

## **EXHIBIT 28**

Community Coverage Showing  
Alternate Propagation Study

Longley/Rice Community Coverage  
of Lexington, NC for

WWLV(FM) – Lexington, NC  
**Channel 231C1 – 94.1 MHz**

**September, 2013**

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## Exhibit 28.1

### Discussion of Community Coverage Showing

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This firm has been retained to prepare an engineering report demonstrating compliance with §73.313 regarding community coverage for this WWLV(FM) – Lexington, NC proposal. The WWLV(FM) facility will operate on Channel 231C1, 94.1 MHz with 53.0 kW ERP at 603 meters AMSL. Alternate propagation methodology (Longley/Rice) has been employed pursuant to §73.313(e).

The proposed transmitter site for WWLV(FM) is identified by FAA Study 2009-ASO-3165-OE bearing NAD 27 coordinates 35° 39' 05" NL; 80° 46' 02" WL. These coordinates and WWLV(FM) operation parameters results in less than 100% coverage of Lexington, NC using the standard 70 dBμ f(50:50) FCC propagation contour. However, pursuant to §73.313(e), 100% of Lexington, NC lies within the 70 dBμ city grade contour of WWLV(FM) when analyzed under the Longley/Rice Propagation methodology.

FCC Rules require several specific stipulations prior to accepting Longley-Rice as an alternate propagation method for coverage issues. Each stipulation will be discussed in detail. Also attached as [Exhibit 28.2](#) is a V-Soft®, Probe IV™ map demonstrating compliance with the below mentioned criteria. All relevant distances and contours as well as operating parameters employed have been noted

***1.) A showing of why a supplemental showing (Longley-Rice) was warranted. (e.g., very flat, very rough or anomalous terrain.) In cases where Delta h ( $\Delta$ ) is to be the sole determinant a showing must be provided that terrain "departs widely" from the average Delta h ( $\Delta$ ) of 50 meters. The applicant must provide evidence that the Delta h ( $\Delta$ ) of the path from the transmitter to the principal city is less than 20 (or more than 100.) Also, the applicant can show that the antenna HAAT along the radials toward the community of license (using an extended radial) varies by more than 30% from the HAAT obtained by using the standard method. For purposes of determining Delta h ( $\Delta$ ), the commission has established a profile length of between the transmitter and community, not to exceed 50 km. See Section 73.313. Alternately, pursuant to DA 10-1760, Skytower Communications – 94.3, LLC; Licensee of Station WULF(FM), Hardinsburg, Kentucky Request for Determination of Compliance with the Main Studio Location Rule, 47 C.F.R. § 73.1125; (MO&O and Notice of Apparent Liability for Forfeiture); adopted September 16, 2010 and released September 17, 2010, the sole qualification for determining if terrain departs widely from the norm was further relaxed to include instances where the Alternate Propagation Method results in a 30% or greater difference in the distance to the 70 dBμ contour compared to the distance provided by the standard prediction method.***

In this case, use of the supplemental Longley-Rice methodology is warranted based on the Skytower Communications decision. The average distance to the 70 dBμ contour as predicted by the supplemental method has been calculated to be 32.0% larger than the distance to the standard contour prediction method over the arc of radials toward the community of license. 70 dBμ contours have been supplied both in map and tabulations as noted on [Exhibit 28.2](#). The applicant would like to note that consistent with FCC policy, in instances where the Longley-Rice 70 dBμ service contour exceeds the FCC 60 dBμ F(50:50) contour, the Longley-Rice contour is to be truncated to no longer than the FCC 60 dBμ f(50:50) contour. Radial truncation is not required in this instance.

## **Exhibit 28.1**

### **Discussion of Community Coverage Showing**

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***2.) Showing that the distance to the 70 dBμ contour as predicted by the supplemental method is at least 10% larger than the distance predicted by the standard contour prediction method.***

As stated before, the average distance to the 70 dBμ contour as predicted by the supplemental method has been calculated to be 32.0% larger than the distance to the standard contour prediction method over the arc of radials toward the community of license. 70 dBμ contours have been supplied both in map and tabulations as noted on [Exhibit 28.2](#). Consistent with FCC policy, in instances where the Longley-Rice 70 dBμ service contour exceeds the FCC 60 dBμ F(50:50) contour, the Longley-Rice contour is to be truncated to no longer than the FCC 60 dBμ f(50:50) contour. Radial truncation is not required in this instance.

***3.) A showing of the coordinates for the proposed main studio locations in compliance with Sec 73.1125.***

The main studio location will remain in compliance with Sec 73.1125. Supplemental showings have been provided for community coverage only and not main studio location.

***4.) A map showing the relative locations of the main studio location or legal boundaries of the community of license and the principal city community contours as predicted by the standard and supplemental method.***

The legal boundaries of the community of license, in addition to the principle city community contours have been shown on the supplied [Exhibit 28.2](#) map.

***5.) A list of assumptions and an explanation of the method used in generating the supplemental analysis.***

Longley/Rice and standard predicted methodology as described by the computer software manufacturer has been included in [Exhibit 28.3](#). It is believed sufficient showing has been presented meriting a grant of the WWLV(FM) proposal with regard to community coverage, however additional showings will be provided upon FCC request.

***6.) Sample calculations using the supplemental procedure.***

Documentation of the supplement city coverage contour and relevant city coverage arcs have been supplied in [Exhibit 28.2](#). Tabulations of each relevant arc and contour distances have been supplied in the exhibit as well. Additional showings will be supplied upon request.

## Exhibit 28.2

### Alternate Propagation Community Coverage Showing (Longley-Rice)

NGDC 30 SEC Terrain Database  
U.S. Census 2010 - PL Database

Azimuth (degrees)	Distance to City Limit (km)	Distance to 70 dBu FCC Contour (km)	Distance to 70 dBu Longley-Rice (km)	Percent Difference 70 dBu dist
63.0°T	50.80	49.08	66.45	35.4%
64.0°T	50.80	49.03	62.05	26.6%
65.0°T	51.10	48.98	63.65	30.0%
66.0°T	52.20	48.94	63.45	29.6%
67.0°T	52.30	48.92	62.25	27.2%
68.0°T	51.80	48.93	61.85	26.4%
69.0°T	52.50	48.96	60.90	24.4%
70.0°T	52.40	49.00	70.90	44.7%
71.0°T	51.00	49.05	59.65	21.6%
72.0°T	50.80	49.09	68.90	40.4%
73.0°T	50.10	49.13	65.45	33.2%
74.0°T	49.80	49.18	65.00	32.2%
75.0°T	49.50	49.20	66.30	34.8%
76.0°T	49.40	49.20	69.70	41.7%
Average 70 dBu % Difference:				32.0%

Longley-Rice 70 dBu F(05:50)

FCC 70.0 dBu F(50:50)

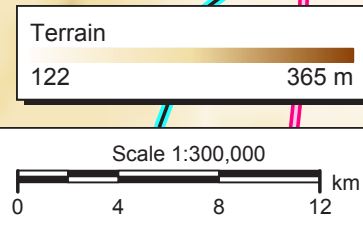
FCC 60.0 dBu F(50:50)

WWLV.P  
WWLV.P



**WWLV.P**  
Lexington, NC  
Proposed Operation  
Facility ID: 15839  
Latitude: 35-39-05 N  
Longitude: 080-46-02 W  
ERP: 53.00 kW  
Channel: 231C1  
Frequency: 94.1 MHz  
AMSL Height: 603.0 m  
Horiz. Pattern: Omni

Prop Model: Longley/Rice  
Climate: Cont temperate  
Conductivity: 0.0050  
Dielec Const: 15.0  
Refractivity: 311.0  
Receiver Ht AG: 9.1 m  
Receiver Gain: 0 dB  
Time Variability: 50.0%  
Sit. Variability: 50.0%  
ITM Mode: Broadcast  
Method: Mean Occurrence



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## Propagation Methodology

### FCC Propagation Curves

The FCC curves were created through a combination of the free-space equations and actual measurements, which augmented the equations with real world experience. Initially, the curves were available only as a set of graphs. However, with the advent of computers, the U.S. Federal Communications Commission employed its staff to translate the curves to a set of digitally stored tables, which could be interpolated by machine. With the input of desired signal level, radiated power, and effective antenna height the curves will give the user an accurate estimate of the distance from the antenna where the signal will exist. The curves can also be used to determine signal level at a distance with the input of power, antenna height and distance from the antenna. Proper use of the curves requires that the input variable "antenna height" be calculated to represent the antenna's height above "average terrain". The FCC specifies certain methods for determining this value. When topographic maps are employed, the Commission requires that at least 50 points be taken from 3.16 to 16 kilometers (FM) and then averaged to produce the height above average terrain. The computer implementation of the curves will generally take terrain samples at one/tenth kilometer intervals. The FCC's method is excellent at representing coverage over somewhat smooth or rolling terrain, however the methods tend to break down in places where the terrain is rugged. Since the method simply averages the terrain elevations, inaccuracies are introduced when the terrain varies widely or when it varies significantly at points beyond the method's 16-kilometer cutoff.

### Longley-Rice Model

In the mid-sixties, the National Bureau of Standards published Technical Note 101. P. L. Rice, A. G. Longley, A. Norton and A. P. Barsis authored this two-volume propagation treatise in the course of their work at the Institute for telecommunications Sciences and Aeronomy at Boulder, Colorado. The concepts expressed in these documents were incorporated into a series of computer routines that came to be known as the "Longley-Rice Model". This model has recently been employed by the Commission to determine the new DTV allocation scheme. It has now become the standard alternative prediction method. Going well beyond the FCC curves, the Longley-Rice method considers atmospheric absorption including absorption by water vapor and Oxygen, loss due to sky-noise temperature and attenuation caused by rain and clouds. It considers terrain roughness, knife-edge, (with and without ground-reflections), loss due to isolated obstacles, diffraction, forward scatter and long-term power fading. The model and our V-Soft Communications implementation require the following inputs for analysis based on multiple point-to-point paths:

Frequency (20 - 20,000 MHz)

Transmitter antenna parameters:



## Exhibit 28.3 - Explanation of Propagation Methodology



Transmitter antenna height (above mean sea level - meters.) Transmitter antenna height (above ground - meters.) Transmitter power. Transmitter antenna pattern.

Receiver antenna height (above ground - meters)


System antenna polarization (vertical or horizontal)

System Ground Conductivity (mhoS/m)

 .001 = Poor Ground

 .005 = Average ground

 .020 = Good ground

 5.000 = Sea water

 .010 = Fresh Water

System dielectric constant (Permittivity)

 4.0 = Poor ground

 15.0 = Average ground


 25.0 = Good ground

 81.0 = Sea and fresh water

System minimum monthly mean surface refractivity (Adjusted to sea level.)


 200 to 450 (available from map, 301 N-units is default.)

Climate Code:

 1 = Equatorial

 2 = Continental sub-tropical

 3 = Maritime Subtropical


 4 = Desert

 5 = Continental temperate (default for U.S. continent)

 6 = Maritime temperate

 7 = Maritime temperate overseas

Probability Factors:

 Qt = (Time variability) The percentage of time the actual path loss is equal or less than the predicted path loss (Standard broadcast coverage = 50%)

## Exhibit 28.3 - Explanation of Propagation Methodology



- ✚ QI = (Location Variability) The percentage of paths (all with similar characteristics) whose actual path loss is less than or equal to the predicted path loss. (Used with area mode only.)
- ✚ Qc = (Prediction Confidence or "Quality") The percentage of the measured data values the model is based on that are within the predicted path loss. (Standard broadcast = 50%, DTV = 90%.)

V-Soft Communication's implementation of Longley-Rice predicts received signal strength level at some 264,000 points. Our programs Probe and Terrain-3D allow instantaneous manipulation of these points to produce numerous graphic representations of the coverage pattern. The user can choose any of the pre-defined signal level representations or input a user-defined signal level. Costal features, cities, political boundaries and streets to the individual road level are available for plotting.

### Okumura Propagation Model

The basic Okumura propagation model uses the height above average terrain to calculate path loss and does not consider specific terrain obstacles. The Okumura propagation model that Probe uses is the Okumura/Hata/Davidson implementation. Hata developed a set of equations that provide Okumura model predictions for computer use. The Davidson correction factors extend the frequency and base antenna height range.

### COST-231 Propagation Model

Probe implements the COST-231/Hata version of the COST-231 propagation model. This model uses the HAAT along each radial to determine the attenuation based the following equation:

$$\text{Path Loss (dB)} = 46.3 + 33.9 \cdot \log(F) - 13.82 \cdot \log(H) + [44.9 - 6.55 \cdot \log(H)] \cdot \log(D) + C$$

where

F = Frequency (MHz)  
D = Distance between base station and receiver (km)  
H = HAAT in the direction of the receiver (m)  
C = Environmental-correction factor (dB)

The Hata correction for receiver height and frequency is then applied to calculate the final attenuation.

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[Probe](#) - [Terrain 3-D](#)