UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF NEW YORK

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NEW YORK SMSA LIMITED PARTNERSHIP d/b/a/ VERIZON WIRELESS, and HOMELAND TOWERS, LLC,

Plaintiffs,

-against-

18-cv-5932 (VB)(PED)

THE VILLAGE OF NELSONVILLE, THE VILLAGE OF NELSONVILLE VILLAGE BOARD, THE VILLAGE OF NELSONVILLE ZONING BOARD OF APPEALS, THE VILLAGE OF NELSONVILLE PLANNING BOARD, MINDY JESEK, FOIL OFFICER AND VILLAGE CLERK (in her official capacity) and WILLIAM BUJARSKI, BUILDING INSPECTOR (in his official capacity),

Defendants.

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Expert Report of Richard Conroy Regarding Proposed Site Located at 15 Rockledge Road, Nelsonville, NY

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I. Background.

1. I am the President of PierCon Solutions, LLC, a New Jersey company specializing in the provision of radio frequency engineering, design and consulting services to the wireless communications industry since 1998. I have thirty years' experience designing complex cellular, PCS and Public Safety communication networks throughout the United States. I have specific training, experience and education in the design of advanced digital wireless networks, including Verizon Wireless's Second Generation ("2G")[1] network based on CDMA (Code Division Multiple Access), Verizon Wireless's advanced wireless networks including its Third Generation ("3G")[2] network based on CDMA2000 technologies, and its Fourth Generation ("4G")[3] network using LTE (Long Term Evolution) technology; 3G & 4G networks are

[1] 2G mobile networks include the CDMA (Code Division Multiple Access) based on the IS-95 standard that Verizon Wireless originally utilized. Three primary benefits of 2G networks over their predecessors are: (1) phone conversations are digitally encrypted, which protects the security of such communications; (2) 2G systems are significantly more "spectrally efficient," which allows for greater number of users, and for communication of much higher quantities of data using the same amount of radio frequency spectrum; and (3) 2G introduces data services for mobile devices, starting with SMS ("Short Message Service") text messages. After 2G was launched, the previous mobile telephone systems were retrospectively dubbed 1G. Radio signals on 1G networks are analog and radio signals on 2G networks are digital. Verizon's 2G network has been migrated to 3G CDMA.

[2] 3G mobile networks include the CDMA2000 1x based on the IS-2000 standard. CDMA2000 1xEV-DO (Evolution Data Optimized), abbreviated EV-DO is the wireless technology for transmitting data through radio signals. The CDMA2000 (3G) technologies offer greater capacity voice services and more advanced services than 2G while achieving greater network capacity through the EV-DO enhancement. Data rates for 3G EV-DO provide typical download speed of 600-1400 kbps with bursts up to 3100 kbps. The technology is an evolution of CDMA2000 – known separately as 1xRTT for voice and 1xEVDO for data transfer.

[3] 4G technology known as Long Term Evolution (LTE) is a wireless communications standard developed by the 3rd Generation Partnership Project (3GPP) that is designed to provide up to 30x the speeds of 3G networks for mobile devices such as smartphones, tablets, netbooks, notebooks and wireless hotspots. The LTE specification provides theoretical downlink peak rates of 300 Mbit/s, uplink peak rates of 75 Mbit/s and QoS provisions permitting a transfer latency of less than 5 ms in the radio access network. Current industry standard is to provide a minimum downlink user throughput of 5 Mbps. LTE is the current wireless technology allowing for high speed data, support of data demanding applications, implementation of the internet of things (IoT) and the foundation for 5G networks.

operated by Verizon Wireless in the Village of Nelsonville, New York. Verizon Wireless's 3G CDMA/EVDO network is operating using the 850 MHz band. Verizon's 3G network is planned for retirement at the end of 2019. The 850 MHz spectrum will be repurposed for 4G LTE service. 3G & 4G networks are used to provide personal wireless services. A copy of my *curriculum vitae* is attached hereto as Appendix 1.

2. References in this Report to "Verizon" are to the Plaintiffs Homeland Towers, LLC and Verizon Wireless, either of the two Plaintiffs in this matter. References in this report to "Subject Site" or "Nelsonville" refer to 15 Rockledge Road, Nelsonville, NY, the location for the proposed wireless facility at issue in this matter.

3. As described above, Verizon has operated three technologies: CDMA (2G), CDMA2000 (3G) and LTE (4G). Verizon's 2G network is no longer operational in and around Nelsonville. Verizon's CDMA network (3G) is planned for retirement at the end of 2019. Long-Term Evolution (LTE) also known as (4G) is the current technology standard. To operate these technologies, the wireless carriers must obtain a Federal Communications Commission (FCC) license on the frequency bands allocated for this type of use. The frequencies provided come from a finite resource and therefore must be acquired (typically at auction for billions of dollars), and deployed timely.

4. The original cellular systems deployed in the 1984 timeframe, referred to as first generation or 1G, operated in the 850 MHz band and were analog only systems. As demand for mobile communication services increased the need for more wireless spectrum (frequencies) and spectrum efficient technology arose. It was during the mid-1990's that the 2nd generation (2G) mobile radio systems were first deployed, known as personal communications systems (PCS), operating on the 1900 MHz PCS frequency band. Systems operating on the original 850 MHz band were migrated from analog to digital during this timeframe as well. 2G technologies were all digital and consisted of GSM or CDMA. The 2G technologies offered voice and data services, which generated once again a demand for more spectrum to address the users' needs.

Additional spectrum in the 2100 MHz Advanced Wireless Services (AWS) band was auctioned off by the FCC to continue the expansion into 3G technology. The 3G technologies offered higher data rates and began the movement from circuit switched to packet switched data. Consistent with spectrum efficient technologies, 3G technologies brought forth UMTS, CDMA2000 and WCDMA to support more users and higher throughput via larger bandwidth channels. The current 4th Generation (4G) technology is known as Long Term Evolution (LTE), which also included additional auctioned 700 MHz spectrum. Beyond 4G lies 5G which includes higher data rates and the Internet of Things[4] (IoTs), which will create more demand for capacity than would have been envisioned at the advent of 1G technology.

5. A common trend through all the generations of wireless systems has been the need to identify more frequencies available for use, more advanced and spectrally efficient technologies and more bandwidth to address the growing capacity and throughput needs of the wireless users. It is not sufficient to provide coverage (signal) only to an area and not be able to support the capacity or throughput demands of the system. A reliable network must provide both coverage signal and capacity.

6. According to the CTIA – The Wireless Association, roughly 396 million mobile devices are in use today, as compared to 681,000 in 1986. As discussed above, the current (LTE) technology is a data network which is experiencing significant year over year growth. According to the CTIA, over the last two years, data use has increased 238 percent. To support this type of growth and usage, carriers acquire new frequency bands at auction for billions of dollars to deploy next generation technologies and provide the appropriate quality of service to their base of users.

7. Verizon Wireless's current frequency holdings include their original cellular license (850 MHz), PCS license (1900 MHz), AWS license (2100 MHz), and LTE (700 MHz) license. Verizon has currently migrated all of their licensed frequency bands, other than 850 MHz, to LTE, as noted the 850 MHz band operating 3G CDMA will be retired at the end of 2019 and migrated to LTE technology.

[4] The IoTs (Internet of Things) is a concept which involves the connection of any device which has an on/off switch to the internet. This concept brings forth many advances like smart cities, applications to reduce traffic congestion, real-time public safety intelligence, healthcare advantages, and better overall access to information in general.

8. Each frequency band has different performance characteristics for both coverage and capacity. From a coverage perspective, the lower frequency bands (700/850 MHz) cover a greater distance and are less attenuated by trees and terrain, while the higher frequency bands (1900/2100 MHz) cover a lesser distance and are more attenuated by trees and terrain. From a coverage perspective if the 700 MHz (lowest) frequency band demonstrates a gap in coverage then all higher frequency bands (850 MHz, 1900 MHz, 2100 MHz) will demonstrate greater gaps in coverage.

9. From a capacity perspective, each frequency band offers a finite amount of spectrum bandwidth. It is through this bandwidth that capacity is supported. Within Village of Nelsonville Verizon has deployed the following three (3) LTE carrier channels:

Channel / LTE Carrier	Frequency Band	Spectrum LTE Bandwidth	Physical Resource Blocks
1	700 MHz	10 MHz	50
2	1900 MHz	20 MHz	100
3	2100 MHz	20 MHz	100

10. In an LTE network, the amount of spectrum LTE bandwidth available defines the capacity of the LTE channel based upon the number of physical resource blocks available. A physical resource block (PRB) is the smallest unit of resource that can be assigned to a user. As can be seen from the table above, Verizon Wireless 1900 & 2100 MHz frequency bands provide for the most LTE capacity.

11. To effectively distribute capacity, an antenna system is divided into three or four sectors with each sector serving a portion of the area. Improperly located sites cause an inefficient design with high levels of interference and noise that result in poor user experiences and ultimately require more sites to cover the same area. From a coverage perspective, signal is not where it is intended, has excessive signal overlap and/or does not complete the coverage objective. From a capacity perspective, signal is not distributed equally amongst all sectors, thereby

limiting the capacity of the site to only the sector or sectors of coverage provided from an improperly located facility.

II. The Village's Denial of Verizon Wireless's Application Materially Inhibits or Limits Verizon Wireless's Ability to Provide its Federally Licensed Services

12. Verizon has established service and performance goals to provide reliable wireless services across all of its FCC licensed frequency bands and technologies. Verizon Wireless service and performance goals include providing adequate coverage and capacity for voice and data services, preparing to provide future services, and otherwise improving service capabilities.

13. The service goals established by Verizon are designed to provide all customers with a positive wireless voice and data experience. Simply put, a positive wireless experience includes the customer connecting to the network on the first try, staying connected throughout the session, and the customer ending the session when ready. For positive experiences with data connections (e.g., internet browsing) the speed is as fast as the technology allows. Unreliable service, meaning service levels that do not meet Verizon Wireless service and performance goals, causes a negative experience: customers cannot place calls when they want to; when they are connected, voice call quality does not meet customer expectations; or, the call simply drops off (disconnects) without notice. A negative data experience is not instantaneous, is much slower than consumers expect and demand, or the connection is never established.

14. Unreliable service that fails to meet Verizon Wireless service and performance goals, which include voice and/or data services, can occur if there is: (i) a lack of reliable signal, including poor signal quality; and/or (ii) a lack of system capacity, or in terms of LTE, insufficient throughput[5], for any of Verizon Wireless services and across all of Verizon licensed frequency bands. Providing quality in-building voice and data services, with sufficient system capacity and high-speed data rates, is critical to Verizon Wireless customers and is essential to Verizon

[5] "Throughput" is a measure of how many units (bits) of data are processed in a given amount of time (seconds). Throughput, abbreviated as Mbps, refers to millions of bits per second.

Wireless ability to compete effectively with its functionally equivalent competitors in a fair and balanced legal and regulatory environment.

15. I am generally familiar with the Telecommunications Act of 1996 and relevant case law concerning section 332 of that Act, including the "Significant Gap" test, as well as the recent FCC Declaratory Ruling (In re Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment, Declaratory Ruling and Third Report and Order, WT Docket No. 17-79 and WC Docket No. 17-84 (adopted Sept. 26, 2018; released Sept. 27, 2018) and the "Materially Inhibit" standard of review, referenced by the FCC in the Declaratory Ruling to determine whether a municipal action has prohibited or effectively prohibited a carrier from providing personal wireless services or telecommunications services. The FCC's Declaratory Ruling states that "an effective prohibition [of service] occurs where a state or local legal requirement materially inhibits a provider's ability to engage in any of a variety of activities related to its provision of a covered service." A local government materially inhibits a provider "not only when filling a coverage gap but also when densifying a wireless network, introducing new services or otherwise improving service capabilities." Thus, an effective prohibition of service specifically includes preventing a carrier from filling a coverage gap. The FCC also stated that technical standards, network design, and performance characteristics are established by the carrier, and not by the local government. Based upon my review of the relevant data, it is my opinion that the Village's denial of the Verizon application materially inhibits or limits Verizon Wireless ability to provide its federally licensed services.

16. Out of an abundance of caution I have also considered whether Verizon has a significant gap in its existing service and whether the proposed facility is the least intrusive means of remedying that gap. It is my opinion that Verizon does have a significant gap in its existing service and that the proposed facility is the least intrusive means to remedy the gap in service.

A. Verizon Wireless Service and Performance Goals as Demonstrated by Actual Drive Test Data.

17. I have reviewed drive test (also known as a scan test) of Verizon Wireless's network collected by Adam Feehan of PierCon Solutions on December 15, 2017. The drive test was performed

utilizing a JDSU/W1314B-E19 Multi-Band receiver capable of measuring signals from the 700 MHz, 850 MHz, 1900 MHz and 1700/2100 MHz frequency bands, including software for recording LTE technologies. Equipment was connected to a laptop computer; GPS antenna and multi-band receive antenna mounted on the rooftop of the vehicle. The vehicle was driven along the drive route in the vicinity of Nelsonville and surrounding roadways which is represented by the drive test plots. The drive test factored signals from all Verizon Wireless's facilities currently on air. Since the drive test was performed during the time of year with minimal foliage, the test results will be overstated, and require a correction factor to account for losses due to dense foliage that will be present during the spring through fall season. The foliage loss correction can vary by the type of environment and range between 5-20 dB. PierCon utilized a conservative 5 dB foliage correction in the analysis to follow.

18. Drive tests are a means to evaluate existing coverage. Drive tests are used to produce maps ("Drive Test Maps"), which demonstrate actual signal levels along roadways that are traveled by specially equipped scan test vehicles. In a drive test, the signals from the surrounding on-air sites are collected by a receive antenna mounted to the roof of the drive test vehicle. The data collected by the receive antenna is then processed by computer equipment within the drive test vehicle. The coordinates and signal strength of each collection point is recorded by the computer equipment and ultimately depicted on a Drive Test Map. Literally thousands of data points are collected during a drive test over the roadways driven by the drive test vehicle to ensure that a complete and statistically relevant number of data points can be evaluated.

1. Verizon Wireless Existing 850 MHz 3G Drive Test Analysis

19. PierCon collected drive test data on December 15, 2017 from Verizon's network of surrounding sites and at each of Verizon's frequency bands and technologies. Verizon's 3G (CDMA) network operates on its 850 MHz band. Verizon is in the process of migrating the 850 MHz frequency band license to 4G (LTE) and in order to do so will be retiring the 3G (CDMA) technology at the end of 2019.

20. Verizon defines the reliable coverage boundary of a site using a value of Operational Path Loss (OPL). This value is derived from industry standard definitions of CDMA receiver sensitivities, voice quality and data throughput, along with statistically quantifiable variations in the physical surroundings. This threshold takes into account additional losses associated with the location of the user; such as on-street, in-vehicle or in-building. The drive data analysis presented for Nelsonville is for service based upon the in-vehicle and in-building thresholds. Verizon has determined that the corresponding OPL for reliable 3G in-vehicle coverage is 120 dB and the corresponding OPL for reliable 3G in-building coverage is 110 dB. Application of Verizon's OPL yields the received channel pilot power design thresholds of -85 dBm (in-vehicle) and -75 dBm (in-building).

21. Attached hereto as Exhibit A is a Drive Test Map that demonstrates the results of a drive test performed on December 15, 2017 for the purposes of confirming existing 3G (CDMA) coverage in the vicinity of the Subject Site. The map represents 3G (CDMA) services in the 850 MHz band. The green circles, on the Drive Test Map, represent reliable 3G (CDMA) in-building residential coverage at a received pilot power of -75 dBm (110 dB OPL). The yellow circles, on the Drive Test Map, represent reliable 3G (CDMA) in-vehicle coverage at a received pilot power of -85 dBm (120 dB OPL). The red circles, on the Drive Test Map, represent neither reliable in-building nor reliable in-vehicle 3G service.

22. As demonstrated by Exhibit A there is a significant gap in reliable 3G service throughout the area due to the lack of reliable in-building and reliable in-vehicle coverage. The lack of reliable 3G signal in the area is due to the location of the existing facilities being too far away combined with the challenging terrain and dense tree coverage in the area. The area of the gap for both in-vehicle and in-building service is over 2.6 square miles and contains approximately 2,900 people according to the 2010 US block census population data. The gap includes major highway corridors such as Route 301, State Highway 9D as well as connecting roads; Peekskill Road, Main Street and surrounding cross roads within the Village of Nelsonville and the Village of Cold Spring. The gap is significant in both area and people impacted.

23. As noted herein, the frequency of operation defines the range of coverage and therefore the higher frequency bands, such as 1900 MHz and 2100 MHz, will have greater gaps in coverage, regardless of technology generation deployed. In any event Verizon does not operate 3G CDMA on its 1900 MHz or 2100 MHz frequency bands.

2. Verizon Wireless Existing 700 MHz 4G Drive Test Analysis

24. As identified earlier, PierCon collected drive test data on December 15th, 2017 in the area of the subject site for all Verizon's licensed frequencies and technologies. Since the 3G network is being retired at the end of 2019 the following represents the analysis of the 700 MHz 4G LTE drive test data. 4G LTE networks utilize reference signal power to define the coverage. Verizon has determined that a reference signal receive power (RSRP[6]) of -95 dBm is necessary for reliable in-building LTE service. Verizon has determined that a RSRP of -105 dBm is necessary for reliable in-vehicle LTE service.

25. Attached hereto as Exhibit B is a Drive Test Map that demonstrates the results of a drive test performed on December 15, 2017 for the purposes of confirming existing 4G (LTE) coverage in the vicinity of the Subject Site. The map represents 4G (LTE) services in the 700 MHz band. The green circles, on the Drive Test Map, represent reliable 4G (LTE) in-building residential coverage at a RSRP of -95 dBm. The yellow circles, on the Drive Test Map, represent reliable 4G (LTE) in-vehicle coverage at a RSRP of -105 dBm. The red circles, on the Drive Test Map, represent neither reliable in-building nor reliable in-vehicle 4G service.

26. As demonstrated by Exhibit B there is a significant gap in reliable 4G service throughout the area due to the lack of reliable in-building and reliable in-vehicle coverage. The lack of reliable 4G signal in the area is due to the location of the existing facilities being too far away combined

[6] RSRP is expressed in units of dBm, which stands for decibels per milliwatt. It measures power ratio, expressed in decibels per 1 milliwatt. The power levels discussed in this report are negative dBm due to their very low power of operation. Because we are dealing with negative power levels, for example, -95 dBm is actually a stronger signal than -105 dBm. -95 dBm RSRP is the design criteria for reliable in-building residential coverage. The -95 dBm is mathematically calculated based upon known levels of receiver sensitivity, industry standard losses for residential buildings including standard deviations and industry standard path loss values to ensure a 95% reliable signal level is delivered to the users.

with the challenging terrain and dense tree coverage in the area. The area of the gap for 700 MHz in-building service is approximately 0.8 square miles and contains approximately 2,800[7] people living in the area according to the 2010 US block census population data. The gap includes major highway corridors such as Route 301, State Highway 9D as well as connecting roads; Peekskill Road, Main Street and surrounding cross roads within the Village of Nelsonville and the Village of Cold Spring. The gap is significant in both area and people impacted. The significance of the gap at Verizon's lowest frequency of operation demonstrates that a significant gap exists on all its higher licensed frequency bands.

27. While data was collected for all frequency bands, it is only necessary to demonstrate data from the 700 MHz band. Due to the lower frequency of operation the propagation characteristics of the 700 MHz band will be the most advantageous, demonstrating the largest area of coverage, when compared to higher frequencies. All other services and technologies, (3G, 4G, etc.) operating on higher frequency bands, (850 MHz, 1900 MHz and 2100 MHz) will demonstrate larger gaps as compared to 700 MHz, due to greater propagation losses experienced as the frequency of operation increases. Therefore, if there is a significant gap at the 700 MHz band there will then be significant gap for each of the higher frequency bands. Nevertheless, I did review the data at the higher bands and confirmed this point. To substantiate this please refer to Exhibit C attached hereto as a Drive Test Map that demonstrates the results of a drive test performed on December 15, 2017 for the purposes of confirming existing 2100 MHz 4G (LTE) coverage in the vicinity of the Subject Site. Exhibit C demonstrates lack of any in-building or in-vehicle reliable service throughout the entire gap area.

B. Verizon Wireless Service and Performance Goals as Demonstrated by Verified Calculated Propagation Maps.

28. Verizon is unable to meet its service and performance goals in the vicinity of the Subject Site as demonstrated by a lack of reliable in-building residential coverage and lack of reliable in-vehicle coverage in all of its licensed frequency bands and technologies. I was able to confirm

[7] The 700 MHz signal covers more area than the 850 MHz signal and therefore the number of people in the gap area is slightly less at 700 MHz versus 850 MHz.

Verizon Wireless's gap in coverage is significant in the vicinity of the Site through the use of the coverage planning tool, which is known as Atoll. Atoll is a comprehensive radio planning and optimization platform with more than 8,000 installed licenses worldwide. Atoll is a wireless coverage planning tool that Verizon Wireless and other carriers use for wireless network planning. The Atoll tool is used to create Verizon Wireless's propagation coverage maps ("Coverage Maps").

29. Atoll coverage maps predict the radio frequency ("RF") coverage and signal strengths that can be expected over a geographic area based on certain input parameters. These parameters include, without limitation, factors such as: the frequency of the RF signal; the height, gain and orientation of the antennas; the terrain over which the RF signals are being propagated; and the strength of the RF signals. Thus, Coverage Maps predict the RF signal strength over geographic areas on a map, unlike Drive Test Maps which only depict signal strength over the roads driven.

30. The Atoll planning tool is utilized by Verizon RF engineers to evaluate and plan coverage throughout the country. The Coverage Maps produced by Verizon using Atoll are highly reliable and scientifically based for the purpose of demonstrating Verizon Wireless current and proposed wireless coverage within Village of Nelsonville, NY and elsewhere.

31. Calculated coverage maps, also known as propagation maps, have been prepared for the surrounding sites using the 700 MHz frequency band and LTE technology deployed as representative of Verizon Wireless coverage. As discussed above, while Verizon operates multiple technologies across multiple frequency bands, each frequency band has different coverage characteristics. The lower frequencies, (700 and 850 MHz) have longer wavelengths, suffer less free space loss as the signal travels through air, are less attenuated by trees, terrain and obstacles and therefore can cover further distances, whereas the higher frequencies, (1900 and 2100 MHz) have shorter wavelengths, suffer greater free space loss as the signal travels through the air, are attenuated more by trees, terrain and obstacles and therefore cover short distances. The gaps represented herein for Verizon Wireless 700 MHz LTE service will be greater for the 850 MHz, 1900 MHz & 2100 MHz service which indicates gaps exist for all

bands. Therefore, to simplify the presentation, only 700 MHz LTE coverage maps are provided herein.

1. Verizon Wireless Existing 700 MHz Coverage Analysis

32. Attached hereto as Exhibit D is an Atoll-generated Coverage Map that indicates Verizon Wireless existing areas of reliable 4G LTE 700 MHz wireless coverage from existing sites surrounding the Subject Site. Exhibit D demonstrates that Verizon has a gap in reliable 4G LTE wireless coverage that is significant. The Village's denial of the permit prevents Verizon from meeting its service and performance goals, and thus materially inhibits or limits Verizon Wireless's ability to compete and to provide services. The areas of green represent reliable 4G LTE coverage at a RSRP level of greater than or equal to –95 dBm, which represents Verizon Wireless design criteria for reliable 4G LTE in-building residential coverage. The areas of yellow represent reliable 4G LTE Low-Band coverage at a RSRP of less than -95 dBm and greater than or equal to –105 dBm, which represents Verizon Wireless design criteria for reliable 4G LTE in-vehicle coverage. Verizon Wireless LTE in-building gap within the vicinity of the site is approximately 0.8 square miles. The gap consists of the yellow colored areas from Market Street to State Highway 9D, approximately 1.5 miles along Main Street (State Highway 301) from State Highway 9D to 0.6-mile northeast beyond Lane Gate Road, approximately 1 mile east and west along State Highway 9D, all homes, business, schools, churches and people within the areas of the Village of Nelsonville and Cold Spring. According to the 2010 US Census approximately 2,800 people live within the 700 MHz in-building gap area. This gap in service, both in size and population, is significant.

33. In order to remedy the gap in service Verizon contracted with Homeland Towers, LLC to locate and develop a facility that will provide reliable service as well as work within Verizon's existing network of facilities. To determine a suitable location, the facility first must work within Verizon's technical geometric grid plan design, taking into account the location of existing sites, existing coverage signal, coverage quality and capacity. Additional technical considerations include the topography, which in this case includes very challenging terrain, and demographics such as business centers, residential areas where people work, play and live.

The technical requirements are then reviewed against the local zoning & planning requirements or wireless telecommunication ordinances. Note the Verizon Wireless report, prepared by Adam Feehan dated 8-30-17, addressed Article VII §188-68 from the Village of Nelsonville's Commercial Communications Tower Ordinance.[8] It is my opinion that all radio frequency items in the Village of Nelsonville's tower ordinance were addressed accurately in Mr. Feehan's report.

34. The location of the subject site at 15 Rockledge Road meets this requirement as the site placement demonstrates reasonable placement with respect to the existing facilities. Furthermore, the site is located such that it takes advantage of the terrain and location to provide coverage to the areas of the gap for both in-building and in-vehicle coverage. A review of the Drive Test Maps and Coverage Maps identify the objective to be to provide coverage on Route 9, Highway 9D, Route 301 and the Villages of Nelsonville and Cold Spring.

35. In seeking a site, Verizon reviewed site candidates provided by Homeland Towers, LLC and identified 15 Rockledge Road as a property that meets its requirements. The subject property is located in a mountain residential M-R zone where, according to the Village of Nelsonville Code, telecommunication towers are approved by the zoning board under special permit review. Furthermore, the maximum height permitted is 110' as measured from the ground to the top most antenna. The property owner expressed interest and Verizon performed a radio frequency coverage analysis to determine the suitability of a facility at this location.

2. Verizon Wireless Existing and Proposed Coverage Analysis

36. Attached hereto as Exhibit E is an Atoll-generated Coverage Map that indicates Verizon Wireless's existing 4G LTE 700 MHz coverage, together with the 4G LTE 700 MHz coverage that the proposed facility will provide. The areas of green represent reliable 4G LTE 700 MHz coverage at a RSRP level of greater than or equal to –95 dBm which represents Verizon Wireless design criteria for reliable 4G LTE 700 MHz in-building residential voice coverage.

[8] Verizon Wireless RF Report Nelsonville (Cold Spring) 8-30-17

The areas of yellow represent reliable 4G LTE 700 MHz coverage at a RSRP of less than -95 dBm and greater than or equal to –105 dBm, which represents Verizon Wireless design criteria for reliable 4G LTE 700 MHz in-vehicle coverage. Exhibit E demonstrates that the facility at 110' will remedy a large portion of Verizon Wireless significant gap in reliable 4G LTE Low-Band in-building coverage in the vicinity of the Subject Site. The 700 MHz in-building coverage provided by the site at 110' is as follows:

- Provides approximately 0.7 square miles of in-building residential coverage to the significant gap area.
- Provides in-building coverage to the residential homes within the -95 dBm RSRP green colored area covered by the site.
- Serves approximately 1,399 people living in the significant gap area.
- Serves travelers through the area per NYS Traffic Data viewer – average daily traffic counts along Route 301 are 3,717; 5,372; and 4,985 near Church Street, Fishkill Avenue and Billy's Way respectively.

C. Verizon Wireless's Service and Performance Goals as Demonstrated by Key Performance Indicator (KPI) data

37. In addition to confirming that Verizon Wireless has a significant gap in both 3G CDMA and 4G LTE coverage with Drive Test Maps and Coverage Maps, I have also evaluated Verizon Wireless's Key System Performance Indicator Data ("KPI Data"). The KPIs utilized consist of call drop call failure rates and access failure rates from Verizon's existing antennas providing signal facing the gap area identified in and surrounding the Village of Nelsonville.

38. The drop call rate and call access failure rate are two performance indicators of a wireless network having a gap in reliable service. Dropped calls, meaning calls that are prematurely ended by the network rather than the customer, are an indicator that the signal strength and/or signal quality is unreliable such that voice calls or data connections are disconnected. Call access failures, or setup failures, meaning the inability for a customer to place a call, are indicators that the signal strength and/or quality are unreliable such that calls or data sessions

are unable to be established at the will of the customer. I was able to confirm Verizon's significant gap in service and the need for the proposed Site by analyzing actual system performance data for the existing sites surrounding the proposed Site.

39. Attached hereto as Exhibit F is a map title "Verizon Wireless Adjacent Site Map". This map represents a wide view of the existing Verizon Wireless facilities located on a topographical map. From a review of the terrain features and distance away from the subject gap area the sites providing signal toward the gap are include McKeels Corners, the West Point HD and West Point Campus sites. All other facilities are located too far away or have substantial terrain features blocking the signal to the area. Therefore, the following analysis includes KPI data from the McKeels Corners, West Point HT and West Point Campus sites only. This data includes a refresh of the KPI data provided in the Nelsonville Feehan Letter dated January 3, 2018. The refresh consists of current last 2 months of data from November 2018 to January 2019 and includes the two West Point facilities to the south of the subject site location.

40. The KPI charts include 3G and 4G dropped call performance data and access failure data for the Verizon's facilities surrounding the proposed site. The drop call percentages and the access failure percentages indicate that Verizon has a significant gap in reliable wireless service in the areas surrounding the proposed Site. Any dropped call or access failure can be deemed unacceptable to a wireless customer, particularly in an emergency situation. Verizon has established a dropped call rate of greater than 1% or an access failure rate of greater than 2% is a measure of unreliable wireless coverage. It is my opinion that these are reasonable criteria. Please refer to the following exhibits attached hereto for the 3G and 4G KPI data:

- Exhibit G – "3G Access Failure Rate"
- Exhibit H – "3G Drop Failure Rate"
- Exhibit I – "4G Access Failure Rate"
- Exhibit J – "4G Drop Failure Rate"

41. The KPI exhibits demonstrate that Verizon's 3G and 4G network on any of its licensed frequency bands is not able to provide reliable service due to a significant gap in the area. The KPI for drop call rate and access failure rates greatly exceed 1% and 2% which are the industry standard metrics for reliable performance. The data presented is a clear indicator of the lack of reliable service. This presented along with the drive test maps and coverage maps further substantiates the specific location of the gap area.

D. Other Sites Were Considered But Failed to Provide Reliable Wireless Service.

42. Verizon is seeking to locate a telecommunication facility within its engineering designed grid plan to solve a significant gap in service due to lack of reliable signal in the area of the subject site. Through my review of the record a number of alternatives were analyzed and presented along with exhibits where applicable. The following is a summary of each alternate analyzed during the course of this application[9].

1. 2 Secor Street Location – This property location was evaluated for a new communication tower at 120' above ground level. This location was identified as a viable alternative in Mr. Feehan's report regarding alternative locations. My opinion is this site as proposed, would be a viable alternative.

2. 50 Fishkill Road – This property location was evaluated for a new communication tower at height up to 210' above ground level. Due to the location of this property north of the gap area it is unable to provide reliable service at a reasonable height above ground. My opinion is this site location will not meet the coverage objectives and is not a viable alternative in comparison to the Subject Site. Moreover, I am informed that the landlord would not agree to allow a tower at this location.

3. Existing structures – Seeking existing structures for use is always the first priority. All existing communication towers in the area are already occupied by Verizon

[9] Independent Radio Frequency Report Regarding Alternate Locations, dated October 27, 2017.

Wireless. As demonstrated by the drive test data, coverage maps and KPI charts the existing facilities cannot cover the gap area using Verizon's most effective frequency band with respect to coverage range. Other existing structures addressed in Mr. Feehan's report include the following:

i. Cold Spring Baptist Church – This location is a 60' steeple and not of adequate height to achieve the coverage objectives. Not a viable alternative.

ii. Cold Spring Methodist Church – Information from the record indicates the landlord at this location was not interested in a lease. Not a viable alternative.

iii. Episcopal Church of St. Mary of the Highlands – Information from the record indicates the existing steeple at this church could be utilized. Therefore, a new structure would be required at this location. Not a viable alternative.

iv. Our Lady of Loretto Church - This location is a 60' steeple and not of adequate height to achieve the coverage objectives. Not a viable alternative.

v. Former Butterfield Hospital – This site is located on Route 9D, south of Grove Court in the Village of Cold Spring. From review of the record this is a hypothetical analysis as the availability of the site was not even known. Nevertheless, the site's location south of the gap area and height of approximately 39' demonstrate that it is incapable of meeting the coverage objectives.[10] Not a viable alternative.

43. As noted on the record and herein, there are no existing telecommunication towers in the area that can be utilized to remedy the gap in service. Two locations were evaluated for new telecommunication towers as an alternate to the proposed. 2 Secor Street was identified as a viable candidate, albeit 10' higher than the subject site. 50 Fishkill Road even at 210' above ground did not fill the gap area and was deemed not viable. All other existing structures

[10] Feehan Letter dated April 18, 2018 – Addressing hypothetical Butterfield Hospital rooftop along with exhibits.

included church steeples that were either not tall enough, not available from a leasing perspective or still required a new telecommunication tower. Based on this analysis and review it is my opinion that the proposed subject site location is the most suitable to meet the RF objectives and the least intrusive.

E. Alternative Site Designs & Alternative Technologies

44. Alternative site designs include faux pine tree poles, obelisks, slim type pole, and flag type poles. All of these alternatives were evaluated and presented on the record. With regard to colocation and effectiveness a tree pole that allows for each colocators' full complement of antennas (antenna array) at one level is the most practical. Utilizing a slim pole or flag pole is extremely limiting in that all antennas cannot be mounted on one elevation therefore requiring two stacked antenna elevations. This often increases the height of the tower and / or requires a separate tower. These alternative site designs were addressed in Mr. Feehan's report dated February 5, 2018. While these alternative tower design approaches are feasible, they each have limitations with regard to aesthetics, height, capacity and usefulness.

45. Alternative technologies such as distributed antenna systems (DAS) or small cells was also presented on the record[11]. DAS and small cells typically consist of low power devices mounted on utility poles or lamp posts. These technologies provide very limited coverage to an area. This coverage is further limited by the extreme terrain and dense foliage. These technologies are more suited for urban areas, tunnels, malls, convention centers or for network densification (capacity) purposes. These technologies are not appropriate for this gap area. Furthermore, both experts hired by the Village opined that DAS and small cells were not appropriate. Mr. Graiff indicated: "The area in and around Nelsonville is quite remarkable with respect to terrain and the existence of deciduous trees. Such conditions do not support the use of DAS systems."[12] Mr. Menkes, retained by the neighboring Town of Philipstown, indicated when addressing DAS and small cells: "It is this author's professional opinion that

[11] Feehan report dated February 5, 2018 & February 14, 2018.
[12] Graiff Report dated February 16, 2018

these technologies are not a viable solution to the coverage gaps that Verizon's is attempting to address in this application."[13] I agree with these conclusions.

III. Conclusions.

46. A review of Verizon Wireless network design within Village of Nelsonville, along with an analysis of drive test maps, propagation coverage maps and key performance indicator data of Verizon Wireless adjacent facilities, demonstrates that Verizon has a lack of reliable in-building residential and in-vehicle 3G CDMA and 4G LTE coverage within the vicinity of the Subject Site.

47. The Village's denial of the permit prevents Verizon from meeting its service and performance goals, thereby materially inhibiting and limiting Verizon Wireless ability to compete and provide service.

48. The existing surrounding sites cannot be modified or enhanced to remedy the gap. This is physically impossible and impractical as the surrounding sites are either existing monopoles and/or tower structures too distant from the subject area to provide coverage. Each site operates with a limited amount of RF power so as to provide coverage to its particular area without causing interference to overlapping areas or areas further away.

49. Although not the relevant standard, and out of an abundance of caution, I have confirmed that Verizon has a significant gap in its 3G and 4G LTE network due to a lack of required system coverage. The solution is to locate a facility within the gap area to remedy the gap in coverage. As identified herein, the area of need does not contain any existing structures and therefore a new facility must be constructed.

50. With regard to alternative locations, both locations with existing structures and those without existing structurers were considered. The existing structures cannot achieve the engineering objective as all are not able to provide coverage to the gap area. One such alternate new tower located at 2 Secor Street (120') was deemed viable. Verizon Wireless's Subject Site otherwise

[13] Menkes report dated November 10, 2017

meets all criteria of the zoning code with regard to being designed as a tree pole and falls within the height requirements (110') of the code. Although not a required standard, it is my opinion that the Subject Site is the least intrusive means of remedying Verizon Wireless lack of required system coverage.

51. The Subject Site consists of a 110' stealth tree-pole facility within an acceptable height to remedy Verizon Wireless lack of LTE coverage. The Village's denial of the application materially inhibits or limits Verizon Wireless ability to provide its services and remedy its significant gap in system coverage in the area.

IV. Additional Disclosures.

52. Pursuant to Rule 26(a)(2) of the Federal Rules of Civil Procedure, I provide the following information:

I have provided RF expert testimony by deposition or in trial in the following cases:

Verizon Northeast LLC v. Howard County Board of Appeals, Civil Action No. RDB-11-0729

Verizon Northeast LLC v. Loudoun County, Virginia County Board of Supervisors, Civil Action No. 11-cv-01201-GBL-JFA

Verizon West Corporation v. City of Huntington Beach, California, U.S. District Court Case No. CV-10-2835 CAS (Ex)

Sprint Spectrum LP and Verizon Northeast, LLC v. The Zoning Board of Adjustment of the Borough of Paramus, New Jersey, U.S. District Court, Civil Action No. 09-04940 (KM) (CLW)

Verizon Northeast LLC v. City of Milton, Georgia, Civil Action No. 1:10-CV-1638-RWS

Verizon Northeast LLC v. City of Wilmington, DE, et. al, C.A. No. 16-1108 (D. De.)

Verizon South, LLC v. City of Roswell, Georgia, Civil Action No. 1:10-cv-1464-AT

Eco-Site, Inc., and Verizon Central LLC v. City of Huber Heights, Ohio and City of Huber Heights Planning Commission, Case No. 3:16-cv-00338-TMR

Los Angeles SMSA Limited Partnership, a California limited partnership d/b/a Verizon Wireless v. County of Los Angeles, California, Case No. 2:16-cv-01412-JAK

Crown Castle NG East LLC v. The Town of Oyster Bay, The Town of Oyster Bay Town Board, Richard Lenz Commissioner of Town of Oyster Bay Highway Department and DPW, and John Bishop Deputy Commissioner of the Town of Oyster Bay Highway Department, Docket No: 17-cv-3445 (SJF)(ARL)

City of Cottleville, Missouri v. Verizon Central, LLC Case No. 4:17-cv-02150-RWS

All facts or data that I considered in forming my opinions are contained in this report, identified in the exhibits attached hereto, and set forth below:

- Visited the subject gap area, visit to Village of Nelsonville and Village of Cold Spring.
- Key Performance Indicator data from Verizon Wireless
- Propagation maps using ATOLL obtained by me;
- MapInfo with 2010 census data;
- Google Earth street view of Subject Site and surrounding area.
- Terrain / topographic analysis of the Subject Site and surrounding area.
- Village of Nelsonville Code – Article VII Commercial Communication Towers § 188-68
- Reports by Adam Feehan PierCon Solutions

    1. Independent Radio Frequency Report dated August 30, 2017

2. Independent Radio Frequency Report Regarding Alternate Locations dated October 27, 2017.
3. Additional Requested Alternate Location Coverage Plots dated November 14, 2017
4. Supplemental Report Regarding the Philipstown Cell Solutions Group Report dated December 18,2017
5. Feehan Letter Dated January 3, 2018. “Supplemental response to Mr. Graiff’s letter dated December 9, 2017.”
6. Feehan Letter Dated January 10, 2018. “Supplemental response to Mr. Comi’s letter dated January 8, 2018.”
7. Feehan Letter Dated February 5, 2018. “Details with regard to flagpole design, DAS and 850 MHz band.”
8. Feehan Letter Dated February 14, 2018. “Details in regard to submission by Philipstown Cell Solutions (PCS) and Richard Comi.”
9. Feehan Letter Dated April 18, 2018. “Details with regard to coverage which could hypothetically be provided by the former Butterflied Hospital Location.”

- Reports from Board Consultant, Ronald E. Graiff, P.E.

1. Report dated October 2, 2017
2. Report dated October 23, 2017
3. Report dated November 7, 2017
4. Report dated December 9, 2017
5. Report dated January 8, 2018
6. Report dated February 16, 2018
7. Report dated February 20, 2018

- Reports from Philipstown Cell Solutions

1. Report dated February 9, 2018 (cover letter and response)
2. Report dated February 9, 2018 ~ 79 pages

3. Report dated February 19, 2018
4. Report dated February 20, 2018
5. Report dated April 16, 2018

- Report from Richard Comi, Center for Municipal Solutions

1. Report dated December 29, 2017

- Report from H.E. Menkes, Menkes Associates, LLCs

1. Report dated November 10, 2017

My compensation for the services provided or expected to be provided in this matter is as follows:

- RF engineering services related to reviews, conference calls, meetings, site visits, preparation of exhibits and report preparation shall be billed at the rate of $180.00 / hour;
- Expenses related to travel, lodging and meals reimbursed at cost; and
- Expert testimony at trial or by deposition shall be billed at $1,600.00 per day.

Date: 1/14/2019

Richard Conroy