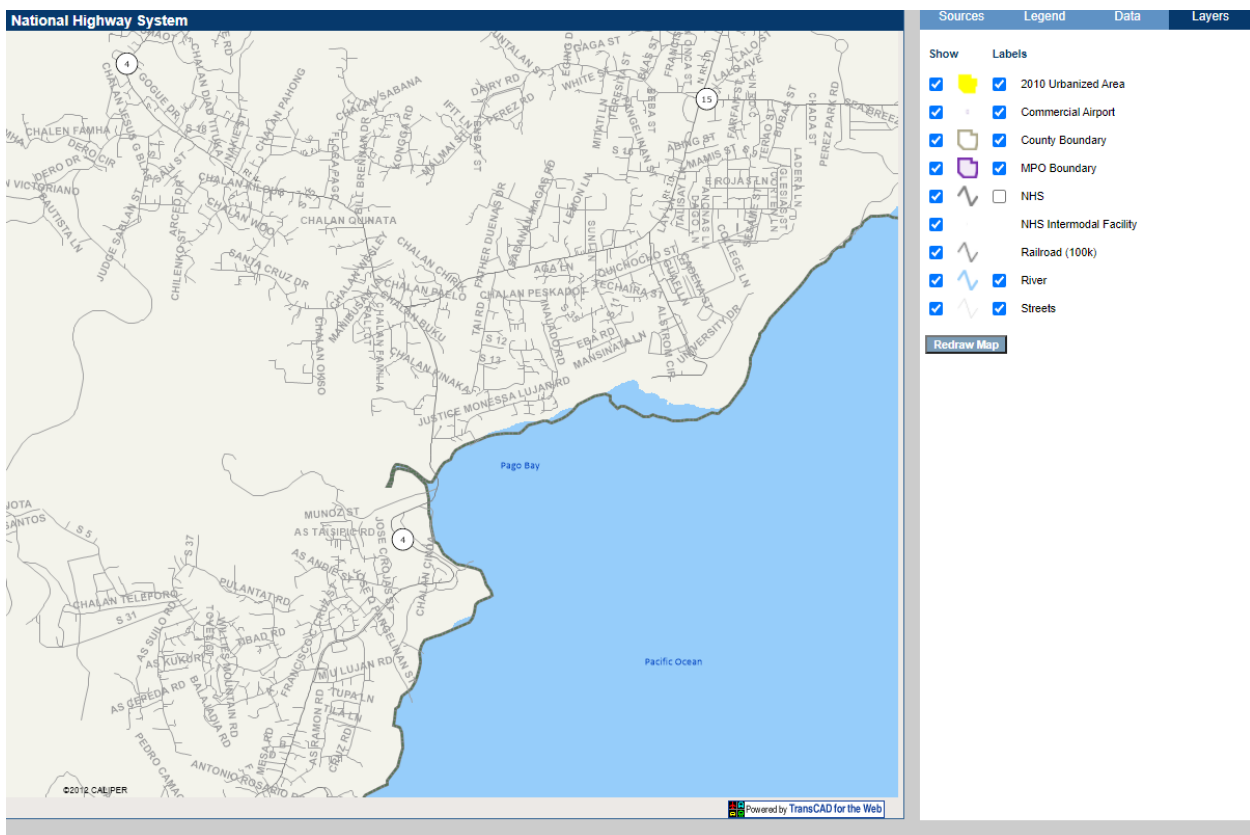
Block ID	Population	Proportion of Area of Census Block Covered by the PFD contour (calculated)	Assumed Population of Contour Coverage
			Portion of Population Covered by the PFD contour (calculated)
9539	4223	3.94 %	169
9540	2257	0.44%	10
Census Block Covered Total Population: 179			
Census Block Total Population: 6480			

Therefore, 179 people are affected by the PFD contour which is below the 450-people limit and confirming compliance with Section 25.136(a)(4)(ii).

3. § 25.136(a)(4)(iii)

Based on a search in Google Maps, there are no major event venues, urban mass transit routes, passenger railroads or cruise ship ports within the Guam Earth Station's PFD contour.

A search was performed on the Federal Highway Administration Office of Planning, Environment, and Realty Executive Geographic Information System (FHWA HEPGIS) portal¹⁷ to confirm that roads that intersect with the Guam Earth station's PFD contour are not designated as Interstates, Other Freeways and Expressways, or Other Principal Arterials. Therefore, and as illustrated in the image below the Guam Earth Station complies with the requirements of this subsection.



¹⁷ See Google Maps; see also National Highway System Map, U.S. Department of Transportation, Federal Highway Administration (last visited Jan. 28, 2021), <https://hepgis.fhwa.dot.gov/fhwagis/>.

4. § 25.136(a)(4)(iv)

The Comsearch Coordination Report in Exhibit B demonstrates that OneWeb completed coordination in compliance with the Commission's rules.¹⁸

¹⁸ See *supra* note 6.

APPENDIX B: RADIATION HAZARD REPORT

In accordance with OET Bulletin 65, this Radiation Hazard Report measured radiation exposure levels in seven zones for two cases—general population and occupational. The radiation levels calculated for each zone in Section II are derived from the calculations made in Section I. The results in Section III for OneWeb’s 3.7-meter Viasat antennas illustrate any radiation hazard that may exist for the general public and/or occupationally will be mitigated by limited access and various protocols to ensure safe exposure levels.

I. Defined Variables for OET Bulletin 65 Calculated Variables

Variables	Value	Unit	OET 65 Calculated Variables	Formula	Value	Unit
$D =$ <i>Aperture Diameter</i>	3.7	Meters	$\lambda =$ Wavelength	c/F	0.0104	Meters
$d =$ <i>Subreflector Diameter</i>	0.367	Meters	P _I = Total Antenna Input Power	P*p	128	Watts
$\eta =$ <i>Aperture Efficiency</i>	57.9%	Percentage	A = Area of reflector	$\pi(D/2)^2$	10.75210	Meters ²
<i>FCC Designation</i>	Ka	Band	a = area of sub-reflector	$\pi(d/2)^2$	0.10578	Meters ²
$F =$ <i>Frequency</i>	28750	MHz	G = Antenna Gain	$G =$ $4\pi\eta A/\lambda^2$	719475.5659	Linear
$P =$ <i>Transmitter Power Watts</i>	128	Watts	Antenna Gain dB	10log ₁₀ (G)	58.57	dBi
$p =$ <i>Number of Transmitters</i>	1	#	R _{nf} = Near-Field Region	$R_{nf} =$ $D^2/4\lambda$	328.22	Meters
$R_{ua} =$ <i>Closest Point to Uncontrolled Area</i>	15	Meters	Transition Region	$>R_{nf}<R_{ff}$	328.22	>Meters
$R_{ua} =$ <i>Elevation angle at closest point</i>	5	Degrees			787.72	<Meters
					R _{ff} = Far-Field Region	$R_{ff} =$ $0.6D^2/\lambda$
					68.92	Meters AGL

II. Radiation Levels in Each Zone

Radiation Analysis Zone		Formula	Level	Value	Exposure Limits Met	
					General Public	Occupational
					<1mW/cm ²	<5mW/cm ²
1	Power Sub-reflector	$4P_I/a$	484.00 ₃	mW/cm ₂	No	No
2	Antenna Surface	$4P_I/A$	4.762	mW/cm ₂	No	Yes
3	Main Reflector Ground	P_I/A	1.19	mW/cm ₂	No	Yes
4	$S_{nf} =$ Near-Field Power Density	$4\eta(P_I/A)$	2.757	mW/cm ₂	No	Yes
5	Transition Max Power Density	$S_{nf} * R_{nf}/R_{nf}$	2.757	mW/cm ₂	No	Yes
6	Far-Field Max Power Density	$P_I * G/4\pi R^2$	1.181	mW/cm ₂	No	Yes
7	Off-axis Near Field	$S_{nf}-20dB$	0.0275 ₇	mW/cm ₂	Yes	Yes

III. Results

General Public Analysis. OneWeb's 3.7 meter Viasat antennas will be located in an area clearly marked with Radiation Hazard signage with no access by the general public. Zones 1 through 5 create no concern for the general public as they lie behind this signage where only authorized personnel may enter. Likewise, Zone 6—Far Field—also creates no concern for the general public because it develops 69 meters above ground level at a minimum elevation angle of five degrees where the general public cannot access. Accordingly, there is no risk of radiation exposure beyond the acceptable limits.

Occupational Analysis. Only around the Power Sub-reflector are any radiation levels exceeded. This measurement is taken at a point between the feed and the sub-reflector. Power to the transmitters will be turned off remotely whenever work needs to be performed in this Zone. Signage will mark the area for Radiation Hazard and access by qualified personnel only, facilitating awareness and safety. Consequently, there is no risk of radiation exposure beyond the acceptable limits.