Rowan County, North Carolina

Telecommunications Site Review
New Telecommunications Facility

CITYSCAPE CONSULTANTS, INC.
2423 S Orange Ave #317
Orlando, FL 32806
Tel: 877.438.2851 Fax: 877.220.4593

August 30, 2022

Mr. Shane A. Stewart, AICP, CFM
Assistant Planning Director
Rowan County Planning & Development
402 N. Main Street, Suite 204
Salisbury, NC 28144

RE: **APPLICANT/PROVIDER:** Amazon Kuiper Infrastructure, LLC
SITE ID: CLT501 / Mt. Ulla
ADDRESS: 0 Upright Road, Mount Ulla, NC 28125
LATITUDE: 35° 38' 58.2" N **LONGITUDE:** 80°40' 05.3" W

Dear Mr. Stewart,

At your request, on behalf of Rowan County, North Carolina ("County"), CityScape Consultants, Inc. ("CityScape") in its capacity as telecommunications consultant for the County, has reviewed a Special Use Permit application submitted by Amazon Kuiper Infrastructure ("Applicant") to construct a new fixed gateway earth station ("gateway") consisting of an array of six (6) satellite dish antennas ("dishes") 2.4 meters (7.9 feet) in diameter and standing at a maximum of thirteen (13) feet above grade, and an equipment cabinet within the dish array footprint that will feed power and data to the dishes, *see Figures 1 and 2*. The address of the proposed facility is 0 Upright Road in Mount Ulla, North Carolina, *see Figure 3*. The property is zoned RA and the proposed structures will not require FAA-approved aviation lighting. The proposed facility is primarily regulated by Section 21-60(4) of the County Ordinance ("Transportation, communications, electric, gas and sanitary services group: Communications and Wireless support structures").

Proposed Facility Overview

The planned Amazon Kuiper network of gateways is intended to "deliver satellite broadband communications services to tens of millions of unserved and underserved consumers and businesses in the United States and around the globe", (Page 1 of "Gateway License Narrative" in the FCC application). Satellite-delivered broadband internet is an alternative to wired systems such as cable and fiber, which generally are lacking or unavailable in rural areas.

The proposed satellite dishes will transmit broadband data originating from a fiber hub to Low Earth Orbit ("LEO") satellites which will, in turn, send the data to homes and businesses that are provided with specialized equipment including a small satellite dish. Amazon's Kuiper system boasts greater speeds and lower latency (lag-time) than conventional satellite-delivered services which use geostationary satellites 22,000 miles above the earth. Since LEO satellites are such closer to earth (up to1,200 miles), the data delivery path through space is much shorter, thus improving speed and latency.

The Applicant proposes to install a ten (10) foot high non-perforated corrugated metal fence around the facility compound for security purposes and to provide a buffer against interference to other communications facilities operating on the same frequencies in the area. The Applicant also proposes to plant Judd Viburnum shrubs around the compound fence on the north, east and south sides (at least four feet tall at time of planting).

The site plan shows a twenty-three (23) foot setback between the center of each dish concrete pad and the compound fence, equal to the maximum dish height of thirteen (13) feet including the pier, plus ten (10) feet in accordance with Section 21-60(4)(c) of the County Ordinance.

RF Exposure Safety

The dishes will transmit signals at frequencies between 27.5 and 30 Gigahertz (part of the Ka band). The dishes will also receive signals from the satellites but this is of no consequence with regard to RF exposure. As part of its application to the FCC (Exhibit B, Radiation Hazard Analysis), the Applicant provided an RF exposure study which concluded that the calculated RF exposure levels in all areas outside the compound fence are below the FCC general public Maximum Permitted Exposure (MPE) level of 1 milliwatt per square centimeter. CityScape agrees with the calculations and the calculation equations used in the study, which are shown in *Figure 4*. Exhibit B also details methods that will be employed by the Applicant to prevent unauthorized access inside the compound and to assure worker RF safety during repair and maintenance activities.

The solid metal fence is not intended to prevent excess exposure to RF radiation to people; in fact, a fence of solid metal is not needed for that purpose but rather to to comply with the FCC rules regarding the prevention of interference to other RF facilities in the area that operate on these frequencies. In going through the Applicant's RF exposure study, the undersigned found that the determinations of compliance with FCC exposure limits do not rely on the extra buffer of protection that would be provided by a solid metal fence. In spite of that, the facility, in theory, would not emit RF energy at levels above the maximum exposure levels set by the FCC, which for these frequencies are 1 milliwatt per square centimeter (mW/cm^2) for general population exposure outside the fence and 5 milliwatts per square centimeter for occupational exposure inside the fence.

The differences between general public exposure and occupational/controlled exposure are explained in FCC OET Bulletin 65 as follows:

"Occupational/controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general

population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

General population/uncontrolled exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment-related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area."

The PFD contours shown in Applicant's documents have nothing to do with RF exposure to people. They are used as part of a showing that the aggregate PFD contour will not encompass a population of more than 450 people and thus making the Applicant exempt from performing more detailed interference studies involving other facilities operating on these frequencies. Unlike the RF exposure study, the Applicant's interference study does take into account the additional attenuation of RF energy caused by the solid fence.

This being said, it is possible that since the solid metal fence is not needed for protection from excess RF exposure, the door may not be totally closed to the idea of a chain link fence instead of the corrugated fence. If the Applicant can show the FCC that the solid metal fence is not needed to comply with the population limit of 450 inside the aggregate PFD contour, then, in CityScape's opinion, the chain link fence becomes an option.

If the Applicant chooses to not use a solid metal fence, or it the County insists on a chain link fence, the Applicant may be required to redo its interference study it submitted to the FCC without the attenuation factor provided by a solid metal fence. This would certainly result in a larger PFD area, but it is not for certain if the facility, without the attenuation factor, would comply with the maximum population requirement and the other requirements of Section 25.136(a)(4). The transmitting frequencies proposed to be used by Amazon are shared with terrain-based facilities that use these frequencies, such as 5G mobile wireless service and the Internet of Things (but not radio, TV or public safety stations) and Amazon's proposed use of the frequencies is secondary to the terrain-based use, thus the FCC wants to be assured that Amazon's proposed facility does not cause interference to terrain-based facilities. Since the current proposed facility meets the requirements of Section 25.136(a)(4) of the FCC Rules, the Applicant is not required to perform more detailed interference studies.

When discussing RF energy levels at locations of various distances from a transmitting antenna, the terms "near-field region" and "far-field region" are often used but these terms are generally unfamiliar to the public. The "near-field region" is a range of distances from a transmitting antenna where the power density (usually expressed in mW/cm^2) can reach a maximum before it begins to decrease with distance. The distance to the end of the near-field region is dependent upon the diameter of the dish and the frequency of operation. The narrow

beam of RF energy emitted by a satellite dish isn't fully formed until it reaches the "far-field region" where the power density becomes inversely proportional to the square of the distance from the antenna. In the case of the proposed Mount Ulla satellite earth station facility, the calculated near-field distance is 138.1 meters (453 feet), so the near-field region would extend much farther than the fence line.

To assess the power density received at locations where people could be standing at ground level outside the fence, the "off-axis" power density is referred to instead of the "main beam" power density, because the minimum tilt angle of the dishes will be no less than 20 degrees above the horizon, thus people standing on the ground outside the fence could not be in the center of the main beam of the dishes where the emitted RF energy is maximum. The calculated off-axis near-field power density is 0.033 mW/cm² which is 3.3% of the maximum power density allowed by the FCC in areas frequented by the public and can be considered as the maximum level at any location outside the fence. Furthermore, this level is comparable to levels involving personal wireless base station towers. At distances greater than 453 feet from a dish, the power density decreases with distance.

Conclusion

It is the opinion of CityScape that the proposed facility, at least from a health and safety viewpoint, would not have a problematic effect on the residents of the County. A fiber communications facility that includes at least one satellite dish is located on the adjacent parcel to the west which may have a mitigating effect on the visual impact of the proposed facility. Should the County approve the Special Use Permit application, CityScape recommends that the permit include the following conditions:

1. Prior to permitting, Applicant shall provide a structural analysis report by a registered North Carolina structural engineer certifying that the satellite dishes will comply with ANSI/TIA-222 G or H standards and the 23-foot fall radius; and,
2. If an emergency power backup generator is to be used, its noise level shall not exceed 65dBa at the nearest property edge. Testing shall be limited to the hours between 9:00 A.M. and 4:00 P.M., (Monday through Friday); and,
3. Clearly visible signs warning of potential RF exposure risk shall be affixed to the compound fence in accordance with FCC Rules and Regulations and OET Bulletin 65; and,
4. No advertising shall be posted on the compound fence.

I certify that, to the best of my knowledge, all the information included herein is accurate at the time of this report. CityScape only works for public entities and has unbiased opinions. All recommendations are based on technical merit without prejudice per prevailing laws and codes.

Respectfully submitted,

CityScape CONSULTANTS, INC.

B. Benjamin Evans
Senior Project Engineer
CityScape Consultants, Inc.

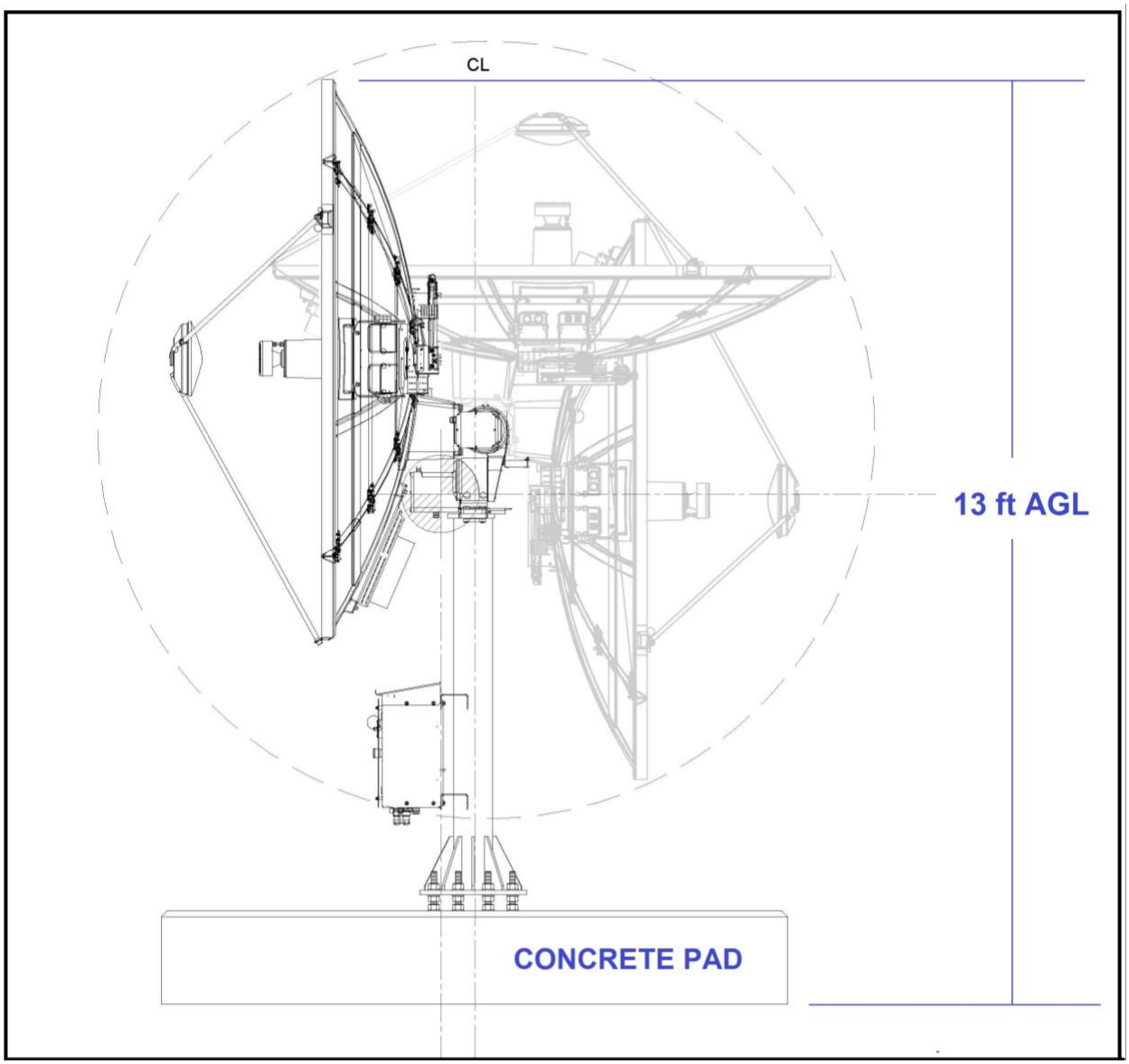

Figure 1 – Satellite Dish Sketch

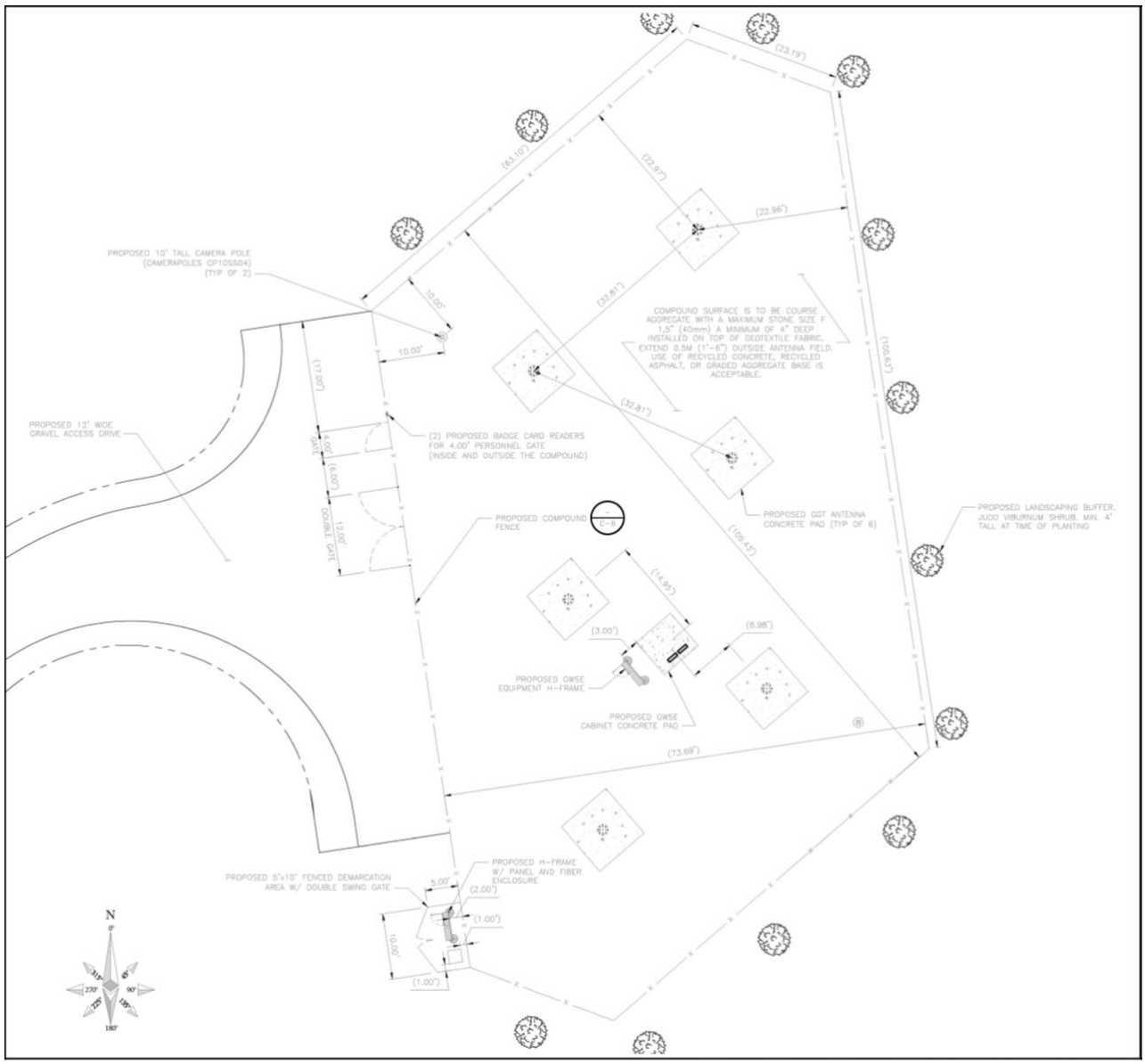
PROPOSED 10' TALL CAMERA POLE (CAMERAPOLES CP10SS04) (TYP OF 2)
PROPOSED 12' WIDE GRAVEL ACCESS DRIVE
(2) PROPOSED BADGE CARD READERS FOR 4.00' PERSONNEL GATE (INSIDE AND OUTSIDE THE COMPOUND)
PROPOSED COMPOUND FENCE
COMPOUND SURFACE IS TO BE COURSE AGGREGATE WITH A MAXIMUM STONE SIZE F 1.5" (40mm) A MINIMUM OF 4" DEEP INSTALLED ON TOP OF GEOTEXTILE FABRIC. EXTEND 0.5M (1'-6") OUTSIDE ANTENNA FIELD. USE OF RECYCLED CONCRETE, RECYCLED ASPHALT, OR GRADED AGGREGATE BASE IS ACCEPTABLE.
PROPOSED GGT ANTENNA CONCRETE PAD (TYP OF 6)
PROPOSED LANDSCAPING BUFFER, JUDD VIBURNUM SHRUB, MIN. 4' TALL AT TIME OF PLANTING
PROPOSED GWSE EQUIPMENT H-FRAME
PROPOSED GWSE CABINET CONCRETE PAD
PROPOSED 5'x10' FENCED DEMARCATION AREA W/ DOUBLE SWING GATE
PROPOSED H-FRAME W/ PANEL AND FIBER ENCLOSURE
N

Figure 2 – Proposed Ground Compound

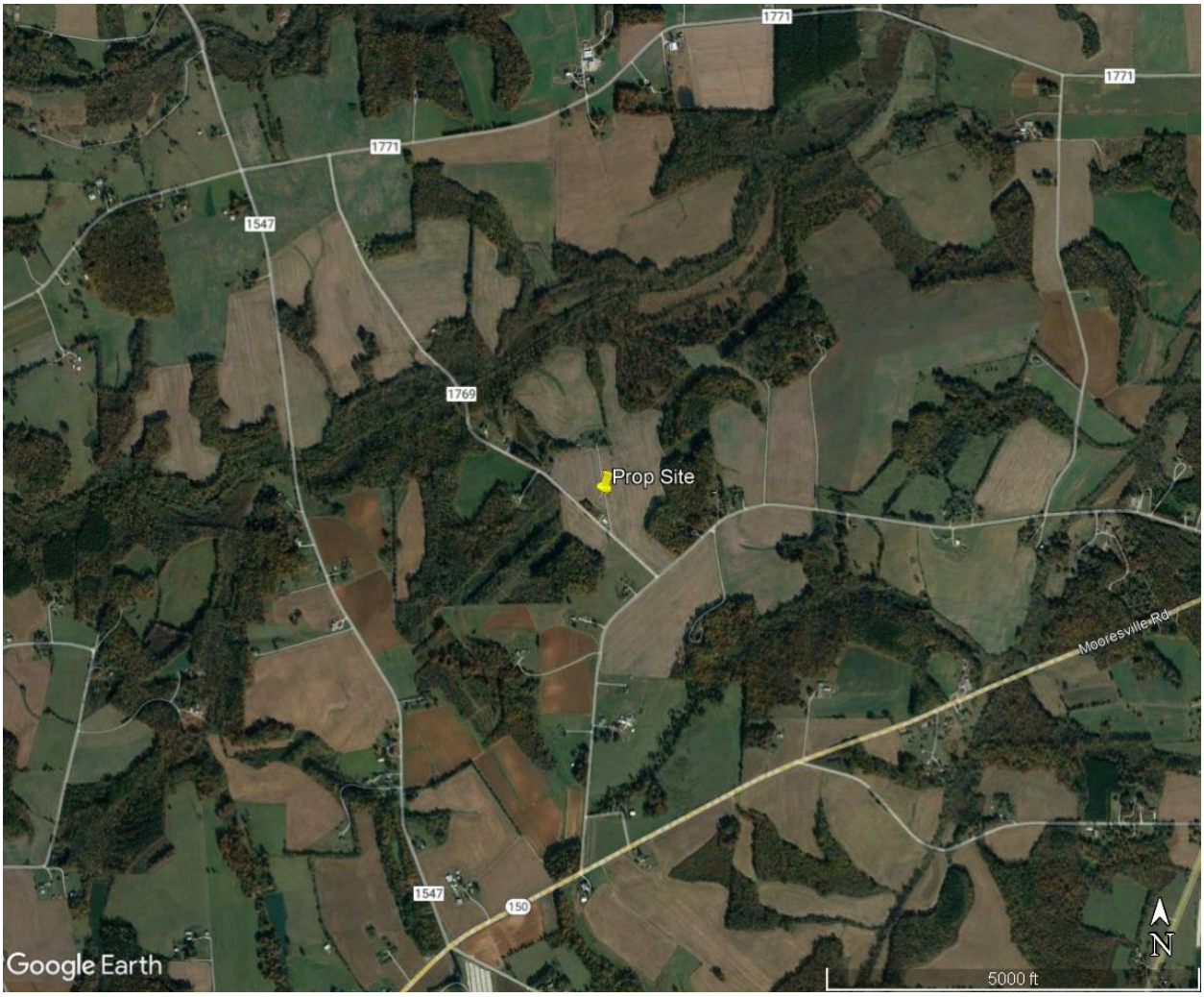

Figure 3 – Site Location Map

Calculated Variables	Unit	Value	Variable	OET Ref
Wavelength	meters	0.01	$\lambda = \frac{c}{f}$	
Area of Reflector	meters^2	4.52	$A = \pi r^2$	
Area of Sub-reflector	meters^2	0.1307	$A_{sub} = \pi r^2$	
Antenna Gain		240499.6	$G = \frac{\eta 4\pi A}{\lambda^2}$	(15)
Antenna Gain	dBi	53.8	$G_{dBi} = 10 * log_{10}(G)$	
Near-Field Distance	meters	138.10	$R_{nf} = \frac{D^2}{4\lambda}$	(12)
Far-Field Distance	meters	331.43	$R_{ff} = \frac{0.6D^2}{\lambda}$	(16)
Far-Field Off-Axis Gain	dBi	-0.53	$G_{ff\,(dBi)} = 29 - 25log_{10}(\theta)$ $\theta = min\ elevation = 20°$	
Far-Field Off-Axis Gain		0.89	$G_{ff} = 10^{(\frac{G_{ff\,(dBi)}}{10})}$	
Power over Sub-reflector	mW/cm^2	244.76	$S_{surface} = \frac{4P}{A_{sub}}$	(11)
Power over Antenna Surface	mW/cm^2	7.07	$S_{surface} = \frac{4P}{A}$	(11)
Near-Field Power Density (Main Beam)	mW/cm^2	3.25	$S_{nf} = \frac{16\eta P}{\pi D^2}$	(13)
Near-Field Power Density (Off-Axis)	mW/cm^2	0.033	$S_{nf} = \frac{16\eta P}{100\pi D^2}$	(13) [5]
Far-Field Max Power Density (Main Beam)	mW/cm^2	1.39	$S_{ff} = \frac{PG}{4\pi R^2}$	(18)
Far-Field Max Power Density (Off-Axis)	mW/cm^2	0.000	$S_{ff\,off-axis} = \frac{PG_{ff}}{4\pi R^2}$	(18) [6]

Figure 4 – RF Exposure Calculations from Applicant