



Thinking outside the sphere

Report on Analysis of Proposed Cell Tower at 831 Derby-Milford Road, Orange, Connecticut

August 27, 2014

David Maxson, WCP

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August 21, 2014

Summary

This report reviews the evidence provided by the applicant Cellco (“Verizon”, or “Applicant”) regarding the Applicant’s requirements for the proposed facility at 831 Derby-Milford Road (“Orange North”) and whether there are other ways to address any real need for a facility in the area.

In short, the Applicant has proposed a facility that does nothing to satisfy the design requirements established by the Applicant. The proposed facility is more than unnecessary; it is useless with respect to the applicant’s stated objectives.

Moreover, in presenting evidence to support its application, the Applicant has misinformed the record with a series of claims and submissions that are incorrect and/or irrelevant. 850/1900 MHz CDMA coverage is irrelevant. 2100 MHz LTE service is a capacity overlay to 700 MHz and is not in itself a coverage issue. 700 MHz service is LTE and should not be represented by CDMA coverage mapping. Capacity relief claims are broad and unsubstantiated. Coverage maps are not indicative of where new overlapping servers provide their capacity relief.

The result is a confusing, inaccurate and incomplete record in the matters of the Applicant’s coverage and capacity as well as in the evaluation of alternatives. By careful analysis of the service areas of the existing sectors and of the three sectors of the proposed facility, we have determined that the proposed facility fails to satisfy any of the design requirements specified by the Applicant. A facility at or near the proposed location would therefore be a waste of the resources of the Applicant and the State of Connecticut.

Finally, the Applicant makes nearly identical claims about a planned facility at 111 New Haven Avenue in Derby (“Derby South”) as it does about the Orange North facility. Notably, the Derby South facility would actually have some influence on relieving capacity demands on certain Derby North and Derby sectors, while the Orange North facility would not. Derby South is not



so much an alternative to Orange North as it is the solution that confirms Orange North is unnecessary.

In sequence, this report addresses coverage claims, then capacity claims, and concludes with a discussion of where effective sites should be looked for to address the Applicant’s stated design objectives. First, below is a table summarizing some findings of this report with respect to the role Orange North plays (fails to play) in providing “significant capacity relief” to other sectors. The proposed Orange North facility dominates substantial portions of the existing service area of only one sector. That sector – highlighted green below – is Derby North Gamma, which is not among the sectors claimed to be approaching exhaustion. It is also one of the sectors on which the applicant did not even submit capacity utilization data.¹

Sectors Initially Said to Receive “Significant Capacity Relief”	700 MHz LTE Stress in Subsequent Submittal?	2100 MHz LTE Stress?	Capacity Replacement by Orange North?
Milford NE Alpha	Exhaust trend 2014	Not reported	Inconsequential: Small patches in Shelton on hillside over river
Derby North Gamma	Exhaust trend 2015	Not reported	Inconsequential: Small patches in Shelton & Derby along river. Much undeveloped area.
Derby Beta	Exhaust trend 2016	Not reported	Essentially none: Tiny patch about 600 feet across.
Shelton 2 Beta	No	Not reported	None
Orange 2 Gamma	No	Not reported	None
Orange 3 Alpha	No	Not reported	None
Derby North Beta	Not reported	Not reported	Three Sectors of Orange North dominate portions of this sector
Orange 3 Gamma	Not reported	Not reported	None

Table 1- Comparison of Eight Sectors Originally Said to Obtain Significant Capacity Relief from Orange North

¹ This report relies on color and shading to present detailed information. It is recommended that this report not be electronically scanned from a printout. Any printouts should be performed with a good quality color printer. The submitted electronic version is the original.



Coverage

The applicant admits any new coverage obtained from the proposed facility is subordinate to the capacity relief offered by the proposed facility.² Nevertheless, the Applicant submitted only coverage data in the original application. The coverage data is in the form of coverage maps for four frequency bands: 700, 850, 1900 and 2100 MHz. Existing coverage from six surrounding facilities is shown in composite on each map. The Applicant provided two maps for each band – one with existing coverage only and one with proposed coverage overlaid on existing.

1. The 850 and 1900 MHz Coverage Maps Are Irrelevant

The Applicant allows only that the addition of 850 and 1900 MHz facilities at Orange North is “expected” sometime in the future.³ There are no plans to add such facilities to Orange North. Voice service is provided by the 850 and 1900 MHz CDMA network. Given that the Orange North facility has no concrete planning for 850/1900 MHz, it is self-evident that there is no pressing need for new CDMA facilities and therefore no coverage gap of any consequence to CDMA voice service. The 850 and 1900 MHz coverage maps are irrelevant.

With respect to certain remarks by the Applicant at the August 12, 2014 hearing, the fact that there continues to be robust use⁴ of the CDMA network should simply be due to the use of CDMA for voice services by all subscriber phones. LTE phones also rely on the CDMA network for voice calling.⁵

² E.g. Sandy Carter, p. 64 line 8, transcript 01, July 17, 014, “...we have to build Orange North as a capacity site...”

³ Application narrative p.2 footnote 1 says “Cellco expects to deploy its 850 MHz and 1900 MHz wireless services at the Orange North facility in the near future.” July 17, 2014 transcript indicates 850 MHz will remain to serve the “legacy” network of non-LTE devices (CDMA only) while “maybe the 1900 MHz frequency” (ln.14) “will be incorporated somewhere in the future in this [Orange North] site.” (ln.9) Such LTE use of 1900 MHz would likely occur when the capacity of the 700 and 2100 MHz LTE services are stressed and the 1900 MHz spectrum is no longer needed for CDMA voice calling. Moreover, the Applicant does not “see any plan yet for the 850 MHz frequency” to be incorporated in the future to Orange North.

⁴ Latorre, August 12, 2014 Transcript p.219, l.13 “...our existing 1xCDMA network is still as busy as ever.”

⁵ Recent press reports indicate Verizon is beginning to turn on its voice over LTE services nationwide.



Only when Voice over LTE (“VoLTE”) becomes widely available – not only on the network, but also on the installed base of user phones – will the voice traffic on the CDMA network decline significantly.

Transition to LTE voice service will not be instantaneous at time of VOLTE turn-on. When LTE voice services are finally turned on for the Verizon network, only the newest LTE phones will have LTE voice capability. Older LTE phones and even older CDMA-only phones will continue to rely on the CDMA network on 850 MHz, and to a lesser extent 1900 MHz, for voice until they are replaced over time as subscribers upgrade.

Demand for CDMA services will only decline. There are no drivers of new CDMA traffic. Gaps in CDMA coverage, if any, in the Verizon network are now (or will be soon) inconsequential because the 2G and 3G CDMA technologies are now on track for full sunset in six years.⁶ By analogy, the analog wireless services had stopped being expanded for about a decade, with the analog network frozen in place and maintained until it was finally “sunsetting” in 2008.

2. The 2100 MHz Coverage Map Is Irrelevant

The Applicant would have the 2100 MHz coverage be evidence of gaps in the Applicant’s provision of service.⁷ However, the 2100 MHz element of the Verizon LTE network provides capacity support to the underlying 700 MHz network. It is commonplace in the technical literature to find discussion of the use of higher frequency facilities (such as 2100 MHz) as a capacity “overlay” to supplement the capacity of the lower frequency (such as 700 MHz).⁸

⁶ For example, <http://www.fiercewireless.com/story/verizon-wireless-sunset-2g-and-3g-cdma-networks-2021/2012-10-10>, “Verizon Wireless plans to shutter its 2G and 3G CDMA network by 2021.”

⁷ For example, “...a series of coverage gaps (at both 700 and 2100 MHz frequencies)...” from p.2 of the May 13, 2014 Application for Certificate of Environmental Compatibility and Public Need.

⁸ For example, while the FCC allows that there can be a gap-filling role for above-1-GHz spectrum where providers lack coverage at lower frequencies, the concept of a multiband facility is based on the higher frequency band serving as a capacity overlay, “As a general matter, a provider is best positioned if it holds complementary spectrum bands. Spectrum below 1 GHz is considered most suitable for establishing base network coverage, especially for wide area and in-building coverage. **Higher frequencies often can best enable providers to increase capacity where needed**, especially to provide higher data rates, and to fill in gaps in coverage. Spectrum from 1 GHz through 2.7 GHz is currently often used as capacity spectrum.” Federal Communications Commission, Sixteenth Annual Mobile Competition Report, FCC 13-34 (2013), p.17. (**emphasis added**)



It is well understood that land cover, and particularly vegetation, attenuates the higher frequency signals more than the lower frequency signals, assuming all other characteristics of a facility are equal (power, antenna positions, air-interface technology, etc.). Consequently, most dual-band cell sites experience greater coverage from the lower frequencies than the upper frequencies. It is almost a universal case that even with an ideal coverage footprint from a lower frequency, there will be gaps (however minor) within that ideal footprint when looking at the higher frequency coverage footprint.

The 700 MHz coverage extends to what is called the “cell edge” while the 2100 MHz signal provides a substantial amount of supplementary coverage under the 700 MHz footprint to provide more capacity within the sector area. Because 2100 MHz coverage is simply a means to increase capacity for the underlying 700 MHz coverage, the 2100 MHz service is a capacity play and not a coverage stratagem. A coverage map for 2100 MHz is irrelevant to this matter.

3. The 700 MHz Coverage Map Is Incorrect

The 700 MHz coverage map does not model LTE service. The Applicant relies on a presentation that muddles LTE and CDMA technology. The application misstates the nature of Orange North when it describes the Cellular System Equipment on pp.10-11 of the May 13, 2014 Application for Certificate of Environmental Compatibility and Public Need (“Cert App”). The System Design is entirely described as a CDMA system, including CDMA product sheets, despite the fact that what is proposed is an LTE implementation on 700 and 2100 MHz without CDMA.⁹

The incorrect conflation of CDMA and LTE technology is continued in the August 5, 2014 response to intervenor interrogatory #25 where the “55% cell loading” factor appearing on all of the coverage maps is explained as the CDMA factor that it is, despite the fact that the maps for 700 and 2100 MHz ought to represent LTE coverage. In LTE technology, there is a relationship

⁹ Unmentioned in the Cert App are two LTE Remote Radio Head (“RRH”) cut-sheets included in Tab 7. It may not be evident to a lay person that these Alcatel radio heads support LTE technology, because the term “LTE” does not appear in the sheets (Alcatel-Lucent sheets in Tab 7) and the Applicant ignores them in its narrative.



between loading and throughput speed, for a given location. However, at cell edge, cell loading is not a determinant of whether there is data service at a given location.¹⁰

Based on the information provided and questions answered, all four pairs of coverage maps provided in the application employ CDMA coverage analysis thresholds. Further, the applicant declined to disclose its link budget for 700 MHz and 2100 MHz LTE. While the coverage threshold of -85 dBm is reported as Verizon's national standard for CDMA mapping and is depicted on all the maps, no mention is made of an LTE coverage mapping threshold.

A recent submission by Verizon to a zoning hearing in Massachusetts employed a threshold of -95 dBm for the 700 MHz LTE coverage (Attachment 1). This coverage model is based on a customary practice of employing the received power level of certain elements of the LTE signal that remain constant during transmission. Not only has the Applicant modeled CDMA instead of LTE coverage, but it has declined to explain its methodology for evaluating coverage of LTE. Without documenting a model with an explanation of the inputs, margins and outputs employed in the link budget, the result is an arbitrary threshold value based on undisclosed assumptions with no way to peer review the analysis.

By analogy, it is well-known that to take the temperature of a turkey in the oven, the thermometer should be placed in a certain more-or-less "standard" location in the turkey. Public health science has established recommended temperature ranges for cooking a turkey, although connoisseurs look for different temps for dark and light meat. Now for LTE, the applicant has not disclosed how it is taking the "temperature" of the LTE "turkey" in its modeling or what "temperature" is the objective for coverage and why. Without the underlying assumptions/methods disclosed, any LTE coverage map the Applicant may provide is meaningless.

At this point, there is no information on the record to determine how the Applicant would model LTE coverage at 700 MHz, if it chose to do so. Isotrope is aware of conventional modeling methods for LTE and has employed those in this analysis.

The Applicant's 700 MHz (and 2100 MHz) coverage maps are based on CDMA technology, are not indicative of LTE coverage, and are irrelevant to the application.

¹⁰ For example, J. Salo *et al* explain that, "As the cell range increases, the cell edge throughput approaches the same limit regardless of cell load" (Practical Introduction to LTE Radio Planning, p.8, http://digitus.itk.ppke.hu/~takacsgy/lte_rf_wp_02Nov2010.pdf)



4. The Purported LTE 700 MHz Coverage Gap Is Not Demonstrated and is Immaterial

Even if the 700 MHz coverage map documented 700 MHz LTE coverage, and the threshold had been properly established, the “gaps” in 700 MHz LTE service in the vicinity of the proposed facility are immaterial because of their small size and the likelihood that there is at least marginal service within those minor coverage holes. The applicant has agreed that the reason for the facility is for capacity relief.¹¹

Capacity

The Applicant made assertions relating to capacity issues in its application that it has since modified or contradicted in subsequent submittals and testimony. Even taken at face value, the modified assertions are incorrect and do not employ appropriate methodology. We are reluctant to assist the Applicant by telling the Applicant how it should present capacity analysis to the Siting Council; however, the Council deserves to be informed of methods for evaluating capacity implications, particularly because the Applicant has failed to do so.

In this section we follow step by step through the claims and conclude that the proposed facility does nothing to satisfy the Applicant’s stated requirements.

5. Initial Claim Is Excessive and Unsubstantiated

The Applicant (App Cert p9) claims the Orange North facility would “provide significant capacity relief” to 8 sectors among 6 cell sites surrounding the proposed facility. The Applicant simply stated that the facilities receiving relief from Orange North are apparent to an expert (the Applicant’s RF engineers) by viewing the proposed coverage maps.¹² We disagree strongly, and explain in the following detailed analysis.

¹¹ *Op. cit.* Hearing transcripts

¹² August 12 Transcript p.324, l.1-12 Latorre: “Our judgment is that when this Orange North Connecticut site is built this will provide capacity relief because we have positioned it in an area where our current Alpha Sector of the Milford Northeast cell site is currently serving some of the capacity demand along with the other sectors in the area.” Coppola: “And when you say, “it's your judgment,” what do you mean by that?” Latorre: “Through our expert RF analysis.”



The Applicant also asserted, incorrectly, that all eight sectors were due for overload by 2016.

The sector utilization data provided by the Applicant on August 5th pared the 8 sectors down significantly, revealing the fanciful nature of the original 8-sector claim. The applicant had this information all along, yet the application made the 8-sector overloading claim. This was an excessive and unsubstantiated claim.

6. Modified Claim Is Excessive and Unsubstantiated

The August 5th submission confirmed (considering 700 MHz LTE only) that only three¹³ of the eight sectors listed were experiencing loading trends that indicate overloading might occur by early 2016. Three more¹⁴ of the eight sectors were shown to have no expected loading issues for more than three years (the predictions do not go past three years). Two¹⁵ of the eight sectors were eliminated from the assessment.

The Applicant asserts that the three Unstressed Sectors, while not trending toward overload, will still obtain significant capacity relief from the proposed facility.¹⁶ Even if there were substantial overlap between Orange North and the existing coverage of the three Unstressed Sectors, it is difficult to interpret such overlap as providing “significant capacity relief” when no capacity relief is needed at any foreseeable time.

In addition, as discussed in detail below, of the three Stressed Sectors, none are materially affected by the Orange North proposal.

Based on the foregoing, the August 5th and 7th responses of the Applicant and the August 12th testimony continue to completely overstate the benefits of the proposed facility. Therefore, the claims as modified in early August still represent excessive and unsubstantiated claims on the capacity benefits to be provided by Orange North.

¹³ The “Stressed Sectors” – Milford NE Alpha, Derby Beta, Derby North Gamma

¹⁴ The “Unstressed Sectors” – Orange 2 Gamma, Orange 3 Alpha, Shelton 2 Beta.

¹⁵ The “Withdrawn Sectors” – Derby North Beta & Orange 3 Gamma

¹⁶ Aug 12, p.309, l.25 Latorre: “I would submit to you that all six of these sites will receive some capacity relief through the deployment of our proposed Orange North Connecticut location, with the three sites, Milford Northeast, Derby, and Derby North seeing the most immediate capacity relief due to their increased capacity demand based on our current trending.”



7. Capacity Data Is Incomplete and Insufficient

The capacity utilization data provided in the August 5th submission only addresses 700 MHz LTE capacity utilization and ignores 2100 MHz capacity relief. The Verizon 700 MHz LTE channel is 10 MHz wide (10 up and 10 down). The Verizon 2100 MHz license is for two adjacent 10 MHz channels (total of 20 MHz up and 20 down). In short, the 2100 MHz element of the Verizon LTE network has the ability to triple the total LTE capacity of the Verizon network within the 2100 MHz overlay of each sector. The lack of capacity utilization data on 2100 MHz spectrum is a material lapse in the documentation of a capacity claim. The applicant has provided no evidence that the 2100 MHz network element is even providing service, let alone answering the question of how much loading it is experiencing.

Moreover, at some point well before 2021, the 1900 MHz spectrum will become available for conversion to LTE service. This provides an additional 20 MHz of new LTE spectrum to further spread out demand. No assessment of the longer term impact of this spectrum on capacity utilization is provided.

8. A Coverage Plot Is Not a Capacity-Relief Plot

The Applicant indicated¹⁷ that the -85 dBm coverage footprint of Orange North (shown as a purple overlay on the second 700 MHz map in Tab 6 of the application) shows the geographic area where the Orange North Facility would provide significant capacity relief to other sectors. This is incorrect.

LTE technology reuses the same entire radio channel at every sector (a frequency reuse factor of 1). This means that the received signal level from one sector can be above the desired level but the overlap signal from another sector could be at an even higher level. The stronger received

¹⁷ Prefiled Testimony of Jamie L. Laredo, Jr., p.3, Q.4, “the portion of the coverage footprint of the new (Orange North) site that overlaps with the coverage footprint from the existing sites is the area where those capacity benefits are realized.” Affirmed in testimony on August 12, 2014, Transcript, p. 325, l.7, Latorre: “Where the purple coverage overlaps with the existing coverage in the dark shade of gray there will be capacity relief for those sectors.” Also, p.314, l.3 Latorre: “Based on our RF modeling we show that the projected RF footprint will -- of the Orange North facility will provide overlapping coverage to each of the six sectors, or I should say, the six sites identified in our prefiled testimony. Therefore, once the site is created, the proposed Orange North facility will, by the nature of overlap, allow customers to utilize the proposed facility in areas of overlap where currently today they have no additional cell site option for them to access the LTE network.”



signal prevails. Cell site placement and antenna selection and positioning are employed to manage the areas where the coverage from adjacent facilities overlaps. These overlap areas are challenging to the network and can be minimized in size and shifted to less populated/traveled areas when practicable. Overlaps occur where the signal levels of the two overlapping sectors are close to the same value. Otherwise, when one or the other signal is stronger, the dominant signal prevails and the interference between sectors diminishes.

Consider the signals emanating from Orange North, for example. The Applicant's coverage map¹⁸ shows that Orange North 700 MHz coverage essentially completely overlaps existing coverage. Based on the Applicant's 700 MHz coverage map, the -85 dBm edge of coverage of Orange North extends relatively close to several other cell sites. One might infer that the proposed facility will provide coverage and capacity relief to sectors of all those nearby cell sites. This would be incorrect.

Even if both sectors are received at one location with levels above the minimum, the dominant signal will tend to mask the other signal. Then, as one travels from an existing sector into a new sector, the signal levels of the existing sector decay as the signal levels of the new sector increase.

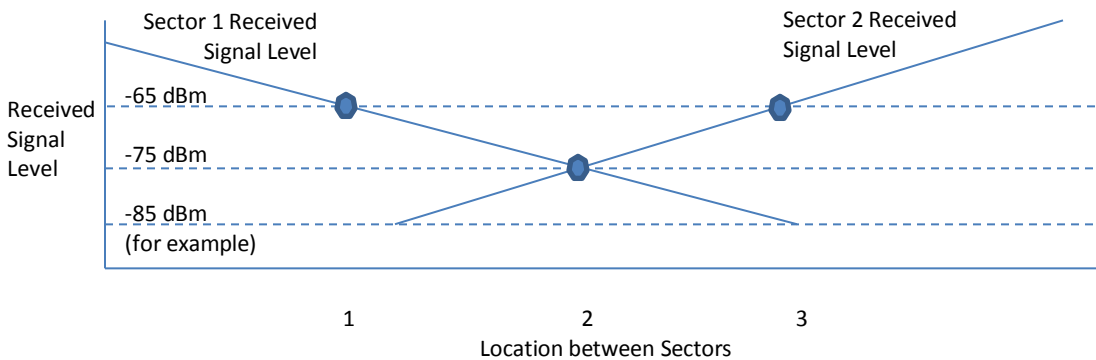


Figure 1 - Cross Section of Overlapping Coverage between Two Sectors, Formatted to Illustrate Overlapping Signal Levels of Two Servers at any Chosen Point

Figure 1 illustrates those cases where there is substantial overlap between an existing sector's coverage and a new sector's coverage. Moving from left to right, the dominant sector on the

¹⁸ For the purposes of discussion, we refer to the applicant's CDMA coverage mapping at 700 MHz due to the lack of LTE coverage mapping at this frequency.



left is Sector 1 at the location marked Location 1. A strong -65 dBm signal, for example, is received from the dominant sector, while the distant sector (Sector 2) also provides a weaker -85 dBm signal, which would have been usable, but for the fact that the dominant Sector 1 prevails. Since both signals are on the same radio frequency channel, the weaker signal is drowned out.

Moving to the right, the user gets to Location 2 where the signal levels from both sectors are about equal. In this example, the level is -75 dBm for each signal. With equal signal levels, there is self-interference in the network. When the user is in this narrow region where neither signal prevails, the sectors can be programmed to cooperate and intermittently interrupt all or portions of one signal so the other can get through. Throughput speed is reduced, but the connection remains viable.

Moving farther to the right, at Location 3 the user is now in the influence of Sector 2 as the dominant sector. The roles have reversed. Sector 1 signal is masked by the stronger Sector 2 signal, even though the -85 dBm Sector 1 signal would otherwise have been a usable signal in the absence of stronger Sector 2 energy. The overlaps between sectors do not always follow this particular set of signal levels. Also, at the point of equal signal strength, the actual signal strength could be lower or higher than -75 dBm. This example illustrates the general case where there is a region where both sectors' received signal levels are potentially mutually interfering, and on either side of that region one sector is the dominant server.

The example above reveals how the -85 dBm raw coverage footprint of a new facility is not necessarily indicative of the area where the new facility will provide capacity relief. In a situation where there is no existing service, and a new-coverage site is planned, the signal level can decay to the threshold at the edge of new service. In contrast, under full-overlap conditions such as the current proposal, where there already is substantial coverage from existing cell sites, the actual area of new server dominance is limited to where its received signal is stronger than the existing signals. As a result, the actual area of server dominance will be smaller than the coverage-only service area described by the coverage threshold.

The next image, Figure 2, simplifies Figure 1 to illustrate which server is dominant, and what the dominant server's signal levels are across the path from one sector to the other. Only the dominant server is assigned a color, which is applied to the map.

Using the method described above to evaluate all points on a map, the dominant server at each location can be displayed, regardless of the signal strengths at the point of overlap. This way to visualize the dominant server coverage area is available in modeling software. It is called a "most likely server," "MLS," "best server," or "dominant server" plot.

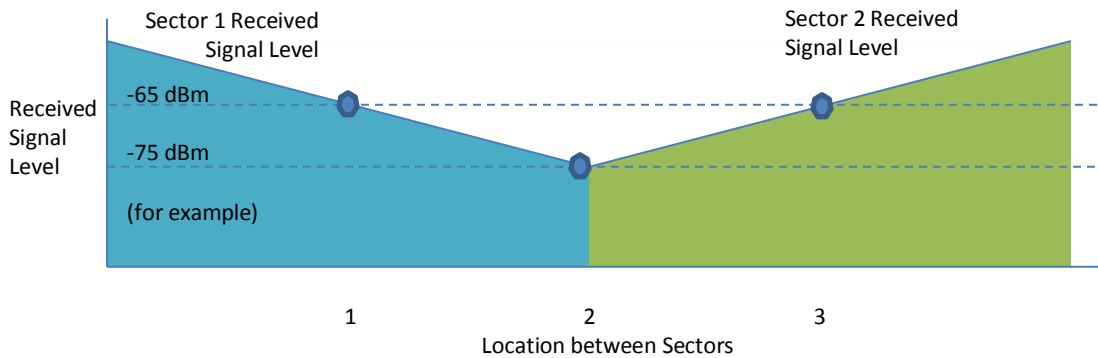


Figure 2 - Cross Section of Overlapping Coverage between Two Sectors, Formatted to Illustrate Most Likely Server

Isotrope has prepared an MLS map of the existing 700 MHz network and one of the existing-plus-proposed situation. They are included in small format below to support the discussion and are placed in Attachment 2 in larger format.

The Applicant’s coverage plots in Tab 6 of the application provide no insight whatsoever into the nature of and location of potential capacity relief obtained from Orange North by any of the 8 listed sectors. Using the Applicant’s 700 MHz existing-plus-proposed coverage map included in Tab 6 of the Application, it is impossible to make any quantitative analysis of whether a given existing sector obtains server relief from a proposed new sector. It is also impossible to use this map to determine that a particular existing sector will obtain “significant capacity relief” from a proposed facility, as was originally claimed for eight existing sectors in the application.

9. MLS Maps Show the Applicant’s Capacity-Relief Assumptions are Incorrect

In the following sections, we consider each of the 6 remaining sectors that are said to obtain significant capacity relief from the proposed Orange North facility. First, in this section, the MLS mapping technique is explained.

Isotrope prepared a most likely server (“MLS”) map of the existing 700 MHz facilities, based on the facility information submitted by the Applicant in response to interrogatories (the “Transmitter Table”). Isotrope employed the Applicant’s power levels and antenna gain factors and other antenna positioning characteristics to simulate existing Verizon coverage in the subject area. An MLS map was generated and is presented below.

The MLS map of existing sectors is set up with the following characteristics.



Each cell site is represented by a set of three wedges that represent the orientation of the three sector antennas.

To indicate the region where a cell site is the most likely server each cell site's service area is presented as a different color. The colors are shown in the key, with abbreviated site names.

The Derby, DerbN, Mil, Or2, Or3 and Shel prefixes represent the Derby, Derby North, Milford NE, Orange 2, Orange 3 and Shelton 2 cell sites, respectively.

The middle value of the key names –“7” – simply indicates the 700 MHz network element was modeled. Since 700 MHz is the base coverage frequency for the LTE network, it is the appropriate representative frequency for evaluating the most likely server.

The last digit in the key name indicates the sector, where 1, 2 & 3 represent Alpha, Beta, and Gamma sectors respectively. While each site has a unique color, the sectors are indicated with minor shifts in the shading of the colors.

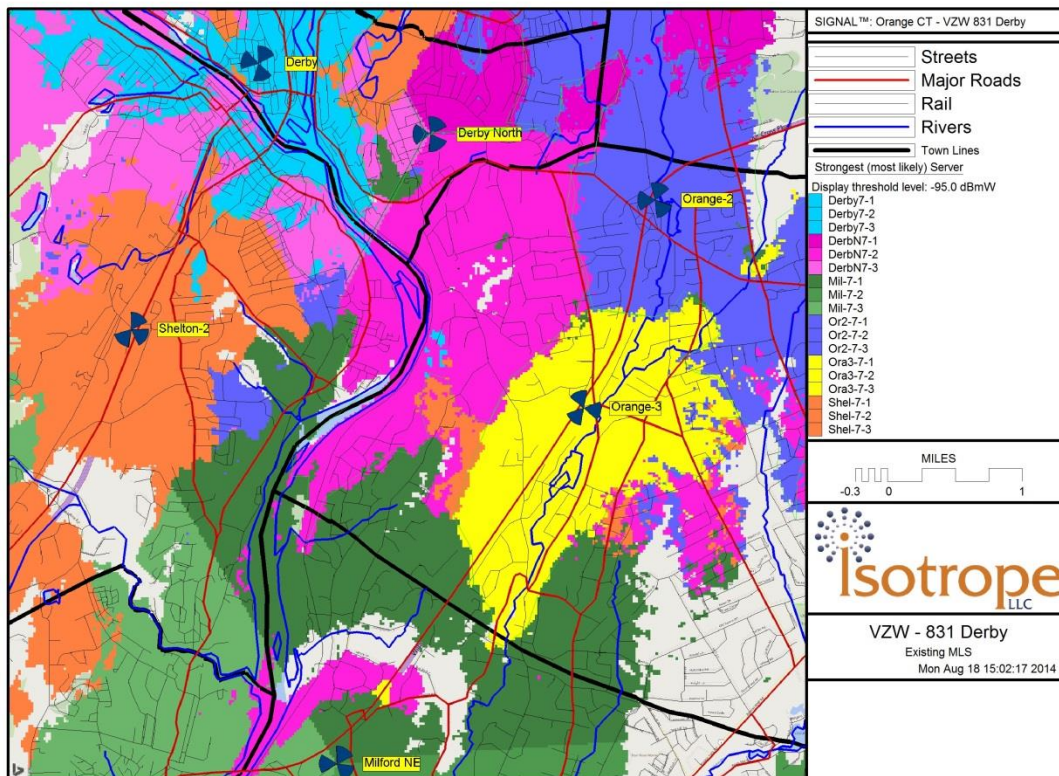


Figure 3 - Most Likely Server Map of Existing Verizon 700 MHz Service



Anywhere a particular color/shading value appears (such as Derby North Beta medium pink¹⁹), that sector is indicated as the most likely server.

We employed an MLS cutoff level of -95 dBm because it is a viable signal level, regardless of what the official threshold may be. At a location where the received level of a sector in this region is below -95 dBm there is usually another sector that dominates. In some small areas, no sector dominates at a level above -95 dBm, and the white background is exposed. Because MLS is a comparison of signal levels at each location and because there is predominantly -85 dBm or higher coverage already serving the region, the impact of changing the MLS cutoff on the maps herein will be immaterial, so any issues with our selection of this value are moot.

To clarify the locations of the various sectors, they are marked in the next figure (Figure 4).

It can be seen that at the general location of the proposed facility in northern Orange the most likely server today is the Derby North Beta sector. Recall that the sectors generally start by going clockwise from north in Alpha, Beta, Gamma order. The Derby North Gamma sector coverage is oriented due west (270 degrees true north) and has a mildly lighter shade of “pink” than the other two Derby North sectors. Note how the Derby North Gamma service jumps across the river valley, where the Derby (light blue) sector is dominant, and reaches the high ground on the west side of the river, and north of Shelton 2 (orange color).

Milford MLS comes in from the south (green); Shelton 2 MLS from the west (orange); Orange 2 and Orange 3 MLS are in the east (blue/lavender and yellow, respectively).

In Figure 5 the Orange North facility has been turned on, and the MLS calculation was run with Orange North and the existing facilities. A new color, a deeper blue/purple, is assigned to Orange North proposed MLS service. To also use Figure 5 in the next discussion, a brown dashed line is drawn around the existing Milford NE Alpha MLS area.

¹⁹ Note that colors will vary among computer screens and among printouts. Use the key to match colors/shades. Primarily, each cell site is surrounded by its own color, and there are more distant areas where hillsides are exposed to “splashover” from a more distant sector. With apologies to those who have color vision deficiency; presenting this complex an array of variables is not particularly effective with shading and texture only. We hope the narrative provides enough explanation that the maps can be followed.

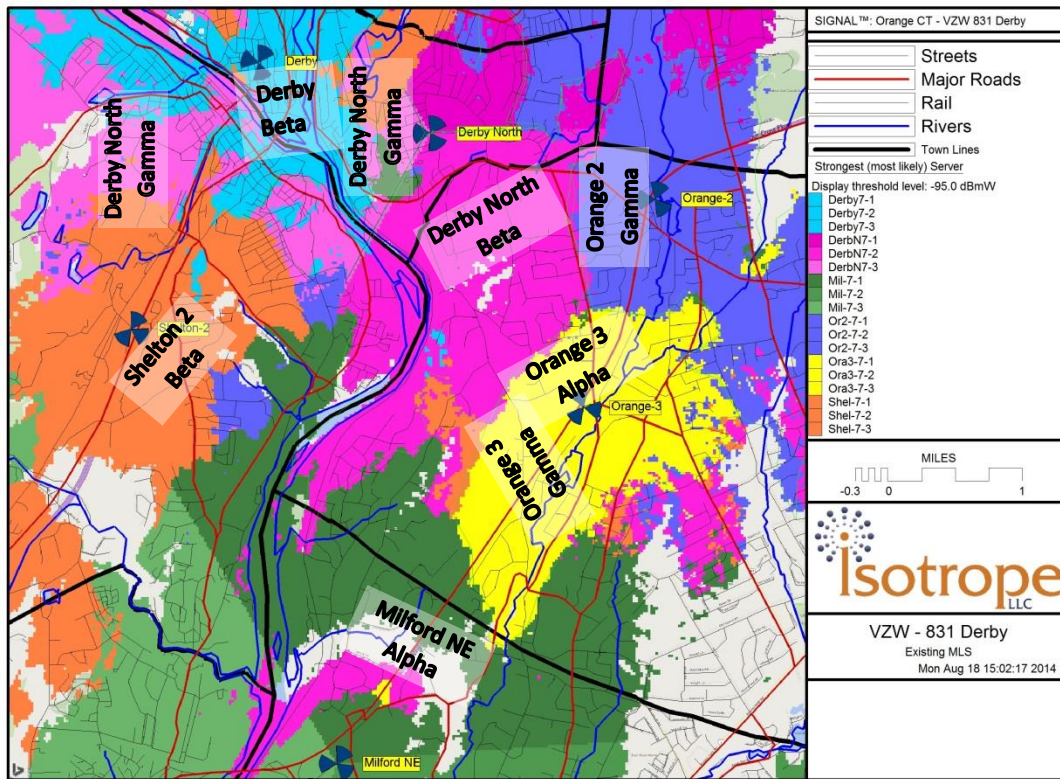


Figure 4 - Existing MLS Map with Eight Sectors Labelled

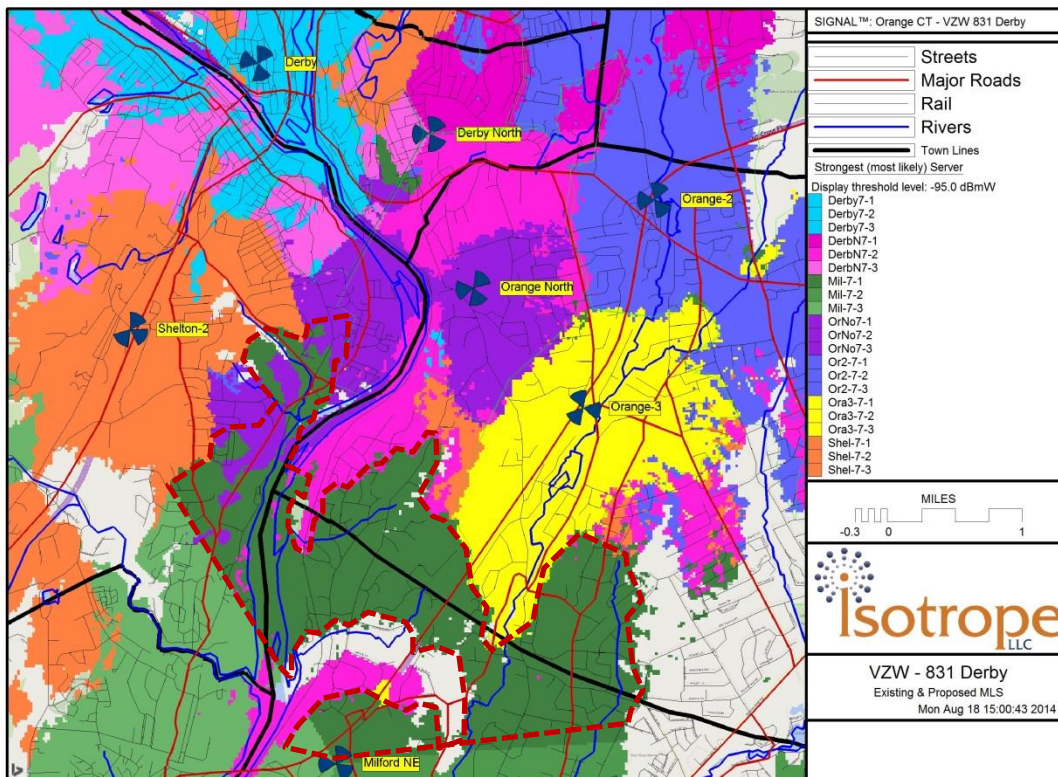


Figure 5 - MLS of Existing plus Proposed Orange North Facility (with outline of existing Milford NE Alpha MLS for comparison)

10. Orange North Has No Material Impact on Milford NE

In Figure 5 (existing-plus-proposed 700 MHz MLS) we outlined the area where Milford NE is the dominant server on the existing MLS map (Figure 3 & Figure 4). In the detail below, Figure 6, we have highlighted with cross hatch the only area where Orange North replaces Milford NE as the dominant server. This area is in Shelton, south of Sunnyside. It is an irregular area of MLS service intertwined with remaining Milford NE MLS service.

Referring to Figure 5 and Figure 6, it is apparent that the total land area of Milford NE MLS replaced by Orange North MLS is in Shelton, south of Sunnyside, and it is a small proportion of the total coverage of Milford NE Alpha. This information confirms the Orange North facility would not provide “significant capacity relief” to the Milford NE Alpha Sector.

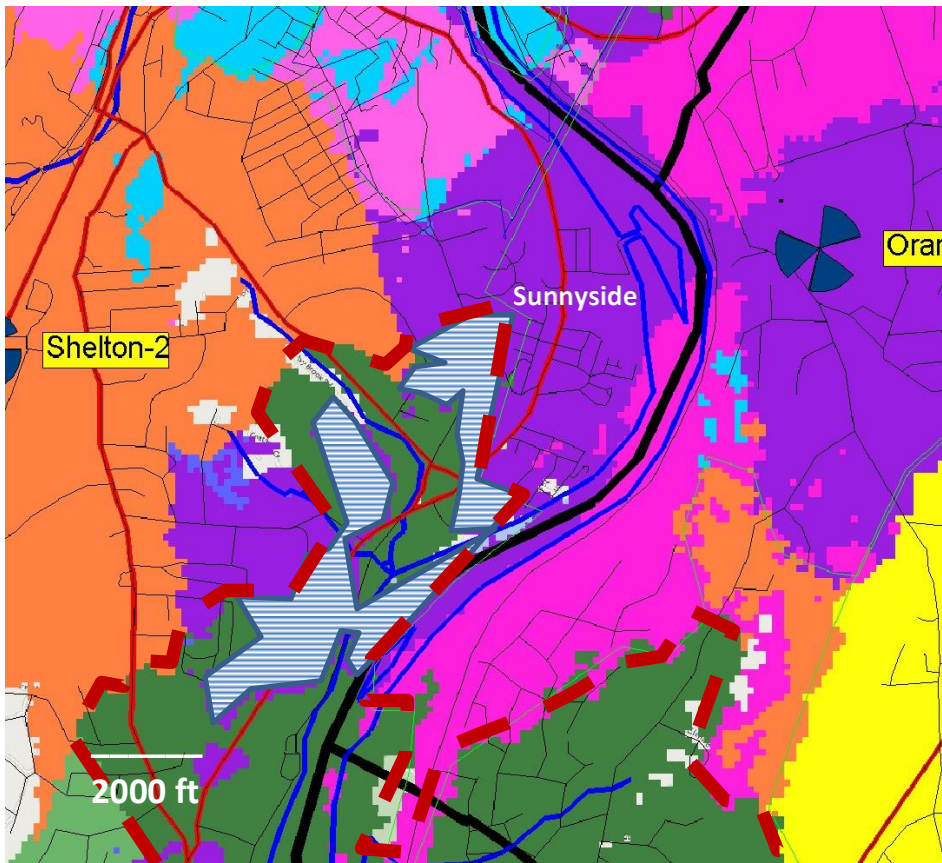


Figure 6 - Detail of Orange North MLS Area that Replaces Milford NE MLS Area (cross hatch).



11. Orange North Has No Material Impact on Derby North Gamma

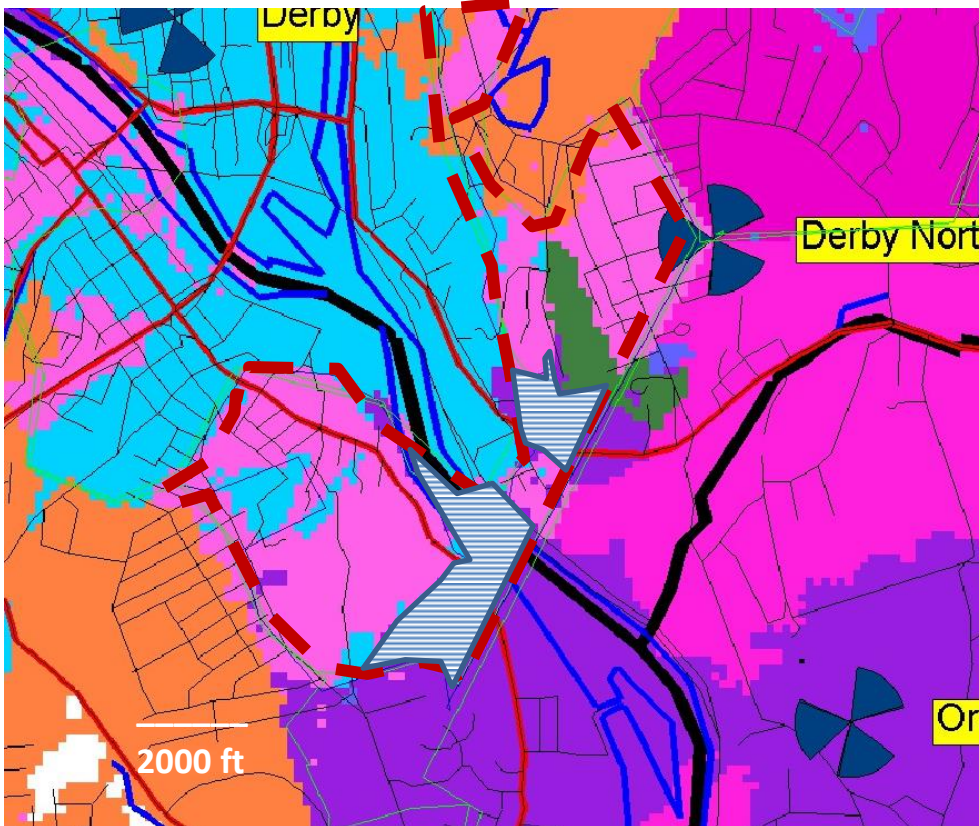


Figure 7 – Detail of Proposed MLS Map Showing Area of Derby North Gamma that Orange North Replaces (cross hatch)

While Milford NE Alpha was the second busiest of the sectors analyzed²⁰ and said to have the most urgent need for capacity relief based on its trends, the next most urgent sector is Derby North Gamma, which is projected to reach overload on its 700 MHz service September 7, 2015. Figure 7 shows (cross hatch) the projected area of MLS replacement Orange North would provide to Derby North Gamma is approximately 35 acres, and approximately half of which is river area and wooded open space.

²⁰ Testimony of Mr. Latorre, August 12, 2014 ; September 14, 2014 Projected-to-Exhaust date shown in *Orange North CT – List of Surrounding Sectors*, Attachment 2; Applicant’s Response to the Siting Council’s Request for Additional Information, August 5, 2014.



12. Orange North Has No Impact on Derby Beta

The MLS area of Derby Beta is unaffected by Orange North. Figure 8 highlights with cross hatch a miniscule MLS-area replacement that is too small to be considered. It appears to be about 600 feet in its largest dimension. This information confirms the Orange North facility would not provide any relief, let alone a “significant capacity relief,” to the Derby Beta Sector.

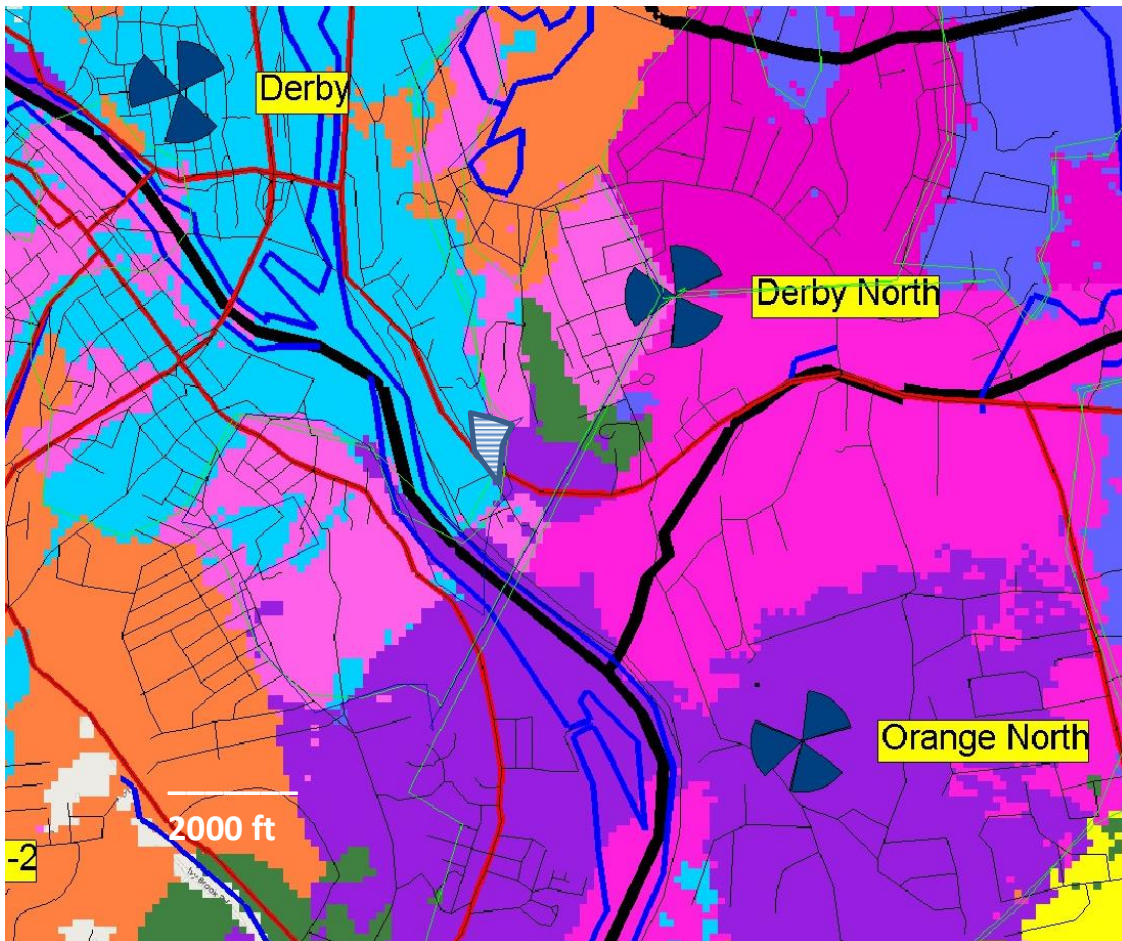


Figure 8 - Detail of Proposed MLS Map Showing Essentially No MLS Replacement of Derby Beta (light blue) by Orange North (dark blue/purple) at cross hatch



13. Orange North Has No Impact on Orange 2, Orange 3 and Shelton 2

A comparison of Figure 3 and Figure 5 will reveal that the proposed Orange North MLS area does not cross over into Orange 2 and Orange 3 MLS territory (easterly and southeasterly) as shown by the brown dashed line in Figure 9. It also does not penetrate the region of Shelton 2 “splashover” appearing as orange color south of the Orange North site.

West of the river, in Shelton, there are two sections of high ground that opportunistically receive Orange 2 as the most likely server and where the Orange North replaces these as MLS (cross hatch Figure 9). While Orange North would dominate these small cross hatched areas in Shelton, doing so provides no significant capacity relief to Orange 2 not only because of the limited size of the spaces but also because Orange 2 Gamma requires no relief.

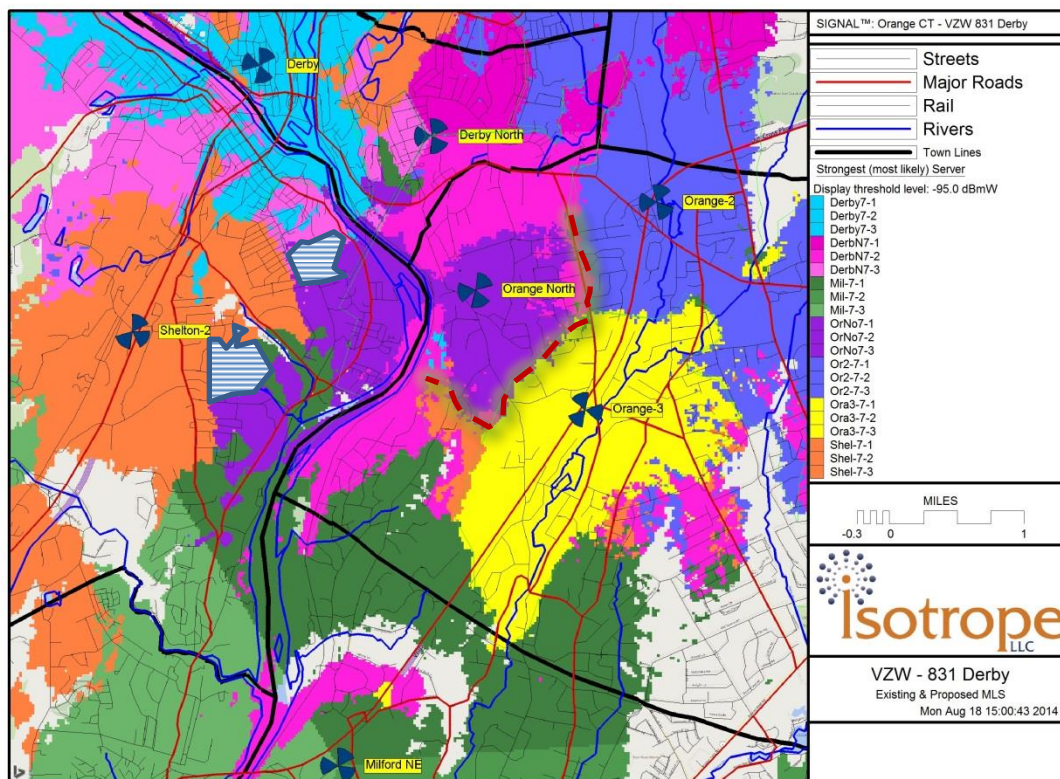


Figure 9 - Proposed MLS Map Showing Unchanged Boundary with Orange 2, Orange 3 and Shelton 2 (dashed line) and Opportunistic Splashes of Orange 2 MLS Service in Shelton Replaced by Orange North (cross hatch)



The data show that Orange North does not provide significant capacity relief to Orange 2 Gamma, Orange 3 Alpha and Shelton 2 Beta sectors.

14. Orange North New MLS Service Unnecessarily Puts Three New Sectors over the Service Area of One Existing Sector

According to the MLS maps, the only existing sector whose service area would be relieved by the proposed facility is Derby North Beta sector. Yet Derby North Beta sector is one of two Withdrawn Sectors (no capacity information was submitted). Figure 3, Figure 5, and Figure 9 collectively illustrate how all three sectors of Orange North replace MLS service of Derby North Beta in northern Orange and in Shelton. In essence, only Derby North Beta sector obtains any material benefit from the three proposed Orange North sectors.

There is no compelling need demonstrated for even one Orange North sector to be devoted to standing in for MLS service of Derby North Beta

A northern Orange location for a new facility is not necessary to address the Applicant's stated requirements.

15. Population Counts: Valuable Assessments the Applicant Did Not Do

Wireless service is provided to people on the roads, people at home and people at nonresidential activities (e.g. at work and leisure). Since it is widely understood that more than 70% of wireless data traffic comes from indoors²¹, service to residential population is one key metric of the potential demand for wireless services in a geographic area. The Applicant explained that population is one of the things Verizon analyzes in determining how cell sites may be reaching a capacity limit.²²

In addition to providing no MLS information to show where the dominant servers are and would be, the Applicant has provided no population data to support its analysis regarding capacity utilization in the service areas of each sector. Population counts underlying the current MLS areas and the MLS areas of new facilities can be compared to determine one measure of

²¹ FCC and industry reports, for instance.

²² Prefiled Testimony of Jamie Laredo, Q6, p.4.



capacity relief obtainable for residential user demand. For example, the total population served by one existing sector (e.g. Milford NE) could be counted on an MLS map before and after a proposed facility (Orange North) is activated on the map. The difference would indicate proportionally how much of the residential demand would be redirected to the new facility. We have not provided MLS population counts because the first step, MLS mapping, reveals that Orange North does not provide substantial MLS replacement to the sectors of concern to the Applicant.

If, before designing the Orange North facility, the Applicant would have done first the MLS mapping and then any MLS population analysis²³ to confirm its assumptions, the Applicant would have become aware that the proposed Orange North facility will not provide significant capacity relief to any of the 6 sectors it presently supports. As a result, the Applicant might also have realized that Verizon resources could be better positioned to address the pressing needs stated for relieving Milford NE Alpha, Derby Beta and Derby North Gamma. The Orange North facility is unnecessary based on the Applicant's stated requirements, and construction of Orange North will defer resources from the development of other facilities that would truly relieve capacity pressures on these three Stressed Sectors.

²³ The Applicant also mentions in prefiled-testimony (of Mr. Laredo Q6) a reliance on "land-use and development trends in a particular area" as its general practice, yet none of this information is provided for the record as well. Using MLS maps, in addition to population counts, the expected demand on individual sectors that is related to land use characteristics can be quantified. Such things as commercial/industrial building occupancy, parking spaces in daily use, traffic flow to/from commercial/industrial areas and the like can be used to infer the number of users within a given area during working hours. This information can be compared to the applicant's traffic maps to isolate on the one hand where the demands are coming from and on the other hand where a particular facility will provide relief.



16. Real Solutions Instead of Alternatives to the Proposed Facility

As detailed in the foregoing analysis, the proposed new Orange North facility at 831 Derby-Milford Road is entirely inconsistent with the design requirements that the Applicant has outlined. Because the proposed facility is unsuitable to the purpose, no alternative in the same general area of north Orange would be any more effective in satisfying the Applicant's design requirements.

To obtain the capacity relief that the Applicant seeks for the Milford NE Alpha, Derby Beta and Derby North Gamma sectors, wireless facilities will be needed to be located where these sectors can be relieved of capacity utilization.

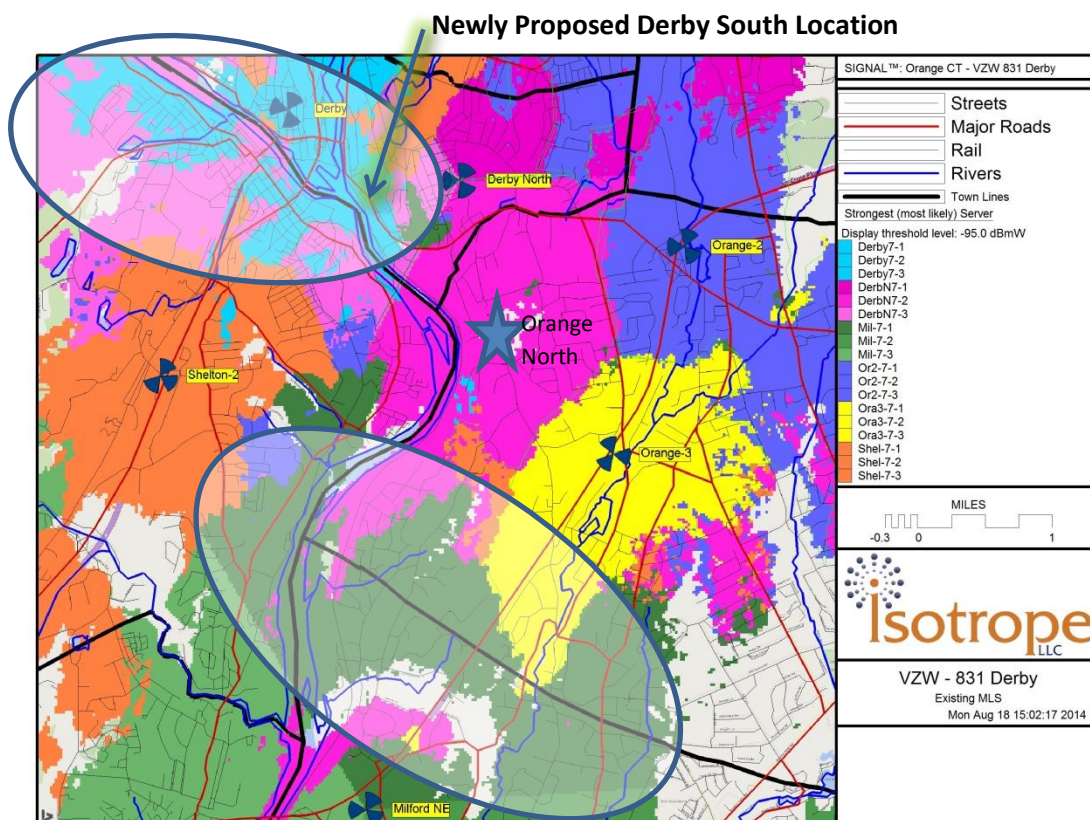


Figure 10 - Probable Search Areas for Capacity Relief of Stressed Sectors



Derby North Gamma and Derby Beta have overlapping and complementary MLS service areas (upper left oval, Figure 10). These areas are northwest of the Orange/Derby boundary and would be best resolved by new facilities in Derby or Shelton. As it turns out, the recently disclosed planned Derby South facility is positioned within the service areas of these two sectors, which are likely to obtain capacity relief from Derby South.

The Applicant states in a June 4, 2014 letter to Derby Mayor Dugatto²⁴, that, "...the proposed Derby South facility will provide significant capacity relief to Cellco's Derby, Derby North, Shelton 2, and to a lesser extent Orange 3 cell sites, each of which are operating at or near their respective capacity limits." We will parse this statement in two ways – First by looking at their similarity to the claims in the present matter; Second by looking at how Derby South eliminates the primary need claimed for the Orange North facility.

These four cell sites mentioned in the Derby South matter are also among those that Orange North purportedly relieves. This "significant capacity relief" claim for Derby South echoes the same such claims in the present matter. We labeled the claims in the present matter as excessive and unsubstantiated because some sites turned out not to have demonstrable capacity exhaustion trends and some sites turned out not to be reached by better service from the proposed Orange North facility (and some sites, both). The inclusion of Shelton 2 and Orange 3 ("to a lesser extent") in the Derby South matter appears to be as overreaching and unsubstantiated as the Shelton 2, Orange 3 and Orange 2 claims in the present matter. None of these sites are demonstrated to have any capacity exhaustion trends in the first place. Moreover, these sites' service areas are not served by the proposed Orange North facility.

The same "coverage" methodology used by the Applicant to imply capacity relief in the present matter is used to imply capacity relief in the Derby South letter. We have shown that the location of capacity relief must be modeled with other methods to verify any assumptions. As a result the same errors in claiming capacity relief to Shelton and Orange in the present matter are likely to have been made in the Derby South matter.

We raise this issue to clarify that two key sites/sectors claimed in the present matter would also be addressed by the Derby South proposal (Derby North Gamma and Derby Beta). Two sites supposedly served by Orange North are also supposedly served by Derby South (Shelton 2,

²⁴ See Attachment 3



Orange 3), however we discount these claims based on MLS analysis and the lack of compelling capacity exhaustion trends.

To show how the planned Derby South facility would replace portions of the service area of Derby North Gamma and Derby Beta, Figure 11 is an MLS map that presents the existing conditions plus Derby South (based on location and height information from the Derby South letter).

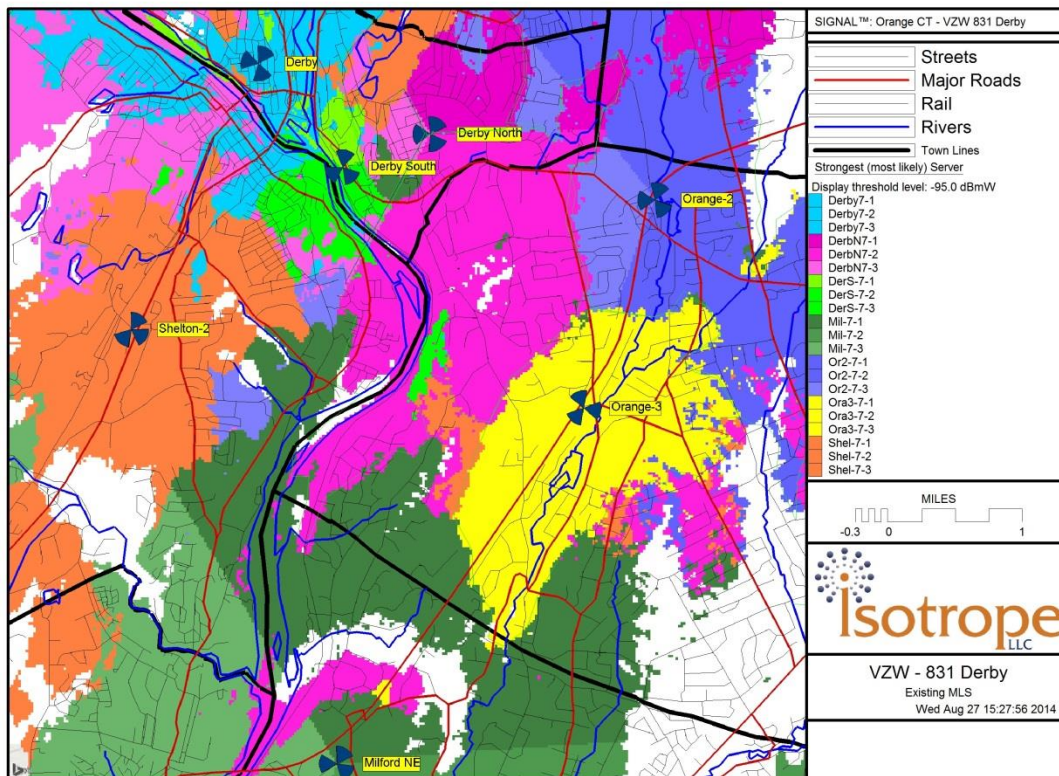


Figure 11 - Existing MLS plus Derby South

Based on the foregoing, Derby South is the solution to the purported problem in the Derby-Shelton area north of Orange. Orange North is not.

On the other side of Orange North –to the south – Orange North has no material impact on Milford NE service. Instead, a facility should be located in northern Milford, southern Shelton or southwestern Orange to supplement the Milford NE Alpha sector (green on the MLS maps – in



lower oval, Figure 10). It is within this area that new service would be necessary to provide capacity relief to Milford NE Alpha.

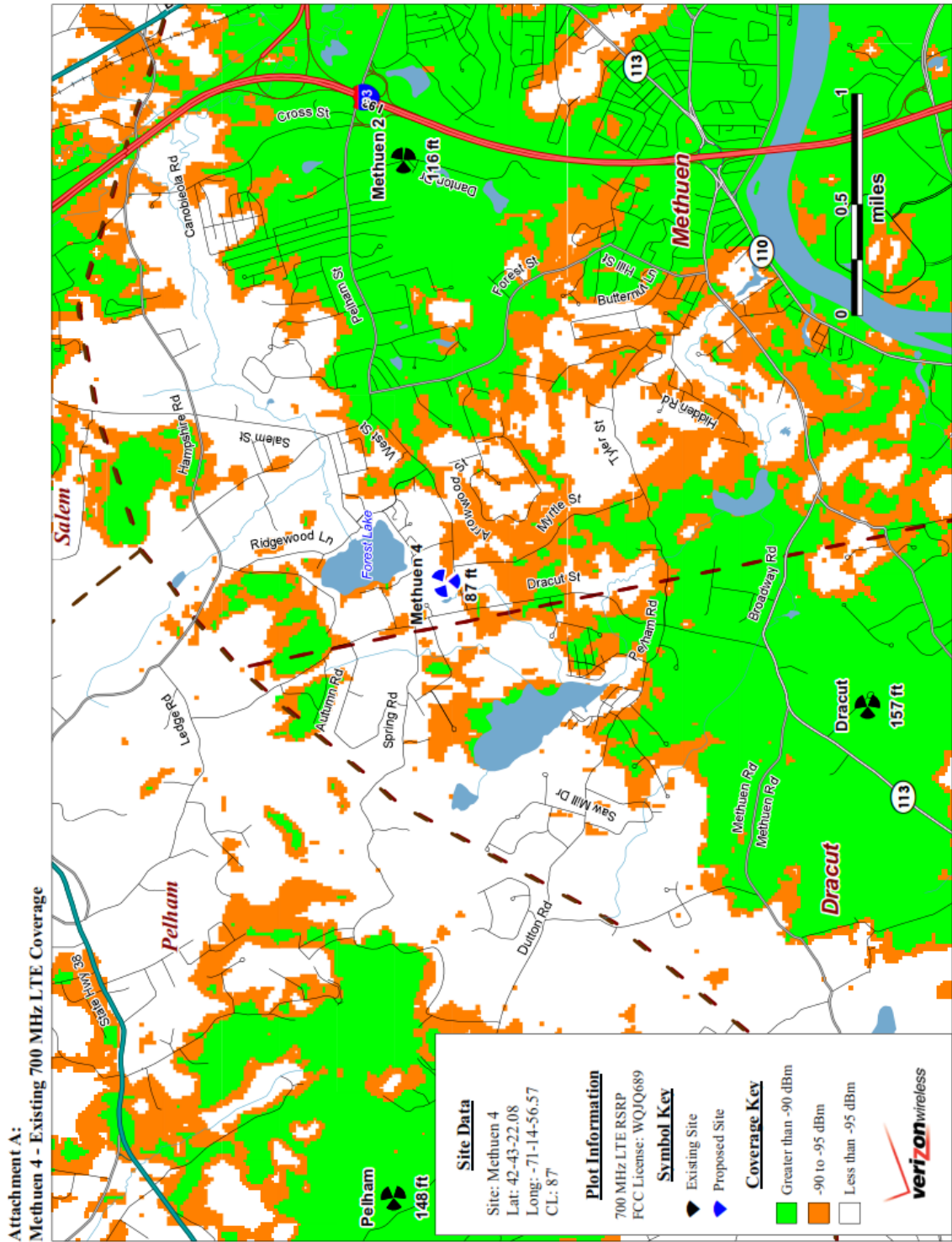
In summation, the Applicant is solving its Derby problem²⁵ with the Derby South facility already proposed in Derby. The Applicant should look closer to Milford NE to find a location for a facility to relieve the Milford NE problem. Finally, there is no demonstrated need for relief to be provided to the one and only sector service area, Derby North Beta, that Orange North would provide service to. Consequently, any serviceable “alternatives” to Orange North would not be alternatives to replicate what Orange North would do; instead, any alternative should be a real solution in entirely different locations to address any of the capacity issues, imagined or real, cited by the Applicant.

²⁵ Recall, that we do not fully accept there is a capacity issue anywhere because the applicant has not provided integrated capacity analysis to include the 2100 MHz spectrum utilization, if it is indeed in operation at the moment, in addition to the 700 MHz spectrum. Moreover, 1900 MHz will become available for LTE capacity as voice traffic migrates to LTE and away from CDMA over the coming several years.



Isotrope, LLC

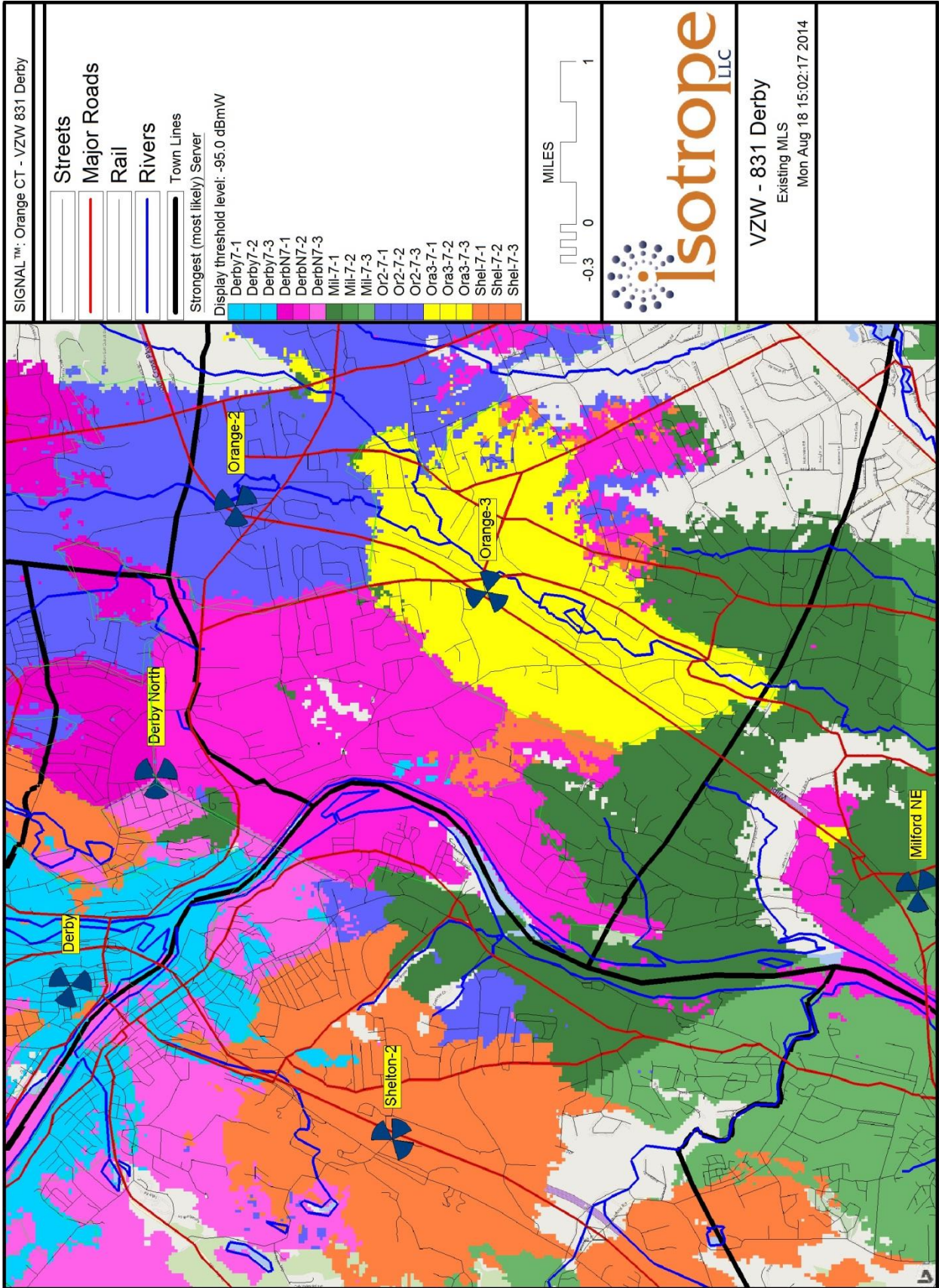
**Attachment 1 -
Recent Verizon LTE Coverage Analysis in Massachusetts
with -95 dBm Threshold**

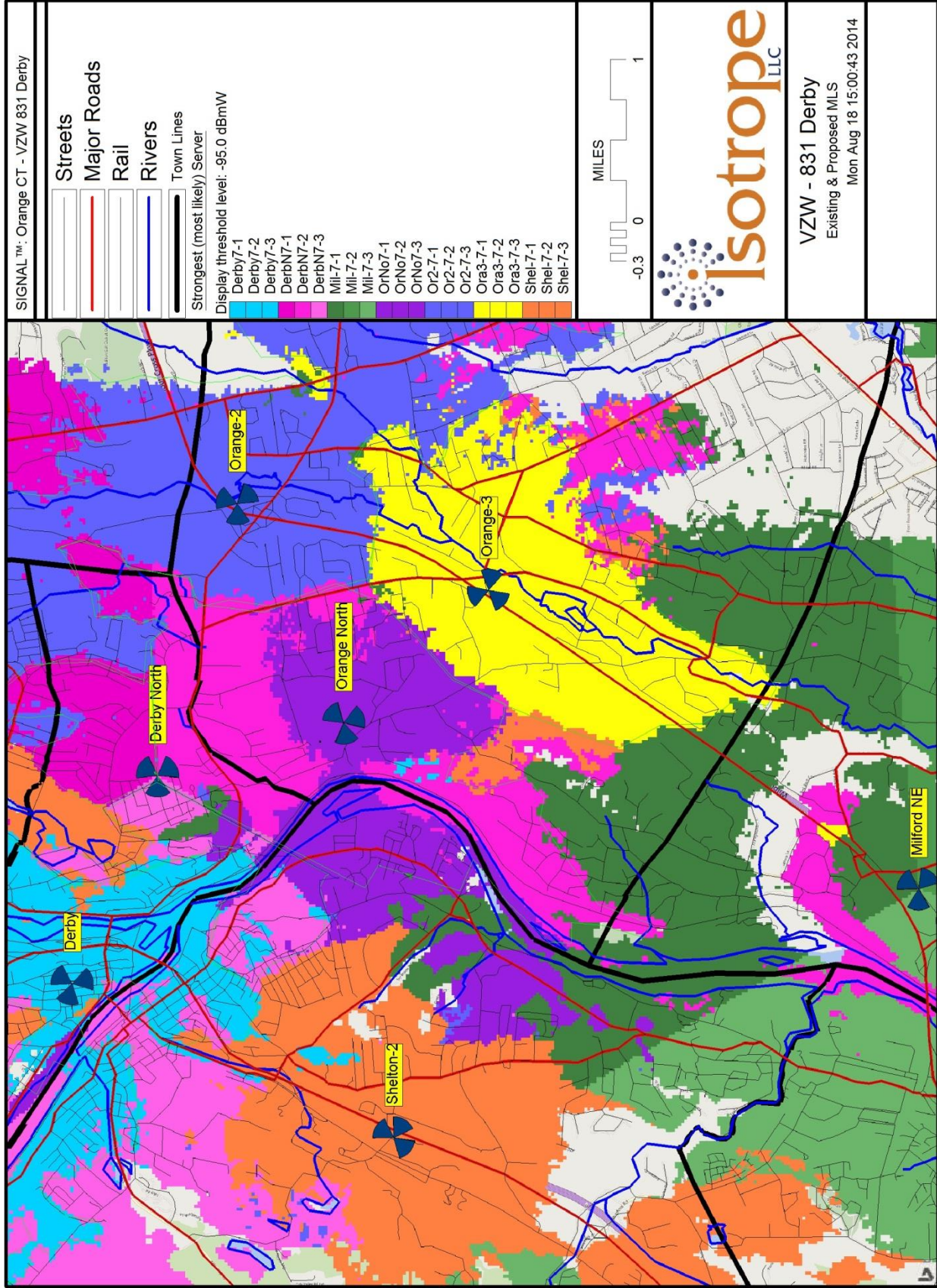




Isotrope, LLC

**Attachment 2 -
Large Prints of Existing MLS Map
and Existing-Plus-Proposed MLS Map**







**Attachment 3 -
Excerpt from June 4 2014 Verizon Letter to
Mayor Dugatto, Derby, Connecticut
(pp. 1-5 of 28)**

ROBINSON & COLE^{LLP}

fee-siting - to be filed 90 days before filing
balloon to be floated

Emphasis by highlight added.

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Also admitted in Massachusetts

June 4, 2014

Via Hand Delivery

Anita Dugatto
Mayor
Derby City Hall
1 Elizabeth Street
Derby, CT 06418

Re: Submission of Technical Information Concerning Proposal to Construct a Wireless Telecommunications Facility at 111 New Haven Avenue in the City of Derby, Connecticut

Dear Mayor Dugatto:

This firm represents Cellco Partnership d/b/a Verizon Wireless ("Cellco"), in its proposal to construct a new wireless telecommunications facility on an approximately 3.3 acre parcel at 111 New Haven Avenue in Derby. For the purposes of this filing, the proposed telecommunications facility is known as Cellco's "Derby South" cell site. This technical report is submitted pursuant to Connecticut General Statutes ("Conn. Gen. Stat.") § 16-50^l(e), which establishes local input requirements for the siting of a wireless telecommunications facility under the jurisdiction of the Connecticut Siting Council (the "Council"). This statutory provision requires the submission of technical information to the municipality where the proposed facility would be located and any municipality within 2,500 feet of the proposed facility. Because a portion of the City of Shelton is located within 2,500 feet of the proposed facility at 111 New Haven Avenue, a copy of this report will be forwarded to Mayor Mark A. Lauretti.

Correspondence and/or communications regarding the information contained in this report should be addressed to:



Law Offices

BOSTON

HARTFORD

NEW YORK

PROVIDENCE

STAMFORD

ALBANY

LOS ANGELES

NEW LONDON

SARASOTA

www.rc.com

12866050-v1

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Anita Dugatto
June 4, 2014
Page 2

Sandy M. Carter, Regulatory Manager
Verizon Wireless
99 East River Drive
East Hartford, CT 06108

A copy of all such correspondence or communications should also be sent to Cellco's attorneys:

Kenneth C. Baldwin, Esq.
Robinson & Cole LLP
280 Trumbull Street
Hartford, CT 06103-3597

Cellco intends to submit an application to the Council for a Certificate of Environmental Compatibility and Public Need ("Certificate") for the construction, maintenance and operation of a wireless telecommunications facility in the City of Derby (the "City" or "Derby"). The Derby South facility would interact with Cellco's existing Derby, Derby North, Orange 3 and Shelton 2 cell sites.

The Derby cell site would provide enhanced coverage along portions of Route 34 in Derby and Route 110 in Shelton and the surrounding area and, more importantly, provide significant capacity relief to its network in southern portions of Derby. The Derby, Derby North, Shelton 2 and, to a lesser extent, Orange 3 cell sites are currently operating at or near their respective capacity limits. Coverage plots for Cellco's existing cell sites in the area, alone and together with the proposed Derby South cell site are included in Attachment 1. These plots show Cellco's existing coverage in the south Derby area and existing gaps in service in the 1900 and 2100 MHz frequency ranges. The significant areas of overlapping service shown on these plots also help illustrate the significant capacity benefits of the Derby South facility.

Cell Site Information

The proposed Derby South facility would be located in the northerly portion of an approximately 3.3 acre parcel at 111 New Haven Avenue in Derby (the "Property"). The Property is owned by Bradley Pond LLC. The Property is currently occupied by a two-story commercial building and related parking areas. The Property is surrounded by an active railroad line and the Naugatuck River to the west, New Haven Avenue (Route 34) to the east, commercial and residential land uses to the south and an industrial land uses to the north.



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Cellco proposes to construct a wireless telecommunications facility in the northerly portion of the Property. The facility will consist of an 80-foot monopole tower and a 12' x 24' shelter located within a 1,085 square foot fenced compound. Cellco will install up to twelve (12) panel-type antennas at the centerline height of 80-feet above ground level ("AGL"). Cellco's antennas would extend to an overall height of approximately 83 feet AGL. Equipment associated with the Cellco's antennas and a diesel-fueled backup generator would be located inside its shelter. Access to the Derby South facility would extend from New Haven Avenue over an existing paved driveway and parking areas to the cell site. Project plans for the Derby South facility are included in Attachment 2.

Connecticut Siting Council Jurisdiction

Municipal jurisdiction over the siting of the proposed telecommunications facility described in this report is pre-empted by provisions of the Public Utilities Environmental Standards Act ("PUESA"), Conn. Gen. Stat. § 16-50g *et seq.* The PUESA gives exclusive jurisdiction over the location, type and modification of telecommunications towers, to the Council (Conn. Gen. Stat. § 16-50x(a); 16-50i(a)(6)). Accordingly, the telecommunications facility described in this report is exempt from Derby's land use regulations.

Upon receipt of an application, the Council will assign a docket number and, following a completeness review, set a hearing date. At that time, the City may choose to become an intervenor or party in the proceeding. Other procedures followed by the Council include serving the applicant and other participants with interrogatories, holding a pre-hearing conference, and conducting a public hearing. The public hearing would be held at a location in the City. Following the public hearing, the Council will issue findings of fact, an opinion and a decision and order. Prior to construction, the Council will also require the Applicant to submit a development and management plan ("D&M Plan") which is, in essence, a final site development plan showing the details of the facility including any conditions imposed by the Council. These procedures are also outside the scope of the City's jurisdiction and are governed by the Connecticut General Statutes, the Regulations of Connecticut State Agencies, and the Council's Rules of Practice. If the Council approves the cell site described in this report, Cellco will submit to the City's Building Official an application for approval of a local building permit. Under Section 16-50x of the General Statutes, which provides for the exclusive jurisdiction of the Council, the building official must honor the Council's decision.



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Municipal Consultation Process

Pursuant to Section 16-50~~l~~ of the General Statutes, City officials are entitled to receive technical information regarding the proposed telecommunications facility at least ninety (90) days prior to the filing of an application with the Council. This technical report is provided to the City in accordance with these provisions and includes information on the need for wireless service in the area; the location of existing wireless facilities in and around Derby; details of the proposed facility; the location of alternative sites considered and rejected; the location of schools and commercial day care facilities in the area and the aesthetic impacts of the facility on those schools and day care facilities, if any, a description of the site selection process, and a discussion of potential environmental effects associated with the proposed facility.

Not later than sixty (60) days after the initial consultation meeting, the municipality may, in cooperation with the prospective applicant, hold a public information hearing on the facility proposal. If such a hearing is held, the applicant must notify all abutting landowners and publish notice in a newspaper of general circulation in the municipality at least fifteen (15) days prior to the hearing.

Not later than thirty (30) days after the initial consultation meeting, the municipality may present the prospective applicant with alternative sites, including municipal parcels, for its consideration. If not previously considered, these alternatives will be evaluated and discussed in its application to the Council.

Pursuant to Section 16-50~~l~~(e) of the General Statutes, Cellco must provide a summary of the City's comments and recommendations, if any, to the Council within fifteen (15) days of the filing of an application.

Need

The primary purpose for the Derby South facility described above is to provide wireless services to existing gaps along portions of Route 34 in Derby and Route 110 in Shelton, and the surrounding areas and increased network capacity in the southern portion of Derby. This area is a mix of densely developed industrial, commercial and residential land uses and major travel corridors. Cellco's existing Derby, Derby North, Orange 3 and Shelton 2 cell sites currently provide wireless service in the area. Even with this service, however, Cellco has identified gaps in reliable service along portions of Routes 34 and 110. Further, the proposed Derby South facility will provide significant capacity relief to Cellco's Derby, Derby North, Shelton 2 and, to a lesser extent Orange 3 cell sites, each of which are operating at or



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near their respective capacity limits. The Derby South facility, described in this report, would improve significantly, Cellco's ability to provide reliable wireless services in south Derby.

Environmental Effects

In our experience, the primary impact of a wireless facility such as the proposed Derby South facility is visual. The visual impact of the proposed facility will vary from place to place around the site location, depending upon factors such as vegetation, topography, distance from the towers, and the location of buildings in the sight-line of the cell site. The Derby South facility will be located in the northerly portion of a commercial business location along the west side of Route 34.

To more fully assess the visual impact of the Derby South facility, Cellco's consultant, All-Points Technology Corporation ("APT") has prepared a Preliminary Visibility Analysis. This analysis indicates that a majority of the year-round visibility of the tower would be limited to the area immediately surrounding the proposed facility location and along select portions of nearby local roads. (See Attachment 3). A more detailed visual report is being prepared and will be included in Cellco's application to the Council.

Pursuant to the provisions of Conn. Gen. Stat. § 16-50p(a)(3)(G), new telecommunications facilities must be located at least 250 feet from schools (defined in C.G.S. §10-154a) and commercial day care facilities (defined in C.G.S. §19a-77(a)(1)) unless the location selected is acceptable to the City's chief elected official or the Council finds that the facility will not have a substantial adverse effect on the aesthetics or scenic quality of the neighborhood where the school or commercial day care use is located. The proposed Derby South tower is not located within 250 feet of any building containing a school or commercial day care facility.

Based on field surveys, Cellco has determined that the construction of the Derby South facility will have no impacts on inland wetlands or watercourses, within or near the tower compound and is not located within any designated flood hazard area. Cellco anticipates that all other physical environmental effects associated with the proposed facility would be minimal.

Power Density

The Federal Communications Commission ("FCC") has adopted a standard (the "Standard") for exposure of radio frequency ("RF") emissions from telecommunications facilities like the Derby South facility. To ensure compliance

