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February 12, 2024

Mr. Anthony Tozzi, Director Of Planning
TOWN OF GLENVILLE NY
18 Glenridge Rd
Glenville NY 12302-4502

RE: Proposed Cellco Partnership d/b/a Verizon Wireless "Swaggertown" Site
Telecommunications Facility RF Site Review
Trinity Presbyterian Church 185 Swaggertown Road

Dear Mr. Tozzi,

This preliminary report discusses the radio-frequency (RF) aspects of the proposed Verizon Wireless (Applicant) project in the Town of Glenville. Subsequent reports, if needed, will address any remaining questions or issues that arise during public hearings at the request of the town. Appendix A is attached to this report as a summary of professional qualifications to render opinions regarding the application. Additional background information related to technical matters is included in Appendix B and following.

The following materials form the basis for this report:

1. Permit Application Materials dated September 7, 2023 (Tabs 1-14)

Summary of Findings and Recommendations

1. The RF coverage threshold levels upon which the proposed site is designed are reasonable values and are consistent with threshold levels used by Applicant in similar sites in this region.
2. Based on the RF coverage threshold levels applicant has minimally demonstrated need[1] for low-band RF coverage that constitutes about 7% of their FCC-licensed spectrum from a base station facility in the general area of the proposed project site.
3. The permit application materials lack justification for any RF coverage for mid-band services that constitute about 93% of Applicant's FCC-licensed spectrum. We

[1] There are several ways by which a wireless telecommunications service provider can establish site need for a "covered service." A "covered service" is "a telecommunications service or a personal wireless service". See "Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment," FCC 18-133, 85 FR 51867, at ¶ 37 and footnote 85 (October 15, 2018) (the FCC regulatory test for establishing an effective prohibition is whether "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," and this test is met "not only when filling a coverage gap but also when densifying a wireless network, introducing new services or otherwise improving service capabilities")

therefore recommend that Applicant discuss plans for deployment of operating bands other than the proposed 700/850 MHz low-band as shown in the RF justification materials (Tab 7A and 7B) and the reasons for and justiiation of such deployment.

4. Base station antennae must be elevated to allow efficient RF propagation and achieve the proposed RF coverage and capacity relief to neighboring cells. Applicant has not provided evidence that (a) a lower height would suffice to accomplish their goals at the proposed location or (b) a higher height was needed but was limited due to aesthetic or other concerns. We recommend a series of propagation plots for the proposed site at lower heights in 10' intervals to show the effects on both RF coverage and, if appropriate, traffic off-load with any additional objective evidence and analysis Applicant can provide to support the proposed height.
5. Deployment of cellular base stations can be affected by developing plans for neighboring sites. We recommend that Applicant discuss with the board whether any neighbor site deployments are at or near a point where they may allow height reduction of the proposed tower.
6. During public hearings and municipal site plan review, other alternate sites that may provide improved visual impact are often identified in addition to those Applicant identified. We recommend Applicant perform an RF analysis for any additional nearby sites identified by municipal staff and others that have potential for improved visual impact.
7. Applicant considered four (4) sites, of which one is the proposed site. Other than the proposed site, the rest were dismissed without documentation of or technical support for that conclusion. We recommend further analysis regarding rejected sites to document landowner rejection or, in the two cases of land owner acceptance, if there is any possibility that they could provide an aesthetic advantage for this site or if the board feels there should be evidence in the record to show the technical and/or aesthetic disadvantages of those sites compared to the proposed site.
8. Regarding alternative sites, the board is faced with only one viable location and has not been presented with any viable alternative sites against which to compare the proposed site as the least intrusive means to fill a service gap. We therefore recommend that Applicant provide the materials suggested in the previous finding and, if needed, identify and analyze other new sites where viable services can be rendered so the board can assess whether the proposed site is indeed the least intrusive means to provide services.
9. FCC regulations[2] require Applicant perform a preliminary analysis to ascertain whether or not it is likely the proposed site will expose members of the "General Population"[3] to excessive electromagnetic energy. Applicant has provided a

[2] 47 CFR §1.1307 and 47 CFR §1.1310

[3] "General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure." 47 CFR §1.1310 footnote (3).

certification that the analysis shows compliance with FCC threshold limits at Tab 12.

10. If the proposed site is ultimately approved it, like the existing neighbor sites currently in operation, will serve as a fixed area of coverage to which future neighbor sites must connect.
11. We note that the FAA airspace analysis (Tab 9) indicates marking and lighting could be required once mandatory notification of the FAA occurs due to proximity to the Schenectady County Airport. We recommend that Applicant address the possible scenarios under which such marking and lighting requirements could occur and that the board consider conditions of approval if necessary to preclude FAA marking and lighting.
12. If the proposed site is ultimately approved, it will meet the FCC requirements in 47 C.F.R. §1.6100 as an "Existing" structure. Modifications of "Existing" structures that fall outside the definition of "Substantial Change" are subject to mandatory local approval as stated in that section. We recommend that review of this proposed site consider the possibility that such a request will come before the town in the future.
13. Wireless networks consist of individual cells that function as a whole. Approval of any one particular site should consider the future need for additional neighbor sites and the locations of those sites. A new tower in a more controversial area may be required to address the remaining coverage gaps, extend the coverage area, off-load traffic from future saturated sectors, and properly connect the proposed site into the larger network.
14. The proposed RF coverage shows that several coverage gap areas will remain in the area. Those gaps that remain after a proposed site is active imply the possibility that Applicant may decide to address those areas as part of their overall wireless network. At this time, the board should understand the potential need to serve remaining gap areas and how approval of the proposed site will influence the placement and height of future sites.

The information in this report concerns the RF engineering issues related to the proposed project to assist the board in weighing the alternatives and planning for the future of the community. Engineering design choices may also implicate aesthetic and legal issues. However, this report must not be relied upon for any legal advice or direction. Legal advice about action on these issues must be obtained from the board's counsel. The remainder of this report addresses the details that support the findings.

Site Details

Applicant proposes a 120' monopole with a 4' lightning rod (124' overall), a 4' x 11.5' equipment platform within a 100' x 100' fenced compound area, nine (9) antennas mounted at 116' antenna centerline ("ACL") on a typical 8' horizontal boom serving three (3) coverage sectors. The facility is proposed in a "Suburban Residential" zoning district.

Introduction

Commercial radio (i.e. "wireless") communication systems have been in use since the late 1800's when Guglielmo Marconi started his entrepreneurial efforts to provide long-distance wireless telegraph communication. In 1973 wireless technology developments allowed Motorola's Martin Cooper and his team to connect through the public switched telephone network ("PSTN") using a prototype hand-held "DynaTAC" mobile "brick" phone with only 25 minutes of battery life. Cooper made the first cellular phone call from Fifth Avenue in Manhattan when he called his technology rival at AT&T Bell Labs with the press corps looking on. In the 1980's relatively few subscribers could afford the equipment and air-time service fees offered by only two competitors in each Major Trading Market. The Telecommunications Act of 1996 opened the door for much less expensive equipment and service fees to the point that most individuals now have access to reasonably priced mobile phone technology. Many wireless subscribers now use only wireless devices for their telephonic needs. In 2020 there were over 417,000 U.S. base stations handling annual mobile traffic of 42.2 trillion megabytes – a 208% increase since 2016.[4] In 2023 the CTIA estimates there are 499M wireless subscriber devices and 97% of U.S. adults have a cell phone.[5] The exponential growth of the commercial personal wireless services continues to stretch existing base station capacity. The original low-band spectrum around 850 MHz and the initial PCS band at 1950 MHz are no longer capable of handling that level of traffic, so the FCC auctioned additional spectrum at higher frequencies collectively called the "mid-band." Mid-band includes the original 1996 PCS and AWS bands along with new spectrum ("C-Band") that was reappropriated for terrestrial use from the 3700-4200 MHz satellite downlink spectrum. The low-band typically can provide about 7% of user traffic capacity compared to the aggregated mid-band spectrum that provides the remaining 93% of base station capacity. The growth in user traffic (both digital voice and data) generally requires both mid-band and low-band deployment that match the area population demographics and major roadways to capture traffic from mobile users in the area.

The U.S. Telecommunications Act of 1996 (the Act) was signed into law during the 1996-1997 legislative year. The Act had the dual intentions of promoting wireless services competition and encouraging continued deployment of the ubiquitous wireless networks on which we have come to rely. Since the Act became law subsequent legislative, judicial and regulatory actions cleared the path to speed implementation of the federal policy at the state and local level. The sometimes-conflicting interests of local communities with the Act, and subsequent legislative and regulatory actions to interpret those laws, have placed local municipalities in the position of balancing local community aesthetic and zoning values with national policies surrounding deployment of wireless facilities. Community members often do not fully appreciate that planning and zoning boards have specific constraints when considering wireless telecommunications facilities – namely that they cannot just say "No", that they must not discriminate between service providers offering essentially the same services, and that any decision to deny must be

[4] See https://www.fiercewireless.com/wireless/u-s-counts-more-than-417k-cell-sites-as-2020
[5] See https://www.ctia.org/the-wireless-industry/wireless-industry

based on substantial evidence and documented in a written record. Similarly, members of those boards may not fully appreciate that they still do have the ability to balance the interests of an applicant with those of the community as long as their decisions are non-discriminatory between providers of essentially the same services, based on substantial evidence, and documented in a written record supported by the evidence. We will assist the reviewing boards using our reports and oral testimony to supplement the record and clarify the often complex engineering issues behind the evidence.

As is the case here with the proposed Swaggertown site, in recent years new coverage and capacity sites have been proposed by wireless service providers in residential and scenic areas that previously were considered somewhat "off limits" to wireless telecommunication facility construction. Wireless service providers have transitioned from companies that provided the convenience of wireless services for the relatively few individuals who could afford and justify the costs of mobile wireless services to the current status of "public utilities" due to the demand by most individuals for reliable and efficient mobile wireless services as part of their daily routine and unexpected emergencies. Household members often own multiple wireless mobile devices that are more than voice communication phones. Consumers are installing wireless "smart" devices, sometimes called the "Internet of Things" (IoT). The IoT technologies encompass everything from household appliances to motor vehicles – and more. These wireless mobile technologies add energy conservation and personal convenience to everyday life. The IoT devices and the mobile terminals which now serve as phones, personal planners, and cameras often communicate and transact data transfers on the wide-area commercial wireless networks. These devices push network data demands higher and higher. If we have issues with wireless site deployment, in certain ways it is our own doing. The lower costs of service and the ever-increasing demand for services by the general public have placed municipal planning and zoning boards in the difficult position of balancing preservation of community aesthetics and safety concerns with the requirements of federal and state law that recognize wireless service providers as public utilities. In particular, it is well-settled that zoning review boards must apply the public utility standard[6] regarding wireless telecommunication facility permit applications. This report is intended to assist the decision makers who may only have a basic level of understanding of the wireless RF engineering issues but are charged to decide whether a project can and should be approved. There are many complex engineering aspects of wireless telecommunication facility site deployment that are in the background of such decisions. This and subsequent reports will help decision-makers understand the engineering issues as they serve their community and balance the necessarily intrusive nature of wireless telecommunications base station site deployment.

Site Justification

Subject to confirmation by the board's legal counsel, in New York area variances, special use permits and use variances for a proposed telecommunication facility are normally based upon an applicant showing that (1) its new construction "is a public necessity in that it is required to render safe and adequate service"; and (2) "there are

[6] *Cellular Tel. Co. v. Rosenberg*, 82 N.Y.2d 364, 371-371 (1993).

compelling reasons, economic or otherwise, which make it more feasible"[7] to build a new facility than to use an alternative site. RF coverage gaps and user capacity limitations both affect delivery of safe and adequate service. Area-wide RF coverage gaps and existing neighbor site sector capacity exhaustion tend to show necessity. Feasibility generally relates to whether the proposed facility adequately addresses the coverage and/or capacity needs, avoids unacceptable performance degradation, and avoids non-RF issues such as public safety and unreasonable community aesthetic impact.

Considering the need to provide wireless service and the impact on the community, the proposed site should represent the most balanced and reasonable solution among all technically viable and available alternatives - i.e. the least intrusive means to remedy the service gap. A "least intrusive means" implies a comparison to other viable alternatives such as lower height or a better location that reduces visual and other impacts. Determination of reasonableness might also involve an analysis of whether a proposed site creates unacceptable precedents or places constraints upon the locations of other future sites in the area needed to provide additional area coverage (SEQRA segmentation) where Applicant's future build-out plans are apparent. Even though no additional sites are currently planned by a service provider, one must keep in mind that base station sites are developed on an approximately three-year cycle. In year one new site candidates are identified. In year two, a subset of candidate sites are identified for funding based on priority need and site acquisition contracts are placed. In year three, municipal zoning approvals are requested. When evaluating a given site, or set of sites, one must always look beyond the current situation to evaluate the likelihood of future development as demand for wireless services increases.

Additional considerations that weigh into the reasonableness of a site, for example, might include whether the proposed structure can be disguised as a "stealth" site, can accommodate additional antenna arrays, or has potential limitations for effective co-location at heights lower than that proposed by Applicant. The need for improved emergency services communications either through the commercial wireless network or by co-located emergency services communications equipment on a proposed structure might also be considered and weighed into the decision-making process.

Telecommunication facilities fall into one of two categories based upon the status of the service provider's technology. The status must be determined by the municipality's legal counsel. Some facilities are deemed to be covered by the Telecommunications Act of 1996, 47 USC §332(c)(7), which limits some aspects of local zoning authority. Other facilities are deemed not included or their status is unclear because of the nature of the service provider's technology or lack of precedential decisions at the FCC or within the courts. Determination of the actual status of any particular applicant requires advice from legal counsel and is beyond the scope of this report. This report will proceed on the assumption that 47 USC §332(c)(7) and related local zoning limitations apply and will, therefore, focus upon the areas of review permitted under those limitations. A subsequent contrary determination by the municipality will affect the application of the law to the facts

[7] *Cellular Tel. Co. v. Rosenberg*, 82 N.Y.2d 364, 371-371 (1993).

and engineering opinions presented in this report, and such determination may open other areas of inquiry.

Subject to confirmation by the board's legal counsel, the federal Telecommunications Act of 1996 (Act) in 47 USC §332(c)(7) limits certain aspects of local zoning authority regarding wireless telecommunication services providers. Beyond the few explicit limitations, "…nothing [else] in this Act shall limit or affect the authority of a State or local government or instrumentality thereof over decisions regarding the placement, construction, and modification of personal wireless service facilities."[8] The main limitations imposed by the Act require that local regulation of "the placement, construction, and modification of personal wireless service facilities . . . (I) shall not unreasonably discriminate among providers of functionally equivalent services; and (II) shall not prohibit or have the effect of prohibiting the provision of personal wireless services."[9] The Act also states that "[n]o State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions."[10] Otherwise, the Act leaves substantial and familiar local zoning authority in place balanced by the familiar conditions that local zoning decisions must be timely[11], based upon substantial evidence, and documented for potential judicial review.[12]

Local Zoning Timeliness for Wireless Telecommunications Facilities

The FCC has established timeframes, collectively called the "Shot Clock," for local municipal action based upon the nature of the proposed wireless facility permit request. Rebuttable presumptively reasonable FCC Shot Clock time limit requirements[13] to review permit applications are currently:

Co-locate a Small Wireless Facility[14], once so identified using permit application documentation, using an existing structure: 60 days;

Co-locate a facility <u>other than</u> a Small Wireless Facility using an existing structure: 90 days;

deploy a Small Wireless Facility using a new structure: 90 days; or

deploy a facility other than a Small Wireless Facility using a new structure: 150 days.

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[8] 47 U.S.C. §332(c)(7)(A).
[9] 47 U.S.C. §332(c)(7)(B)(i).
[10] 47 U.S.C. §332(c)(7)(B)(iv).
[11] Timeliness relates to the rebuttable multiple "Shot Clock" requirements established by the Federal Communications Commission (FCC) that establish presumptively reasonable time limits for final municipal decisions on new support structures, co-location on existing structures, and extension of existing structures for co-location.
[12] This balance is discussed at length in *Sprint v Willoth* 176 F.3d 630 (2nd Cir 1999).
[13] 47 C.F.R. §1.6003
[14] A "Small Wireless Facility" is defined as one meeting <u>all</u> requirements in 47 C.F.R. §1.6002 (l)

If time has lapsed it may be possible to negotiate the Shot Clock deadlines with Applicant in writing for good cause to allow time for a thorough review of alternate sites, analysis of height requirements, addition of supplemental materials to support action, and additional justification of need where appropriate and allowed. FCC rules allow the modification of "Existing" structures with minimal municipal administrative review when the modifications do not introduce a "Substantial Change." The term "Substantial Change" is defined by the FCC for various scenarios.[15] Note that once a new structure is approved and becomes an "Existing" structure, a future co-location request for such an "Eligible Facility" may result in a height increase with minimal municipal review if the co-location does not cause a "Substantial Change" as cited above. It is recommended that the current zoning review for a new tower should include consideration of that possibility.

Public Necessity

Wireless service providers, such as Applicant, establish the radio-frequency (RF) coverage level and user capacity margin necessary for what they each unilaterally define as reliable service consistent with their business model. The business model involves a trade-off between the quality of service experienced by a subscriber and the cost of network deployment and operation. Several factors determine the level of subscriber service. Some important factors for base station site selection are the wireless RF signal level, the system capacity to support multiple users, and the potential interference from their own neighbor sites due to inappropriately close base station sites. The choices of site location, RF coverage, and system capacity directly affect service reliability. Despite business model trade-offs, historically high growth of wireless subscribers often places cell site capacity as a high priority.

Applicant's mobile wireless subscribers are often located inside buildings or vehicles that are screened by foliage from direct view of a base station. Foliage, buildings and vehicles are obstacles to radio wave penetration. In order to "render safe and adequate service"[16], the wireless RF signal must travel over the terrain in the coverage area, penetrate obstacles that block a direct path to the subscriber, and then arrive with sufficient signal level to achieve the desired level of service. Wireless telecommunication systems must operate simultaneously in both directions between the base station facility and the subscriber's mobile equipment. Therefore, the return signal from the subscriber's mobile or stationary equipment must also overcome the signal losses due to terrain and other obstacles. Generally, when a high level of service reliability or high user capacity are needed, network base stations must be placed closer together to provide both high RF signal levels and increased network user capacity over a smaller area. In less populated areas where user capacity is not as much an issue, the base stations can be spaced at greater distances where the separation is generally limited by path loss caused by terrain features, buildings, and other obstacles. For RF coverage considerations from a particular base station, the wireless service provider's choice of minimum RF signal level limits the extent of cell coverage. If the RF signal level requirement is high, then the acceptable coverage

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[15] See 47 C.F.R. §1.6100(b)(4),(5),(7)
[16] *Cellular Tel. Co. v. Rosenberg*, 82 N.Y.2d 364, 371-371 (1993).

area is generally small. When a service provider adopts lower but acceptable reliability and uses a lower RF signal threshold for their network design, a single base station will cover more area at the reduced level.

Design engineers for wireless service providers use an RF link budget to quantify the RF signal level required for "safe and adequate" wireless network operation. The RF link budget ultimately establishes the maximum permitted path loss between the base station and mobile terminal. The RF link budget includes all relevant system design assumptions, including measures of dropped connections related to signal strength and ultimately quantifies maximum permissible path loss. Path loss, or signal attenuation during propagation, is the reduction in RF signal level as it travels from the base station to the subscriber's mobile device and, likewise, from the mobile device back to the base station. If the path loss is too high, then the received signal will be below the established minimum RF signal level threshold. When the received signal is below threshold, unreliable operation (i.e. dropped connections or reduced data transmission speed) may result. Service providers monitor network performance for reliability and may adjust link budget assumptions to respond to the actual performance experience. Thresholds for future sites may show different service level requirements as new technology, additional operating bands, and propagation model adjustments are implemented.

After establishing the minimum RF signal threshold level the design engineer can analyze the area RF coverage path loss encountered from a proposed base station. The path loss analysis predicts the actual coverage area. For this proposed project Applicant Verizon Wireless used -85 dBm[17] in the 700/850 MHz to show RF area coverage. We anticipate Applicant will also use 2110 MHz and 3900 MHz bands in this region but the permit application materials are silent regarding these bands other than implied by NIER analysis. Higher signal levels for "in-vehicle" and "Indoor" are needed when the location of wireless subscribers so demand. For purposes of this report, and where disclosed by Applicant, the bands are grouped into "low-band" (700/850 MHz) and "mid-band" (2110 MHz and above) spectrum. Low-band and mid-band signals have different propagation characteristics. The differing propagation characteristics generally mean that the low-band signals, which have much less capacity bandwidth capability than the mid-band spectrum, will cover an area more readily than mid-band signals since the later experience higher losses due to the RF environment obstacles and terrain. A current and on-going challenge for all wireless service providers is how to provide mid-band coverage to areas where user demand forces existing sites to occasionally, or in some cases regularly, operate above capacity thresholds for reliable service. In such cases "network densification" to relieve existing site congestion requires a new base station facility properly situated near user demand areas. The current permit application materials are silent as to deployment of mid-band and high-band services. We therefore recommend that Applicant discuss plans for deployment of operating bands other than the proposed 700/850 MHz low-band as shown in the RF justification materials (Tab 7A and 7B).

[17] The unit "dBm" is decibels above 1 milliwatt and is calculated from the power level (in watts) as dBm=10Log(power/0.001). One milliwatt is 0.001 Watts. Negative values represent power levels that are less than 1 mW. Less negative values in dBm represent stronger signal levels (e.g. -7dBm is a stronger signal than -8dBm).

Wireless system engineers use RF propagation plots that are generated by computer modeling for area coverage analysis and prediction. An RF propagation plot shows predicted area signal power levels with respect to the minimum signal threshold for site performance analysis in units of dBm. Visually, an RF propagation plot maps the area surrounding a proposed base station using various colors to represent locations where the RF coverage levels meet or exceed the minimum RF signal levels as stated in dBm. By the absence of color, an RF propagation plot will also show locations where the base station cannot provide the minimum signal levels. These areas (called coverage "gaps") differ by band and are a graphic indication of whether a particular site achieves RF design coverage levels for the given location and height. A gap could be only slightly below threshold or it might represent a deep lack of coverage. A designer usually anticipates slight gaps surrounding a cell because of difficult area terrain and clutter. When gaps are deep and located along critical roadways or near relatively high population areas, one can anticipate unreliable wireless service. A particular site may fail as a suitable location because of such unfilled RF gaps or insufficient capacity areas. Computer-based RF propagation analysis is reliable information when properly interpreted.

As a side note regarding RF propagation plot validity, since 2020 we have been aware that certain parties who solicit local residents as clients to oppose deployment of wireless facilities have made incorrect and arguably deceptive statements regarding document FCC 20-94 titled "SECOND REPORT AND ORDER AND THIRD FURTHER NOTICE OF PROPOSED RULEMAKING" (see also GN Docket No. 19-367 "MOBILITY FUND PHASE II COVERAGE MAPS INVESTIGATION STAFF REPORT"). The parties in question purport that the FCC has declared computer-based propagation plots inaccurate and that only RF drive tests are acceptable to the FCC. This assertion is patently incorrect. An excerpt from the Federal Register from August 18, 2020, that formalized the proposed rules in FCC-20-94 states the following:

> In this document, a Second Report and Order adopted by the Commission establishes important measures for developing improved broadband data, including requiring fixed wireline and satellite providers to submit shapefiles, or lists of addresses or locations, representing where they have customers or could install service within 10 business days of a request; requiring terrestrial fixed wireless providers to report their coverage areas <u>based on propagation maps and models using prescribed parameters</u>, or based on lists of addresses or locations, to define their specific coverage areas; and <u>requiring mobile providers to submit coverage maps and propagation model details based on minimum specified parameters</u> and to disclose other assumptions underlying the models.[18] (emphasis added)

FCC-20-94 as adopted by the FCC *does not assert the claims of inaccurate RF computer-based analysis*. It states that computer-based modeling is part of the information the FCC requires.[19] FCC-20-94 describes the outcome of an FCC project that sought to measure "speed" (bandwidth) claimed by service providers. The information previously

[18] See https://www.govinfo.gov/content/pkg/FR-2020-08-18/pdf/2020-17633.pdf (Federal Register / Vol. 85, No. 160 / Tuesday, August 18, 2020 / Final Rule)
[19] See FCC-20-94

submitted to the FCC *may have been* overstated or the measurement techniques used by the FCC field personnel who sought to confirm the measurements *may have been flawed* due to site sector saturation and/or measurement techniques that did not account for heavy site sector utilization. Perhaps without realizing it, those who cite FCC-20-94 to discount computer-based modeling have made a stronger case for a service provider's use of RF propagation plots as endorsed by the FCC. The ultimate goal of a service provider's design is to provide adequate bandwidth to subscribers. Network bandwidth (i.e. data speed) performance is not just based on RF propagation levels as would be documented by an RF drive test assuming the sector serving the area is not "saturated." An adequate RF propagation level is a "necessary" but not a "sufficient" condition for capturing user traffic and providing adequate bandwidth. The "sufficient" conditions include sector capacity, user demand over time, and interference from other users attempting to use the cell. The data demand and throughput is collected by the base station's control center (i.e. the MTSO switch). Ideally this set of information is available from a project sponsor to show need when capacity issues are to be addressed.

RF Propagation Plots

Cellular networks provide wide-area services by deployment of small areas of RF coverage that provide a finite subscriber capacity in each cell. When there is a low density of subscribers a larger diameter cell will often suffice to allow subscribers simultaneous access to services. Sometimes cells are too far away to provide reliable service. In those situations, low-band connections might frequently "make" and "break" as signal strength fades or, in the case of higher frequency bands, the added cell capacity for which those bands are deployed is not available due to inadequate signal strength.

In support of the application, Applicant has provided only two RF propagation plots that show existing RF coverage in the low-band (700/850 MHz) west of the Schenectady County Airport and how the proposed site fills the coverage need relative to provision of wireless service to their subscribers. These plots are shown in the permit application materials at Tab 7B. The exhibit plot for existing RF coverage shows the majority of the target area lacks RF signal level above -85 dBm and, based on that RF level, constitutes a significant coverage gap.

Neighbor Site Capacity

Even when there is sufficient RF signal strength to support reliable service, arguably the case for the area surrounding the proposed facility, each cell sector's capacity limitations may cause users to intermittently encounter a service gap when the number of users exceeds the capacity threshold at times during a 24-hour period. That condition is documented by the network equipment to produce worst-case metrics to determine the severity of the traffic load leading to "exhaustion." Cell sector exhaustion can cause denial of service to otherwise eligible subscribers even when there is sufficient signal strength above threshold requirements. The operational effect is the same as if no RF signal was present – calls cannot be initiated and data transfer may be impossible or severely limited as many wireless users compete for available bandwidth. A new cell can be deployed to "off-load" traffic from the saturated sector and provide a stronger local RF signal. The added capacity and increased RF signal strength provides local subscribers more robust service.

There are numerous metrics used in each technology approach to cellular service reliability. Three metrics used to show LTE (Long Term Evolution) system performance are FDV (Forward Data Volume), ASEU (Average Scheduled Eligible User), and AvgAC (Average Active Connections). Plots of LTE FDV (Forward Data Volume) show the limits of reliable service in terms of data throughput for low-band and mid-band operation. Plots of LTE ASEU (Average Scheduled Eligible User) show how subscriber connections are loading the cell sector and often indicates when distant subscriber devices are having difficulty maintaining connections. AvgAC (Average Active Connections) is a measurement of the number of active connections compared to the limit after which no additional devices will be able to access services. These metrics, and sometimes others, are used to document traffic capacity issues that may serve to justify additional base station facilities.

The present permit application materials do not include any graphs for FDV and ASEU metrics that show the current capacity issues at the neighbor cell sites and there is no reference to the need for any capacity off-load from those sites.

The presence of *significant* RF coverage gaps predicted by the RF propagation plots for existing coverage and, when applicable, the actual and predicted trends toward maximum capacity of neighbor sites, tend to demonstrate need. Analysis of whether these gaps can be addressed by the proposed site or a less intrusive alternate site when balanced between the technical performance and aesthetic advantages serves to justify the proposed site.

Feasibility - Addressing the Need and Balancing of Impact

A service provider makes decisions to provide wireless RF coverage based on the location and travel habits of their subscriber base. Base stations are limited to coverage in areas surrounding the site since they must be able to communicate with low-power wireless subscriber devices. Design of wireless mobile devices include requirements for minimal output power to reduce likelihood of a user being exposed to excessive radio-frequency signal levels. Therefore, to achieve maximum effect, a base station facility generally should be placed near the center of the target coverage area when zoning, land use, and aesthetic considerations allow. After the location of a proposed base station is established, the terrain features and other “scatter” obstacles, sometimes called “clutter,” of the target area must be analyzed to determine how effectively the base station can cover that area. In addition to area coverage, wireless service providers attempt to position their base station sites to achieve continuous coverage from one cell to the next with few intervening coverage gaps. Even if the area of the proposed project is relatively flat, it may still contain foliage and obstacles that can produce shadowing and absorption of the RF radio waves. Shadowing and scatter cause the jagged pattern shown on the RF propagation prediction plots. RF coverage becomes more uncertain at lower antenna heights because local obstacles in the area through which the signal must propagate are usually not individually modeled in the computer simulation. In addition, physical clearance to near-field obstructions is required to allow proper "beam forming" that assures adequate signal propagation to the edges of the proposed cell. Unlike visual clearance, the lack of sufficient Fresnel Zone clearance[20] can have an impact on radio-wave propagation that is similar to a physical obstruction.

The significance of visual impact from the tower and antennas and the significance of that impact to nearby residents and visitors are appropriate matters for the board to consider. The board may also wish to consider the prospects for possible future co-location on the proposed site. While considering the local impact, consider that any nearby alternate site location would probably require at least the same antenna height if the proposed site is nearly central to the existing gap area. Generally, base stations at the center of a coverage gap area result in the shortest antenna height requirement. When a base station must cover a gap from a non-central location, the height must usually increase to overcome terrain shadowing to provide comparable levels of RF coverage and maintain adequate connectivity to the adjacent neighbor cells. In the alternative, area coverage might be achieved from a non-central location by utilization of multiple shorter sites. Use of multiple sites increases the cost to cover the target area.

Reasonableness of the Proposed Project

Approval of a base station facility usually requires review for use and area variances and/or site plan approval that considers similar concerns common to use and area variances. The review is governed by standards applicable to an applicant's status as a utility, broadcaster, telecommunication services provider or other category. Board decisions must not be arbitrary or capricious. Therefore an applicant should provide objective evidence of their need and, when weighing alternatives, objective evidence regarding the strengths and weaknesses of the alternative sites. The board then weighs that evidence to determine whether the site is reasonable and properly balances the interests of the community and the applicant.

Where an applicant is also classified as a public utility, a less restrictive standard for area and use variances may apply. Subject to confirmation by the board's legal counsel, a provider of wireless telecommunication services like Applicant is considered a public utility in New York.[21] As a public utility, there may also be legal constraints on the whether a municipality can impose restrictions on Applicant that will unreasonably increase project costs. Unreasonable costs may accrue when mandated co-location or use of sub-optimum sites causes the need for additional base stations to fill an existing significant coverage gap. Under some limited circumstances the need for multiple sites may also increase technical complexity beyond what might be considered reasonable. If the board determines that the site as proposed cannot be approved, the alternatives for

[20] The first Fresnel Zone is the locus of points that show where a reflected wave can arrive at the receiver with a 180 degree phase shift. When two waves arrive and one is out of phase, a partial or complete cancellation of received signal can occur. Proper design requires first Fresnel Zone clearance from obstacles where at all possible.

[21] Cellular Tel. Co. v. Rosenberg, 82 N.Y.2d 364 (1993)

Applicant would include options that could increase network costs or decrease potential coverage area. These options include:

> (1) modification of the proposed site to conform to zoning and visual impact requirements,
> (2) identification of nearby sites that collectively meet both the RF coverage objectives and zoning and/or aesthetic requirements,
> (3) construction of an alternate site that meets aesthetic and zoning requirements and provides some coverage even if it does not completely provide coverage to the gap area, or
> (4) abandonment of the project.

The range of options is not particularly limited by the technology and engineering issues. However, the choice of a specific option could implicate the previously mentioned legal and land control issues. The legal implications are beyond the scope of the present report and, if necessary, should be discussed with the board's counsel. If one or more of these options are deemed viable by the board, a more focused analysis on the specific option(s) can be provided in a supplemental report.

We are told that the proposed tower facility originally proposed for 120' (124' with lightning rod) might be reduced in height to achieve improved aesthetics without apparent impediment to Applicant's service needs. We have no additional RF propagation plots or other information with which to evaluate the impact of height reduction. Further, we are not able to assess whether the proposed height, or the reduced height, is the minimum height needed to provide adequate service. We therefore <u>recommend</u> that Applicant provide parametric height propagation plots to allow assessment of minimum necessary height.

The proposed site plan and zoning analysis, if applicable, for any particular site usually considers the nature of the proposed site in the context of the surrounding area and the nature of other alternate sites that can provide adequate, even if not identical, RF coverage. The analysis also balances the impact of a new facility with the benefits derived from the availability of wireless services. The characteristics of the area in which the site is proposed, the proximity and visibility of the site to nearby residences, and accessibility of the site generally weigh into the analysis. In some circumstances, other considerations may include whether a particular site exceeds Federal Communications Commission (FCC) human exposure limits and whether it is necessary to illuminate the tower for aircraft safety even if not required by Federal Aviation Administration (FAA) requirements.

Sometimes the objectionable aesthetics of a tower can be partially mitigated by use of stealth structures to blend into the area. Stealth structures tend to limit the co-location opportunities for future wireless service providers because the structures are usually customized for reduction of aesthetic impact. Generally, the design of stealth structures attempts to minimize height and cross-section. Minimization of height and cross section usually limits RF coverage and reduces the mechanical load-bearing ability of the structure compared to other support technologies such as a monopole or lattice tower. The reduced cross-section limits the ability to host additional antenna arrays within the structure's

envelope. However, where a stealth structure is appropriate to achieve the desired aesthetic goals the trade-off between future co-location and acceptable appearance are appropriate.
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Alternative Sites

Alternative sites identified by Applicant, municipal staff, or residents in the vicinity of the proposed site can sometimes provide opportunities for mitigating undesirable visual impacts of a proposed site. Alternate sites will generally not produce the same RF coverage and/or capacity off-load of the proposed site, but will sometimes provide sufficient technical performance. Alternate sites may not be viable from a technical performance perspective or they may not be available due to a landlord's reluctance to enter into a lease agreement with Applicant. During site review, municipal staff recommendations and public comments may identify potential alternative site locations that have not been explicitly considered by Applicant. Local residents and municipal staff often have insights into such locations that come from their familiarity with the area and their knowledge of community values. We recommend Applicant perform an RF analysis for any additional nearby sites identified by municipal staff and others that have potential for improved visual impact.

Applicant submitted four (4) sites as documented in the site selection analysis (Tab 7C). The first site listed in the site selection analysis is the proposed site Trinity Presbyterian Church (Parcel ID# 22.17-1-3). The remaining locations analyzed are:

- Lewis Construction (Parcel ID# 22.17-2-12.1)
- Shady Lane Realty LLC (Parcel ID# 22.18-1-3)
- Amedore Land Developers LLC (Parcel ID# 30.5-1-35.3)

Lewis Construction and Shady Lane Realty LLC were both dismissed without presentation of any RF analysis justification to show how the sites perform compared to the proposed site other than to mention that the ground elevation is lower than the proposed site. While lower ground elevation usually indicates need for a taller tower, a taller structure does not necessarily mean a site is less preferable for aesthetic purposes. The last site, Amedore Land Developers LLC, was dismissed due to lack of land owner response. No documentation of attempts to reach land owner are included to support the assertion. We are therefore left with a single site, the proposed site, and three other locations that are said to be not viable without substantial evidence of their inability to provide service. Alternative site analysis implies comparison of the proposed site to *viable* alternate sites, otherwise the planning and zoning commission is left with a single site as the choice and no evidence to support that decision. While we do not necessarily disagree that the three dismissed sites may be less preferable, the planning and zoning commission has no documentation to support that assertion in the permit application materials. We therefore recommend that Applicant address each of the three rejected sites with substantial evidence to support their dismissal.

Additional Considerations

FAA Marking and Lighting

The applicant is proposing a tower that is less than 200' that would otherwise trigger FAA marking and lighting requirements if not already required for a shorter tower in this location. 47 U.S.C. § 303(q), 47 C.F.R §17.21. Generally, all towers in excess of 200' require FAA marking and lighting. Under certain circumstances such as proximity to airports or other critical facilities, towers below 200' also require marking and lighting. Restriction of height may limit future collocation of other wireless service providers.

Tab 9 contains a preliminary air space study dated September 21, 2022. Quoting that report from page 2 of 4:

> Marking and Lighting are not normally required for structures 200 feet or less. However, it may become a requirement based upon the outcome of the aeronautical study conducted by the FAA. It will then become part of the determination and a requirement of the determination.

Although the regulatory issues described in the report are beyond the scope of this review, we call this information to the board's attention since the proposed height is only 20' below the height that triggers a formal FAA review.

Future Co-location

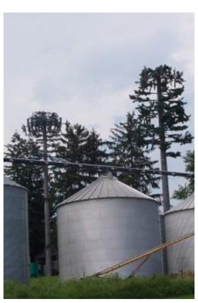
Many municipalities specify that, as a condition of approval, a tower must be designed to accommodate several additional wireless service providers. Generally a wireless service provider designs a cell for an antenna centerline that provides the required coverage but is not so high as to cause interference and excessive overlap to their own adjacent neighbor cells. Since each service provider builds their network to achieve their own reliability and service design requirements, the coverage maps for two wireless service providers can be remarkably different even for those operating in the same frequency band. Future build-out plans are closely guarded secrets based on proprietary customer demographics and technology deployment, so it is usually challenging to know what a given service provider will require in the years ahead and how those requirements will translate to co-location opportunities. Given the uncertainties, there are two views on the matter of co-location each having advantages and disadvantages.

First, some municipalities take the position that it is better to concentrate the co-locations at one site rather than conduct hearings for multiple shorter towers. Under this approach, the current tenant and each future service provider with an area coverage gap will ideally locate on the proposed tower. If co-location is agreeable to a service provider, it will force an approximately similar coverage grid to that of the existing carriers. In some cases the similar grid pattern can increase the likelihood that future neighbor tower sites will be required in a location that may be more controversial or in places where it may be undesirable to stack multiple service providers on the same tower. The concentration of a large number of service providers on the same tower can result in a visual impact that far exceeds that of the original tower as proposed even if the height remains unchanged.

Second, some municipalities prefer multiple shorter towers since the lower height may make them more easily buffered by foliage and/or facilitate stealth structures. Stealth structures include structures designed to look like clock towers, church steeples, building facades, or trees. Stealth tree structures are generally effective when antenna centerline and tower height are within 15' of the existing tree canopy, so this generally precludes future co-location without additional height. When the tower height dramatically exceeds the existing tree canopy the advantages of a stealth tree are arguably diminished. Stealth structures are generally more expensive to implement and exhibit some structural limitations for future co-locations. An additional advantage to the multiple-shorter-site approach using more traditional tower structures is that it does provide co-location for capacity expansion when multiple shorter towers are already in place. As more wireless subscribers join the network, the need increases for smaller cells where each cell can handle approximately the same number of calls and will then relieve the burden of the additional subscribers on existing cells. This affect will be more likely in suburban or urban settings, but may occur in rural installations where population is concentrated in a specific sector and demand starts to reach capacity.

There are many variables that affect successful co-location. There is no guarantee that any future service provider will be interested in co-location at a specific site since their RF coverage requirements may be remarkably different than the service provider that proposed the tower in the first place. Given the advantages and disadvantages, some municipalities handle it with a compromise solution.

A compromise between multiple short towers and consolidation of service providers on a single tower is to build a proposed tower to the minimum required height as currently required but design the tower foundation and the lower superstructure to accommodate a future height increase if so justified by a future co-location application. Increases in height can generally be in 20' increments on a tower designed for expansion. Future expansion in height, unlike the mere addition of antennas to an existing tower, is arguably a *substantial change* and, if so, would likely fall outside of the Middle Class Tax Relief and Jobs Creation Act of 2012 (PL 112-96, February 22, 2012, 126 Stat 156) which includes Sec. 6409: Wireless facilities deployment. That law limits municipal review of an *eligible facility request* under specific circumstances. This matter and the implications for future site review of a tower designed for expansion should be discussed in more detail with the board's attorney if or when needed.



Non-Ionizing Electromagnetic Radiation (NIER) Exposure Compliance

Wireless facilities like the one proposed by the applicant are generally found to comply with FCC Office of Engineering and Technology (OET) Bulletin 65 thresholds as codified at 47 CFR §1.1307 and 47 CFR §1.1310. FCC regulations set maximum permissible human exposure levels for far-field Non-Ionizing

Electromagnetic Radiation (NIER). When transmission antennas are installed in or near accessible or occupied areas of a building, it raises concern regarding occupants of the building and maintenance personnel who may need to access the rooftop. Thresholds for subjecting a wireless transmission facility to a more thorough emission analysis are specified according the frequencies of operation. The above-cited FCC regulations require that Applicant perform a preliminary analysis to ascertain whether or not it is likely the proposed site will expose members of the "General Population"[22] to excessive electromagnetic energy. Applicant has provided a certification that their analysis shows compliance with FCC threshold limits. The certification was produced by Centerline and in included at Tab 12. The report states that "Verizon Wireless is compliant with the FCC rules and regulations governing human exposure to RF electromagnetic fields as described in 47 CFR § 1.1307(b) and 1.1310 in all areas at ground level."[23]

If a proposed site is shown to meet the FCC threshold requirements federal law[24] precludes consideration of "environmental effects" (i.e. human exposure) as a basis for denial. The proposed site has been certified by Centerline Communications to meet FCC threshold requirements. Appendix B provides a summary and some additional background information regarding NIER.

SEQRA Segmentation

Like the more familiar subdivision and phased housing development project, an RF wireless network functions as a whole. In order to avoid inadvertent incremental impact segmentation, it may be appropriate that the design for Applicant's future neighbor sites required to address remaining RF coverage gaps and capacity needs within the jurisdiction be considered during the current site plan review. The lack of coverage that will exist after the proposed site is operational may indicate a need for future facilities in those areas to improve or expand Applicant's wireless network coverage in the area. It is recommended that Applicant discuss the entire proposed network build-out in the jurisdiction since approval of any single site, such as the proposed facility, creates a fixed area of RF coverage to which other neighbor sites must connect. Additional sites in the area may need to be located in other zoning-controversial locations in order for the applicant to properly meet their coverage objectives and connect to the currently proposed and existing sites. In the worst case, approval of the proposed site could force one or more future neighbor sites to require a tower in an area where such a structure may be even more controversial than the proposed location.

The overall area coverage map shows the existing network neighbor sites and can be used by the town to identify coverage gap locations where controversial zoning may be

[22] "General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure." 47 CFR §1.1310 footnote (3).

[23] Centerline Communications NIER analysis report, page 2 (Executive Summary).

[24] No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions. 47 USC §332 (c)(7)(B)(iv)

required for future sites. While Applicant is currently before the board, the board may choose to ask Applicant to estimate the height and location of structures needed to fill the remaining gaps within and near the town's jurisdictional boundaries. This information could then assist the town in planning efforts and allow evaluation of whether the presently proposed site will later unduly restrict municipal planning goals or otherwise conflict with the comprehensive plan.

Alternative Technologies

The reader may already be aware of other approaches to deliver wireless communications that could avoid tall towers in a given area. On one extreme certain cellular-type systems can be implemented using low-Earth orbit satellites. On the other extreme, very small pico-cell systems can allow subscribers to connect to their own home or office network using technology similar to a cordless phone. Each approach has its advantages and disadvantages. Appendix C provides a summary of these technologies.

Photo Simulation of Proposed Tower

Photographic simulation is one assessment technique offered by project sponsors to assess the visual impact of a proposed tower or tower modifications. The physical laws that govern propagation of radio waves at the frequencies used by wireless service providers requires elevation of the base station antennas above the surrounding buildings, trees and natural terrain to facilitate reliable reception. Photo simulations of the elevated structures provide a two-dimensional photograph of a specific vantage point scene that shows the existing view and the same view with a superimposed likeness of the proposed tower or tower modification. This provides a pre-build "before" and "after" photograph to assist in assessing the potential visual impact. Photo simulations, like any assessment tool, have advantages and limitations.

Photo simulation of a new tower structure is produced using a brightly-colored balloon tethered at the height of the proposed tower on a day when weather will allow observation of the balloon from a distance. Since the goal is to hold the balloon at a height representing the proposed tower, the wind velocity on the day of observation must be low. After the balloon is positioned, a photographer moves around the area to capture photographs of the balloon from critical vantage points. Later, the photographs are modified by stripping out the balloon and replacing it with an photo image of a tower like the one that is proposed. The tower image is properly scaled and post-processed into the photograph. This composite photograph that shows the expected scene that will result if the tower is constructed.

When viewing a tower scene, one's attention is generally drawn to visual discontinuities or abnormalities that result from a disruption of the horizon. As we walk around our own neighborhood we mentally process the foreground and background objects based on our previous experiences of size and proportion. When one views a visual discontinuity scene in-person, the viewer is usually able to mentally process the near-field "clutter" using three-dimensional visual clues and remove them from the scene to get an accurate proportional assessment of the situation. Two-dimensional photographs lack the three-dimensional clues we use to get a proper proportional assessment, so a viewer supplements their assessment by inferring the proportionality information. Generally that process provides a good appraisal of the visual impact provided care is taken when producing the photo simulations to avoid unintentional false clues.

False clues are often foreground clutter that appears to minimize the visual discontinuity of a proposed tower or tower modification. Objects such as telephone poles, trees, utility wires, and roadway signage in the foreground are a few of the possible clutter items that require a two-dimensional viewer to take special care in assessing visual discontinuities produced by a proposed tower or tower modification. Reasonable care should be taken to avoid photo simulations that include unnecessary items in the foreground because they can sometimes mask the assessment of the tower or tower modifications. Most of us have seen humorous photographs of friends holding their hands out in such a way as to make it appear an object in the background is resting on their hands in the foreground. This effect is possible when proportionality clues are misinterpreted by the viewer. An example is shown below.

1. Two examples of false visual clues in two-dimensional photographs.

In the first example, one eventually discerns that the person is located in the foreground and the Gateway Arch in St. Louis is some distance in the background – but for most viewers it takes a few seconds to make that connection. Unless one knows the proportion of the arch, it would be easy to draw the false conclusion that the arch is fairly minimal in size.

2. Gateway Arch in St. Louis with minimal foreground objects

In the second example, the visual perspective is an arguably "accurate" depiction of the scene of view. Some viewers would conclude that the tower, although a dramatic visual continuity on the horizon, is in proportion to the surrounding scene. If that photograph had been produced with a perspective that excluded the building and foreground trees, the true visual discontinuity would be more apparent. In a worst-case example of photo simulations gone bad, a photograph showed a large tree in the foreground with the caption “Proposed tower buffered by existing vegetation” when, in fact, had the photograph been taken from a position only ten feet either side of the tree, the balloon would have been clearly visible from that street view. However, with careful scene selection and minimal editing, photo simulations can provide a good assessment of visual impact.

Conclusion

The information in this report concerns the RF engineering issues related to the proposed project to assist the board in weighing the alternatives and planning for the future of the community. Engineering design choices implicate aesthetic and legal issues as well. However, this report must not be relied upon for any legal advice or direction. Legal advice about action on these issues must be obtained from the board’s counsel.

Thank you for the opportunity to assist the Town of Glenville. Please feel free to let us know if there are additional questions or other concerns at this time.

Sincerely,

William P Johnson
Consultant

Appendix A: Summary of Qualifications
Appendix B: Human Exposure to NIER
Appendix C: Alternative and Supplemental Technologies

Appendix A: Summary of Qualifications

I, William P. Johnson, certify that I:

1. joined the faculty of Rochester Institute of Technology (RIT) in September, 1989, and currently hold the rank of Professor Emeritus;

2. served as Graduate Program Director for the Telecommunications Engineering Technology program at RIT until June 30, 2020;

3. am and have been employed since 1972 in the radio-frequency (RF) and microwave industry holding positions prior to 1989 such as design engineer, staff engineer, VP Engineering, and consultant;

4. am actively involved in RF/microwave consulting;

5. hold graduate degrees in both electrical engineering and law;

6. am qualified to analyze radio-frequency design and performance documentation relevant to the justification of minimum radio antenna height and tower locations;

7. am qualified to comment upon alternate site analysis, aesthetic characteristics, and visual impact effects relevant to telecommunication towers by virtue of extensive involvement since 1997 in telecommunications site plan and New York SEQRA reviews and administrative agency and court litigation;

8. have consulted for over 80 municipalities and private organizations since 1997 in the area of broadcast and telecommunication facility tower review;

9. have a reputation in both the industry and among clients for being qualified and having the necessary relevant technical expertise needed to provide telecommunication facility tower review;

10. am the author of the technology content for the New York Department of State Land Use Technical Series publication *Planning and Design Manual for the Review of Applications for Wireless Telecommunications Facilities* (2001) (available at http://www.dos.state.ny.us/lgss/localgovt.html);

11. provided expert services and subsequent engineering testimony on behalf of defendant Town of Ontario, NY, during successful litigation defense in *Sprint v Willoth*, 996 F.Supp. 253 (WDNY 1998) and during petitioner Sprint's appeal in *Sprint v Willoth*, 176 F.3d 630 (2nd Cir. 1999).

Signed: 

William P. Johnson
Consultant

Appendix A: Summary of Qualifications

I, Steven M. Ciccarelli, certify that I:

1. am currently an Associate Professor at Rochester Institute of Technology (RIT) and joined the faculty in September, 2001;
2. served as Program Chair for the Electrical Engineering Technology program at RIT from September, 2005 until November, 2009;
3. served as Co-Chair of the IEEE Rochester Section, Microwave Theory and Techniques Society from 2004 until 2008;
4. successfully completed graduate courses and laboratories in analog IC design, MEMS devices and systems, microelectronics, micro-optics and photonics, RADAR and RFIC design from 2002 until 2007;
5. received The IEEE Third Millennium Medal *In recognition and appreciation of valued services and outstanding contributions* in 2000;
6. have been employed since 1993 in the radio-frequency (RF) and wireless industry holding positions such as RF/Analog Engineer, Senior RF/Analog Engineer and Director of Technology Development;
7. am actively involved in RF/wireless consulting;
8. hold graduate degrees in both electrical engineering and education;
9. am qualified to analyze radio-frequency design and performance documentation relevant to the justification of minimum radio antenna height and tower locations;

Signed:

Steven M. Ciccarelli

Consultant

Federal law preempts local zoning authorities from considering environmental effects of and human exposure to cellular/PCS RF emissions as long as the proposed base station complies with Federal Communications Commission (FCC) emission standards.[25] Nonetheless, the matter is sometimes of concern to residents, municipal staff and board members. In response to those concerns, the following information is offered for your consideration.

The FCC is required by the National Environmental Policy Act of 1969 to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment.[26] Toward this end, a substantial effort has been made by the FCC and other agencies to provide information to both the public and the wireless/broadcast industries. Guidelines and information relevant to Non-Ionizing Electromagnetic Radiation (NIER) health and safety assessment are published by the Federal Communications Commission Office of Engineering and Technology (FCC-OET).[27] FCC-OET and the Federal Drug Administration (FDA) jointly maintain an internet web site that provides basic information to consumers regarding cell phone health effects.[28] FCC-OET also publishes detailed technical information for the industry that recommends calculations and field measurement methodology to demonstrate compliance with the NIER exposure guidelines.[29] These methods and calculations were codified at 47 CFR §1.1307 and 47 CFR §1.1310.

At the international level, the International Agency for Research on Cancer (IARC), which is part of the World Health Organization (WHO), and the U.S. National Toxicology Program (NTP), which is formed from parts of several different government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA) provide on-going research and summary information regarding a wide range of RF emissions including emissions from cell phones and base stations.[30] To date neither IARC nor NTP have declared that the radio signals emitted from cellular 4G and 5G base stations that comply with FCC human exposure regulations cause human cancer or other human health abnormalities.[31]

In light of the information available, Congress and the FCC decided in the 1990s to exclude cellular/PCS and other base stations from mandatory NIER analysis when those sites meet certain emission and height requirements. In a study that spanned 13 counties and included 13,000 cell phone users, the World Health Organization (WHO) International Agency for Research on Cancer (IARC) Interphone Study Group published the results of a 13-country study in the International Journal of Epidemiology on May 17,

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[25] 47 USC §332(c)(7)(B)(iv).
[26] See National Environmental Policy Act of 1969, 42 U.S.C. Section 4321, et seq.
[27] http://www.fcc.gov/oet/rfsafety/
[28] http://www.fda.gov/cellphones/
[29] http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf and updates.
[30] http://www.who.int/peh-emf/en/
[31] See a very user-friendly summary of research and issues at the American Cancer Society web site https://www.cancer.org/cancer/cancer-causes/radiation-exposure/cellular-phone-towers.html

2010.[32] According to the World Health Organization in June, 2011, "[a] large number of studies have been performed over the last two decades to assess whether mobile phones pose a potential health risk. To date, no adverse health effects have been established as being caused by mobile phone use."[33]

Commenting on the Interphone study, Dr. Christopher Wild, IARC's director, said that "[a]n increased risk of brain cancer is not established from the data from Interphone. However, observations at the highest level of cumulative call time and the changing patterns of mobile phone use since the period studied by Interphone, particularly in young people, mean that further investigation of mobile phone use and brain cancer risk is merited."[34]

Beyond the potential damage to tissue caused by exposure to high-intensity NIER fields, some individuals report symptoms they attribute to low level NIER exposure. One hypothesis is that symptoms are correlated with physiological changes. Measurable physiological changes include metrics such as heart rate, blood pressure, and skin conductance. A three-year study performed at the University of Essex, UK, published in July, 2007, failed to find a correlation between low-level NIER exposure and such physiological changes.[35] In the study, the number of symptoms reported during the double-blind portion of the experiments was not related to the actual presence of low-level NIER.[36] This result is in agreement with earlier more limited studies.

On the arguably more conservative side, a report released on August 25, 2009[37] by International EMF Collaborative entitled "Cellphones and Brain Tumors: 15 Reasons for Concern, Science, Spin and the Truth Behind Interphone" includes, according to the report, endorsement by Ronald B. Herberman, MD, University of Pittsburgh Cancer Institute. While serving as director, Dr. Herberman had previously urged his staff[38] and the general population to recognize and understand that, while research has not proved conclusively one way or the other and given the uncertainty about the ultimate long-term safety of wireless radio signals, there are precautions that one can take. The report urges a skeptical individual and public policy approach to NIER exposure and encourages the on-going study of radio emissions and health concerns. The report urges prudent defensive actions to protect one's self and to move public policy toward a conservative

[32] Elisabeth Cardis et. al., *International Journal of Epidemiology* (2010;1–20) (Oxford University Press on behalf of the International Epidemiological Association) (May 17, 2010).
[33] "Electromagnetic fields and public health: mobile phones ", Fact Sheet No. 193 (updated June, 2011) http://www.who.int/mediacentre/factsheets/fs193/en/.
[34] CNET News at http://news.cnet.com/8301-27083_3-20005235-247.html (May 18, 2010).
[35] Stacy Eltiti et. al. "Does short-term exposure to mobile phone base station signals increase symptoms in individuals who report sensitivity to electromagnetic fields? A double-blind randomised provocation study" (Environmental Health Perspectives, 7/25/2007) (University of Essex, UK) available at http://www.ehponline.org. The study is also available at http://www.essex.ac.uk/psychology/EHS/eltiti%20et%20al%20BEMS%20ON-LINE%20PUBLICATION.pdf
[36] *Ibid*.
[37] See http://www.radiationresearch.org/pdfs/15reasons.asp
[38] See http://www.post-gazette.com/downloads/20080722upci_cellphone_memo.pdf

approach to NIER exposure. More recently, Dr. Brenden Curley[39], a medical doctor who specializes in hematology and oncology, stated in an interview with a news reporter that

> There is currently no definitive scientific evidence that cell phone use causes cancer. Some people may worry that cell phones emit radio waves or radiofrequency energy that can damage nearby tissue, causing brain cancer. According to recent research, patients with brain cancer do not report more cell phone use than controls or people without brain cancer. However, current research does have limitations, mostly because cell phones are relatively new and we're using them more now. So it's difficult to give a definitive answer right now. However, evidence currently does not support cell phones causing cancer.[40]

A report of partial findings from the National Toxicology Program (NTP) released on May 26, 2016, and the draft reports for tests on lab mice and lab rats was released on February 2, 2018. These releases present initial and final data regarding development of tumors during a multi-year study of lab mice and rats[41]. The study exposed lab rats to high levels of whole-body electromagnetic radiation (CDMA and GSM modulation formats) for 9 hours a day over a two-year period. The level of exposure was chosen to avoid thermal issues beyond that which the animal could self-regulate body temperature.[42] While this level is far more than exposure based on mass than allowed by the FCC for humans, the higher level (i.e. a "provocation" study) was used to allow study of the impact on the animal's organs other than just the brain. After release of the initial report, a press briefing was held to allow reporters to ask questions about the study data and preliminary results[43]. The audio and transcript may be a useful way for the general public to hear answers to some of the complex issues raised by release of the initial report. Researcher Dr. John Bucher, when asked by a reporter for the "take away" from the initial report for the general public said:

> So this is a study that is looking at the plausibility, biological plausibility, of carcinogenic effect due to cell phone radiation. The direct translation of these findings to the way humans are using cell telephones is not currently completely worked out and that's part of the evaluation that's going forward. This may have relevance, it may have no relevance.[44]

As of February, 2018, the NTP study has been released for peer review to establish independent credibility. The technical reports and related information is available on the NTP web site.[45] When last checked, an updated summary of the NTP study of high-level and long-duration NIER exposure to rats and mice is available online.[46] It should be

[39] See his bio at https://www.honorhealth.com/physicians/brendan-curley
[40] See http://www.12news.com/news/local/outreach/healthcheck/debunking-9-common-cancer-myths/452221027
[41] See http://biorxiv.org/content/early/2016/05/26/055699
[42] A 1-degree body temperature rise.
[43] Audio and transcript available at http://www.niehs.nih.gov/news/newsroom/releases/2016/may27/
[44] See transcript of press briefing available at http://www.niehs.nih.gov/news/newsroom/releases/2016/may27/ Page 24 of 36.
[45] https://www.niehs.nih.gov/news/newsroom/releases/2018/february2/index.cfm
[46] See https://www.niehs.nih.gov/health/materials/cell_phone_radiofrequency_radiation_studies_508.pdf

noted that the NTP study used much higher exposure levels and duration than a human using a cell phone held to their head would experience. The human exposure from a base station that complies with FCC threshold regulations is orders of magnitude lower than that of a cell phone held to the head or near the body. While the information in the technical reports is highly technical and uses terminology unfamiliar to most readers who do not perform research or services in the medical field, NTP summarizes the study findings for the rest of us and its application to human health by answering this question: Do the rat and mouse findings apply to humans? The published answer is as follows.

> The findings in animals cannot be directly applied to humans for two key reasons:
>
> - The exposure levels and durations were greater than what people may receive from cellphones.
> - The rats and mice received RFR across their whole bodies, which is different from the more localized exposures humans may receive, like from a cellphone in their pocket or next to their head.
>
> However, the studies question the long-held assumption that radio frequency radiation is of no concern as long as the energy level is low and does not significantly heat the tissues. [47]

Without meaning to minimize concerns on the part of any individual on this matter, the scientific information to date as a whole seems to favor a conclusion that neither the biological effects of tissue heating nor symptoms allegedly due to low-level NIER DNA damage are likely caused by a base station facility that complies with FCC guidelines. If anything, the use of a hand-held mobile device held to one's head or in proximity to the body is more of a concern since the mobile device transmits radio signals while communicating with a base station. When a base station is nearby, the propagation losses are less and the transmit power of the mobile device can be reduced (base stations control the mobile device output power to maintain low levels of interference with other users who are more distant or behind obstacles that block the RF signals. We note that while it is possible to prove scientifically that something is "unsafe" (i.e. identifiable and repeatable conditions that lead to the undesired result) it is logically impossible to prove that something is "safe" by performing any number of tests that are limited in scope and time. Wireless mobile device use, as is the case with other environmental exposure, is in the later category.

It remains undisputed that someday a peer-reviewed study and subsequent historical data validation *may* show that low-level NIER (as opposed to high-level and long-duration exposure of lab rats and mice) is likely problematic for a class of human population, such evidence does not currently appear to exist. The lack of such clear and objective evidence tends to defeat the assertion that low-level NIER from base station facilities may be dangerous. Naturally, a person who has health-related concerns or experiences any health-related symptoms should consult with a heath care professional – not an RF engineer.

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[47] Ibid.

Appendix B: Human Exposure to Non-ionizing Electromagetic Radiation (NIER)

Other Technology Approaches to Mobile Wireless Services - Satellite Systems, Distributed Antenna Systems, Small/Micro Cells, and Pico Cells

The board may already be aware of other approaches to deliver wireless communications that could avoid tall towers in a given area. On one extreme certain cellular-type systems can be implemented using low-Earth orbit satellites. On the other extreme, very small pico-cell systems can allow subscribers to connect to their own home or office network using technology similar to a cordless phone. Each approach has its advantages and disadvantages. Satellite systems provide a very large "cell" that is about 50 miles in diameter. Such a system is useful when there are very few users in the "cell" that require service, such as ocean-going vessels and land locations where natural disasters or other locations where there are limited base stations. Pico-cell technology uses a hard-wired subscriber's broadband connection to bypass the cellular network for that localized location. One such system that fits between satellite systems and pico-cells is called a Distributed Antenna System (DAS). Another approach, similar to a DAS, is a micro-cell that implements functions of a regular base station in a localized area. DAS and micro-cell systems, including transport sites, are presented here for completeness because this issue can arise in zoning hearings for new towers.

Distributed Antenna Systems (DAS)

DAS systems are designed and deployed by companies such as CommScope[48], Corning Inc.[49], JMA Wireless[50], NextG Networks[51], ExteNet Systems[52], and others who install and then lease use of the DAS to wireless service providers. Essentially a DAS involves an array of antennas mounted on existing telephone poles and short towers/structures that are otherwise unsuitable for a "macro" wire-area base station facility. The antennas and associated transceivers, sometimes called "nodes", are interconnected by fiber optic or coaxial cable links called a "backhaul." In the case of backhaul fiber optic links, the wireless RF signals are converted at each node to optical signals which can then be routed to a hub site and converted back into the signals useable by a specific service provider at a "head end" facility that will interface with the service provider's network.

Some wireless service providers use DAS technology to service tunnels, airport terminals, office buildings and other facilities where either signal penetration limitations, subscriber capacity demands, or lack of ability to construct a tower would stop wireless services. When above-ground utilities exist in an area, a DAS may have the distinct advantage of allowing wireless services from short sites that would tend to alleviate certain aspects of aesthetic concern over tall towers. Unfortunately, the multiplicity of antenna sites, the backhaul interconnection of the nodes using hard-wired connections and the lack of contingency power tend to limit their practical use to very dense areas or areas that are not serviceable by other means. Examples of DAS limitations include:

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[48] See https://www.commscope.com/
[49] See https://www.corning.com/
[50] See https://jmawireless.com/
[51] See https://www.nextgennetworksinc.com/
[52] See http://www.extenetsystems.com/

- need for numerous closely-spaced above-ground utility poles or light stanchions in the service area
- potential lack of of E-911 location technology to allow emergency responders to know a more precise location of an outdoor emergency call (an in-building DAS would not present such a problem since it is localized to the building in question),
- the regulatory constraints and deployment/operating costs to negotiate outdoor pole attachments and ground equipment locations,
- the potential fragility of the fiber optic or wired inter-node links that are usually more extensive and more exposed to falling trees or ice as in a conventional wireless base station topology, and
- lack of reliable/durable/cost-effective remote power at each node.

These limitations present significant potential reductions in performance and reliability that should be carefully weighed. Further, since the systems are sometimes deployed and operated by a third party, the cost to use the system may be excessive. While the limitations are real, in situations where it is not feasible to approve a tower that provides the necessary RF coverage and capacity a permit applicant seeks, a DAS to supplement their network or one that replaces the proposed tower is a possible approach. If necessary, the board's prerogative in this matter should be thoroughly discussed with the board's counsel because it is subject to all the legal limitations associated with the Telecommunications Act, court decisions, and Applicant's legal standing as a public utility in New York.

For an example of where DAS systems were previously operational and where new nodes were being installed, Lower Merion Twp in Pennsylvania had a twelve-node operational DAS.[53] The system was reported to be operational and, in the spring of 2009, there were zoning proposals before the municipality to increase the number of nodes in the system. Please refer to the township web site for the most up-to-date information. As of September, 2009, the City of Mount Vernon planning board had a joint application from ExteNet, a DAS system provider, and Metro PCS, a wireless service provider, for a special use permit for the installation of a DAS consisting of fiber optic cable and telecommunications equipment placed on utility pole structures located within the corridor of the public right of way throughout the city. Previously, the City of Yonkers granted pole attachment rights to ExteNet within that jurisdiction. A July 15, 2009 article that briefly discusses the use of the ExteNet DAS by MetroPCS is available online[54]. A more detailed news report dated March 31, 2009, is available from Reuters at their web site[55].

Micro-cells and Transport Sites

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[53] See http://www.lowermerion.org/index.aspx?recordid=558&page=50 or search the base URL for "DAS" and "NextG" for multiple documents, including the January 22, 2009, press release.
[54] See http://www.govtech.com/gt/articles/702090 (available as of September 7, 2009)
[55] See http://www.reuters.com/article/pressRelease/idUS254010+31-Mar-2009+BW20090331

Micro-cells provide the functionality of a regular base station in a very localized area. Depending on the deployment, the micro-cell communicates through a fiber optic or radio link backhaul, similar to a base station. Power backup and the reliability of fiber optic cable runs between antennas above ground are similar to the issues described in the DAS system discussion. Micro-cells are particularly useful in applications where user demand is limited to a small area such as a shopping or business area where mobile users are concentrated. Micro-cells can also be used in more densely populated areas where a tower base station is impractical due to zoning constraints. About nine (9) micro cell installations were approved by the Town of Pittsford, NY, for Verizon Wireless in 2022. The micro-cells can be mounted on existing above-ground utility poles, light stanchions, or on buildings in the area. These sites use self-contained electronics and antennas that communicate with a transport site, a "head end" facility, or a mobile telephone switching center via fiber optic or wired connections. The transport site can be an existing tower site, a tall structure, or a new tower either central to or within range of the micro-cells. A transport site will typically be in the range of 70' to 120'. The use of micro-cell antennas, sometimes called "cantennas," provide localized service and avoid a tall tower central to the coverage area In the case of a radio backhaul, the transport site, a tall tower, can be located off-center from the coverage area to collect the traffic from the local micro-cell. The combination of the micro-cells and one or more transport sites potentially replace the use a tall tower in the center of the coverage or capacity gap area. A discussion of one municipality and their reaction to the use of micro cells can be found online.[56]

Both micro-cells and DAS installations have become more important in recent years as wireless service providers struggle to bring increased use capacity and bandwidth to their subscribers. This push has placed municipal boards and planning staff in the difficult position of determining how to handle zoning applications for these systems. Transport sites (75' – 120' or more) are sometimes proposed in right-of-way areas adjacent to roadways and pedestrian walkways where the potential for ice shedding can be a public safety issue. Beyond the obvious aesthetic and issues related to fall zones and proximity to vehicles and pedestrians, municipalities are still trying to develop a process to represent the financial impact incurred by use of municipal infrastructure (light poles, traffic light support poles, etc.) due to the installation of equipment on these structures that increase wind loading and can affect the galvanizing on steel poles that potentially will decrease the service life of the structure. On the positive side, the use of micro-cells can avoid the challenges of zoning a tall tower in areas where aesthetics of the tower can be deferred to the aesthetics of the numerous micro-cell DAS antennas throughout the area.

[56] See http://buffalonews.com/2017/04/22/towns-confronted-ever-shrinking-cell-antennas/