advantage engineers

9/5/2017

City of Colorado Springs
Planning Department
Land Use Review

RE:

School District 11
Site Number CO-0075
5055 Montebello Place
Tax ID – 63221-07-001

Project Description:

Eco-Site Inc., proposes to construct and own a free-standing Stealth 60' Canister Pole Tower telecommunications facility to be located at 5055 Montebello Pl.., Colorado Springs, on land owned by School District 11. The facility will be used by T-Mobile, which will collocate its antennas and related equipment inside the Canister Tower and within a fenced compound. T-Mobile is licensed and regulated by the Federal Communications Commission and is responsible for providing wireless telephone service to emergency services, businesses and individuals in the geographic area that is shown on the coverage maps provided. T-Mobile is currently upgrading its network in the City of Colorado Springs to provide its service to the residents and visitors in the area and improve its service capacity due to customer demand. In order to provide adequate wireless services to the city, T-Mobile must place a telecommunications facility in a technologically and geographically appropriate location. Included in the application are RF justification statements from T-Mobile, showing coverage maps and reasoning on the location, height and size of the tower.

Based upon the requirements of T-Mobile, the applicant requests that the Canister Pole Tower height to be 60', to allow the potential co-location of up to three carriers.

The ground equipment will be in a fenced compound at the base of the tower. The compound will enclose all the equipment for the facility and will be landscaped per city requirements.

FIGURE 2

The site will be accessed by using a road off Montebello Place. There will be limited disturbance outside of the leased area that is shown on the site plan.

I have attached 6 full size copies and one reduced copy of the site plan, per comments summary.

Engineering –

1. The potential landslide susceptibility boundary is shown on page Z1, site plan and in the Geo Hazard Report.
2. Geo Hazard Repost is enclosed.

Review Criteria:

A. **Surrounding Neighborhood:** The site is on School District 11 property, which is R1-6 zoned land, as are the surrounding properties.

B. **Intent of Zoning Code:** The purpose of the Telecommunications facility addresses all three variables listed in the review criteria.

1. **Health** – All of the structures surrounding the project will remain below the main horizontal beam of the antennas (56') to which will lessen the impact of any RF radiation. The antennas will remain within the FCC's mandated power density limits, which remain well under 1% of the maximum deemed safe by the FCC.
2. **Safety-** The project will provide sufficient coverage for the surrounding residents in the community and more reliability in emergencies.
3. **General Welfare** – The project will initially house T-Mobiles cellular service and will be available for additional carriers to collocate thus providing fast and reliable service to cell phone users in the areas that depend on that coverage for everyday use.

C. **Comprehensive Plan** – The service will provide a higher quality of life for many residents who depend on the cell phone coverage. The service will also provide an upgrade in the increasingly demand for fast and reliable data service.

RF Justification:

See Attached T-Mobile Site RF Justification.

FIGURE 2

If you have any questions or concerns, please contact me.

Thank you,

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ecarroll@advantageengineers.com

FIGURE 2

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T-Mobile Site DN01602A RF Justification
CO-0075

T-Mobile Wireless submits this RF analysis in association with its proposed wireless communications facility to be located at 5055 Montebello Place, Colorado Springs.

1. QUALIFICATIONS

This report was prepared by T-Mobile Wireless' in-house RF Engineering Department, which consists of experienced and properly credentialed radio frequency engineers. The RF Engineering Department designs T-Mobile Wireless' nationwide network to provide adequate and effective wireless communications services in compliance with all FCC requirements, including T-Mobile Wireless' licensure requirements. The RF Design Engineers use proprietary software and tools in addition to industry-standard RF propagation modeling and network performance simulation programs to identify network coverage, performance and capacity deficiencies, and develop and implement solutions based on these analyses with the goal of maximize network performance and efficiency.

2. WIRELESS TELECOMMUNICATIONS SYSTEMS

The FCC licenses a specific amount of RF spectrum to each wireless carrier and stipulates that each carrier efficiently use that spectrum to provide adequate wireless communication services to emergency services, businesses and individuals in the licensed areas. Wireless carriers achieve this mandate by continuously reusing the allocated radio frequencies throughout their licensed service area. This is accomplished by building small radio base stations, or cell sites, in a particular pattern (also known as a grid). The application of the grid concept affords a wireless carrier the ability to effectively and efficiently plan the reuse of radio frequencies. Indeed, it is the only way a cellular system can adequately function. Following proper planning techniques (as originally defined by Bell Labs and further refined by the wireless industry), the same radio frequency is reused at reasonably close intervals throughout the licensed area, without causing harmful interference (noisy or dropped calls or the inability to originate a call are typical manifestations of harmful interference), but only if placed properly. There is extremely limited flexibility as to where a cell site can be located, and limited flexibility as to the proper height.

When designing a wireless network, an RF Design Engineer starts with a theoretical grid pattern and applies it to the licensed area. Each licensed area has many variables that can affect the design and must be considered. These variables include terrain features, use of existing structures, traffic distribution, and many others. In order to provide effective coverage while maintaining an appropriate frequency reuse plan, the RF Design Engineer must perform a balancing test of all applicable technological variables. The primary variables that the engineer must balance/take into consideration are location, and the overall height of the cell sites. Too close and there is interference. Too far and calls are dropped. If a cell site is too high, it will have increased coverage but will cause interference throughout the rest of the wireless network, thereby significantly affecting network efficiency. If a cell site is too low, it will not provide effective coverage.

Therefore, a properly designed wireless network design begins with strategically located cell sites. At each cell site there is a building, tower, water tank or other structure on which antennas are mounted.

FIGURE 2

Typically, radio-transmitting equipment (base station) is located at the base of the structure. Radio signals leave the base station and travel through transmission lines to the antennas or to fiber optic cable to the remote radio head (RRH) at the top of structure and then to the antennas. Radio signals are broadcast through the antennas and travel to the customer's wireless device, thereby completing a call. When a wireless customer transmits back to the cell site, the signal is received by the antennas, travels down the transmission line and into the base station. The base station converts the signal into digital data and combines it with all the other wireless calls and digital traffic at that cell site. This data is then sent over fiber optic digital leased lines to the main switching computer. The main switching computer or Mobile Switching Center (MSC) is interconnected to the national Public Switched Telephone Network (PSTN) and Internet service providers where calls are routed to other wireless or land-line phones, or Internet locations.

As this technology enables mobile calling, once a wireless call is originated and the customer travels away from the cell site of origination, the system tracks the changes and begins a process of determining if there is a better serving cell site (a "dominant server"). Upon determination of a stronger serving site, the system automatically switches the wireless customer over to the new cell site. This process is known as a handover and allows for seamless coverage within a wireless carrier's service area. By design, this process is supposed to happen so quickly, the wireless customer does not perceive it. If the network is designed properly, there is no interruption of service and connection quality remains adequate. Proper, effective RF design requires the location (and height) of cell sites in fairly rigid parameters.

3. PERFORMANCE METRICS

(a) Coverage

The critical issue for T-Mobile Wireless is the provision of "adequate and substantial" Radio Frequency (RF) service to serve its wireless customers. The wireless industry is governed by the Rules of the FCC. The FCC mandates in CFR 47, Parts §22.940 and §24.16 that each carrier must provide "substantial service" in its licensed service area, or risk having their license revoked. The FCC defines "substantial service" as service which is sound, favorable, and substantially above a level of mediocre service.

A metric called Reference Signal Received Power ("RSRP") is used to specify the coverage capabilities of wireless networks. This standard best represents the Long-Term Evolution ("LTE") data technology (also known as 4G) being utilized as well as the Voice-Over LTE ("VoLTE") technology, which is being deployed on 4G to augment and ultimately replace T-Mobile Wireless' wireless voice capacity. RSRP is the average received power measured across an LTE broadband channel.

RSRP is measured in units of "decibels" referenced against 1 milliwatt, or dBm. The decibel is a logarithmic unit that allows ratios to be added or subtracted. The definition formula for decibels referenced against 1 milliwatt is $dBm = 10\log(P / 1mW)$ with P measured in milliwatts. So 10 mW would be 10dBm, 100 mW would be 20dBm, etc.

The service boundary of a 4G site is defined using a RSRP equating to an acceptable receiver signal threshold. This value is derived from industry standards, 4G receive signal levels and quality and acceptable signal to noise ratios, along with statistically quantifiable variations in terrain. This threshold must also take into account additional losses associated with location of the mobile user.

T-Mobile Wireless must provide adequate service to all of its users. In order to account for users within buildings, additional margin must be added to RSRP so that adequate coverage exists inside. Industry and T-Mobile Wireless engineering standards include an additional 10dB of margin to RSRP to be used for light suburban areas, with increasing values for higher density land usage. This additional

FIGURE 2

margin is also required for in-vehicle service specifically to account for increased attenuation associated with the use of hands-free headsets, where the phone is typically placed on the seat or in the center console.

An industry standard RF computer-aided engineering tool is used in the design of wireless networks. This tool is used to generate a plot of RSRP that shows underlying geographic data (highways, arterial roads, etc.). The propagation map is drawn showing the region where the RSRP equates to the minimally acceptable received signal level for adequate service, as measured at the device's receiver. The propagation map depicts the RSRP of the surrounding environment including the attenuation of in-building and in-vehicle use of service and visually demonstrates existing coverage patterns. Plots can also be generated to demonstrate proposed coverage patterns.

With the preceding in mind, T-Mobile Wireless' network standard for reliable 4G LTE wireless service for highway and rural settings is -105 dBm RSRP. Network reliability and accessibility decreases dramatically for mobile devices operating in or traveling into RF environments outside (or weaker than) the -105 dBm RSRP coverage boundary (represented as white space in the provided coverage plots). Similarly, and as described above, -95 dBm RSRP is used in areas where additional signal strength is needed to penetrate into buildings (e.g., city centers, dense residential, commercial and industrial type environs).

(b)Capacity

Significant deficiencies in service can occur in T-Mobile Wireless' telecommunication network in and around the existing sites. These deficiencies can be a result of capacity demands that are taxing the surrounding sites in the T-Mobile Wireless network. The FCC mandates in CFR 47 Part §22.940 that when a Commercial Mobile Radio Service ("CMRS") licensee (i.e. "wireless carrier") is up for renewal, the carrier must demonstrate its proposal for expanding system capacity in a coordinated manner in order to meet anticipated increasing demand for both local and roamer service, or be at risk of license revocation.

T-Mobile Wireless regularly monitors customer traffic on each site in its network and identifies which sites are reaching 4G capacity limits or are projected to reach these limits over a rolling two-year window. Capacity is defined as the amount of customer data traffic (voice and data) a given site can process before significant performance degradation occurs. Performance issues include an inability to access the network (make a call), calls being abruptly dropped from the network (dropped calls), or poor call or data throughput performance while connected to the network (delayed upload or download speeds). Data volume, or throughput, is the main factor used to determine the existing 4G capacity for a given site and to project when that site is expected to run out of capacity (i.e., reach a point where it can no longer process the volume of data requested by local wireless devices). Capacity relief solutions, typically development of additional sites capable of "offloading" the "loaded" sites, are then required to solve the problem.

Forward Data Volume ("FDV"), a measure of usage (data throughput) on a particular site over a given period of time, is the performance metric used to evaluate the capacity of an existing facility. The "forward link" is used since there is generally more data being downloaded[1] (or transmitted) from a given site to the mobile devices within its coverage area, than uploaded. Therefore, it is the "forward link", not the "reverse link" that is used to determine the capacity limitations. Spikes resulting from anomalies such as seasonal events (tourist spikes, major outdoor concert venues or sporting events, etc.), college

[1] By comparison the reverse link, or information transmitted from mobile devices to an associated wireless facility, generally carries in the order of 1/10th of the data volume as the forward or downlink path.

breaks, holiday sales events or celebrations, and major accidents or emergencies are accounted for as they can inflate the capacity demand and result in a premature capacity offload prediction. Trending actual and recorded throughput data over time for a site and comparing it to the theoretical maximum throughput capabilities for that site determines when that site will require capacity relief.

The above are some of the concepts and parameters used when determining adequacy of the existing network.

4. PERFORMANCE SOLUTIONS

When the T-Mobile Wireless Radio Frequency Engineer identifies coverage gaps in the system or sites that have or will reach data capacity exhaustion, they issue a "search area." A search area is a geographical area located within the inadequately serviced area, and it is designed such that if a wireless telecommunications facility is located within the search area, and at an appropriate height, it will likely provide the required coverage. For the most part, locations outside of the search area will fail to provide adequate service to the cell. Due to technological constraints, there is limited flexibility as to where a new facility can be located, and still function properly. The goal of the search area is to define the permissible location for placement of a cell site that will provide adequate service in the subject cell, and also work properly as part of the overall network.

5. Coverage and Capacity Maps and Justification- Attached

T-Mobile Site DN01602A RF Justification

T-Mobile is requesting to build a Stealth Tower, 3825 Montebello Drive W. Colorado Springs, CO 80918, with a height of 60' AGL in order to provide new coverage and improved existing service coverage and quality in the residential and commercial areas and have continuous coverage between existing sites. Enhanced coverage and improved service will affect the residential areas, official and public buildings and commercial zones as follows:

Residential areas

- Montebello Drive W (North and South)
- Montebello Drive (North)
- Saddlewood Drive (North and South)
- Academy Blvd (North-East)

Official and Public buildings

- Russell Middle School
- Keller Elementary School
- Keller Park
- Fire Station 10
- US Postal Office

Commercial areas

- Austin Bluff Plaza

The accompanying coverage prediction plots exhibit the need for this height and location. The colored pink shade shows "In-Building Residential" quality coverage. The blue colored shade shows additional "In-Building Residential" quality coverage.

Existing T-Mobile Coverage

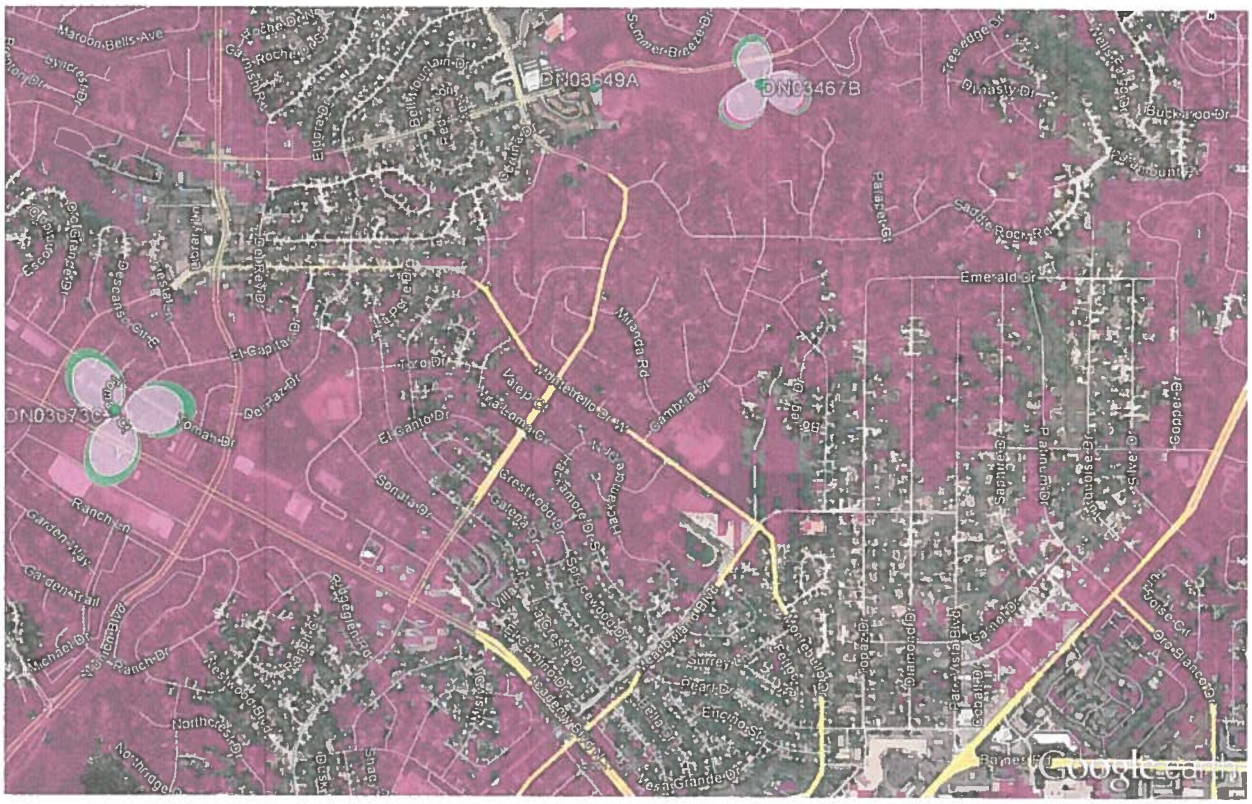
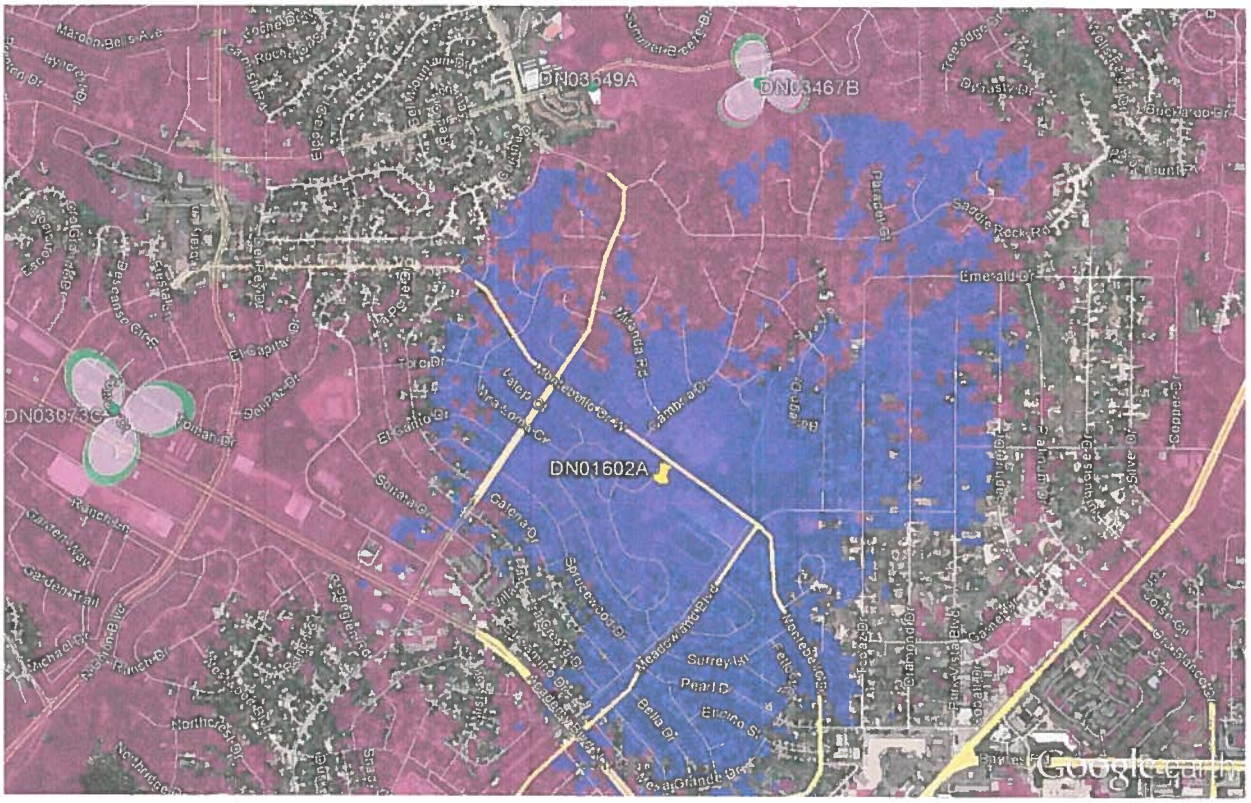


FIGURE 2

Coverage with DN01602 A @ 56'



There is improvement in coverage and service quality around the proposed site and in all areas listed above. We have continuous coverage between existing sites.

Because this is a very dense residential community the number of homes benefiting from quality coverage is reduced significantly with height limitations. Additional height would be required to completely fill in these gaps, but T-Mobile engineers believe 56' is a good compromise, allowing for better indoor coverage for the customers. In addition, 56' will provide significant offload of neighboring congested cell sites alleviating current call performance issues and providing a buffer for future network traffic growth.

FIGURE 2