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Thinking outside the sphere

Report on Analysis of Proposed Cell Tower at Bald Hill Road, Kent, Connecticut

July 16, 2020

David Maxson, WCP

NOTE: Color Document – Please rely on electronic version or original color prints.

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Summary

This report reviews the evidence provided by the applicant Homeland Towers, LLC (Homeland" or "Applicant") for approval to develop a cell tower at Bald Hill Road, in Kent. The Applicant is accompanied by New Cingular Wireless PCS, LLC ("AT&T") as the personal wireless service provider of record who would be the tenant of a tower at Bald Hill. This report also relies on new material produced by the author, David P. Maxson, WCP, to refine the record. My *curriculum vitae* is Exhibit B.

In reviewing the application, including the reporting by C-Squared Systems, and in conducting my own analysis, I conclude the following based on the facts:

1) The proposed tower at Bald Hill appears to be the result of real estate speculation, not the result of good engineering practice in the deployment of a wireless network. The site looks like it was a purchase of high ground in search of a tower occupant. This is indicated by its suboptimal position – given the terrain and distances – for providing coverage in Kent and the Route 341 corridor.
2) It is important to note that the proposed tower at Bald Hill fails to provide for coverage overlap with any adjacent wireless facilities, which runs counter to the design criterion to provide for smooth "handoffs" from one cell site to the next for mobile subscribers.
3) Despite the Applicant's stock protest against the deployment of small cells, the use of utility-pole-mounted small cells along Rt 341 and environs can provide more useful coverage to more residences and more streets than the proposed tower at Bald Hill. Moreover, the small cell solution has far less impact to this region, which is recognized for its scenic value.
4) The proposed tower at Bald Hill is excessively tall, as coverage from the 80-foot-above-ground height is not materially different from that at 150 feet above ground.
5) The proposed tower at Bald Hill is not part of any strategic plan for Kent public safety communications. There is no substantiation that a tower at Bald Hill (or Richards Road) is *necessary* for the provision of public safety communications. It is simply being offered

as a potential site that reportedly provides beneficial coverage. It is being accepted by the public safety community because it is free, not because it is necessary.

6) The main public safety benefit of increasing wireless coverage in Kent is the increased ability of residents and travelers to make 911 calls. The proposed tower at Bald Hill fails to provide coverage to the most dangerous curve on Route 341 (a.k.a. Segar Road) in Kent (west of Bald Hill), known locally for its numerous crashes. A small-cell network can address this dangerous area of Rt 341 and cover much more of Rt 341 than the proposed tower.
7) The Alternative B location at Richards Road also fails to serve the stated objective. It further reduces coverage and quality of service in the Rt 341 corridor, compared to the proposed Bald Hill site and the small-cell solution. Alternative B shifts more than half of its coverage away from the targeted area around Rt 341. This reduces the capacity available to the area around Rt 341 by directing coverage to the south and east of the target area. Alternative B fails to reach the South Road neighborhood and the area around the Kenmont Camp campus.

Below is a table showing key metrics of the proposed tower at Bald Hill, in comparison with a model small-cell installation.

Facilities	Square Miles	Number of Residences	Miles of Streets (includes Rt 341)	Miles of Rt 341
Bald Hill Road	3.7	148	8.8	1.9
7-Node Small Cells	3.9	178	11.4	3.7

Table 1- Comparison of Bald Hill and Small Cell Deployments using the contiguous footprints at -93 dBm

Coverage

While the proposed tower at Bald Hill would enable AT&T to increase its wireless coverage in Kent, it is by no means the most effective, nor a proposal with the least environmental impact. The Applicant provided a coverage report prepared for the Applicant by C-Squared Systems. coverage for AT&T's wireless network. In the Application narrative, Section III.B., the Applicant states,

> *The proposed Facility at either candidate site will provide reliable services in AT&T's network to an area of the Town currently experiencing deficient coverage, including along Route 341 (Segar Mountain Road), Richards Road, Bald Hill Road, Stonefence Lane, Spectacle Road, and the neighboring residential and business/retail areas near the proposed Facility.*

This clearly outlines the immediate goal of the proposed facility. It is obvious that the coverage goal is defined by the coverage obtained from the Bald Hill site. This is evident despite the assertion Section IV.A. "AT&T conducted both propagation modeling and real-world drive testing in the area of Kent to define the extent of the coverage gap to be filled." The "extent of the coverage gap to be filled" is not simply defined by the foregoing description of a few streets within the reach of a Bald Hill tower. It is much larger. If AT&T indeed "defined" its coverage gap in Kent, it would be so broad it could not reasonably be concluded that a Bald Hill tower is necessary to "close the gap." A Bald Hill facility is one way to improve coverage in the area, but not the only way or the best way.

The Applicant also states,

> *Closing the coverage gaps and providing reliable wireless services in central Kent requires a tower site that can provide reliable service…*

The Applicant clearly indicates the design objective of new wireless facilities is substantially for "closing coverage gaps" in central Kent. The Applicant reinforces the fact that the coverage gaps to be closed relate to the Rt 341 corridor:

> *The intention of the site is to cover State Highway 341 and as much of the area adjacent to State Highway 341 as possible.* (Responses to Interrogatories, A30.)

As the C-Squared coverage analysis shows, AT&T's coverage from the proposed tower does not *close* a gap. It creates a coverage island unto itself, having no gap-closing overlap with any existing facilities.

The C-Squared Report (Attachment 1 of the Application) further reinforces best practices in network design:

> *There is a significant coverage deficiency in the existing AT&T wireless communications network along Segar Mountain Road, Richards Road and the neighboring residential and business/retail areas in Kent, referred to herein as the "targeted area". A deficiency in coverage is evidenced by the inability to adequately and reliably transmit/receive quality calls and/or utilize data services offered by the network. Seamless reliable coverage provides users with the ability to successfully originate, receive, and maintain quality calls and data applications throughout a service area. Appropriate overlapping coverage is required for users to be able to move throughout the service area and reliably "hand-off" between cells to maintain uninterrupted connections.*

The proposed facility at Bald Hill leaves a coverage gap between it and the Rt 7 corridor. This is the result of the default approach to tower-siting in which the high ground is mistakenly assumed to be the best option. The high ground of Bald Hill is too distant from Route 7 to provide continuity of service from Route 7, easterly along Rt 341 across Kent. Additional towers in Kent would be necessary to "close the gap" and "reliably 'hand-off' between cells to maintain uninterrupted connections." This implies an additional tower would be required to close the gap between the Bald Hill and Rt 7 coverage footprints, because the Bald Hill tower fails to do so.

Because of its inefficient location, the proposed Bald Hill tower actually *invites a proliferation of towers* in Kent instead of reducing the risk as claimed by the Applicant (IV.A "…the Applicants seek to avoid the unnecessary proliferation of towers…"). Moreover, if a future tower were proposed to fill the gap left by the Bald Hill tower, it would likely be close to the designated scenic roads Cobble Lane and Cobble Road, which joins Rt 341 in the unaddressed gap. In short, the rational outcome of putting a tower at Bald Hill is a future effort to further impinge on the Kent skyline with another tower in another scenery-challenging location nearby. As the purpose of avoiding a proliferation of towers is to prevent scenic impact, the Application fails to balance public need with environmental compatibility.

The C-Squared report mentioned an effort "to define the extent of the coverage gap in the area of Kent." That process led to this conclusion:

> *Analysis of the propagation modeling and drive testing in Kent reveal that AT&T's network is unreliable throughout much of the area due to gaps in coverage, and that there is a service deficiency as a result. In order to fill in these coverage gaps and improve the network reliability to Kent, a new facility is needed in the area.*

On behalf of AT&T, C-Squared is stating merely the obvious, that "a new facility is needed." As the Applicant describes it (Application IV.A.) "…Homeland developed a search ring in the central portion of the town of Kent to address AT&T's coverage gap in that area." AT&T has noted the general need for improving coverage in the Rt 341 corridor in Kent, but has not specified that Bald Hill is the solution. Homeland chose the location of the proposed tower. Based on the evidence, Bald Hill is a poor choice of a solution.

A Better Solution All-Around

The best way to provide coverage in very irregular terrain is to distribute the access points (base stations) instead of relying on a tall tower that is never tall enough to see over each hill into each dell. This is where the use of small cells along the public ways can meet the public need more effectively while simultaneously increasing environmental compatibility. The applicant, a tower infrastructure provider, anticipated this question, saying at Section III.C.

> *Technologies like small cells are best suited for specifically defined areas where capacity is necessary, such as commercial buildings, shopping malls, and tunnels. Small cells and other types of transmitting technologies are not viable as an alternative to the need for a replacement macro tower site in this area of Kent to continue providing wireless services to the public… The Applicants submit that there are no equally effective, feasible technological alternatives to a new tower facility for providing reliable personal wireless services in this area of Connecticut.*

The implication of this claim is not just the one "new tower facility" along Route 341 in Kent, but multiples over the longer term. Indeed, as the Applicant suggests, the uses of small cells include deployment in areas already having adequate coverage to increase the capacity for numerous subscribers. In addition, small cells are suitable for filling in where coverage is less than optimal as is the case in the Kent hills.

To illustrate the way a group of small cells can do better than the proposed tower in providing coverage to the "gap" in Kent, Isotrope modeled a set of small cell "nodes" at strategic locations along and near Rt 341. An antenna height of 50 feet was used (the maximum height under FCC rules for enjoying certain protections as qualifying small cells.) Utility poles in the area are typically about 30 feet to 38 feet above ground (based on viewing local pole "birthmarks" containing the pole lengths and accounting for standard embedment depths.) However, new or replacement poles and pole extensions are relatively inexpensive and can be installed for the purpose. Claims that the local utility will not permit antennas above the high-voltage primaries are not dispositive. In such cases, there are often a) poles without primaries, b) tension poles

(empty poles stabilizing the loaded poles across the street) and c) the prospect of placing new poles where needed.

The 700 MHz frequency is less affected by vegetative absorption and scattering, so it is not critical to have poles extending above tree height. Computer models account for the average impact of foliage on 700 MHz propagation. Power levels typical of small cell transmissions were employed in the model.

Exhibit A contains three figures containing coverage maps produced on the Isotrope computer modeling platform.

The similarity between the Isotrope coverage model for the Bald Hill site at 150 feet above ground and the C-Squared model validates the Isotrope modeling. There is nearly complete agreement between the two models on the approximate area of proposed -93 dBm coverage from the proposed tower. Isotrope's models are generated based on years of experience and field-calibration.

C-Squared used the -83 dBm and -93 dBm coverage levels to illustrate AT&T coverage, both for its existing coverage and for coverage from each of the proposed sites. To simplify interpretation, Isotrope used one level: -93 dBm coverage. (Recall that -93 dBm is a weaker signal level than -83 dBm; however, note that -93 dBm signal levels for 4G technology are quite robust, enabling relatively high bandwidth communications). Voice calling, text messaging and similar low-bandwidth communications will carry into areas with lower signal levels not shown on the maps.

The first coverage map, Figure 1, predicts coverage from the Bald Hill site with antenna heights of 80, 100 and 150 feet. The 80-foot coverage is shown as orange. The 100-foot coverage includes that from 80 feet plus the pink areas. The 150-foot coverage includes orange and pink as well as the green areas. Note how the change in coverage from 80 to 150-foot antenna heights is slight. This indicates the tower does not need to be anywhere nearly as tall as proposed.

The same is done for the Richards Road tower (Figure 2). The changes in coverage with substantial height reductions are also slight.

Figure 3 shows a model of a 7-node small cell network. Antenna heights that are potentially below tree height were accounted for in the model. The orange areas represent the -93 dBm threshold that C-Squared applied for AT&T coverage. The yellow areas represent one additional order of magnitude lower signal level, to -103 dBm, which is still a workable signal level for low-bandwidth applications and for outdoor use. This was applied because it can be the nature of a

distributed system to have dips in signal strength within the contiguous coverage area. The yellow areas reassure us that these pockets are not likely to be fatal to an existing connection.

The small cell network illustrated in Figure 3 is not a fully designed configuration. It is intended to illustrate the way that small cells can be used in irregular terrain to provide coverage where a single tower cannot. The finer points of pole location and coverage fine-tuning can be addressed by the network designer before selection of final locations and node count. Additional nodes are easily incorporated to expand or fill in coverage where it is desired.

The coverage of the three options is compared. To produce some statistics, we selected the contiguous footprint of each modeled facility, neglecting the small areas where signal strikes the tops hills in the distance. We limited our analysis to the area within Kent (which only affected the results of the Richards Road model). The total area of each model's contiguous footprint was computed. Our "residences covered" count is a direct count of the houses seen on the geographic information system ("GIS"). This is more reliable than the significantly less-accurate statistical count by census block employed by the Applicant. We counted buildings that are residences, avoiding barns and sheds. Our street footage is directly taken off the GIS map within the coverage overlay.

These metrics – residence counts, street footage and contiguous coverage area – are helpful for comparison between solutions evaluated with the same model. It is inappropriate to compare sets of data from this analysis with similar data from the C-Squared analysis, as the methodologies differ. For example, the C-Squared analysis provides population estimated based on census block data. This can be effective for wide-area coverage analysis such as for broadcast TV or radio services where hundreds of census blocks are captured in full, such that the effect of estimating the partial census blocks on the reliability of the result is *de minimus*. With smaller coverage areas like that of the Bald Hill tower, a large census block with the population concentrated at one end of it will almost certainly skew the results. [1] In such cases, it is less

[1] For example, Kent Census Block 2003 Is bounded by Kent Hollow Road, Segar Road, Richards Road, Anderson Road and others. Its perimeter is 7 miles and contains ~1200 acres. The population is not evenly distributed, with large tracts of open space. It is partially intersected by the coverage from Bald Hill. To calculate the population covered, computer models assume the population in the census block is evenly distributed and they report a percentage of the block's population in proportion to the percentage of wireless coverage over the block. This can lead to substantial mis-estimations. Census block source: https://tigerweb.geo.census.gov/tigerweb2010/

reliable to compare the census results of two wireless tower sites because of the large uncertainty in census block count interpolation for each.

As show in Table 1 above, a small-cell network can provide coverage on Rt 341 essentially from the edge of the Rt 7 corridor's coverage to the Warren town line. Neither tower site can cover even half of Rt 341. The small cell network provides coverage to the dangerous curve on Rt 341 that the two tower sites miss. The small cell network can reach places behind hills that are shadowing one or both tower sites, such as on South Road, Flat Rock Road and Jennings Road. And of special interest is the fact that modeling shows the scenic-designated valley that contains Cobble Road and points north can be illuminated from a utility pole on Rt 341. There are numerous residences in this valley that lack reliable AT&T coverage. This is also the location of the dangerous hairpin curve on Rt 341. The Bald Hill and Richards Road tower proposals are incapable of providing service to these areas.

The notional small cell model is generic; in other words, it could apply to a network of C-RANS[2] installed by and for a single service provider or to a DAS[3] orchestrated by a neutral host provider enabling carriers to share a single antenna on a pole. The Applicant or the Applicant's landlord (InSite) could have a role as neutral host provider in a DAS-like network. C-RAN installations dedicated to the installing carrier eliminate the middleman.

Conclusion

In my opinion, based on the facts in the matter, the proposed tower at Bald Hill is unnecessary. Even if approved, it is unnecessarily tall. The small-cell model addresses the ruggedness of the local terrain, provides complete coverage along Rt 341 and can address a larger share of Kent's residences and streets. The alternative at Richards Road is even less effective than Bald Hill at addressing the objective of serving the Rt 341 corridor. Erecting a cell tower at either location not only invites the negative consequences articulated by others, but also sets up an inevitable

[2] Cloud radio access nodes, which are small-cell base stations that connect directly to a corporate network and are managed in the "cloud."

[3] Distributed antenna system, usually provided by a third party for multiple carriers to share. Traditionally DAS required a local base station hotel to act as the base station facility, equivalent to one found at the bottom of a tower. Cloud radio access networking techniques and various wireless networking standards bypass the base station gear. DAS can support C-RAN-like architecture when clients require it.

need for more towers to complete wireless service coverage along Rt 341 in the future. These problems can be avoided through the deployment of an array of small cells.

David Maxson

July 16, 2020

Exhibit A –
Isotrope Coverage Analysis

Figure 1 – Height/Coverage Comparison for Bald Hill

Figure 2 – Height/Coverage Comparison for Richards Road

Figure 3 – Notional Small Cell Network Coverage

Figure 1 – Height/Coverage Comparison for Bald Hill

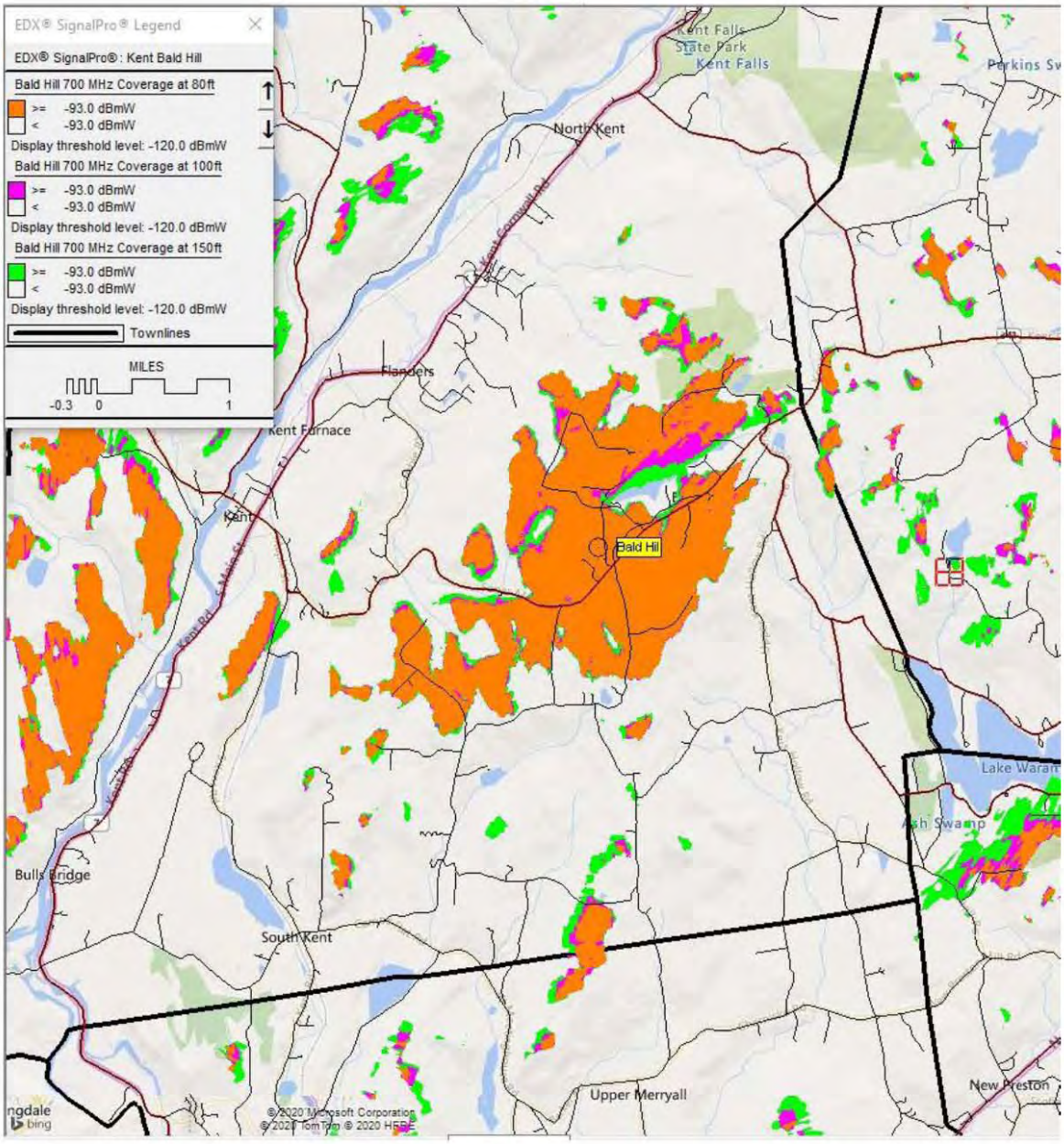


Figure 2 – Height/Coverage Comparison for Richards Road

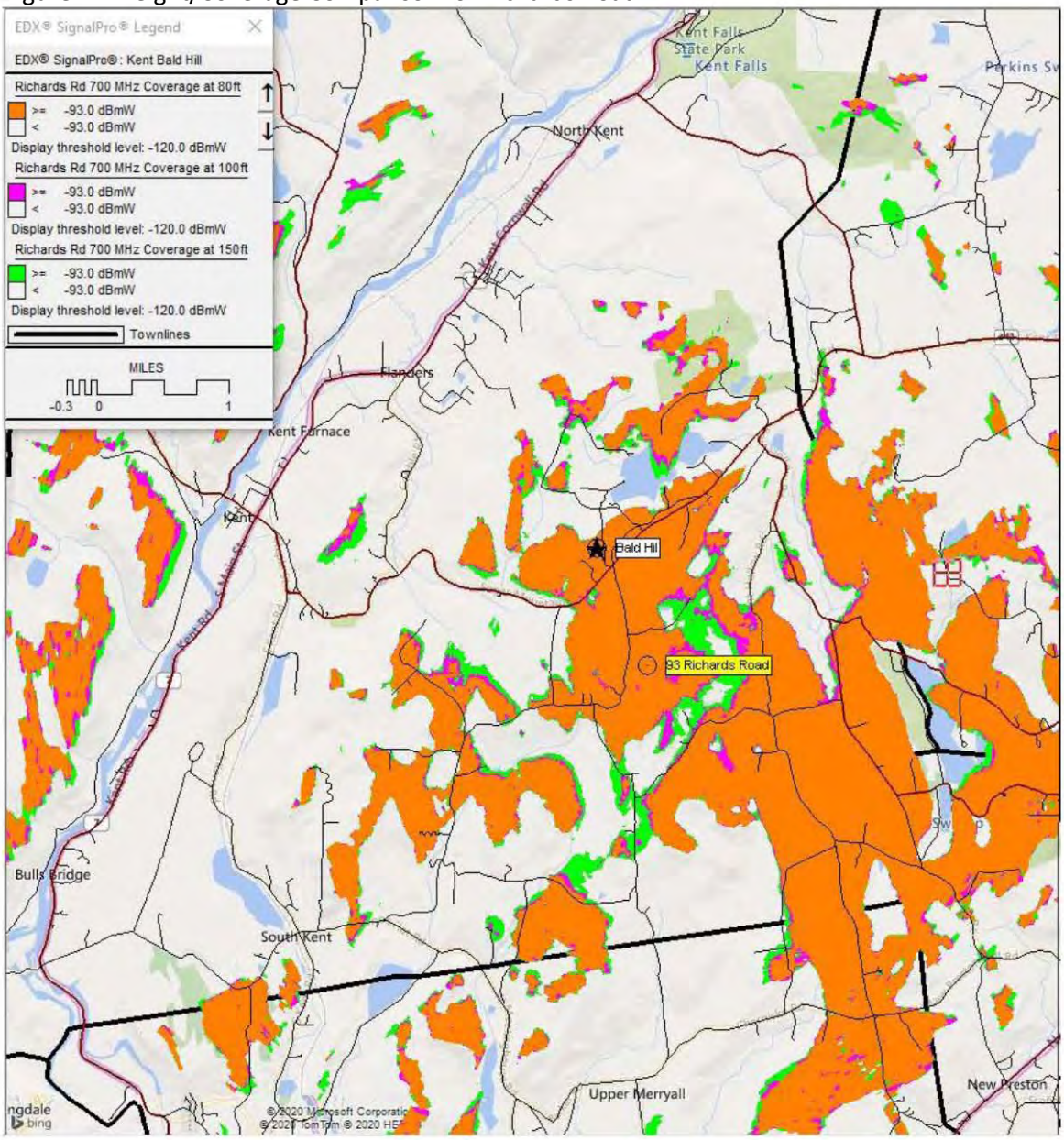
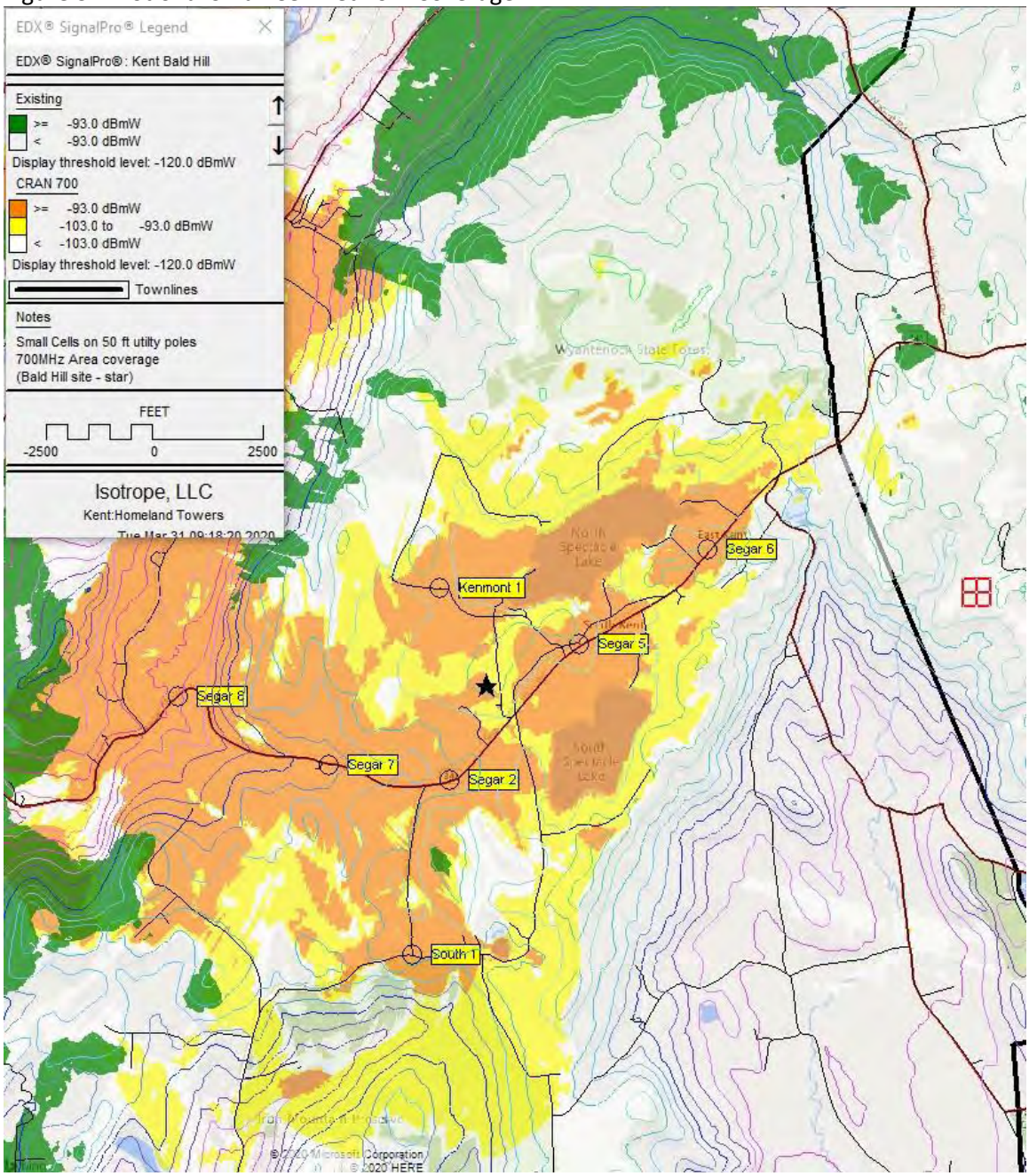


Figure 3 – Notional Small Cell Network Coverage



Note – Area of coverage including northern Cobble Road and Studio Hill Road obscured by legend.

Exhibit B –
Curriculum Vitae of David P. Maxson, WCP

David P. Maxson, WCP
Curriculum Vitae

Isotrope, LLC, Medfield, Massachusetts, 1982*-present — Founder, CEO

a) Communications facility and network design and construction
b) Safety planning and evaluation of communications facilities, safety protocol development
c) Research and development on digital media initiatives
d) Evaluation of radio frequency facilities for compliance with technical and regulatory standards
e) Radio frequency interference remediation
f) Expert consultation in radio and digital communications litigation
g) Subsidiary: RFSigns.com – ANSI-compliant RF safety sign products
h) Municipal guidance in wireless planning and regulation

*Note – Isotrope, LLC continues a prior business operated by David Maxson since 1982. Isotrope was formed in 2009.

Charles River Broadcasting Company, Waltham, Massachusetts, 1978-1998.
Vice President, Director of Engineering and Technical Operations

Affiliations

- Certified IEEE Wireless Communications Professional®, demonstrating "a thorough understanding of different key technologies in the wireless arena."
- Member of National Radio Systems Committee, 1998-present.
  - Digital Radio Broadcasting Subcommittee, IBOC Standards Development Working Group
    - Chairman: Location Based Services Working Group, 2012-2015
  - RBDS Subcommittee, AM/FM Analog Broadcasting Subcommittee
- Member of International Committee on Electromagnetic Safety ("ICES") 2016 – present
  - Maintaining the human exposure safety standards
- Member of the Committee on Man and Radiation ("COMAR") 2019 – present
  - Electromagnetic safety policy and information
- Charter Member of Wireless Infrastructure Association's Het-Net Forum (the small-cell group) 2008 – present
- Corresponding Member: IEEE-USA Committee on Communications Policy, 2012 to present
- Senior Member, IEEE; Certified Broadcast Radio Engineer, Society of Broadcast Engineers; FCC General Class Radiotelephone License with Radar Endorsement, Massachusetts Licensed Construction Supervisor #CS073481.

Project Highlights

- Subject Matter Expert and Design and Construction Manager for Trackside Facilities – Amtrak wireless data trackside network, 2014-2018
- Subject Matter Expert and Project Manager - Utah Broadband Project's Wireless Broadband Surveys: developed test plan and conducted 7000-mile drive tests of wireless broadband service availability across Utah in 2011 and 2013.
- Project Reviewer - NTIA Broadband Technology Opportunities Program and USDA Rural Utilities Service Broadband Initiatives Program – American Recovery and Reinvestment Act, 2009.
- Project Director and Engineer, PAVE PAWS Radar Environmental Emissions Modeling and Survey, for PAVE PAWS Public Health Steering Group, 2004-2005 (results peer reviewed by Nat'l Academies of Science)
- Massachusetts Department of Public Health, follow-up survey of specific locations not evaluated in PAVE PAWS study; 2007-2008
- US House of Representatives Telecom Subcommittee, Testimony on RF interference study, February 2000.
- Wireless facility evaluation and planning consultant to the Cape Cod Commission as well as to over a hundred municipalities in New England and beyond, 1999 to present. Performed more than 500 wireless facility reviews

- Appointed member of Massachusetts Department of Public Health ad hoc committee on revisions to electromagnetic energy safety regulations 105 CMR §122, 1997.

Selected Publications

- Author, *Your Mileage May Be Different – Reflections on Megabits per Second and Miles per Day [on a statewide drive test of broadband data connectivity in Utah],* Above Ground Level Magazine, December 2011.
- Chapter Author, *Managing Workplace and Environmental Hazards,* NAB Engineering Handbook, 10th Edition, 2007, updated for 11th Edition, 2017.
- Chapter Author, *AM Equipment Performance Measurements,* NAB Engineering Handbook, 11th Edition, 2017.
- Principal Author, *A Tractable Approach to Defining and Measuring IBOC Signals against the RF Masks,* Annex 1, NRSC Guideline -G201: NRSC-5 RF Mask Compliance: Measurement Methods and Practice, 2010, affirmed 2016
- Paper: *New Kinds of Interference in the FM Band: 2 Case Studies of Stuff You Didn't Know,* Proceedings of the National Association of Broadcasters Broadcast Engineering Conference ("NAB-BEC"), 2016
- Author, *The IBOC Handbook— Understanding HD Radio Technology*, 2007, Focal Press.
- Article, *Evaluating Emissions of Your New IBOC Transmitter*, Radio World Engineering Extra, June 2005.
- Article, *Posting Hazard Communications Signs at Your Radio Transmission Plant,* Radio Guide, April 2005.
- Published Paper: *Interference Potential of Hybrid Digital Transmission: An IBOC Occupied Bandwidth Case Study*, NAB-BEC, 2004.
- Published Paper: *Integrating ANSI-Compliant RF Signs into Corporate RF Safety Programs*, NAB-BEC 2004.
- Published Paper, co-author: *Applying the Principles of Data Communications to the Development of an Open and Universal IBOC Data Protocol,* NAB-BEC 2003.