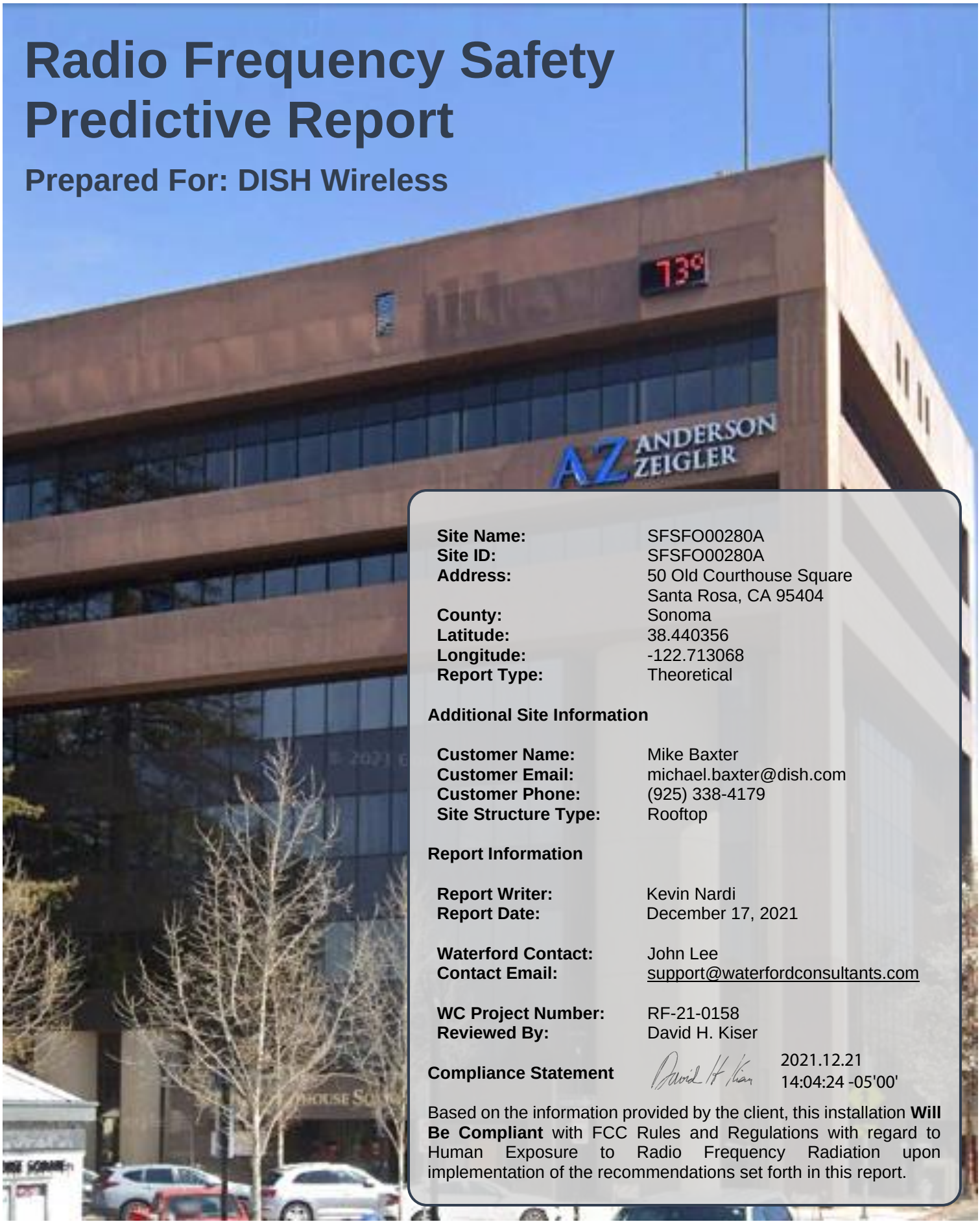
Radio Frequency Safety Predictive Report

Prepared For: DISH Wireless



Site Name:	SFSFO00280A
Site ID:	SFSFO00280A
Address:	50 Old Courthouse Square Santa Rosa, CA 95404
County:	Sonoma
Latitude:	38.440356
Longitude:	-122.713068
Report Type:	Theoretical

Additional Site Information

Customer Name:	Mike Baxter
Customer Email:	michael.baxter@dish.com
Customer Phone:	(925) 338-4179
Site Structure Type:	Rooftop

Report Information

Report Writer:	Kevin Nardi
Report Date:	December 17, 2021
Waterford Contact:	John Lee
Contact Email:	support@waterfordconsultants.com
WC Project Number:	RF-21-0158
Reviewed By:	David H. Kiser

Compliance Statement David H. Kiser 2021.12.21 14:04:24 -05'00'

Based on the information provided by the client, this installation **Will Be Compliant** with FCC Rules and Regulations with regard to Human Exposure to Radio Frequency Radiation upon implementation of the recommendations set forth in this report.

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WATERFORD

Table of Contents

1 General Summary

DISH Wireless contracted Waterford Consultants, LLC to conduct a ***radiofrequency (RF) electromagnetic safety and FCC compliance assessment*** of the site located at 50 Old Courthouse Square, Santa Rosa, CA 95404. The compliance framework is derived from the FCC Rules and Regulations for preventing human exposure in excess of the MPE (Maximum Permissible Exposure) limits.

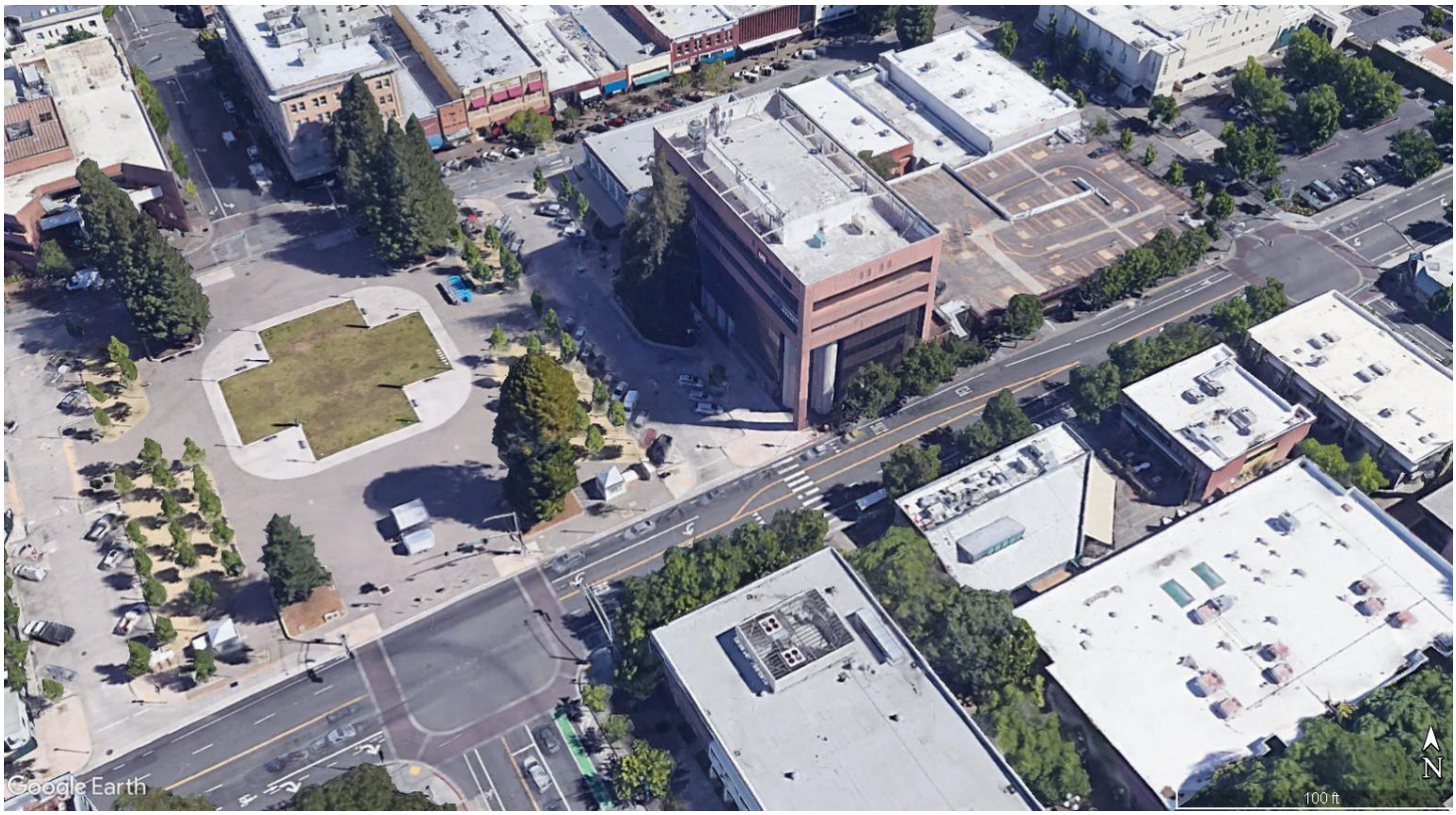
An overview of the applicable FCC Rules and analysis guidelines is presented in Appendix A. The subsequent sections contain information regarding the radio telecommunications equipment installed at this site and the surrounding environment regarding RF Hazard compliance.

As summarized in Section 5 of this report, potentially hazardous conditions were identified, and mitigating action is recommended to achieve or maintain compliance.

All known RF sources have been included in this analysis. Predictive modeling using worst-case operating parameters for antennas regardless of accessibility is the basis for mitigation recommendations. Similarly, theoretical assessment of antennas mounted in close proximity is used to characterize and mitigate cumulative exposure conditions.

Documents Utilized in this Analysis:
SFSFO00280A_ZD_20211129184157.pdf
RFDS-SFSFO00280A-Preliminary-20211117-v.3_20211117191104.pdf

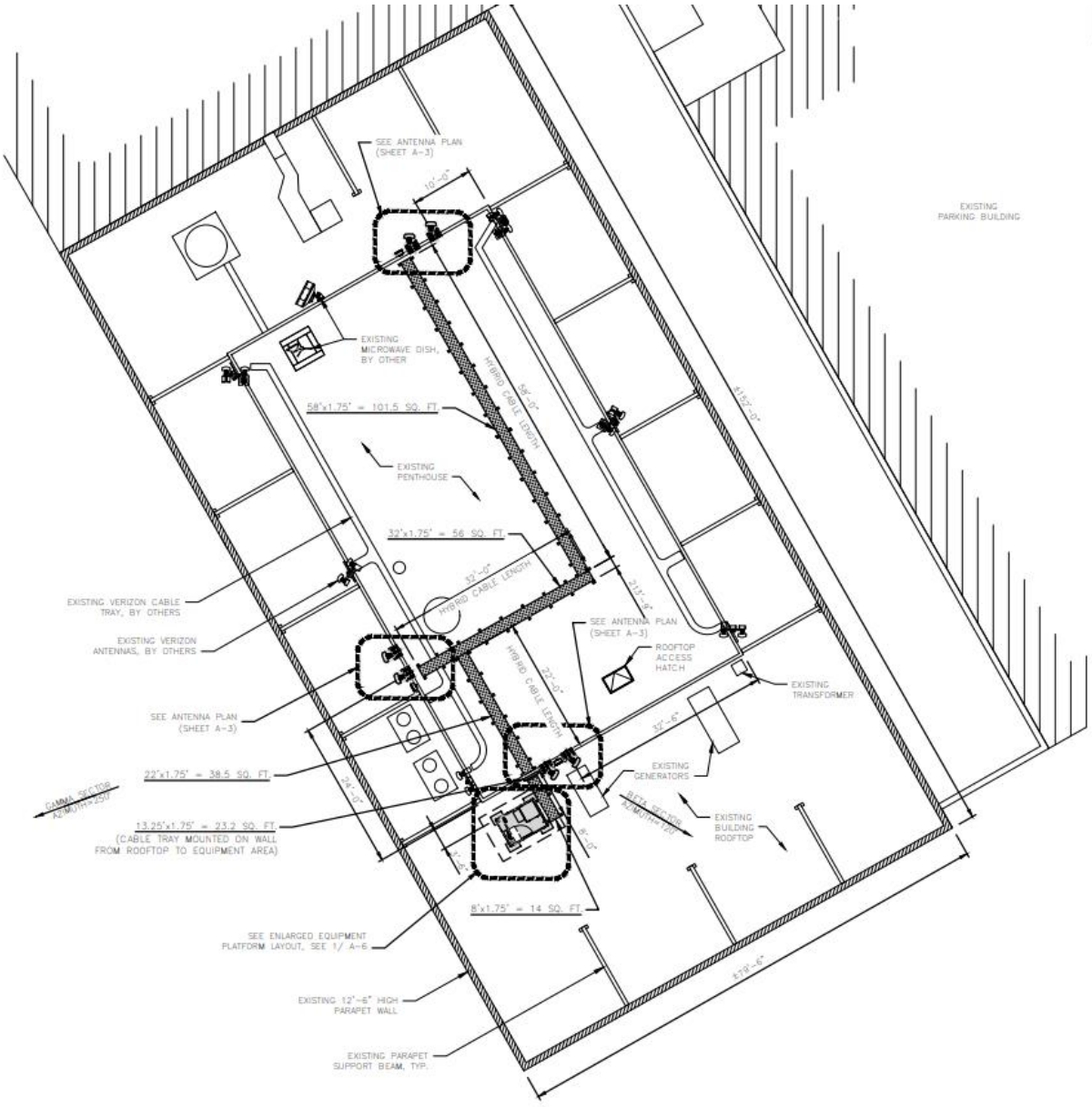
1.1 Area(s) of Study



Surrounding Environment

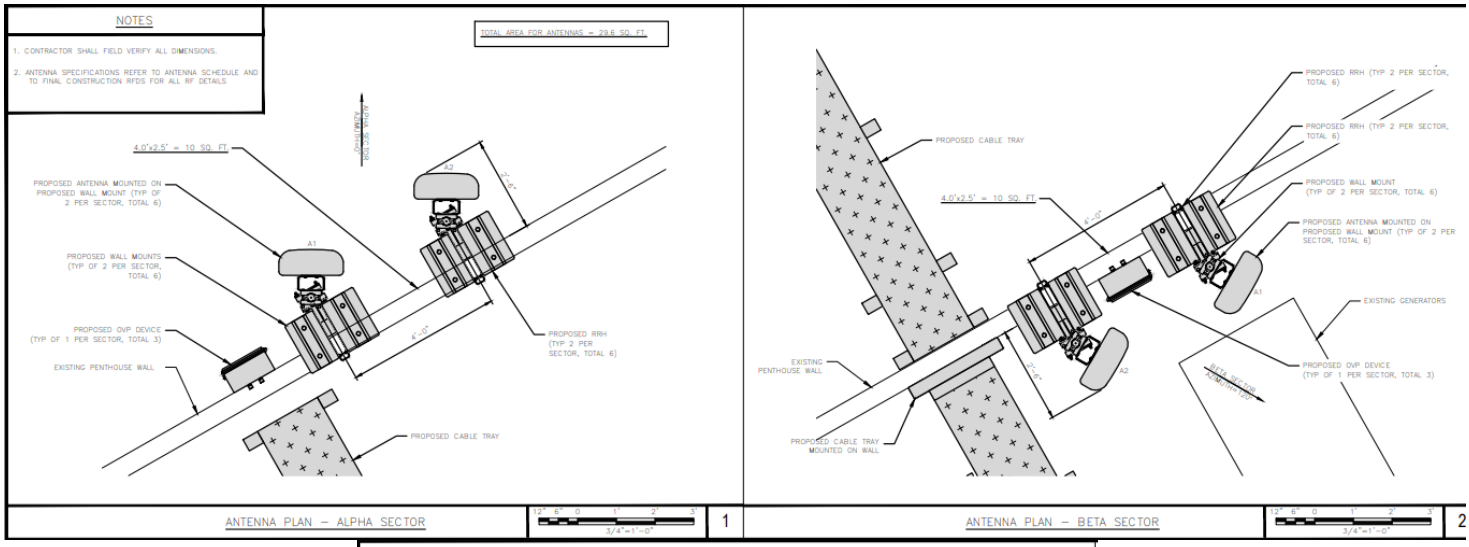
Street View Image

2 Site Details



Installation Design

2.1 Antenna Locations



Installation Design

3 Antenna Inventory

The operations listed in the following tables have been compiled based on information provided by client.

Ant #	Operator	Antenna Make	Antenna Model	Type	Frequency (MHz)	Az (Deg)	Downtilt (Deg)	Horizontal Beam Width (Deg)	Ant (ft)	Ant Gain (dBd)	TPO (W)	Paths	Loss (dB)	Total ERP (W)	Total EIRP (W)	Antenna Centerline Ground Level (0 ft)
1	Dish Wireless	JMA	MX08FRO665-21 06DT	Panel	600	0	0	59	6	11.25	30	4	0	1600	2625	107
2	Dish Wireless	JMA	MX08FRO665-21 04DT	Panel	2007	0	0	63	6	16.05	40	4	0	6443	10571	107
2	Dish Wireless	JMA	MX08FRO665-21 04DT	Panel	2100	0	0	65	6	16.75	40	4	0	7570	12420	107
3	Dish Wireless	JMA	MX08FRO665-21 03DT	Panel	600	120	0	61	6	11.45	30	4	0	1676	2749	107
4	Dish Wireless	JMA	MX08FRO665-21 02DT	Panel	2007	120	0	62	6	15.75	40	4	0	6013	9866	107
4	Dish Wireless	JMA	MX08FRO665-21 02DT	Panel	2100	120	0	65	6	16.75	40	4	0	7570	12420	107
5	Dish Wireless	JMA	MX08FRO665-21 07DT	Panel	600	250	0	60	6	11.25	30	4	0	1600	2625	107
6	Dish Wireless	JMA	MX08FRO665-21 06DT	Panel	2007	250	0	64	6	16.15	40	4	0	6594	10817	107
6	Dish Wireless	JMA	MX08FRO665-21 06DT	Panel	2100	250	0	66	6	16.75	40	4	0	7570	12420	107
7	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	700	60	0	65	6	12.3	80	2	0	2711	4448	108
7	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	850	60	0	60	6	12.6	20	8	0	2938	4821	108
8	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	1900	60	0	69	6	15.7	40	4	0	5875	9638	108
9	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	2100	120	0	64	6	16.2	40	4	0	6701	10993	108
10	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	700	120	0	65	6	12.3	80	2	0	2711	4448	108
10	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	850	120	0	60	6	12.6	20	8	0	2938	4821	108
11	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	1900	180	0	69	6	15.7	40	4	0	5875	9638	108
12	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	2100	180	0	64	6	16.2	40	4	0	6701	10993	108
13	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	700	270	0	65	6	12.3	80	2	0	2711	4448	108
13	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	850	270	0	60	6	12.6	20	8	0	2938	4821	108
14	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	1900	270	0	69	6	15.7	40	4	0	5875	9638	108
15	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	2100	300	0	64	6	16.2	40	4	0	6701	10993	108
16	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	700	300	0	65	6	12.3	80	2	0	2711	4448	108

ANTENNA INVENTORY

Ant #	Operator	Antenna Make	Antenna Model	Type	Frequency (MHz)	Az (Deg)	Downtilt (Deg)	Horizontal Beam Width (Deg)	Ant (ft)	Ant Gain (dBd)	TPO (W)	Paths	Loss (dB)	Total ERP (W)	Total EIRP (W)	Antenna Centerline Ground Level (0 ft)
16	Verizon	COMMSCOPE	NHH-65B-R2B 02DT	Panel	850	300	0	60	6	12.6	20	8	0	2938	4821	108
17	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	1900	0	0	69	6	15.7	40	4	0	5875	9638	108
18	Verizon	COMMSCOPE	NHH-65B-R2B 00DT	Panel	2100	0	0	64	6	16.2	40	4	0	6701	10993	108
19	Unknown	GENERIC	MICROWAVE 6FT	Microwave	6000	330	0	1.5	6	38.7	0.2	1	0	1462	2399	108

NOTE 1: Waterford Consultants has assumed transmission parameters for co-located RF emitters based on similar installations found at other radio communications sites. Generic antenna models have been used where existing antenna part numbers or radiation patterns are not available. The frequencies presented in this table may have been assumed in order to represent the approximate band of operation and to support a maximum-case calculation of power density.

NOTE 2: Some antennas identified by the SON designation may employ beamsteering technology where RF energy allocated to each customer device is dynamically directed toward their location. In the analysis presented herein, predicted exposure levels are based on all beams at full utilization (i.e. full power) simultaneously focused in any direction. As this condition is unlikely to occur, the actual power density levels at ground and at adjacent structures will be less than the levels reported below.

NOTE 3: No other transmitting antennas are known to be operating in the vicinity of this site.

4 Predicted Emission Levels

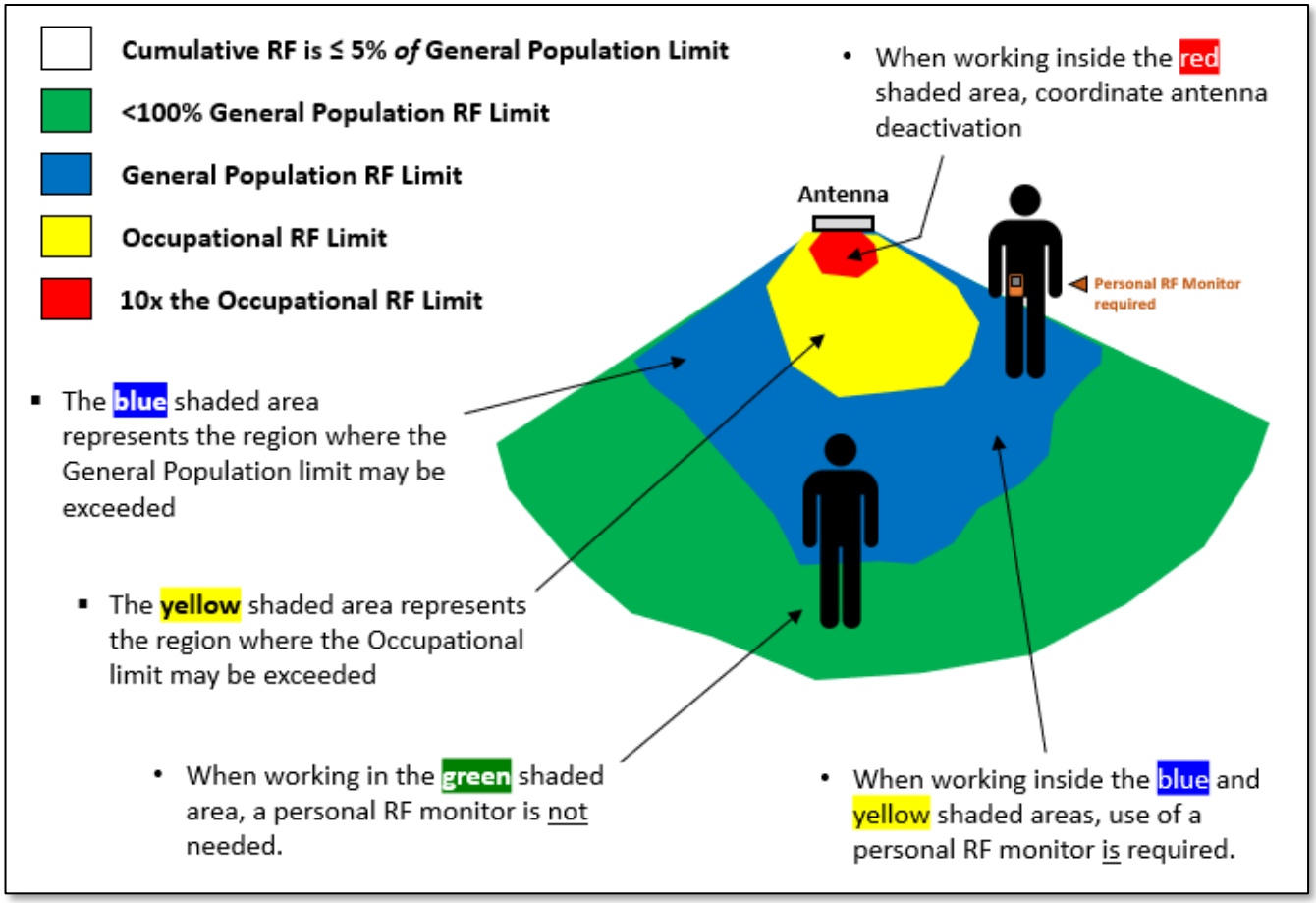
The following plots show the spatial average predicted power density level at any given location as a percentage of the FCC General Population limits. These plots depict the cumulative exposure based on all RF sources listed in the corresponding antenna table.

Exposure to non-ionizing radiation at a given spatial average power density level, during the appropriate time interval, determines hazard. MPE predictions are not dependent on the exposure duration as only the intensity of the exposure is calculated. In this manner, areas of concern are identified and delineated from areas where exposures will not exceed the FCC limits. Recommendations for mitigating these zones are recommended in this report. Rules for access to impacted area are based on policy set by property management.

Predictive MPE plots may be provided for plan view (*top-down*) or section view *(profile)* studies. Profile studies account for antennas that are placed individually with separation that assumes cumulative emissions from other antennas are negligible. Section detail plots depict spatially averaged power MPE conditions at the middle of the six-foot exposure area. Plan view studies may include cumulative analysis where the contributions of nearby antennas may impact exposure conditions and compliance recommendations. The reference plane for each plot is indicated in the caption and legend. For example, “Avg 10 to 16 Feet” appearing in the legend indicates that the top-view plot depicts spatially averaged predicted power densities between 10 and 16 feet which a person could occupy. Plots are produced for each accessible level or walking surface; areas that are not accessible are not shown. Antenna level plots are also created to depict maximum-case exposure conditions at potential elevated work areas. Unless otherwise noted, Ground Level or Main Level represents the default access elevation and is the baseline for antenna centerline reference.

PREDICTED EMISSION LEVELS

What do the shaded colors mean in the RF plots provided in this report?



SUMMARY

10X the Occupational RF exposure limit. When working inside this area, trained personnel with personal protective equipment (PPE) is required; may also require coordinating a scheduled deactivation/outage with operator.

Occupational RF exposure limit. When working inside this area, trained personnel with personal protective equipment (PPE) is required; untrained person(s) must be accompanied by trained personnel.

General Population RF exposure limit. When working inside this area, trained personnel with personal protective equipment (PPE) is required; untrained person(s) must be accompanied by trained personnel.

<100% of the General Population RF exposure limit (or <20% of the Occupational RF exposure limit). When working in this area, personal protective equipment (PPE) is not required. No special action or behavior is required to maintain a safe work environment. This area is safe for continuous exposure.

Area is outside of General Population and Occupational RF exposure limits (less than 5% of the General Population limits). When working in this area, personal protective equipment (PPE) is not required. No special action or behavior is required to maintain a safe work environment. This area is also safe for continuous exposure.

PREDICTED EMISSION LEVELS

Scenario: Ground Level 0’

The reference plane for the plot is the Ground Level 0’ (DISH Wireless Only).

Assessment: Based on consideration of all operations, the maximum predicted cumulative MPE is **0.3546%** of the FCC General Population limits.

PREDICTED EMISSION LEVELS

Scenario: Ground Level 0’

The reference plane for the plot is the Ground Level 0’ (All Carriers).

PREDICTED EMISSION LEVELS

Scenario: Adjacent Building Level 30’

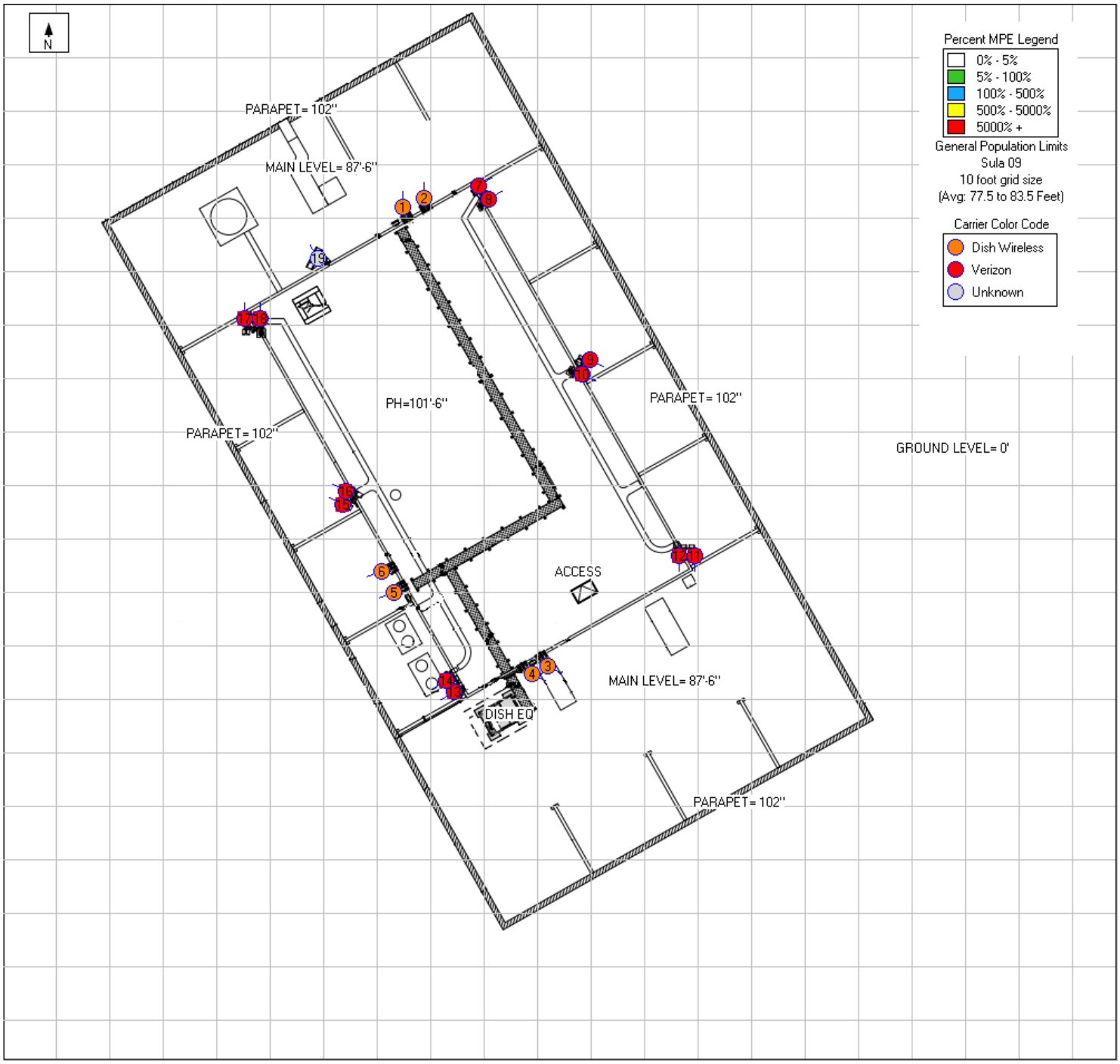
The reference plane for the plot is the Adjacent Building Level 30’ (DISH Wireless Only).

Assessment: Based on consideration of all operations, the maximum predicted cumulative MPE is **0.4061%** of the FCC General Population limits.

Scenario: Adjacent Building Level 30’

The reference plane for the plot is the Adjacent Building Level 30’ (All Carriers).

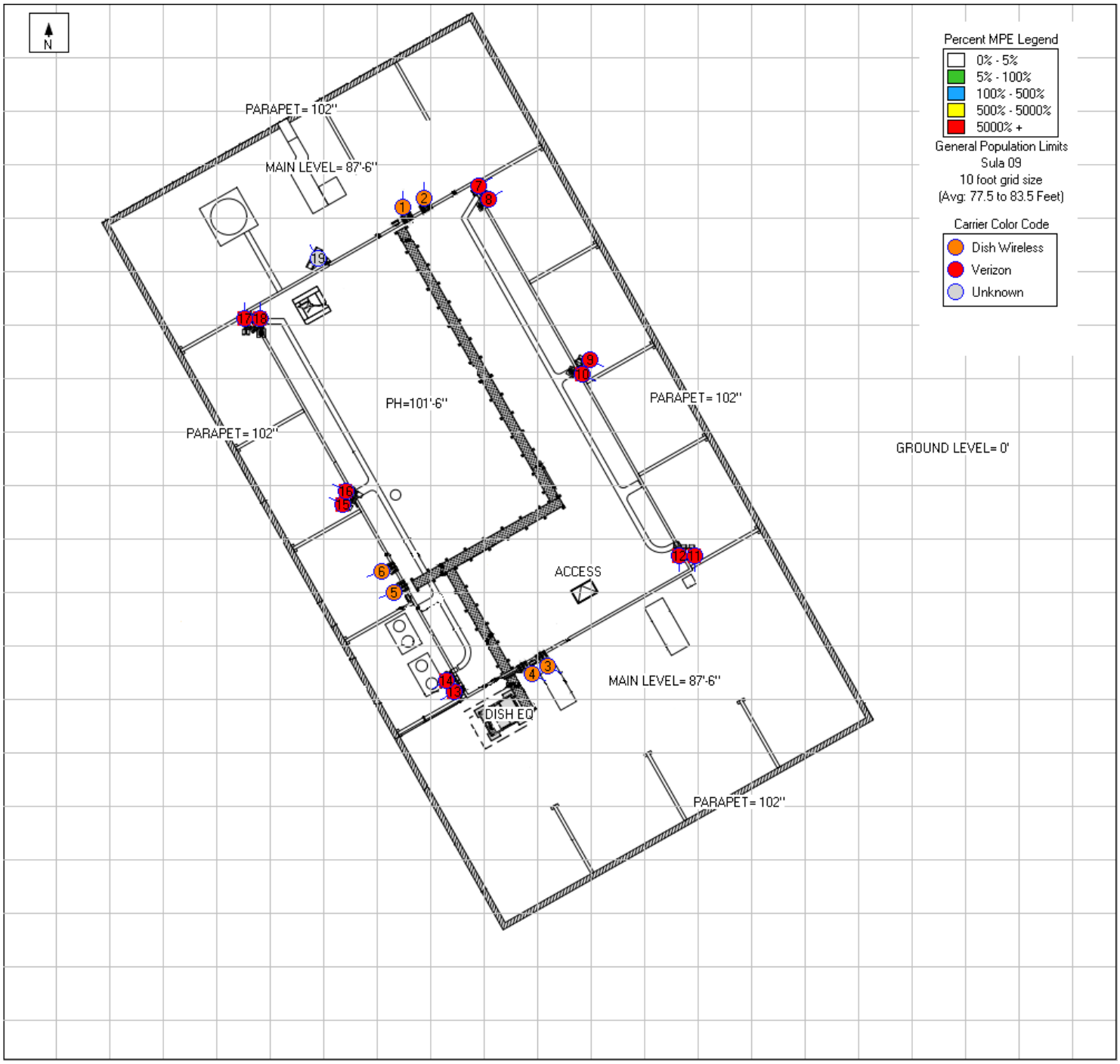
Scenario: Top Floor Level 77’-6”



The reference plane for the plot is the Top Floor Level 77’-6” (DISH Wireless Only).

Assessment: Based on consideration of all operations, the maximum predicted cumulative MPE is **1.3303%** of the FCC General Population limits.

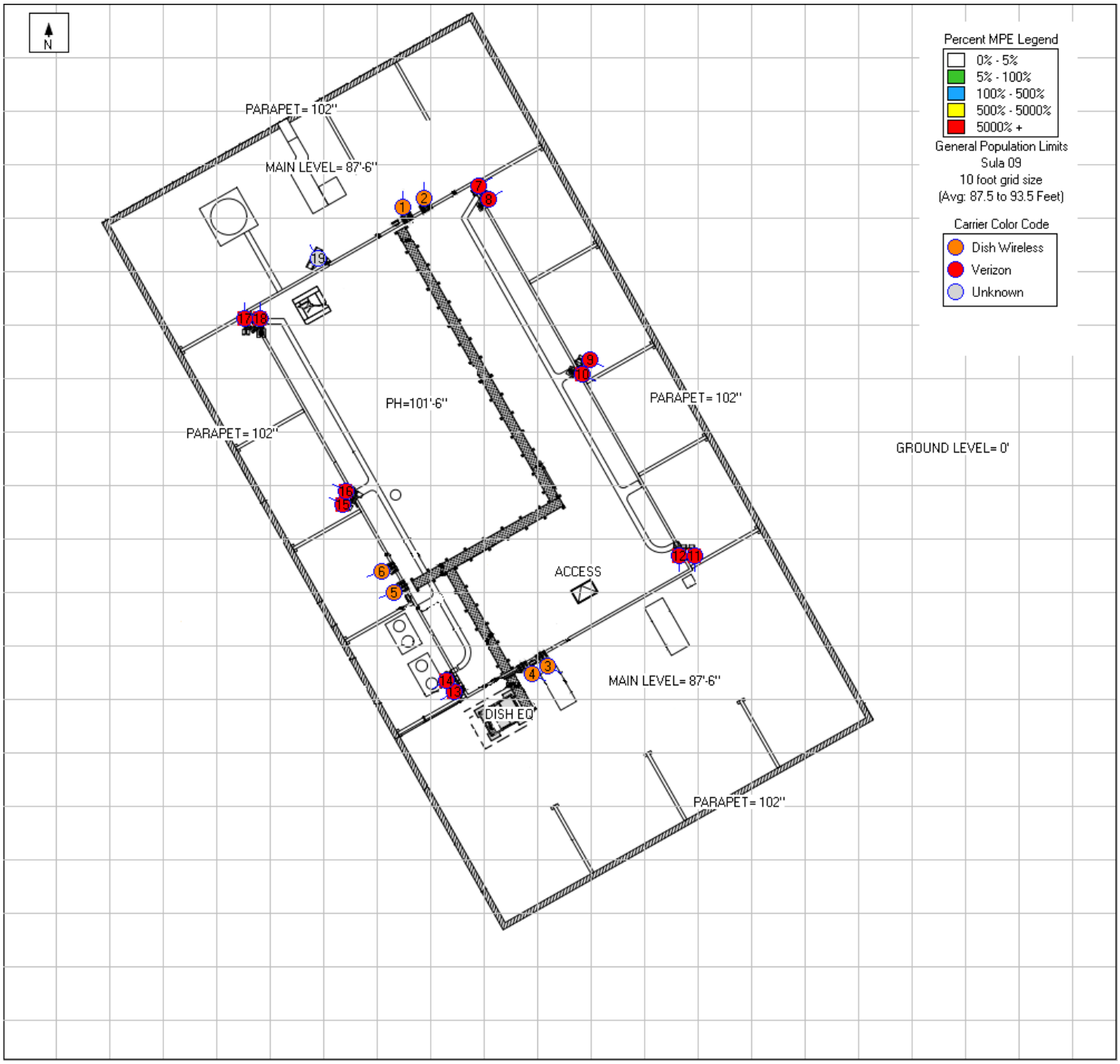
Scenario: Top Floor Level 77’-6”



The reference plane for the plot is the Top Floor Level 77’-6” (All Carriers).

PREDICTED EMISSION LEVELS

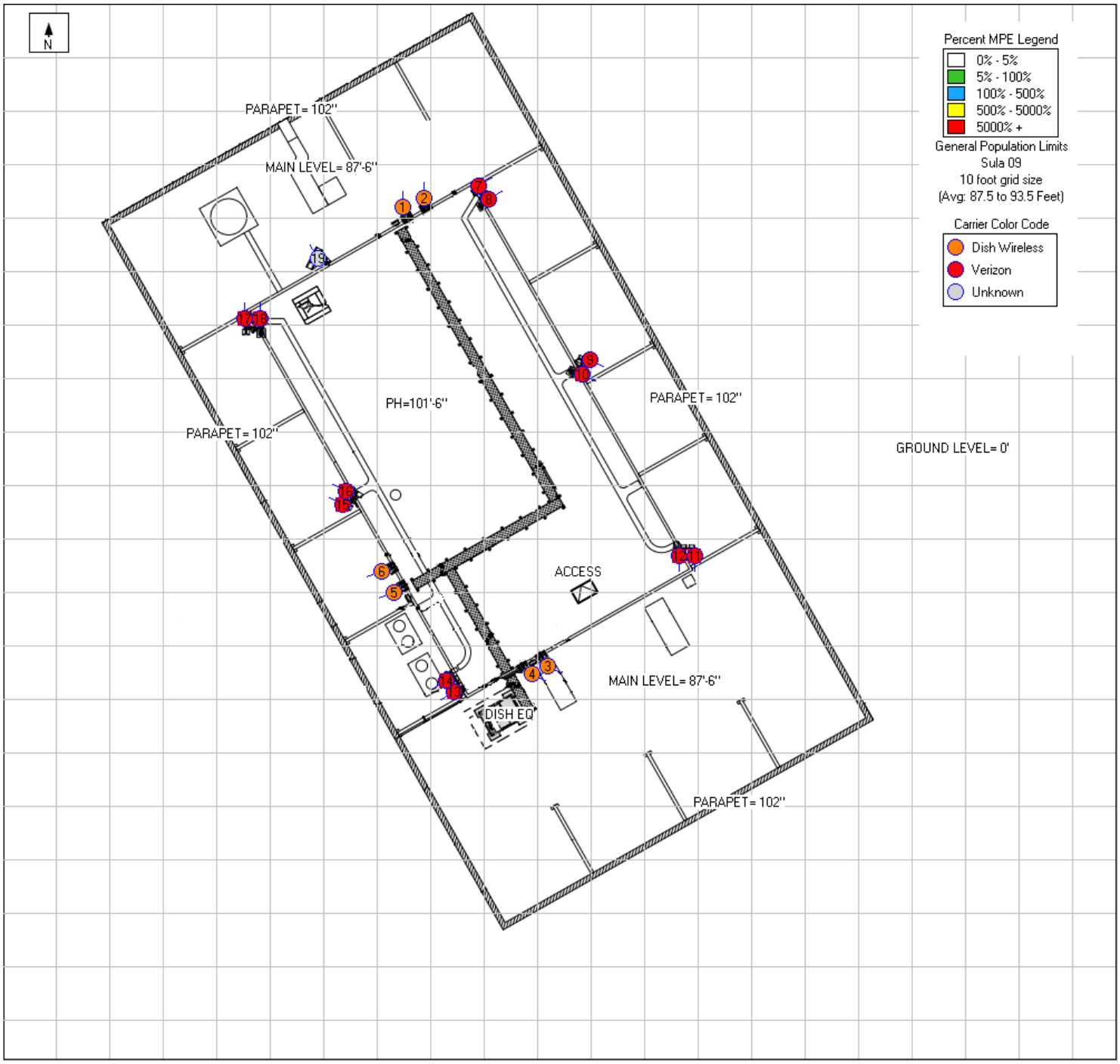
Scenario: Main Level 87’-6”



The reference plane for the plot is the Main Level 87’-6” (DISH Wireless Only).

Assessment: Based on consideration of all operations, the maximum predicted cumulative MPE is **4.3667%** of the FCC General Population limits.

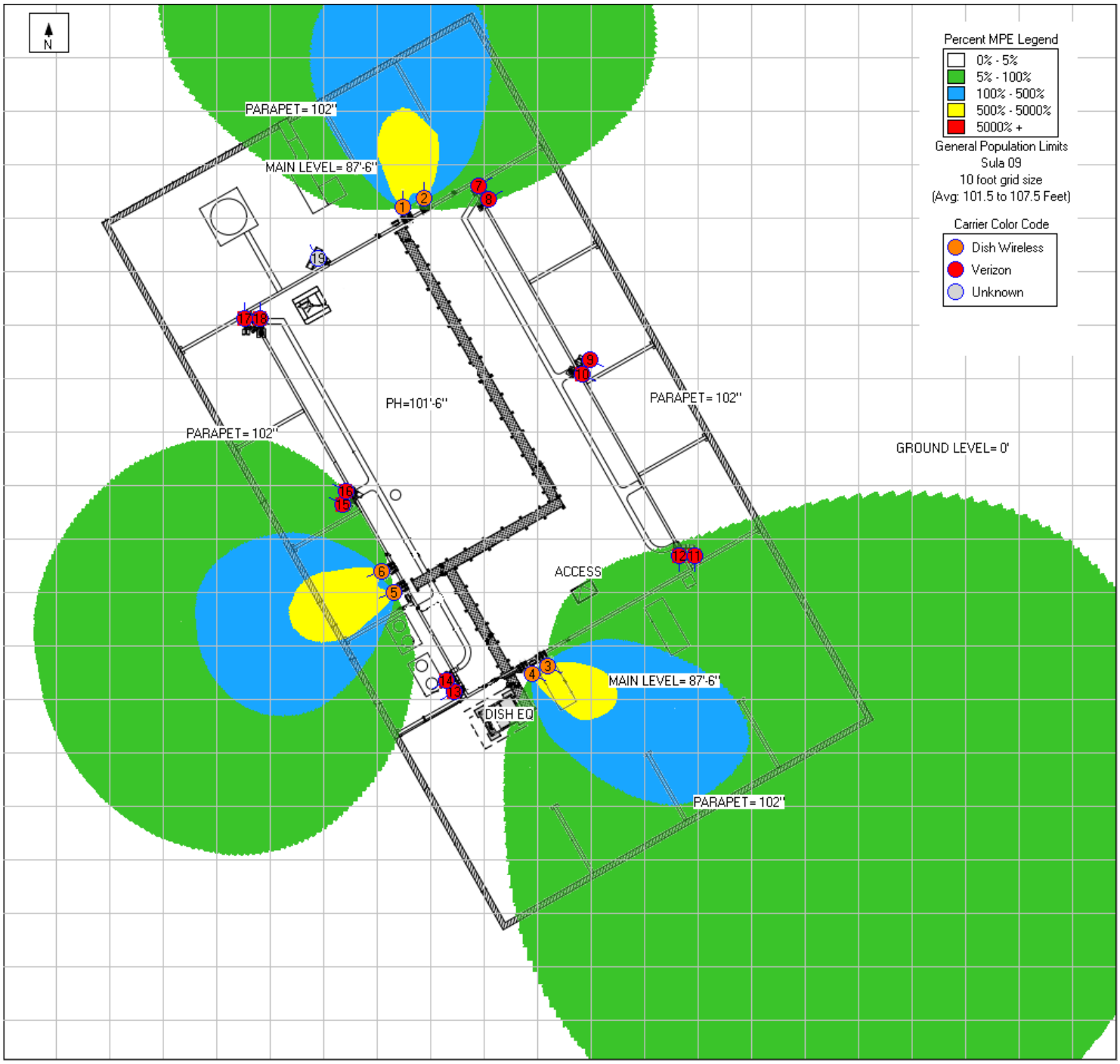
Scenario: Main Level 87’-6”



The reference plane for the plot is the Main Level 87’-6” (All Carriers).

PREDICTED EMISSION LEVELS

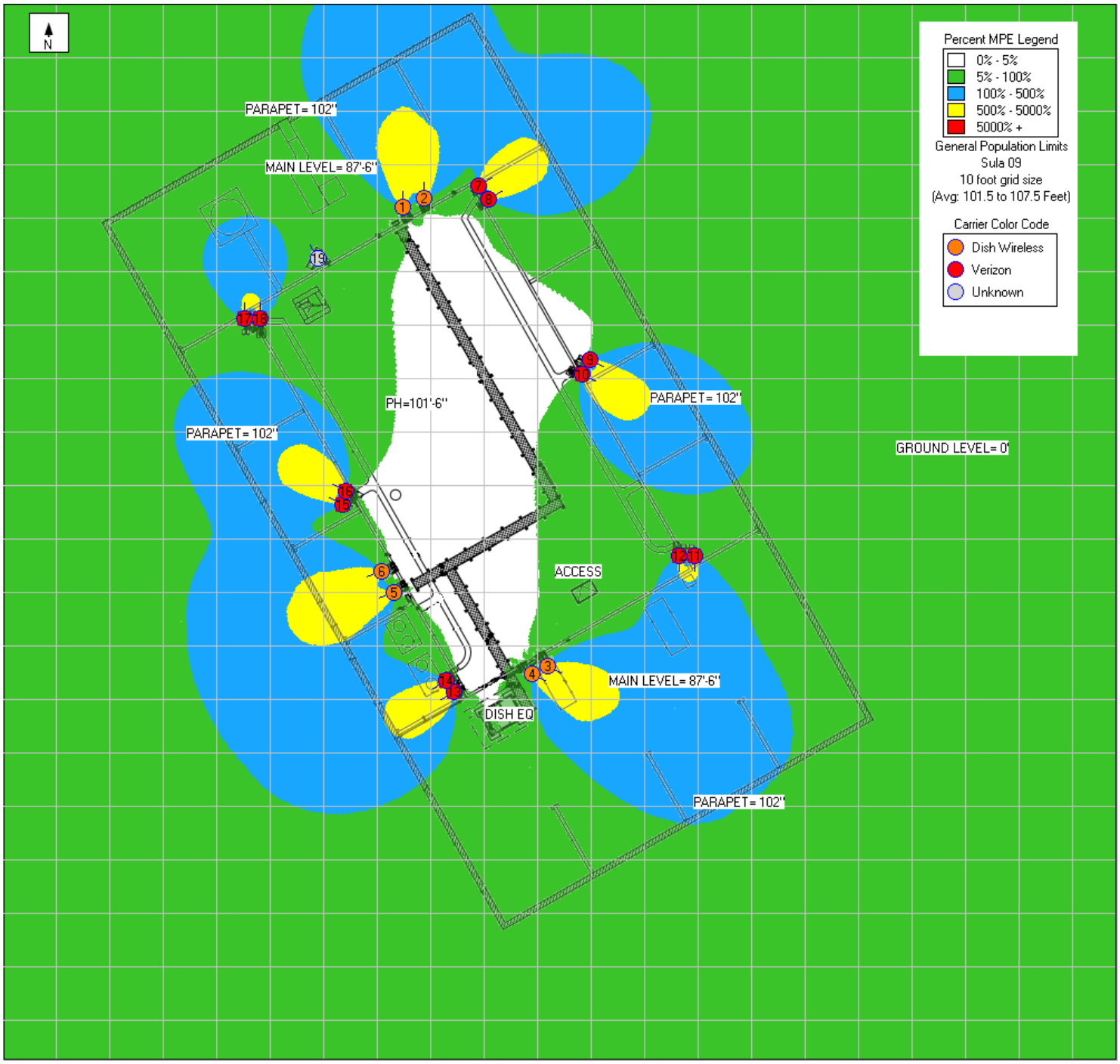
Scenario: Penthouse Level 101’-6”



The reference plane for the plot is the Penthouse Level 101’-6” (DISH Wireless Only).

Assessment: Based on consideration of all operations, the maximum predicted cumulative MPE is **23.4163%** of the FCC General Population limits.

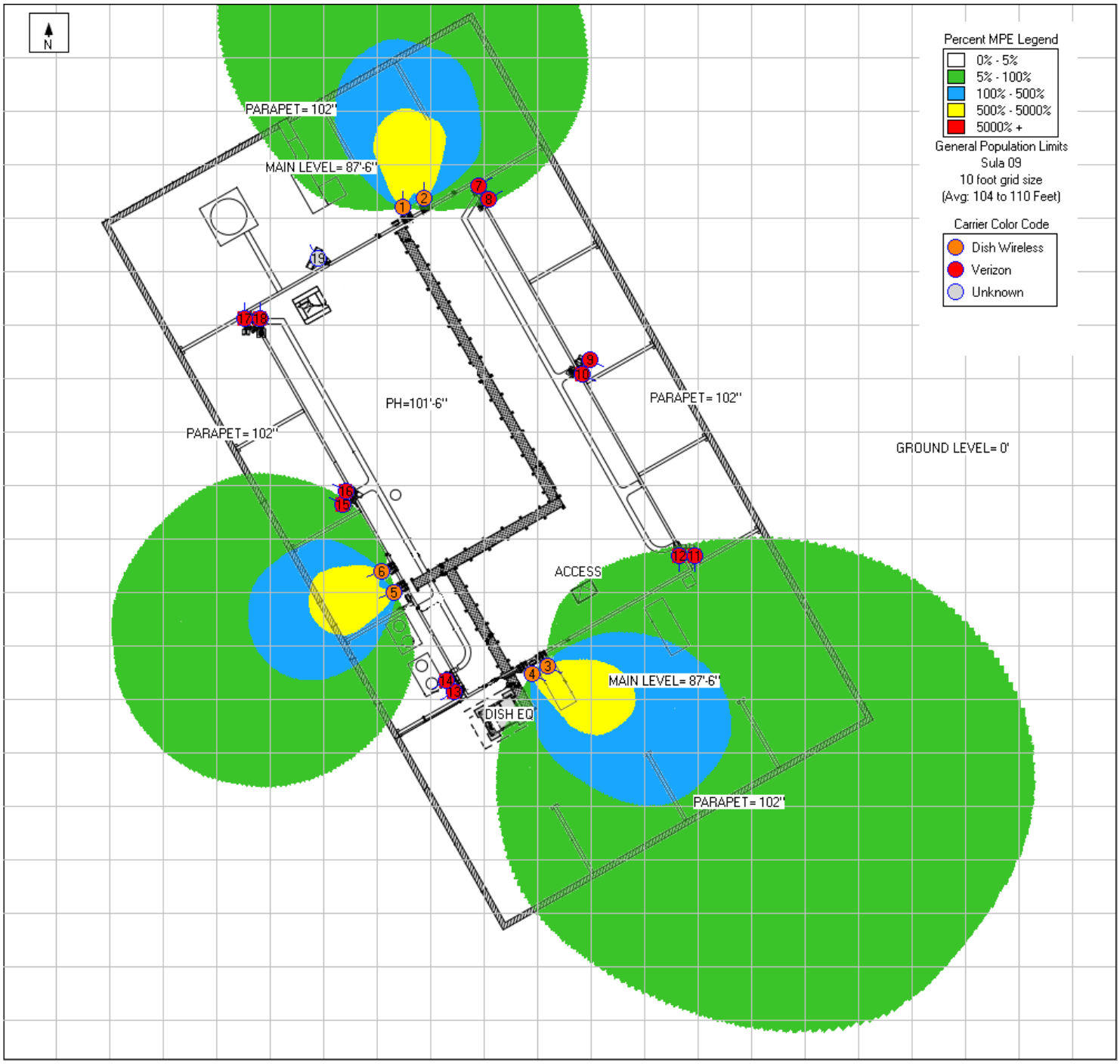
Scenario: Penthouse Level 101’-6”



The reference plane for the plot is the Penthouse Level 101’-6” (All Carriers).

PREDICTED EMISSION LEVELS

Scenario: Antenna Level 104’



The reference plane for the plot is the Antenna Level 104’ (DISH Wireless Only).

Assessment: Based on consideration of all operations, the maximum predicted cumulative MPE is **2870.1456%** of the FCC General Population limits.

5 Recommendations for Compliance

Predictive modeling indicates that cumulative RF power densities at ground level or adjacent structures as a result of the operations documented herein are below the FCC General Population limits. However, accessible areas near the antennas may exceed the FCC General Population limits.

Work plans near any transmitting antennas should be evaluated with respect to any actions needed to maintain a safe work environment. These actions may include scheduled outages or power reductions. It is recommended that all workers needing to access areas the front of the transmitting antennas listed below be properly trained and certified in the area of RF exposure and safety, as well as have the means to monitor and control their exposure.

Signs should be sized according to OSHA standards to be clearly legible from the separation distance noted and multiple signs may be required to provide notification of potential exposure conditions from all possible approaches to the antenna. Workers must be provided information about the locations of these areas of concern and the meaning of RF alerting signage.

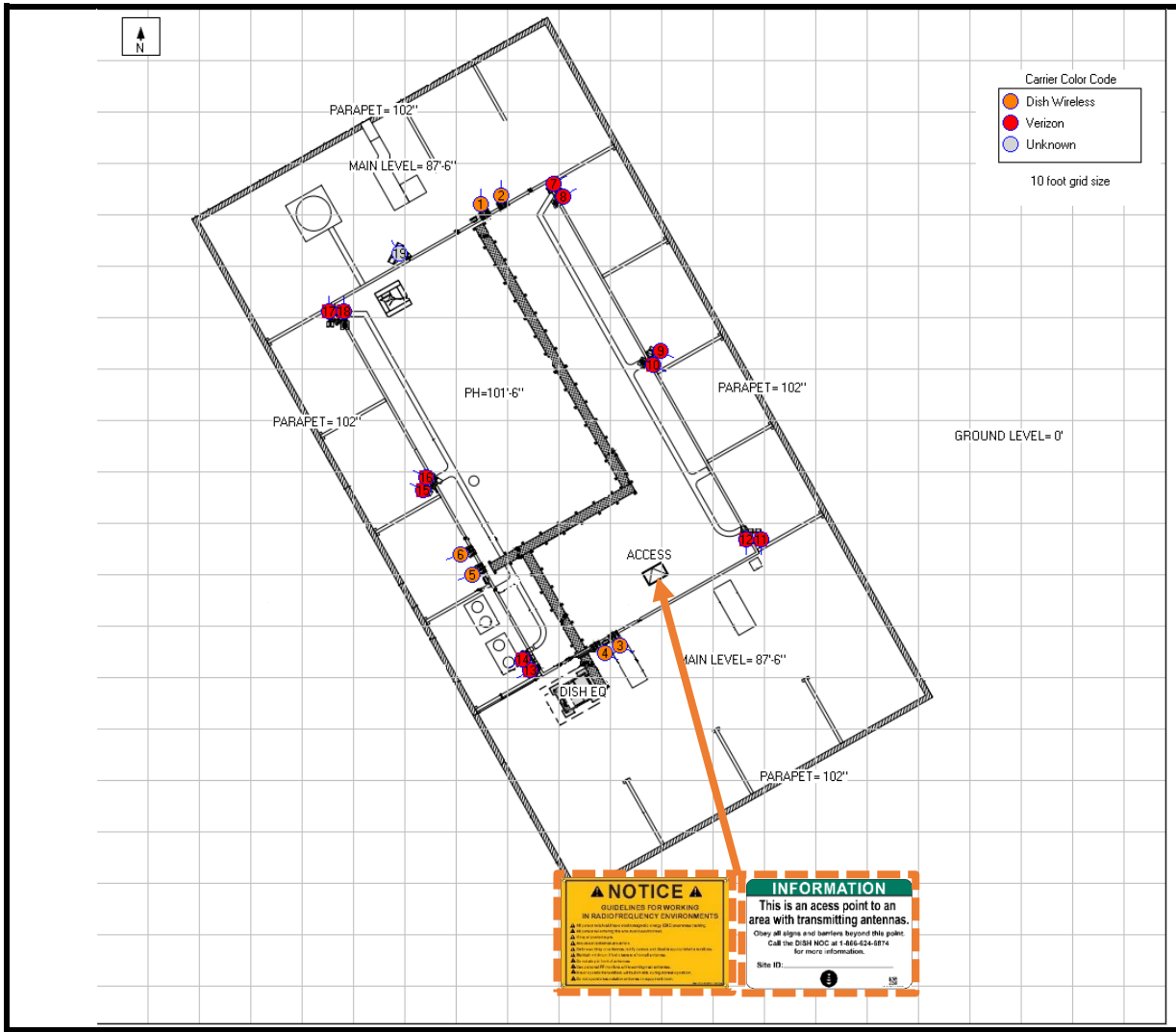
Site Access Location
- NOC and Guideline signs required at all access points.

DISH Wireless Alpha Sector
- Caution signs required.

DISH Wireless Beta Sector
- Caution signs required.

DISH Wireless Gamma Sector
- Caution signs required.

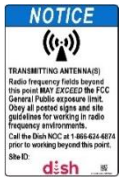
Compliance Requirement Diagram (Site Access)



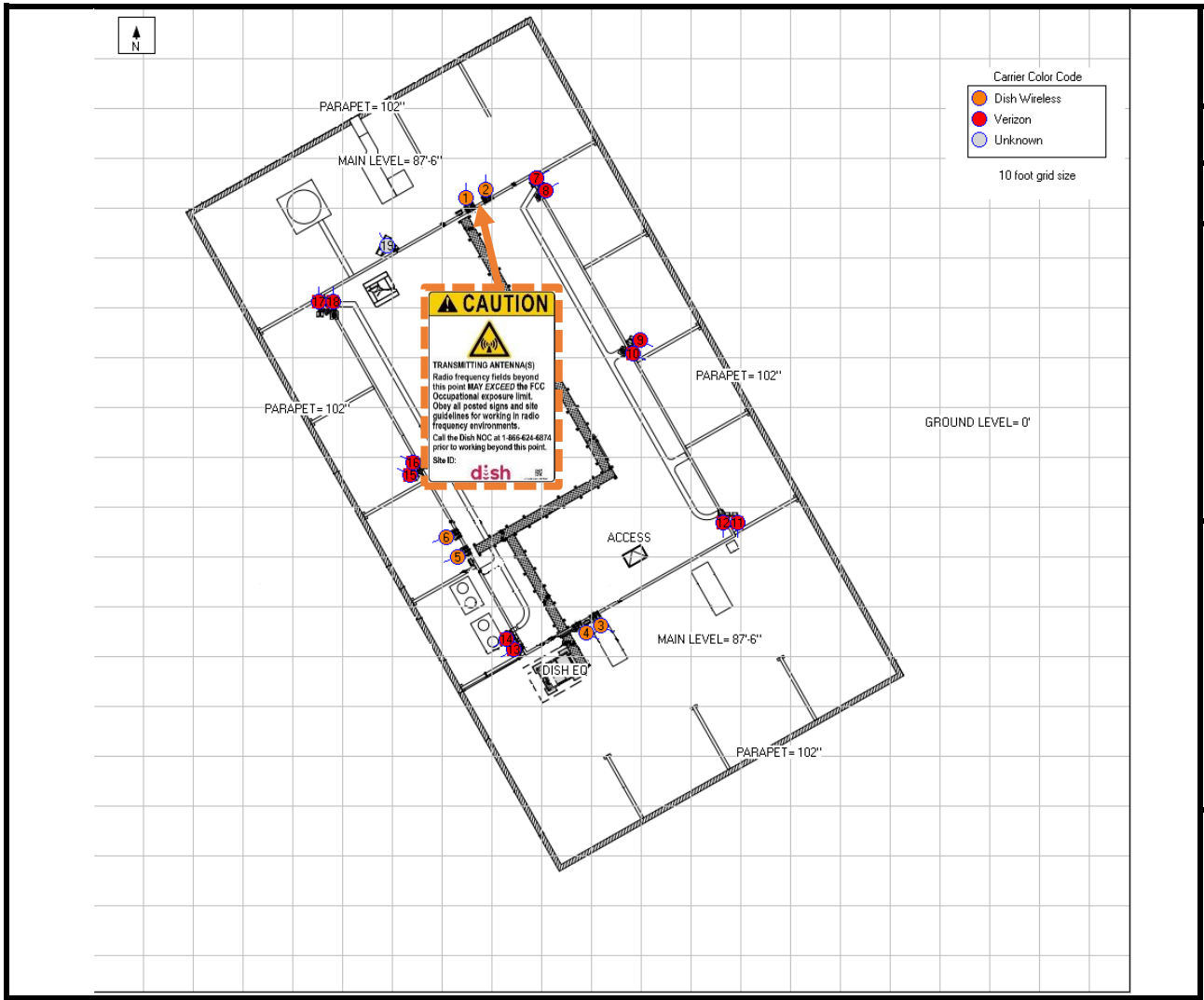
Proposed Signs/Barriers

Existing Signs/Barriers

**** Install NOC and Guideline sign at all access points visible from approach.**

Recommendations	
Site Access	
How Many Access Points - 1	
 NOC	x 1
 10 Step Guidelines	x 1
 Notice (Blue) Sign	x 0
 Caution (Yellow) Sign	x 0
 Warning (Red) Sign	x 0

Compliance Requirement Diagram (Alpha Sector)

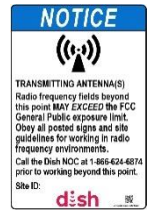


Proposed Signs/Barriers

Existing Signs/Barriers

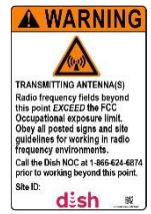
**** Install (1) Caution signs behind the antennas visible from approach.**

Recommendations
Alpha Sector
Barriers: No



Notice (Blue) Sign — x 0

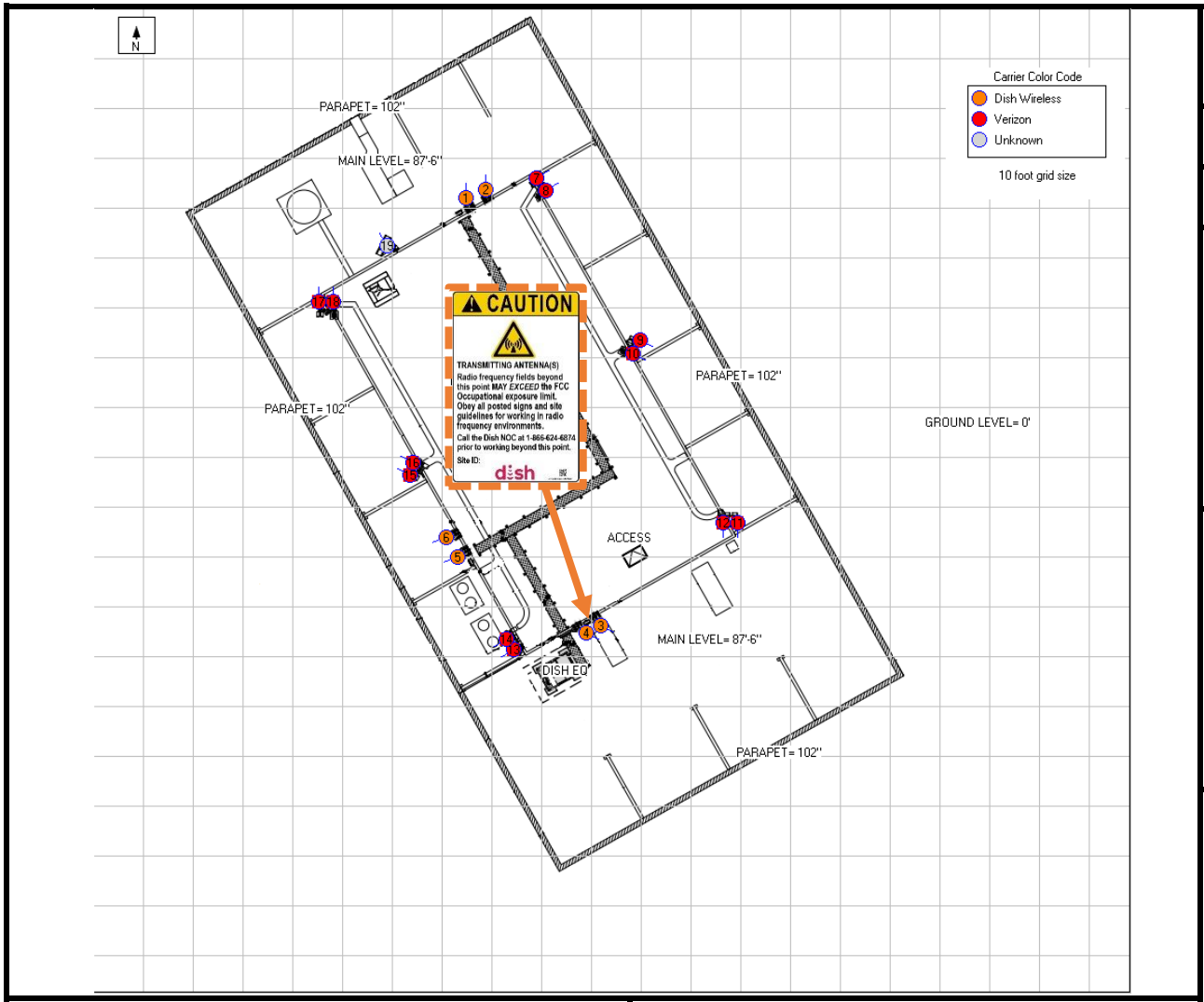
Caution (Yellow) Sign — x 1



Warning (Red) Sign — x 0

RECOMMENDATIONS FOR COMPLIANCE

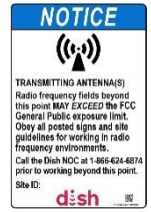
Compliance Requirement Diagram (Beta Sector)



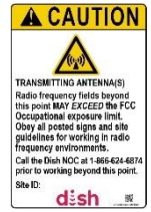
Proposed Signs/Barriers	Existing Signs/Barriers

**** Install (1) Caution signs behind the antennas visible from approach.**

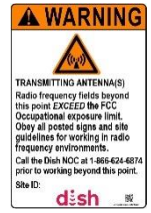
Recommendations
Beta Sector
Barriers: No



Notice (Blue) Sign x 0

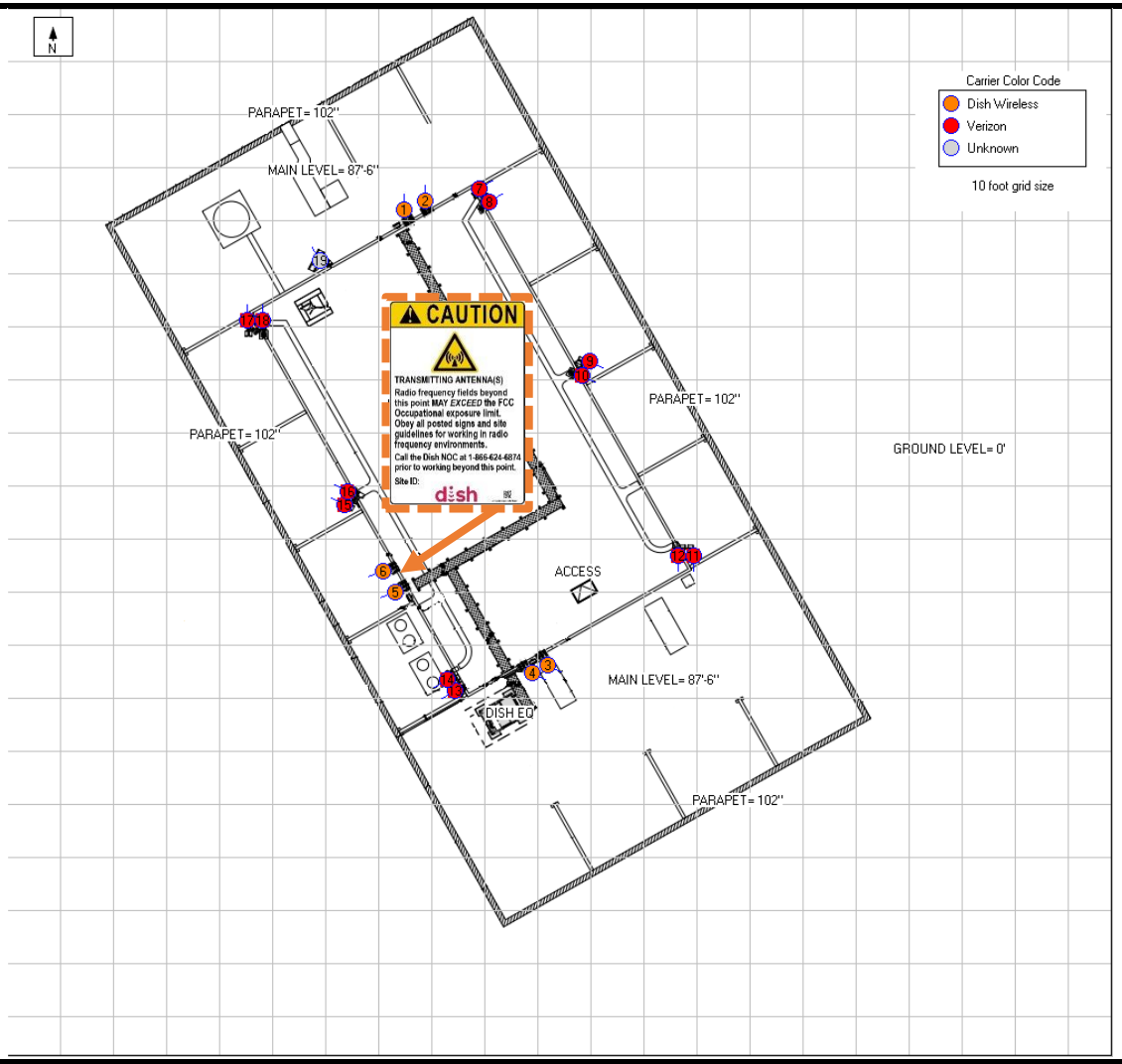


Caution (Yellow) Sign x 1



Warning (Red) Sign x 0

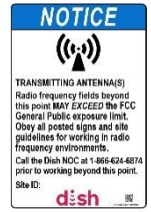
Compliance Requirement Diagram (Gamma Sector)



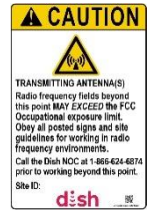
Proposed Signs/Barriers	Existing Signs/Barriers

**** Install (1) Caution signs behind the antennas visible from approach.**

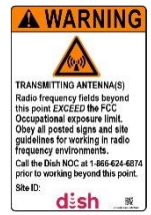
Recommendations
Gamma Sector
Barriers: No



Notice (Blue) Sign — x 0



Caution (Yellow) Sign — x 1

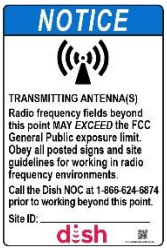


Warning (Red) Sign — x 0

Mitigation for Compliance

For any area where cumulative RF power density exceeds 100% of the FCC General Population MPE limits, access controls with appropriate RF alerting signage must be established and maintained to restrict access to authorized personnel. Signage must be posted to be visible upon approach from any direction to provide notification of potential conditions within these areas.

Category 2	Category 3	Category 4
Exceeds General Population Limit; Below Occupational Limit	*Exceeds Occupational Limit; Below 10x Occupational Limit*	*Exceeds 10x Occupational Limit*



Per FCC requirements for compliance, the following content is required on RF alerting signage:

a) RF energy advisory symbol and signal word appropriate for the potential exposure category

b) A description of the RF source (*e.g.*, transmitting antennas)

c) Behavior necessary to avoid over-exposure (*e.g.*, do not climb tower unless you know that antennas are not energized; stay behind barrier or off of markings)

d) Up-to-date contact information (*e.g.*, monitored phone number or email address connected to someone with authority and capability to provide prompt response).

e) Any sign attached directly to an antenna must include the separation distance at a font size commensurate with the safe separation distance.

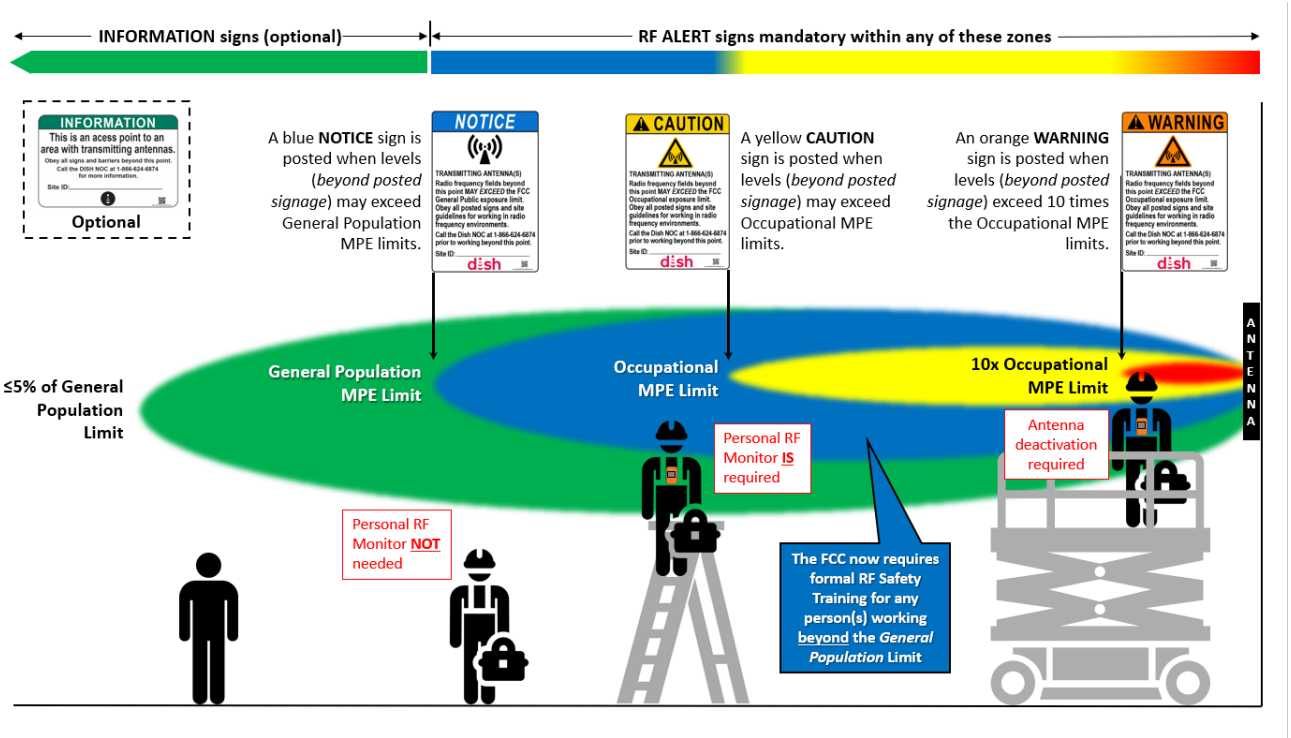
Additional Requirements

- Signage should conform to IEEE C95.2-2018 and the ANSI/NEMA Z535 series of standards.
- RF alerting signs must be legible from a distance of 5 feet from the boundary of the area where the FCC General Population limits are exceeded in accordance with OSHA rules (29 CFR § 1910.145(f)(4)(ii))).

- INFORMATION signs displaying contact information AND GUIDELINES signs are considered *optional* and may be utilized at antenna installations where the FCC limits may not be exceeded.

- **Positive access control is required to restrict access to areas where the FCC General Population limits may be exceeded.** Controls such as physical barriers to entry imposed by locked doors, hatches and ladders or other access control mechanisms may be supplemented by alarms that alert the individual and notify site management of a breach in access control.

- **Appropriate RF Safety & Awareness Training is required <u>for any person</u> that may encounter *controlled* areas in order to understand the meaning of RF alerting signage, as well as the behaviors necessary to ensure safety**. In order to perform work within restricted area where the General Population limits may be exceeded, workers should be trained in RF safety and equipped with personal protective equipment (e.g. RF personal monitor). Lockout/tagout or scheduled outages may be employed to maintain a safe work environment within these areas. Further, untrained workers should not have access to controlled locations without supervision by trained occupational personnel.



Standard Minimum Font Sizes & Safe Viewing Distances

(Source: ANSI Z535.2-2001 (Table B1))

Minimum Safe Viewing Distance		Minimum Letter Height for FAVORABLE Reading Conditions			Minimum Recommended Sign Size *
(ft)	(m)	(point size)	(in)	(cm)	(in)
≤4	≤1.2	16	0.16	.4	5 x 7
6	1.8	24	0.24	0.6	7 x 10
8	2.4	32	0.32	0.8	8 x 12
10	3.0	40	0.40	1.0	11 x 18
15	4.6	60	0.60	1.5	15 x 24
20	6.1	80	0.80	2.0	19 x 30
30	9.1	120	1.20	3.0	TBD**
40	12.2	160	1.60	4.1	TBD**
60	18.3	240	2.40	6.1	TBD**
80	24.4	320	3.20	8.1	TBD**
100	30.5	400	4.00	10.2	TBD**
125	38.1	500	5.00	12.7	TBD**
150	45.7	600	6.00	15.2	TBD**

** Sign sizes reflect the minimum size(s) needed to meet FCC/OSHA requirements based on (i) the sign content and artwork shown in this section, and (ii) the minimum safe viewing distance, as specified by ANSI and calculated by our RoofMaster™ software.*

All minimum safe viewing distances are depicted in the RF modeling diagrams provided in this report.

*** Minimum recommended sign sizes are provided herein only for signs that require a minimum safe viewing distance of 0 – 20 feet. Signs requiring a minimum safe viewing distance >20 feet shall be graphically calculated and confirmed by Waterford on a case-by-case basis.*

6 Appendix A: Technical Framework

The FCC requires licensees to ensure that new and existing wireless operations do not expose people to hazardous levels of RF electromagnetic energy. Service providers consider compliance with these rules when designing new sites or modifying existing operations that could change the RF environment. The FCC exposure rules have been codified in response to the National Environmental Policy Act of 1969 which requires government agencies to evaluate the impact of their actions on the "quality of the human environment." Documentation of adherence to these rules is typically included in the environmental compliance applications submitted to local authorities responsible for reviewing and approving new or modified telecommunications installations and is maintained by the FCC licensee.

The FCC rules are based on exposure limits established by scientific and engineering organizations that review human health research in this field. At RF frequencies, the electromagnetic waves utilized by cellular sites represent non-ionizing radiation which can be absorbed by the human body. The FCC limits include a 50-fold safety factor above exposure levels where adverse thermal effects may result. By contrast, the energy available in ionizing radiation (e.g. X-rays) is higher and has the ability to permanently damage tissue cells at the molecular level. Unlike ionizing radiation, exposure to non-ionizing radiation does not have cumulative effects and the FCC limits are based on the body's thermoregulation capabilities.

The FCC requires licensees to ensure that persons are not exposed to radiofrequency electromagnetic energy power densities in excess of the Maximum Permissible Exposure ("MPE") limits as set forth in 47 C.F.R. §§ 1.1307(b) and 1.1310. The limits are derived from maximum Specific Absorption Rate (SAR) values of the human body for two tiers of permissible exposure differentiated by the situation in which the exposure takes place and/or the status of the individuals who are subject to exposure.

> **General Population / uncontrolled** exposure limits apply to those situations in which persons may not be aware of the presence of electromagnetic energy, where exposure is not employment-related, or where persons cannot exercise control over their exposure.
>
> **Occupational / controlled** exposure limits apply to situations in which persons are exposed as a consequence of their employment, have been made fully aware of the potential for exposure, and can exercise control over their exposure.

Based on these criteria, the FCC limits for the General Population are associated with continuous exposure conditions and exposure levels below these limits are not hazardous. The FCC General Population limit is 5 times more restrictive than the Occupational limits.

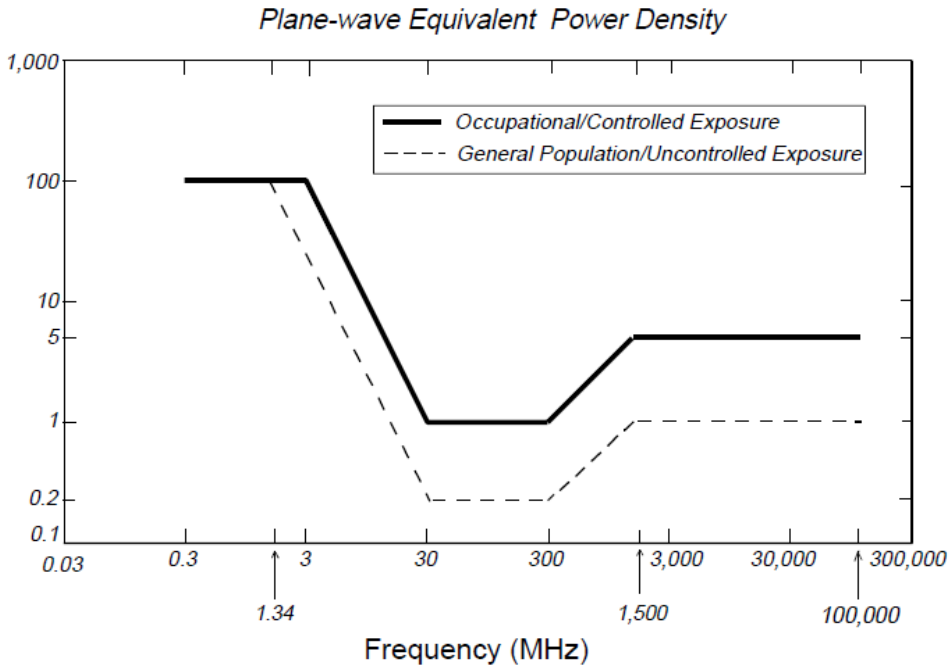
As a practical method of evaluating compliance in deployment scenarios, the FCC has set forth MPE limits shown in Table 1 below which are derived from the *whole-body SAR limits*. Specified in terms of electric field strength, magnetic field strength and equivalent plane-wave power density, compliance may be evaluated through computational or measurement methods provided in the FCC Office of Engineering & Technology Bulletin 65, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields" (OET-65). Factors that determine exposure conditions include frequency, operating power, distance, and directivity of the antenna.

Table 1: FCC Exposure Limits (47 C.F.R. § 1.1310)

Frequency (MHz)	*Limits for General Population/ Uncontrolled Exposure*		*Limits for Occupational/ Controlled Exposure*	
	Power Density (mW/cm^2)	Averaging Time (minutes)	Power Density (mW/cm^2)	Averaging Time (minutes)
30-300	0.2	30	1	6
300-1500	f/1500	30	f/300	6
1500-100,000	1.0	30	5.0	6

f=Frequency (MHz)

Figure 1. *FCC Limits for Maximum Permissible Exposure (MPE)*



From OET-65

Compliance assessment involves consideration of the cumulative contributions of all wireless operations. The power density resulting from an RF source may be expressed as a percentage of the frequency-specific limits. In scenarios involving multiple RF emitters, the percentage of the FCC limits from each source are *summed* to determine if 100% of the exposure limit has been exceeded at a given location. At these areas of concern, access controls with appropriate RF alerting signage must be established and maintained to restrict access to authorized personnel.

An evaluation of existing environmental conditions may be performed through predictive modeling as set forth in OET-65 or collecting power density measurements. The impact of new or modified wireless operations must be assessed in this cumulative scenario and any area of concern that is accessible to members of the General Population must be mitigated. In situations where the predicted MPE exceeds the General Population threshold in an accessible area as a result of emissions from multiple transmitters, FCC licensees that contribute greater than 5% of the aggregate MPE share responsibility for mitigation.

APPENDIX A: TECHNICAL FRAMEWORK

Based on the computational guidelines set forth in FCC OET Bulletin 65, Waterford Consultants, LLC has developed software to predict the overall Maximum Permissible Exposure possible at any location given the spatial orientation and operating parameters of multiple RF sources. The power density in the *far-field* of an RF source is specified by OET-65 Equation 5 as follows:

$$S = \frac{EIRP}{4 \cdot \pi \cdot R^2} \ (\mathrm{mW/cm^2})$$

where EIRP is the Effective Radiated Power relative to an isotropic antenna and R is the distance between the antenna and point of study. Additionally, consideration is given to the manufacturers' horizontal and vertical antenna patterns as well as radiation reflection. At any location, the predicted power density in the *far-field* is the spatial average of points within a 0 to 6-foot vertical profile that a person would occupy. *Near-field* power density is based on OET-65 Equation 20 stated as

$$S = \left(\frac{180}{\theta_{BW}}\right) \cdot \frac{100 \cdot P_{in}}{\pi \cdot R \cdot h} \ (\mathrm{mW/cm^2})$$

where P_{in} is the power input to the antenna, θ_{BW} is the horizontal pattern beamwidth and h is the aperture length.

Exposure conditions in the *near-field* of a microwave dish antenna may vary but the maximum power density is provided by OET-65 Equation 13 as follows:

$$S_{nf} = \frac{16 \ \eta \ P}{\pi \ D^2} \ (\mathrm{mW/cm^2})$$

where η is aperture efficiency (0.75) and D is the antenna diameter.

Some antennas employ beamforming technology where RF energy allocated to each customer device is dynamically directed toward their location. In this analysis, predicted exposure levels are based on all beams at full utilization (i.e. full power) simultaneously focused in any direction. As this condition is unlikely to occur, the actual power density levels at ground and at adjacent structures are expected to be less that the levels reported. These theoretical results represent worst-case predictions as all RF emitters are assumed to be operating at 100% duty cycle.

7 Appendix B: Qualifications of Waterford Consultants, LLC

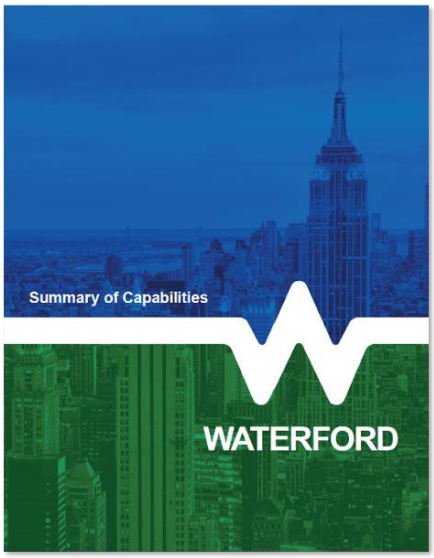
With more than 100 team-years of experience, Waterford Consultants, LLC [Waterford] provides technical consulting services to clients in the Radio Communications and antenna locating industry. Waterford retains professional engineers who are placed in responsible charge of the processes for analysis.

Waterford is familiar with 47 C.F.R. § § 1.1307(b)(3) and 1.1310 along with the general Rules, Regulations, and policies of the FCC. Waterford work processes incorporate all specifications of FCC Office of Engineering and Technology, Bulletin 65 ("OET65"), from the website: www.fcc.gov/oet/rfsafety and follow criteria detailed in 47 CFR § 1.1310 "Radiofrequency radiation exposure Limits".

Within the technical and regulatory framework detailed above, Waterford developed tools according to recognized and generally accepted good engineering practices. Permissible exposure limits are band specific, and the Waterford computerized modeling tools correctly calculate permissible exposure based on the band(s) specified in the input data. Only clients and client representatives are authorized to provide input data through the Waterford web portal. In securing that authorization, clients and client representatives attest to the accuracy of all input data.

Waterford Consultants, LLC attests to the accuracy of the engineering calculations computed by those modeling tools. Furthermore, Waterford attests that the results of those engineering calculations are correctly summarized in this report.

To download an electronic copy of our ***Summary of Capabilities*** brochure, please clicking the image below ….



8 Appendix C: RoofMaster

RoofMaster™ is the software package that Waterford Consultants, LLC created to model RF environments associated with multiple emitters where the potential exists for human exposure. Based on the computational guidelines set forth in OET Bulletin 65 from the Federal Communications Commission (FCC), RoofMaster™ considers the operating parameters of specified RF sources to predict the overall Maximum Permissible Exposure possible at a given location. These theoretical results represent worst-case predictions as emitters are assumed to be operating at 100% duty cycle.

From the FCC document:

> *"The revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to radiofrequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance."*

http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf

9 Appendix D: Statement of Limiting Conditions

Waterford Consultants, LLC field personnel have visited the site and collected data with regard to the MPE environment. Waterford Consultants will not be responsible for matters of a legal nature that affect the site or property. The property has been analyzed under the premise that it is under responsible ownership and management and our client has the legal right to conduct business at this facility.

Due to the complexity of some wireless sites, Waterford Consultants has created this report utilizing best industry practices and due diligence. Waterford Consultants cannot be held accountable or responsible for anomalies or discrepancies due to actual site conditions (i.e., mislabeling of antennas or equipment, inaccessible cable runs, inaccessible antennas or equipment, etc.) or information or data supplied by Wireless Carrier, the site manager, or their affiliates, subcontractors or assigns.

Waterford Consultants has provided the results of a computer-generated model in this MPE Site Compliance Report to show approximate dimensions of the site, and the model results is included to assist the reader of the compliance report to visualize the site area, and to provide supporting documentation for Waterford Consultants' recommendations.

Waterford Consultants will not be responsible for any existing conditions or for any engineering or testing that might be required to discover whether adverse safety conditions exist. Because Waterford Consultants is not expert in the field of mechanical engineering or building maintenance, this MPE Site Compliance Report must not be considered a structural or physical engineering report.

Waterford Consultants obtained information used in this MPE Site Compliance Report from sources that Waterford Consultants considers reliable and believes them to be true and correct. Waterford Consultants does not assume any responsibility for the accuracy of such items that were furnished by other parties.

10 Appendix E: Glossary of Terms

Definitions of the following technical words, terms, and/or phrases reflected in the report provided by Waterford are included as follows:

Compliance assessment	Sometimes referred to as a GAP assessment, it is intended to identify gaps between an existing control environment and what is required for compliance with Federal (FCC) regulations
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.
Cumulative exposure	Cumulative exposure is the total dose resulting from repeated exposures of radiation to an occupationally exposed worker to the same portion of the body, or to the whole body, over a period of time.
Effective Radiated Power (EIRP or ERP)	An IEEE standardized definition of directional radio frequency (RF) power, such as that emitted by a radio transmitter.....It is equal to the input power to the antenna multiplied by the gain of the antenna.
Electromagnetic emissions (EME)	Aka *electromagnetic radiation*, EME is energy that is propagated through free space or through a material medium in the form of electromagnetic waves, such as radio waves, visible light, and gamma rays.
Far field	The far field is the region in which the field acts as "normal" electromagnetic radiation. In this region, it is dominated by electric or magnetic fields with electric dipole characteristics.
FCC	Federal Communications Commission; an independent agency of the United States government that regulates communications by radio, television, wire, satellite, and cable across the United States. The FCC maintains jurisdiction over the areas of broadband access, fair competition, radio frequency use, media responsibility, public safety, and homeland security
General Population limit	Applicable 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

APPENDIX E: GLOSSARY OF TERMS

IEEE	Institute of Electrical and Electronics Engineers; a professional association for electronic engineering and electrical engineering (and associated disciplines). It was formed in 1963 from the amalgamation of the American Institute of Electrical Engineers and the Institute of Radio Engineers
Ionizing radiation	A type of energy released by atoms that travels in the form of electromagnetic waves (gamma or X-rays) or particles (neutrons, beta or alpha); can penetrate the human body and the radiation energy can be absorbed in tissue. This has the potential to cause harmful effects to people, especially at high levels of exposure
Maximum permissible exposure (MPE)	The FCC's regulations have specific MPE requirements for radiated electric fields, magnetic fields. and power density. MPEs are derived from the Specific Absorption Rate (SAR) at which tissue absorbs RF energy, usually expressed in watts per kilogram (W/kg).
Mitigation for compliance	Actions or activities required for compliance with FCC/OSHA regulations and to ensure a safe working environment. A harmonized and integrated compliance program – one that includes appropriate risk-management activities and controls – will eliminate redundant efforts, enable execution, ensure safety, and facilitate adherence to compliance requirements by the business and governing federal agencies.
Narda/Wave Control	Leading international suppliers of measuring equipment in the EMF / EME Safety, RF Test & Measurement and EMC sectors
Near field	A part of the radiated field that is below distances shorter than the Fraunhofer distance, which is given from the source of the diffracting edge or antenna of longitude or diameter; near field, as the name suggests, is very close to the antenna while far field is further away.
Non-ionizing radiation	Non-ionizing radiation includes the spectrum of ultraviolet (UV), visible light, infrared (IR), microwave (MW), radio frequency (RF), and extremely low frequency (ELF); does not penetrate deep into the tissues but increases the risk of damage to the skin and eyes. Dependent on the energy and exposure time, non-ionizing radiation can cause localized heating, or photochemical reactions can occur with possible permanent harm. Exposure should therefore be minimized.

APPENDIX E: GLOSSARY OF TERMS

Occupational limit	Apply to situations in which persons are exposed as a consequence of their employment, have been made fully aware of the potential for exposure, and can exercise control over their exposure.
OET-65	Bulletin published by the FCC's Office of Engineering & Technology in 1997; establishes guidelines for human exposure to radiofrequency electromagnetic field and achieving FCC compliance
Personal RF monitor	Part of the personal protective equipment (PPE) worn by a person working in areas exposed to radio frequency radiation. A personal RF safety monitor is typically worn either on the torso region of the body or handheld and is required by the occupational safety and health acts of many telecommunication companies
Positive access control	Refers to the practice of restricting entrance to a property, a building, or a room to authorized persons; can be achieved by a human (a guard, bouncer, or receptionist), through mechanical means such as locks and keys, or through technological means such as access control systems
Power density	The amount of power (time rate of energy transfer) per unit volume; power density may also refer to a volume. It is then also called volume power density, which is expressed as W/m3
Radio frequency (RF)	The oscillation rate of an alternating electric current or voltage or of a magnetic, electric, or electromagnetic field or mechanical system in the frequency range from around 20 kHz to around 300 GHz
Specific Absorption Rate (SAR)	A measure of the rate at which energy is absorbed per unit mass by a human body when exposed to a radio frequency (RF) electromagnetic field. ... It is defined as the power absorbed per mass of tissue and has units of watts per kilogram (W/kg)
Spatial average	The average power density observed when the Narda meter and probe is swept over an entire person (0 – 6 feet) for purposes of comparing with FCC exposure limits
Spatial peak	The maximum power density observed when the Narda meter and probe are swept over an entire person (0 – 6 feet) for purposes of comparing with FCC exposure limits; considered "*worst case*" – the average will not exceed this value
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