ENGINEERING REPORT

RADIO FREQUENCY EXPOSURE MEASUREMENTS
LAKEVIEW HILLS WATER TOWER
1202 NORTHPORT DRIVE
MADISON, WISCONSIN

NOVEMBER 2017

Prepared by:

Evans Engineering Solutions
Telecommunications Engineers
524 Alta Loma Drive
Thiensville, WI 53092-1406
Phone (262) 518-0178
www.evansengsolutions.com

© 2017 by Evans Engineering Solutions, LLC

All Rights Reserved

ENGINEERING REPORT

RADIO FREQUENCY EXPOSURE MEASUREMENTS
LAKEVIEW HILLS WATER TOWER
1202 NORTHPORT DRIVE
MADISON, WISCONSIN

Introduction

The purpose of this report is to detail the results of a radio frequency (RF) exposure measurement survey performed on and near the grounds of the Dane County Department of Human Resources buildings. The Lakeview Hills water tower just northeast of the Human Resources building is the site of many radio transmitting antennas including the cellular antennas of Verizon, AT&T and Sprint.

The RF measurements detailed herein were taken on October 26, 2017 by Ben Evans, President of Evans Engineering Solutions, an RF communications engineer who has over 20 years' experience in conducting these types of measurements. The measuring devices used were a Holaday HI-3012 RF exposure meter and MSE (E-field) probe. The date of the most recent calibration of the meter is October 13, 2017 (see Figure 4 for calibration certificate). The provisions of OST Bulletin 65 were observed in the taking of these measurements.

Determination of Maximum Permitted Exposure for the Site

According to an RF facilities inventory for the water tower that was obtained from the Madison Water Utility, the multidirectional and omnidirectional transmitting facilities on the water tower range in frequency from 737 MHz to 2637.5 MHz, well within the measuring range of the Holaday field meter and probe. Attached as Figure 1 is a graph showing the Maximum Permitted Exposure (MPE) level versus frequency for both occupational and general population environments. Since the areas to be measured are in a general population environment, the general population line of the graph is to be used. The MPE level for 737 MHz is 0.491 mW/cm^2, as shown in the Figure 1 graph. This is calculated by the formula MPE = frequency (MHz) divided by 1500.

For the frequencies above 737 MHz, the MPE levels are higher (up to 1.0 mW/cm^2). Thus, the MPE level of 0.491 mW/cm^2 for 737 MHz is the most restrictive, so we use this value as the benchmark for the exposure measurements.

Description of Measurement Methodology

All locations at ground level are in the "far-field" of the RF emissions, that is, at distances from the antennas several times the wavelength of the lowest frequency; thus, only the electric field (E-field) levels and not the magnetic field (H-field) levels were measured, according to accepted practice. Using the E-field probe, the Holaday 3012 meter measures the E-field squared, or E^2, in units of volts squared per meter squared (V^2/m^2). Since the MPE level is described in units of milliwatts per square centimeter (mW/cm^2), the E^2-field value that corresponds to the RF exposure level of 0.491 mW/cm^2 must be calculated. This is done using the following formula:

$$S = \frac{E^2}{3770} = 37.7H^2$$

where: S = power density exposure level (mW/cm^2)
E^2 = electric field strength squared (V^2/m^2)
H^2 = magnetic field strength squared (A^2/m^2)

Since the H^2-field will not be measured, only the E^2-field is calculated thusly: S value of 0.491 times 3770 = E^2 value of 1852 V^2/m^2. The Holaday meter settings display the exposure level in exponential notation, so 1852 V^2/m^2 is displayed as 1.852×10^3 V^2/m^2. This is the E^2-field that represents the Maximum Permitted Exposure level for the exposure measurements near the water tower.

Because the Holaday 3012 field meter is a broadband meter, it is capable of measuring simultaneously the power density of multiple signals over a wide range of frequencies, from 0.5 MHz to 5 GHz. According to the radio facility inventory, there are microwave antennas on the water tower operating on the 6 and 11 GHz bands, outside the measuring range of the meter; however, the exposure levels on the ground from these facilities are insignificant and below detection levels due to the fact that microwave transmissions are concentrated in a very tight beam directed high above ground towards the horizon in a discrete path to another microwave site.

Measurement Locations

The RF exposure measurements detailed in this report were taken within 200 yards of the water tower location. Measurement areas included stretches along the nature trails, walkways near the Human Resources building and residential streets within 200 years of the water tower, as well as the driveway and parking lots for Human Resources. Attached as Figure 2 is a Google aerial photo map showing the paths along which the measurements were taken. Only the maximum reading along each path was recorded.

Results of Measurements

The measurements were conducted on October 26, 2017 between the hours of approximately 10:30 AM and 12:30 PM. All mobile devices were either turned off or placed in “airplane mode” so as not to affect the readings. The results of the measurements are shown in attached Figure 3.

Conclusion

Since all of the exposure readings recorded are far below the Maximum Permitted Exposure (MPE) level, in most cases too low to be measured, and in no case greater than 1.35% of the MPE level, it is the opinion of this engineer that the radio facilities located at the Lakeview Hills water tower are in substantial compliance with OET Bulletin 65 and the RF exposure standards in areas frequented by the public.

The information contained in this report is true and accurate to the best of my knowledge and belief.

B. Benjamin Evans

November 9, 2017

Attached Figures:

Figure 1 - - - - - Graph of FCC Limits for Maximum Permissible Exposure (MPE)
Figure 2 - - - - - Google Aerial Map showing Measured Paths near Water Tower
Figure 3 - - - - - RF Exposure Measurement Results
Figure 4 - - - - - Certificate of Calibration for RF Exposure Measurement Meter

EVANS ENGINEERING SOLUTIONS

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

Plane-wave Equivalent Power Density

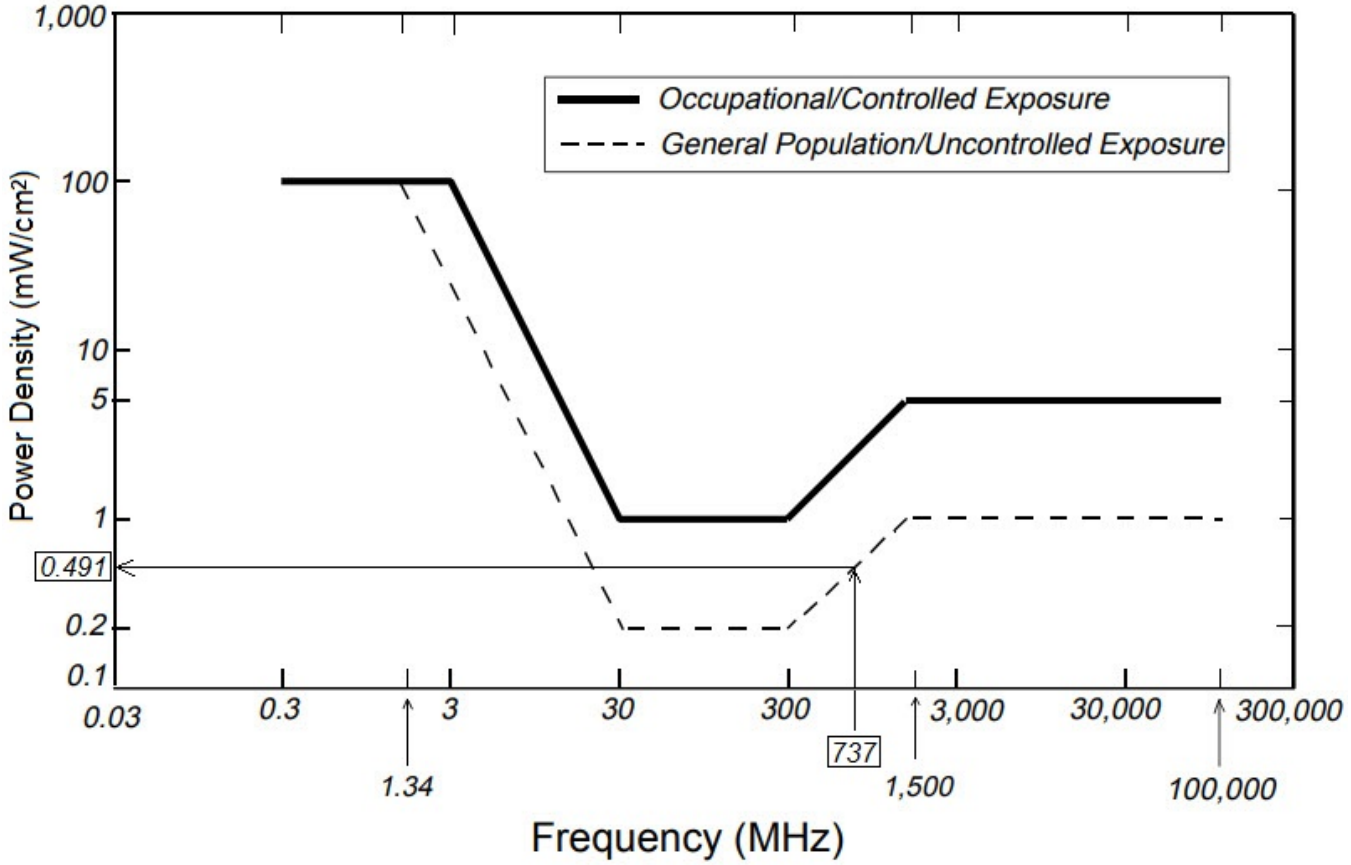
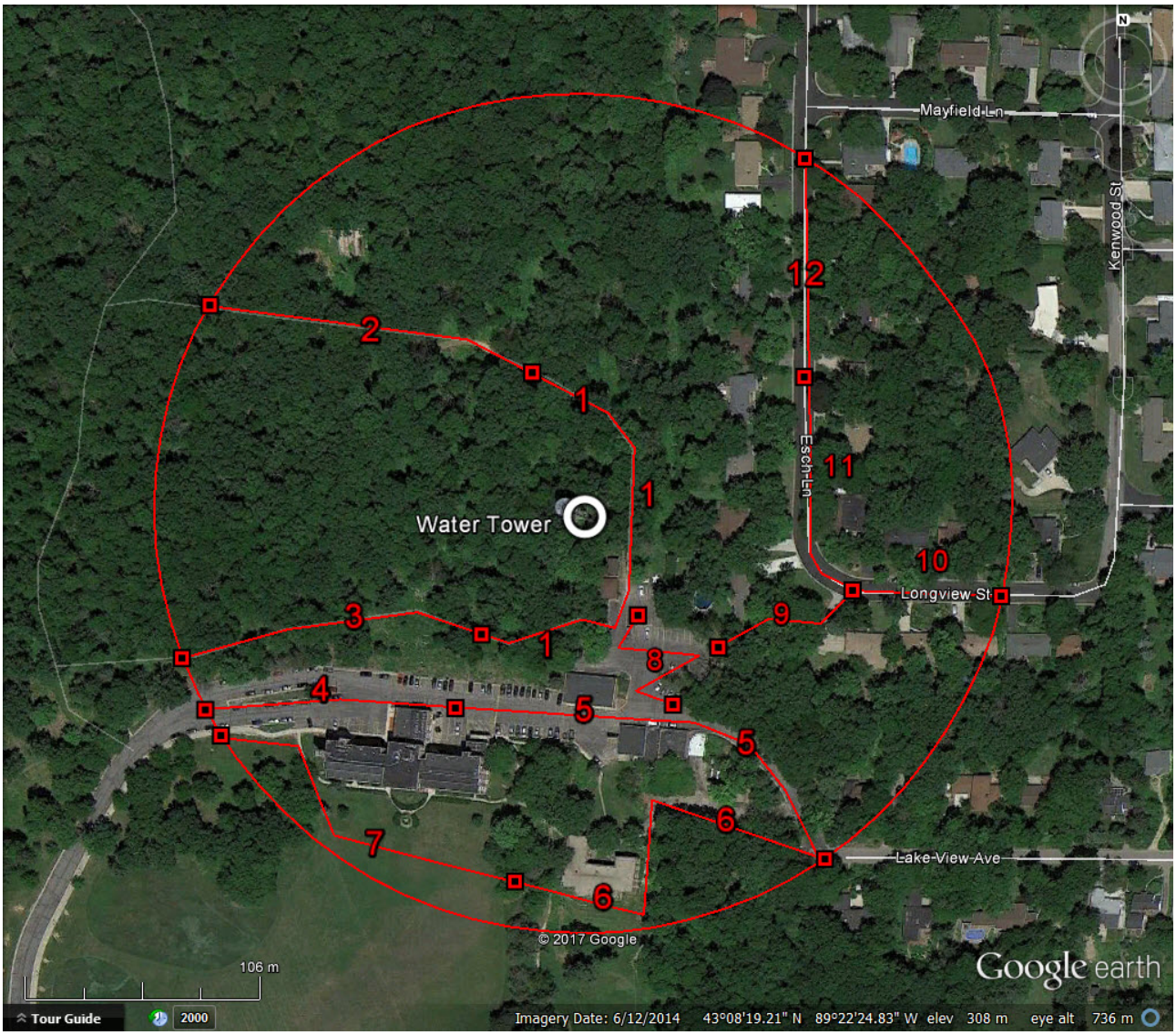


FIGURE 2

GOOGLE AERIAL MAP SHOWING MEASURED PATHS NEAR THE LAKEVIEW HILLS WATER TOWER



Geographic Coordinates of Water Tower: N 43-08-19.22, W 89-22-24.88

EVANS ENGINEERING SOLUTIONS

FIGURE 3

RF EXPOSURE MEASUREMENT RESULTS FOR AREA NEAR LAKEVIEW HILLS WATER TOWER MADISON, WISCONSIN

Maximum Permitted Exposure Level = 1.852×10^3 V^2/m^2

Path #	Description of Path	Maximum Reading (V^2/m^2)
1	210-yd stretch along nature trail N of tower, alongside transmitter shelters, thru parking lot and along nature trail S of tower.	Too low to meas.
2	Stretch of 155 yds along nature trail NW of tower.	Too low to meas.
3	Stretch of 145 yds along nature trail SW of tower.	Too low to meas.
4	120-yd stretch along HR Dept driveway, from just W of island to east wing of main building.	0.1×10^2 (10)
5	210-yd stretch along HR Dept driveway, from east wing of main bldg, along curve in road to end of Lake View Ave.	0.1×10^2 (10)
6	Starting at end of Lake View Ave, proceeding W and S along drive and walk ways, then W crossing grounds SE of main bldg..	0.1×10^2 (10)
7	Across grounds S of main bldg and along walkways W of bldg.	Too low to meas.
8	Around maintenance building parking lot.	0.25×10^2 (25)
9	Path from maintenance building parking lot to Longview Street.	0.1×10^2 (10)
10	70-yd stretch along Longview Street.	Too low to meas.
11	110-yd stretch along Esch Lane around curve and N of Longview Street.	Too low to meas.
12	105-yd stretch along Esch Lane S of Mayfield Lane.	0.1×10^2 (10)

Path numbers are reference to Figure 2 map.

FIGURE 4

MICRO PRECISION CALIBRATION

MICRO PRECISION CALIBRATION
22835 INDUSTRIAL PLACE
GRASS VALLEY CA 95949
530-268-1860

Certificate of Calibration

Date: Oct 13, 2017 **Cert No. 512200813063968**

Customer:
EVANS ENGINEERING SOLUTIONS
524 ALTA LOMA DRIVE
THIENSVILLE WI 53092

		Work Order #:	SAC-70090488
		Purchase Order #:	MPC-100417
MPC Control #:	DK6147	Serial Number:	92778/295C/237E/237H
Asset ID:	N/A	Department:	N/A
Gage Type:	BROADBAND FIELD METER W/ 3 PROBES	Performed By:	IAN LEGASPI
Manufacturer:	HOLADAY	Received Condition:	IN TOLERANCE
Model Number:	HI-3012	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	October 13, 2017
Temp/RH:	69.9°F / 49.0%	Cal. Interval:	12 MONTHS
Location:	Calibration performed at MPC facility	Cal. Due Date:	October 13, 2018

Calibration Notes:

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
CT2148	SIGNAL GENERATOR	SMA 100A-B103-B22	103538	ROHDE & SCHWARZ	Jan 6, 2018	512200812659669
DF8059	DIGITAL MULTIMETER	34401A	US36090404	AGILENT	Sep 27, 2018	512200813041826

Procedures Used in this Event

Procedure Name	Description
33K4-5-202-1	Microwave Survey Meter

Calibrating Technician: IAN LEGASPI

QC Approval: DANNY BOY B. BUTIAL

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comform with ISO/IEC 17025:2005, ANSI/NCSL Z540-1-1994, ANSI/NCSL Z540.3-2006, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.