COUNTY OF SAN MATEO
PLANNING AND BUILDING DEPARTMENT

DATE: February 8, 2017

TO: Planning Commission

FROM: Planning Staff

SUBJECT: EXECUTIVE SUMMARY: Consideration of a Use Permit to replace an existing 38-foot 7-inch tall utility pole with a new 47-foot 6-inch tall joint utility pole and to install a new wireless telecommunications facility on the new pole located in the public right-of-way in front of 231 Cuesta Real in the unincorporated La Honda area of San Mateo County. (Appeal of the Zoning Hearing Officer's approval of the project).

County File Number: PLN 2016-00216

PROPOSAL

The applicant proposes to replace an existing 38-foot 7-inch utility pole with a new 47-foot 6-inch joint utility pole located in the public right-of-way in front of 231 Cuesta Real. Joint utility poles are poles that are shared, by mutual agreement, between cable and telecommunication service providers and utilities. The new joint utility pole will replace the existing utility pole currently used by PG&E in the same location. A new wireless telecommunications facility owned by ExteNet Systems, Inc. will be installed on the new joint utility pole and be used by PG&E and AT&T. The new facility will consist of two panel antennas mounted on the pole and extending from 33 feet to a maximum of 37 feet in height from existing grade and four equipment clusters will be located at the bottom base of the new joint utility pole between 7 feet and 15 feet from existing grade. No grading or tree removal is proposed.

RECOMMENDATION

That the Planning Commission deny the appeal and uphold the decision of the Zoning Hearing Officer to approve the Use Permit, County File Number PLN 2016-00216, by making the required findings and adopting the conditions of approval listed in Attachment A.

SUMMARY

The project site is located in the public right-of-way along Cuesta Real, east of the intersection of Canada Vista in the unincorporated La Honda area. The existing utility pole is on the north side of the right-of-way in front of 231 Cuesta Real. The surrounding area is a single-family residential neighborhood. The proposal to replace the existing 38-foot 7-inch utility pole with a new 47-foot 6-inch joint utility pole, as proposed and conditioned, complies with the applicable policies and standards of the General Plan, Zoning Regulations, and Wireless Telecommunication Facilities (WTF) Ordinance.

History: Use Permits for similar proposals by the same applicant were presented to the Zoning Hearing Officer (ZHO) on March 19, 2015 and April 16, 2015. On the third public hearing on November 19, 2015, the ZHO recommended the applicant research an alternative project location. The current project was presented to the ZHO on October 20, 2016 as the alternative to the two proposals. After discussion which included comments from the public in opposition of the project and responses from the applicant, the ZHO made the findings and approved the project subject to the conditions of approval in Attachment A. The decision of the ZHO was appealed on November 3, 2016.

Point of Appeal Regarding Alternative Sites and Co-Location: The appellant states that evidence submitted by the applicant is insufficient in determining the infeasibility of alternative sites and co-location. The appellant submitted quantitative data and analysis to show that Verizon Wireless facilities within the subject area, but outside residential areas, provide adequate coverage. Staff determined that the analysis submitted by the applicant was sufficient in justifying the proposed site location as the primary candidate to fill the gap in service coverage. The applicant complied with all the applicable requirements and provided an analysis of alternative sites presented by the affected community.

Point of Appeal Regarding Community Engagement: The appellant states that the applicant did not engage with the entire La Honda community. The noticing requirement for use permit applications is a newspaper publication of general circulation in the County or postal card notice to owners of properties within 300 feet of the exterior limits of the project location. Staff complied with both requirements. Although not a County requirement, the applicant voluntarily invited those in attendance at the public hearing on November 19, 2015 for the previous two alternative site proposals (PLN 2014-00395 and PLN 2014-00396) to the subject site location. At that time, there was no opposition expressed. It is not a County requirement for the applicant to engage with the entire community in the affected area.

Point of Appeal Regarding Intrusiveness of Proposed Site Location: Although the proposed site location is the least visually intrusive of the alternative sites analyzed, the appellant states that the intrusion is still significant. The project complies by using colors and materials that blend in with the surrounding environment and a radio frequency level that complies with standards limiting public exposure to radio frequency energy. The proposed antennas will be at the same height as the existing utility pole which is out of sight from the natural view of any drivers, pedestrians, or private property owners in the surrounding area. No trees or vegetation are proposed for removal.

Point of Appeal Regarding Inconsistencies in Application: The appellant states that the applicant has not complied with California Public Utilities Commission (CPUC) regulations and should not be categorically exempt from the California Environmental Quality Act (CEQA). The appellant also states that there are errors in the application. The County does not require the applicant to prove compliance with CPUC regulations or other applicable regulatory bodies. The applicant is only required to submit evidence of licenses and registrations from applicable regulatory bodies prior to initiating operation of the wireless telecommunication facility. Staff has reviewed the project with County Counsel and determined it be categorically exempt from CEQA. The errors in the application are also minor and do not change the accuracy of the analysis submitted by the applicant.

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COUNTY OF SAN MATEO
PLANNING AND BUILDING DEPARTMENT

DATE: February 8, 2017

TO: Planning Commission

FROM: Planning Staff

SUBJECT: Consideration of a Use Permit, pursuant to Sections 6500 and 6510 of the San Mateo County Zoning Regulations, to replace an existing 38-foot 7-inch tall utility pole with a new 47-foot 6-inch tall joint utility pole and to install a new wireless telecommunication facility on the new pole located in the public right-of-way in front of 231 Cuesta Real in the unincorporated La Honda area of San Mateo County. (Appeal of the Zoning Hearing Officer's approval of the project).

County File Number: PLN 2016-00216 (ExteNet Systems, Inc.)

PROPOSAL

The applicant proposes to replace an existing 38-foot 7-inch utility pole with a new 47-foot 6-inch joint utility pole located in the public right-of-way in front of 231 Cuesta Real. Joint utility poles are poles that are shared, by mutual agreement, between cable and telecommunication service providers and utilities. The new joint utility pole will replace the existing utility pole currently used by PG&E in the same location. A new wireless telecommunication facility owned by ExteNet Systems, Inc. will be installed on the new joint utility pole and be used by PG&E and AT&T. The new facility will consist of two (2) panel antennas mounted on the pole and extending from 33 feet to a maximum of 37 feet in height from existing grade and four (4) equipment clusters will be located at the bottom base of the new joint utility pole between 7 feet and 15 feet from existing grade. No grading or tree removal is proposed.

History

On March 19, 2015, the Zoning Hearing Officer (ZHO) considered requests for Use Permits for similar proposals by Extenet Systems, Inc., owner of the proposed equipment for the subject application, both involving the replacement of an existing utility pole with a taller joint utility pole and a new wireless telecommunication facility mounted on each pole. The locations were in public right-of-ways; one in front of 150 Canada Vista and the other in front of 170 Cuesta Real. The ZHO continued both projects to allow time for interested parties to review the project information, correct public hearing notices, and allow time for the applicant to arrange for an engineer to attend the next public hearing.

On April 16, 2015, the projects were considered by the ZHO and continued again to a future date to allow time to submit justification as to why the joint utility poles exceed the maximum height allowed in the zoning district and written documentation showing that wireless telecommunication facilities within 2.5 miles of the project location were contacted for the opportunity to co-locate. The projects were considered again on November 19, 2015, with the ZHO recommending that the applicant research an alternative project location.

After researching alternative locations and consulting with the neighboring community, the subject application was considered by the ZHO on October 20, 2016 and presented as the primary candidate for locating the proposed wireless telecommunication facility. During the public hearing, the public had the opportunity to comment. Several speakers opposed the project for reasons such as the proposed location, its visual impact, insufficient data regarding alternative sites outside the residential areas, the applicant's communication with the affected community, and the application materials submitted. The applicant also presented and responded to comments and questions.

After the discussion, the ZHO made the findings and approved the project subject to conditions of approval (see Attachment A).

On November 3, 2016, an appeal of the ZHO's decision was made to the Planning Commission.

RECOMMENDATION

That the Planning Commission deny the appeal and uphold the decision of the Zoning Hearing Officer to approve the Use Permit, County File Number PLN 2016-00216, by making the required findings and adopting the conditions of approval listed in Attachment A.

BACKGROUND

Report Prepared By: Carmelisa Morales, Project Planner, 650/363-1873

Appellant: David W. Ehrhardt

Applicant: ExteNet Systems, Inc.

Land Owner: Public Right-of-Way (San Mateo County Department of Public Works)

Pole Owner: Pacific Gas and Electric

Location: Public Right-of-Way in front of 231 Cuesta Real

APN: None (Public Right-of-Way in front of 083-043-420)

Sphere-of-Influence: None

Existing Land Use: Utility Pole in the Public Right-of-Way

General Plan Designation: Low Density Residential Rural

Zone: R-1/S-10 (Single-Family Residential/Minimum Lot Size 20,000 Square Feet)

Flood Zone: Zone X (area of minimal flood risk); FEMA Panel No. 06081C 0384E; effective October 2012

Environmental Evaluation: Categorically exempt under provisions of Class 3, Section 15303, of the California Environmental Quality Act (CEQA) Guidelines for construction of a new small structure and installation of small new equipment and a facility in a small structure.

Setting: The project site is located in the public right-of-way along Cuesta Real, approximately 420 feet east of the intersection of Canada Vista in the unincorporated La Honda area. The existing 38-foot 7-inch tall utility pole is on the north side of the right-of-way in front of 231 Cuesta Real. The surrounding area is an urbanized single-family residential neighborhood. Mature trees and vegetation fall between the public right-of-way and the private property lines.

Chronology:

Date		Action
March 19, 2015	-	Two alternative site proposals (PLN 2014-00395 and PLN 2014-00396) presented at public hearing. Projects continued by Zoning Hearing Officer (ZHO).
April 16, 2015	-	Second public hearing. Hearing continued by ZHO.
November 19, 2015	-	Third public hearing. Hearing continued by ZHO (these two proposals are currently on hold. Condition of Approval No. 20 in Attachment A will require the applicant to close these two proposals if this current proposal is approved).
May 24, 2016	-	Use permit application for the current proposal submitted.
August 2, 2016	-	Application deemed complete.
October 20, 2016	-	Hearing approved by ZHO at public hearing.
November 3, 2016	-	Appeal filed by the Appellant to the County.
February 8, 2017	-	Planning Commission public hearing date.

DISCUSSION

A. KEY ISSUES

1. Compliance with the General Plan

Staff has determined that the project complies with all applicable County General Plan policies, specifically:

Visual Quality Policies

Policy 4.21 (*Utility Structures*) requires minimizing adverse visual impacts generated by utility structures. The project site is located within the public right-of-way along a residential road within a single-family residential area. Although the new joint utility pole will be 8 feet 11inches taller than the existing utility pole, existing vegetation and trees between the public right-of-way and adjacent private property lines buffer the proposed project from residential areas. The proposed antennas, located 33 to 37 feet above ground, will also be surrounded by existing trees and be above the natural view of any drivers, pedestrians, or private property owners in the surrounding area. Four equipment clusters (two remote radio units, one baseband unit cabinet, and one disconnect switch) will be located on the lower half of the new joint utility pole. To ensure visual impacts are minimized, the equipment clusters will be similar in scale and appearance to equipment typically found on utility poles and be painted brown to match the wood material of the new joint utility pole.

2. Compliance with Zoning Regulations

The proposed project area is located within the public right-of-way in the R-1/S-10 Zoning District. The zoning district standards, with the exception of height, are not applicable since the site is located within the Cuesta Real public right-of-way.

The maximum height allowed in the R-1/S-10 Zoning District is 36 feet. The proposed project involves replacing an existing 38-foot 7-inch utility pole and installing a new wireless telecommunication facility on the new joint utility pole, resulting in a maximum pole height of 47 feet 6 inches.

Section 6512.2.l.2 (*Development And Design Standards For New Wireless Telecommunication Facilities That Are Not Co-Location Facilities*) of the San Mateo County Zoning Regulations states, in any Residential (R) District, that no monopole or antenna shall exceed the maximum height for structures allowed in that district, except that new equipment on an existing facility in the public right-of-way shall be allowed to exceed the maximum height for structures allowed in that district by 10% of the height of the existing facility, or by five feet, whichever is less. Although the utility pole will be replaced, the new joint utility pole will remain in the same location and serve its original use as a PG&E facility. The increase in height of the new joint utility pole from 38 feet 7 inches to 47 feet 6 inches will allow the equipment used by PG&E to comply with California Public Utilities Commission regulations and principles of electrical safety that County regulations do not seek to contradict. The new equipment for the wireless telecommunication facility will be in compliance with this section by maintaining a maximum height of 37 feet.

3. Compliance with Wireless Telecommunication Facilities Ordinance

Staff has reviewed the project against the provisions of the Wireless Telecommunication Facilities (WTF) Ordinance and determined that the project complies with the applicable standards discussed below:

a. Development and Design Standards

Section 6512.2.A states that new wireless telecommunication facilities shall be prohibited in a Sensitive Habitat, as defined by Policy 1.8 of the General Plan (*Definition of Sensitive Habitats*) for facilities proposed outside of the Coastal Zone.

The project is not located in a sensitive habitat, as defined by Policy 1.8 of the General Plan. The new joint utility pole will replace the existing utility pole and be in the same location.

Section 6512.2.B prohibits new wireless telecommunication facilities from being located in areas zoned Residential (R), unless the applicant demonstrates that a review has been conducted of other options and no other sites or combination of sites allow feasible service or adequate capacity and coverage.

The proposed facility will be located on a new joint utility pole within a public right-of-way in the R-1/S-10 Zoning District. The applicant chose the proposed location to adequately provide AT&T wireless voice and data coverage to the surrounding area where there is currently a significant gap in service coverage. The proposed facility is a part of a larger Distribution Antenna System (DAS) providing coverage to the La Honda area that is very difficult to cover using traditional macro wireless telecommunication facilities due to local topography and mature vegetation. The proposed facility will cover transient traffic along the roadways and provide in-building service to the surrounding residences (e. g. coverage accessible inside residences and other buildings).

Alternative locations were submitted in 2014 under PLN 2014-00395 and PLN 2014-00396, but continued by the Zoning Hearing Officer (ZHO) for the applicant to research alternative sites. After the applicant conducted research as directed by the ZHO, the current proposal was selected as the primary alternative candidate. Condition of Approval No. 20 in Attachment A will require the applicant to close the proposals for these two alternative locations if this current proposal is approved.

In the Extenet La Honda Node 61G Alternative Site Analysis (see Attachment C), the applicant has identified and researched alternative sites within a 2.5-mile radius. The analysis includes eighteen alternative locations, which include the two locations presented in 2014. The two locations would both need to be constructed to fill the wireless coverage gap, and in addition to the outcome of their projects in 2014, they were ruled out as viable candidates. The other sixteen alternative locations were ruled out due to additional impacts that may be presented if chosen, which may require the relocation of existing transformers, and tree trimming or removal. Other challenges were presented for these alternative locations such as inadequate space on the existing poles, limited climbing space for maintenance, inability to co-locate, topographical challenges, and increased intrusiveness on the surrounding neighborhoods. A macro antenna farm at 155 Sears Ranch Road was the only one tower site found within a 2.5-mile radius. However, placing the proposed facility at the macro antenna farm would not fill the significant gap in coverage. Two alternative locations in the eastern portion of the neighborhood were also proposed by the La Honda community, but the nearby trees and terrain would prevent the facility from working effectively.

Among the researched locations, the proposed location is the least intrusive and will fill the significant wireless coverage gap necessary to provide adequate wireless and data coverage.

Section 6512.2.C prohibits new wireless telecommunication facilities to be located in areas where co-location on existing facilities would provide equivalent coverage with less environmental impacts.

The applicant was unable to identify any existing wireless facilities within a 2.5-mile radius that would either allow co-location or provide coverage to the target area. The only viable alternative location is the existing macro antenna farm at 155 Sears Ranch Road. However, as discussed in the section above, this alternative site is not feasible due to its inability to fill the significant gap in coverage.

Section 6512.2.D requires new wireless telecommunication facilities to be constructed so as to accommodate co-location, and must be made available for co-location.

Future co-location is technically feasible as long as the proposed facility complies with California Public Utilities Commission General Order 95 (GO95) engineering requirements. However, it would be difficult to comply with the GO95 safety and separation requirements if another wireless facility were to be installed at this location. Therefore, the applicant does not expect future co-location.

Sections 6512.2.E and F seek to minimize and mitigate visual impacts from public views by siting new facilities outside of public view, using natural vegetation for screening, painting equipment to blend with existing landscaping, and designing the facility to blend in with the surrounding environment.

The proposed facility includes two panel antennas located at a maximum height of 37 feet mounted on a new joint utility pole located in a public right-of-way. The new joint utility pole will replace the existing utility pole in the same location. The antennas will be above the natural view of any drivers, pedestrians, or private property owners in the surrounding area. No trees or vegetation are proposed for removal. The new joint utility pole will be constructed of wood material and the four equipment clusters and antennas will be painted brown to match the utility pole as recommended in Condition of Approval No. 4 (see Attachment A).

Section 6512.2.G requires that the exterior of wireless telecommunication facilities be constructed of non-reflective materials.

The proposed facility will be constructed of non-reflective materials. As discussed in the section above, the facility will be painted brown to match the brown wood material of the new joint utility pole.

Section 6512.2.H requires that wireless telecommunication facilities comply with all the requirements of the underlying zoning district, including, but not limited to, setbacks.

As discussed in Section 2, Compliance with Zoning Regulations, the proposed facility will comply with all requirements of the R-1/S-10 Zoning District. The new joint utility pole will be in the same location as the existing utility pole in the public right-of-way and is not subject to the development standards for setbacks.

Section 6512.2.I.2 allows in any Residential (R) district that new equipment on an existing facility in the public right-of-way shall be allowed to exceed the maximum height for structures allowed in that district by 10% of the height of the existing facility, or by five feet, whichever is less.

The maximum height allowed in the R-1/S-10 Zoning District is 36 feet. The proposed project involves replacing an existing 38-foot 7inch tall utility pole and installing a new wireless telecommunication facility on the new joint utility pole, resulting in a maximum height of 47 feet 6 inches. As discussed in Section A.2, the new equipment for the wireless telecommunication facility will be in compliance with this section by maintaining a maximum height of 37 feet.

b. Performance Standards

The proposed project meets the required standards of Section 6512.3 (*Performance Standards for New Wireless Telecommunication Facilities That Are Not Co-Location Facilities*) for lighting, licensing, provision of a permanent power source, timely removal of the facility, and visual resource protection. There is no lighting proposed, proper licenses will be obtained from both the Federal Communications Commission (FCC) and the California Public Utilities Commission (CPUC), power for the facility will be provided by PG&E, visual impact will be minimal, and conditions of approval will require maintenance and/or removal of the facility when no longer in operation. Furthermore, road access to the project site is existing and no noise in excess of San Mateo County's Noise Ordinance will be produced. Conditions of Approval Nos. 8-19 were added to ensure compliance with the performance standards of this section (see Attachment A).

4. Compliance with Use Permit Findings

For the use permit to be approved by the Zoning Hearing Officer, the following findings must be made:

a. That the establishment, maintenance and/or conducting of the use will not, under the circumstances of this particular case, be detrimental to the public welfare or injurious to property or improvements in said neighborhood.

Cellular communications facilities, such as this proposed project, require the submittal and review of radio frequency (RF) reports to ensure that the RF emissions from the proposed antennas do not exceed the Federal Communications Commission public exposure limits. The applicant submitted a radio frequency report prepared by Hammett & Edison, Inc., dated May 19, 2016 confirming that the proposed facility will comply with the prevailing standards for limiting public exposure to radio frequency energy and thus will not cause a significant impact on the environment (see Attachment D). The report states that the maximum RF level at ground level is calculated to be 1.6% of the applicable public exposure limit. The maximum calculated level at the second-floor elevation of the nearby residences is 4.6% of the public exposure limit. It should be noted that these results include several “worst-case” assumptions and therefore are expected to overstate actual power density levels from the proposed operation. Due to the location of the mounted antennas, they will not be accessible to the general public and therefore no mitigation measures are necessary to comply with the FCC public exposure guidelines. To ensure compliance with occupational exposure limitations, as recommended by Hammett & Edison, Inc., Staff has included Condition of Approval No. 19 for the posting of explanatory warning signs at the antennas and/or on the pole below the antennas, readily visible from any angle of approach to persons who may need to work within the area (see Attachment A).

Furthermore, the proposed facility will be unmanned, operate at all times, and be serviced once a year by an AT&T technician. The proposed facility will not generate significant traffic, noise, or intensification of use of the site.

With the discussion above, Staff has determined that the proposed project will not have a negative environmental, health, or visual impact on persons or property within the project vicinity.

b. That this telecommunication facility is necessary for the public health, safety, convenience or welfare of the community.

Staff has determined that installation of a cellular facility at this location will allow for increased clarity, range, and capacity of the existing cellular network and will enhance services for the public. The proposed facility is the least intrusive option available to close the significant AT&T service gap in this area of La Honda. The proposed facility will use existing utility infrastructure and add small equipment without disturbing the character of the neighborhood.

B. <u>ENVIRONMENTAL REVIEW</u>

This project is categorically exempt pursuant to Section 15303, Class 3, of the California Environmental Quality Act (CEQA) related to the construction of a new, small structure and installation of small new equipment and a facility in a small structure.

C. <u>CONCERNS OF THE APPELLANT</u>

An appeal of the decision made by the Zoning Hearing Officer (ZHO) was filed on November 3, 2016 (see Attachments F through I). The applicant submitted a response letter and a radio frequency (RF) statement prepared by the project’s AT&T RF engineer responding to the concerns of the appellant (see Attachments J and K respectively). The concerns of the appellant are summarized below with staff’s response following each point.

Inadequate Analysis of Alternative Sites and Lack of Evidence against Co-Location

1. **In the ExteNet La Honda Node 61G Alternative Site Analysis (alternative site analysis) there is no evidence that proves the inadequacy of Nodes 61F, 61L, 61N, and 61O (see Attachment C). It states that they are more intrusive than the proposed site, but are potentially viable. (No. 1.1 of Attachment H.)**

   Section 6512.5.B.11 of the Wireless Telecommunication Ordinance states that the applicant must identify existing wireless telecommunication facilities within a 2.5-mile radius of the proposed location and explain why co-location on these existing facilities, if any, is not feasible. The applicant is required to provide a list of all existing structures considered as alternatives to the proposed location and a written explanation as to why the alternatives considered are either unacceptable or infeasible. As discussed in Section A.3.a above, the applicant has fulfilled this requirement. Nodes 61F, 61L, 61N, and 61O are more visually intrusive than the currently proposed site. They are more noticeable at eye level and to neighboring residences due to the lack of natural vegetation surrounding it. The project site was chosen because it was not only the primary candidate to adequately fill the AT&T coverage gap, specifically in-building coverage, but also because it was the least intrusive site out of all the potentially viable yet intrusive alternative sites.

2. **The applicant did not identify alternative sites in the periphery of the town away from residential buildings. (No. 1.3 of Attachment H).**

   As stated in the applicant's response letter (see Attachment J), the applicant identified 18 alternative sites in the alternative site analysis (see Attachment C) and informally evaluated many other sites including alternative sites that could reasonably provide coverage to the intended area. The analysis concluded that the proposed site is the primary candidate.

3. **The proposed antennas have similar specifications to antennas used for Verizon Wireless facilities at the macro antenna farm at 155 Sears Ranch Road. Quantitative data was not included to support the infeasibility of this location. Co-location also cannot be excluded based on the characteristics and cost of equipment. (No. 1 and 3 of Attachment G, No. 1.3 and 1.5 of Attachment H, and concerns from Attachment I).**

   The applicable regulations do not require the applicant to submit a comparison of the proposed wireless telecommunication facility (WTF) and other nearby facilities of other carriers such as Verizon Wireless. As stated in the applicant's response letter, the FCC and governing courts have rejected the "one provider" argument in favor of the "own coverage rule" that each carrier is entitled to provide overlapping coverage to an area (see Attachment J). AT&T relies on different frequencies and technologies that do not result in the same propagation as Verizon Wireless. The applicant is not required to use the same frequencies and technologies as other carriers. Therefore, this concern cannot be legally used to determine the approval of this project.

As discussed in the alternative site analysis, the macro antenna farm at 155 Sears Ranch Road was the only tower site found within a 2.5-mile radius (see Attachment C). The propagation maps in the alternative site analysis show that a significant gap in coverage exists and that it cannot be adequately filled by co-locating at the macro antenna farm. A radio frequency (RF) statement prepared by Brian Williams, the project's AT&T RF engineer, also includes propagation maps that shows the coverage gap and how the installation of the proposed WTF will be advantageous to the affected area (see Attachment K). Since the applicant focused on the viable 18 alternative sites, no quantitative data was submitted for the macro antenna farm for this location.

4. **The analysis of the two alternative sites located near a water tank east of the community does not provide quantitative data on the antennas that were used to analyze the infeasibility of these locations. (No. 1.6 of Attachment H).**

The applicant conclusively demonstrated that placing the proposed facility anywhere near the water tanks would not fill the coverage gap in the alternative site analysis which is the main objective of the subject application (see Attachment C). Staff determined this was sufficient in justifying why a location near the water tanks is not desirable.

5. **No combination of sites has been considered as an alternative to the proposed site. (No. 1.7 of Attachment H).**

The "History" section above provides information regarding the applicant's two proposals submitted in 2014 to install wireless telecommunication facilities located within the residential areas of La Honda that would both be used to fill the AT&T coverage gap. At the third public hearing on November 19, 2015 for these two proposals, the ZHO recommended that the applicant research alternative sites. In May 2016, the applicant submitted the subject application in response to the recommendation of the ZHO. The current proposal is now only one location proposed within a residentially zoned area. In conjunction with the proposed site, the applicant has a separate proposal submitted to the State of California, Department of Transportation (Caltrans) to install a WTF on a utility pole located at 8865 La Honda Road, a location outside the La Honda residential area.

6. Technical analysis prepared by Dr. Angelo Dragone was submitted with the appeal that provides evidence of 4G LTE reception at 217 sites, more than 40 of which are in the AT&T coverage gap (see Attachments H and I). Dr. Dragone's analysis proves there are viable alternative sites other than the current site proposed. (No. 2 from Attachment G and concerns from Attachment I.)

The appellant provided evidence of adequate outdoor coverage through Verizon Wireless facilities in the subject area (see Attachment G through I). As addressed in the applicant's response letter (see Attachment J) and discussed in Section D.3 above, by law, the existence of 4G LTE coverage from another carrier cannot be used to prohibit coverage from the proposed carrier. In addition, the applicant chose the proposed location due to its ability to provide adequate in-building coverage to the subject area. In-transit and outdoor service are considered inadequate service coverage and constitutes a service gap. Although the applicant's main objective is to provide adequate in-building coverage, the alternative site analysis and AT&T Mobility Radio Frequency Statement (RF statement) provide propagation maps that show the existing in-building, in-transit, and outdoor service and how the proposed location would significantly increase the coverage in all three categories (see Attachments C and K respectively).

The RF statement further discusses how AT&T's existing infrastructure in the area does not adequately serve its customers in the subject area or address the rapidly increasing data usage. AT&T's 4G LTE service coverage has also not been fully deployed in this area. The proposed site is required to ensure AT&T customers receive reliable in-building service. AT&T uses industry standard propagation tools to identify the areas in its network where signal strength is too weak to provide reliable in-building service quality. This information is developed from sources including terrain and clutter databases and propagation modeling that stimulates signal propagation in the presence of terrain and clutter variation. The RF statement provides analysis and visual evidence of inadequate in-building coverage and how the proposed location is the least intrusive and most viable site to fill the coverage gap in the subject area.

<u>Failure to Engage the Community</u>

7. The applicant did not engage with the entire La Honda community. Instead, the applicant had private meetings with a few individuals who do not represent the entire community. (No. 2 of Attachment H).

The applicable regulations do not require the applicant to inform and meet with the entire community affected by the project. Pursuant to Section 6503 of the San Mateo County Zoning Regulations, notice for use permit applications shall be done by either one publication in a newspaper of general circulation in the County within ten days preceding the public hearing date or by mailing a postal card notice not less than ten days prior to the date of the public hearing to the owners of property within 300 feet of the exterior limits of the project location. Staff complied with this requirement by publishing the project information in the San Mateo County Times and mailing out the required public notices to owners within the required radius from the project location. Both noticing methods included the project planner's contact information.

Although not a requirement by the County, the applicant voluntarily invited all those in attendance at the public hearing on November 19, 2015 to the current project site location in December 2015. The applicant also met with residents living near the project location. At that time, the community members and neighbors did not express any objections to the proposal. It was not until shortly before they submitted for the current project site that a community member expressed opposition due to health reasons. Since the Federal Communications Commission (FCC) has exclusive jurisdiction of the airwaves and associated health concerns, the applicant chose to continue with the submittal of the project proposed.

Intrusiveness of Proposed Site Location

8. The proposed site location is the least visually intrusive of the alternative sites analyzed, but is still significant. The WTF proposed will not be hidden by vegetation, is extremely close to residences, and can be seen from the inside of nearby residences and front patio areas. The WTF will be visible from every angle as a pedestrian walks on La Cuesta Real, a road many residents frequent daily. (No 3. of Attachment H).

Pursuant to Section 6512.2.I.2 of the Wireless Telecommunication Facilities Ordinance and as discussed in Section A.3.a above, the project is in compliance with all applicable regulations. The proposed antennas will be at approximately the same height as the existing utility pole and above the natural view of any drivers, pedestrians, or private property owners in the surrounding area. The new joint utility pole will be constructed of wood material and the four equipment clusters and antennas will be non-reflective and painted brown to match the pole. In addition, no trees or vegetation are proposed for removal which lessens the visual impact of the new, taller joint utility pole. Compared to alternative sites that may not only require a taller pole, but also tree or vegetation removal to install the new WTF, the current proposal is presented as the most viable.

The new WTF will be located near existing residences in a residentially zoned area. However, as discussed in Section A.2 above, the project complies with applicable zoning regulations and is not subject to the development standards for setbacks due to its location in the public right-of-way. To ensure safety to residents within the surrounding vicinity of the project area, the applicant submitted a required radio frequency (RF) report to ensure the proposed antennas do not exceed the FCC mandated public exposure limits (see Attachment D). The RF report confirms the proposed WTF complies with prevailing standards for limiting public exposure to RF energy and will not cause a significant impact on the environment.

Inconsistencies in Application

9. There are errors in the alternative site analysis submitted (see Attachment C). (No. 1.1 and 4 of Attachment H).

These errors were the following: the same photo used for two sites (Nodes 61B and 61C) and failure to analyze the two previously proposed locations from 2014. The applicant confirmed at the public hearing on October 20, 2016 that this was a mistake, but the justification for each of those sites were correct. The information on the pages for Nodes 61B and 61C are correct. The analysis of the two locations proposed in 2014 would also not change the outcome of the analysis since the ZHO recommended on November 19, 2015 that the applicant research alternative sites instead. The applicant has chosen the proposed site as the alternative to those two sites. The errors are minor and do not change the accuracy of the analysis.

10. An Initial Study/ Mitigated Negative Declaration was prepared for each of the applicant's initial two proposals from 2014. According to a Public Utilities Commission document in the application, a modification of the Certificate of Public Convenience and Necessity allows the Commission Energy Division (CED) to grant CEQA exemptions to the applicant after their review of the project. No evidence was submitted to confirm approval from the CED. The applicant also claims in a document also submitted that the project is categorically exempted based on previous court decisions that does not adequately justify the project's exemption. (No. 4 of Attachment H).

The appellant is referring to the Application of ClearLinx Network Corporation (U-6959-C) for a Modification to its Certificate of Public Convenience and Necessity in Order to Provide Competitive Local Exchange, Access and Non-Dominant Interexchange Services, a document submitted by the applicant to explain their role and ownership in relation to this project. ExteNet Systems, Inc. (the applicant) owns the proposed equipment and applicable portions of the utility pole. The applicant is required to comply with all the California Public Utilities Commission (CPUC) regulations and requirements in the document. Evidence of compliance with these regulations and requirements is not a requirement of the Wireless Telecommunication Facilities (WTF) Ordinance. Pursuant to Section 6512.3.B of the WTF Ordinance and as conditioned under Condition of Approval No. 9 in Attachment A, the applicant is only required to submit evidence of licenses and registrations from the FCC, CPUC, and any other applicable regulatory bodies prior to initiating the operation of the wireless telecommunication facility.

Furthermore, Staff consulted County Counsel to determine if this project is categorically exempt from CEQA. County Counsel determined that this project is categorically exempt pursuant to Section 15303, Class 3, of the California Environmental Quality Act (CEQA) related to the construction of a new, small structure and installation of small new equipment and a facility in a small structure.

11. The photo simulations submitted do not accurately show guy wires (see Attachment E). (No. 4 of Attachment H).

The photo simulations submitted accurately depict the applicant's proposal. The project does not include guy wires. Guy wires are installed and removed pursuant to CPUC General Order 95 safety requirements.

D. <u>REVIEWING AGENCIES</u>

	Approve	Conditions	Deny
Building Inspection Section	X		
Cal-Fire	X		
Department of Public Works	X	X	

<u>ATTACHMENTS</u>

A. Recommended Findings and Conditions of Approval
B. Project Plans
C. ExteNet La Honda Node 61G Alternative Site Analysis
D. Radio Frequency Radiation Report prepared by Hammett & Edison, Inc., dated May 19, 2016
E. Photo Simulations
F. Appeal Application and Supplemental Letter prepared by David W. Ehrhardt
G. Attachment No. 1 of Appeal
H. Attachment No. 2 of Appeal (letter prepared by Dr. Angelo Dragone)
I. Attachment No. 3 of Appeal (additional technical evidence) (Please note: Due to size constraints, only the Planning Commission is receiving a complete copy of this document. This document can be viewed and downloaded from the San Mateo County Planning and Building Department website at: http://planning.smcgov.org/events/planning-commission-hearing-feb-8-2017

J. Appeal Response Letter prepared by Matthew S. Yergovich of ExteNet Systems, Inc., dated December 7, 2016
K. AT&T Mobility Radio Frequency Statement prepared by AT&T Radio Frequency Engineer Brian Williams, dated November 22, 2016

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County of San Mateo
Planning and Building Department

RECOMMENDED FINDINGS AND CONDITIONS OF APPROVAL

Permit or Project File Number: PLN 2016-00216 Hearing Date: February 8, 2017

Prepared By: Carmelisa Morales
Project Planner

For Adoption By: Planning Commission

RECOMMENDED FINDINGS

Regarding the Environmental Review, Find:

1. That this project is categorically exempt from environmental review, per Class 3, Section 15303, of the California Environmental Quality Act (CEQA) Guidelines for construction of a new, small structure and installation of small new equipment and a facility in a small structure.

Regarding the Use Permit, Find:

2. That the establishment, maintenance, and/or conducting of the use will not, under the circumstances of this particular case, be detrimental to the public welfare or injurious to the property or improvements in said neighborhood because the project will meet current Federal Communications Commission (FCC) standards as shown in the radio frequency radiation report and has been conditioned to maintain a valid FCC and California Public Utilities Commission (CPUC) license.

3. That this telecommunications facility is necessary for the public health, safety, convenience, or welfare of the community in that installing a cellular facility at this location will provide increased and improved cellular coverage in the area for residents, commuters, and emergency personnel.

RECOMMENDED CONDITIONS OF APPROVAL

Current Planning Section

1. This approval applies only to the proposal, documents, and plans described in this report and submitted to and approved by the Zoning Hearing Officer on May 20, 2016. Minor revisions or modifications may be approved by the Community Development Director if they are consistent with the intent of and in substantial conformance with this approval.

2. This use permit shall be for the proposed project only. Any change or change in intensity of use shall require an amendment to the use permit. Amendment to this use permit requires an application for amendment, payment of applicable fees, and consideration at a public hearing.

3. This permit shall be valid for ten (10) years until February 8, 2027. If the applicant seeks to renew this permit, renewal shall be applied for six (6) months prior to expiration with the Planning and Building Department and shall be accompanied by the renewal application and fee applicable at that time. Renewal of this permit shall be considered at a public hearing.

4. The applicant shall paint the proposed antennas brown and the equipment cabinets shall be painted a non-reflective color to match the utility pole. Two copies of color samples shall be submitted to the Current Planning Section at the time of application for a building permit. Color verification will be confirmed by the Current Planning Section prior to a final inspection for the building permit.

5. During project construction, the applicant shall, pursuant to Chapter 4.100 of the San Mateo County Ordinance Code, minimize the transport and discharge of stormwater runoff from the construction site into storm drain systems by:

   a. Stabilizing all denuded areas and maintaining erosion control measures continuously between October 1 and April 30. Stabilizing shall include both proactive measures, such as the placement of hay bales or coir netting, and passive measures, such as revegetating disturbed areas with plants propagated from seed collected in the immediate area.

   b. Storing, handling, and disposing of construction materials and wastes properly, so as to prevent their contact with stormwater.

   c. Controlling and preventing the discharge of all potential pollutants, including pavement cutting wastes, paints, concrete, petroleum products, chemicals, wash water or sediments, and non-stormwater discharges to storm drains and watercourses.

   d. Avoiding cleaning, fueling, or maintaining vehicles on-site, except in a designated area where wash water is contained and treated.

   e. Delineating with field markers clearing limits, easements, setbacks, sensitive or critical areas, buffer zones, trees, and drainage courses.

   f. Protecting adjacent properties and undisturbed areas from construction impacts using vegetative buffer strips, sediment barriers or filters, dikes, mulching, or other measures as appropriate.

   g. Performing clearing and earth-moving activities only during dry weather.

   h. Limiting and timing application of pesticides and fertilizers to prevent polluted runoff.

i. Limiting construction access routes and stabilizing designated access points.

j. Avoiding tracking dirt or other materials off-site; cleaning off-site paved areas and sidewalks using dry sweeping methods.

k. The contractor shall train and provide instruction to all employees and subcontractors regarding the construction best management practices.

6. This permit does not allow for the removal of any trees. Any tree removal will require a separate permitting process.

7. The applicant shall not enter into a contract with the landowner or lessee which reserves for one company exclusive use of structures on this site for telecommunications facilities.

8. The wireless telecommunication facility shall not be lighted or marked unless required by the Federal Communications Commission (FCC) or the Federal Aviation Administration (FAA).

9. The applicant shall file, receive, and maintain all necessary licenses and registrations from the Federal Communications Commission (FCC), the California Public Utilities Commission (CPUC), and any other applicable regulatory bodies prior to initiating the operation of the wireless telecommunication facility. The applicant shall supply the Planning and Building Department with evidence of each of these licenses and registrations. If any required license is ever revoked, the applicant shall inform the Planning and Building Department of the revocation within ten (10) days of receiving notice of such revocation.

10. Once a use permit is obtained, the applicant shall obtain a building permit and build in accordance with the approved plans.

11. The project's final inspection approval shall be dependent upon the applicant obtaining a permanent and operable power connection from the applicable energy provider.

12. The wireless telecommunication facility and all equipment associated with it shall be removed in its entirety by the applicant within 90 days if the FCC and/or CPUC license and registration are revoked or the facility is abandoned or no longer needed, and the site shall be restored and revegetated to blend with the surrounding area. The owner and/or operator of the wireless telecommunication facility shall notify the County Planning Department upon abandonment of the facility. Restoration and revegetation shall be completed within two (2) months of the removal of the facility.

13. Wireless telecommunication facilities shall be maintained by the permittee(s) and subsequent owners in a manner that implements visual resource protection requirements of Section 6512.2.E and F above (e.g., landscape maintenance and painting), as well as all other applicable zoning standards and permit conditions.

14. Noise sources associated with demolition, construction, repair, remodeling, or grading of any real property shall be limited to the hours from 7:00 a.m. to 6:00 p.m., weekdays and 9:00 a.m. to 5:00 p.m., Saturdays. Said activities are prohibited on Sundays, Thanksgiving, and Christmas (San Mateo Ordinance Code Section 4.88.360).

15. If a diesel generator is proposed at the building permit stage, the applicant shall provide written documentation as to why the installation of options such as electricity, natural gas, solar, wind or other renewable energy sources is not feasible. The use of diesel generators or any other emergency backup energy source shall comply with the San Mateo County Noise Ordinance.

16. If technically practical and without creating any interruption in commercial service caused by electronic magnetic interference (EMI), floor space, tower space and/or rack space for equipment in a wireless telecommunication facility shall be made available to the County for public safety communication use.

17. To reduce the impact of construction activities within the public right-of-way and/or on neighboring properties, the applicant shall ensure that no construction-related vehicles impede through traffic along Cuesta Real, Canada Vista, or other public right-of-ways.

18. To reduce the impact of potential traffic hazards from service visits to the facility, the applicant shall ensure that no vehicles related to the service and/or maintenance of the cellular facility impede through traffic along Cuesta Real, Canada Vista, or other public right-of-ways.

19. To limit human exposure to radio frequency energy, explanatory signs are required to be posted at the antennas and/or on the pole below the antennas, readily visible from any angle of approach to persons who might need to work within the project area.

20. Prior to final inspection for the building permit, the applicant must contact the Project Planner to close the two alternative site proposals under PLN 2014-00395 and PLN 2014-00396.

<u>Department of Public Works</u>

21. No proposed construction work within the County right-of-way shall begin until County requirements for the issuance of an encroachment permit, including review of the plans, have been met and an encroachment permit issued. The applicant shall contact a Department of Public Works Inspector 48 hours prior to commencing work in the right-of-way.

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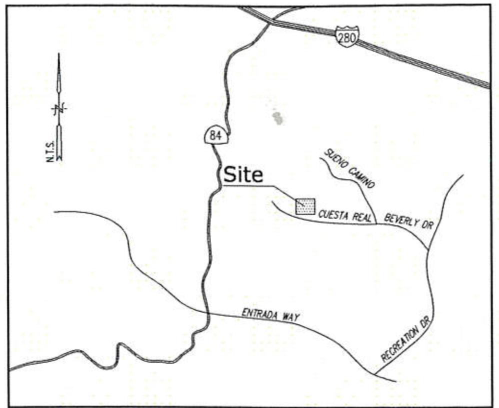


Vicinity Map

Title Report

NOT APPLICABLE, RIGHT-OF-WAY

Legal Description

NOT APPLICABLE, RIGHT-OF-WAY

Assessor's Parcel No.

NOT APPLICABLE, RIGHT-OF-WAY

Easements

NOT APPLICABLE, RIGHT-OF-WAY

Geographic Coordinates at Existing Utility Pole

1983 DATUM: LATITUDE 37° 19' 17.51" N LONGITUDE 122° 16' 08.33" W
ELEVATION = 617.8 FEET ABOVE MEAN SEA LEVEL

CERTIFICATION:
THE LATITUDE AND LONGITUDE SHOWN ABOVE ARE ACCURATE TO WITHIN +/– 15 FEET HORIZONTALLY AND THAT THE ELEVATIONS SHOWN ABOVE ARE ACCURATE TO WITHIN +/– 3 FEET VERTICALLY. THE HORIZONTAL DATUM (GEOGRAPHIC COORDINATES) IS IN TERMS OF THE NORTH AMERICAN DATUM OF 1983 (NAD 83) AND IS EXPRESSED IN DEGREES (°), MINUTES (') AND SECONDS ("), TO THE NEAREST HUNDREDTH OF A SECOND. THE VERTICAL DATUM (ELEVATIONS) IS IN TERMS OF THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88) AND IS DETERMINED TO THE NEAREST TENTH OF A FOOT.

Basis of Bearings

THE BASIS OF BEARING FOR THIS SURVEY IS THE CALIFORNIA COORDINATES SYSTEM (CCS 83), ZONE 3, 1983 DATUM, DEFINED BY SECTIONS 8801 TO 8819 OF THE CALIFORNIA PUBLIC RESOURCES CODE.

Bench Mark

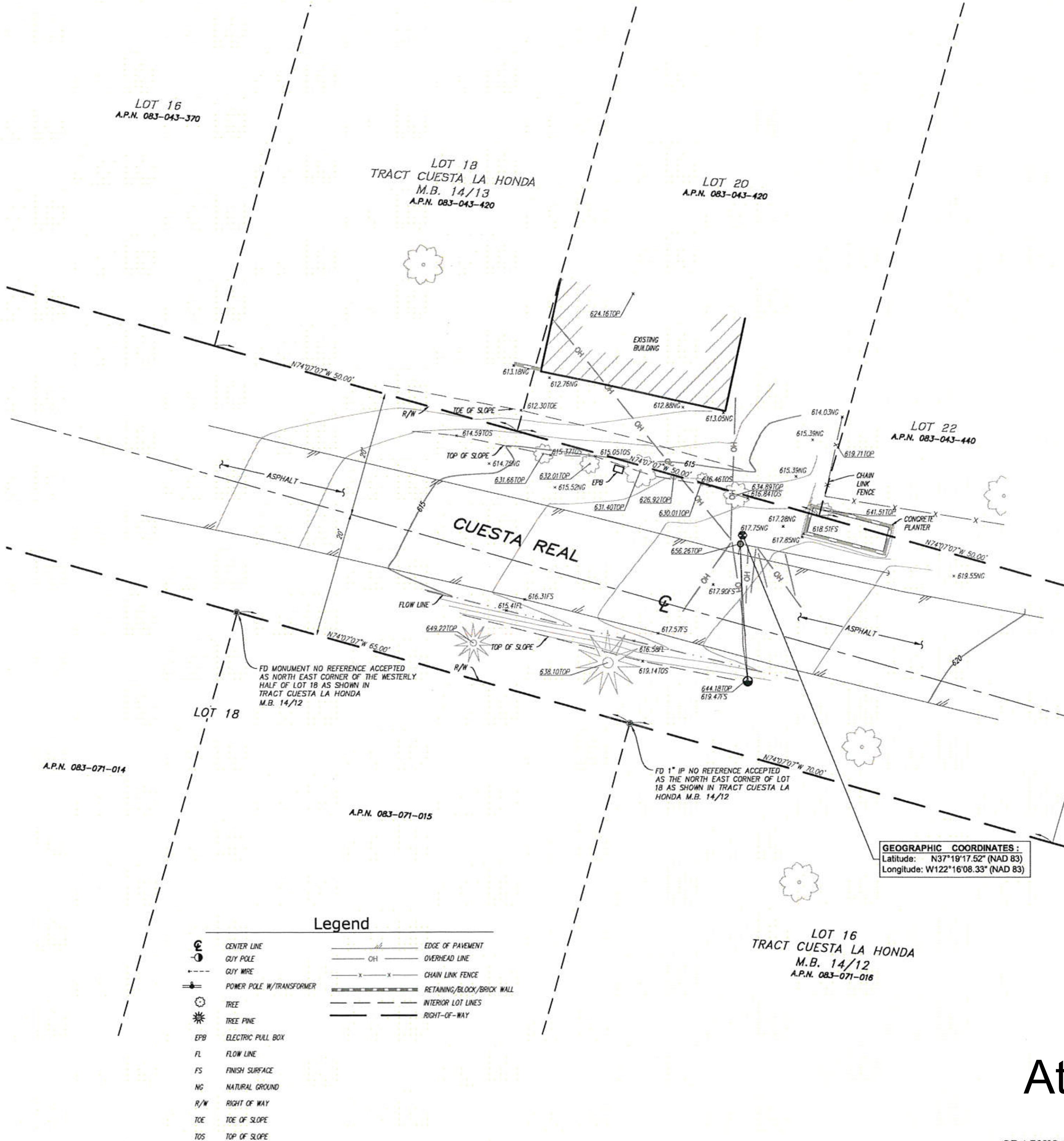
THE CALIFORNIA SPATIAL REFERENCE CENTER C.O.R.S "P176", ELEVATION = 1531.73 FEET (NAVD 88).

Date of Survey

MARCH 21, 2016

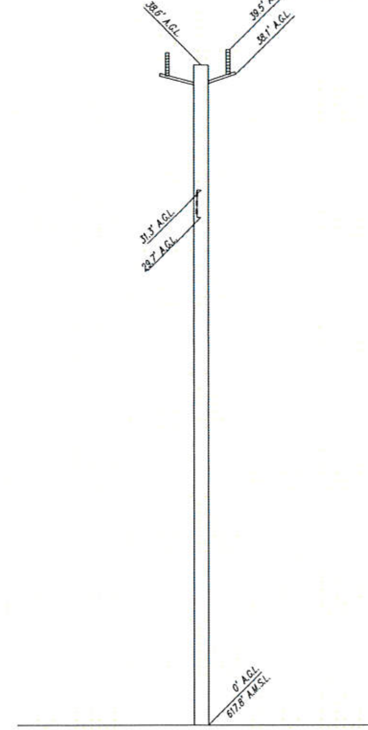
Overall Site Detail

SCALE: 1"=10'

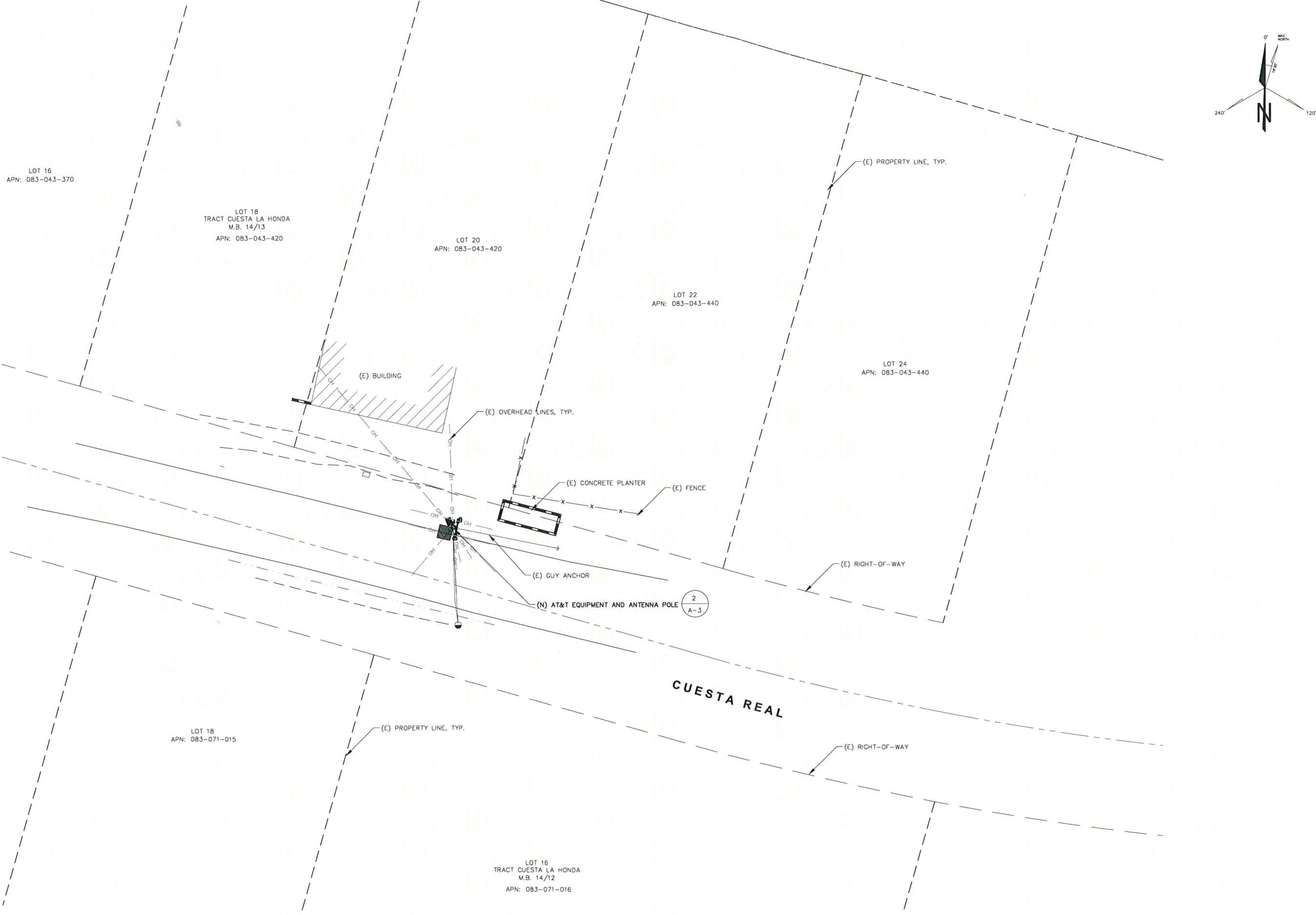


Existing Utility Pole

WESTERLY ELEVATION (N.T.S.)



Attachment B



Attachment B

1 **OVERALL SITE PLAN**

SCALE: 1" = 10'-0"

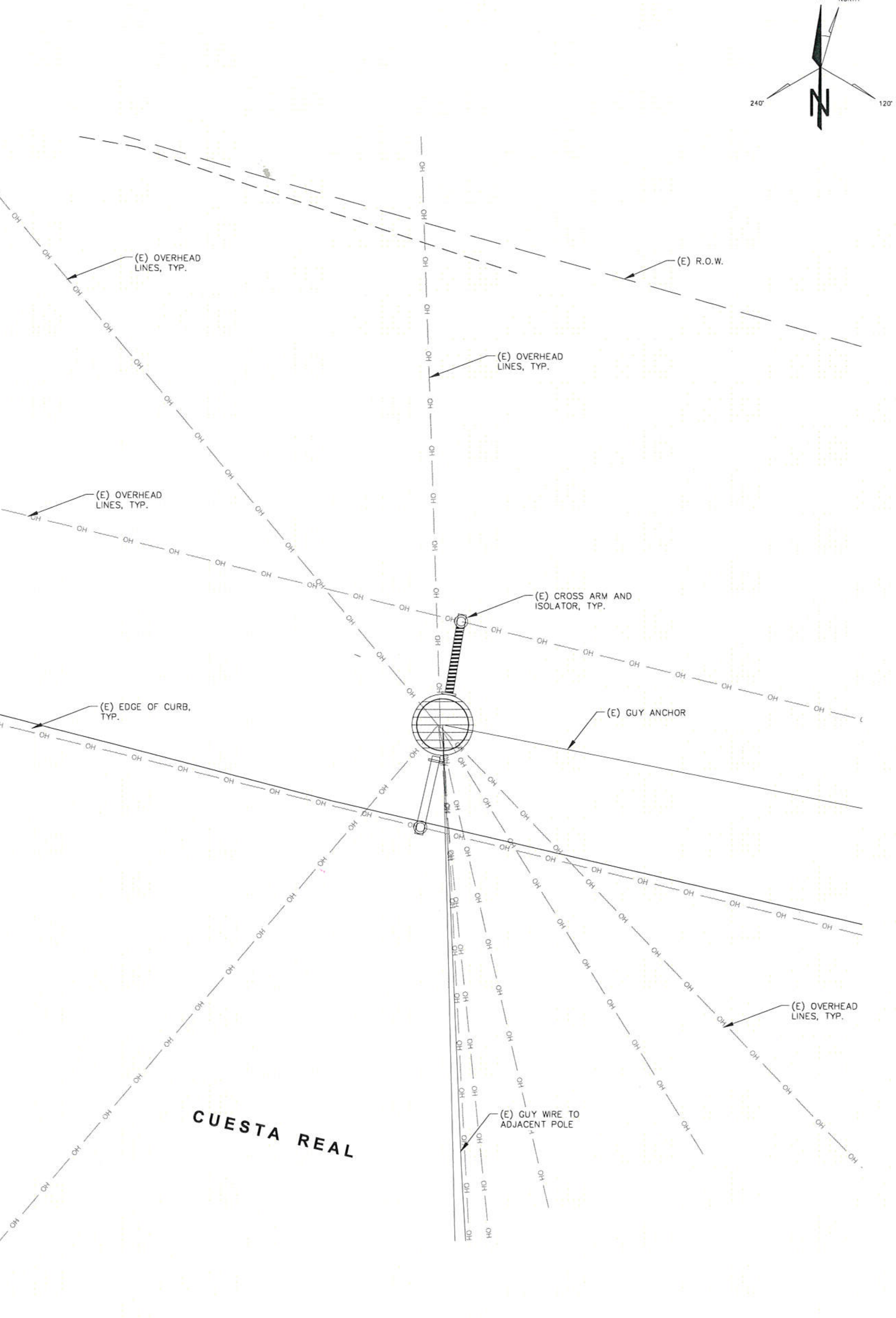
0' 10' 20' 30'

Attachment B

1 ROAD PERSPECTIVE - SITE VIEW #1

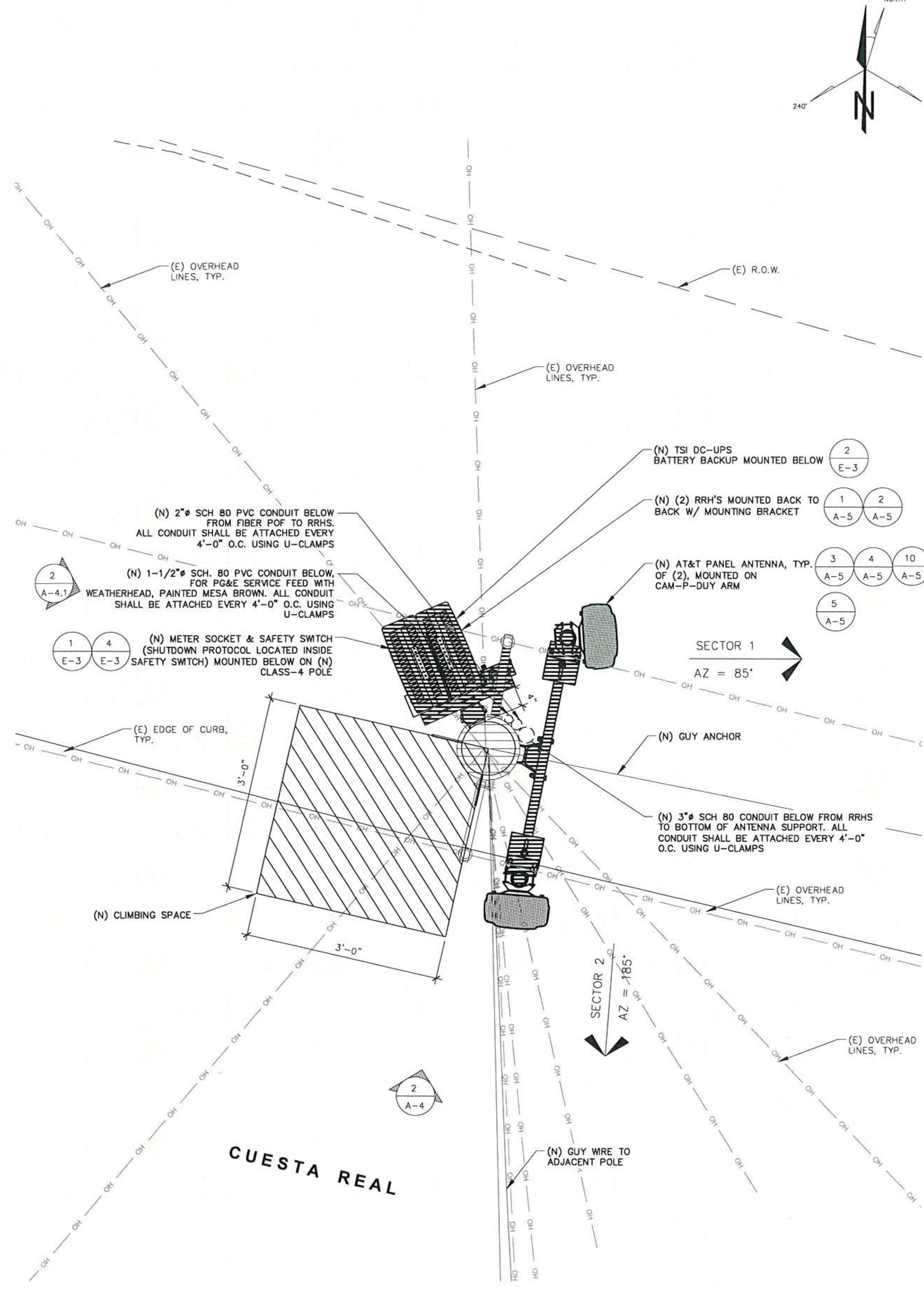
Attachment B

1 ROAD PERSPECTIVE - SITE VIEW #2



EXISTING PROJECT AREA PLAN

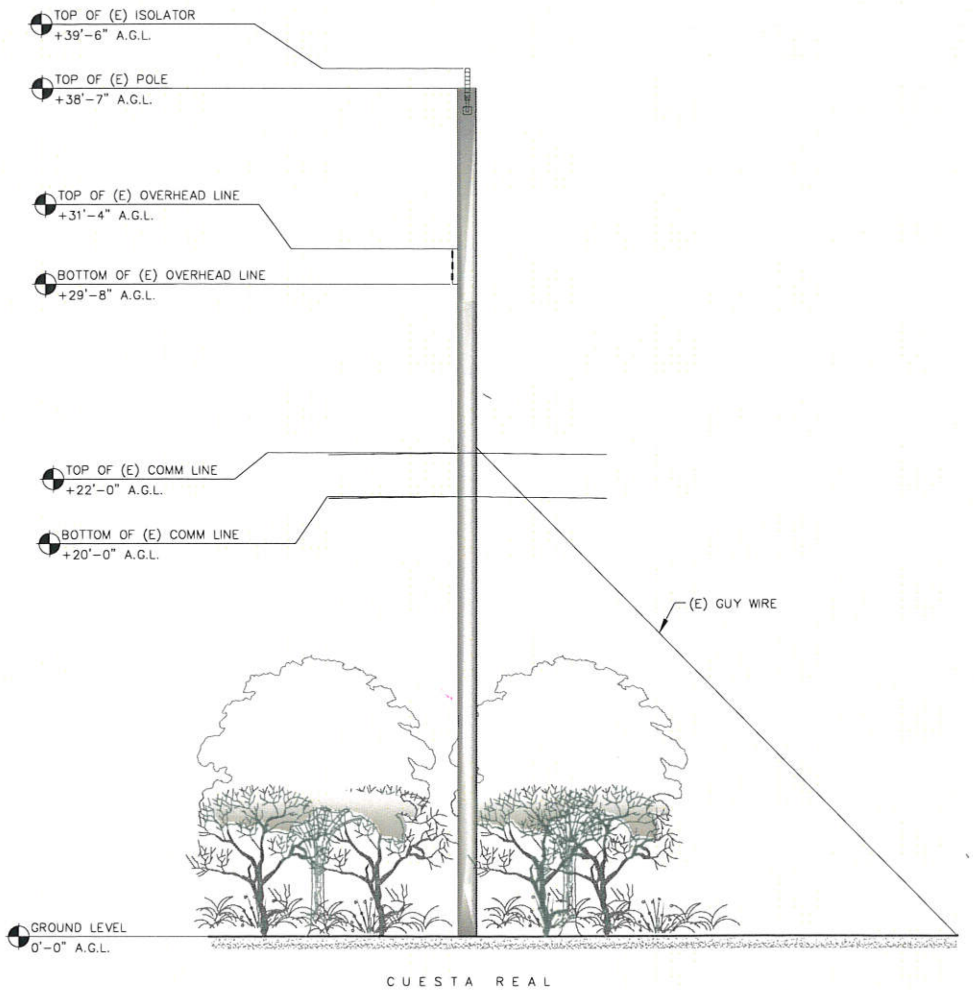
SCALE: 1/8" = 1'-0"



Attachment B

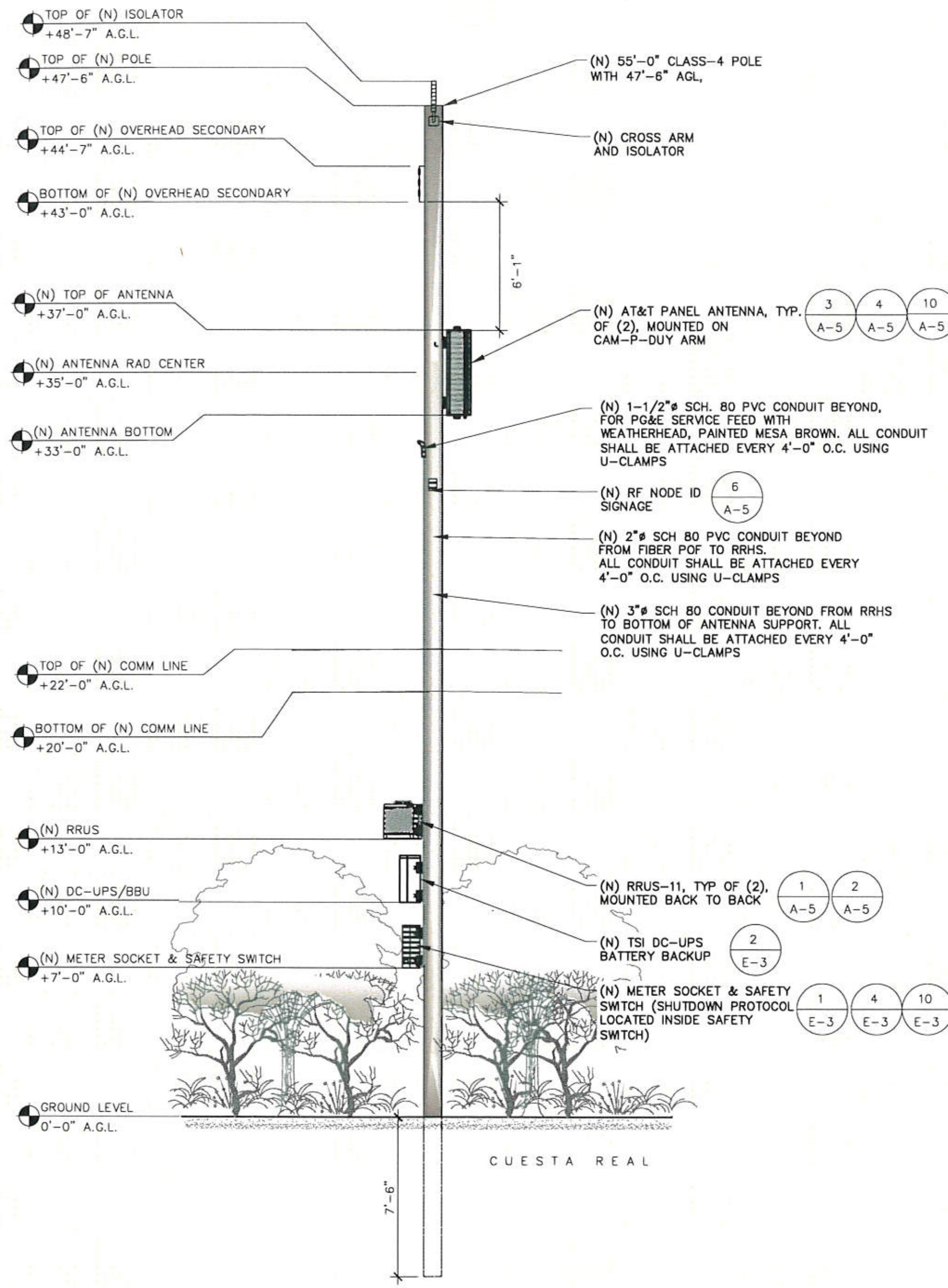
2 PROPOSED PROJECT AREA PLAN

SCALE: 1/8" = 1'-0"



EXISTING SOUTH ELEVATION

SCALE: 1/2" = 1'-0"

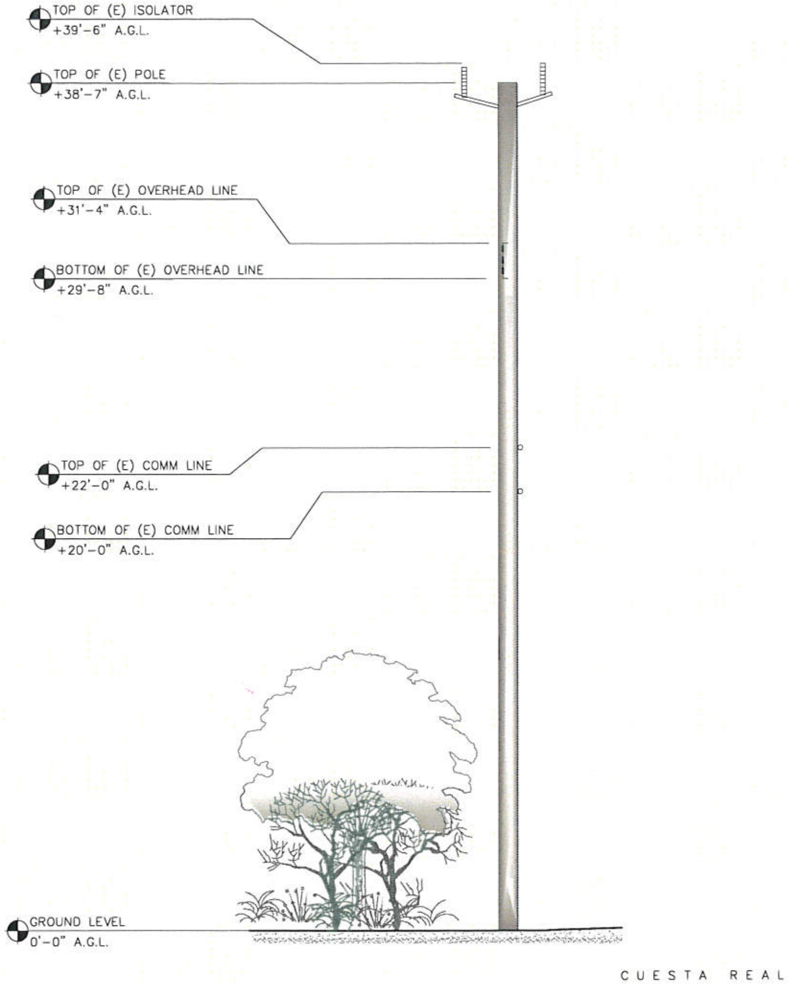


Attachment B

2 PROPOSED SOUTH ELEVATION

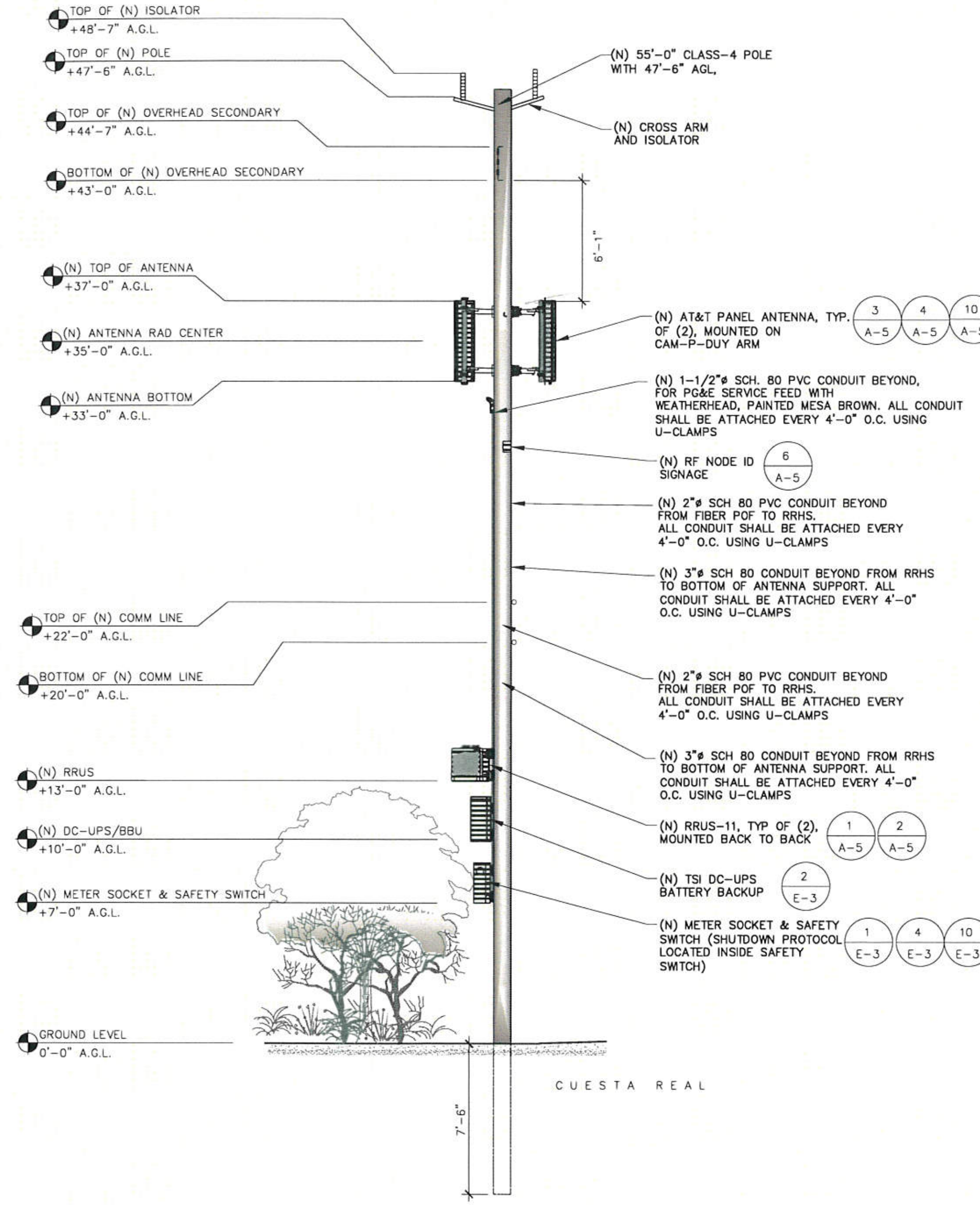
SCALE: 1/4" = 1'-0"

Attachment B



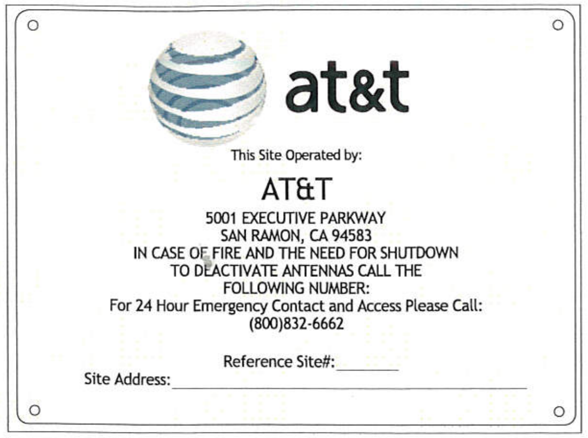
EXISTING WEST ELEVATION

SCALE: 1/2" = 1'-0"



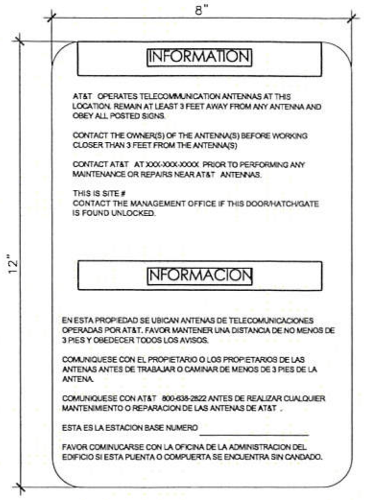
2 **PROPOSED WEST ELEVATION**

SCALE: 1/4" = 1'-0"

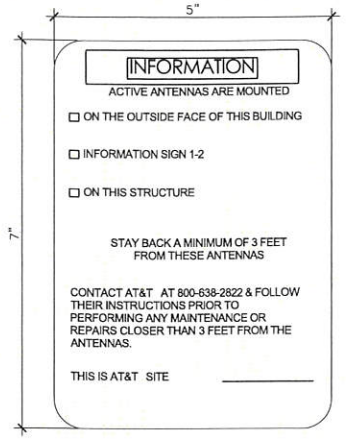


10 FENCED COMPOUND SIGNAGE
NOT TO SCALE

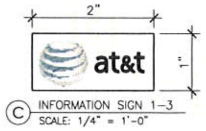
7 FENCED COMPOUND SIGNAGE
NOT TO SCALE



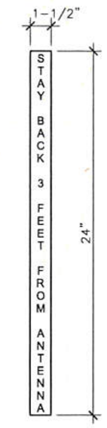
A INFORMATION SIGN 1-1



B INFORMATION SIGN 1-2



C INFORMATION SIGN 1-3
SCALE: 1/4" = 1'-0"



D INFORMATION SIGN 1-4

FRONT OF THE SIGN.

ALL PAINT WILL BE BAKED w/ENAMEL w/ UV PROTECTIVE COATING OVER THE FACE OF THE SIGN.

*SIGN 1-2: POLE, SEE DETAIL 1B, THIS SHEET

SIGN 2 MUST BE A NON METALLIC LABEL w/ AN ADHESIVE BACKING, THE LABEL SHALL BE MADE USING VINYL OR SIMILAR WEATHERPROOF MATERIAL. THE LABEL SHALL BE APPROXIMATELY 5X7 INCHES w/ A WHITE BACKGROUND AND BLACK LETTERING. THE GREEN BAND SHALL BE 1.375 INCH IN HEIGHT & THE LETTERING SHALL BE BLACK w/ 0.75 INCH HIGH LETTERS. THE TEXT LETTERING SHALL BE BLACK w/ $\frac{1}{8}$ INCH HIGH LETTERS. UV PROTECTION SHALL BE PLACED OVER THE FRONT OF THE LABEL.

*SIGN 1-3: BACK OF ANTENNAS, SEE DETAIL 1C & 3, THIS SHEET

*SIGN 3 IS A 1 INCH X 2 INCH PANEL THAT CAN BE APPLIED TO THE BACK OR SIDE OF AN ANTENNA TO IDENTIFY IT AS AN AT&TANTENNA.

*SIGN 1-4: SIDE OF ANTENNAS, SEE DETAIL 1D & 3, THIS SHEET

SIGN 4 IS MADE FROM TRANSPARENT MATERIAL 1-1/2 INCHES WIDE & 24 INCHES LONG. THE LETTERING IS TO BE BLACK w $\frac{1}{2}$ INCH LETTERING IN A VERTICAL COLUMN. THE SPACING BETWEEN WORDS MUST BE SUCH THAT IT IS EASILY READ & FILLS THE LENGTH OF THE SIGN.

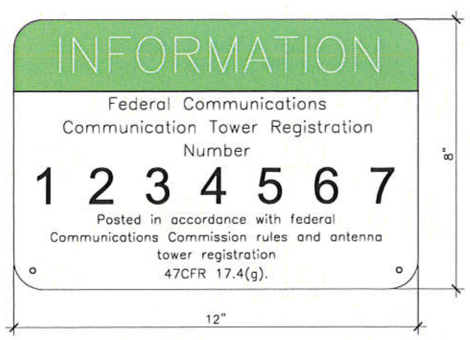
8 INFORMATION SIGNAGE
NOT TO SCALE

SIGNAGE AND STRIPING INFORMATION

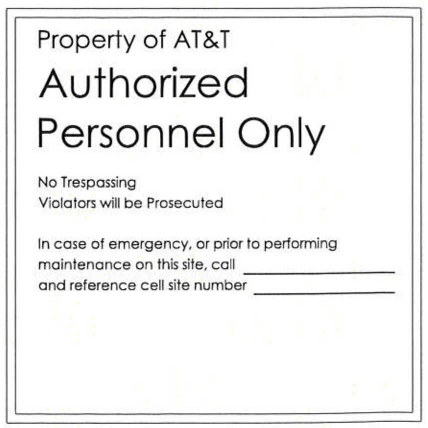
1. THE FOLLOWING INFORMATION IS A GUIDELINE w/ RESPECT TO PREVAILING STANDARDS LIMITING HUMAN EXPOSURE TO RADIO FREQUENCY ENERGY AND SHOULD BE USED AS SUCH. IF THE SIT EMF REPORT OR ANY LOCAL, STATE OR FEDERAL GUIDELINES OR REGULATIONS SHOULD BE IN CONFLICT w/ ANY PART OF THESE OR PLANS, THE MORE RESTRICTIVE GUIDELINE OR REGULATION SH FOLLOWED AND OVERRIDE THE LESSER.
2. THE PUBLIC LIMIT OF RF EXPOSURE ALLOWED BY AT&TIS 1mWcm THE OCCUPATIONAL LIMIT OF RF EXPOSURE ALLOWED BY AT&TIS 5mWcm*2
3. IF THE BOTTOM OF THE ANTENNA IS MOUNTED (8) EIGHT FEET AE THE GROUND OR WORKING PLATFORM LINE OF THE PERSONAL COMMUNICATION SYSTEM (PCS) AND DOES NOT EXCEED THE PUBL LIMIT OF RF EXPOSURE LIMIT THEN NO STRIPING OR BARRICADES SHOULD BE NEEDED.
4. IF THE PUBLIC LIMIT OF RF EXPOSURE ON THE SITE IS EXCEEDE THE AREA IS PUBLICLY ACCESSIBLE (e.g. ROOF ACCESS DOOR TH CANNOT BE LOCKED, OR FIRE EGRESS) THEN BOTH BARRICADES STRIPING SHALL BE PLACED AROUND THE ANTENNAS. THE EXACT OF THE BARRICADES AND STRIPING SHALL BE DETERMINED BY TH REPORT FOR THE SITE DONE BEFORE OR SHORTLY AFTER COMPLE OF SITE CONSTRUCTION. USE THE PLANS AS A GUIDELINE FOR PLACEMENT OF SUCH BARRICADES AND STRIPING.
5. IF THE PUBLIC LIMIT OF RF EXPOSURE ON THE SITE IS EXCEEDE THE AREA IS PUBLICLY ACCESSIBLE (e.g. ROOF ACCESS DOOR TH CANNOT BE LOCKED, OR FIRE EGRESS) THEN BOTH BARRICADES STRIPING SHALL BE PLACED AROUND THE ANTENNAS. THE EXACT OF THE BARRICADES AND STRIPING SHALL BE PLACED AROUND TH ANTENNAS. THE EXACT EXTENT OF THE BARRICADES & STRIPING BE DETERMINED BY THE EMF REPORT FOR THE SITE DONE BEFOR SHORTLY AFTER COMPLETION OF SITE CONSTRUCTION. USE THE P AS A GUIDELINE FOR PLACEMENT OF SUCH BARRICADES AND STR
6. ALL TRANSMIT ANTENNAS REQUIRE A THREE LANGUAGE WARNING WRITTEN IN ENGLISH, SPANISH, AND CHINESE. THIS SIGN SHALL B PROVIDED TO THE CONTRACTOR Y THE AT&TCONSTRUCTION PROJE MANAGER AT THE TIME OF CONSTRUCTION. THE LARGER SIGN SHA PLACED IN PLAIN SIGHT AT ALL ROOF ACCESS LOCATIONS AND ON BARRICADES. THE SMALLER SIGN SHALL BE PLACED ON THE ANTE ENCLOSURES IN A MANNER THAT IS EASILY SEEN BY ANY PERSON THE ROOF. WARNING SIGNS SHALL COMPLY w/ ANSI C95.2 COLOR SYMBOL, AND CONTENT CONVENTIONS. ALL SIGNS SHALL HAVE AT NAME AND THE COMPANY CONTACT INFORMATION (e.g. TELEPHONE NUMBER) TO ARRANGE FOR ACCESS TO THE RESTRICTED AREAS. TELEPHONE NUMBER SHALL BE PROVIDED TO THE CONTRACTOR B AT&TCONSTRUCTION PROJECT MANAGER AT THE TIME OF CONSTRU
7. PHOTOS OF ALL STRIPING, BARRICADES & SIGNAGE SHALL BE PAR THE CONTRACTORS CLOSE OUT PACKAGE & SHALL BE TURNED IN AT&TCONSTRUCTION PACKAGE & SHALL BE TURNED INTO THE AT&TCONSTRUCTION PROJECT MANAGER AT THE END OF CONSTRU STRIPING SHALL BE DONE w/ FADE RESISTANT YELLOW SAFETY PA A CROSS-HATCH PATTERN AS DETAILED BY THE CONSTRUCTION DRAWINGS. ALL BARRICADES SHALL BE MADE OF AN RF FRIENDLY MATERIAL SO AS NOT TO BLOCK OR INTERFERE w/ THE OPERATIC THE ANTENNAS. BARRICADES SHALL BE PAINTED w/ FADE RESTRA YELLOW SAFETY PAINT. THE CONTRACTOR SHALL PROVIDE ALL RF FRIENDLY BARRICADES NEEDED, & SHALL PROVIDE THE AT&TCONSTRUCTION PROJECT MANAGER w/ A DETAILED SHOP DRA OF EACH BARRICADE. UPON CONSTRUCTION COMPLETION.

9 GENERAL NOTES
NOT TO SCALE

5 DOOR/EQUIPMENT SIGN
NOT TO SCALE



6 FCC ASR SIGNAGE
NOT TO SCALE



1 GATE SIGNAGE
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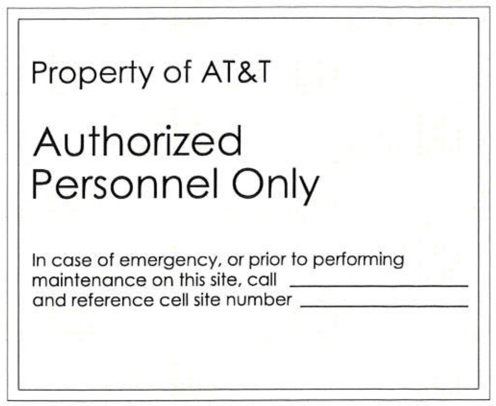
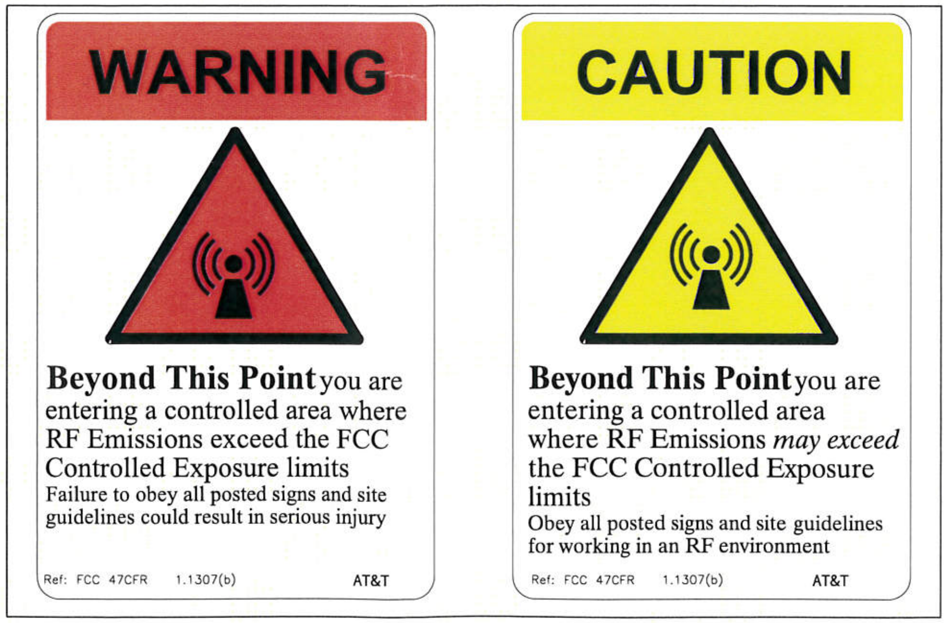


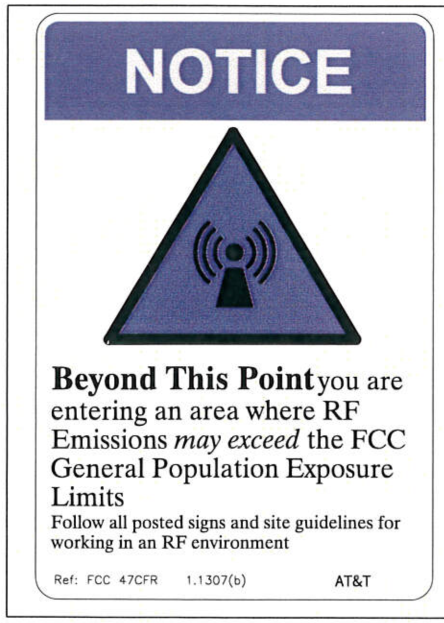
2 SHELTER/CABINET DOOR
NOT TO SCALE

NOTE:
1. CONTRACTOR SHALL INSTALL ALL INFORMATION SIGNAGE IN ACCORDANCE w/ AT&T DOCUMENT #03-0074, RF EXPOSURE POLICY AND RF SAFETY COMPLIANCE PROGRAM, LATEST EDITION.

2. CONTRACTOR SHALL CONTACT AT&TR-RFSC FOR INFORMATION ON MPE LEVELS AND INSTRUCTIONS ON LEVEL AND LOCATION OF SIGNAGE



3 CAUTION & WARNING SIGN
NOT TO SCALE



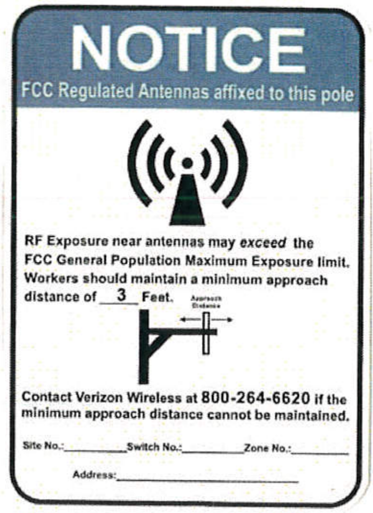
Attachment B

4 NOTICE SIGN
NOT TO SCALE

NOT USED

SCALE: N.T.S | 11

NOTE:
NEW VINYL SIGN TO BE PROVIDED BY VERIZON WIRELESS AND BE PLACED ON THE POLE 13'-0" ABOVE GROUND LEVEL. COLOR TO BE DETERMINED PRIOR TO INSTALL.



RF WARNING SIGNAGE

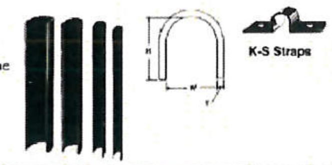
SCALE: N.T.S | 6

GUARDS & STRAPS, CABLE
PROTECT TELEPHONE AND POWER LINES WHERE CIRCUITS LEAD FROM UNDERGROUND TO OVERHEAD. GUARDS ARE 14-GUAGE HOT DIP GALVANIZED STEEL, FORMED INTO "U" SHAPE. STRAPS ARE MADE FROM HOT DIP GALVANIZED FLAT STEEL, SHAPED TO FIT GUARDS.

Cable Guards				M
Catalog Number	Inside Dia.	Length	Approx. Ship Wt. per Each	Mounting Strap Catalog Number - Order Separately
C2030452*	3/4"	5'	2.76 lbs.	C2030455
C2030450*		8'	4.80 lbs.	
6531*	1-1/8"	5'	4.80 lbs.	6538*
653112*		8'	5.60 lbs.	
6532*	2-3/16"	5'	8.60 lbs.	6539*
6533*		8'	12.60 lbs.	
6534T*	3 3/16"	5'	15.25 lbs.	6540*
6535*		8'	18.00 lbs.	
C2030451*	3-11/16"	8'	22.69 lbs.	C2030456

GUARDS, PLASTIC MOLDING

KOVER-GARD® molding protects surface ground wires, lead wires and conductors. Flame retardant and easy to install. Makes wood or metal molding obsolete.



Cable Guards					Mounting Strap			
Catalog Number	Inside Dia.	Length	Thickness	Approx. Ship Wt. per Each	Mounting Strap Catalog Number - Order Separately	Mounting Hole Dia.	Material Size	Approx. Ship Wt. per Each
96KG12	1/2"	96"	1/16"	0.48 lbs.	KS12	1/8"	1/16" x 5/8"	.006 lbs.
96KG34	3/4"			0.76 lbs.	N/A			
96KG1	1"		5/64"	0.96 lbs.	N/A			

RISER GUARD DETAIL

SCALE: N.T.S | 5

1). INSERT SCISSOR BRACKETS BETWEEN THE UPPER ANTENNA MOUNTING BRACKET AND THE UPPER POLE ADAPTER BRACKET. SECURE USING 1/2 INCH HARDWARE PROVIDED.

2). TO SET THE DEGREE OF DOWNTILT, ALIGN THE DESIRED HOLES ON THE SCISSOR BRACKETS AND SECURE USING 5/16 INCH HARDWARE PROVIDED.

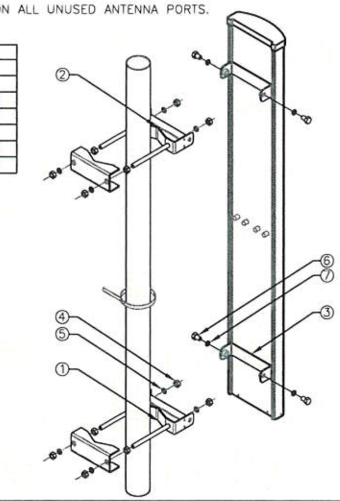
3). THE NUMBER OF CONNECTORS WILL VARY BASED ON ANTENNA TYPE.

4). PLACE RF TERMINATIONS OR CAPS ON ALL UNUSED ANTENNA PORTS.

PARTS:

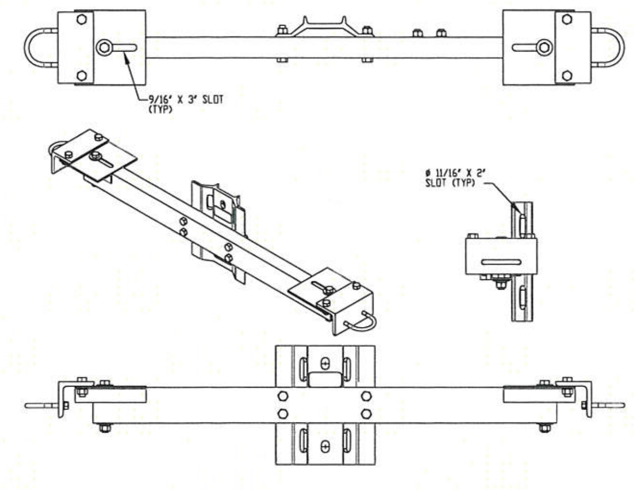
Item	QTY	Description
①	1	Adaptor, Pole, Lower
②	1	Bracket, Downtilt, Pole
③	1	Bracket, Downtilt, Antenna
④	4	1/2 X 1 Hex Head Bolt
⑤	4	1/2 Split Washer
⑥	2	5/16 X 1 Hex Head Bolt
⑦	2	5/16 Split Washer

NOTE:
VERIFY EXISTING CONDITIONS, ALL MOUNTING ATTACHMENTS AND HARDWARE SHALL BE VERIFIED BY CONSTRUCTION MANAGER



ANTENNA MOUNT DETAIL

SCALE: N.T.S. | 3

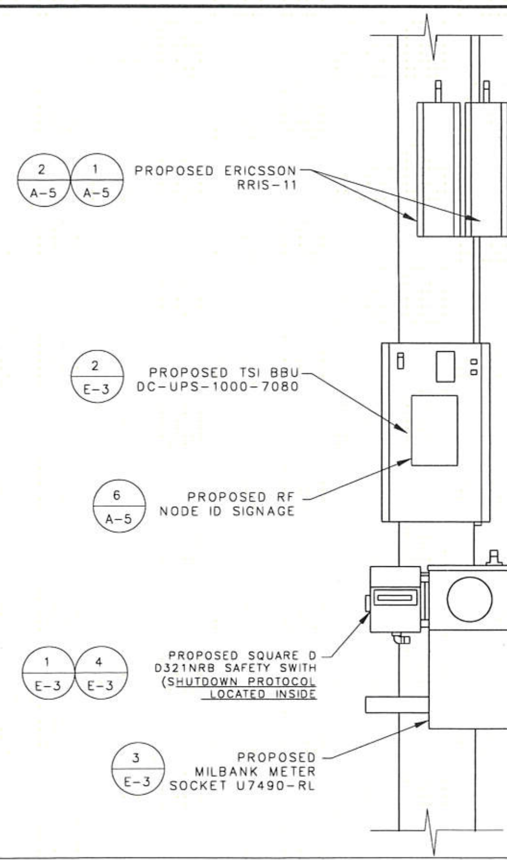


ALUMA-FORM, Inc.
3625 OLD GETWELL ROAD,
MEMPHIS, TN 38118-6072 U.S.A.
TEL (901) 362-0100

SUPPLIER:
ACE SUPPLY COMPANY INC. CONTACT: BRUCE DOLL
3095 KERNER BLVD. SUITE K CELL: 415-827-0749
SAN RAFAEL, CA 94901 EMAIL: BruceDolle@att.net

CAM-P-DUY MOUNTING BRACKET

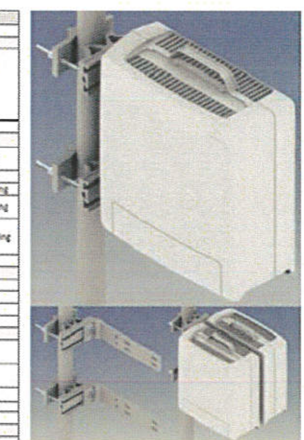
SCALE: N.T.S | 10



EXTENET EQUIPMENT CONFIG.

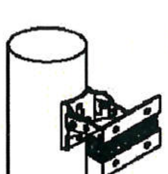
SCALE: N.T.S | 8

Technical information for RRU support kit				
Ordering p/n:	Function description:			
SXK 107 2839/1	Single RRU support kit for installation of one RRU with possibility to attach PSU or A2 units or 1-2 T580A units. (RRU not included)			
SXK 107 2839/2	Expansion kit for installation of two RRU units with possibility to attach PSU or A2 units. (RRU not included)			
Clamp mounting range:				
	Tubes ○	Square profiles □	90° Angle ∨	60° Angle V
Minimum (mm)	Ø25	35 x 35	35 x 35	40 mm opening
Maximum with 180mm bolts (mm)	Ø80	65 x 65	90 x 90	80 mm opening
Maximum with 200mm bolts (mm) not included	Ø120	90 x 90	90 x 90	100 mm opening
Mechanical data:				
Clamp profiles	Aluminum, Nature anodized 20µm			
Support arms	Aluminum, Nature anodized 20µm			
Fasteners	Acid proof stainless steel			
Performance:				
Installation type	Max Net Wind Area* at Wind speed 180 Km/h (50 m/s)			
Support kit installed in two levels on tube.	0,6 m²			
*Net Wind Area is the projected area multiplied with a shape factor [illegible]				
Package dimensions:				
	Length	Width	Height	Weight
SXK 107 2839/1	530 mm	95 mm	85 mm	5 kg
SXK 107 2839/2	370mm	80 mm	80 mm	2 kg

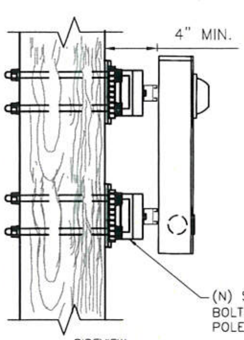


RRU SUPPORT KIT DETAIL

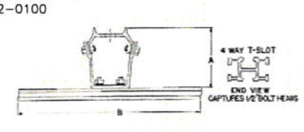
SCALE: N.T.S. | 2



Catalog Number	Product	"A" Dimension
6-CSO-12	2 WAY T-SLOT	6"
6-CSO-24	2 WAY T-SLOT	6"
6-CSO-36	2 WAY T-SLOT	6"
9-CSO-12	2 WAY T-SLOT	9"
9-CSO-24	2 WAY T-SLOT	9"
9-CSO-36	2 WAY T-SLOT	9"
6-CSO-12-4WT	4 WAY T-SLOT	6"
6-CSO-24-4WT	4 WAY T-SLOT	6"
6-CSO-36-4WT	4 WAY T-SLOT	6"
9-CSO-12-4WT	4 WAY T-SLOT	9"
9-CSO-24-4WT	4 WAY T-SLOT	9"
9-CSO-36-4WT	4 WAY T-SLOT	9"



ALUMA-FORM BRACKET SYSTEM
AVAILABLE FROM ACE SUPPLY
CAM-P-DUY-3ACE
ALUMA-FORM INC.
(901) 362-0100



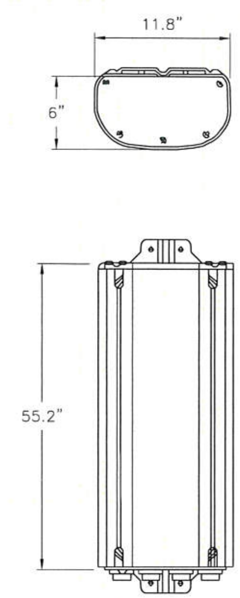
TYPICAL EQUIPMENT STANDOFF DETAIL

SCALE: N.T.S | 9

NOT USED

SCALE: N.T.S | 7

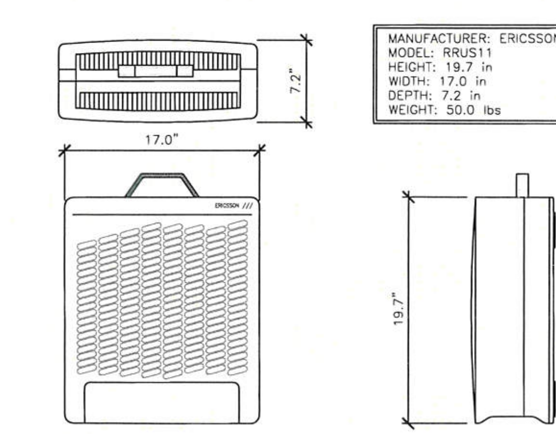
SPECIFICATIONS:
DIMENSIONS: 55.2X11.8X6 INCHES
WIND LOAD: 93 MPH
WIND SURVIVAL RATING: 150 MPH
WEIGHT: 50 LBS
MOUNTING: MOUNTING HARDWARE INCLUDED FOR 2 TO 4.6 INCH



KATHREIN PANEL ANTENNA

SCALE: N.T.S | 4

MANUFACTURER: ERICSSON
MODEL: RRUS11
HEIGHT: 19.7 in
WIDTH: 17.0 in
DEPTH: 7.2 in
WEIGHT: 50.0 lbs

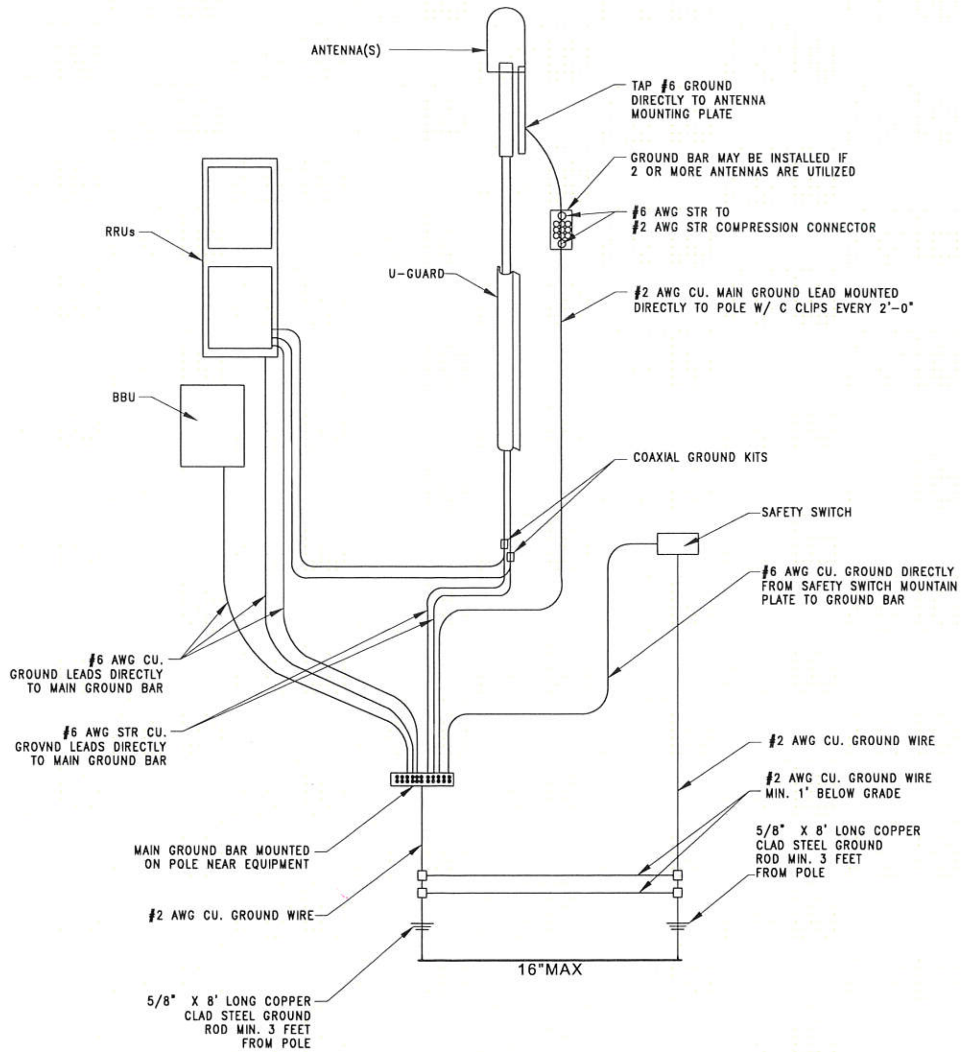


DIMENSIONS: (HxWxD)
-17.8x17.0x7.2" (452x431x285mm)
-WEIGHT: 55 LB (25KG)
-CLIMATE: -40°C TO +55°C
-POWER CONSUMPTION: -TYPICAL 200 WATTS
-BREAKERS/POWERCABLE:
120-250 VAC (1X20 AMP BREAKER) -MAX AC CABLE SIZE 8 -10 SWG
-48 VDC (1X20 AMP BREAJER)
ERICSSON 12 AWG SHIELD POWER CABLE (SCREW PLINT CONNECTOR_

Attachment B

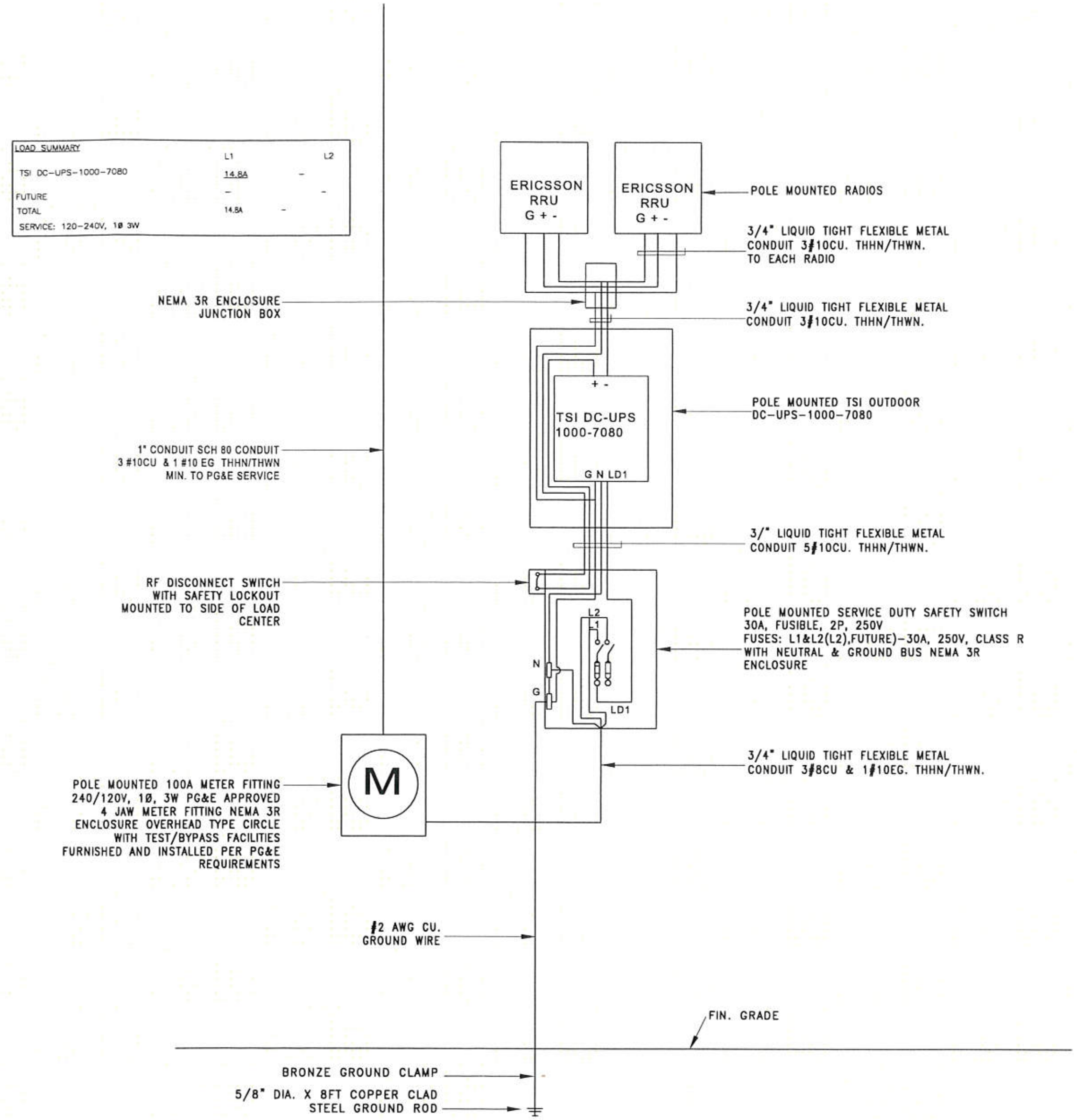
RRUS-11 DETAIL

SCALE: N.T.S. | 1



GROUND SCHEMATIC

SCALE: 3/8" = 1'-0"



Attachment B

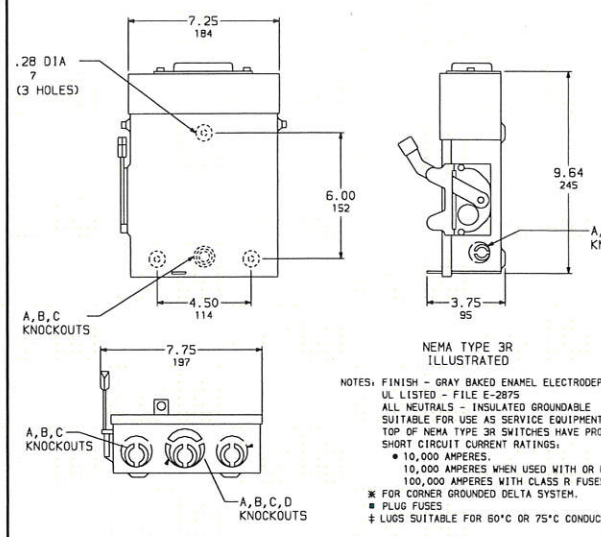
2 SINGLE LINE DIAGRAM OVERHEAD SERVICE

SCALE: 1-1/2" = 1'-0"

NOT USED

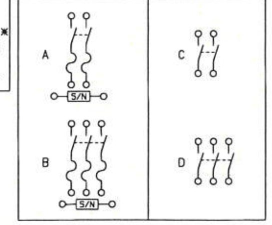
SCALE: N.T.S | 8

SHUTDOWN DISCONNECT SWITCH



CATALOG NUMBER	VOLTAGE RATINGS	WIRING DIAG.	HORSEPOWER RATINGS 120VAC STD. 1Ø	120VAC MAX. 1Ø	240VAC STD. 1Ø	240VAC STD. 3Ø	240VAC MAX. 1Ø	240VAC MAX. 3Ø
D211NRB ● ■	240VAC	A	1/2	2	1 1/2	-	3	-
D221NRB	240VAC	A	-	-	1 1/2	3✱	3	7 1/2✱
D321NRB	240VAC	B	-	-	1 1/2	3	3	7 1/2
DU221RB	240VAC	C	-	-	-	-	3	-
DU321RB	240VAC	D	-	-	-	-	3	7 1/2

WIRING DIAGRAMS



DUAL DIMENSIONS: INCHES / MILLIMETERS

TERMINAL LUGS‡			
AMPERES	MAX. WIRE	MIN. WIRE	TYPE
30	# 6 AWG	# 12 AWG	AL
	# 6 AWG	# 14 AWG	CU

KNOCKOUTS				
SYMBOL	A	B	C	D
CONDUIT SIZE	.50	.75	1	1.25

NEMA TYPE 3R
ILLUSTRATED

NOTES: FINISH - GRAY BAKED ENAMEL ELECTRODEPOSITED OVER CLEANED PHOSPHATIZED STEEL.
UL LISTED - FILE E-2875
ALL NEUTRALS - INSULATED GROUNDABLE
SUITABLE FOR USE AS SERVICE EQUIPMENT
TOP OF NEMA TYPE 3R SWITCHES HAVE PROVISIONS FOR MAXIMUM 2 1/2" BOLT-ON HUB.
SHORT CIRCUIT CURRENT RATINGS:
● 10,000 AMPERES.
10,000 AMPERES WHEN USED WITH OR PROTECTED BY CLASS H OR K FUSES.
100,000 AMPERES WITH CLASS R FUSES.
✱ FOR CORNER GROUNDED DELTA SYSTEM.
■ PLUG FUSES
‡ LUGS SUITABLE FOR 60°C OR 75°C CONDUCTORS.

GENERAL DUTY SAFETY SWITCHES
VISIBLE BLADE TYPE
30 AMPERE
ENCLOSURE - NEMA TYPE 3R RAINPROOF

SQUARE D COMPANY

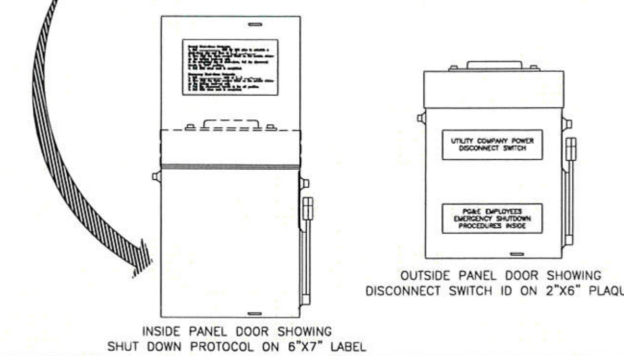
DWG. NO. 1852

SCALE: N.T.S | 4

SHUTDOWN DISCONNECT BOX

Normal Shut-Down Protocols:
1. Call ____________ NOC 24 HRS prior to schedule a shut-down day and time at (800) 264-6620.
2. Give NOC the Node number listed on the outside sticker on the battery back-up unit.
3. On scheduled day of shut-down, Pull the disconnect handle to "OFF" position.
4. Call NOC when work is completed.

Emergency Shut-Down Protocols:
1. Call ____________ NOC at (800)264 - 6620.
2. Give NOC the Node number listed on the outside sticker on the battery back-up unit.
3. Pull the disconnect handle to the off position.
4. Call NOC when work is completed.

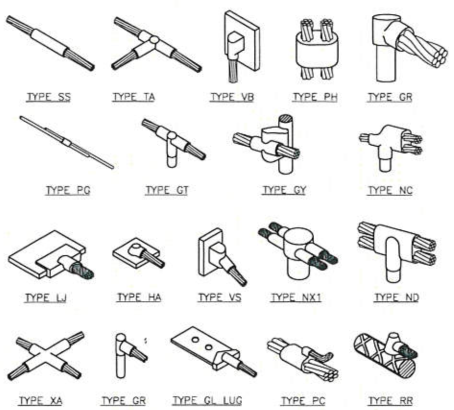


INSIDE PANEL DOOR SHOWING
SHUT DOWN PROTOCOL ON 6"X7" LABEL

OUTSIDE PANEL DOOR SHOWING
DISCONNECT SWITCH ID ON 2"X6" PLAQUE

SCALE: N.T.S | 1

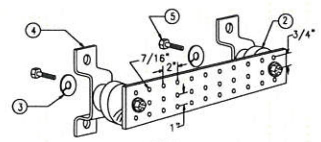
EXOTHERMIC CONNECTIONS



EXOTHERMIC CONNECTIONS

SCALE: N.T.S | 9

GROUND BAR DETAIL



LEGEND

1– COPPER GROUND BAR, "X 1/4"X 20", NEWTON INSTRUMENT CO. CAT. NO. B-6142 OR EQUAL. HOLE CENTERS TO MATCH NEMA DOUBLE LUG CONFIGURATION. (ACTUAL GROUND BAR SIZE WILL VARY BASED ON NUMBER OF GROUND CONNECTIONS)

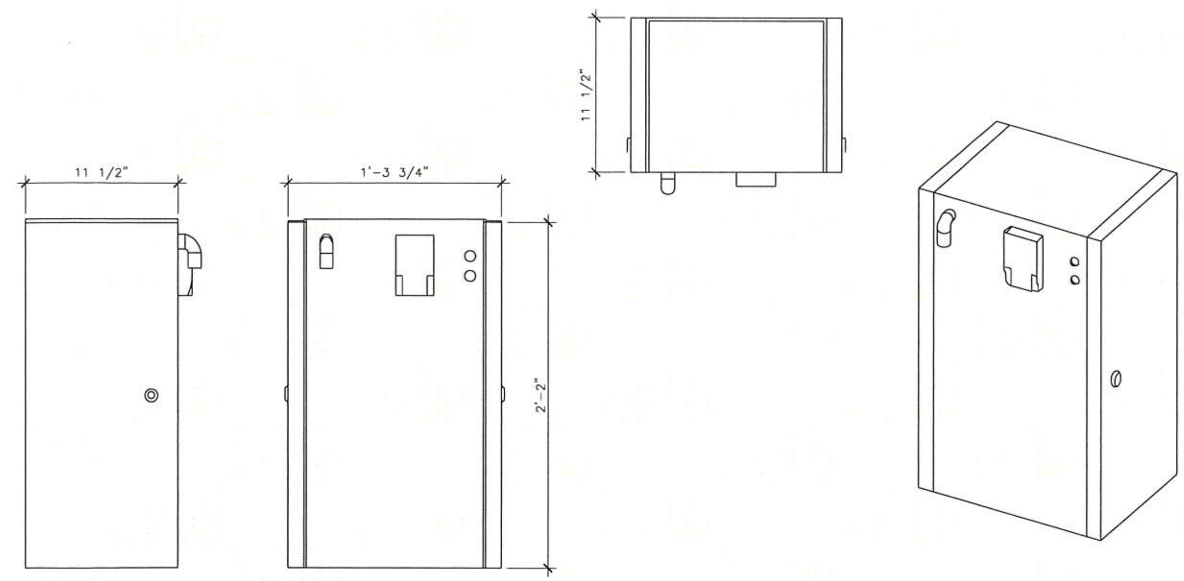
2– INSULATORS, NEWTON INSTRUMENT CAT. NO. 3061-4 OR EQUAL

3– 5/8" LOCKWASHER, NEWTON INSTRUMENT CO. CAT. NO. 3015-8 OR EQUAL
4– WALL MOUNTING BRACKET, NEWTON INSTRUMENT CO. CAT NO. A-6056 OR EQUAL
5– 5/8-11 X 1" HHCS BOLTS, NEWTON INSTRUMENT CO. CAT NO. 3012-1 OR EQUAL
6– INSULATORS SHALL BE ELIMINATED WHEN BONDING DIRECTLY TO TOWER/MONOPOLE STRUCTURE. CONNECTION TO TOWER/MONOPOLE STRUCTURE SHALL BE PER MANUFACTURERS RECOMMENDATIONS.

NOTE: ALL HARDWARE SHALL BE STAINLESS STEEL

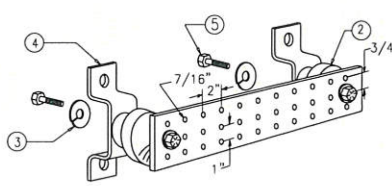
SCALE: N.T.S | 6

TSI BBU DC-UPS-1000-7080



SCALE: N.T.S | 2

BUSS BAR DETAIL

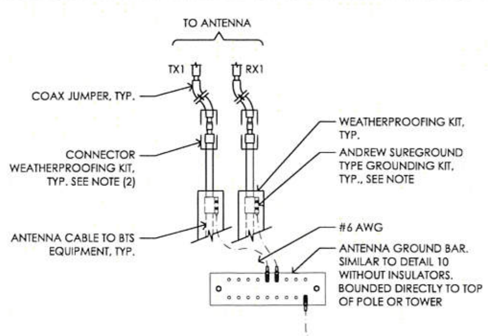


NOTES:
1. COPPER GROUND BAR, "X 1/4"X 20", NEWTON INSTRUMENT CO. CAT. NO. B-6142 OR EQUAL. HOLE CENTERS TO MATCH NEMA DOUBLE LUG CONFIGURATION. (ACTUAL GROUND BAR SIZE WILL VARY BASED ON NUMBER OF GROUND CONNECTIONS)
2. INSULATORS, NEWTON INSTRUMENT CAT. NO. 3061-4 OR EQUAL
3. 5/8" LOCKWASHER, NEWTON INSTRUMENT CO. CAT. NO. 3015-8 OR EQUAL
4. WALL MOUNTING BRACKET, NEWTON INSTRUMENT CO. CAT NO. A-6056 OR EQUAL
5. 5/8-11 X 1" HHCS BOLTS, NEWTON INSTRUMENT CO. CAT NO. 3012-1 OR EQUAL
6. INSULATORS SHALL BE ELIMINATED WHEN BONDING DIRECTLY TO TOWER/MONOPOLE STRUCTURE. CONNECTION TO TOWER/MONOPOLE STRUCTURE SHALL BE PER MANUFACTURERS RECOMMENDATIONS.

NOTE: ALL HARDWARE SHALL BE STAINLESS STEEL

SCALE: N.T.S | 10

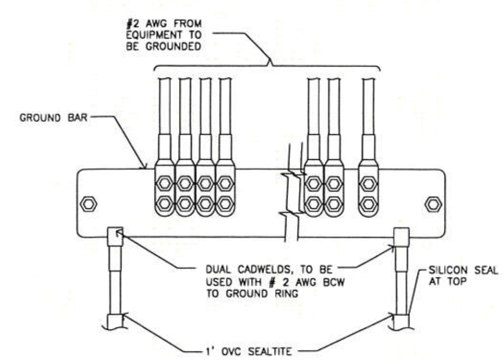
GRND CONNECTION TO GRND BAR



NOTE:
1. DO NOT INSTALL CABLE GROUND KIT AT A BEND AND ALWAYS DIRECT GROUND WIRE DOWN TO ANTENNA GROUND BAR.
2. WEATHER PROOFING SHALL BE ANDREW TWO-PART TAPE KIT. COLD SHRINK SHALL NOT BE USED

SCALE: N.T.S | 7

GROUND BAR CONNECTION DETAIL



NOTE:
1. CONTRACTOR TO UTILIZE KOPR-SHIELD (THANS & BETTS) ON ALL LUG CONNECTIONS OR APPROVED EQUAL
2. ALL LUGS TO BE DUAL HOLE LONG BARREL AND CRIMPED TWICE WITH MFR'S RECOMMENDED TOOL

SCALE: N.T.S | 5

NOT USED

Attachment B

SCALE: N.T.S | 3

SCALE: N.T.S	8	NOT USED	SCALE: N.T.S	5

Test Block Bypass TB Series

100 Amp/600 Volt Socket Only/Self-Contained

114TB

Application

- Single meter position
- Designed to receive watthour meters that meet ANSI C12.10
- Overhead/underground feed
- Surface mount
- Top or bottom load exit

Construction

- Type 3R construction
- Safety socket with factory installed test/bypass facilities[1]
- Snap type sealing ring included
- 5th jaw provision at nine o'clock – 114TB only
- Provisions for 2 AW base caps or hub kits on top
- Padlock provision
- Ring style

Standards

- UL 414 listed, complies with ANSI C12.7

Finish

- ANSI 61 gray acrylic electrocoat finish

Accessories

- Fifth jaw kit — catalog #50371
- Center and offset pole mounting brackets
- Bussed gutters, see page 68
- AW hubs
- Screw type sealing ring — catalog #25016D
- Steel or clear lexan covers for socket opening

Overhead/Underground-Surface Mount

Catalog Number	AIC Rating	Branch Circuits	Ampacity Max.	Ampacity Cont.	Voltage	Service Type	Number of Jaws	Hub Prov.	Conductor Lug Range: Phase Conductor Line/Load	Conductor Lug Range: Neutral Conductor	Figure Number	Dimensions (Inches): Height (H)	Width (W)	Depth (D)
114TB	†	NONE	125	100	600	1Ø 3W	4	AW	14 AWG - 2/0 AWG	14 AWG - 1/0 AWG	Fig. 1	24	12	4 5/8
115TB	†	NONE	125	100	600	3Ø 3W	5	AW	14 AWG - 2/0 AWG	14 AWG - 1/0 AWG	Fig. 1	24	12	4 5/8
117TB	†	NONE	125	100	600	3Ø 4W	7	AW	14 AWG - 2/0 AWG	14 AWG - 1/0 AWG	Fig. 1	24	12	4 5/8

Attachment B

SCALE: N.T.S	7	NOT USED	SCALE: N.T.S	4	TB METER MAIN	SCALE: N.T.S

ExteNet La Honda
Node 61G
Alternative Site Analysis

RECEIVED
JUL 05 2016
San Mateo County
Planning and Building Department

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Attachment C

61G- PROPOSED LOCATION

- The location for ExteNet's proposed Node 61G is a joint utility pole located at 231 Cuesta Real.
- ExteNet's objective is to provide AT&T 3G and 4G wireless coverage and capacity to the La Honda area.
- ExteNet evaluated this site and nearby alternatives to verify that the selected site is the least intrusive means to close AT&T's significant service coverage gap.

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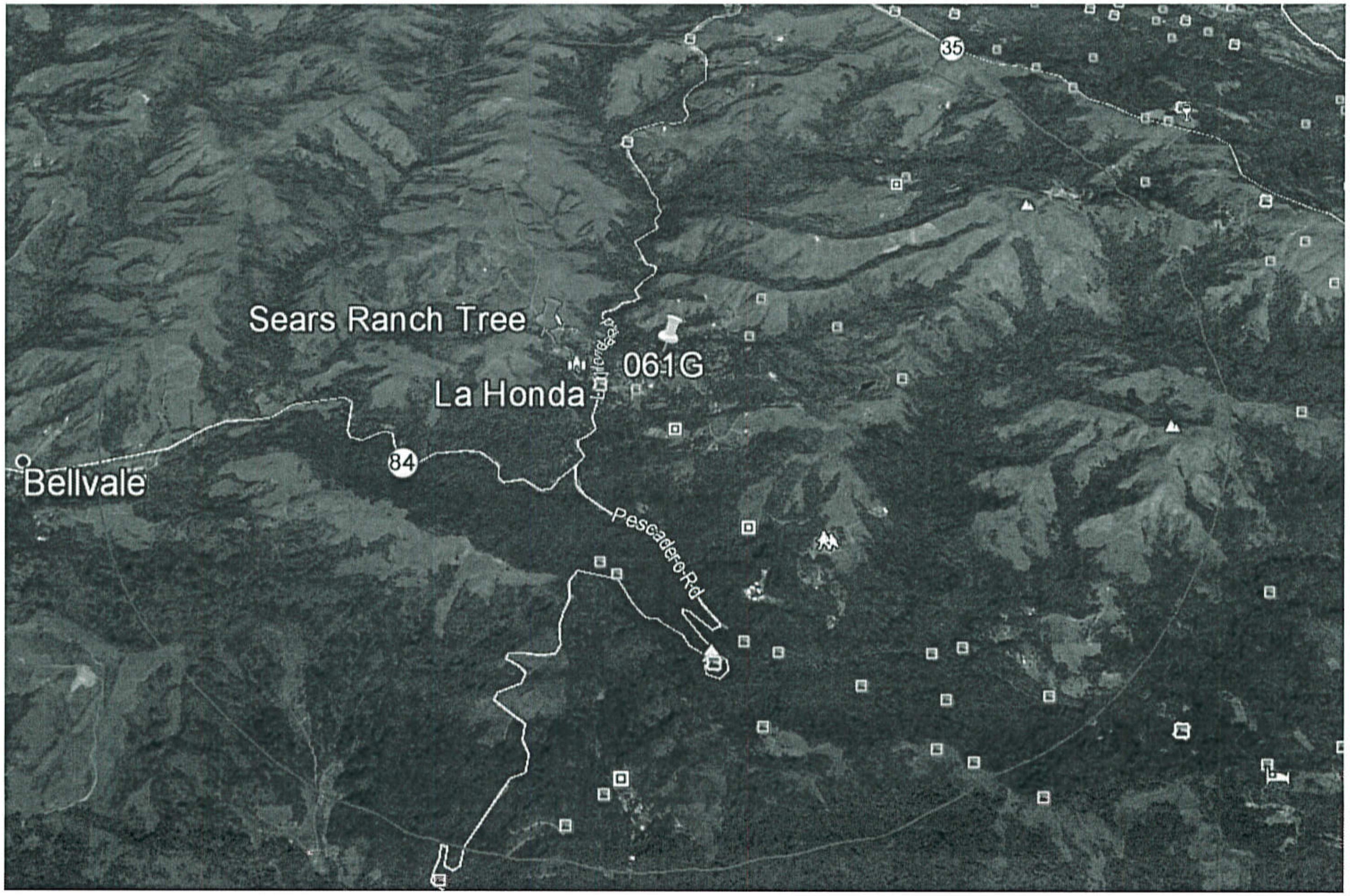
Attachment C

Map of Nodes 48A, 61B, Sears Ranch Macro & 2.5 Mile Radius



•This map depicts the ExteNet proposed Node 61G in relation to the Sears Ranch Road macro antenna Farm location – which is the only tower site within a 2.5 mile radius (displayed above in the red circle).
•We searched for existing towers that might be viable for co-location of our facilities by personally investigating the area and by searching on the FCC's website listing registered antenna structures (http://wireless2.fcc.gov).

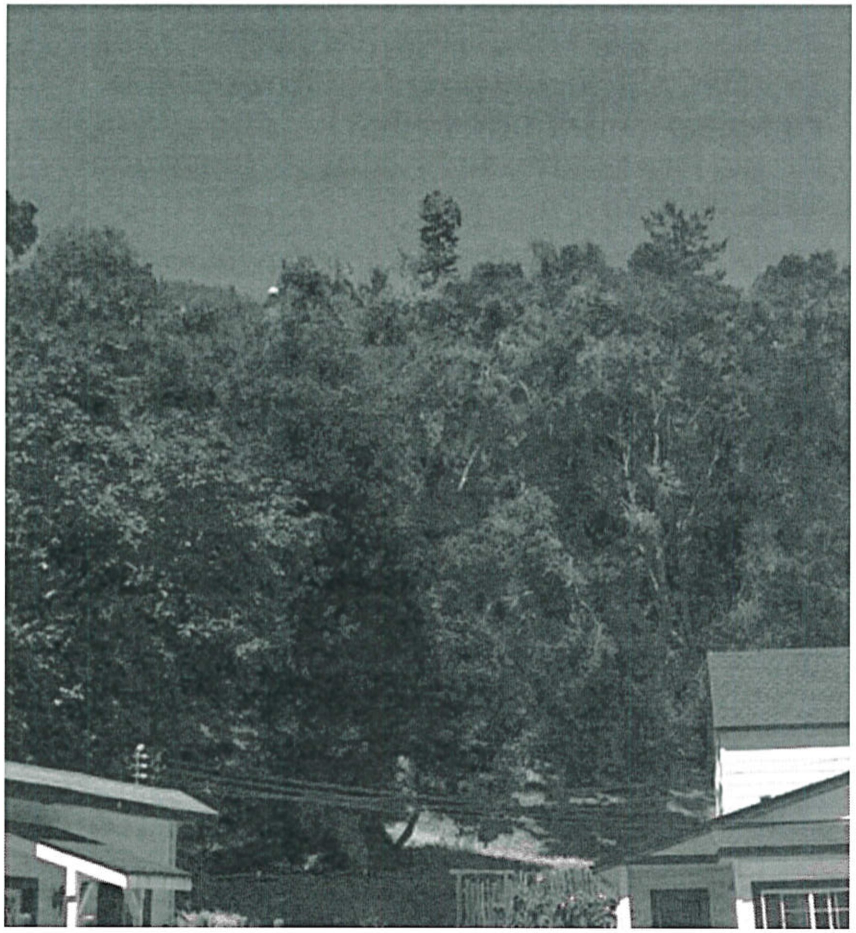
Attachment C

Map of Alternative Poles Evaluated for Node 61G

- The above maps depict ExteNet's proposed Node 61G in relation to other poles in the area that were evaluated as possibly being viable alternative candidates.
- The following is an analysis of each of those 18 alternative locations.

Attachment C

Alternative Sears Ranch Road Antenna Farm



- A monopole designed to look like a pine tree (a "monopine") is located at about 155 Sears Ranch Road (latitude 37.322616, longitude -122.279332).
- Placing an ExteNet wireless facility here is not viable to fill the significant gaps in coverage that would otherwise be filled by Node 61G.
- Placing an ExteNet wireless facility here is too far away from the intended coverage area and would result in a signal that is otherwise blocked by trees and terrain, leaving significant coverage gaps.

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Attachment C

Node 64G in combination with proposed Node 61G

- ExteNet will deploy proposed Node 61G in combination with Node 64G located at 8865 La Honda Road (latitude 37.319918, longitude -122.274406).
- Node 64G is located in a commercial area.
- By using both nodes, one in a commercial area and Node 61G, in a residential area, ExteNet will be able to adequately provide coverage to the residential area.
- A combined deployment of the existing wireless facility located at Sears Ranch Road and Node 64G on La Honda Road leaves a significant coverage gap of in-building coverage in the residential area.

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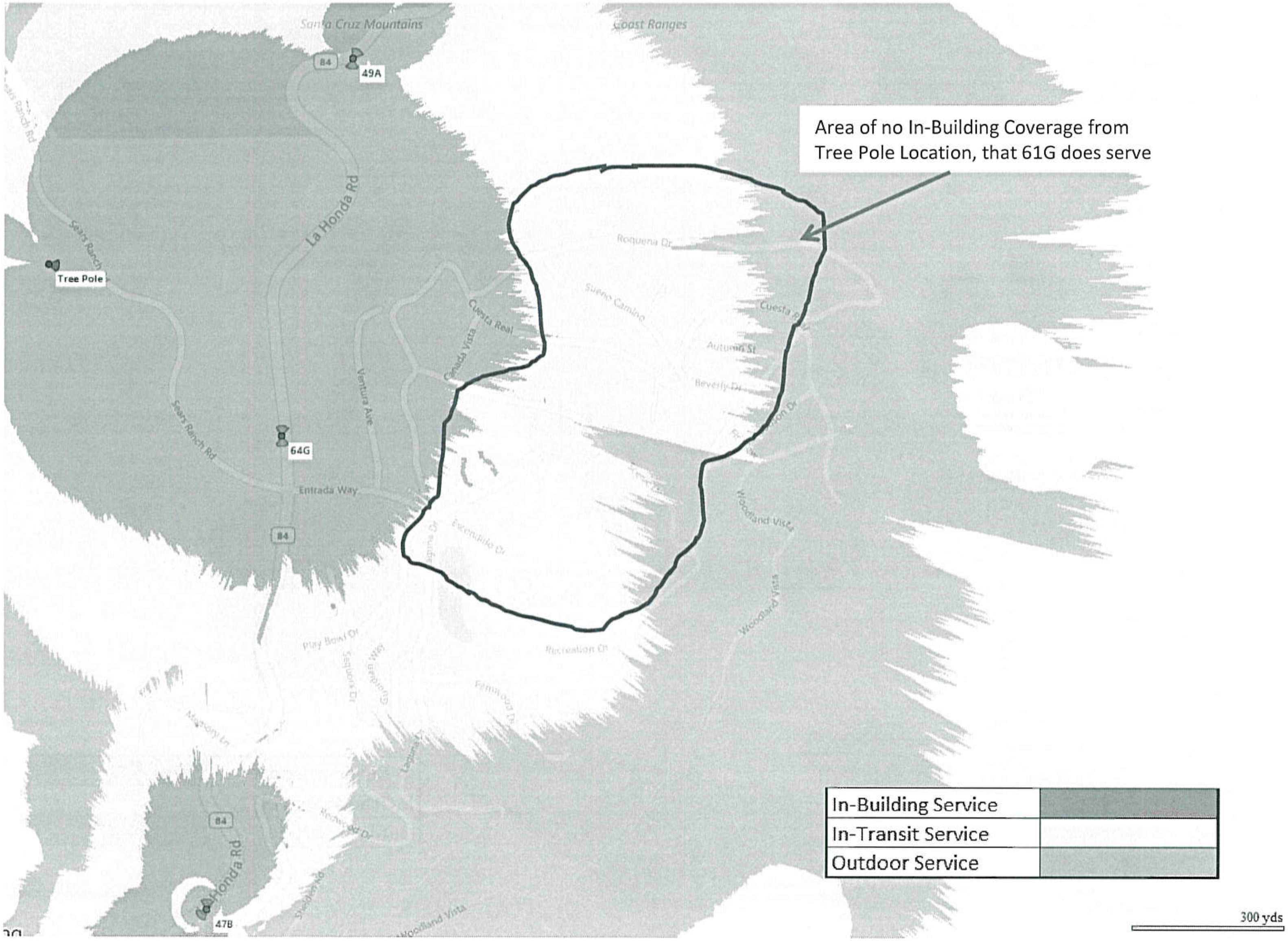
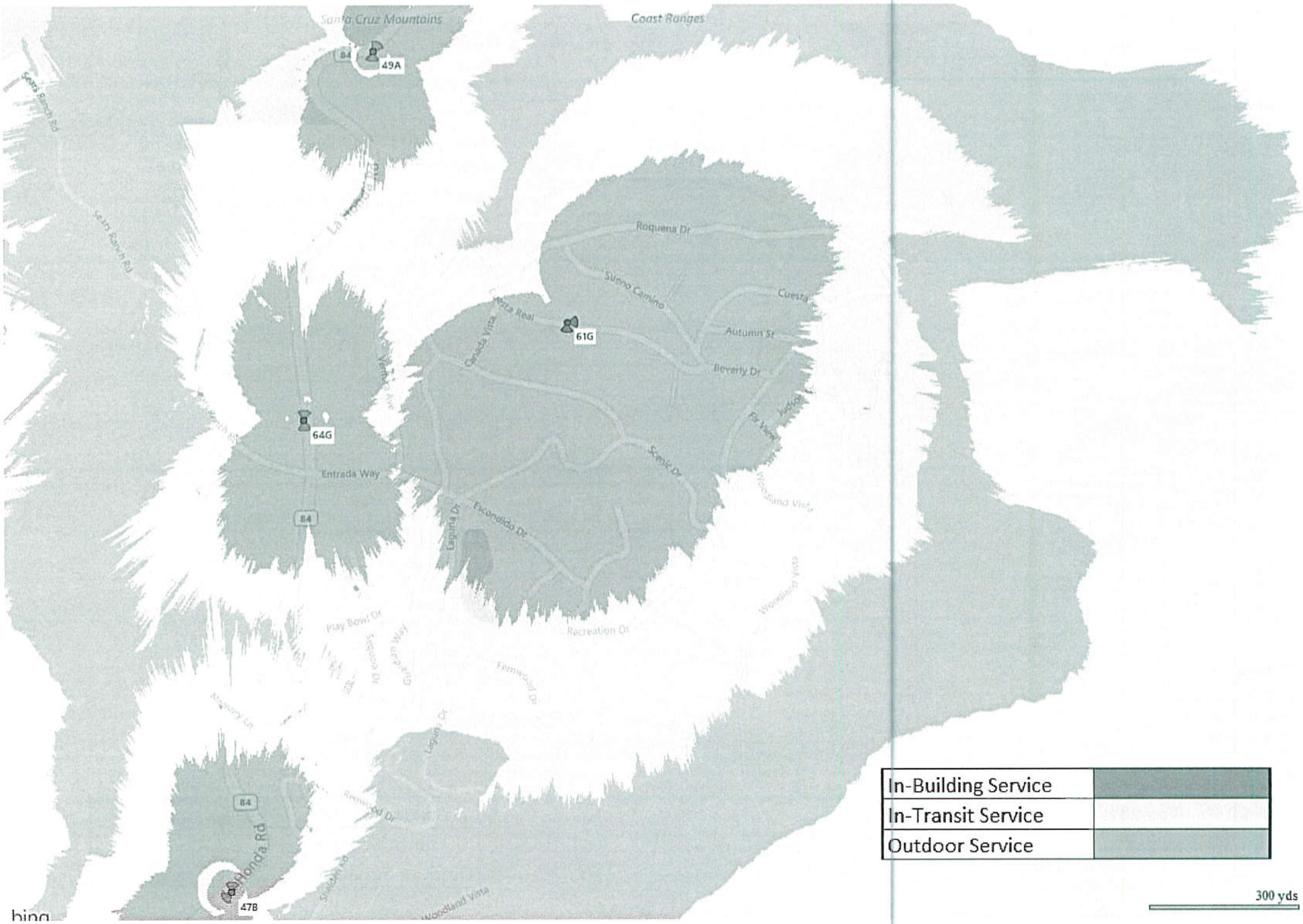
Attachment C

4G LTE Coverage – Sears Ranch Does Not Fill Coverage Gap



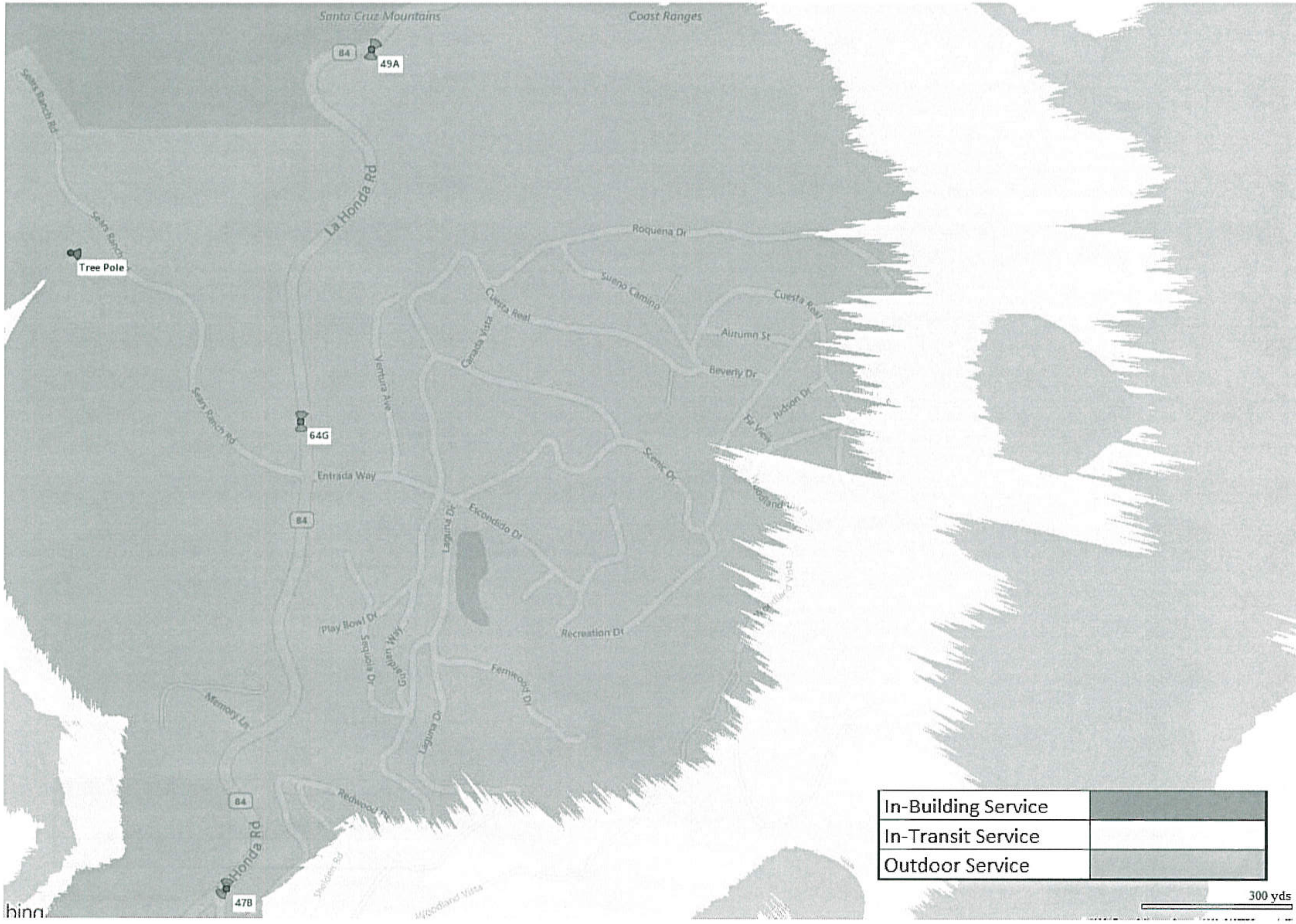
Attachment C

4G LTE – Node 61G Does Fill Coverage Gap



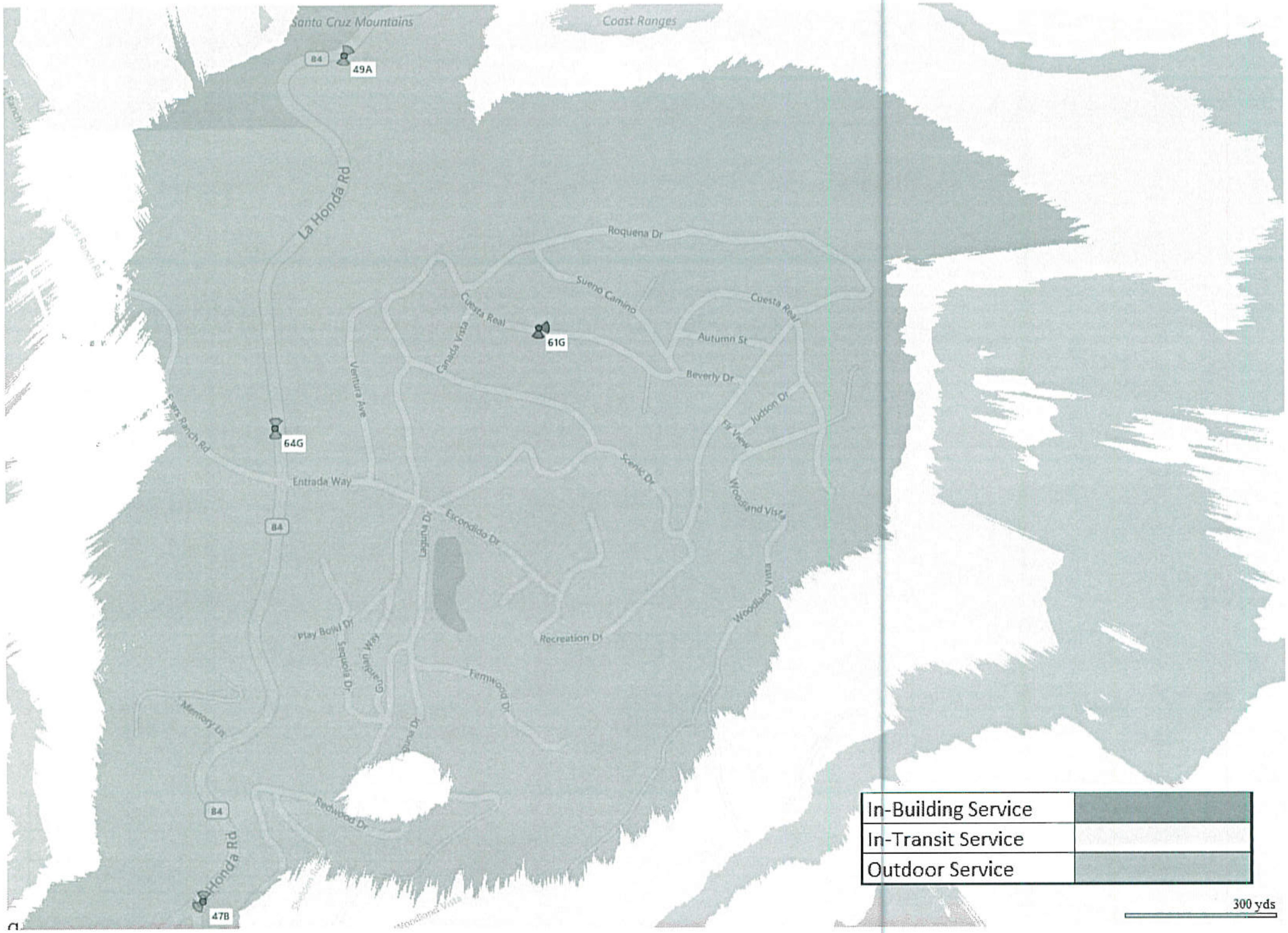
Attachment C

3G UMTS – Sears Ranch Coverage



Attachment C

3G UMTS – Node 61G Coverage



In-Building Service	
In-Transit Service	
Outdoor Service	

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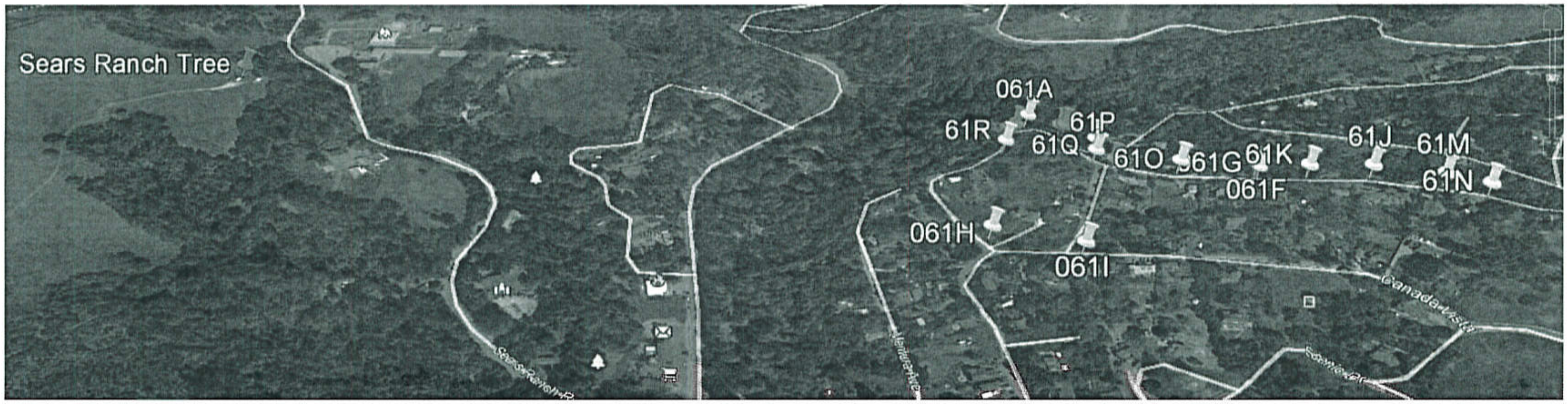
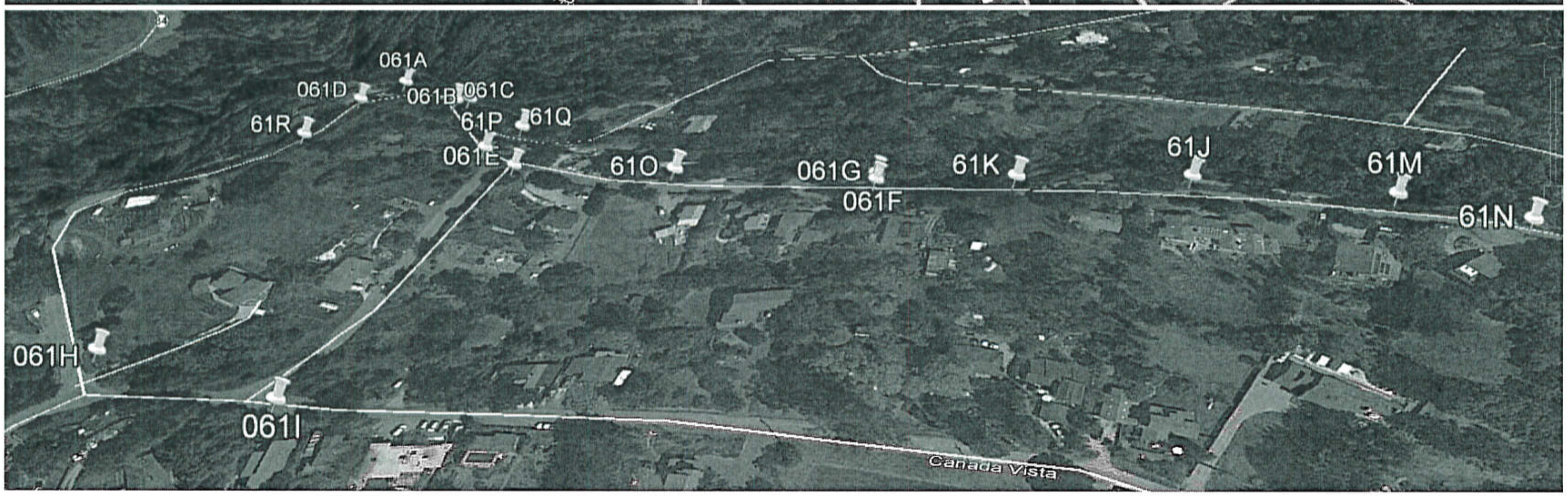
Attachment C

Map of Alternative Poles Evaluated for Node 61G





•The above maps depict ExteNet's proposed Node 61G in relation to other poles in the area that were evaluated as possibly being viable alternative candidates.
•The following is an analysis of each of those 18 alternative locations.

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Attachment C

Alternative Node 61A

- Node 61A is at a joint utility pole near 155 Cuesta Real (37.322724, -122.271023).
- This pole was originally selected to host ExteNet's wireless facility but was eventually ruled out because cross lines and cross arms prevent adequate climbing space on the pole pursuant to CPUC General Order 95, thus prohibiting a wireless facility from being installed at this location.

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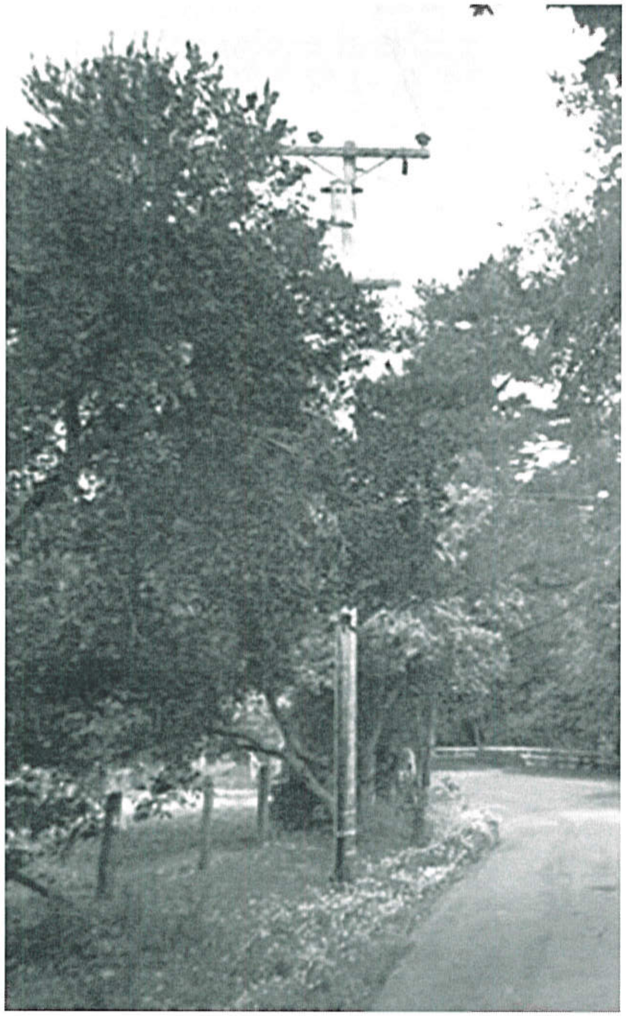
ALTERNATIVE NODE 61B



- **Node 61C is at a joint utility pole across from 155 Cuesta Real (37.322490, -122.270670).**
- **This pole is not a viable alternative candidate because the existing transformer on the pole would need to be relocated to an uncertain destination in order to facilitate our proposed wireless installation.**

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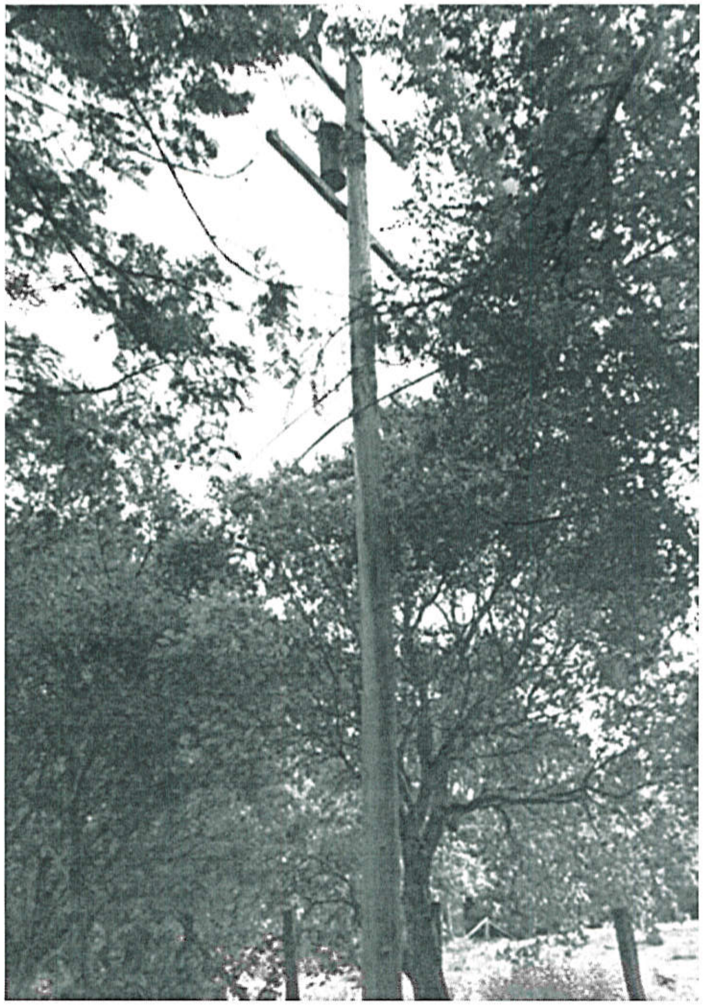
ALTERNATIVE NODE 61C

- **Node 61C is at a joint utility pole at 37.322475, -122.270725**
- **This pole is not a viable alternative candidate because the existing transformer on the pole would need to be relocated to an uncertain destination in order to facilitate our proposed wireless installation.**

Attachment C

Alternative Node 61D



- Node 61D is at a joint utility pole near 126 Cuesta Real (37.322562, -122.271176), just southwest of candidate 61A.
- This pole is not a viable alternative candidate because the existing transformer on the pole would need to be relocated to an uncertain destination in order to facilitate our proposed wireless installation
- Nearby tree trimming would be required to facilitate a wireless facility here, possibly requiring tree removal.

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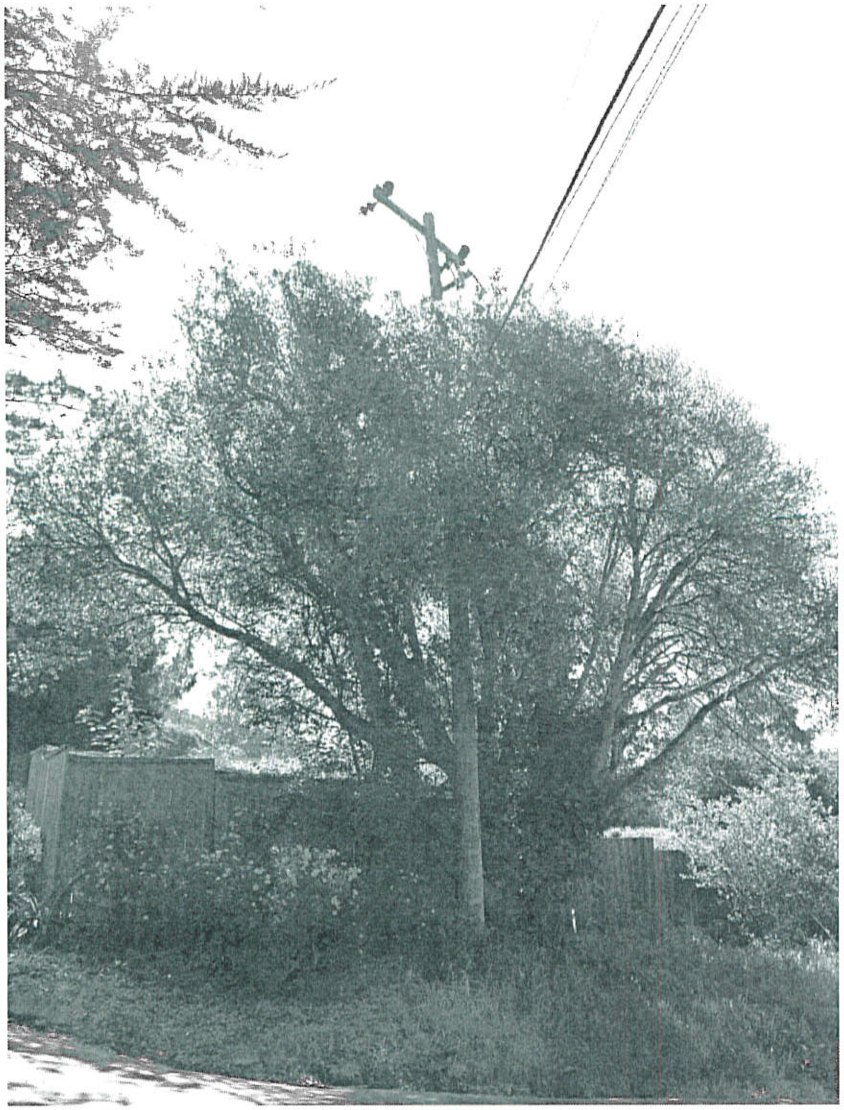
ALTERNATIVE NODE 61E



- Node 61E is at a joint utility pole at the intersection of Cuesta Real and Canada Vista (37.321796, -122.270318), just northwest of candidate 61G.
- This pole is not a viable alternative candidate because nearby tree trimming would be required to facilitate a wireless facility here, possibly requiring tree removal.

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Alternative Node 61F

- Node 61F is at a joint utility pole near across from 231 Cuesta Real (37.321485, -122.268971).
- This is a potentially viable alternative depending on final RF testing, but is more intrusive than the proposed Node 61G because it is more exposed and within the viewshed of a residence.

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NODE 61G – PROPOSED LOCATION

- **Node 61G is at a joint utility pole near 126 Cuesta Real (37.321554, -122.268966), just southwest of candidate 61A.**
- **This is the primary candidate.**

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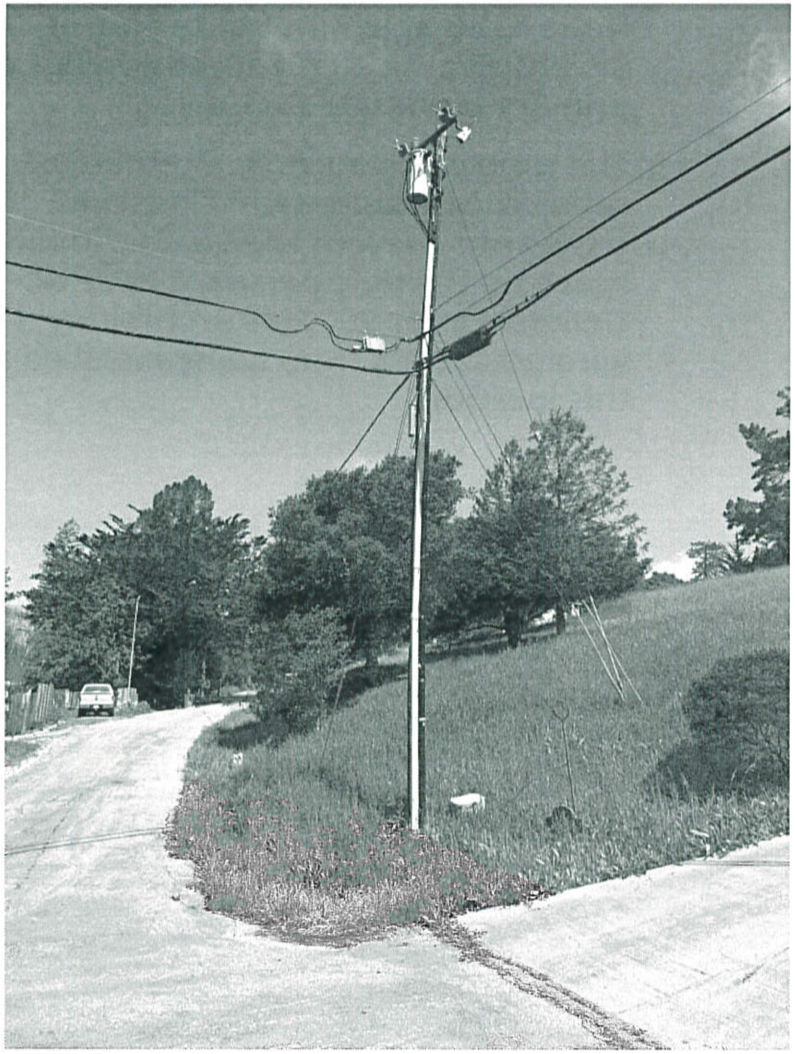
ALTERNATIVE NODE 61H



- Node 61H is at a joint utility pole near the intersection of Cuesta Real and Canada Vista (37.321129, -122.271623), southwest of candidate 61G.
- This pole is not a viable alternative candidate because the existing power riser on the pole prevents us from installing a wireless facility, pursuant to CPUC General Order 95.

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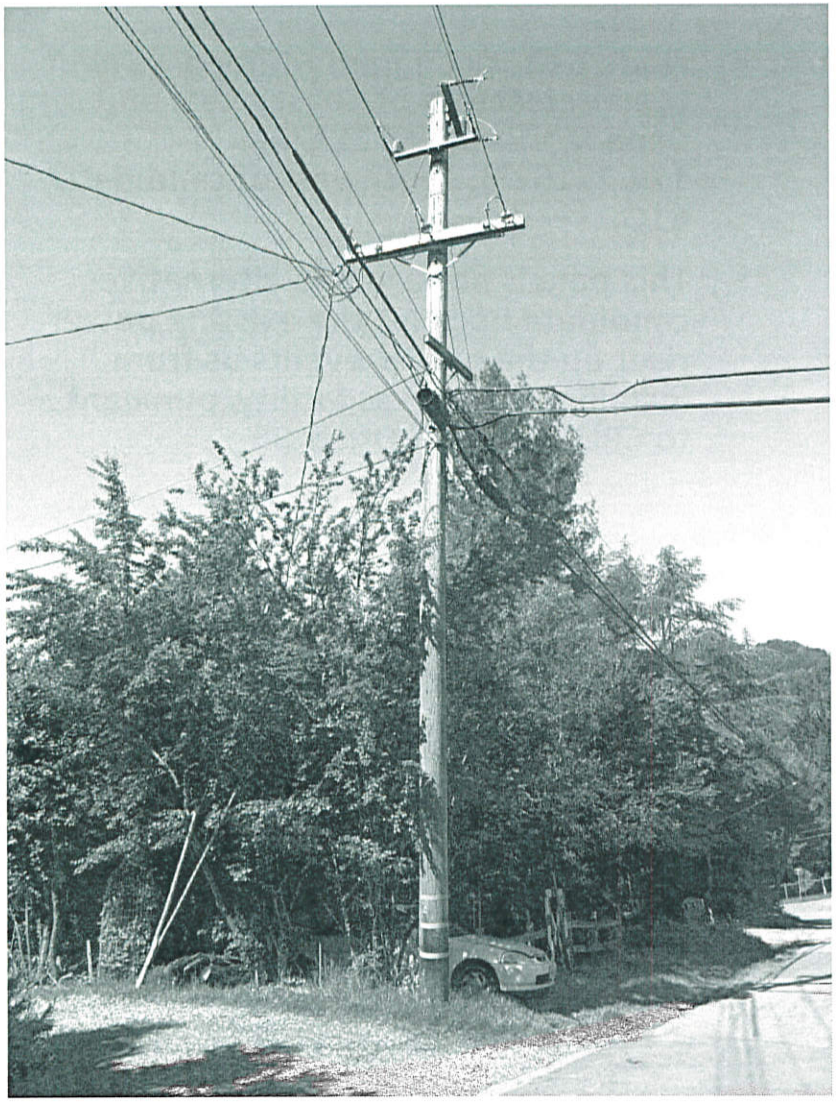
ALTERNATIVE NODE 61I



- **Node 61I is at a joint utility pole at 37.320707, -122.270820, southwest of primary candidate 61G.**
- **This pole is not a viable alternative candidate because cross lines and cross arms prevent adequate climbing space on the pole pursuant to CPUC General Order 95, thus prohibiting a wireless facility from being installed at this location.**

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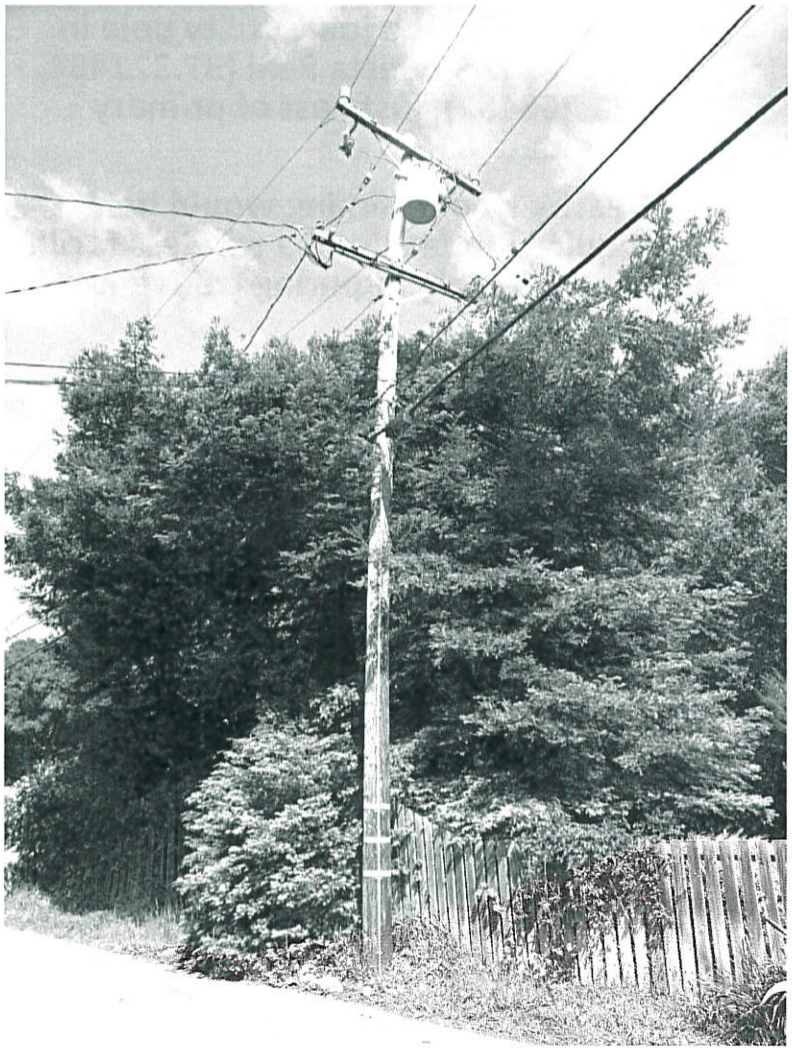
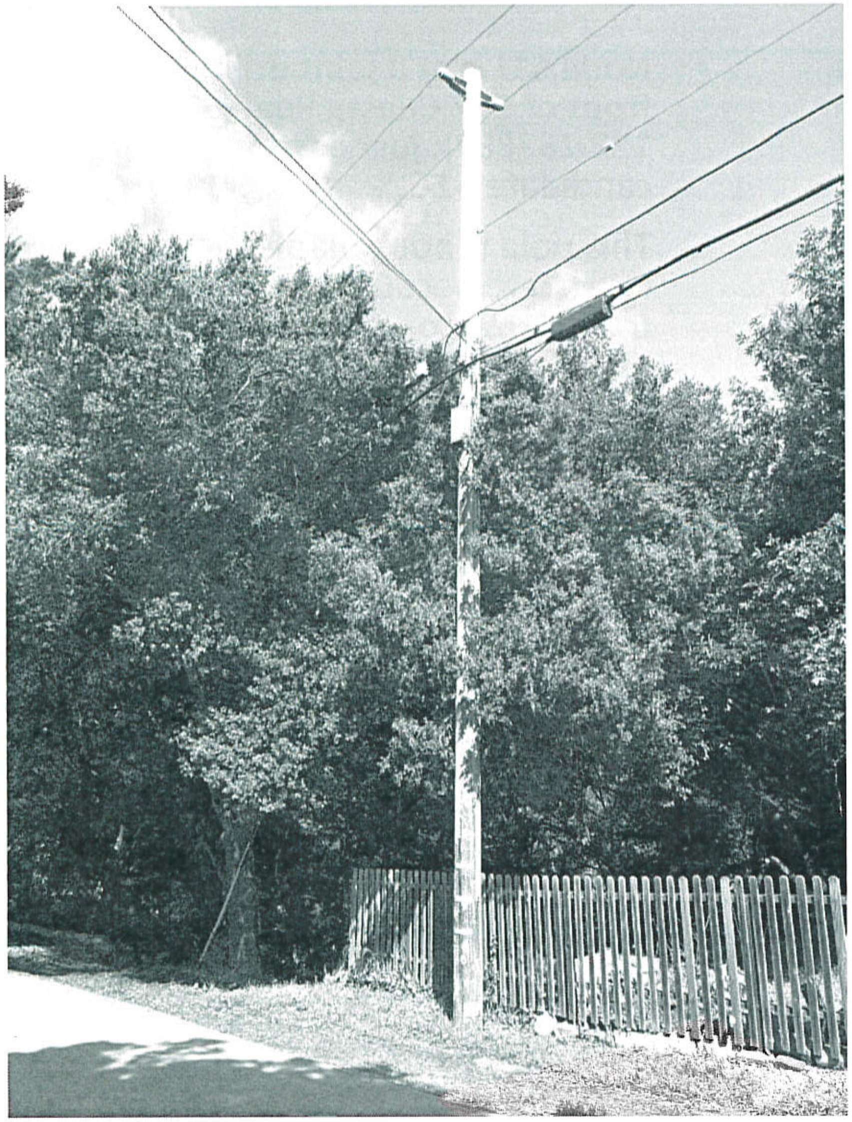
ALTERNATIVE NODE 61J



- Node 61J is at a joint utility pole in front of 257 Cuesta Real (37.321426, -122.267889), just east of primary candidate 61G.
- This pole is not a viable alternative candidate because the existing transformer on the pole would need to be relocated to an uncertain destination in order to facilitate our proposed wireless installation

Attachment C

ALTERNATIVE NODE 61K



- Node 61K is at a joint utility pole in front of 253 Cuesta Real (37.321484, -122.268482), just east of primary candidate 61G.
- Nearby tree trimming would be required to facilitate a wireless facility here, possibly requiring tree removal.

Attachment C

ALTERNATIVE NODE 61L

- Node 61D is at a joint utility pole in front of 221 Cuesta Real (37.321629, -122.269407), just west of primary candidate 61G.
- This is a potentially viable alternative depending on final RF testing, but is more intrusive than the proposed Node 61G because it is more exposed.

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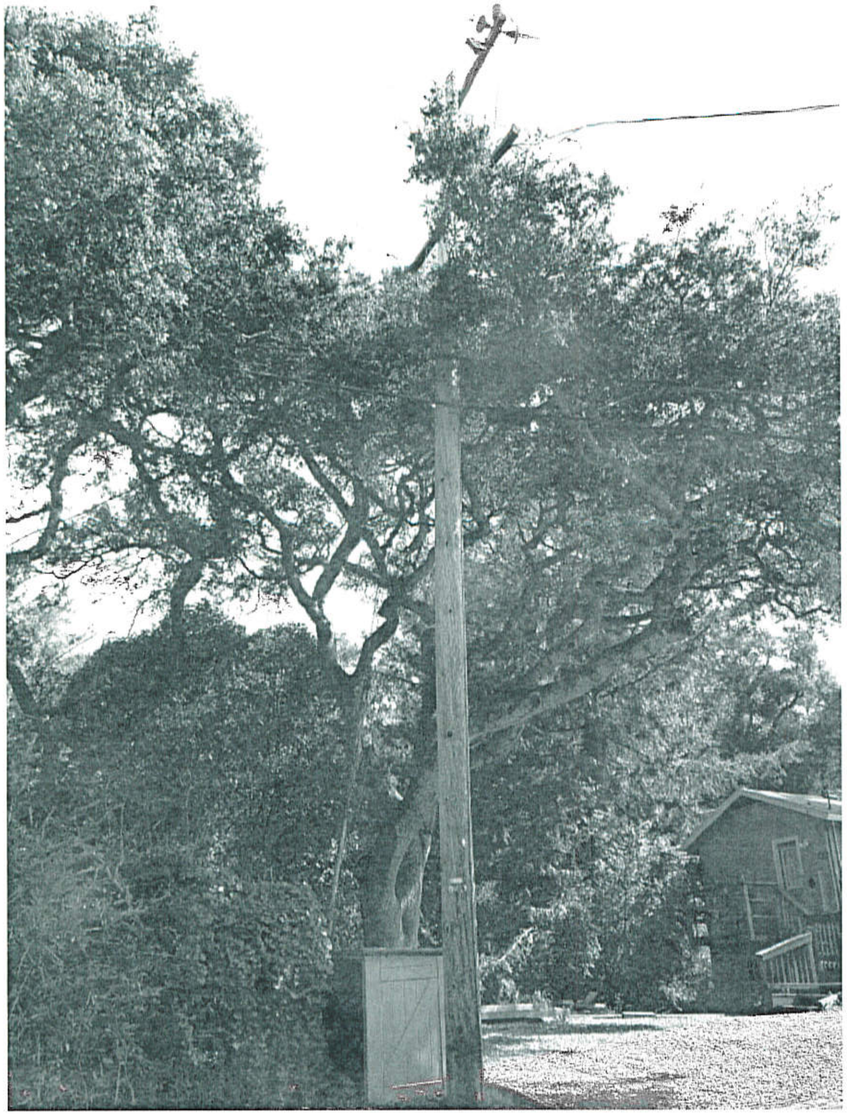
ALTERNATIVE NODE 61M



- Node 61M is at a joint utility pole near 271 Cuesta Real (37.321238, -122.267277), west of candidate 61G.
- This pole is not a viable alternative candidate because placing wireless equipment on this pole would likely violate CPUC General Order-95 Regulation because all four quadrants of the pole appear occupied.
- Nearby tree trimming would be required to facilitate a wireless facility here, possibly requiring tree removal.

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ALTERNATIVE NODE 61N

- **Node 61N is at a joint utility pole near 278 Cuesta Real (37.321018, -122.266969), east of primary candidate 61G.**
- **This is a potentially viable alternative depending on final RF testing, but is more intrusive than the proposed Node 61G because it is more exposed.**

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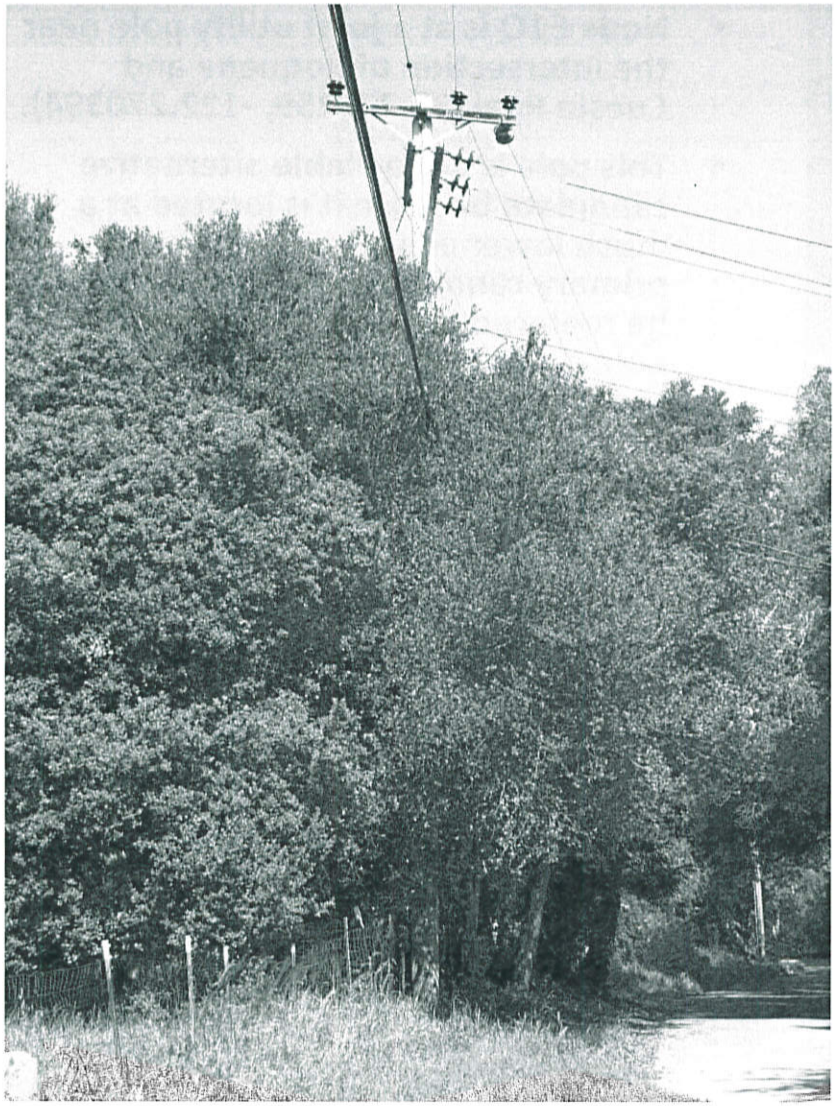
ALTERNATIVE NODE 61O

- Node 61O is at a joint utility pole near 205 Cuesta Real (37.321650, -122.269695), just west of primary candidate 61G.
- This is a potentially viable alternative depending on final RF testing, but is more intrusive than the proposed Node 61G because it is more exposed.

Attachment C

ALTERNATIVE NODE 61P



- Node 61P is at a joint utility pole located at 37.321941, -122.270465, across from alternative candidate 61E.
- This pole is not a viable alternative candidate because placing wireless equipment on this pole would likely violate CPUC General Order-95 Regulation because all four quadrants of the pole appear occupied.
- Nearby tree trimming would be required to facilitate a wireless facility here, possibly requiring tree removal.

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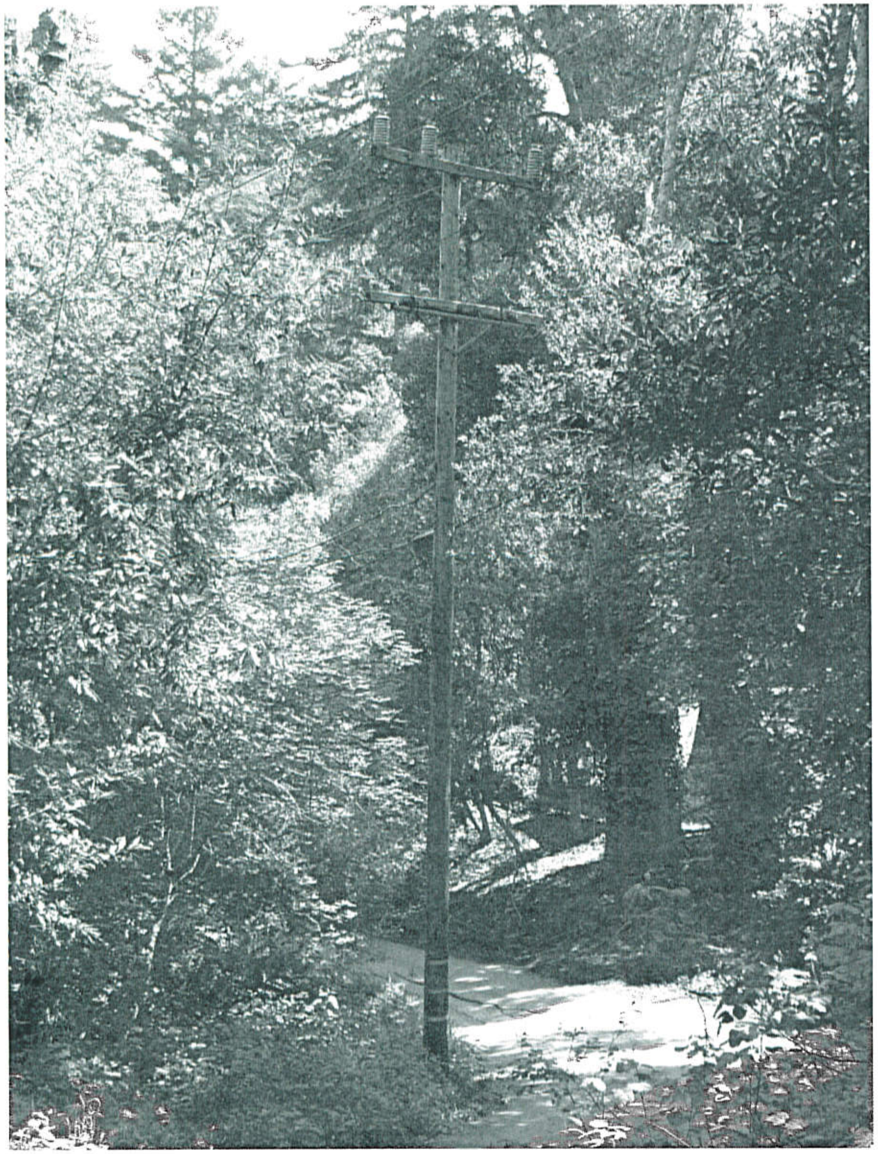
ALTERNATIVE NODE 61Q



- Node 61Q is at a joint utility pole near the intersection of Roquena and Cuesta Real (37.322259, -122.270394).
- This pole is not a viable alternative candidate because it is located at a much lower elevation than the primary candidate and would need to be replaced by a substantially taller pole thus being more intrusive than the primary candidate.

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Alternative Node 61R

- **Node 61R is at a joint utility pole located at 37.322289, -122.271326.**
- **Extensive nearby tree trimming would be required to facilitate a wireless facility here, possibly requiring tree removal.**

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Alternatives 1 and 2 in Relation to 61G

•ExteNet additionally evaluated two alternatives proposed by the La Honda community on utility poles near the water tank to the east of town: Alternatives 1 and 2.
•This map shows those alternatives in relation to the proposed Node 61G.
•As can be seen by the following slides, the nearby trees and terrain prevent Alternatives 1 and 2 from being viable to fill the existing significant gap in coverage.

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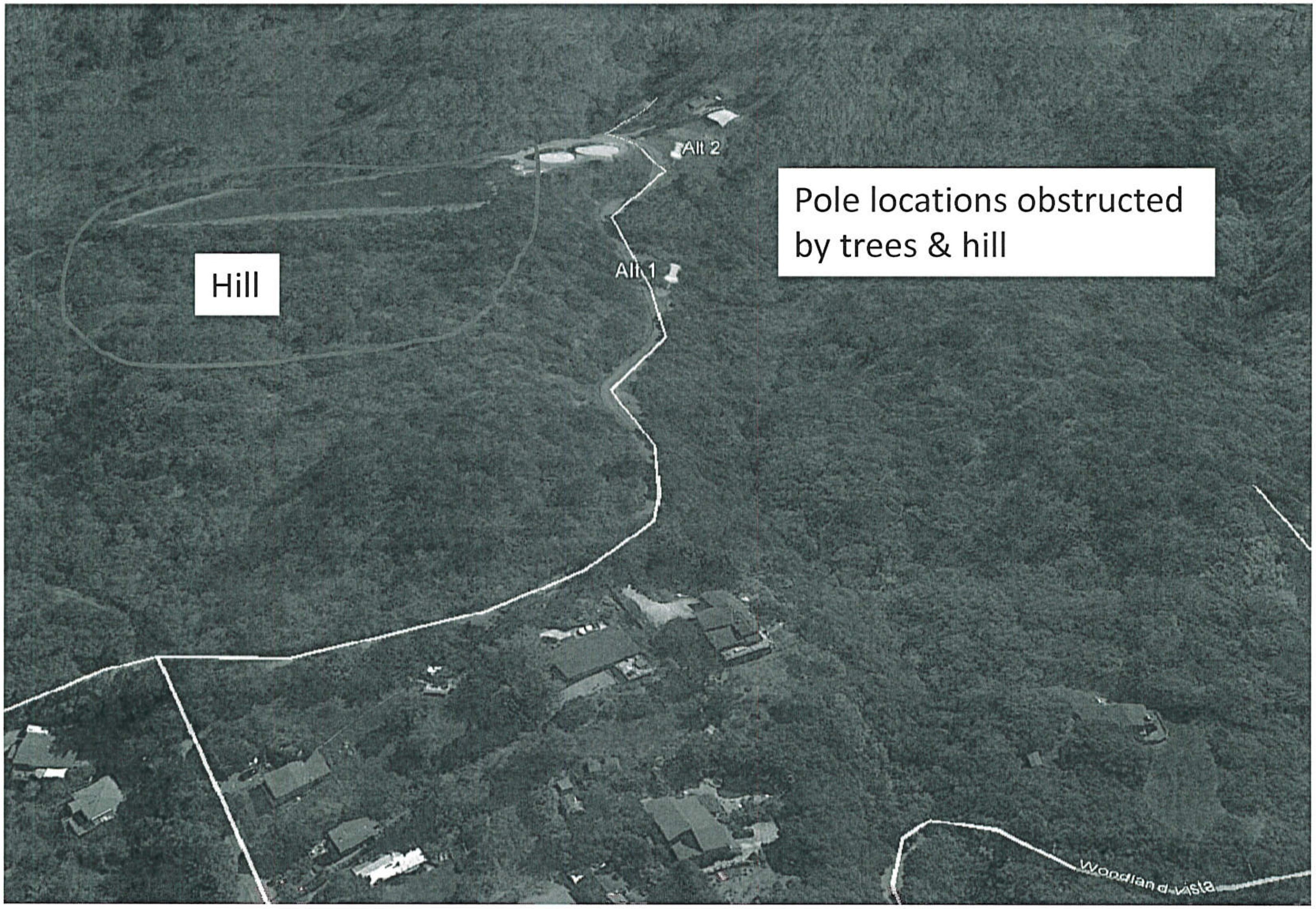
Alternatives 1 and 2 in Relation to Terrain and Clutter

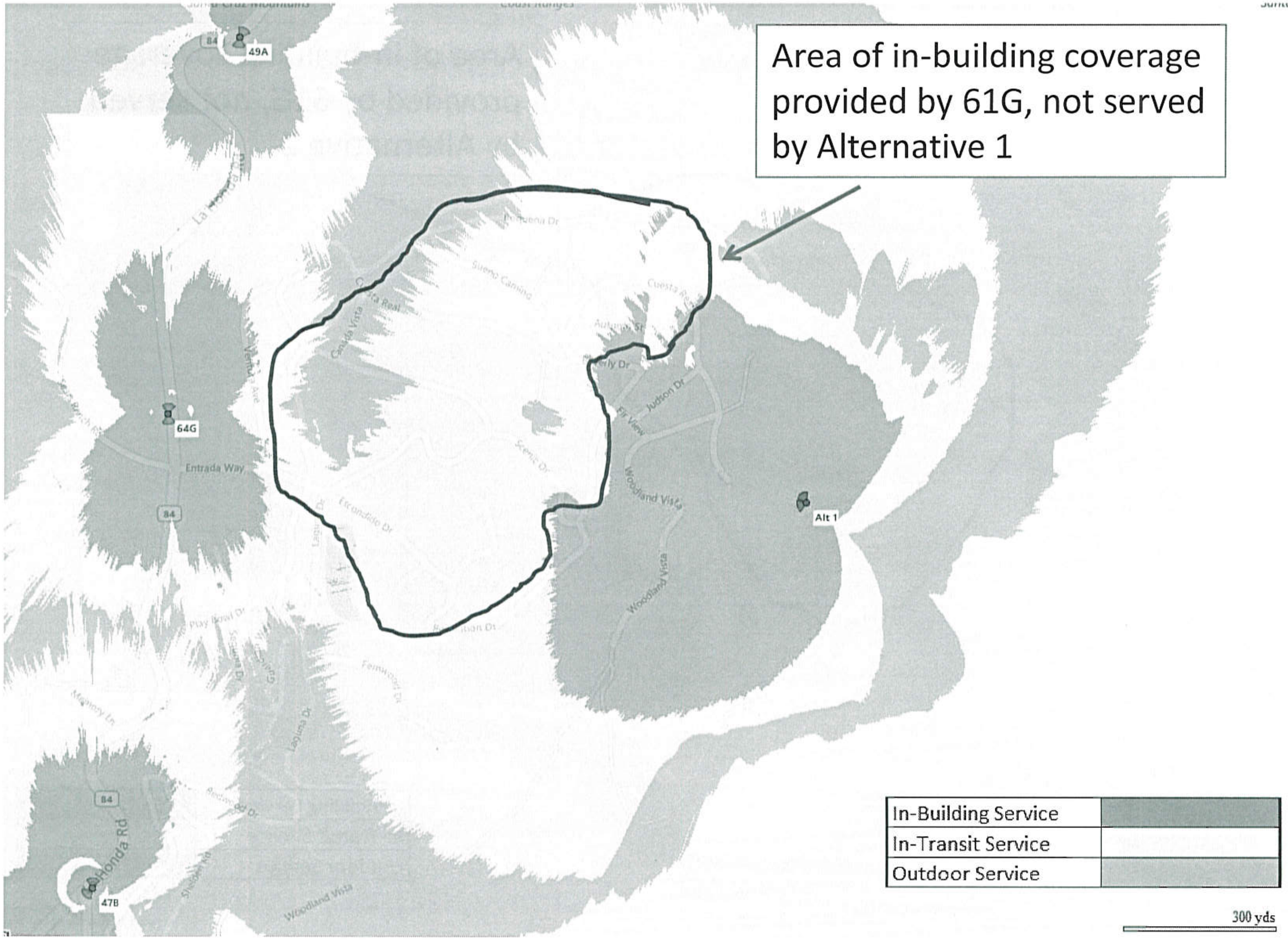


Attachment C

4G LTE Coverage – Node 61G

Attachment C

4G LTE Coverage – Alternative 1



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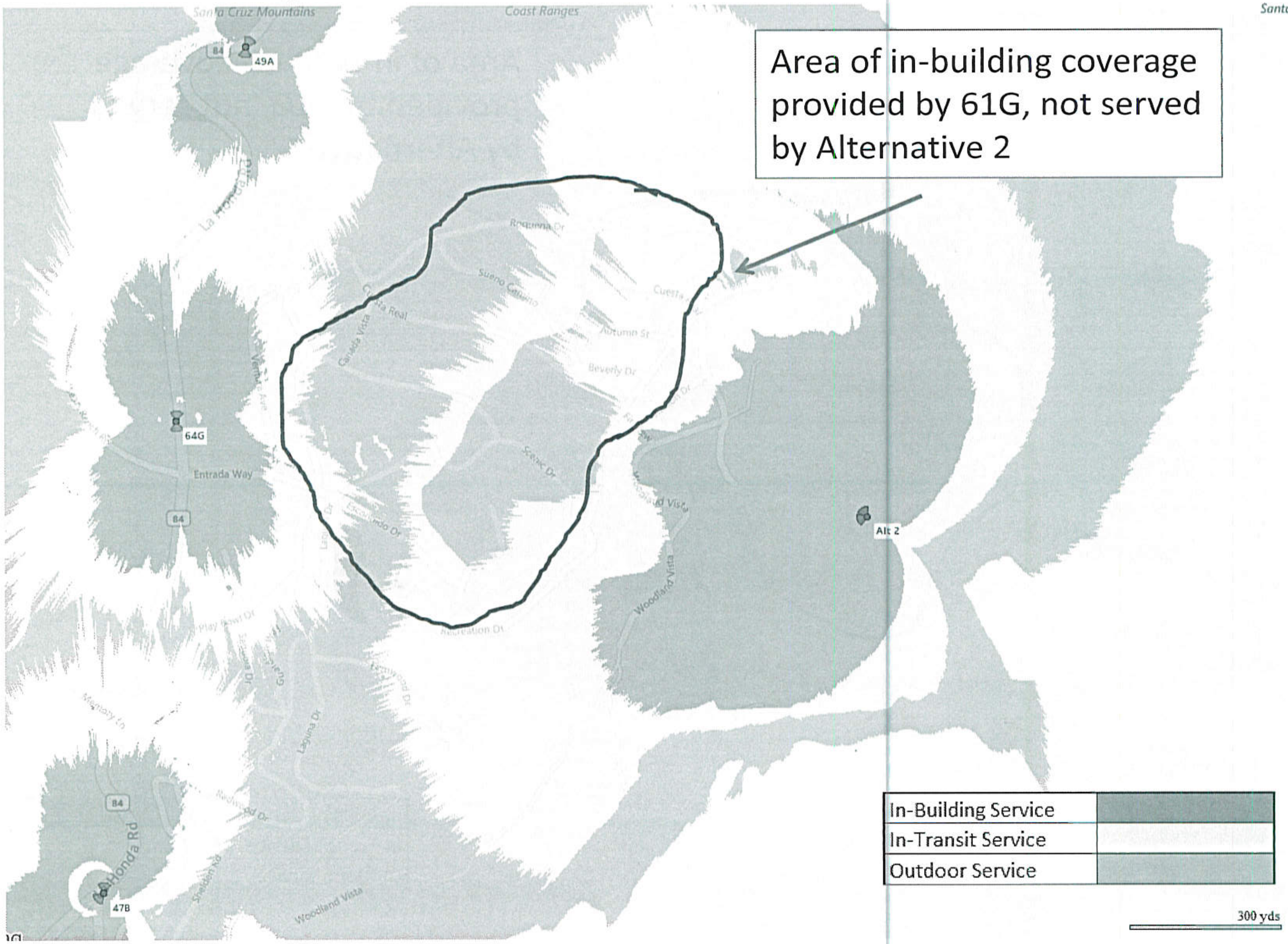
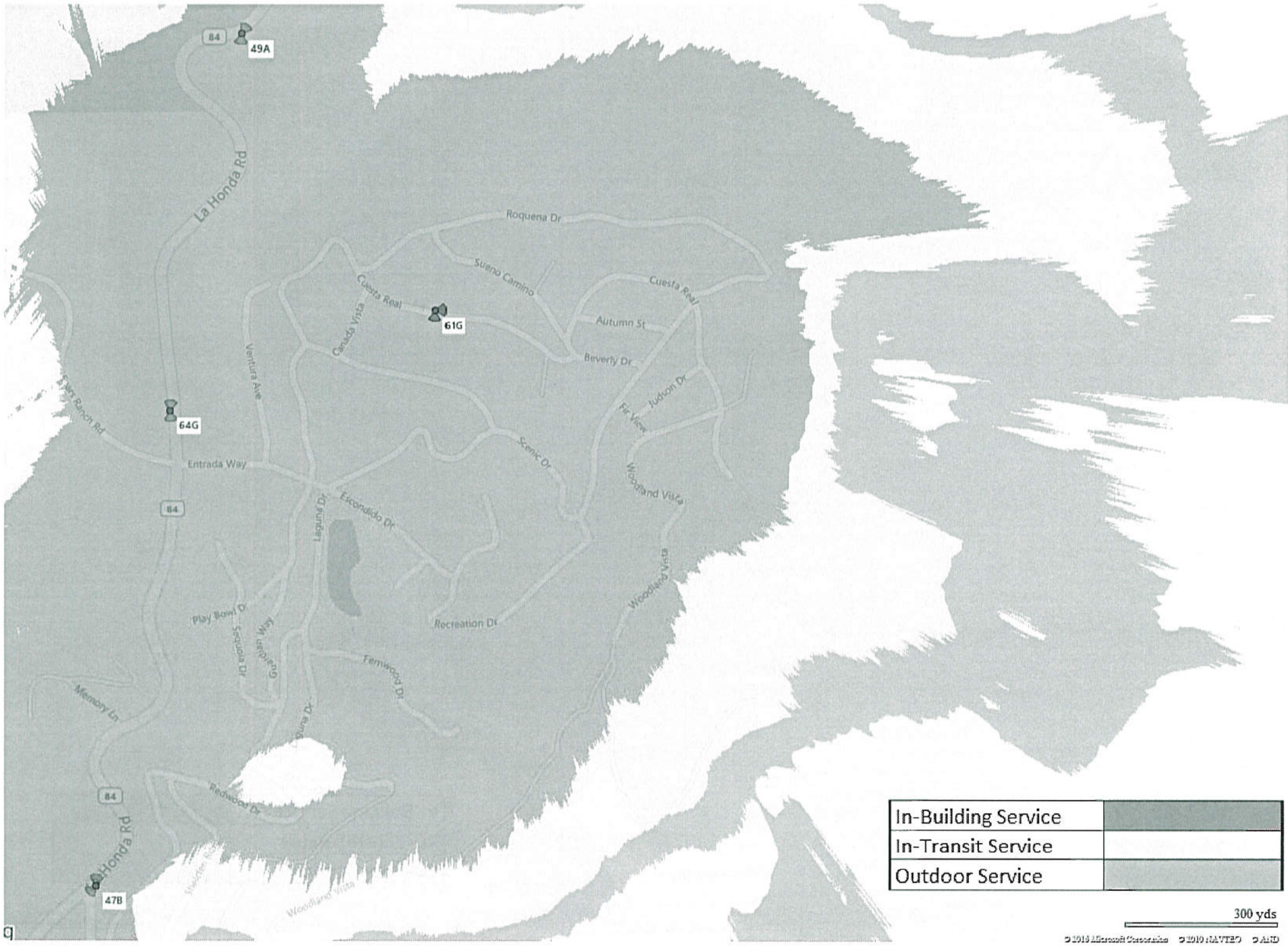
4G LTE Coverage – Alternative 2



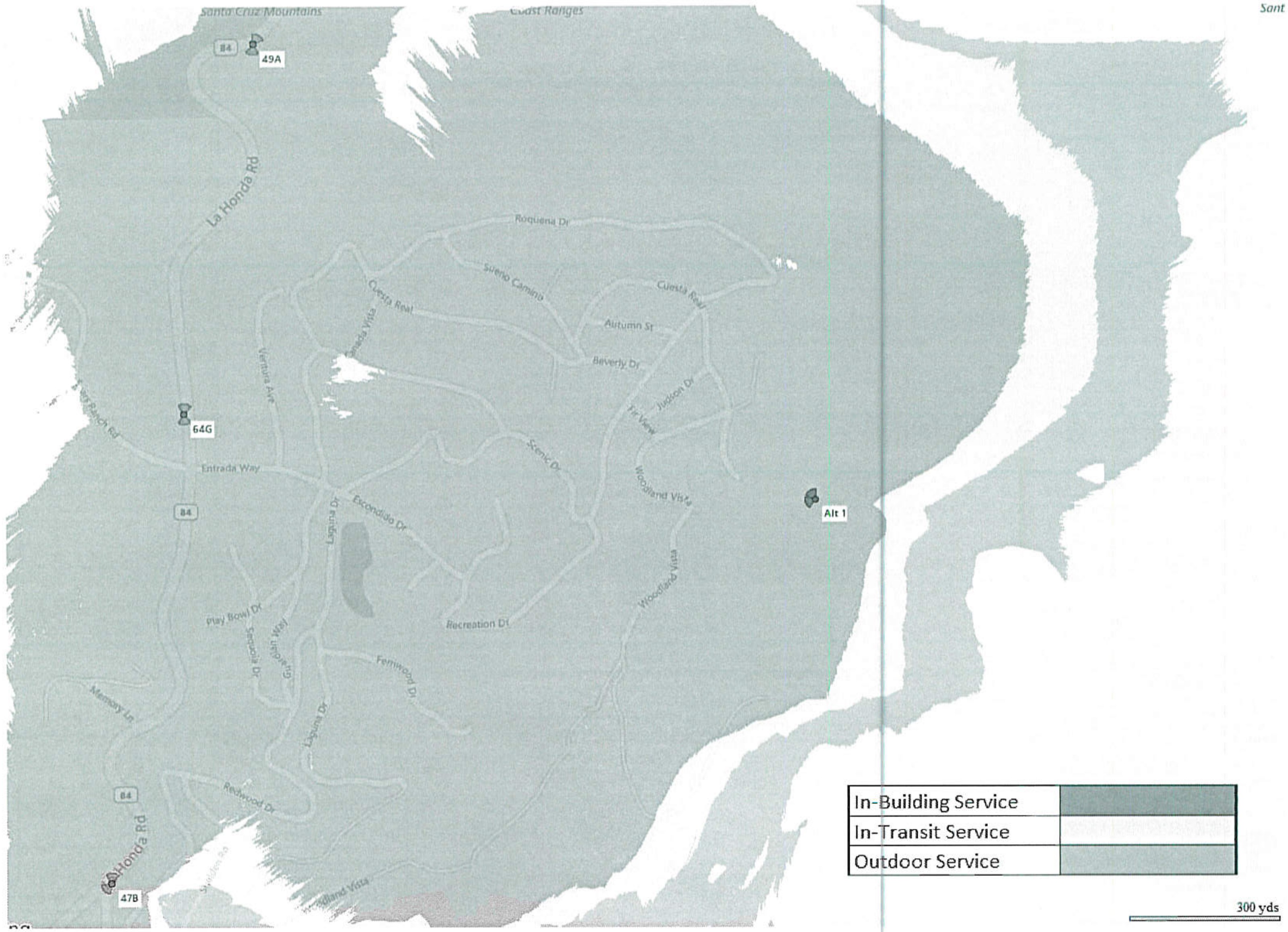
Attachment C

3G UMTS Coverage – Node 61G



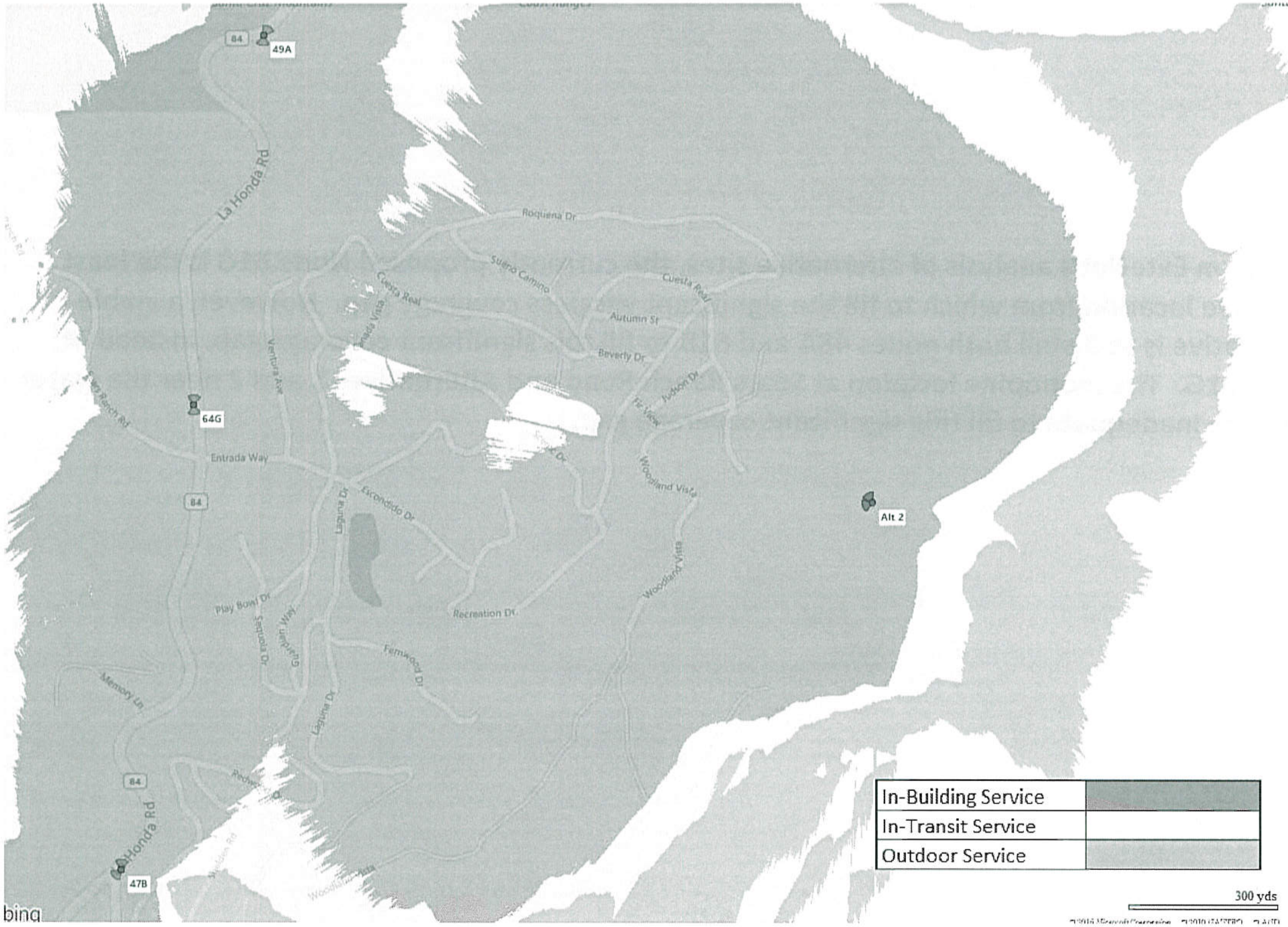
Attachment C

3G UMTS Coverage – Alternative 1



Attachment C

3G UMTS Coverage – Alternative 2



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ALTERNATIVE SITE ANALYSIS CONCLUSION

Based on ExteNet's analysis of alternative sites, the currently proposed Node 61G is the least intrusive location from which to fill the significant wireless coverage gap. However, a viable alternative is to install both nodes 48A and 61B to fill this significant coverage gap, instead of Node 61G. The monopine location at Sears Ranch Road and Alternatives 1 and 2 near the water tank are inadequate to fill this significant coverage gap.

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Statement of Hammett & Edison, Inc., Consulting Engineers

The firm of Hammett & Edison, Inc., Consulting Engineers, has been retained on behalf of AT&T Mobility, a personal wireless telecommunications carrier, to evaluate the base station (Site No. Node-061G) proposed to be located at 231 Cuesta Real in La Honda, California, for compliance with appropriate guidelines limiting human exposure to radio frequency ("RF") electromagnetic fields.

Executive Summary

AT&T proposes to install directional panel antennas on a tall utility pole sited in the public right-of-way near 231 Cuesta Real in La Honda. The proposed operation will comply with the FCC guidelines limiting public exposure to RF energy.

Prevailing Exposure Standards

The U.S. Congress requires that the Federal Communications Commission ("FCC") evaluate its actions for possible significant impact on the environment. A summary of the FCC's exposure limits is shown in Figure 1. These limits apply for continuous exposures and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health. The most restrictive FCC limit for exposures of unlimited duration to radio frequency energy for several personal wireless services are as follows:

Wireless Service	Frequency Band	Occupational Limit	Public Limit
Microwave (Point-to-Point)	5–80 GHz	5.00 mW/cm^2	1.00 mW/cm^2
WiFi (and unlicensed uses)	2–6	5.00	1.00
BRS (Broadband Radio)	2,600 MHz	5.00	1.00
WCS (Wireless Communication)	2,300	5.00	1.00
AWS (Advanced Wireless)	2,100	5.00	1.00
PCS (Personal Communication)	1,950	5.00	1.00
Cellular	870	2.90	0.58
SMR (Specialized Mobile Radio)	855	2.85	0.57
700 MHz	700	2.40	0.48
[most restrictive frequency range]	30–300	1.00	0.20

Power line frequencies (60 Hz) are well below the applicable range of these standards, and there is considered to be no compounding effect from simultaneous exposure to power line and radio frequency fields.

General Facility Requirements

Base stations typically consist of two distinct parts: the electronic transceivers (also called "radios" or "channels") that are connected to the traditional wired telephone lines, and the passive antennas that

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Planning Division

Attachment D

send the wireless signals created by the radios out to be received by individual subscriber units. The transceivers are often located at ground level and are connected to the antennas by coaxial cables. A small antenna for reception of GPS signals is also required, mounted with a clear view of the sky. Because of the short wavelength of the frequencies assigned by the FCC for wireless services, the antennas require line-of-sight paths for their signals to propagate well and so are installed at some height above ground. The antennas are designed to concentrate their energy toward the horizon, with very little energy wasted toward the sky or the ground. This means that it is generally not possible for exposure conditions to approach the maximum permissible exposure limits without being physically very near the antennas.

Computer Modeling Method

The FCC provides direction for determining compliance in its Office of Engineering and Technology Bulletin No. 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation," dated August 1997. Figure 2 describes the calculation methodologies, reflecting the facts that a directional antenna's radiation pattern is not fully formed at locations very close by (the "near-field" effect) and that at greater distances the power level from an energy source decreases with the square of the distance from it (the "inverse square law"). The conservative nature of this method for evaluating exposure conditions has been verified by numerous field tests.

Site and Facility Description

Based upon information provided by AT&T, including construction drawings by Byers Engineering Company, dated March 29, 2016, it is proposed to install two Kathrein Model 800-10764 directional panel antennas on a 47½-foot utility pole to replace the existing 38½-foot pole sited in the public right-of-way in front of the residence located at 231 Cuesta Real in La Honda. The antennas would employ 3° downtilt, would be mounted at an effective height of about 35 feet above ground, and would be oriented toward 85°T and 185°T. The maximum effective radiated power in any direction would be 680 watts, representing simultaneous operation at 290 watts for cellular and 390 watts for 700 MHz service. There are reported no other wireless telecommunications base stations at the site or nearby.

Study Results

For a person anywhere at ground, the maximum RF exposure level due to the proposed AT&T operation is calculated to be 0.0085 mW/cm^2, which is 1.6% of the applicable public exposure limit. The maximum calculated level at the second-floor elevation of the nearby residence is 4.6% of the public exposure limit. It should be noted that these results include several "worst-case" assumptions and therefore are expected to overstate actual power density levels from the proposed operation.

Recommended Mitigation Measures

Due to their mounting location and height, the AT&T antennas would not be accessible to unauthorized persons, and so no mitigation measures are necessary to comply with the FCC public exposure guidelines. To prevent occupational exposures in excess of the FCC guidelines, it is recommended that appropriate RF safety training, to include review of personal monitor use and lockout/tagout procedures, be provided to all authorized personnel who have access to the structure including employees and contractors of AT&T and of the utility companies. No access within 7 feet directly in front of the AT&T antennas themselves, such as might occur during certain maintenance activities on the pole, should be allowed while the base station is in operation, unless other measures can be demonstrated to ensure that occupational protection requirements are met. It is recommended that explanatory signs* be posted at the antennas and/or on the pole below the antennas, readily visible from any angle of approach to persons who might need to work within that distance.

Conclusion

Based on the information and analysis above, it is the undersigned's professional opinion that operation of the base station proposed by AT&T Mobility at 231 Cuesta Real in La Honda, California, will comply with the prevailing standards for limiting public exposure to radio frequency energy and, therefore, will not for this reason cause a significant impact on the environment. The highest calculated level in publicly accessible areas is much less than the prevailing standards allow for exposures of unlimited duration. This finding is consistent with measurements of actual exposure conditions taken at other operating base stations. Training authorized personnel and posting explanatory signs are recommended to establish compliance with occupational exposure limits.

* Signs should comply with OET-65 color, symbol, and content recommendations. Contact information should be provided (*e.g.*, a telephone number) to arrange for access to restricted areas. The selection of language(s) is not an engineering matter, and guidance from the landlord, local zoning or health authority, or appropriate professionals may be required. Signage may also need to comply with the requirements of California Public Utilities Commission General Order No. 95.

Authorship

The undersigned author of this statement is a qualified Professional Engineer, holding California Registration Nos. E-13026 and M-20676, which expire on June 30, 2017. This work has been carried out under his direction, and all statements are true and correct of his own knowledge except, where noted, when data has been supplied by others, which data he believes to be correct.

REGISTERED PROFESSIONAL ENGINEER
WILLIAM F. HAMMETT
E-13026
M-20676
Exp. 6-30-2017
ELECTRICAL
MECHANICAL
STATE OF CALIFORNIA

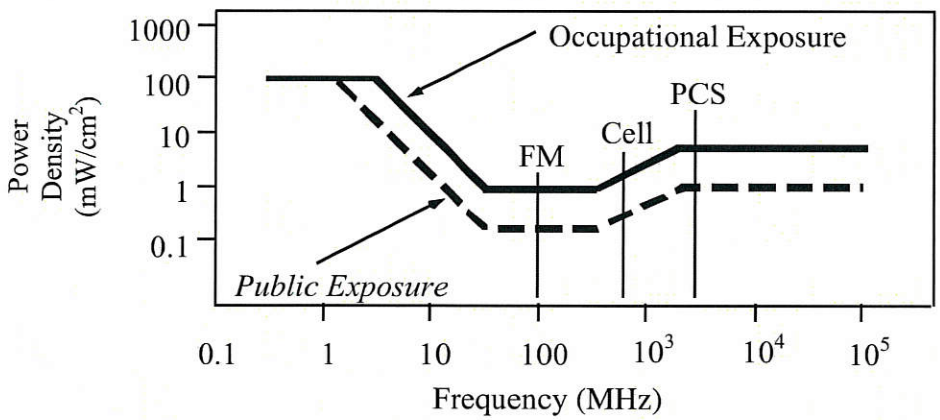
William F. Hammett, P.E.
707/996-5200

May 19, 2016

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The FCC adopted the limits from Report No. 86, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," published in 1986 by the Congressionally chartered National Council on Radiation Protection and Measurements ("NCRP"). Separate limits apply for occupational and public exposure conditions, with the latter limits generally five times more restrictive. The more recent standard, developed by the Institute of Electrical and Electronics Engineers and approved as American National Standard ANSI/IEEE C95.1-2006, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," includes similar limits. These limits apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health.

As shown in the table and chart below, separate limits apply for occupational and public exposure conditions, with the latter limits (in *italics* and/or dashed) up to five times more restrictive:

Frequency	Electromagnetic Fields (f is frequency of emission in MHz)					
Applicable Range (MHz)	Electric Field Strength (V/m)		Magnetic Field Strength (A/m)		Equivalent Far-Field Power Density (mW/cm^2)	
0.3 – 1.34	614	*614*	1.63	*1.63*	100	*100*
1.34 – 3.0	614	*823.8/f*	1.63	*2.19/f*	100	*180/f²*
3.0 – 30	1842/ f	*823.8/f*	4.89/ f	*2.19/f*	900/ f²	*180/f²*
30 – 300	61.4	*27.5*	0.163	*0.0729*	1.0	*0.2*
300 – 1,500	3.54√f	*1.59√f*	√f/106	*√f/238*	f/300	*f/1500*
1,500 – 100,000	137	*61.4*	0.364	*0.163*	5.0	*1.0*



Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits, and higher levels also are allowed for exposures to small areas, such that the spatially averaged levels do not exceed the limits. However, neither of these allowances is incorporated in the conservative calculation formulas in the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) for projecting field levels. Hammett & Edison has built those formulas into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radio sources. The program allows for the description of buildings and uneven terrain, if required to obtain more accurate projections.

Assessment by Calculation of Compliance with FCC Exposure Guidelines

The U.S. Congress required (1996 Telecom Act) the Federal Communications Commission ("FCC") to adopt a nationwide human exposure standard to ensure that its licensees do not, cumulatively, have a significant impact on the environment. The maximum permissible exposure limits adopted by the FCC (see Figure 1) apply for continuous exposures from all sources and are intended to provide a prudent margin of safety for all persons, regardless of age, gender, size, or health. Higher levels are allowed for short periods of time, such that total exposure levels averaged over six or thirty minutes, for occupational or public settings, respectively, do not exceed the limits.

Near Field.

Prediction methods have been developed for the near field zone of panel (directional) and whip (omnidirectional) antennas, typical at wireless telecommunications base stations, as well as dish (aperture) antennas, typically used for microwave links. The antenna patterns are not fully formed in the near field at these antennas, and the FCC Office of Engineering and Technology Bulletin No. 65 (August 1997) gives suitable formulas for calculating power density within such zones.

For a panel or whip antenna, power density $$S = \frac{180}{\theta_{BW}} \times \frac{0.1 \times P_{net}}{\pi \times D \times h}, \text{ in } mW/cm^2,$$

and for an aperture antenna, maximum power density $$S_{max} = \frac{0.1 \times 16 \times \eta \times P_{net}}{\pi \times h^2}, \text{ in } mW/cm^2,$$

where θ_{BW} = half-power beamwidth of the antenna, in degrees, and
P_{net} = net power input to the antenna, in watts,
D = distance from antenna, in meters,
h = aperture height of the antenna, in meters, and
η = aperture efficiency (unitless, typically 0.5-0.8).

The factor of 0.1 in the numerators converts to the desired units of power density.

Far Field.

OET-65 gives this formula for calculating power density in the far field of an individual RF source:

power density $$S = \frac{2.56 \times 1.64 \times 100 \times RFF^2 \times ERP}{4 \times \pi \times D^2}, \text{ in } mW/cm^2,$$

where ERP = total ERP (all polarizations), in kilowatts,
RFF = relative field factor at the direction to the actual point of calculation, and
D = distance from the center of radiation to the point of calculation, in meters.

The factor of 2.56 accounts for the increase in power density due to ground reflection, assuming a reflection coefficient of 1.6 (1.6 x 1.6 = 2.56). The factor of 1.64 is the gain of a half-wave dipole relative to an isotropic radiator. The factor of 100 in the numerator converts to the desired units of power density. This formula has been built into a proprietary program that calculates, at each location on an arbitrary rectangular grid, the total expected power density from any number of individual radiation sources. The program also allows for the description of uneven terrain in the vicinity, to obtain more accurate projections.

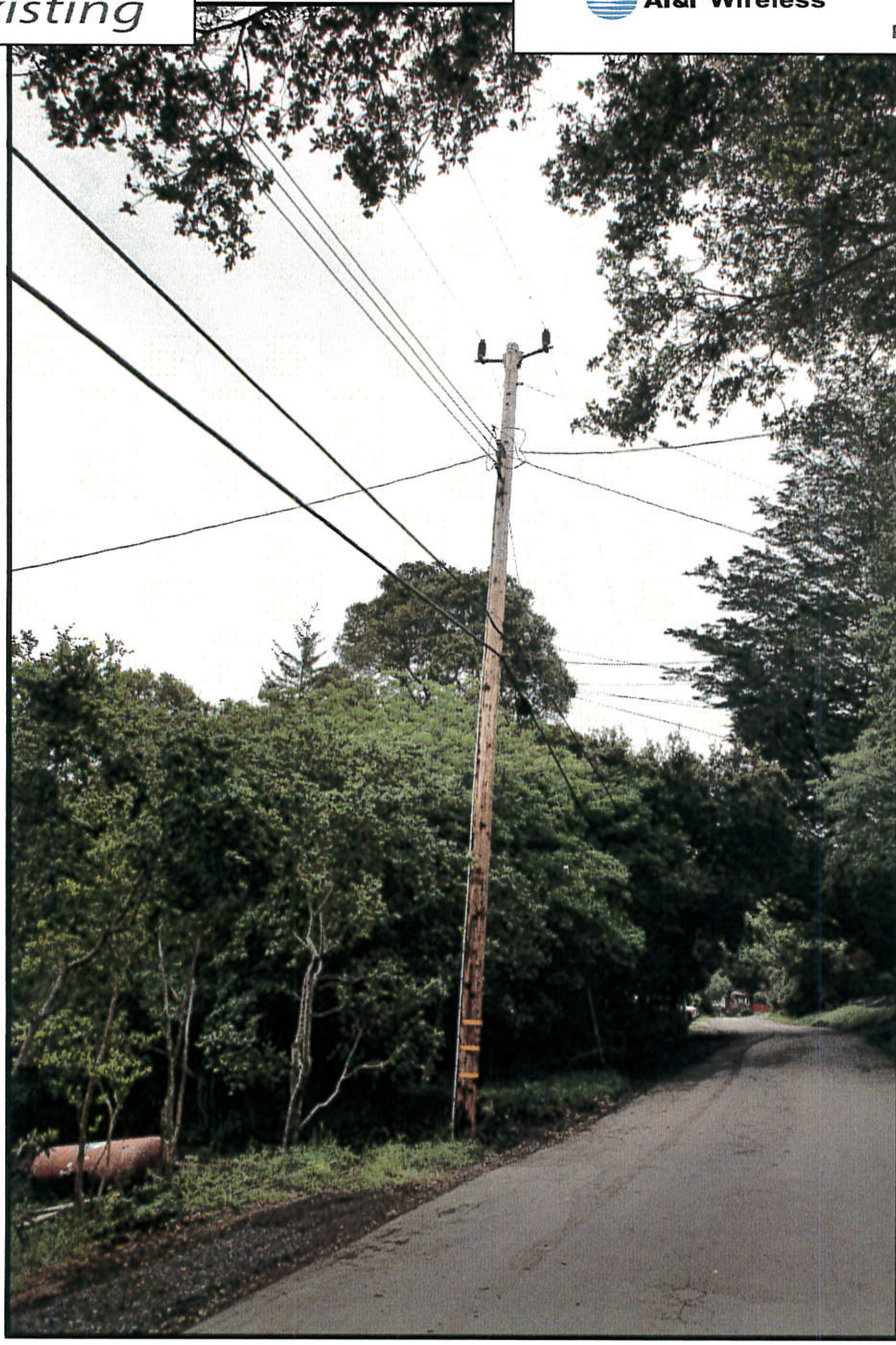
PLN 2016-00216

view from Cuesta Real looking northeast at site

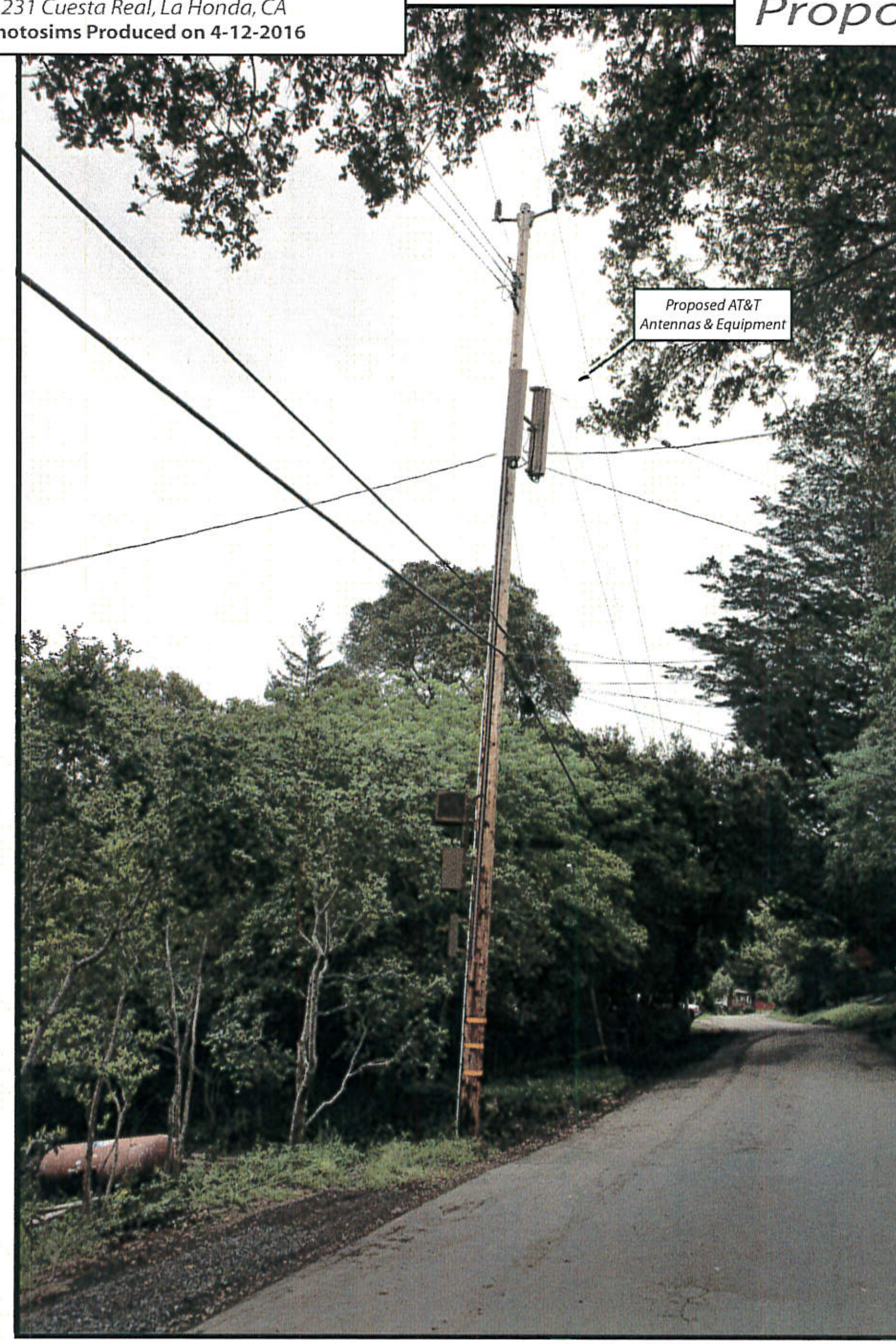
AT&T Wireless

HWY8435 061G
231 Cuesta Real, La Honda, CA
Photosims Produced on 4-12-2016

Existing



Proposed

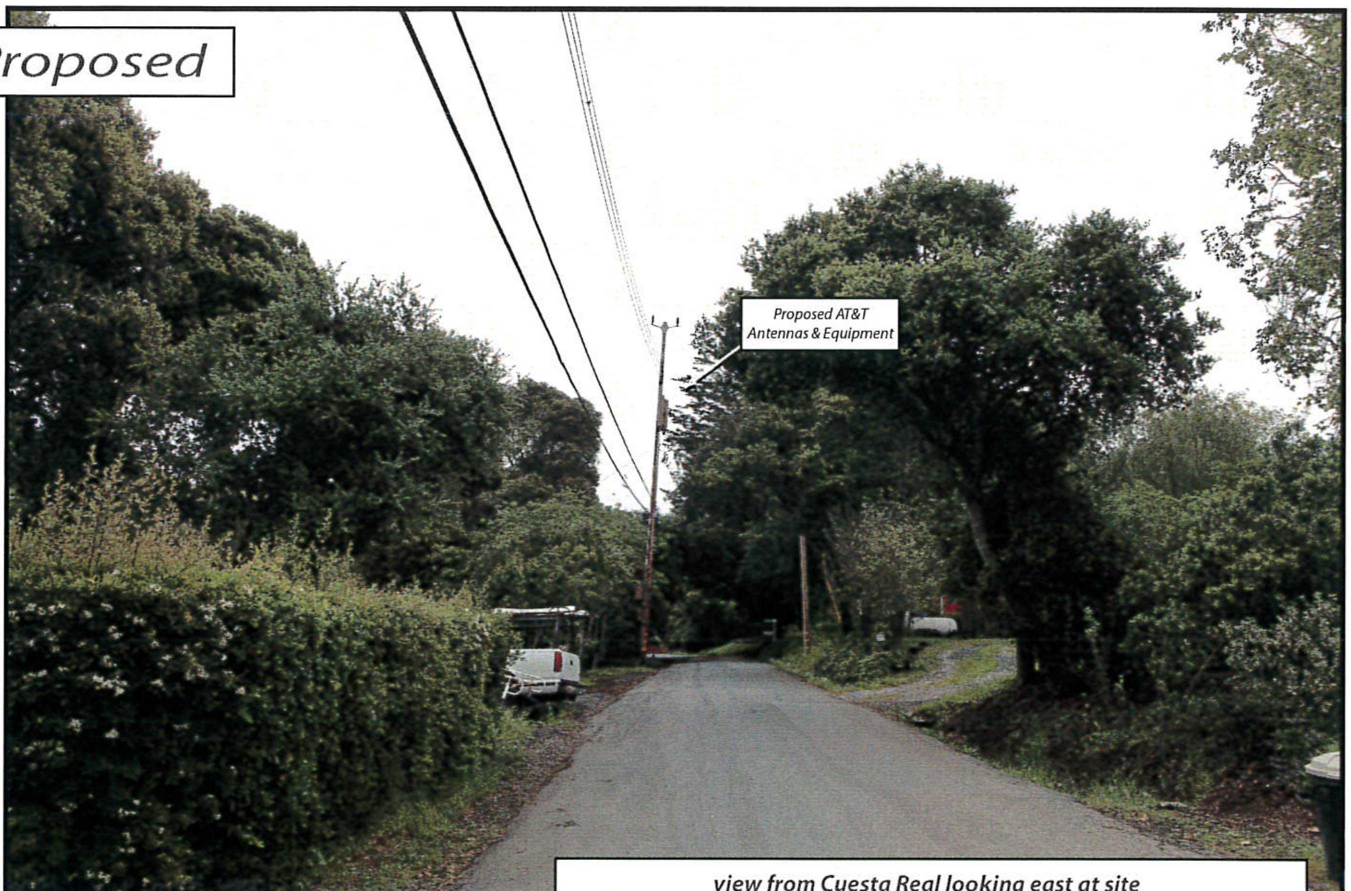


AdvanceSim
Photo Simulation Solutions
Contact (925) 202-8507

Attachment E

Existing

Proposed



view from Cuesta Real looking east at site

AT&T Wireless

HWY8435 061G
231 Cuesta Real, La Honda, CA
Photosims Produced on 4-12-2016

AdvanceSim
Photo Simulation Solutions
Contact (925) 202-8507

Attachment E

Application for Appeal

☑ To the Planning Commission

☐ To the Board of Supervisors

County Government Center ▪ 455 County Center, 2nd Floor
Redwood City ▪ CA ▪ 94063 ▪ Mail Drop PLN 122
Phone: 650 ▪ 363 ▪ 4161 Fax: 650 ▪ 363 ▪ 4849

Name: David W. Ehrhardt
President Cuesta Board

Phone, W: 650 747 1513 H: 650 520 5779

Address: 25 Laguna Dr
La Honda CA

Zip: 94020

Permit Numbers involved:

PLN 2016-00216

I hereby appeal the decision of the:

☐ Staff or Planning Director

☑ Zoning Hearing Officer

☐ Design Review Committee

☐ Planning Commission

made on 10/20 20 16, to approve/deny the above-listed permit applications. AND BY REVISED LETTER DECISION ON 10/25/2016

I have read and understood the attached information regarding appeal process and alternatives.

☑ yes ☐ no

Appellant's Signature: [signature]

Date: 11/03/2016

Planning staff will prepare a report based on your appeal. In order to facilitate this, your precise objections are needed. For example: Do you wish the decision reversed? If so, why? Do you object to certain conditions of approval? If so, then which conditions and why?

(see attachment)

RECEIVED
NOV 03 2016
San Mateo County
Planning and Building Department

Attachment F

Dear Zoning Hearing Officer, 10/19/2016

The Board of Directors of the Cuesta La Honda Guild represents 280 homes in rural San Mateo County. The revisions of the Staff Reports on this project have addressed numerous concerns raised by the Cuesta La Honda Board of Directors at the initial hearing for this application. However, county ordinances are clear that telecommunication antennas should not be installed in residential neighborhoods unless particular conditions are met. As reviewed by our attorneys in response to past applications, Section 6512.2(B) requires that the applicant prove, by a preponderance of the evidence, that:

- A review has been conducted within at least a 2.5 mile radius, of all other options for the proposed facility [6512.5(B)11]

- The review must specifically identify the radio frequency coverage and/or capacity needs and objectives of the applicant [6512.5(B)11]

- The review must include an identification of all existing wireless telecommunication facilities within a 2.5 mile radius [6512.5(B)11]

- It must include an explanation as to why co-location is not feasible at each such existing facility, including technical information to support the explanation
[6512.5(B)11]

- The review must include a list of all other alternatives considered, and a written explanation as to why each was rejected, specifically addressing why modification of any alternative existing tower is not viable [6512.5(B)11]

- No other site or combination of sites allows feasible or adequate (not optimal) service [6512.5(B)11]

- A boundary or other survey may be required to evaluate applicant's survey

The Board feels that the conditions set forth in section 6512.2 have not been met by the applicants. The conditions need to meet the criteria of the ability to allow "feasible service" or adequate capacity or coverage". The applicant claims that alternative tower locations to the west of Cuesta, near or along Sear Ranch road, are not feasible because they fail to provide adequate coverage. However, measurements of coverage within the community of service provided on the Verizon network from that location, and a basic physical analysis as delineated in the materials provided by Dr. Angelo Dragone, an electronics specialist at SLAC, indicate that highly adequate coverage of Cuesta from that location would indeed be feasible. It is possible that such coverage might involve equipment that deviates from that which was planned for the 231 Cuesta Real location, but that is not a sufficient reason to deem this location as inadequate.

Attachment F

We want to stress that this objection should not be interpreted as a rejection of introducing ATT cellular coverage to the community, indeed, much the community would see this as a significant benefit. However, The Board feels strongly that a solution needs to be reached that maximizes benefits all parties, both residential and commercial.

Sincerely,

David Ehrhardt

President
Cuesta La Honda Board of Directors

Attachment F

Summary. Applicant ExeNet, a subcontractor for AT&T, (and referred to here as "AT&T") proposes to install two panel antennas on a new 47' 6" utility pole ("Node 61G") in front of a single family residence at 231 Cuesta Real in the unincorporated La Honda area of San Mateo County. The new pole will replace a significantly shorter (38'7") pole and will be within 19 feet of 231 Cuesta Real and visible to all residents in the immediate area and those who walk through the area to adjacent hiking trails. The Zoning Hearing Officer's ("ZHO") decision was made based primarily on AT&T's map illustrating a "coverage gap" for 4G LTE coverage for an otherwise viable alternative co-location at Sears Ranch (a Verizon facility). 3G UMTS coverage was shown to be adequate from that co-location. Although AT&T's map depicted a 4G LTE coverage gap, AT&T declined to reveal how the map was constructed or the assumptions made in creating it, citing proprietary concerns. Thus, the ZHO had a picture and a request to "take my word for it" as far as its technical foundation. The ZHO also had, but disregarded, a coverage map based on actual measured 4G LTE reception signal levels across La Honda including locations in the purported coverage "gap". This map was presented by Dr. Angelo Dragone's October 19, 2016 analysis ("Analysis") to the ZHO. As a result, there was no well-founded basis for finding that there was no alternative to Node 61G which provided feasible service or adequate capacity and coverage. [Section 6512.2(b)]. In fact, the ZHO did not make any finding in her Revised Letter of Decision dated October 25, 2016 or in Attachment A thereto. Therefore, the ZHO decision should be reversed and the matter submitted to this Commission for full consideration of the adequacy of the coverage provided by Sears Ranch.

Analysis.

1. AT&T's technical justification for rejecting Sears Ranch is simply its picture of a 4G LTE coverage "gap".

Section 6512.5(B)(11) requires that an applicant identify existing wireless telecommunications facilities within a 2.5 mile radius of the proposed new location and an explanation, *including such technical information and other justifications as are necessary* to document the reasons why co-location is not viable. The Report notes that the existing macro antenna farm at 155 Sears Ranch Road is a viable alternative location. (p. 6 Planning Staff Report to ZHO dated October 20, 2016 -- "Report".) The staff rejected that location based on a "significant gap in coverage". (p.5 "Report".) However, there is no *technical information or other justifications* documenting this conclusion. In fact, the only information submitted by staff was AT&T's "map" depicting an "area of no In-Building Coverage from Tree Pole Location [Sears Ranch]". (Attachment C, page 7 to Report.) When questioned at the hearing about the underlying technical assumptions on which this map was built, AT&T refused to provide such information on the basis it was proprietary. Thus, the ZHO was left solely with the map itself; no technical information or other justifications supporting it was provided.

2. Technical information was submitted by Dr. Dragone showing actual 4G LTE reception at 217 sites, more than 40 of which are in the supposed coverage "gap".

Dr. Angelo Dragone surveyed 217 sites, more than 40 of which are in the supposed coverage "gap", to document 4G LTE reception[1]. As a PhD in electrical engineering with a major in telecommunications, Dr. Dragone understands the physics laws behind propagation and is familiar with the telecommunication standards, including 4G LTE. Dr. Dragone measured the Reference Signal Received Power ("RSRP") using a cell phone and an app (Network Signal Info Pro v 3.52.14) that logs signal levels and associates them to the GPS location of the measurement site[2] He found that RSRP signal levels were on average higher than -88dBm across the entire town, including in the "gap" area. "dBm" is an abbreviation for the power ratio expressed in decibels (dB) of the measured power referenced to one milliWatt (mW). It is used in radio, microwave and fiber optic networks as a convenient measure of absolute power. RSRP levels greater than -90dBm, such as -88dBm, are excellent signal levels in the 4G LTE standard. He also found that the signal degraded by not more than 5dBm inside houses. His mapping of these signals was presented to the ZHO on his map (Figs 1 and 2, below and at page 4 of the Analysis.) Thus, the ZHO had a map, plus technical information and justifications, which *supported the alternative location.*

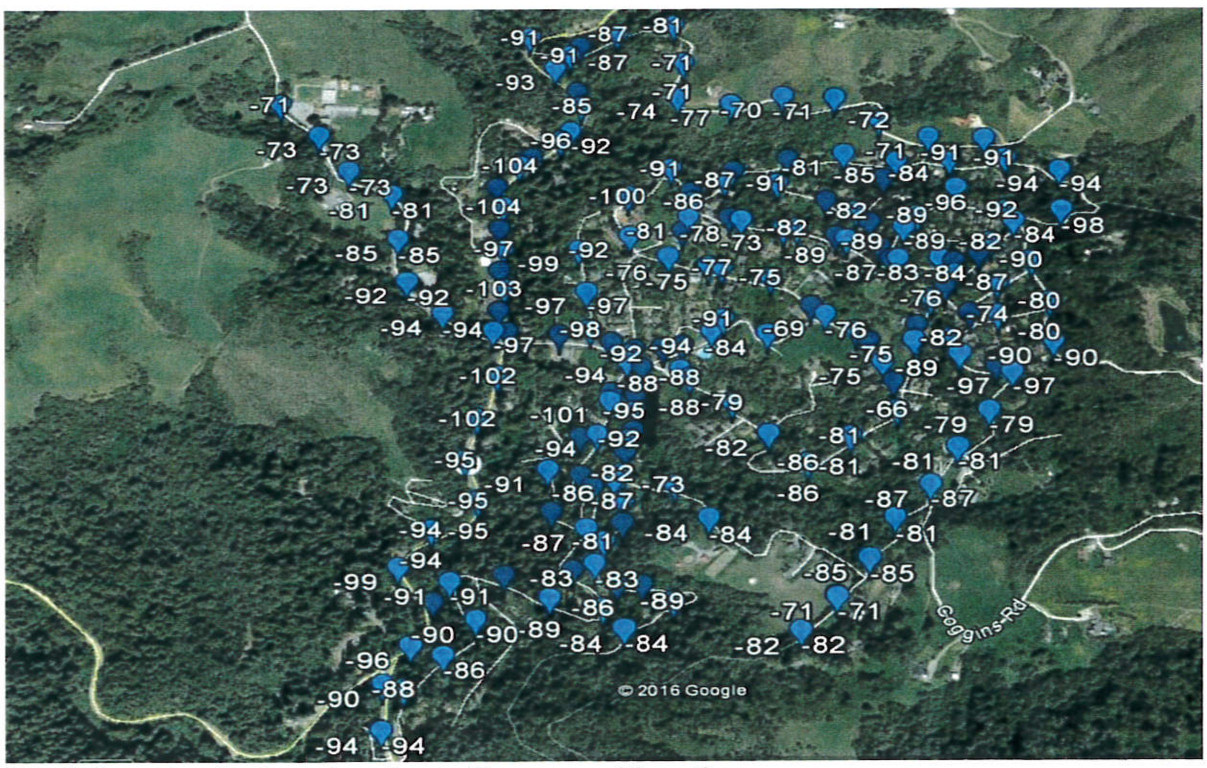


Fig 1 from Analysis – signals at all surveyed locations

[1] This mapping was done on March 4, 2016, during adverse weather conditions.
[2] GPS coordinates of the 217 logged sites are reported in Appendix B of the Analysis.

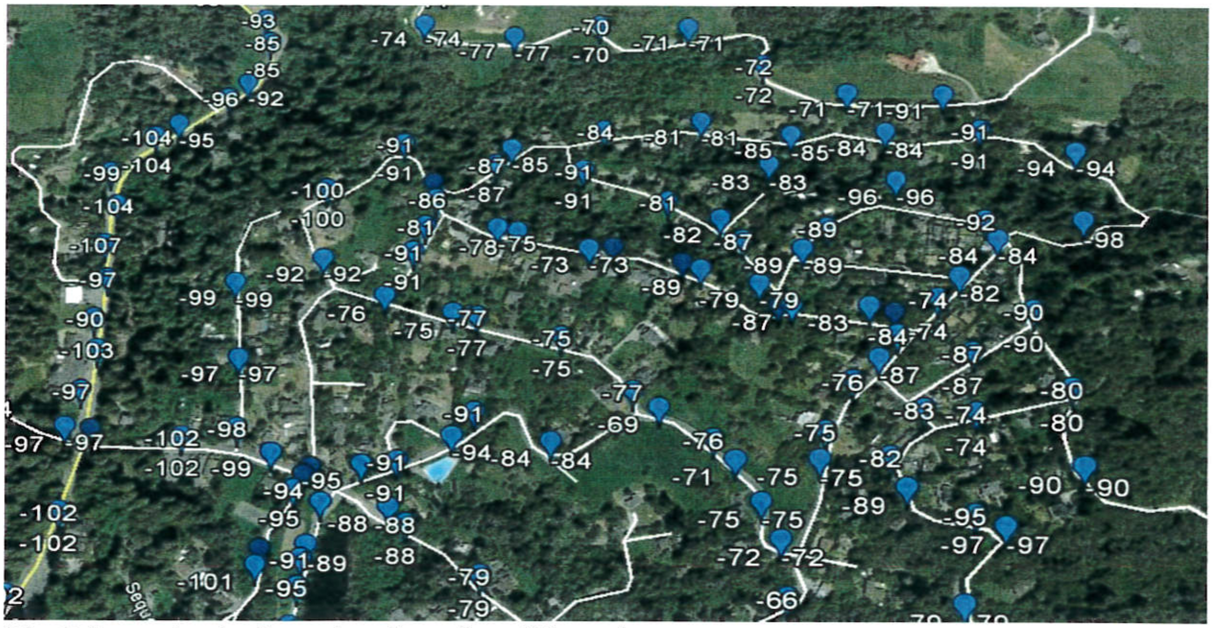


Fig 2 from Analysis – signals at "gap" locations

3. Technical information was also submitted to the ZHO concerning the different frequencies used by AT&T and Verizon.

4G LTE signals from Verizon (1700-2100MHz B4) and from AT&T (700MHz B13) are carried in different frequency bands. Nonetheless, the antennas AT&T is proposing to use for 4G LTE have similar specifications to Verizon's installed equipment at 155 Sears Ranch Road[3],[4]. Thus, with multiple antennas, and adjusting for the output power of the radio units to compensate for the difference in the antenna gains, the propagation length of the AT&T signal from Sears Ranch Road should match the propagation length achieved by Verizon from the same location. Furthermore, the lower carrier frequency of AT&T compared to Verizon should play in favor of AT&T for coverage inside structures, requiring less power due to reduced penetration losses. This technical explanation supports the logical conclusion – if Verizon is producing adequate 4G LTE coverage from Sears Ranch, AT&T can do the same. The ordinance requires use of an alternative to a residential location if the alternative is feasible and adequate, not if it is "acceptable" to the applicant.

Conclusion. The ZHO was presented with detailed technical evidence, both in Dr. Dragone's mapping and in his oral presentation at the hearing, as to the feasibility and adequacy of the Sears Ranch alternative location. Because of his diligence in sampling, he was not able to complete and submit his written materials until the day before the

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[3] List of equipment available at the San Mateo County Building Department.

[4] As noted by Dr. Dragone in the Analysis and at the hearing, the Kathrein 800-10764 antennas (2 units) proposed for node 61G are similar to the Andrew SBNHH1D65B antennas (2 arrays of 3 units) installed by Verizon in terms of polarization and beam width.

hearing. Although the materials were discussed during the hearing and in his oral presentation, there is no mention of it in the Report, and it is likely no one had the opportunity to truly evaluate it and its significance. Instead, the ZHO apparently ignored that substantiated technical information in favor of AT&T's map based on undisclosed proprietary information. (There is no specific finding made on adequacy of alternative sites in the decision.) Since the entire foundation for the adequacy of the Sears Ranch alternative was based on the purported 4G coverage "gap", the failure to critically analyze AT&T's models and the failure to analyze the real world coverage mapping undermines the ZHO's decision. When this core defect is combined with the fact that there is no reason why AT&T can't provide 4G LTE coverage from Sears Ranch to the same extent as currently done by Verizon, given that the location and number of antennas could be equivalent, the ZHO's decision should be reversed, and the matter submitted to this Commission for full consideration of the adequacy of the coverage provided by Sears Ranch.

To: San Mateo County Planning and Building Department
455 County Center
Redwood City, CA 94063
19th of October 2016

Re: PLN2016-00216 (231 Cuesta Real) and related applications within the residential area of the town of La Honda, CA (PLN 2014-00395 (150 Canada Vista), PLN2014-00396 (170 Cuesta Real) and 865 La Honda Rd (Number Unknown))

Application PLN2016-00216 requests a Use Permit to replace an existing 38'7" utility pole with a new 47'6" joint utility pole, and to install a new Wireless Telecommunications Facility (WTF) on the new pole located in the public-right-of-way in front of 231 Cuesta Real, in the unincorporated town of La Honda, San Mateo County. The application follows up on the Zone Hearing Officer (ZHO) recommendation, dated November 2015, to research alternative project locations for applications PLN 2014-00395 and PLN2014-00396 which ExteNet Systems (California) LLC filed to request Use Permits to install WTFs at:

- 150 Canada Vista, La Honda CA (PLN 2014-00395)
- 170 Cuesta Real, La Honda CA (PLN 2014-00396)

Applications PLN 2014-00395 and PLN2014-00396 received opposition from some La Honda residents, and the Cuesta La Honda Guild, based on height limitations (Section 6512.2 of County regulation Chapter 24.5), lack of evidence of sole feasible location (Section 6512.2(B) and Section 6512.5(B) of County Regulation Chapter 24.5), site ownership inconsistencies, applications errors, adverse visual impact and inappropriate aesthetics (Section 6512.2(E) of County regulation Chapter 24.5). In November 2015 the Zone Hearing Officer recommended that the applicant, ExteNet, research an alternative project location.

In the application letter, ExteNet presented to the County Planner on May 20th 2016, and as reported in the new proposal (PLN2016-00216 (231 Cuesta Real)), ExteNet claims to have engaged the La Honda community to identify a less intrusive location for a WTF as identified in PLN2016-00216 and proposes to withdraw the PLN 2014-00395 and PLN2014-00396 applications conditioned on the approval of application PLN2016-00216.

With this letter I request the Planning and Building Department and the Zone Hearing Officer to RE-EVALUATE and REJECT application PLN2016-00216 for the following reasons:

1) Inadequate analysis of alternatives sites, lack of evidence against co-location (non-compliance with **6512.2.B** and the application requirements detailed in **6512.5.11)**
2) Failure to engage the community
3) Intrusiveness
4) Inconsistencies in the application

which I will discuss below:

1. **Inadequate analysis of alternatives, lack of evidence against co-location**

   "Section 6512.2.B prohibits new wireless telecommunication facilities from being located in areas zoned Residential (R), unless the applicant demonstrates that a review has been conducted of other options and no other sites or combination of sites allow feasible service or adequate capacity and coverage."

   In addition **Section 6512.5.11 requires the following documentation in the application**:

- Identification of existing wireless telecommunication facilities within a 2.5-mile radius of the proposed location of the new wireless telecommunication facility,
- An explanation of **WHY** co-location on these existing facilities, if any, is not feasible. This explanation shall include such **TECHNICAL** information and other justifications as are necessary to document the reasons why co-location is not a viable option.
- The applicant shall provide a list of **ALL** existing structures considered as alternatives to the proposed location.
- The applicant shall also provide a written explanation why the alternatives considered were either unacceptable or unfeasible.
- If an existing tower was listed among the alternatives, the applicant must specifically address why the modification of such tower is not a viable option.
- The written explanation shall also state the radio frequency coverage and/or capacity needs and objective(s) of the applicant.

1.1. The application has inconsistencies.
On page 5, where compliance to Section 6512.2.B is discussed, it is reported that in the Alternative Site analysis (Attachment C), ExteNet has identified and researched 18 alternative sites in an area of 2.5 mile radius from the proposed location (Node 61G), including the two locations 61B and 48A proposed respectively in PLN2014-00396 (170 Cuesta Real) and PLN 2014-00395 (150 Canada Vista). This statement is incorrect because Node 48A is then not discussed as an alternative site in attachment C. Node 61B is listed as an alternative site but there is no supporting documentation in attachment C. Attachment C slide associated with node 61B is a copy of the slide describing node 61C. As a consequence the analysis should be deemed incomplete.

1.2. In addition to the proposed node 61G, nodes 61A, 61C, 61D, 61E, 61F, 61G, 61H, 61CI, 61J, 61K, 61L, 61M, 61O, 61P, 61Q, 61R are considered in Attachment C. The majority of these nodes have been found NOT viable alternatives to node 61G with the exception of nodes 61F, 61L, 61N, and 61O which are listed as potentially viable but more intrusive than 61G. Although 61F, 61L, 61N, and 61O are more intrusive than 61G no evidence has been presented to support the potential adequacy of these sites. As a consequence these sites cannot be considered as alternatives and the analysis should be deemed incomplete.

1.3. In addition, the nodes listed in attachment C are located in the vicinity of node 61G. Thus, neglecting the possibility to identify adequate nodes in the periphery of the town away from residential buildings. Examining the simulated coverage map associated to node 61G (regardless of its incompleteness which will be discussed later. See 1.4) one can see that the coverage extends into the periphery of the residential area where many other poles are present. Because of the Antennas Reciprocity Theorem, transmission and receiving propagation patterns are identical. Thus, if an antenna in position A can transmit to position B also an antenna in position B can transmit to position A. In other words nodes located at the periphery of the area covered by node 61G are all potential candidate to cover the same area covered by node 61G, and thus need to be evaluated as alternative sites. As a consequence, the alternative site analysis presented is incomplete and fails to satisfy 6512.2.

1.4. In addition, as reported in Attachment C, ExteNet examined three additional sites: first of all, the Antenna farm located at 155 Sears Ranch Road. This site is a potential candidate for co-location and needs to be carefully evaluated according to 6512.2C. ExteNet claims that co-location at Sears Ranch Road is not a viable solution because of a significant gap in coverage that would otherwise be filled by node 61G. The claim is **not** supported with **quantitative data**. ExteNet compared **simulated** coverage maps of a WTF located at 155 Sears Ranch Road with the combination of the coverage maps of two WTFs located in node 61G and node 64G. Node 64G is located at 8865 La Honda Road, right in front of La Honda Post Office (Highly intrusive location). In attachment C, and nowhere else in the application, ExteNet stated they want to deploy 61G in combination with 64G (according to ExteNet, 64G is located in a commercial area and not subjected to 6512.2). Two sets of coverage maps are compared: one for 3G UMTS and one for 4G LTE. The 3G UMTS coverage map of a WTFs at 61G plus 64G and the 3G UMTS coverage map of a WTF at Sears Ranch Road are comparable, showing that, for this kind of service, co-location is possible. The coverage map for 4G LTE service of a WTF located at Sears Ranch Road instead shows a gap of coverage (only for indoor services), in a peripheral area of the town which instead would be covered by 61G. The simulations, at least as presented, are qualitative **not quantitative**. No legend is present quantifying the signal levels in the various highlighted regions and identifying the minimum required signal levels in reference to the 4G LTE standard. No characteristics of the antennas used in the simulations are given (number of elements, orientation, input power). No measurement of the signal strength for a 4G LTE signal is presented to confirm the simulation results. Furthermore, it is apparent from the maps that node 64G would be absolutely superfluous if co-location would be considered (see also coverage maps presented in previous applications).
The documentation presented fails to rule out the possibility of co-location because the simulations are not supported with a quantitative analysis supported by measurements. As a consequence the applications should be rejected.

1.5. Simple measurements testing the Reference Signal Received Power (RSRP) for the Verizon 4G LTE network across town (transmitted from 155 Sears Ranch) seem to indicate excellent signal levels on average higher than -88dBm across the whole town and in particular in the supposed gap, identified by ExteNet, that allegedly could not be covered from Sears Ranch Road (see Fig.1 and Fig.2 and data reported in appendix B). RSRP levels greater than -90dBm are considered excellent signal levels in the 4G LTE standard.

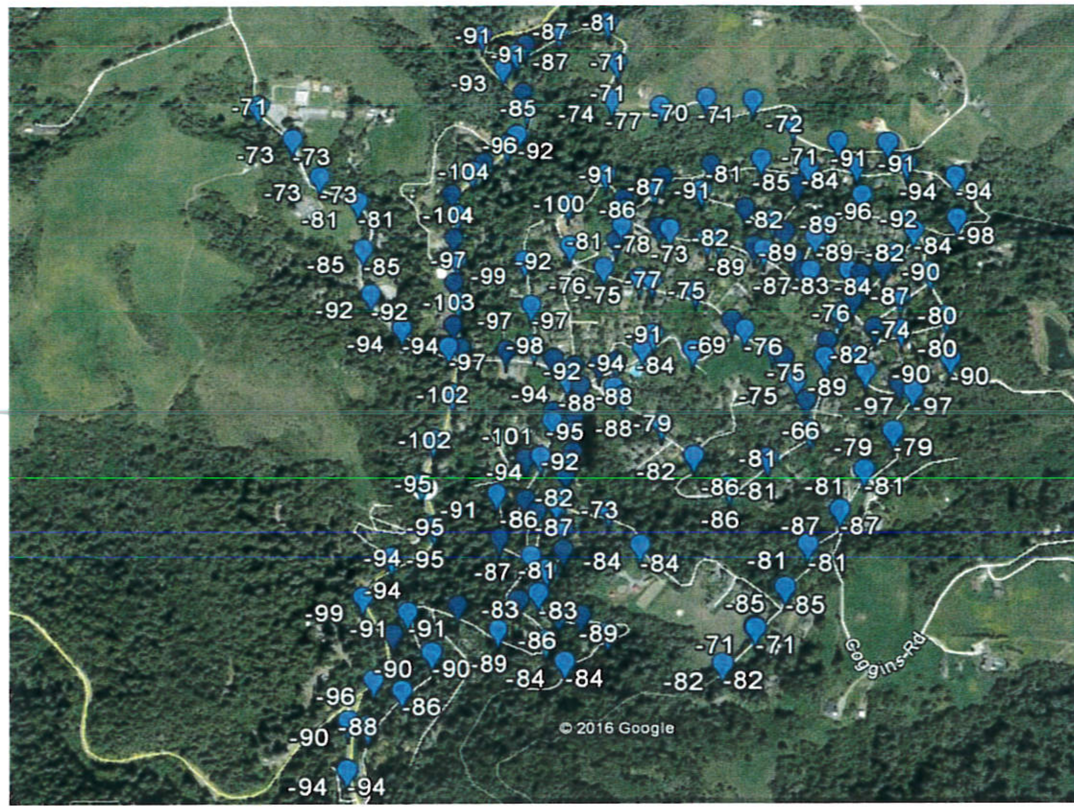


Fig. 1 RSRP levels of the Verizon 4G LTE signal across town radiated from Sears Ranch Road

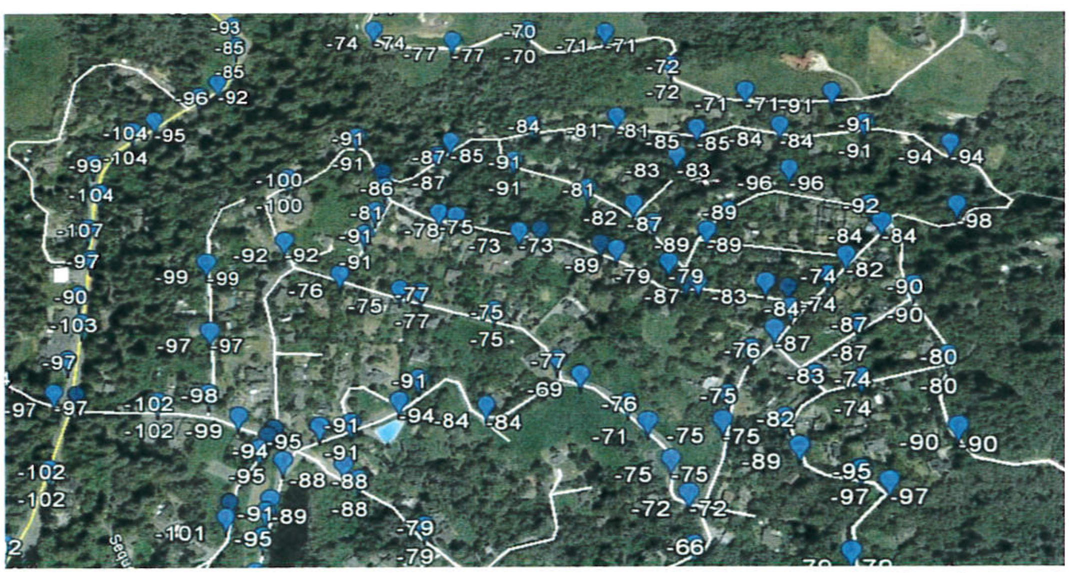


Fig. 2 RSRP levels of the Verizon 4G LTE signal radiated from Sears Ranch Road in the supposed gap

Our own measurements of the signal inside houses across town showed not more than 5dBm attenuation, which seems to be in accordance with typical penetration losses in rural areas with wooden buildings. For completeness, it is important to note also that 4G LTE signals from Verizon (1700-2100MHz B4) and from AT&T (700MHz B13) are carried in different frequency bands. Nonetheless, the antennas required to propagate 4G LTE signals that ExteNet is proposing to use, have similar specifications to the equipment installed by Verizon at 155 Sears Ranch Road (list of equipment can be reviewed at the Building Department of San Mateo County). In particular, the Kathrein 800-10764 antennas (2 units) proposed for node 61G are similar to the Andrew SBNHH1D65B antennas (2 arrays of 3 units) installed by Verizon in terms of polarization and beam width. Thus, with multiple antennas, and adjusting for the output power of the radio units to compensate for the difference in the antenna gains, the propagation length of the AT&T signal from Sears Ranch Road should match the propagation length achieved by Verizon from the same location. Furthermore, the lower carrier frequency of AT&T compared to Verizon should play in favor of AT&T for coverage inside of structures, requiring less power due to reduced penetration losses. It is totally unreasonable to believe that AT&T cannot match the same performance as Verizon from Sears Ranch Road. Co-location cannot be excluded on the basis of the characteristics of the equipment. If the terrain characteristics allow the propagation, then the equipment specifications need to be sized correctly to reach the required signal levels. Perhaps ExteNet's opposition to co-location is to avoid the associated costs, but this is not an acceptable argument. For these reasons the application should be rejected.

1.6. In addition, the analysis of two additional sites located at the water tank of the La Honda water filtration plant is reported. The analysis show coverage levels comparable with node 61G for 3G UMTS signals but again a gap is identified for 4G LTE signals. Again, these coverage maps present qualitative simulations and no accompanying information on the characteristics of the antenna used. This analysis cannot then be considered complete.

1.7. No combination of sites has been considered as an alternative to node 61G. If needed, multiple sites located outside the residential area would be preferable to minimize the impact on the town and the community. For this reason the analysis cannot be considered complete and the application should be rejected.

2. Failure to engage the community

In the application letter ExteNet presented to the County Planner on May 20th 2016, and as reported in the new proposal (PLN2016-00216 (231 Cuesta Real)), ExteNet claims to have engaged the La Honda community to identify a less intrusive location for a WTF and proposes to withdraw the PLN 2014-00395 and PLN2014-00396 applications conditioned to the approval of application PLN2016-00216. The claim that ExteNet has engaged the La Honda community is false.

ExteNet did not take any action to engage with the entire La Honda community (for instance promoting a town meeting). Instead, ExteNet had private meetings with a few individuals who have no authority to represent the will of the entire community. These individuals have opposed the previous applications (PLN2014-00396 (170 Cuesta Real) and PLN 2014-00395 (150 Canada Vista)) with sincere intention to help the community. Nevertheless, living close by to the originally selected sites 61B and 48A, these individuals also opposed for personal interests. Discussing alternative solutions, even if less intrusive, with only few people and promising to cancel the previous applications pending approval of the new application, without then asking the rest of the community or at least the residents living closer to the new location for an approval, creates conflicts in the community and is a despicable behavior. Such behavior can be perceived as an attempt to favor the interest of few in exchange for an agreement and might expose ExteNet to legal litigations. As a consequence, the La Honda community reacted and is presenting a petition to strongly oppose the installation of Wireless Telecommunication Facilities (WTF) in the residential areas and in proximity to houses within the town of La Honda. The text of the petition, a map of the signee houses, statistics and a copy of the collected signatures are available at the County. The petition was signed by 149 household (more than half of the residents in the Cuesta La Honda Guild area) representing a total of 339 people. A Map of the households opposing the installation of WTF in the town is reported in figure 3.

Fig. 3 Map of the houses of the community members who signed the petition

Attachment H

It is important to underline that the La Honda community members who signed the petition are not completely against the installation of WTF, but instead wants identification of sites for the antennas that are far away from houses and at the periphery of the town. If ExteNet sincerely wants to engage the La Honda community and at least find a solution that accommodates the desire of half of the habitants, it is important to research alternative sites outside the residential area.

The petition also invites:

- San Mateo County to support the La Honda community (who contribute to elect its administration), and to promote and favor proposals minimizing the impact on the environment and the burden on the residents, by rejecting plans to place WTF in the residential area of La Honda today and in the future.
- San Mateo County, the telecommunication companies (AT&T) and their contractors (ExteNet) to work with the community to identify locations outside the residential area that protect the beauty of the town we live in, the safety of its residents, and the value of their properties.
- The Cuesta La Honda Guild, in its role of managing guild residents' common property, to locate areas outside the residential part of the town that would be suitable for tower placement, and to help facilitate the connections between the telecommunication companies, their contractors and private land owners who might be willing to rent space for WTFs outside the residential area of La Honda.

3. Intrusiveness

PLN2016-00216 (231 Cuesta Real) claims that 61G is the least intrusive of the considered sites in the reported alternative site analysis (Appendix A). I agree with this statement although I believe that the level of intrusiveness of 61G is still significant, as can be seen from the photo simulations presented by ExteNet and from photos taken from the houses located in proximity of 61G (shown in appendix C). Claiming that the WTF will be hidden by vegetation is incorrect. Node 61G is extremely close to the house at 231 Cuesta Real and can be clearly seen from every window on the street side of the house and the front patio. It can also be seen from inside the house at 226 Cuesta Real. Cuesta Real is one of the roads mostly frequented by people enjoying a nice stroll during the day or in weekends. The antenna will be quite visible from every angle walking on the street and from the gardens of 220 Cuesta Real. The height proposed for the new pole in 61G is also higher than the one proposed in previous projects. Given the reasons presented in the previous sections, these arguments represent an additional encouragement to look for solutions outside the residential areas aiming at minimizing adverse visual impact according to Policy 4.21 of the County General Plan.

4. Inconsistencies in the applications

Besides the inconsistencies reported in 1.1, it seems PLN2016-00216 (231 Cuesta Real) has the following potential inconsistencies that should also be addressed:

- PLN 2014-00395 (150 Canada Vista), PLN2014-00396 (170 Cuesta Real) show a Mitigated Negative Declaration following an Environmental Review. Suddenly in the new application PLN2016-00216 (231 Cuesta Real), ExteNet claimed to have a California Environmental Qualities Act (CEQUA) categorical exemption for its proposed WTF in La Honda. According to the documentation deposited by ExteNet at the Planning Office (Application 05-07-025 to the Public Utilities Commission of the State of California and letter of July 22, 2016), a modification of the Certificate of Public Convenience and Necessity allows the Commission Energy Division to grant CEQUA exemptions to ExteNet after reviewing a project. It seems to me that no document has been presented showing the approval of the Commission Energy Division for the project in La Honda. Furthermore ExteNet seems to claim the exemption based on previous Courts decisions: an argument that in my view does not guarantee the exemption of this specific project. The decision of the County Planner to accept the exemption request by ExteNet requires additional justification and a review of the application.

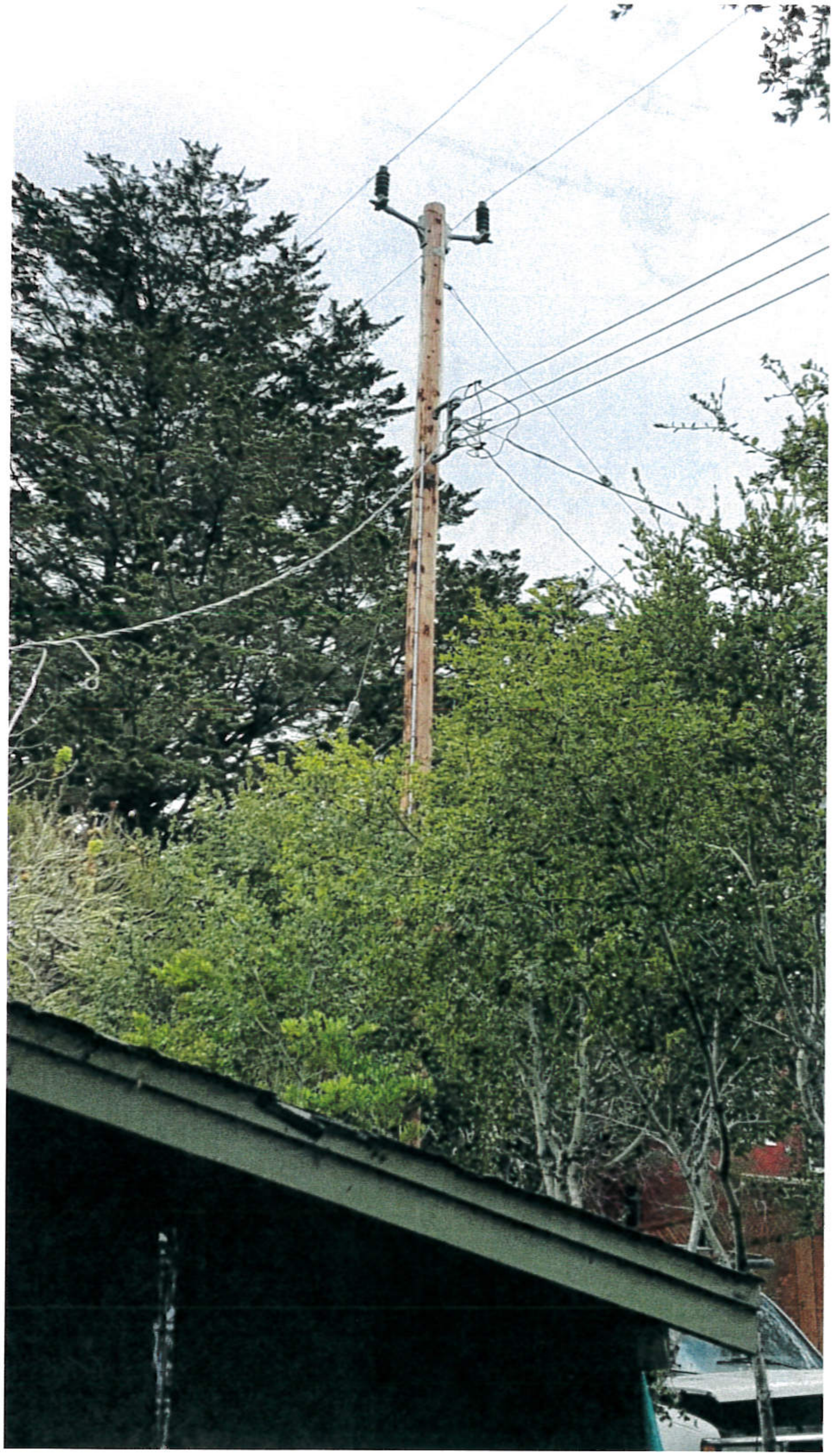
- In the drawings presented in attachment B no guy wire is shown in the existing west elevation page. Instead a guy wire runs between 61G and 61F. In the proposed north and west elevations for the new pole no guy wire is drawn. Simplistically thinking, one would expect that a taller pole, bearing the additional load of the WTF equipment would also require guy wires. If so the drawings the application should be rejected as incomplete.

Thank you in advance for considering my objections, comments and questions.

Regards,

Angelo Dragone

Appendix A



Entrance of 231 Cuesta Real

Appendix A

Street side of 231 Cuesta Real

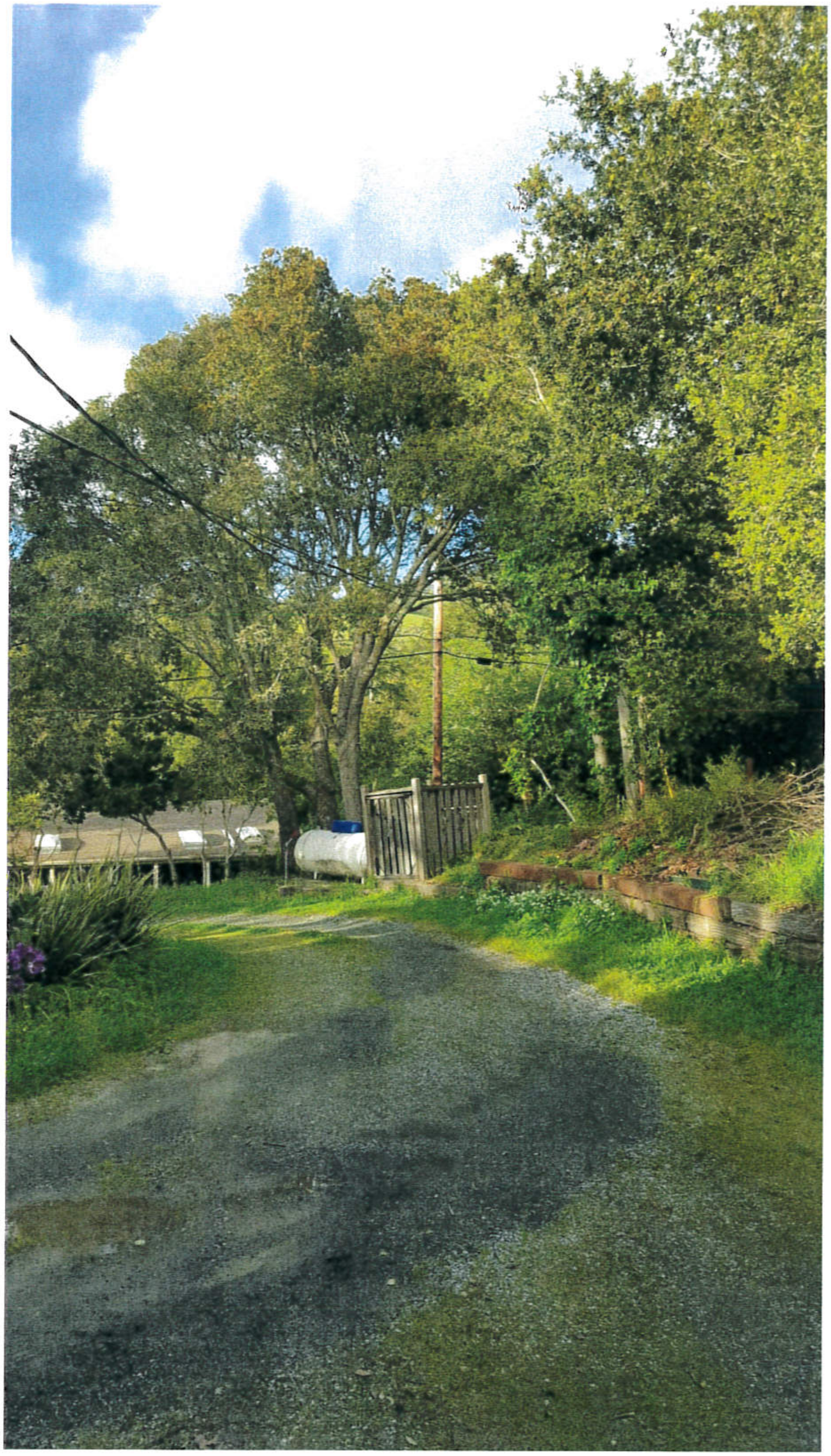
Appendix A

From the deck of 231 Cuesta Real

Appendix A

Entrance of 226 Cuesta Real

Appendix A

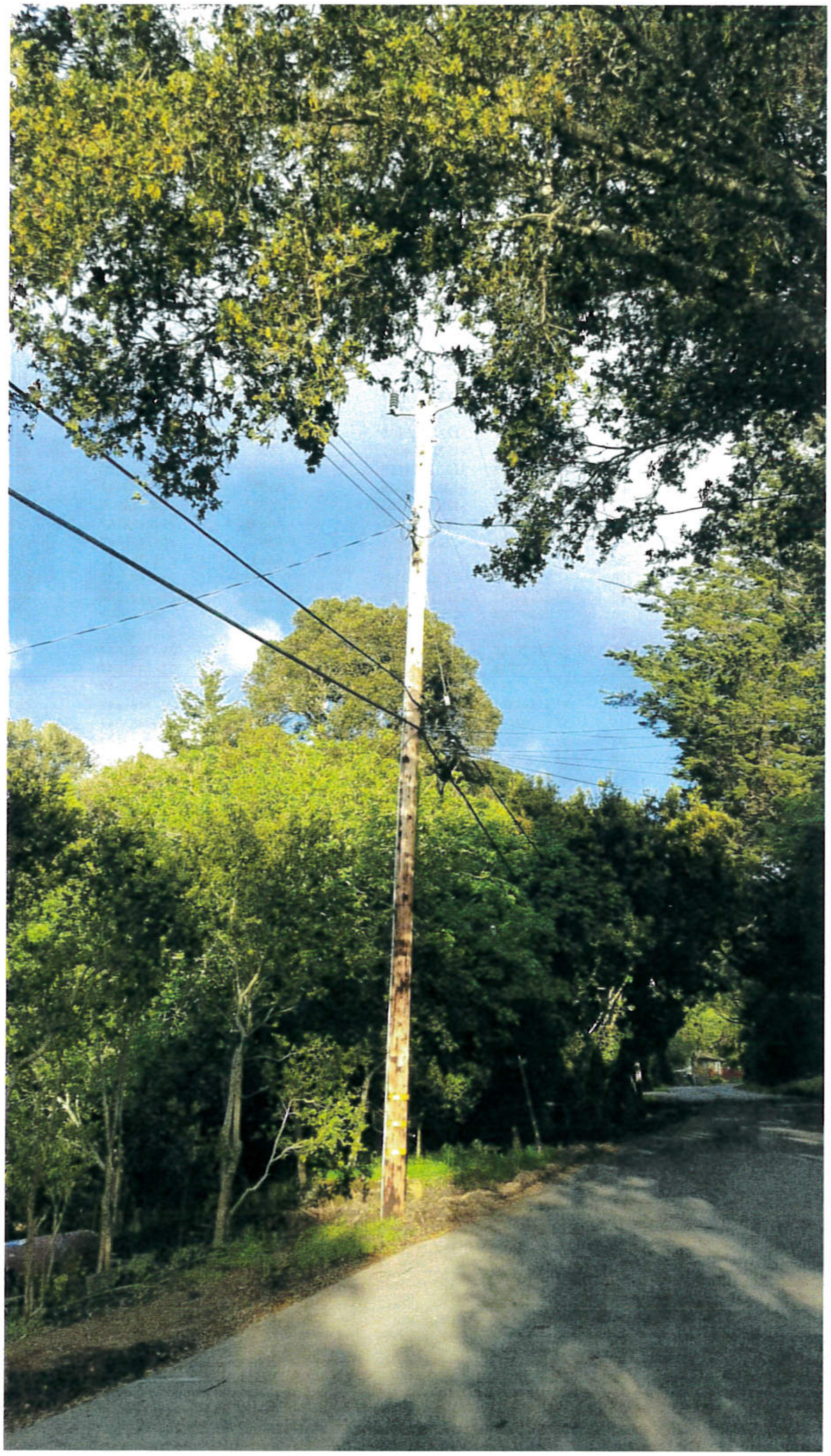


Entrance of 220 Cuesta Real

Appendix A

Street view

Appendix A



Street view

Appendix B - LOG File

Counter	Date: Log date: 3/4/2016 Log start: 10:56:10 Log interval: 2 seconds Device/Model: SM-G920V Android: Version 5.1.1 Net. op.: Verizon Wireless Sim op.: Verizon Network type LTE Phone type: CDMA Country code: us Device ID: 990004882611654	Time (24h)	Network type	RSRP (dBm)	Latitude	Longitude	Tower Cell ID - short	Tower Cell ID - long	Tower LAC
1	3/4/2016 * 10:56:12	10:56:12	LTE	-83	37.32122223	-122.2694301	65535	2147483647	697
2	3/4/2016 * 11:0:8	11:00:08	LTE	-84	37.32136764	-122.268333	65535	2147483647	697
3	3/4/2016 * 11:0:30	11:00:30	LTE	-87	37.32119493	-122.2672451	65535	2147483647	697
4	3/4/2016 * 11:0:50	11:00:50	LTE	-85	37.3207618	-122.2662725	65535	2147483647	697
5	3/4/2016 * 11:1:12	11:01:12	LTE	-87	37.32157093	-122.2667246	65535	2147483647	697
6	3/4/2016 * 11:1:26	11:01:26	LTE	-81	37.32206852	-122.2676423	65535	2147483647	441
7	3/4/2016 * 11:1:41	11:01:41	LTE	-91	37.32243104	-122.2686927	65535	2147483647	441
8	3/4/2016 * 11:2:7	11:02:07	LTE	-87	37.32250978	-122.2697879	65535	2147483647	441
9	3/4/2016 * 11:2:46	11:02:46	LTE	-75	37.32161874	-122.269645	65535	2147483647	697
10	3/4/2016 * 11:3:3	11:03:03	LTE	-73	37.32140378	-122.2685205	65535	2147483647	697
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52	3/4/2016 * 11:17:43	11:17:42	LTE	-85	37.31450379	-122.2665093	65535	2147483647	697
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166	3/4/2016 * 12:13:50	12:13:50	LTE	-94	37.3185039	-122.2716314	65535	2147483647	697
167	3/4/2016 * 12:14:1	12:14:01	LTE	-101	37.31764583	-122.2719188	65535	2147483647	697
168	3/4/2016 * 12:14:16	12:14:16	LTE	-100	37.3168468	-122.2724873	65535	2147483647	697
169	3/4/2016 * 12:14:36	12:14:36	LTE	-91	37.31612251	-122.2731048	65535	2147483647	697
170	3/4/2016 * 12:14:51	12:14:51	LTE	-90	37.31524087	-122.2729607	65535	2147483647	697
171	3/4/2016 * 12:15:22	12:15:22	LTE	-80	37.31601794	-122.2724031	65535	2147483647	697
172	3/4/2016 * 12:15:42	12:15:42	LTE	-94	37.31690699	-122.2721297	65535	2147483647	697
173	3/4/2016 * 12:15:57	12:15:57	LTE	-100	37.31782354	-122.2718973	65535	2147483647	697
174	3/4/2016 * 12:16:13	12:16:13	LTE	-92	37.31867028	-122.2715484	65535	2147483647	697
175	3/4/2016 * 12:16:32	12:16:31	LTE	-91	37.31773961	-122.2714008	65535	2147483647	697
176	3/4/2016 * 12:16:42	12:16:42	LTE	-92	37.31682859	-122.2714641	65535	2147483647	697
177	3/4/2016 * 12:16:57	12:16:57	LTE	-86	37.31596097	-122.2716889	65535	2147483647	697
178	3/4/2016 * 12:17:10	12:17:10	LTE	-84	37.31506033	-122.2714651	65535	2147483647	697
179	3/4/2016 * 12:17:24	12:17:24	LTE	-83	37.31419781	-122.2719615	65535	2147483647	697
180	3/4/2016 * 12:17:41	12:17:41	LTE	-90	37.31380997	-122.2709738	65535	2147483647	697
181	3/4/2016 * 12:18:20	12:18:20	LTE	-84	37.31292362	-122.271276	65535	2147483647	697
182	3/4/2016 * 12:20:0	12:20:00	LTE	-89	37.31350657	-122.2703421	65535	2147483647	697
183	3/4/2016 * 12:20:26	12:20:26	LTE	-89	37.31379944	-122.2714775	65535	2147483647	697
184	3/4/2016 * 12:20:44	12:20:43	LTE	-81	37.31466252	-122.2718052	65535	2147483647	697
185	3/4/2016 * 12:20:55	12:20:55	LTE	-87	37.31550595	-122.2714954	65535	2147483647	697
186	3/4/2016 * 12:21:26	12:21:26	LTE	-75	37.31585963	-122.2704449	65535	2147483647	697
187	3/4/2016 * 12:21:42	12:21:41	LTE	-84	37.31520385	-122.2697165	65535	2147483647	697
188	3/4/2016 * 12:22:21	12:22:21	LTE	-73	37.31588078	-122.2704687	65535	2147483647	697
189	3/4/2016 * 12:22:35	12:22:35	LTE	-82	37.31609222	-122.271547	65535	2147483647	697
190	3/4/2016 * 12:22:48	12:22:47	LTE	-81	37.31701212	-122.2713875	65535	2147483647	697
191	3/4/2016 * 12:22:59	12:22:58	LTE	-89	37.31788871	-122.2713703	65535	2147483647	697
192	3/4/2016 * 12:23:21	12:23:21	LTE	-88	37.31819439	-122.2702864	65535	2147483647	697
193	3/4/2016 * 12:23:33	12:23:33	LTE	-79	37.31767091	-122.2693606	65535	2147483647	697
194	3/4/2016 * 12:23:50	12:23:49	LTE	-82	37.31701843	-122.2685952	65535	2147483647	697
195	3/4/2016 * 12:24:20	12:24:19	LTE	-86	37.31642262	-122.2677683	65535	2147483647	697
196	3/4/2016 * 12:24:34	12:24:34	LTE	-81	37.31700398	-122.2669294	65535	2147483647	697
197	3/4/2016 * 12:24:48	12:24:48	LTE	-66	37.31757341	-122.2660173	65535	2147483647	697
198	3/4/2016 * 12:25:9	12:25:08	LTE	-81	37.3184398	-122.2663392	65535	2147483647	697
199	3/4/2016 * 12:25:21	12:25:21	LTE	-76	37.31924665	-122.2669017	65535	2147483647	697
200	3/4/2016 * 12:25:34	12:25:33	LTE	-77	37.31976031	-122.2678558	65535	2147483647	697
201	3/4/2016 * 12:25:46	12:25:46	LTE	-75	37.32034012	-122.2687318	65535	2147483647	697
202	3/4/2016 * 12:25:57	12:25:56	LTE	-79	37.32049214	-122.2698559	65535	2147483647	697
203	3/4/2016 * 12:26:9	12:26:08	LTE	-76	37.32077422	-122.2709007	65535	2147483647	697
204	3/4/2016 * 12:26:24	12:26:24	LTE	-81	37.3216366	-122.270523	65535	2147483647	697
205	3/4/2016 * 12:26:46	12:26:45	LTE	-78	37.32158358	-122.2694023	65535	2147483647	697
206	3/4/2016 * 12:26:59	12:26:58	LTE	-82	37.32143503	-122.2682364	65535	2147483647	697
207	3/4/2016 * 12:27:10	12:27:09	LTE	-87	37.32113469	-122.2671761	65535	2147483647	441
208	3/4/2016 * 12:27:25	12:27:25	LTE	-87	37.32077776	-122.2661131	65535	2147483647	697
209	3/4/2016 * 12:27:38	12:27:37	LTE	-82	37.32071152	-122.264981	65535	2147483647	697
210	3/4/2016 * 12:27:55	12:27:55	LTE	-76	37.31989632	-122.2654385	65535	2147483647	697
211	3/4/2016 * 12:28:5	12:28:04	LTE	-75	37.3190209	-122.2657499	65535	2147483647	697
212	3/4/2016 * 12:28:17	12:28:16	LTE	-72	37.31816169	-122.2661162	65535	2147483647	697
213	3/4/2016 * 12:28:32	12:28:31	LTE	-71	37.3190134	-122.2666467	65535	2147483647	697
214	3/4/2016 * 12:28:42	12:28:41	LTE	-69	37.31957599	-122.2675426	65535	2147483647	697
215	3/4/2016 * 12:28:54	12:28:54	LTE	-84	37.31919506	-122.2686028	65535	2147483647	697
216	3/4/2016 * 12:29:11	12:29:11	LTE	-91	37.31945038	-122.2696495	65535	2147483647	697
217	3/4/2016 * 12:29:52	12:29:52	LTE	-91	37.31887546	-122.2704837	65535	2147483647	697

To: San Mateo County Planning and Building Department
455 County Center
Redwood City, CA 94063
21st of December 2016

Re: Appeal PLN2016-00216

The purpose of this report is to expand the technical explanations and evidence in support of the arguments stated in appeal application presented by David Ehrhardt in quality of president of the Cuesta La Honda Board of Directors on November 13th 2016 and in the analysis ("Analysis") presented by Dr. Angelo Dragone on October 19th 2016 to San Mateo County Planning and Building Department, attached to the appeal application.

Given the analysis in the appeal application, the following additional information is presented:

An AT&T document describing the guidelines to design LTE network (referred to as "AT&T guidelines" in the following) can be found on internet (ND-00369) and is attached to this letter. Some important information can be extracted from this document.

1) AT&T key performance parameters

   The key performance parameter that AT&T uses to determine the required 4G LTE signals levels are reported parameter in paragraph 1.2 page 11.
   The minimum required RSRP signal level is declared to be -113dBm in 95% of the area (note dBm has a negative sign, so for instance -90dBm is stronger than -113dBm). This number is also consistent to what indicated by AT&T in several "Build-out Demonstration and Engineering Justification" reports to the FCC (one example is attached to this letter but many more can be find on the FCC website. The value is indicate in Table 1, last row) .
   The qualitative simulated coverage maps from Sears Ranch Rd., presented by Extenet in the application, do not indicate this minimum required signal level but we have to assume Extenet believes that in the supposed gap indicated in the maps the RSRP level is below -113dBm.
   This is in clear contradiction with the Verizon data measured by Dr. Dragone presented to the County, from which is evident that signal levels around -90dBm can be achieved in the supposed uncovered area.
   Note that the data presented by Dr. Dragone are not measured inside the houses, so don't take into account the building attenuation. Sampling in a few houses Dr. Dragone found that the signal degraded by not more than 5dBm. This number is consistent with the "in-building attenuation coefficients declared in the AT&T design guidelines. According to the classifications in Appendix 1 of the AT&T guidelines, La Honda has to be classified as "Rural, with trees". From figure 26 on page 46 of the AT&T guideline it can be seen that the indoor attenuation considered by AT&T in areas classified as "Rural with trees" is 6dB.

As a consequence we need to assume that in the supposed gap Extenet believes that the RSRP level outside the building is not more than 6dB higher than the minimum require signal level of -113dBm. In other words we have to assume Extenet believes that in the supposed gap indicated in the maps outside the building the RSRP level is below -107dBm which is again quite lower than the measured Verizon signal.

As a consequence, we have to conclude that Extenet simulation is too conservative because the models used do not model perfectly the propagation in La Honda or that the additional input parameters in terms of number of antennas and power are not equivalent to what is used by Verizon. In either case Extenet documentation fails to prove that colocation is not feasible.

2) Propagation laws and propagation models

From the AT&T guidelines we also have some information on the model used to simulate the coverage maps.

In general propagation is governed by the Friis equation:

$$P_r = \frac{P_t G_t G_r}{L_p}$$

where:

P_r is the received power
P_t is the transmitted power
G_t is the gain of the transmitting antenna (function of the direction)
G_r is the gain of the receiving antenna (function of the direction)
L_p is the attenuation due to the environment

Note that in "free space" when the effects of the environment are not considered:

$$L_p = \left(\frac{4\pi d f}{c}\right)^2$$

Where c is the speed of light (a constant), d is the distance between the transmitter and the receiver and f is the frequency.

Thus in "free-space":

$$P_r = P_t G_t G_r \left(\frac{c}{4\pi d f}\right)^2$$

So in general from this law of physics it is apparent that for a given transmitted power, characteristics of antennas and distance, if the frequency is higher the received power is lower. In other words higher frequencies, like in the case of Verizon versus AT&T, propagate less and thus for AT&T is easier to cover the same area that Verizon covers. Furthermore from the same formula we can deduct that to achieve the same coverage of Verizon from Sears Ranch given that the characteristics of the receivers don't change (all cell phones are comparable), AT&T propagating at lower frequency would need less Effective Isotropic Radiated Power (EIRP) which is the product of the transmitted power and the gain of the transmitted antenna:

$$EIRP = P_t G_t.$$

Given the difference in frequency between AT&T and Verizon and noticing the quadratic dependence on the frequency, to achieve the same coverage AT&T could use an EIRP about a factor 6 lower than what is needed by Verizon.

It is important to note obviously the territory characteristics are the same for Verizon and AT&T and when we take into consideration the geography of the territory and all possible attenuating factors (clutter) the Friis formula becomes more complicated although the same dependencies remains.

To properly design the antennas a model for the attenuation needs to be used. In the AT&T guidelines, some information on the adopted model is reported in paragraph 2.4.

Obviously this model it is not well representative of the propagation in the La Honda area as its results are contradicted by the measurements, unless the EIRP used in the simulation is lower than the Verizon one. No information on the EIRP levels used for the simulation has been presented.

Furthermore given that Verizon can cover the supposed gap with excellent levels and give the law of physics above there is no reason why AT&T could not reach the same EIRPlevel as Verizon.

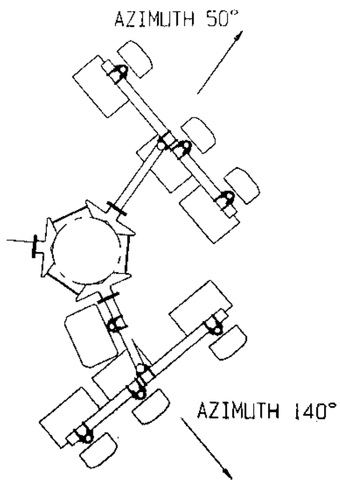
3) EIRP levels

The EIRP level used by Extenet in the simulation from Sears Ranch Rd has not been disclosed and also the EIRP level used by Verizon for its 4G LTE transmission is not known to us, but there is no reason why AT&T could not reach the same EIRP and if that was the case this constitutes a reasonable argument against co-location.

As explained previously:

$$EIRP = P_t G_t.$$

The parameter G_t in a given direction depends on the gain, radiation pattern of the antennas, its orientation in space (elevation, azimuth and tilt). Verizon uses at Sears Ranch two arrays of three Andrew SBNHH1D65B antennas, located at 77' with zero degrees of tilt. One array has an azimuth of 50 degrees and the other an azimuth of 140 degrees (data can be found at the County). These antennas have a gain of !18dBi, a 65 degree horizontal beam-width and a +/-45 degree polarization (datasheet can be found online).



Paragraph 1.3 of the AT&T guidelines indicates the parameters of choice in the design that can be used. Among which, elevation, azimuth, tilt, number of elements. The antennas can be chosen in a list of approved ones several of which have similar specifications to the Andrew SBNHH1D65B. Also the Kathrein 800-10764 antennas proposed by Extenet for node 61G have similar characteristics. These antennas have a gain of ~14.5dBi, a 65 degree horizontal beam-width and a +/-45 degree polarization (datasheet can be found online). The gain of the Kathrein 800-10764 is a factor 1.5 lower that the Andrew SBNHH1D65B, thus to achieve similar EIRP a factor 1.5 higher power would be required. But since AT&T requires an EIRP a factor 6 lower than Verizon, even whit these antennas AT&T would require half of the power needed by Verizon to achieve the same coverage.
Finally Verizon uses Ericsson RRUS12 remote radio units while Extenet has proposed to use Ericsson RRUS11. These radio units are also comparable in specification and transmitting power capabilities (datasheet can be found online).

In conclusion there is no indication that AT&T could not achieve the same performances of Verizon from Sears Ranch with properly designed antennas.

We ask the planning commission to take into consideration this additional evidence which we believe is important to demonstrate why PLN2016-00216 fails to demonstrate that co-location at Sears Ranch is not feasible and thus should be rejected.

Attachment I

LTE RF Network Design Guidelines

AT&T Mobility Network Services Document: ND-00369 Rev. 1.1 May 2010

Overview

This document provides the minimum guidelines that should be followed for all the AT&T Long Term Evolution (LTE) network designs.

IMPORTANT: This document supports the following policy letter(s):

- None

Any changes to this document must go through the network document update process outlined at http://ns.cingular.net/createpl.aspx prior to publishing to the Network Document Library.

Attachment I

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Contents

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Document Revision History

This table identifies content revisions made to this document.

Date	Rev	Revision Description	Writer	Sponsor
01/25/10	1.0	Initial LTE Design Considerations - Proxy Design Process	Julius Fodje	Nico Vlok
05/20/10	1.1	LTE RF Network Design Guidelines (Initial Release)	Julius Fodje	Nico Vlok

RACI

This table identifies RACI team members.

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0. About This Document

This document provides guidance that should be used by the design teams in carrying out the designs of the LTE markets. The set of guidance makes use of the following:

- Builds on any previous LTE proxy design initiatives and lessons learned
- Makes use of vendor specific parameters and LTE specific simulations to accurately model the LTE network
- Introduces the use of LTE-based demand/traffic maps to enhance the LTE design decisions
- Introduces many design options that were not used for the UMTS designs but are deemed important towards the delivery of a best in class LTE network
- Provides an end-to-end design process needed towards the successful rollout of LTE

All the design assumptions, design input, design options, design reviews and design output listed in this document are integral components of the end-to-end LTE design process needed towards making sure that the design goals of the LTE network are met.

0.1 Purpose

This document is written to complement “Attachments I and H” of the LTE contract with the OEM vendors. It serves as a guide for the market RF design teams to use in designing the LTE network in a consistent way to meet the company’s goal for the LTE network as well as meeting the capacity and performance targets outlined in “Attachments I and H” of the LTE contract. This document outlines the minimum set of considerations that should be used for the LTE network designs within AT&T Mobility. As always this document serves, above all, as a guide with the intent that certain situations and business needs will require further guidance and case by case decisions will be made in order to facilitate the timely launch of the LTE networks with a quality product meeting the currently defined goals of the network.

0.2 Scope

This document provides a guideline for designing the AT&T LTE RF network. It provides the LTE design goals, provides guidelines on the use of propagation models for the 700 MHz and AWS frequency bands, antenna choices to consider for the LTE designs, the various LTE design optimization options allowed, RF planning tool settings; traffic spreading, as well as the LTE design output and deliverables. The document does not include the vendor specific LTE parameters. However, it provides the steps needed in configuring the projects with the vendor specific LTE parameters.

0.3 Audience

The audience for this document includes all RF engineers participating in the initial LTE RF Design, RF engineering management, Construction and Engineering (C&E), Project Management, OEM vendors and all those individuals involved in project support.

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0.4 Related Documentation

The following documents are related to this document:

NOTE: LTE Infrastructure Contracts – Attachments I and H	Network Element Naming Standards (ND-00067) UMTS RF Design Guidelines (ND-00311) 3GPP TS 36.101-880 3GPP TS 36.211-890 3GPP TS 36.214-870

0.5 Acronyms and Terms

The following acronyms and terms are used in this document:

3GPP	**3**rd **G**eneration **P**artnership **P**roject
ACP	**A**utomatic **C**ell **P**lanning
ANR	**A**utomatic **N**eighbor **R**elation
A&P	**A**rchitecture and **P**lanning (AT&T Group)
BAU	**B**usiness **as** **U**sual
BBU	**B**ase **B**and **U**nit (see also MU)
BW	**B**and**w**idth
DFCD	**D**efinitive **F**inal **C**luster **D**esign
DFFT	**D**iscrete **F**ast **F**ourier **T**ransform
DL	**D**own **L**ink
EDT	**E**lectrical **D**own **T**ilt
E-UTRAN	**E**volved **U**MTS **T**errestrial **Radio** **A**ccess **N**etwork
FDD	**F**requency **D**ivision **D**uplex
Feeder	Hardline Feeder such as COAX. Contrast to jumper.
FNP	**F**undamental **N**etwork **P**lanning (AT&T Group)
FTP	**F**ile **T**ransfer **P**rotocol
HBW	**H**orizontal **B**eamwidth
HQ	**H**ead**q**uarters
IFFT	**I**nverse **F**ast **F**ourier **T**ransform
IP3	3rd Order Intercept
Jumper	A short portion (typically flexible) of RF cabling
KPI	**K**ey **P**erformance **I**ndicator
HS	**H**igh **S**peed Packet Access (HSPA)
LTE	**L**ong **T**erm **E**volution
MDT	**M**echanical **D**own **T**ilt

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MIMO	**M**ultiple **I**nput **M**ultiple **O**utput
MU	**M**ain **U**nit (Distributed eNode-B) also known as BBU
NF	**N**oise **F**igure
OOBE	**O**ut **of** **B**and **E**missions
PICD	**P**reliminary **I**nitial **C**luster **D**esign
SPM	**S**tandard **P**ropagation **M**odel
RAN	**R**adio **A**ccess **N**etwork
RB	**R**esource **B**lock
RFDS	**R**adio **F**requency **D**ata **S**heet
RH	**R**adio **H**ead (part of Distributed eNode-B)
RSRP	**R**eference **S**ignal **R**eceived **P**ower
RSRQ	**R**eference **S**ignal **R**eceived **Q**uality
SON	**S**elf-**O**rganizing **N**etwork
TMA	**T**ower **M**ounted **A**mplifier
UE	**U**ser **E**quipment
UL	**U**p **L**ink
UMTS	**U**niversal **M**obile **T**elecommunications **S**ystem
VBW	**V**ertical **B**eam**w**idth
VoIP	**V**oice **o**ver **I**nternet **P**rotocol

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0.6 Trademarks

The trademarks used in this document are the property of their respective owners.

0.7 Conventions

The following conventions are used throughout this document:

- N/A

0.8 Contacts

For questions or comments about this document's technical content or to request changes to the document, contact:

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1. LTE Network Design Goals, Targets and Options

1.1 LTE Design Goals

In our effort to deliver the best network by championing the end-to-end customer experience and do it while maintaining an industry leading cost structure, the main goals of the LTE Radio Access Network (RAN) design contained within this document has been outlined to include but not limited to the following:

Provide outstanding service to the customer:

- Subscribers can access, retain, and meet the quality of service targets on the network - ARQ (accessibility, retainability and quality) for both data and voice
- RF design should provide a high probability that our subscribers can meet or exceed throughput targets where they work, live and travel in the LTE network. The RF Design should provide the necessary Reference Signal Received Power (RSRP) Reference Signal Received Quality (RSRQ) and Signal-to-Interference + Noise Ratio (SINR) for an increased probability for higher order modulation coding schemes, required for higher user throughput.
- The design should provide a network with a high probability of having a consistent user experience across the entire geographic footprint of the LTE network.

Maximize the efficiency of deployed network resources

- Maximize capacity and coverage by creating dominance and eliminating co-channel coverage overlay.
- Maximize system capacity by reducing the level and number of interferers through design optimization.
- Carry out a cost-benefit analysis in all design and design optimization decisions in order to deliver the most efficient network design to AT&T
- Determine the optimum network configuration with the minimum number of network resources to meet the projected demand, performance and capacity targets

Provide an efficient inter-technology overlay LTE network

- Provide a design that minimizes the impact to the core network (transport, processor load, excessive signaling, etc.)
- Minimize inter-technology (GSM/UMTS/LTE) and inter-layer (within LTE) transitions
- Provide an LTE network where users stay on the LTE network as much as possible and do not transition to UMTS/GSM in both LTE idle and active modes

These LTE design goals can be realized through an end-to-end LTE design process. The end-to-end design process for LTE is divided into three phases with a review carried out in each phase of the design process. The three phases are:

Phase 1 — *Initial LTE Baseline Design Effort:* The key objective of this phase of the end-to-end design process is the early identification of long lead time network enhancement items. This facilitates the early start of work on those items so as to have a high probability of the enhancement items being ready when LTE is rolled out. It also forms the basis for the initial submission of the scoping RFDS for C&E staging activities.

Phase 2 — *Preliminary LTE RF Design*: The key objective of this phase of the end-to-end design process is the refinement of the initial baseline design effort with more detail LTE specific analysis with the primary goal of producing the best LTE network design possible. This phase of the design leads to the development of

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the preliminary initial cluster design (PICD) for LTE which forms the basis of the review package towards LTE design acceptance and certification in line with the performance targets of the LTE contracts. In this phase of the design, as a result of the LTE design refinement, revisions are made to the subset of initially issued scoping RFDS' that are significantly different to those previously issued in Phase 1 and re-issued for C&E scoping.

Phase 3 — *Final LTE RF Design:* This is final phase of the design that takes into consideration all the feedback from the C&E teams and the various design review and audit teams. This is the design that leads to a definitive final cluster design (DFCD) for LTE. At this stage, the design is an implementable design based on do-ability feedback from C&E. The final RFDS for LTE is released at this stage and all the punch list items collected and documented.

The details of how each phase of the end-to-end design process will be accomplished are covered in subsequent sections in this document. First, in an attempt to make sure that the LTE designs meet the design goals outlined above, a set of design key performance indicators have been established that will form the basis of gauging the quality of the network designs. The design key performance indicators and targets are as outlined in the next section of this document.

1.2 LTE Key Performance Indicators and Design Targets

As LTE is still a developing technology, it is important to note that as more field trials are carried out and results validated against AT&T's LTE network performance goals, the design targets outlined in this section are subject to change.

The quality of the LTE RF design will be evaluated using Atoll[1]. This will be based on a combination of area predictions and Monte Carlo simulations. It is important to note that the emphasis of the design evaluation will be on focusing where demand is and where potential LTE users are located. The following are a non comprehensive list of key performance indicators that will be used to validate the quality of the LTE RF network design.

Reference Signal Received Power (RSRP)

Reference signal received power (RSRP) identifies the signal level of the Reference Signal. It is defined as the linear average over the power contributions of the resource elements that carry cell-specific reference signals within the considered measurement frequency bandwidth.

Design KPI for RSRP:

10MHz Channel Bandwidth (700MHz & AWS): -113dBm

5MHz Channel Bandwidth (700MHz & AWS): -113 dBm

A minimum of 95% of the weighted average of the LTE design service area (Cluster or Polygon) must meet the RSRP targets specified above. The criterion of 95% is based on a weighting using the same clutter weights used for traffic spreading. The target specified above is after taking into consideration the indoor loss values (see section 4.5) assigned per clutter type (In-building losses enabled).

Note: The targets for AWS are only applicable in cases where the AWS design is being carried out as a standalone design and not be used as an isolated hotspot capacity layer over an existing 700 MHz layer LTE network.

[1] Atoll version 2.8.x is used for designs. All references to Atoll in this document are based on Atoll 2.8.x.

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Reference Signal Received Quality (RSRQ)

Reference Signal Received Quality (RSRQ) identifies the quality of the Reference Signal. It is defined as the ratio N×RSRP/(E-UTRA carrier RSSI), where N is the number of RB"s of the E-UTRA carrier RSSI measurement bandwidth. The measurements in the numerator and denominator shall be made over the same set of resource blocks.

E-UTRA Carrier Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power observed only in OFDM symbols containing reference symbols for antenna port 0, in the measurement bandwidth, over N number of resource blocks by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc. The Design KPI is based on traffic load—traffic load is discussed later in Sections 3.5 and 5.5.

Design KPI for RSRQ:

2 Transmit Paths:

50% Load:	-15 dB
100% Load:	- 18 dB

A minimum of 95% of the weighted average of the LTE design service area (Cluster or Polygon) must meet the RSRQ targets specified above. The criterion of 95% is based on a weighting using the same clutter weights used for traffic spreading.

Overlapping Zones (Number of Servers)

The overlapping zones (number of servers) criteria are used to establish the quality of the RF propagation environment from an interference point of view. The goal of the number of servers' criteria is to establish dominance and reduce the waste of network resources and degraded network performance that may occur when multiple servers exist in the same geographic area. The calculation is based on the Reference Signal (RS) signal levels of the servers.

Design KPI for Overlapping Zones (Number of Servers):

Within 5 dB of the best server

% area with 4 or more servers should be < 2%.

% of area with 2 or more servers should be < 30%.

Within 10dB of the best server

% of area with 7 or more servers should be < 2%.

The calculation is based on area importance. The clutter weights used for traffic spreading establishes the importance of the geographic area. The idea here is to focus the LTE design where LTE users are located (for example, core urban areas, convention centers, major stadiums, etc.) instead of areas within the LTE polygon with no users (for example, schrublands, forests, etc.)

DL Cell Aggregate Throughput

The DL Cell Aggregate throughput (Effective RLC Aggregate Throughput) is the sum of the throughputs to all the users in the cell at an instant in time. This is to be measured following Monte Carlo simulations only.

Design KPI for DL Cell Aggregate Throughput:

10MHz Channel Bandwidth: 13.4 Mbps per cell

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5MHz Channel Bandwidth: 6.7 Mbps per cell

A minimum of 90% of the cells in the LTE design reference area (Cluster or Polygon) should have the DL Cell Aggregate Throughput (Effective RLC Aggregate Throughput) exceeding the minimum design KPI values specified above.

No cells should have Aggregate DL Throughput (Effective RLC Aggregate Throughput) less than 50% of this KPI target.

DL Cell Edge User Throughput

The DL Cell Edge User Throughput (Effective RLC Aggregate Throughput) is established as the minimum throughput for users at the cell edge of the network at 50% loading. This is to be measured following Monte Carlo simulations only.

Design KPI for DL Cell Edge User Throughput:

10MHz Channel Bandwidth: 1000 kbps per user

5MHz Channel Bandwidth: 500 kbps per user

A minimum of 90% of all users in the LTE design reference area should have the DL Cell Edge User Throughput (Effective RLC Aggregate Throughput) exceeding the minimum design KPI values specified above.

No more than 2% of the users should have a DL Cell Edge User Throughput (Effective RLC Aggregate Throughput) less than 50% of this KPI target.

All the statistics for the LTE designs must be generated on a cluster by cluster or super cluster basis following the criteria defined later in the document.

In addition to the quantitative evaluation of the LTE design using the KPIs stated above, a qualitative evaluation of the design will also be carried out as outlined in the design evaluation section of this document. The exit criteria of a design are met when both the quantitative (KPIs) and qualitative evaluation of the designs are successfully completed.

1.3 Design Options

While the goals and design targets specified above may be aggressive, options have been approved for consideration in the design that when used properly, will lead to a more efficient network compared to the existing 3G network. Therefore, in the quest to produce the best network possible in a cost-effective manner while meeting the goal to launch an excellent LTE network on schedule, the following design optimization options have been approved for consideration as part of the entire LTE design process.

	Design Option	Degree of Freedom Allowed
1	Site Relocations	Relocations are allowed for a **maximum of 10%** of the final LTE sites when compared to their current UMTS site locations
2	LTE Overlay Site Sparsing	There is **no limit** on site sparsing of LTE sites on existing UMTS sites as long as the performance targets and goals of the LTE network are met and the forecasted demand is carried by the final network design. The key driver is that a quality design is done.
3	Radiation Center Changes	Radiation center changes are allowed for a **maximum of 10%** of the final LTE sites when compared to their current UMTS site radiation centers

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4	Antenna Type	Antenna type changes are allowed. **100%** of the antennas should come from the **AT&T approved antenna list.** The choice of antenna should not be limited by antenna size but by what will bring out the best LTE network performance.
5	Antenna Azimuth	**100% flexibility** on antenna azimuth changes is allowed as long as the recommended minimum separation or isolation between sectors is maintained.
6	Antenna Tilts	**100% flexibility** on antenna tilt optimization is allowed
7	Shared Antenna Systems	No design sites should share antennas with UMTS or GSM unless pre-approved by A&P and HQ RAN.
8	"Remotely Located[2]" Radio Heads (RH)	Remotely located RHs should be used as needed for distributed remote transmitter locations. This will bring the transmitter closer to the users to provide a uniform user experience and increased coverage and capacity. The number of RHs should not exceed the maximum allowed per MU.

Any other design option not outlined above should be discussed with the HQ RAN design review team member responsible for the market where the design is being done before it is used as part of the design.

[2] The term “Remotely Located” is reserved for situations where the RH is located at a different address or would require a different USID from the USID used for the MU.

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2. LTE RF Design Input

In this section of the guidelines, all the design input information is outlined and the expectations of how the material is to be used are presented.

2.1 Project and Work Environment

There are three distinct possibilities of projects to be used for LTE designs.

1. Markets with LTE Proxy Design Projects: These are the first set of projects that should be used for the LTE design analysis.
2. Markets or areas without LTE proxy projects but within the existing UMTS coverage areas: For these markets or areas without an LTE proxy project, their corresponding UMTS projects are to be converted to LTE and used for LTE designs.
3. Markets or areas without LTE proxy projects and without an existing UMTS project: For these markets/areas, the LTE designs are to be carried out using the GSM sites as the baseline for LTE site selection.

LTE project templates have been created with the current set of vendor parameters and stored in the master Atoll-Oracle database to be uses as the foundation for all the LTE network designs. The project templates are as follows:

WR	CR	SER	NER
WR_AK_UMT6_LTE	CR_AROK_LTE	SER_AL_ LTE	NER_NEW_ENGLAND_LTE
WR_AK_UMT8_LTE	CR_CHIC_LTE	SER_CAROLINAS_LTE	NER_NEW_YORK_STATE_LTE
WR_AZ_LTE	CR_CNIL_LTE	SER_GA_ LTE	NER_NY_METRO_NJ_LTE
WR_CO_LTE	CR_DET_LTE	SER_KY_ LTE	NER_PHILADELPHIA_LTE
WR_HI_LTE	CR_IND_LTE	SER_LA_ LTE	NER_THE_VIRGINIAS_LTE
WR_ID_LTE	CR_KS_LTE	SER_MS_ LTE	NER_WASHINGTON_BALTIMORE_LTE
WR_LA_LTE	CR_MIIND_LTE	SER_NFL_ LTE	
WR_LV_LTE	CR_MN_LTE	SER_PR_ LTE	
WR_MT_LTE	CR_MO_LTE	SER_SFL_ LTE	
WR_NM_LTE	CR_NEIA_LTE	SER_TN_ LTE	
WR_OR_LTE	CR_NTX_LTE		
WR_SD_LTE	CR_OHPA_LTE		
WR_SFSA_LTE	CR_OMI_LTE		
WR_UT_LTE	CR_STX_LTE		
WR_WA_LTE	CR_WSC_LTE		
WR_WY_LTE			

All the LTE project templates are accessible via the Atoll GeoSelector on the thin client server. In order to carry out an LTE design the corresponding market's template should be used for the analysis.

1. Get a copy of the LTE project template from the master database via the “Geo Selector” in Atoll and save it in the individual work folder on the H: drive

2. Carry out all design work on the H: drive and not in the F:\ drive. The F:\Common folder should only be used for the temporary exchange of work files

3. Once the design is complete and ready for review, a copy of the LTE design *.atl file only with the prediction layers should be transferred to the review folder created on the

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F:\common shared folder. The review folder is located at: F:\Common\LTE_Design_Reviews.

Access to data above is only available to those on the AT&T intranet with an Atoll access account. For any work being done remotely, obtaining the information set must be coordinated through the AT&T local market's LTE RF design lead.

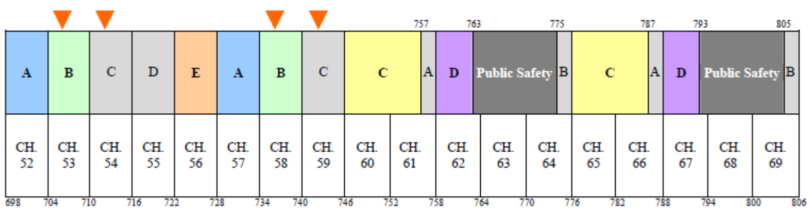
2.2 Frequency Band

Prior to the start of each LTE design for a market, the LTE band (or bands) for which a design (or designs) is required will be confirmed by AT&T. This information will be made available when resources are being requested to support a market's LTE design activities but not later than the LTE design Kickoff meeting. The decision of which band (or bands) to use will be governed by the LTE rollout strategy of AT&T.

However, at this time, only the **700 MHz** and Advanced Wireless Services (**AWS)** frequency bands will be considered for LTE. The LTE designs should therefore be carried out for the **700 MHz** and/or Advanced Wireless Services (**AWS)** frequency bands only. At the moment, the priorities of the designs for each market are based on the following spectrum and spectrum depth availability.

1. 10 MHz allocation in 700 MHz Band
2. 5 MHz allocation in 700 MHz Band
3. 10 MHz allocation in 2100 Band
4. 5 MHz allocation in 2100 Band

The 700 MHz band and the AWS bands are as depicted below:



Block	Frequencies (MHz)	Bandwidth	Pairing
A	698-704, 728-734	12 MHz	2 x 6 MHz
B	704-710, 734-740	12 MHz	2 x 6 MHz
C	710-716, 740-746	12 MHz	2 x 6 MHz
D	716-722	6 MHz	unpaired
E	722-728	6 MHz	unpaired
C	746-757, 776-787	22 MHz	2 x 11 MHz
A	757-758, 787-788	2 MHz	2 x 1 MHz
D	758-763, 788-793	10 MHz	2 x 5 MHz
B	775-776, 805-806	2 MHz	2 x 1 MHz

Depending on the CMA, these are the frequency blocks where AT&T has got a license

Figure 1: 700 MHz band frequency block and bandwidth allocation. AT&T holds lower B and C block licenses

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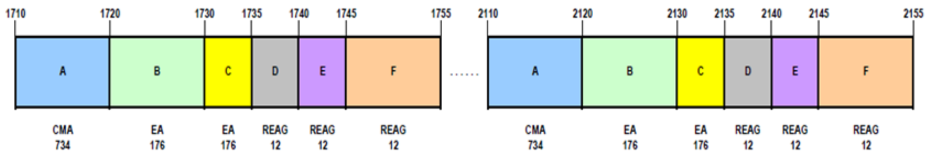
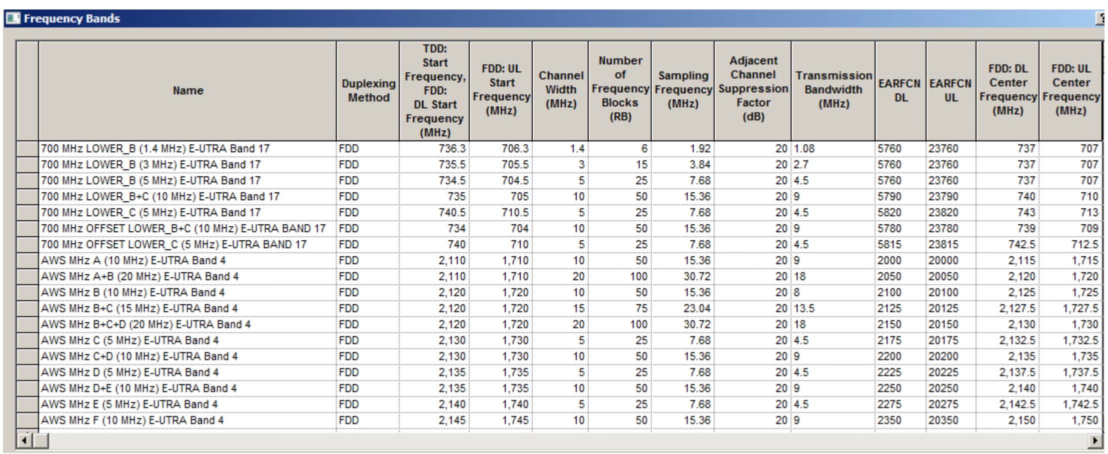


Block	Frequencies	Pairing	Bandwidth
A	1710-1720 and 2110-2120 MHz	2 x 10 MHz	20 MHz
B	1720-1730 and 2120-2130 MHz	2 x 10 MHz	20 MHz
C	1730-1735 and 2130-2135 MHz	2 x 5 MHz	10 MHz
D	1735-1740 and 2135-2140 MHz	2 x 5 MHz	10 MHz
E	1740-1745 and 2140-2145 MHz	2 x 5 MHz	10 MHz
F	1745-1755 and 2145-2155 MHz	2 x 10 MHz	20 MHz

Figure 2: AWS band frequency block and bandwidth allocation across A, B, C, D, E and F block licenses.

All the frequency bands have been configured in the master Atoll project template. The corresponding frequency band table is as shown below. The frequency band table properties should not be modified as these may affect the properties of the cells table entry and hence the accuracy of the simulations.



Frequency Bands

Name	Duplexing Method	TDD: Start Frequency, FDD: DL Start Frequency (MHz)	FDD: UL Start Frequency (MHz)	Channel Width (MHz)	Number of Frequency Blocks (RB)	Sampling Frequency (MHz)	Adjacent Channel Suppression Factor (dB)	Transmission Bandwidth (MHz)	EARFCN DL	EARFCN UL	FDD: DL Center Frequency (MHz)	FDD: UL Center Frequency (MHz)
700 MHz LOWER_B (1.4 MHz) E-UTRA Band 17	FDD	736.3	706.3	1.4	6	1.92	20	1.08	5760	23760	737	707
700 MHz LOWER_B (3 MHz) E-UTRA Band 17	FDD	735.5	705.5	3	15	3.84	20	2.7	5760	23760	737	707
700 MHz LOWER_B (5 MHz) E-UTRA Band 17	FDD	734.5	704.5	5	25	7.68	20	4.5	5760	23760	737	707
700 MHz LOWER_B+C (10 MHz) E-UTRA Band 17	FDD	735	705	10	50	15.36	20	9	5790	23790	740	710
700 MHz LOWER_C (5 MHz) E-UTRA Band 17	FDD	740.5	710.5	5	25	7.68	20	4.5	5820	23820	743	713
700 MHz OFFSET LOWER_B+C (10 MHz) E-UTRA BAND 17	FDD	734	704	10	50	15.36	20	9	5780	23780	739	709
700 MHz OFFSET LOWER_C (5 MHz) E-UTRA BAND 17	FDD	740	710	5	25	7.68	20	4.5	5815	23815	742.5	712.5
AWS MHz A (10 MHz) E-UTRA Band 4	FDD	2,110	1,710	10	50	15.36	20	9	2000	20000	2,115	1,715
AWS MHz A+B (20 MHz) E-UTRA Band 4	FDD	2,110	1,710	20	100	30.72	20	18	2050	20050	2,120	1,720
AWS MHz B (10 MHz) E-UTRA Band 4	FDD	2,120	1,720	10	50	15.36	20	8	2100	20100	2,125	1,725
AWS MHz B+C (15 MHz) E-UTRA Band 4	FDD	2,120	1,720	15	75	23.04	20	13.5	2125	20125	2,127.5	1,727.5
AWS MHz B+C+D (20 MHz) E-UTRA Band 4	FDD	2,120	1,720	20	100	30.72	20	18	2150	20150	2,130	1,730
AWS MHz C (5 MHz) E-UTRA Band 4	FDD	2,130	1,730	5	25	7.68	20	4.5	2175	20175	2,132.5	1,732.5
AWS MHz C+D (10 MHz) E-UTRA Band 4	FDD	2,130	1,730	10	50	15.36	20	9	2200	20200	2,135	1,735
AWS MHz D (5 MHz) E-UTRA Band 4	FDD	2,135	1,735	5	25	7.68	20	4.5	2225	20225	2,137.5	1,737.5
AWS MHz D+E (10 MHz) E-UTRA Band 4	FDD	2,135	1,735	10	50	15.36	20	9	2250	20250	2,140	1,740
AWS MHz E (5 MHz) E-UTRA Band 4	FDD	2,140	1,740	5	25	7.68	20	4.5	2275	20275	2,142.5	1,742.5
AWS MHz F (10 MHz) E-UTRA Band 4	FDD	2,145	1,745	10	50	15.36	20	9	2350	20350	2,150	1,750

Figure 3: Pre-configured Frequency Band Table in Atoll

The pre-defined frequency band table has been configured to comply with the 3GPP LTE standards and should not be changed or modified. To fully understand how the table has been configured, it is important to re-visit the 3GPP LTE standard to understand some of the key parameters.

2.3 Technical Details behind the Frequency Band Table

The following covers certain key technical details behind many of the key LTE parameters from the 3GPP LTE standards and reflected in the ATOLL Frequency Band Table.

Sampling Frequency:

The rate at which sampling of signals is carried out. Its origin is the WCDMA chip rate: 3.84 Mcps. The same clock that generates 3.84 Mcps chip rate in WCDMA can be used to generate various sampling frequencies in LTE:

1.92 MHz = 0.5 x 3.84 Mcps

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3.84 MHz = 1 x 3.84 Mcps
7.68 MHz = 2 x 3.84 Mcps
15.36 MHz = 4 x 3.84 Mcps
23.04 MHz = 6 x 3.84 Mcps
30.72 MHz = 8 x 3.84 Mcps

These are the values that have been configured in the frequency band table in Atoll for use in the designs with a focus on the spectrum depth that is currently available to AT&T and is being used for the current LTE design initiatives.

Time:

The basic unit of time in LTE is derived from the highest sampling frequency: 30.72 MHz.

Ts = 1/30720000 = 32.552 ns

All the time-domain parameters are multiples of this unit time:
Frame = 307200 x Ts = 10 ms
Subframe (TTI) = 30720 x Ts = 1 ms
Slot = 15360 x Ts = 0.5 ms
OFDM Symbol = 2048 x Ts = 66.67 us

Frequency:

The OFDM symbol duration corresponds to the subcarrier spacing in the frequency domain:
f = 1/(2048 x Ts) = 15000 Hz

The subcarrier spacing is linked with the sampling frequency as follows:

FFT Size x Subcarrier Spacing = Sampling Frequency
128 x 15000 = 1.92 MHz
256 x 15000 = 3.84 MHz
512 x 15000 = 7.68 MHz
1024x 15000 = 15.36 MHz
1536 x 15000 = 23.04 MHz
2048 x 15000 = 30.72 MHz

The FFT Size is the size of the IFFT/DFFT components. These are available in / operate in blocks of multiples of 2. The smallest FFT block used in LTE is of size 64, which is used for decoding the Synchronization Signals (transmitted using 62 subcarriers).

Transmitting as many subcarriers as the FFT size with each subcarrier being 15000 Hz apart from its adjacent ones, would require as much bandwidth as the sampling frequency. However, it has been opted to transmit less numbers of subcarriers so as to limit the transmission bandwidth to a nominal value. The following table gives the numbers of “used” subcarriers corresponding to each FFT size:

FFT Size	Used Subcarriers
128	72
256	180
512	300
1024	600
1536	900
2048	1200

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Each of these numbers of used subcarriers corresponds to a "Transmission Bandwidth". The mapping between the "Transmission Bandwidth" to "Used Subcarriers" is as presented below:

Used Subcarriers	Transmission Bandwidth
72	72 x 15000 = 1.08 MHz
180	180 x 15000 = 2.7 MHz
300	300 x 15000 = 4.5 MHz
600	600 x 15000 = 9 MHz
900	900 x 15000 = 13.5 MHz
1200	1200 x 15000 = 18 MHz

Nominal carrier bandwidths corresponding to each used bandwidth have been defined by the 3GPP and the mapping is as shown below:

Transmission Bandwidth	Nominal Carrier Bandwidth
1.08 MHz	1.4 MHz
2.7 MHz	3 MHz
4.5 MHz	5 MHz
9 MHz	10 MHz
13.5 MHz	15 MHz
18 MHz	20 MHz

The difference between the used and the nominal bandwidth is considered to serve as guard bands on the upper and lower sides of the spectrum. This becomes an important consideration when detail analysis on system performance relative to other systems (for example, MediaFlo) is being carried out. However, for the normal day-to-day LTE design analysis, this type of precision analysis is not needed. Hence, the frequency band configuration has been standardized with the "Nominal Carrier Bandwidth". Custom fields have been added to the frequency band table in Atoll to capture the "Transmission Bandwidth" information for reference only. For completion, the Evolved Absolute Radio Frequency Channel Number (EARFCN) for both the uplink and the downlink has been added to the frequency band tables.

<u>Resource Blocks:</u>

The last step of the frequency band table configuration is that of the resource blocks (12 consecutive subcarriers) associated with each "Nominal Carrier Bandwidth". The corresponding mapping table is provided below:

Nominal Carrier Bandwidth	Number of Frequency Blocks
1.4 MHz	6
3 MHz	15
5 MHz	25
10 MHz	50
15 MHz	75
20 MHz	100

To minimize the possibility of errors with the LTE designs, the frequency band table has been standardized based on the different design possibilities currently available for AT&T and taking into consideration the spectrum depth available at this time. Additionally, entries for 700 MHz with a 1 MHz offset have been added to the frequency to cater for the coexistence of the AT&T LTE network with MediaFlo. Details on all aspects of the coexistence of the AT&T LTE network with MediaFlo and what to do in each case is included later in this document in the chapter called "*MediaFlo Coexistence with the AT&T LTE Network*".

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As can be seen, due diligence has been used towards configuring the content of the frequency band table. Information from the frequency band table will also be used to feed other processes that may have been developed based on the standards established and pre-configured in the table. The table should therefore not be changed except specifically requested to do so by the HQ RAN Design team.

2.4 RF Propagation Models for LTE Designs

Unlike other design initiatives in the past, the LTE designs are being carried out using pre-calibrated propagation models. The models have been tuned using a consistent process across all AT&T markets. Newfield Wireless is the third party vendor that has been outsourced by AT&T for the tuning and delivery of the propagation models. Only the Newfield Wireless-tuned and validated 700 MHz and AWS Band propagation models are therefore to be used for all the LTE-based designs. These models are tuned with the latest geo-data consisting of 38/39 clutter classes. No other models are to be used. To maintain the accuracy of the models for all LTE design work steps must be taken by the markets that the following are adhered to:

- The propagation models are properly assigned for all the transmitters in the market
- The propagation models are **not** to be renamed or changed in any way from what is delivered by Newfield Wireless.

The calibrated propagation models are based on the Forsk Atoll Standard Propagation Models (SPM). The Atoll SPM model is a derivative of the Hata formula. The SPM formula is follows:

$$P_R = P_{Tx} - \begin{pmatrix} K_1 + K_2 \times Log(d) + K_3 \times Log(H_{Tx_{eff}}) + K_4 \times DiffractionLoss + K_5 \times Log(d) \times Log(H_{Tx_{eff}}) + \\ K_6 \times H_{Rx_{eff}} + K_7 \times Log(H_{Rx_{eff}}) + K_{clutter} \times f(clutter) + K_{hill,LOS} \end{pmatrix}$$

Where:

- P_R received power (dBm)
- P_{Tx} transmitted power (EIRP) (dBm)
- K_1 constant offset (dB)
- K_2 multiplying factor for $Log(d)$
- d distance between the receiver and the transmitter (m)
- K_3 multiplying factor for $Log(H_{Tx_{eff}})$
- $H_{Tx_{eff}}$ effective height of the transmitter antenna (m)
- K_4 multiplying factor for diffraction calculation. K_4 must be a positive number.
- $DiffractionLoss$ losses due to diffraction over an obstructed path (dB)
- K_5 multiplying factor for $Log(d) \times Log(H_{Tx_{eff}})$
- K_6 multiplying factor for $H_{Rx_{eff}}$
- K_7 multiplying factor for $Log(H_{Rx_{eff}})$
- $H_{Rx_{eff}}$ effective height of the receiver antenna (i.e., mobile antenna height) (m)
- $K_{clutter}$ multiplying factor for $f(clutter)$
- $f(clutter)$ average of weighted losses due to clutter
- $K_{hill,LOS}$ corrective factor for hilly regions (=0 in case of NLOS)

The following should be noted about the propagation models delivered for use in the LTE designs.

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- The calibrated models are area models and are not designed for individual sectors
- Each model was calibrated using approximately 13 sectors; the process of identifying the area of applicability of each model takes place after all data has been collected; therefore, the number of sectors per model may be greater or less than 13.
- As part of the calibration process, sanity checks are carried out on the data and invalid data is discarded from the calibration.

Despite the fact that it is expected that 700 MHz and AWS models will be in place at the start of the LTE design, there is a remote possibility that designs for some markets may be started prior to the availability of the 700 MHz or AWS calibrated propagation models. In this case, the *K1* values of the market's existing tuned 850MHz and 1900MHz calibrated and approved propagation models should be adjusted and used for the LTE designs.

Note that in areas where the 700 MHz and AWS models are not available, only the Newfield Wireless-tuned and validated 850 MHz and 1900 MHz propagation models are to be adjusted and used for these specific the LTE-based designs areas. These models are tuned with the same set of geo-data consisting of 38/39 clutter classes as would have been the case with the 700 MHz or AWS models. For consistency and to keep a reference of the original models within the same project for comparative analyses, the standard model adjustment process that is allowed to be used is as follows:

- Import (copy and paste) the existing 850 MHz and 1900 MHz tuned propagation models into the LTE project
- Create duplicate copies of all the 850 MHz and 1900 MHz tuned propagation models
- Rename the copies of the duplicated models only to *existing_name_700ADJ* and *existing_name_AWSADJ*. This will show that the model have been **adj**usted for **700** MHz and **AWS** frequency band.
- Adjust the *K1* values of the new models by using the following correction factors

For the 700 MHz frequency band, the *K1* adjustment is carried out at the center frequency between the B and C blocks (722 MHz). That is:

$$K1_{700\,MHz} = K1_{850\,MHz} + 20\log\left(\frac{722}{850}\right)$$

Therefore,

$$K1_{700MHz} \approx K1_{850MHz} - 1.4$$

Where *K1* is a constant offset in dB in the propagation model

For the AWS frequency band, the *K1* adjustment is carried out at the center frequency of the AWS band (2132.5 MHz):

$$K1_{AWS} = K1_{1900\,MHz} + 20\log\left(\frac{2132.5}{1900}\right)$$

Therefore,

$$K1_{AWS} \approx K1_{1900} + 1.0$$

Where *K1* is a constant offset in dB in the propagation model

The adjusted models should be used in the LTE design until such a time that the 700 MHz and AWS specific calibrated models become available.

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Note: Ray Tracing models that are better suited for dense urban area designs are not covered in this document. For all dense urban area designs, a task force made up of the AT&T market, Design Vendor/OEM, HQ RAN and A&P should discuss and come up with the best design plan for the dense urban area. Until Ray Tracing modeling becomes available for general use for the LTE designs, the foundation of what needs to be considered for the dense urban LTE designs is included in section 4.7.

2.5 Geo Data

All the designs should use the latest set of geo-data supplied by AT&T. The geo-data consists of:

- 25m resolution for both terrain (DTM) and clutter class data
- A minimum of 38 clutter (Land Use) classes for all markets

The following snapshot shows an example of the clutter class data available for the LTE designs.

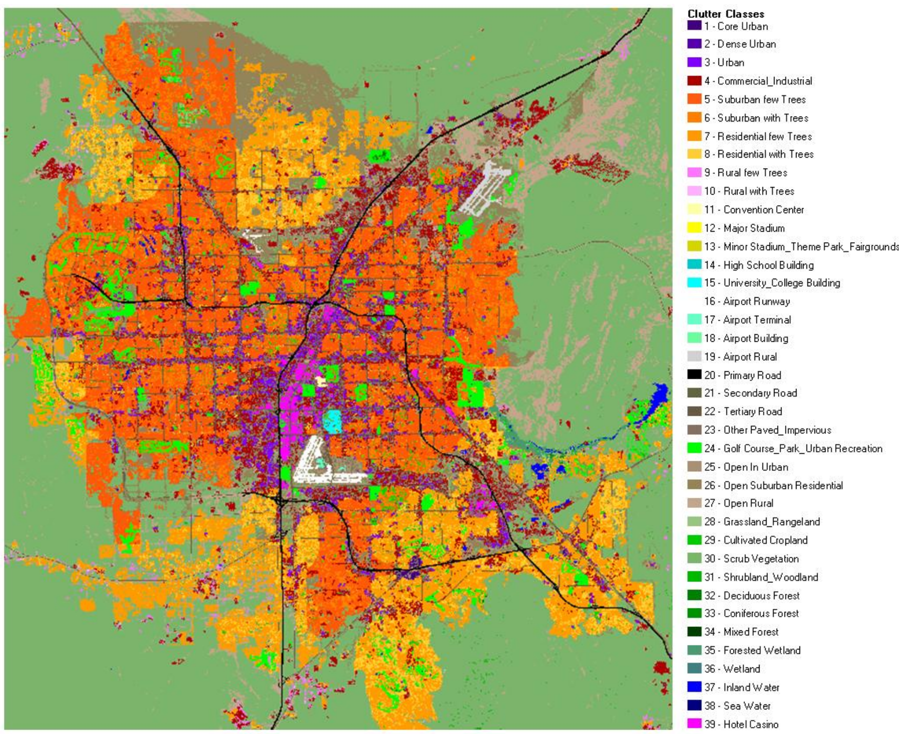

Figure 4: Sample 25m resolution Clutter Classes available in Atoll for LTE Designs

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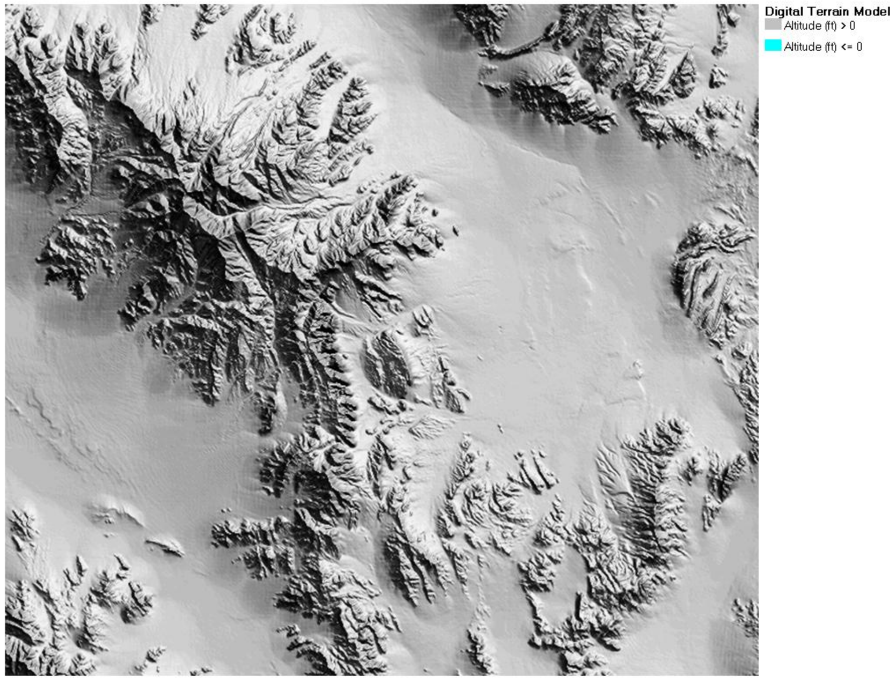

Figure 5: Sample 25m resolution DTM available in Atoll for LTE Designs

All issues associated with terrain and clutter data inaccuracies must be reported to the AT&T HQ RAN Design team so that the issues can be addressed by the supplier. The terrain and clutter files should not be edited locally in an attempt to correct issues as the accuracy of the edits cannot be guaranteed.

2.6 Candidate Sites for LTE Design

All the existing on-Air UMTS and/or GSM ONLY sites plus all the planned sites due to come on air 45 days before the expected LTE launch date of any markets LTE network and within the market's LTE design polygon are to be **considered as candidates** for site selection for the LTE design. The design team is allowed to carry out site relocations of **existing** sites up to the limit outlined under the design options section. The LTE network performance targets, service offering and traffic demands are the key drivers that determine how sites are selected from the portfolio of the LTE candidate sites.

It is important to note that some sites (typically high sites or sites on high ground relative to other sites) will not be suitable for use in the LTE network as they will by nature of their height or location cause excessive interference to the surrounding sites.

If any new site build (currently planned for UMTS/GSM) is expected to come on air less than (<) 45 days before the expected LTE launch date for the market, it should not be considered in the LTE network design due to a high probability of the site not being ready for the Go/No-Go KPI reviews.

When the existing candidate sites do not resolve all the LTE performance issues after taking into consideration the approved design options, the following additional candidate site portfolio databases should then be considered as possible options:

- AT&T Asset Locations
- American Tower Corporation (ATC) sites

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- Crown Castle Sites

Atoll compatible databases (MapInfo tables) have been created with these site locations to facilitate the design process. All the MapInfo tables are located on the Atoll thin client server at F:\GlobalData\CommonGeoDataLayers\.

2.7 LTE Design Polygon

The "LTE design polygon" for the markets is maintained by the National RF GIS team. These polygons form the basis for the required service areas for LTE and provide an indication of where LTE designs are to be carried out. The polygon files have been converted for use in Atoll. The Atoll compatible files are located on the Atoll thin client server at F:\GlobalData\LTE Polygons. Due to the importance of the LTE polygons in relationship to all the LTE design decisions, it is extremely important that the reference polygon is not changed in any way whatsoever by the LTE design team. The LTE polygon will be reviewed with HQ RAN as part of the Kickoff meeting. All LTE polygon issues must be routed to the Fundamental Network Planning (FNP) team via the HQ RAN Design Review team so that the issue can be addressed accordingly. See Section 6.1.1 for specific details on how to evaluate the Design Polygon and how to request changes to the design polygon.

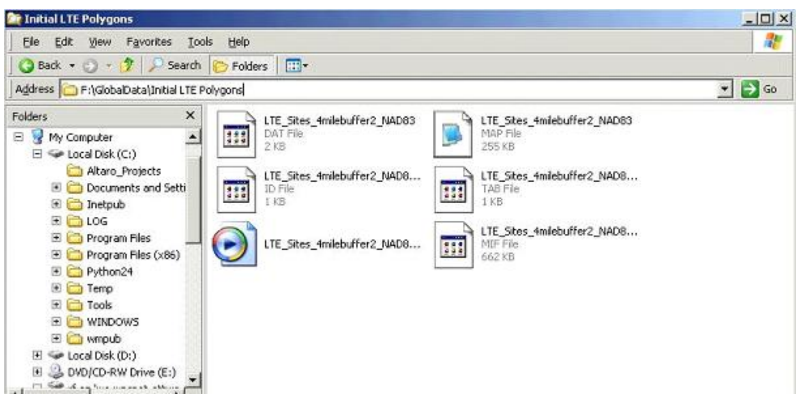

Figure 6: LTE polygons vector file on the Atoll server

By importing polygon vector file into Atoll, a reference is available to aid in the initial design decisions. All the LTE designs and reference statistics will be computed using the LTE design polygon (or as divided into clusters or super clusters) as a reference.

2.8 Broadband Antennas and Antenna Patterns

All broadband antennas to be used for the designs should come from the AT&T approved antenna list. Please note that when selecting antennas from the approved vendor list, the guidance on antenna selection provided later in this document should be used. The availability of an antenna on the approved vendor list does not necessarily mean that the choice of that antenna is good in all design scenarios. Likewise, if an antenna (for example, narrower horizontal beamwidth antennas) is not currently on the approved vendor list but their benefits are demonstrated, the situation should be raised to HQ RAN so that an effort can be made to have that included in the approved list.

Currently, four vendors have been approved as providers for LTE broadband antennas. The four vendors are:

1. Andrew
2. Kathrein Scala
3. Powerwave
4. KMW

The antenna patterns from these three vendors to use in the LTE designs should come from the AT&T Antenna pattern library only. The broadband antennas approved for use are as follows:

Andrew:

Model/Part Number	Description
LNX-6514DS-R2M	single broadband (700/850 MHz) X-polarization, dual-port, 6' 65-deg
LNX-8511DS-R2M	single broadband (700/850 MHz) X-polarization, dual-port, 4' 85-deg
DBXNH-6565B-R2M	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 6' 65-deg
DBXNH-8585A-R2M	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 4' 85-deg

Kathrein Scala:

Model/Part Number	Description
800-10734 K	single broadband (700/850 MHz) X-polarization, dual-port, 4' 65-deg
800-10735 K	single broadband (700/850 MHz) X-polarization, dual-port, 6' 65-deg
800-10701 K	single broadband (700/850 MHz) X-polarization, dual-port, 4' 85-deg
800-10764 K	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 4' 65-deg
800-10765 K	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 6' 65-deg
800-10721 K	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 4' 85-deg
800-10722 K	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 6' 85-deg

Powerwave:

Model/Part Number	Description
P65-16-XL-R	single broadband (700/850 MHz) X-polarization, dual-port, 6' 65-deg

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P90-14-XL-R	single broadband (700/850 MHz) X-polarization, dual-port, 4' 85-deg
P65-15-XLH-RR	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 4' 65-deg
P65-16-XLH-RR	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 6' 65-deg
P90-14-XLH-RR	dual broadband (700/850 and AWS/PCS) X-polarization, quad-port, 4' 85-deg

KMW:

Model/Part Number	Description
AM-X-CD-14-65-00T-RET	dual broadband (700/850 and PCS/AWS) X-polarization, quad-port, 4' 65-deg
AM-X-CD-16-65-00T-RET	dual broadband (700/850 and PCS/AWS) X-polarization, quad-port, 6' 65-deg
AM-X-CW-14-65-00T-RET	single broadband (700/850) X-polarization, dual-port, 4' 65-deg
AM-X-CW-16-65-00T-RET	single broadband (700/850) X-polarization, dual-port, 6' 65-deg

For all the antennas, the beamwidth and electrical tilts vary per frequency band. It is therefore important to also refer to the antenna specification datasheet when selecting a particular antenna for use with any LTE design. The detail specification of the antennas (including the beamwidth and tilt variation at different frequencies) together with the complete approved antenna list can be found at the following location.

http://ns.cingular.net/sites/RFEng/tools_d.aspx

Only the approved antenna patterns in the AT&T Atoll antenna pattern library on the thin client server should be used for any LTE-based design exercise. The library is located on the Atoll thin client server at F:\GlobalData\Antenna_Library. Patterns should not be downloaded from any other source and used for any AT&T designs.

The antenna pattern names or pattern properties are **not** to be renamed or changed in any way from what is delivered in the antenna library.

To maintain the accuracy of the antenna patterns and to avoid errors associated with manipulating the pattern data, the antenna patterns are included in all the project templates as a default.

2.9 Feedline/Jumper Replacement

If the feeder (COAX) has a loss greater than 2 dB for the band that LTE is deployed on (or at 700 MHz if a dual band deployment), then every effort must be made to ensure that the RH on the site is deployed at the top of the tower. This will ensure that the link budget is not compromised thereby compromising the quality of the reference signal and the indoor coverage levels.

In situations where the feedback from C&E is that the RH cannot be deployed at the top of the structure closer to the antennas, then every effort must be made to replace the feeders so as to

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bring the total loss to less than 2 dB. When tower top placement is not possible, then the LTE feeders should be 1 5/8" minimum diameter.

When simulations at the design load level show per user failures for the cell (best server) due to insufficient coverage (even if feeder is less than 2 dB loss) and lower per user throughput and lower aggregate DL cell throughput compared to the design targets, then effort must be made to reduce feedline loss using tower top RH placement or feedline replacement.

All losses in the link (feeder, jumper, TMA, Diplexer, Rx-tray, Bias-T, etc) have to be reflected in the Atoll planning tool. Feeder losses and TMA gains are explicitly accounted for in Atoll. All other losses will have to be combined as one loss factor and added into the transmitters "Miscellaneous Loss" field. All miscellaneous hardware losses should be less than 1.0 dB.

To ensure consistency across all projects and reduce the possibility of errors, all the approved feeder types and their associated loss/m (loss/ft) have been pre-configured in the project templates for both 700 MHz and AWS. The design teams should use the feeders properties as-is. A depiction of the pre-configured table is as shown below.

Name	Loss per length (dB/ft)	Connector reception loss (dB)	Connector transmission loss (dB)
1 1/4" ANDREW LDF6-50A_700 MHz	0.007	0.17	0.17
1 1/4" ANDREW VXL6-50_2100 MHz	0.015	0.29	0.29
1 1/4" ANDREW VXL6-50_700 MHz	0.008	0.17	0.17
1 1/4" EUPEN EC6-50A_2100 MHz	0.013	0.29	0.29
1 1/4" EUPEN EC6-50A_700 MHz	0.007	0.17	0.17
1 1/4" RFS LCFS114-50JA_2100 MHz	0.014	0.29	0.29
1 1/4" RFS LCFS114-50JA_700 MHz	0.007	0.17	0.17
1 5/8" ANDREW AVA7-50_2100 MHz	0.011	0.29	0.29
1 5/8" ANDREW AVA7-50_700 MHz	0.006	0.17	0.17
1 5/8" ANDREW FXL 1873_2100 MHz	0.011	0.29	0.29
1 5/8" ANDREW FXL 1873_700 MHz	0.006	0.17	0.17
1 5/8" ANDREW LDF7-50A_2100 MHz	0.012	0.29	0.29
1 5/8" ANDREW LDF7-50A_700 MHz	0.006	0.17	0.17
1 5/8" COMMSCOPE CR1873 PE_2100 MHz	0.011	0.29	0.29
1 5/8" COMMSCOPE CR1873 PE_700 MHz	0.006	0.17	0.17
1 5/8" EUPEN EC7-50A_2100 MHz	0.011	0.29	0.29
1 5/8" EUPEN EC7-50A_700 MHz	0.006	0.17	0.17
1 5/8" RFS LCF158-50JA_2100 MHz	0.011	0.29	0.29
1 5/8" RFS LCF158-50JA_700 MHz	0.006	0.17	0.17
1/2" ANDREW LDF4-50A_2100 MHz	0.033	0.29	0.29
1/2" ANDREW LDF4-50A_700 MHz	0.018	0.17	0.17
1/2" COMMSCOPE CR 540 JUMPER_2100 MHz	0.032	0.29	0.29
1/2" COMMSCOPE CR 540 JUMPER_700 MHz	0.017	0.17	0.17
1/2" RFS LCF12-50J_2100 MHz	0.033	0.29	0.29
1/2" RFS LCF12-50J_700 MHz	0.018	0.17	0.17
2 1/4" ANDREW LDF12-50_2100 MHz	0.01	0.29	0.29
2 1/4" ANDREW LDF12-50_700 MHz	0.005	0.17	0.17

Figure 7: Partial Depiction of Pre-Configured Feeder Equipment Table in Atoll.

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2.10 TMA Requirements and TMA Settings in the Atoll

The guideline on the use of TMAs in the LTE design is dependent on the frequency band that is used for LTE. The initial assumption is as follows:

- No TMAs are to be used at 700 MHz for any site in the LTE polygon. Exceptions are:
  - Use of 700 Bypass TMAs
  - Tall rural sites with RH at the base of the tower or when simulation analysis shows the uplink as the limiting link.
- In all, TMAs should NOT be used when the RH is located at the top of the tower, for rooftop deployments where the RH is near the antennas, or for in-building deployments. Recall that the first preference is to locate the RH at the top of the tower in which case this replaces the need for an additional TMA.

Only the TMAs in the AT&T approved TMA list and their quoted specifications should be used in the designs. The list of approved TMAs and their specifications can be found at http://ns.cingular.net/sites/RFEng/tools_d.aspx .

All the TMAs that have been approved for use in the LTE designs have been pre-configured and included in the default Atoll LTE project templates for use by the design teams. These settings include the following that are automatically considered by Atoll in the link budget calculations.

- Noise Figure (dB)
- Reception Gain (dB)
- Transmission Losses (dB)

These are the only TMAs that should be used. Their names or associated properties should not be changed in any way. The pre-configured TMAs are as shown below.

Name	Noise Figure (dB)	Reception gain (dB)	Transmission losses (dB)
CCI DTMA1721VG14A	1.5	14	0.3
CCI DTMABP0721VG12A	1.5	12	0.4
CCI DTMADB0721VG12A	1.5	12	0.4
CCI TMABP0721VG12A	1.5	12	0.4
KMW KUNAPA101001	1.45	13	0.3
KMW KUNAPA102001	1.45	13	0.3
KMW KUNAPA103001	1.45	13	0.3
KMW KUNAPA105001	1.6	13	0.3
Powerwave TS07-AWDB111-001	1.6	13	0.4
Powerwave TSAW-07BP111-001	1.6	13	0.4
Powerwave TTAW-07BP111-001	1.6	13	0.4
Powerwave TTAW-60BW111-001	1.8	12	0.35
Triasx TMA2042F1V1-1	2.1	12	0.4
Triasx TMA2043F1V1-1	2	12	0.4
Triasx TMA2044F1V1-1	2	12	0.4
Triasx TMA2045F1V1-1	2	12	0.4

Figure 8: Pre-Configured TMA Equipment Table in Atoll.

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2.11 Existing Market Problem Areas

All the problem areas in the current 3G network within the market's LTE polygon needs to be addressed through the LTE design. The problem areas include but not limited to those identified below:

- Existing network churn maps or areas of concern. The churn information is in the CMNDr web system located at http://titan.homer.att.com:54280/novarf/login.htm
- Existing drive test data from GWS. The post processed data using NOVA RF should be used to identify areas with dominance issues. The polygons encapsulating all problem areas should be imported into the planning tool and used for the design exercise. The NOVA RF application is located at http://titan.homer.att.com:54280/novarf/login.htm
- Existing network statistics summarized in the AT&T design scorecard. All issues identified on the scorecard needs to be addressed as part of the LTE-based design.
- Existing Atoll design and simulations. This includes areas with pilot pollution/lack of dominance, degraded Ec/Io, degraded HS user throughput, coverage overshoot, etc.
- IRAT problem areas and/or IFHO problem areas where service continuity on one technology and on one layer must be addressed.

Note: The CMND web system and NovaRF system are both hosted and managed by AT&T Labs. Prior account creation is required for their use and is not available to outside third partly vendors. As a result the relevant information required from those systems must be managed by the local AT&T market LTE Design engineer representative. These items must be reviewed during the LTE design kickoff call with the LTE Design engineering team.

When design reviews are carried out, these problems areas will also be reviewed to gauge how the problem areas are addressed by the LTE network design.

2.12 LTE Link Budget Consideration

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When looking at the LTE Link Budget it is important to note that the link budget is calculated for a single mobile (user) located at cell edge; for a single service and transmitting at maximum power in a network with only a single cell even though attempts are made to factor into the link budget the existence of other cells and their impact in terms of cell geometry. This is different from reality (multitude of services, cells, varying user distribution, varying site configurations, etc.). However, in order to establish a foundation to be used as a reference for the LTE design activities a link budget analysis is carried out taking into consideration different bit rates, services and site configuration options. An individual link budget is then generated for the different services and network configuration options. The purpose of using the different bit rates and services is to establish the foundation of the link budget for LTE design decisions and to demonstrate the dynamic nature of the LTE link budget.

To account for the varying user distribution, varying LTE demand profiles, varying network configuration options, varying propagation environment, mix of services that must co-exist in the system and the interaction between cell sites, the Atoll Radio Network Planning Tool becomes the best option to analyze the system and not the standard LTE link budget spreadsheet.

Note that the detailed link budget spreadsheet and document is available upon request from the HQ RAN Design and A&P teams. The document has also been posted on Solar at the following link:

http://solar.edc.cingular.net/livelink/livelink?func=ll&objaction=overview&objid=15571095&viewType=1

The LTE link budget information has purposely not been included in this document. The reason for this is due to the confidential nature of the link budget as it contains vendor specific information. However, the vendor specific parameters have been included in the Atoll radio network planning tool settings for use with the designs as will be seen in subsequent sections of this document.

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3. Atoll LTE Traffic Model and Capacity Analysis

The traffic model available in Atoll is based on the definition of bearers, services, user equipment, and user profiles. It is possible to create as many services and user equipment as required, and create and import traffic data in various formats.

Atoll lets you create and import raster, vector, as well as live traffic data in the form of maps. The Atoll LTE module also includes a database for fixed subscribers, which allows one to model traffic demands from fixed user locations. You can study the behavior of the network for fixed and mobile users combined.

For the AT&T LTE designs, project parameters have been customized to facilitate the design exercise as well as to ensure that the vendor specific LTE parameters are taken into consideration in the simulations. The following sections outline some of the configurations that have been taken into consideration.

<u>**LTE Parameters Setup**</u>

These parameters are automatically set up as part of the project template. However, it is required that the RF Design Engineer inspects the project to make sure that all parameters are set up correctly.

Please note that all screenshots provided below are for illustration only and should not be used except specifically stated otherwise.

Expand on 'LTE Parameters' by clicking on the '+' sign to the left of it.

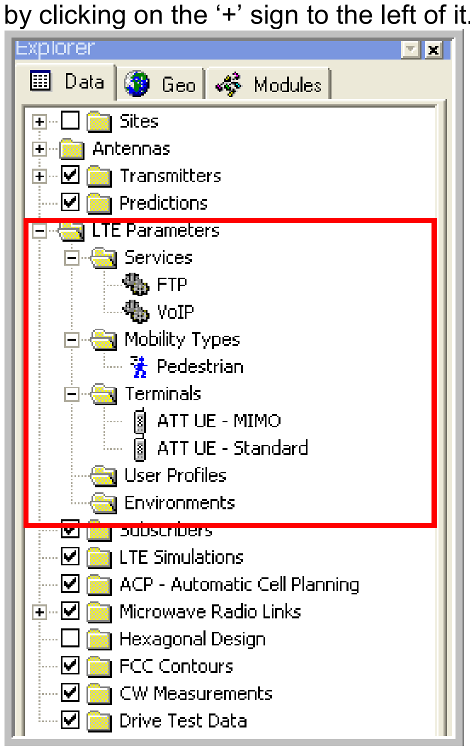

Figure 9: Pre-Configured LTE Parameters Setup (Representative Sample).

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Expand on ‘Terminals’ folder by clicking on the ‘+’ sign to the left of it. Double click on ‘Terminals, Mobility and Services’ to view its properties and make sure that nothing is amiss. Any issue seen must be reported to the HQ RAN design team responsible for Atoll for clarification or correction before any design activity is carried out using the settings.

3.1 Bearers

Bearers in Atoll define the modulation and coding schemes and their respective properties. Bearers support data transfer for the different services that the network might offer. The bearer tables in the Atoll templates on the thin client server have been configured with vendor specific parameters to reflect the capabilities of their system. Only the approved vendor configurations should be used in the designs.

Bearers

Radio Bearer Index	Name	Modulation	Channel Coding Rate	Bearer Efficiency (bits/symbol)
1	QPSK 1/12	QPSK	0.0761719	0.1523
2	QPSK 1/9	QPSK	0.117188	0.2344
3	QPSK 1/6	QPSK	0.188477	0.377
4	QPSK 1/3	QPSK	0.300781	0.6016
5	QPSK 1/2	QPSK	0.438477	0.877
6	QPSK 3/5	QPSK	0.587891	1.1758
7	16QAM 1/3	16QAM	0.369141	1.4766
8	16QAM 1/2	16QAM	0.478516	1.9141
9	16QAM 3/5	16QAM	0.601563	2.4063
10	64QAM 1/2	64QAM	0.455078	2.7305
11	64QAM 1/2	64QAM	0.553711	3.3223
12	64QAM 3/5	64QAM	0.650391	3.9023
13	64QAM 3/4	64QAM	0.753906	4.5234
14	64QAM 5/6	64QAM	0.852539	5.1152
15	64QAM 11/12	64QAM	0.925781	5.5547

Rec. 0

Figure 10: Sample Radio Bearer Index Table (Representative Sample).

The most important parameter of a bearer is its efficiency, which is the number of useful data bits that the bearer can transfer in one modulation symbol (resource element) of the LTE frame.

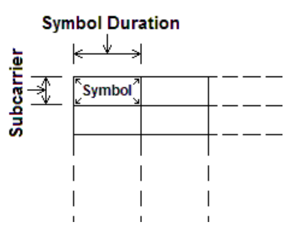

Figure 11: A Modulation Symbol or resource element.

LTE equipment models the reception characteristics of eNode-Bs and UE in Atoll. The vendor (Ericsson and Alcatel-Lucent) specific equipment properties have been pre-configured in the Atoll project templates. The LTE equipment lists the SINR requirements for the selection of bearers, quality indicator characteristics, and SU-MIMO and diversity gains.

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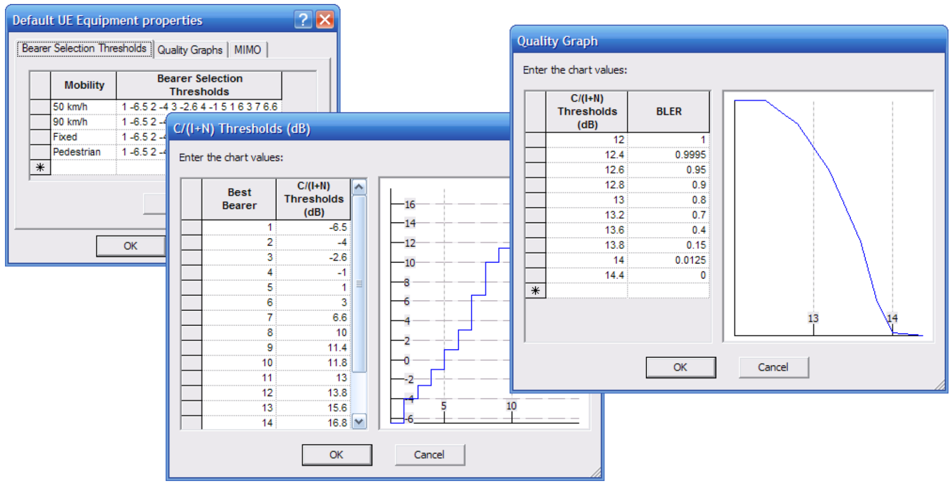

Figure 12: Reception equipment: LTE Bearer characteristics (Representative Sample).

3.2 Services

Of the different services that can be modeled in an LTE network, only the following two services will be considered design work.

1. FTP
2. VoIP

These two services have been pre-configured in Atoll as part of the standard configuration with the vendor approved parameters. All design analysis and simulations leading to design certifications will be based on FTP (data services) only. VoIP is included for those wishing to evaluate designs with future VoIP servers but VoIP is not part of the initial design process at this time..

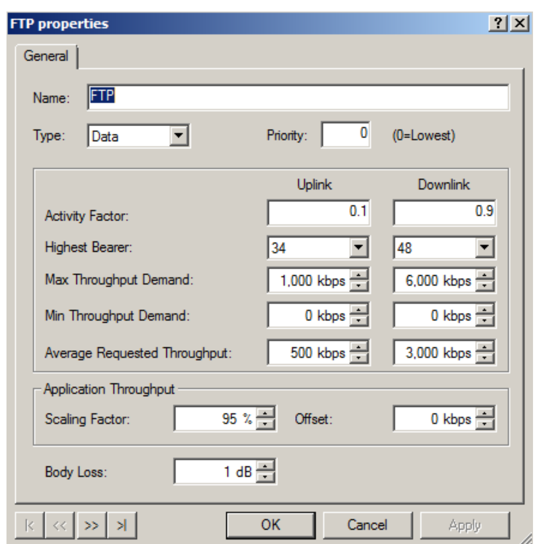

Figure 13: Sample FTP Service Definition in Atoll (Representative Sample).

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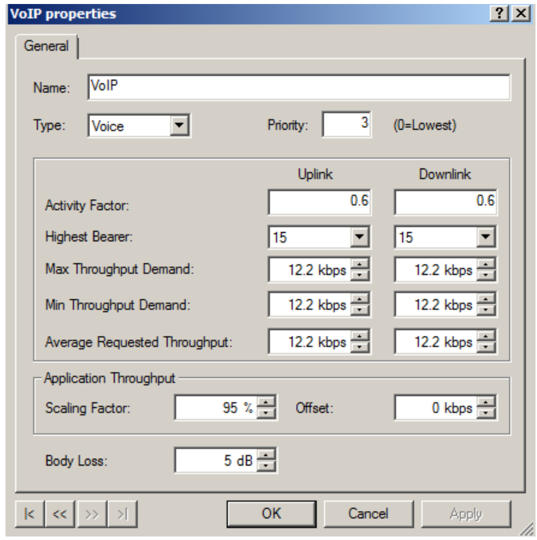

Figure 14: Sample VoIP Service Definition in Atoll (Representative Sample).

The actual demand for each service will be defined in the traffic mapping process. While these two services are pre-configured, if as an example, the design calls for FTP service only, then the simulations will be based on an FTP demand map only.

3.3 User Equipment (Terminals)

Two terminal types have been pre-configured in Atoll for use in the LTE designs. The two terminals are:

1. ATT UE - MIMO
2. ATT UE - Standard

The transmission/reception properties of the UEs are the same and are as follows:

Max Power: 23 dBm

Min Power: -40 dBm

Noise Figure: 8 dB

Losses: 5 dB

The key difference between the two devices is in their diversity support where one supports MIMO and the other does not. An example of the configuration of the UE terminal for the two vendors is as shown below.

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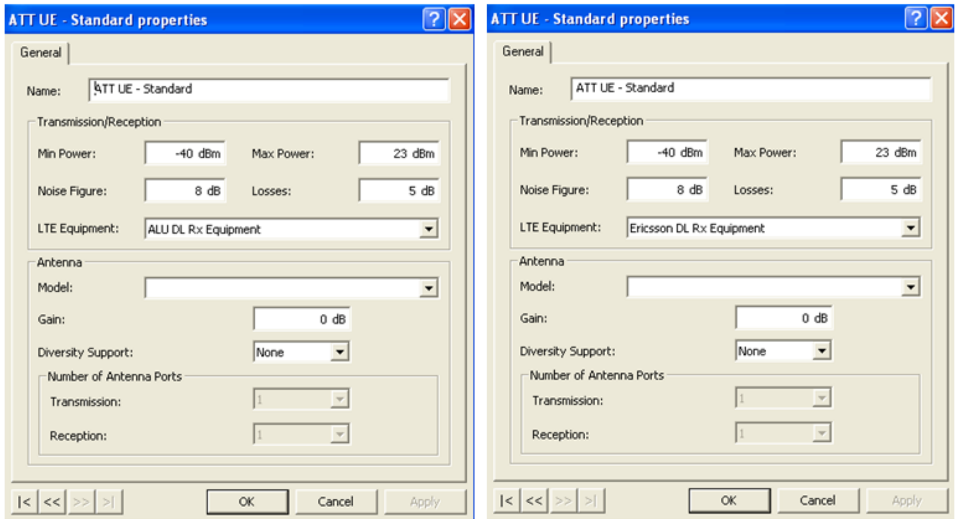

Figure 15: Sample Terminal Properties Dialogue for ATT UE - Standard (Representative Sample).

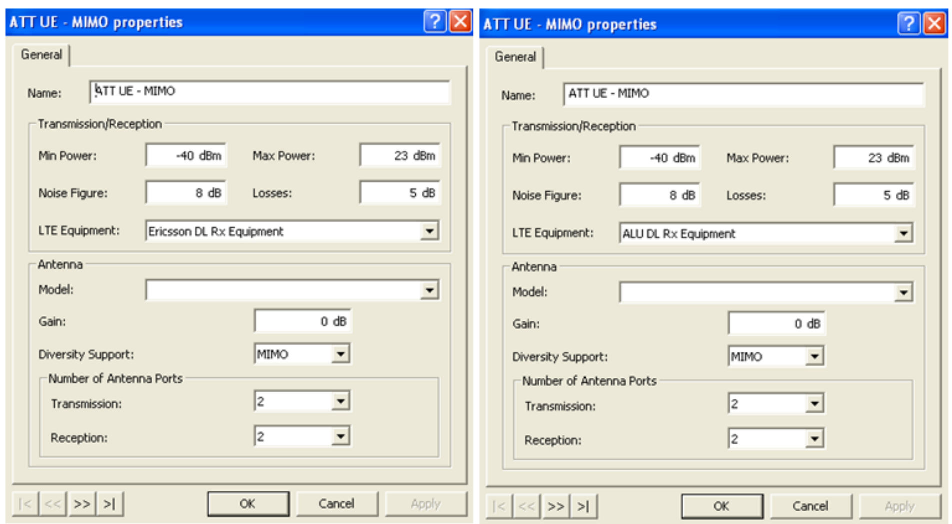

Figure 16: Sample Terminal Properties Dialogue for ATT UE - MIMO (Representative Sample).

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3.4 Mobility Type

Of the different mobility types that can be modeled in an LTE network, only the following mobility type will be used for all the initial designs.

- Pedestrian

This mobility type has been pre-configured in the LTE project templates of all the vendor specific performance curves linked to this mobility type. All the traffic demand from the traffic map will be linked to this mobility type only.

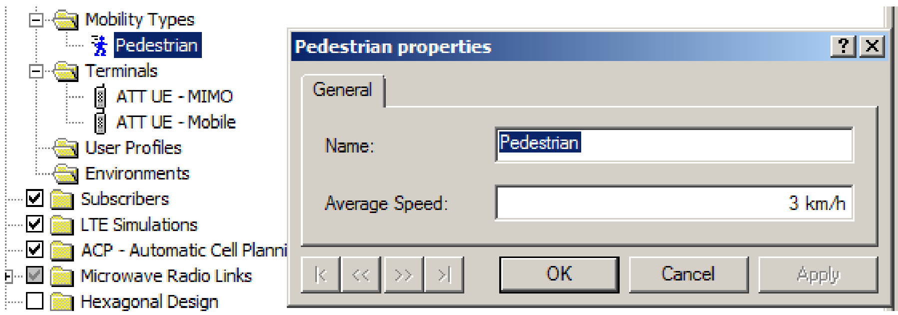

Figure 17: Pre-configured Mobility Type for Use in LTE Designs (Representative Sample).

3.5 Traffic Data

Network traffic data can be input in Atoll in various forms - one of the forms being to create a traffic map directly within the LTE project. . However, for initial LTE designs the traffic will be spread in UMTS using DVCF forecast data and then imported into the LTE design ATOLL file. This imported traffic will be scaled for LTE design work as covered in Section 5.5. The key assumption here is that the initial LTE designs for certification will be based on HS data only and the profile of the LTE data demand will follow that of the existing UMTS network HS data traffic maps within the LTE polygons. By using the UMTS traffic density approach, unrealistic uniform loading of the sectors in the network for simulation is avoided.

The high-level of the LTE demand map creation from UMTS for use in the LTE design is as shown on the flow chart below. Note that the latest available DVCF forecast should be used but with a forecast date of the current month. This way, UMTS traffic should be spread based on existing on-air sites—avoiding NSBs. When building the UMTS traffic map, any forecast data with multiple carriers should sum together the total traffic for all carriers on the sector before spreading and exporting the traffic map.

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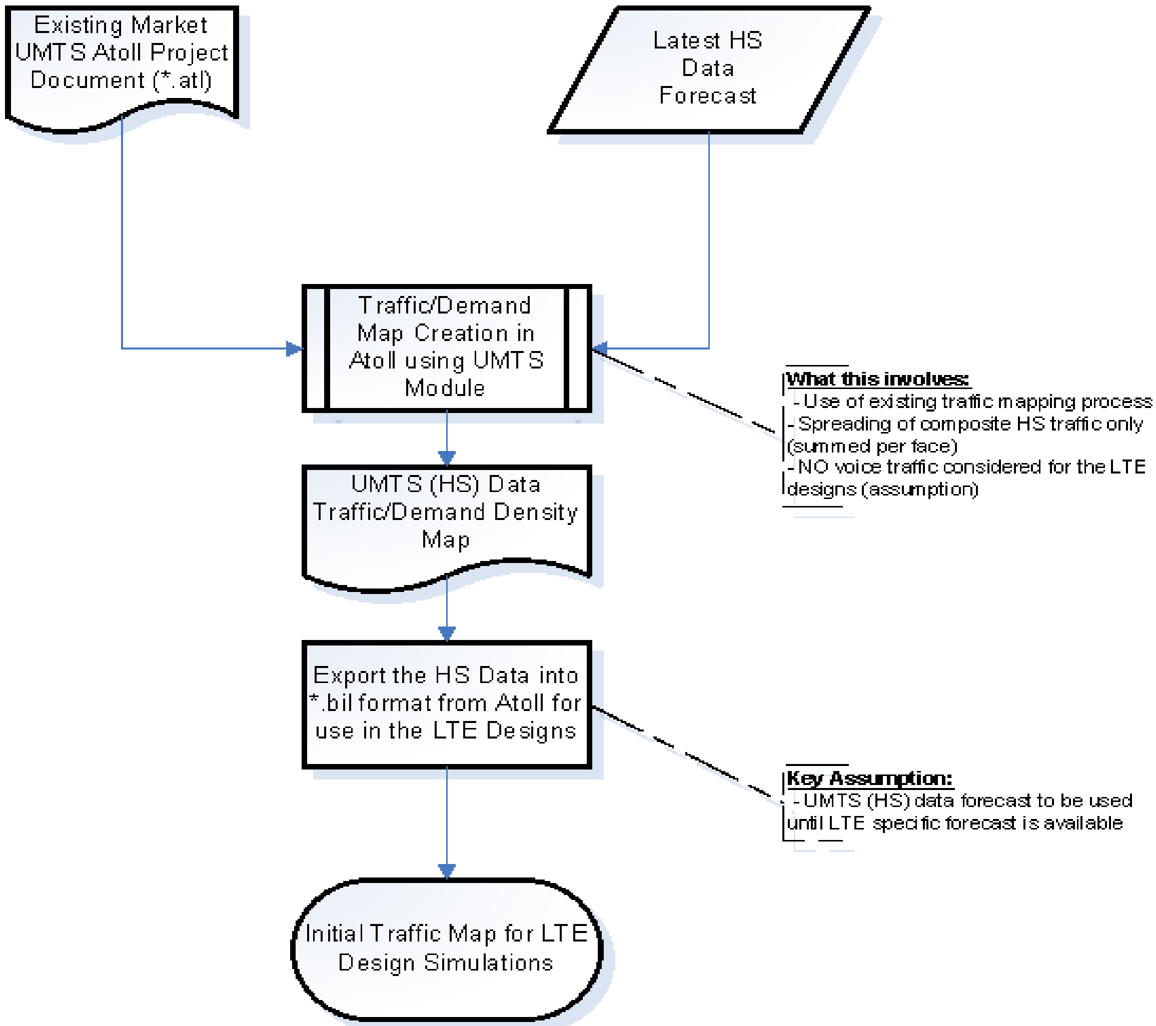

Figure 18: Going from a UMTS Traffic Map to Demand Map for LTE Simulations.

Note: The same process as that outlined above can be used when a voice traffic density map is being exported from UMTS for any VoIP designs. VoIP is not used for initial LTE design work leading to certification.

The step-by-step process in creating the UMTS traffic map is covered in the "UMTS Traffic Mapping Process".

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4. Project Configuration and Additional Atoll Settings

This section of the document outlines all the additional Atoll settings that are not included by default in the LTE project templates and may have to be manually configured by the LTE design engineer in the course of the design activities. All the configuration and settings in this section will be reviewed either as part of the LTE Design Kickoff Meeting, pre-design project configuration check; and initial project design review and/or as part of the final design review.

4.1 Radio Head (RH) Locations and Atoll Configurations

The distributed eNode-B is made up of two units. The two units are:

1. Base Band Unit (BBU) or Main Unit (MU)
2. Radio Head (RH)

One MU can support multiple RHs. The common interface between the MU and RH is fiber. The fiber distance between MU and RH can be up to ~ 9 miles. Two options exists for installing the RH

1. RH at the top of the tower close to the antenna – RF advantage (less feeder loss) but possible operations disadvantage
2. RH at the base of the tower close to the MU – possible operational advantage (ease of maintenance) but RF disadvantage

The default criteria for all the LTE designs is to assume the first option where all the eNode-B radio heads will be at the top of the structure close to the antennas. This configuration will yield the best LTE performance from an RF point of view. This configuration will also form the basis for all scoping RFDS sheets in Phase 1 of the LTE designs and simulations.

In Atoll, a RH is configured as a separate transmitter linked to a site. However, the precise location of the RH may result in different configuration considerations. Here with the guidelines for configuration of the RH in Atoll depending on the location of the RHs with reference to the MU location.

<u>Main Unit</u>

- The physical location of the MU (Latitude and Longitude) should be configured as the site location in Atoll.
- This is the latitude and longitude entry in the Atoll sites table

<u>Radio Head (RH) Location and Transmitter Coordinate Location</u>

- The physical location of the transmitter is accommodated in the current version of Atoll through the DX, DY offsets (relative to the Site Latitude-Longitude) in the transmitters table. The current version of Atoll (version 2.8) now allows the specific latitude and longitude of the specific transmitter entry to be entered directly instead of pre-calculating the DX, DY offsets as shown in Figure 18. When the Latitude-longitude values are entered in this manner, the offsets relative X and Y to the site location (MU location) are automatically calculated by Atoll.

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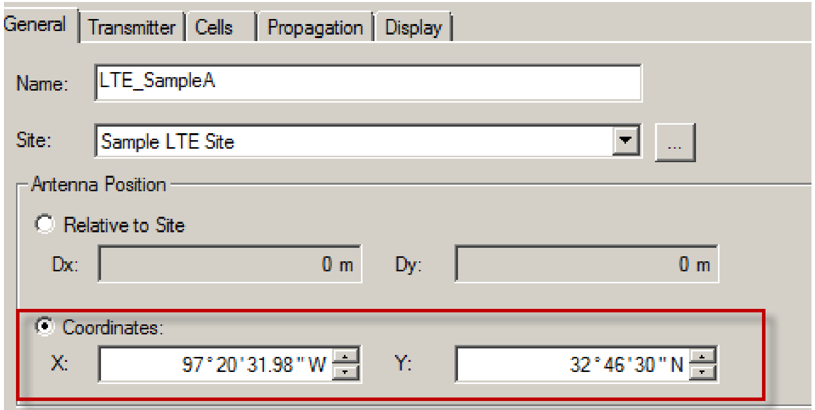

Figure 18: Latitude-Longitude Entry Dialogue for Transmitters

Now that RHs can be located at a variety of locations (In same shelter, at tower top, on different sides of a building, or “remotely located” at a different address), it is important to correctly specify the correct transmitter table location in ATOLL for accurate analysis.

The following configuration options should be used for the MU and RH in Atoll.

- **RH at base of Tower**: MU, RH, and transmit antennas all located at the same physical location (Latitude, Longitude)
  - Configure RH served transmitter as any other regular transmitter in Atoll
  - No DX, DY offsets (that is: DX=0 and DY=0)
  - Configure feeder runs as required from RH to the antenna
- **RH at Base of Tower**: but MU is at a **different physical location** (Latitude, Longitude) from the RH
  - Configure RH served transmitter as any other regular transmitter in Atoll
  - Enter the precise latitude and longitude values for the transmit antenna location and ATOLL calculate the DX, DY offsets in the transmitters
  - Configure feeder runs as required from RH to the antenna
- **RH at TOP of Tower (or rooftop)**: MU, RH, and transmit antennas all located at the same physical location (Latitude, Longitude)
  - Configure RH served transmitter as any other regular transmitter in Atoll
  - Configure individual radiation centers for the RH served transmitters
  - No DX, DY offsets (that is: DX=0 and DY=0)
  - Configure only jumpers runs as required from RH to the antenna
- **RH at TOP of Tower (or Rooftop)**: but MU is at a **different physical location** (Latitude, Longitude) from the RH
  - Configure RH served transmitter as any other regular transmitter in Atoll
  - Configure individual radiation centers for the RH served transmitters
  - Enter the precise latitude and longitude values for the transmit antenna location and ATOLL calculate the DX, DY offsets in the transmitters
  - Configure **only jumpers** runs as required from RH to the antenna

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In all cases:

- Configure interface between MU and RH as fiber (use loss/m for the fiber as **0 dB**) in the feeder equipment table.
- All other transmitter properties are configured as would be the case with any other transmitter.

4.2 Jumper and Connector Losses

The following assumptions have been established for use in the calculation of connector and jumper losses for the LTE designs. The composite loss for the connectors and jumpers are to be configured as a single entry towards getting the total of the Miscellaneous Losses column in Atoll.

Connector Loss:

Loss = 0.05 x (√(Operating Frequency in GHz)) (dB)

This gives per connector losses of:

700 MHz	850 MHz	1900 MHz	AWS (2100 MHz)
0.0418 dB	0.0454 dB	0.0689 dB	0.0724 dB

For example at 700 MHz, the connector loss would be:

Loss = 0.05 x (√ (0.7))

= 0.0418 dB per connector

Jumper Loss:

Loss = Loss per ft x Jumper Length

Assuming Jumper Length = 10 ft per Jumper,

For 700 MHz,

Loss = 0.0174x10

= 0.174 dB per Jumper

Using the above calculations, several different configurations and the calculated loss values are shown in the following examples:

<u>Example 1: Single Carrier RH Configuration (Tower Base):</u>

For Figure 18 at 700 MHz:
Miscellaneous Losses = 4 x connector + 2 x Jumper
= 0.515 dB

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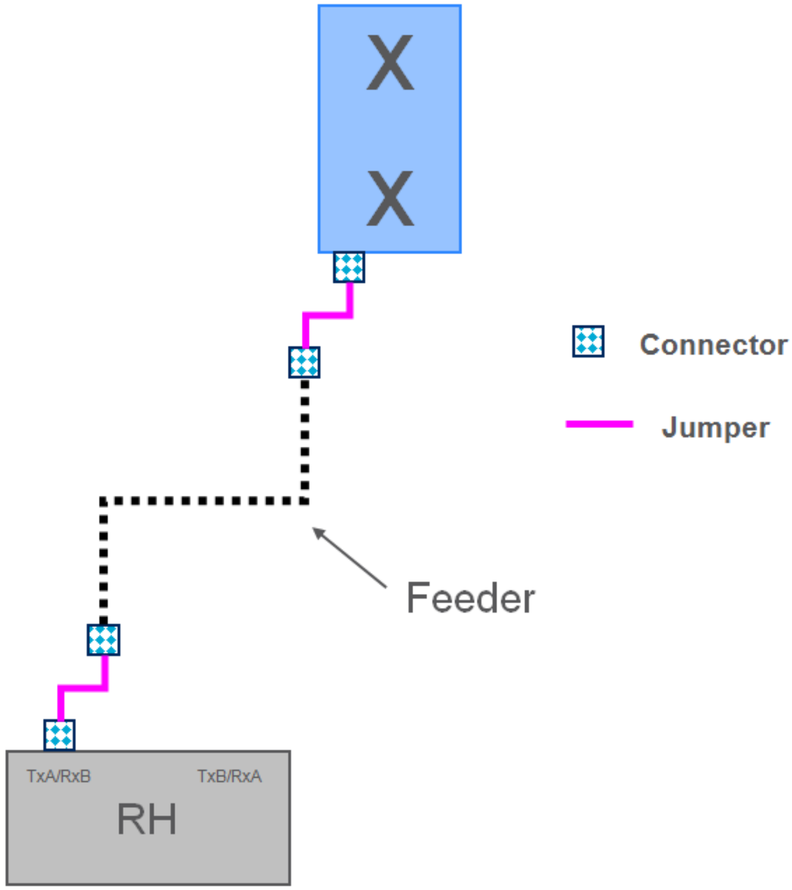

Figure 19: Single Carrier RH Configuration.

Example 2: Single/Dual Carrier RH Configuration (Tower Top):

For Figure 19 at 700 MHz:
Miscellaneous Losses = 2 x connector + 1 x Jumper
= 0.258 dB

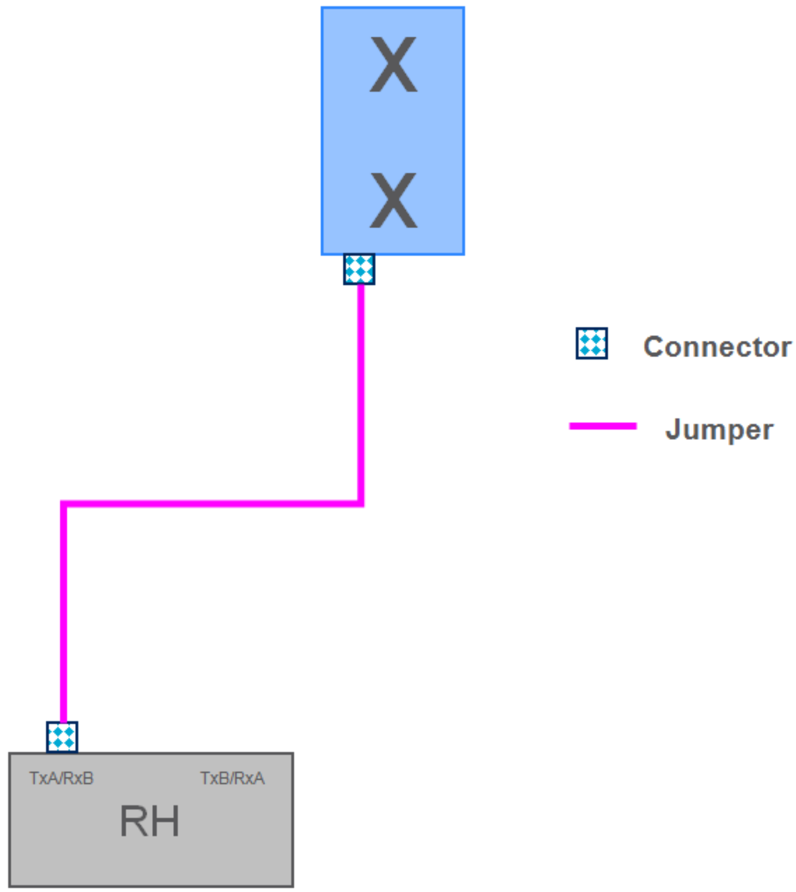

Figure 20: Single/Dual Carrier RH Configuration

<u>Example 3: Dual Carrier RH Configuration (Tower Base):</u>

For Figure 20 at 700 MHz:
Miscellaneous Losses =8 x connector + 4 x Jumper + Insertion Loss (Diplexer)
= 1.03 dB
Where Diplexer Insertion Loss is 0.216 dB

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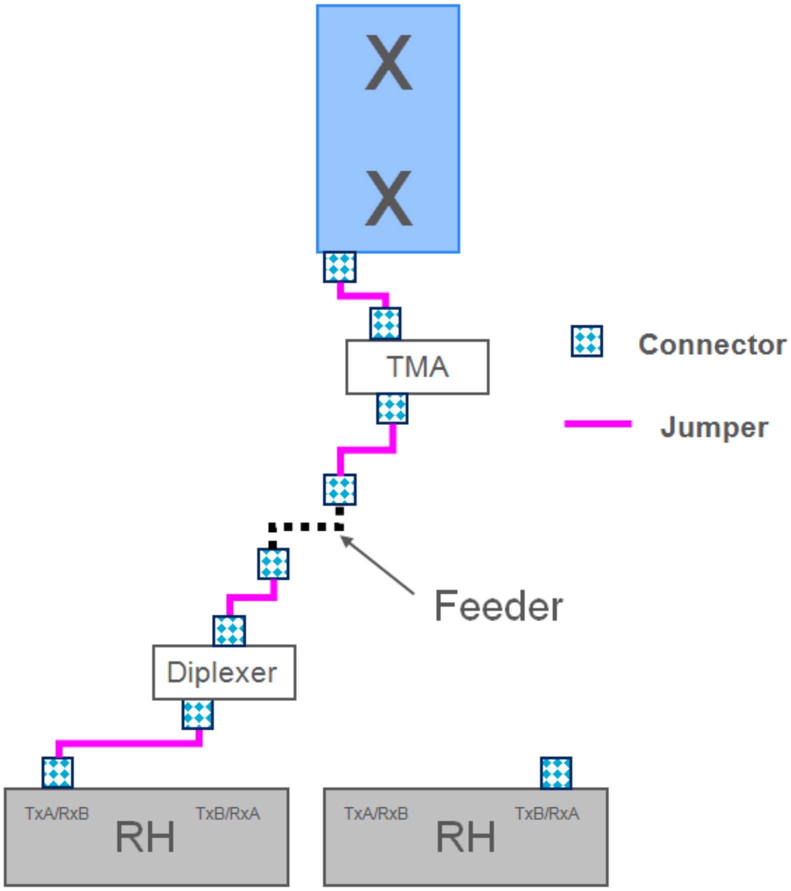

Figure 21: Dual Carrier RH Configuration (Tower Base)

4.3 Number of Transmitters per Site

For all the LTE designs, a three (3) sector site configuration should be used as the standard configuration. All omni-directional or two-sector sites (except where highway coverage is the main targeted coverage objective) must be reconfigured to three sectors. This will lead to a better capacity management (interference control and greater overall number of sub-carriers on the site), better physical cell identifier planning which will ultimately result in an improved LTE network performance and end-user experience.

In cases where an omni-directional or two sector site must be used for LTE, it must be reviewed and technically approved by the National RAN design review team before it is considered in the design.

In cases where the coverage footprint from the site is expected to be less than 360 degrees due to natural obstructions, narrower horizontal beamwidth antennas should be considered so that proper isolation is maintained between sectors and at the same time three (3) sectors utilized on the site. Narrow beamwidth antennas typically require following the exception process to order the antennas. However, effort is being made to make the narrow beamwidth antennas to be available on the approved antenna list.

For high capacity sites, a six sector configuration should be considered for use in the designs (subject to LTE Equipment support). When a 6-sector configuration is considered, it is important

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to make sure that narrower horizontal beamwidth antennas are used and proper separation and isolation maintained between sectors.

The summary of the transmitter configuration options is as summarized on the table below.

Number of Transmitters Per Sites	LTE Application
Omni	Not to be used for outdoor macros with prior approval from the HQ RAN Design Review team
2-sectors	Highways/Roadsides/Canyons
3-sectors	**Standard Configuration**
>3 sectors (up to 6)	High Capacity Sites

Figure 22: Summary of Transmitter Configurations

4.4 Sites-Transmitter-Cell Configuration and Frequency Band Definition

For LTE it is important to note that the frequency band assignment has been taken to the cells table in Atoll. This allows for the easy configuration of cells of varying carrier bandwidth and to take into consideration of the power dimensioning (for example, Reference Signal EPRE) of the cells automatically based on the number of resource blocks available. The following should be noted as LTE projects are configured in Atoll.

- 700 MHz and AWS projects should be configured in one Atoll project. This is consistent with the project templates that have been created for LTE.

  For dual band design markets, the site-transmitter-cells relationship for the sites that have both 700MHz and AWS cells configured in the design will be as shown below.

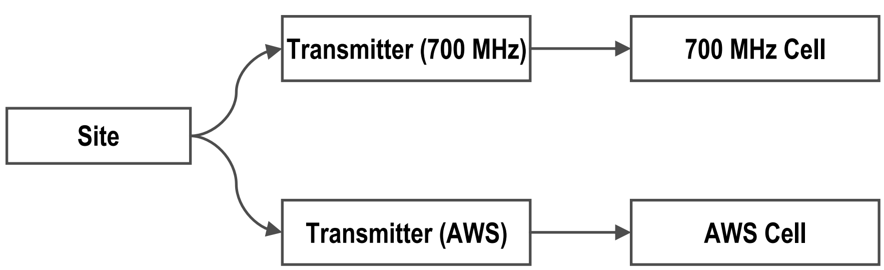

Figure 23: Site-Transmitters-Cells for Dual Band Design Markets

- In cases where a only a single band design is being carried out, then the site-transmitter-cell relationship will be as shown below:

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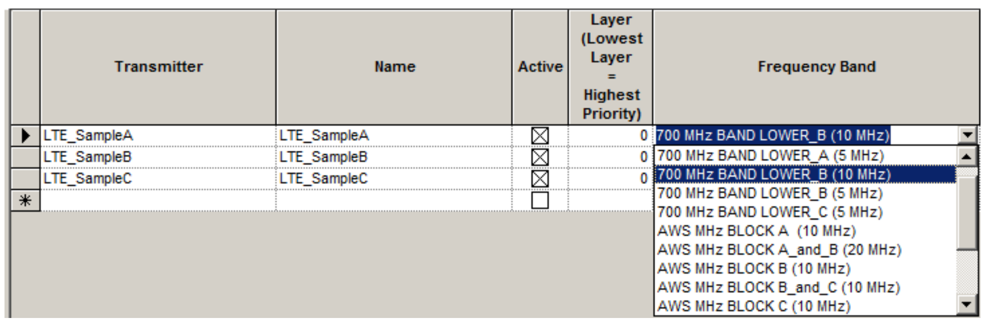
Figure 24: Site-Transmitters-Cells for Single Band Design Markets

- On the transmitters table, all the transmitters are to be configured with their frequency band specific transmitters properties (propagation models, feeder assignment, antenna assignment, TMA/no-TMA, etc.). Only the pre-defined feeder equipment, imported antenna patterns and pre-defined TMA equipment in the projects are to be used for the designs.
- On the cells table, the frequency bands and the corresponding channel bandwidth from the frequency band pull down menu are to be selected. Only the pre-defined frequency band table entries are to be used.



Transmitter	Name	Active	Layer (Lowest Layer = Highest Priority)	Frequency Band
LTE_SampleA	LTE_SampleA	☒	0	700 MHz BAND LOWER_B (10 MHz)
LTE_SampleB	LTE_SampleB	☒	0	
LTE_SampleC	LTE_SampleC	☒	0	
		☐		

Figure 25: Cells Table Frequency Band Pull Down Menu

4.5 Clutter Properties Setup and Indoor Losses

The default indoor losses configured for all the 38 clutter classes should be used for all phases of the LTE designs. However, if a market wishes to use non-standard indoor Loss values based on detailed measurements or other supporting data, RAN HQ approval is required prior to their use in the designs

Under the ‘Geo’ tab, double click on ‘Clutter Classes’ folder. Under the ‘Description’ tab, verify and set the following:

- Height (m) or (ft) depending on units used in the project
- Model standard deviation (dB)
- C/I Standard Deviation (dB)
- Indoor Loss (dB)
- SU-MIMO Gain Factor
- Additional Diversity Gain (DL) (dB)
- Additional Diversity Gain (UL) (dB)

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Clutter height values should be the ones that your propagation models are based on. The values should not be changed and should be an exact replica of the clutter heights delivered with the propagation models for 700 MHz and AWS designs. Any modifications to the 'Height' column invalidates all propagation models in the project. The penetration losses for all the clutter classes in the LTE analysis should be set as shown below:

Code	Name	Height (m)	Model standard deviation (dB)	C/I Standard Deviation (dB)	Indoor Loss (dB)	SU-MIMO Gain Factor	Additional Transmit Diversity Gain (dB)	Additional Receive Diversity Gain (dB)
1	Core Urban	Project Dependent - Based on Model Tuning	7.7	1	15	1	0	0
2	Dense Urban		7.7	1	15	1	0	0
3	Urban		7.7	1	15	1	0	0
4	Commercial_Industrial		7.7	1	15	1	0	0
5	Suburban few Trees		6.7	1	12	1	0	0
6	Suburban with Trees		6.7	1	12	1	0	0
7	Residential few Trees		6.7	1	12	1	0	0
8	Residential with Trees		6.7	1	12	1	0	0
9	Rural few Trees		6.9	1	6	1	0	0
10	Rural with Trees		6.7	1	6	1	0	0
11	Convention Center		7.7	1	15	1	0	0
12	Major Stadium		6.9	1	12	1	0	0
13	Minor Stadium_Theme Park_Fairgrounds		6.9	1	6	1	0	0
14	High School Building		6.9	1	12	1	0	0
15	University_College Building		7.7	1	15	1	0	0
16	Airport Runway		6.9	1	6	1	0	0
17	Airport Terminal		7.7	1	15	1	0	0
18	Airport Building		6.7	1	12	1	0	0
19	Airport Rural		6.7	1	6	1	0	0
20	Primary Road		6.7	1	6	1	0	0
21	Secondary Road		6.7	1	6	1	0	0
22	Tertiary Road		6.7	1	6	1	0	0
23	Other Paved_Impervious		6.7	1	6	1	0	0
24	Golf Course_Park_Urban Recreation		6.9	1	6	1	0	0
25	Open In Urban		6.9	1	6	1	0	0
26	Open Suburban Residential		6.9	1	6	1	0	0
27	Open Rural		6.9	1	6	1	0	0
28	Grassland_Rangeland		6.9	1	6	1	0	0
29	Cultivated Cropland		6.9	1	6	1	0	0
30	Scrub Vegetation		6.9	1	6	1	0	0
31	Shrubland_Woodland		6.9	1	6	1	0	0
32	Deciduous Forest		6.9	1	6	1	0	0
33	Coniferous Forest		6.9	1	6	1	0	0
34	Mixed Forest		6.9	1	6	1	0	0
35	Forested Wetland		6.9	1	6	1	0	0
36	Wetland		6.9	1	6	1	0	0
37	Inland Water		6.9	1	6	1	0	0
38	Sea Water		6.9	1	6	1	0	0

Figure 26: LTE Design Clutter Property Parameters.

As part of the project template creation, any project pulled from the Atoll master server using the Atoll GeoSelector will automatically have the clutter properties configured by default. However, the LTE design engineer must review the clutter properties to make sure that it is accurate. If upon review, the clutter properties are seen to be inaccurate, then they must be re-configured. To facilitate the re-configuration of the of the clutter properties, the clutter script should be used that will automatically update all the clutter properties except the clutter height.

The following steps should be followed when using the scripts to update the clutter properties.

- Open the LTE project in Atoll located on the AT&T thin client server
- From the Atoll menu, go to **"Tools"** -> ***"Add-ins and Macros"*** and select ***"Add"***
- Browse to "F:\GlobalData\LTE Parameters" and select script called *38ClutterUpdate.vbs*
- Select the script and click on "run" to update the clutter properties
- Verify that clutter properties to make sure that the parameters were updated successfully.

Notes:

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1. If analysis are being done outside the AT&T thin client facilities using the same set of clutter data as those used by AT&T, the clutter update script can be requested from HQ RAN design for remote use.
2. The penetration losses must be set in order to take into account the additional penetration for the percentage of users that that are allocated as in-building users (during the traffic map configuration) when the Monte Carlo simulation is run. If the penetration losses are not set, all the users are considered as outdoor users during Monte Carlo simulations.

4.6 Propagation Model Assignment to Transmitters

When the area-based calibrated propagation models are delivered, polygon areas corresponding to the areas where each model applies (Assignment Map) is also delivered. All the models and the model tuning reports are located on the Atoll thin client servers in the folder F:\GlobalData|LTE_Models. Two sets of models are delivered:

1. 700 MHz Propagation Models
2. AWS Band Propagation Models

For clarity, the following terminology will be used in this section.

Model Template: This is the reference Atoll project file (*.atl) created by Newfield Wireless that contains the calibrated propagation models, Model Assignment Maps, Measurement data after filtering, processing and editing together with the drive test site information.

LTE Project: This is the LTE Atoll project file (*.atl) that is currently being used for the design into which the calibrated propagation models will be imported and assigned to the transmitters.

The steps to be used when working with the propagation models are as follows:

<u>Copying the Models from the Model Templates into the LTE Project:</u>

1) Open the *Model Template* for the market under consideration
2) Select "Modules" Tab in the Explorer pane
3) Open "Propagation Models" folder
4) Select the propagation model
5) Copy tuned model (Ctrl + C) from Newfield project
6) Open LTE project to be updated
7) Select model from the "Modules" Tab in the Explorer pane
8) Open "Propagation Models" folder
9) Paste the tuned model (Ctrl + V, **<u>not right-click</u>**) into the LTE project – Ctrl + V has to be used to paste the model otherwise it will not work
10) Repeat the process for every model that needs to be copied and immediately save the work upon completion.

Once all the models have been copied and the work saved, the next step is to have the models assigned to the transmitters.

<u>Assigning the Models to Transmitters:</u>

- 700 MHz Model Assignment to 700 MHz Transmitters
    - Assign the 700 MHz Band models to the 700 MHz transmitters in the *LTE Project* using the Model Assignment Maps provided with the models
    - No offsets are required for 700 MHz to account for the delta between the uplink and downlink frequencies.
- AWS Model Assignment to 2100/1700 MHz Transmitters

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- Assign the AWS Band models to the 2100 MHz transmitters in the *LTE Project* using the Model Assignment Maps provided with the models
- In the case of the 2100/1700 MHz modeling, the delta of 400 MHz needs to be accounted for in the modeling. Since two propagation models (2100 MHz and 1700 MHz) cannot be used on a transmitter to account for the downlink and uplink differences, a correction offset value is used.
- The difference is quantified as 20log(2100/1700) which is equivalent to a gain of 1.83 dB in the uplink.
- Correct the uplink (Reception) Miscellaneous Losses for the AWS transmitters with a gain of **1.83 dB** (that is a loss of **- 1.83 dB**). Despite the fact that there could be other hardware components (connectors, jumper cables, etc) that have different losses at the two different frequencies, they have deliberately not been included here as they will be within the margin of error of the analysis.

Note:

- For the life-cycle of the design, the propagation names and properties must not be changed. They should be identical to what was provided in the Model Template for the market. Any unauthorized changes will void the design when they are reviewed.

4.7 Considerations for Dense Urban Area Designs

While as part of the model assignment process, models other than Ray Tracing may have been assigned to Dense Urban transmitters, it is important to note that the SPM-based models are not the best suited models for designs in these dense urban areas. Until Ray Tracing models become available, the following guidance should be used in the dense urban areas.

- The dense urban polygons should be used as a starting point to define the areas that are considered as dense urban (where transmitters are consistently below clutter).
- The transmitters in the dense urban areas should be locked when wide area ACP runs are being carried out.
- The current optimized UMTS configuration (azimuths and tilts) should be used as the starting point for manual optimization using the best engineering judgment possible
- Consideration must be made for in-building users that are located in the vertical plane (3D) so that coverage is maintained.
- Special considerations to be made in the neighbor list and Physical Cell ID planning in the dense urban areas.

4.8 Main Calculation Radius and Resolution

Atoll uses the concept of main calculation radius and calculation resolution to determine the number of radials needed for path profile extraction in calculating pathloss before interpolation is used between the profiles. The relationship between the geo-data bin resolution and main calculation radius is as shown below.

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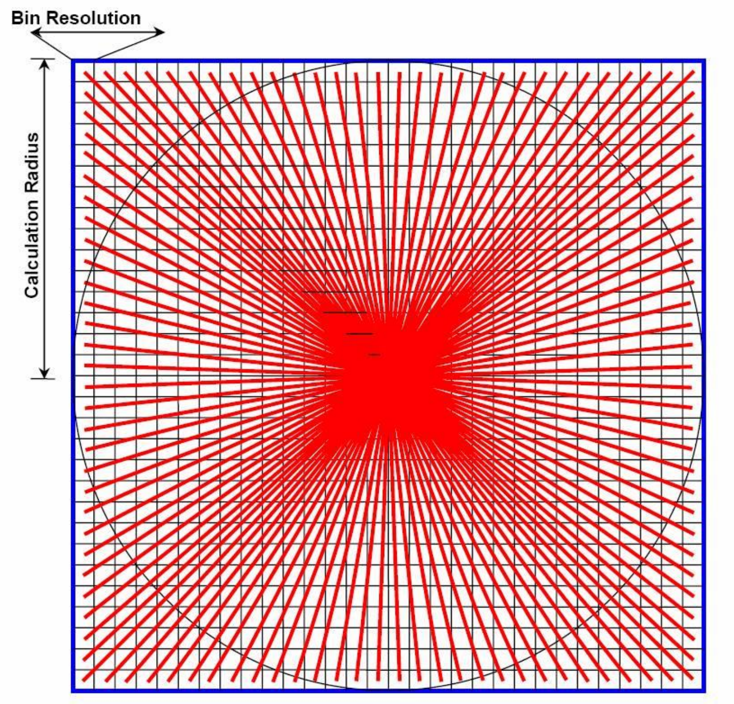

If the main calculation radius and resolution are not set correctly, it may result in an additional burden on computing resources, possible analysis failures and less efficient use of design time. To ensure that that the accuracy of the design analysis is maintained, the main calculation radius and resolution should be set for the transmitters in the Atoll transmitters table using the guidelines below:

Morphology	Main Calculation Radius	“Main Resolution" Settings
Urban and Suburban Sites	30 km	100 m
Rural Sites	50 km	150 m

4.9 Indoor/Outdoor Distribution of Users

The percentage of LTE in-building users that are located in-building must be set when the traffic density map is imported into Atoll. The values vary by clutter and for LTE have been set between a value of 75% and 100%. The table below shows the distribution on a clutter by clutter basis. For completeness, the default weights used for the traffic spreading is also included in the table. However, it must be noted that the clutter weights had already been taken into consideration when the traffic density map was exported from the UMTS project.

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Atoll clutter type	Traffic Weight	% indoor Users
Core Urban	350	75
Dense Urban	150	75
Urban	55	75
Commercial_Industrial	30	75
Suburban few Trees	30	75
Suburban with Trees	30	75
Residential few Trees	30	75
Residential with Trees	30	75
Rural few Trees	4	75
Rural with Trees	4	75
Convention Center	600	100
Major Stadium	250	75
Minor Stadium_Theme Park_Fairgrounds	25	75
High School Building	60	100
University_College Building	80	100
Airport Runway	5	75
Airport Terminal	250	75
Airport Building	15	100
Airport Rural	30	75
Primary Road	25	75
Secondary Road	35	75
Tertiary Road	35	75
Other Paved_Impervious	30	75
Golf Course_Park_Urban Recreation	15	75
Open in Urban	20	75
Open Suburban Residential	20	75
Open Rural	4	75
Grassland_Rangeland	3	75
Cultivated Cropland	3	75
Scrub Vegetation	3	75
Shrubland_Woodland	3	75
Deciduous Forest	5	75
Coniferous Forest	5	75
Mixed Forest	5	75
Forested Wetland	3	75
Wetland	3	75
Inland Water	3	75
Seawater	3	75
Hotel_Casino	250	100

Figure 27: Distribution of In-building vs. Outdoor LTE Users and Clutter Weights

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5. LTE Network Design Analysis

This section of the document outlines how the LTE design analysis should be carried out and lays the foundation of what will be considered in the design reviews in order to make sure that the designs are meeting the design goals.

5.1 LTE Design Views

The LTE designs will make use of a lot of existing network resources (existing sites, radiation centers, etc.). Using the various design options allowed (outlined in Section 1.3), it is therefore important that not only is the performance level with the minimum number of changes looked at but also to measure the gains made in performance as a result of considering the design choices outlined in Section 1.3. Only by doing a comparison between the design views can a cost-benefit analysis be carried out. As a result, the following three views are expected from every design.

1) Baseline Network View
2) Optimized Network View ("Best Possible RF Design" considering all allowed options)
3) Constructible Optimized Network View (based on feedback from C&E scoping and cost benefit analysis).

The "Baseline Network View", "Optimized Network View" ", and "Constructible Optimized Network View" forms the foundation of what will be considered as part of the LTE network design review and design acceptance.

Note:

The LTE design process differs from past UMTS and GSM practices in that the initial optimized RF design considers all possible design options (site relocations, radiation center changes, sparsing, separate antenna systems, etc.) without considering civil constraints. This yields the "best possible", or "wish list" RF design to maximize customer performance without considering constructability constraints. Then after C&E investigates construction and other limitations, the final design, the "Constructible Network View" is then generated and optimized.

For clarity, the various design views are as defined below:

Baseline Network View:

The baseline network view reflects the starting point of the LTE design. The baseline performance is the basis upon which all optimized design efforts are compared against.

The baseline network view is an LTE converted project, using the LTE module with the following considerations

a. Reviewed and approved LTE proxy design with the proxy design configuration

   or

b. If no LTE proxy design was done, existing UMTS network configuration with the following adjustments:
   - 850-only transmitters configured for 700 MHz or 1900 only transmitters configured for AWS. Broadband antennas applied to project and tilts/azimuths/heights maintained as those for UMTS

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or

c. If outside the UMTS polygon, existing GSM network configuration with the following adjustments:
    - 850-only transmitters configured for 700 MHz or 1900 only transmitters configured for AWS. Broadband antennas applied to project and tilts/azimuth/heights maintained as those for GSM

Optimized Network View:

The Optimized Network View represents the “Best Possible RF Design” considering all eight “degrees of freedom” listed in Section 1.3 (Design Options). The goal here is to not limit the initial design to “preconceived” limitations but instead come up with the best possible RF design the let C&E meet the challenge. Note the Optimized Network View is not the final design nor is it the design which sent to the vendor for certification.

Constructible Optimized Network View:

This Constructible Optimized Network View applies feedback from C&E to the Optimized Network View to finalize the LTE design. This essentially is taking the “best Possible RF Design” and applying what can, and can’t, be built to produce the final design. To arrive at this decision, C&E feedback is reviewed and a cost-benefit analysis of each site is completed. After this is completed, another round of optimization is typically required based on final “constructible” site configurations.

The Constructible Optimized network View is considered the final RF Design and is the design which is passed to the vendor for design certification.

The next section of this document provides guidance on each of the design views and how they should be configured as a project and designed with the aid of the Atoll LTE simulation module.

5.1.1 Baseline LTE Network View from LTE Proxy Design Projects

When the input to the LTE design analysis is based on the LTE proxy designs, the following checks must take place to ensure that the work done in the LTE proxy design does not go to waste.

- Only the approved design following an HQ RAN technical design review should be converted for LTE. This ensures that work done so far does not go to waste.
- The feedback from HQ RAN from the proxy design technical review, LTE Design Kickoff review and/or Pre-Design session (Section 6) must be included in the project as part of next phase of the LTE designs.

The next phase of the LTE design will make use of the converted proxy design project into an Atoll LTE module. The process for carrying out the conversion activity is as follows:

The HQ RAN design team facilitates the conversion of the proxy design project to an Atoll LTE module and this forms the baseline project for the LTE design. As part of the conversion, all non-standard and approved project content elements (non-approved antenna patterns, etc.) are deleted from the project and a default value used that will help the design engineers in identifying the transmitters whose properties needs to be reconfigured using the approved equipment properties that have been included as a standard configuration in all the converted LTE projects. The output of the conversion is entered in the Atoll master database where the engineer can then pull a copy for further design analysis.

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It is the LTE Design engineer's responsibility to complete the configuration of the project to make sure that it is ready for LTE design analysis. The list of items to be further configured by the LTE Design engineer includes, but not limited, to the following:

[ ] Re-naming of sites, transmitters and cells using the AT&T approved naming convention outlined in ND-00067

[ ] Project updates using feedback from the HQ RAN Technical Review team

[ ] Importation and Assignment of tuned propagation models (700 MHz and AWS) to transmitters

[ ] Calculation and assignment of miscellaneous losses for every transmitter in the project

[ ] Assignment of appropriate feeder types to transmitters using the pre-configured feeder types

[ ] Assignment of TMAs from the approved TMA list using the TMA guidelines

[ ] Configuration of the appropriate main calculation radius and main resolution for all the transmitters using the guidelines

[ ] Configuration of the RH locations in the project using the guidelines for RH configuration

[ ] Importation and Configuration of traffic density map for LTE Analysis

Once the steps above are completed and the project configuration completed, design analysis can then begin. The following flow-chart summarizes the steps that have been outlined above.

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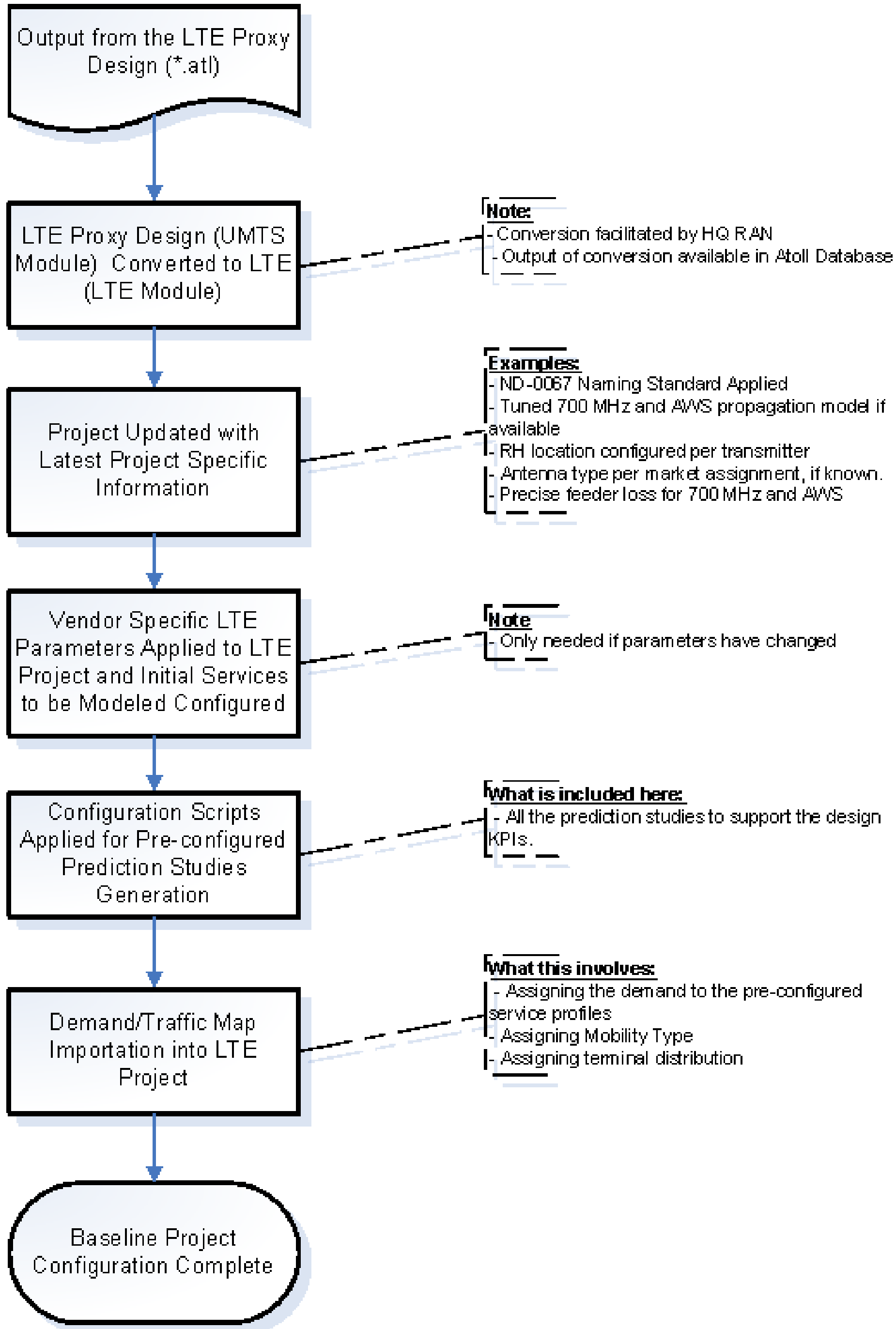

Figure 28 : Baseline LTE Designs from LTE Proxy Design Projects

5.1.2 Baseline LTE Network View from Existing UMTS Projects

In markets where LTE proxy designs where not done, existing UMTS project information has been used to establish the markets LTE project design template. The projects have been

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converted as a one-time activity and stored in the Atoll Oracle master database. As part of the process in creating the LTE project template for the market, all existing 850 MHz UMTS transmitters have been converted as 700 MHz LTE transmitters and all existing 1900 MHz UMTS transmitters have been converted as 2100 MHz LTE transmitters. Note that this is only to facilitate the conversion work being carried out for LTE. The converted sites should only act as a portfolio for candidate site selection and not as a mandate to use all the converted sites for LTE. Site selection is governed by the LTE network performance alone.

It is the LTE Design engineer's responsibility to obtain a copy of the project from the database to facilitate the LTE design activity.

The LTE Design engineer should carry out the follow

- [ ] Obtain a copy of the project from the master database and save it as an Atoll LTE *.atl document.
- [ ] Filter or choose the appropriate sites, transmitters and cells that are applicable to the markets LTE design condition under consideration (for example, sites within the LTE design polygon, transmitters applicable to the frequency band under consideration, making sure that only one transmitter per face is selected, etc.)

Once this is completed, the LTE Design engineer should proceed to the next steps outlined below to complete the configuration of the project in order to make sure that it is ready for LTE design analysis. The list of items to be further configured by the LTE Design engineer includes, but not limited, to the following:

- [ ] Re-naming of sites, transmitters and cells using the AT&T approved naming convention outlined in ND-00067
- [ ] Project updates using feedback from the HQ RAN Technical Review team
- [ ] Importation and Assignment of tuned propagation models (700 MHz and AWS) to transmitters
- [ ] Calculation and assignment of miscellaneous losses for every transmitter in the project
- [ ] Assignment of appropriate feeder types to transmitters using the pre-configured feeder types
- [ ] Assignment of TMAs from the approved TMA list using the TMA guidelines
- [ ] Configuration of the appropriate main calculation radius and main resolution for all the transmitters using the guidelines
- [ ] Configuration of the RH locations in the project using the guidelines for RH configuration
- [ ] Importation and Configuration of traffic density map for LTE Analysis

Once the steps above are completed and the project configuration completed, design analysis can then begin.

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5.1.3 Baseline LTE Network View from Existing GSM Projects (no UMTS)

There may be situations where a market did not go through and LTE proxy design exercise and does not have an existing UMTS network. In this case, HQ RAN will facilitate the creation of an LTE template using the existing GSM project information and archived in the database. As part of the LTE template creation, 850 MHz GSM transmitters will be converted to 700 MHz LTE transmitters and all existing 1900 MHz GSM transmitters will be converted as 2100 MHz LTE transmitters. Note that this is only to facilitate the conversion work being carried out for LTE. The converted sites should only act as a portfolio for candidate site selection and not as a mandate to use all the converted sites for LTE. Site selection is governed by the LTE network performance alone.

It is the LTE Design engineer's responsibility to obtain a copy of the project from the database to facilitate the LTE design activity.

The LTE Design engineer should carry out the follow

- [ ] Obtain a copy of the project from the master database and save it as an Atoll LTE *.atl document.
- [ ] Filter or choose the appropriate sites, transmitters and cells that are applicable to the markets LTE design condition under consideration (for example, sites within the LTE design polygon, transmitters applicable to the frequency band under consideration, making sure that only one transmitter per face is selected, etc.)

Once this is completed, the LTE Design engineer should proceed to the next steps outlined below to complete the configuration of the project in order to make sure that it is ready for LTE design analysis. The list of items to be further configured by the LTE Design engineer includes, but not limited, to the following:

- [ ] Re-naming of sites, transmitters and cells using the AT&T approved naming convention outlined in ND-00067
- [ ] Project updates using feedback from the HQ RAN Technical Review team
- [ ] Importation and Assignment of tuned propagation models (700 MHz and AWS) to transmitters
- [ ] Calculation and assignment of miscellaneous losses for every transmitter in the project
- [ ] Assignment of appropriate feeder types to transmitters using the pre-configured feeder types
- [ ] Assignment of TMAs from the approved TMA list using the TMA guidelines
- [ ] Configuration of the appropriate main calculation radius and main resolution for all the transmitters using the guidelines
- [ ] Configuration of the RH locations in the project using the guidelines for RH configuration
- [ ] Importation and Configuration of traffic density map for LTE Analysis

Once the steps above are completed and the project configuration completed, design analysis can then begin.

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5.2 Optimized LTE Network View Design Steps

No matter what the source of the baseline project is, once it is properly configured to LTE, traffic maps imported into the project and all sanity checks completed, the LTE design analysis process can then be started towards the goal of the "best possible LTE RF design". This step must include considerable design freedom utilizing all eight “degrees of freedom” listed in Section 1.3 (Design Options). The Optimized Network View is not the final design, but the best possible RF design to pass to C&E for attempt to build.

5.3 Constructible Optimized Network View Design Steps

Once all the feedback from C&E is received for every site in the LTE design polygon, it must be reviewed by the entire review team (to include but not limited to the LTE Design team, C&E, market RF management, HQ RAN) the final results of the review is then incorporated into the optimized design. This is followed by a re-optimization of the design using the results of the approved feedback from C&E as constraints. This then forms the constructible optimized design.

The flow chart below summarizes the migration from one design view to the next.

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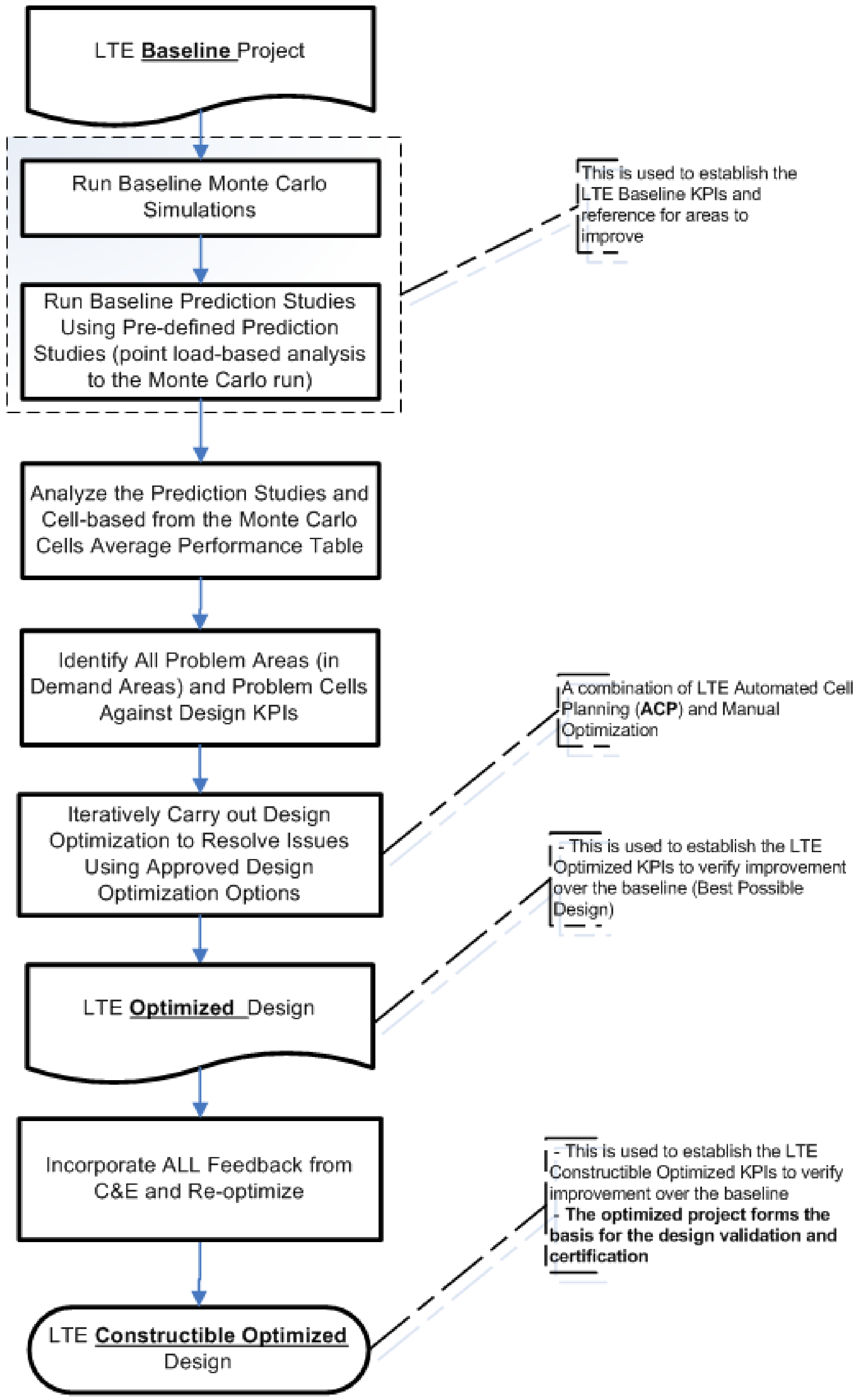

Figure 29 : Going from an LTE Baseline Design to an LTE Optimized Design

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The details on each section of the above flow chart are outlined in subsequent sections of this document.

5.4 Monte Carlo Simulations and Settings

The calculations performed during a Monte Carlo simulation include determining the serving cells for each mobile, performing fractional power control and power adjustment, calculating the uplink allocated bandwidth, calculating the SINR (radio conditions), determining the best available bearers for mobiles, calculating channel throughputs at mobile locations, scheduling and resource allocation to mobiles, and calculating the user throughputs depending on the resources allocated to them. MIMO systems are fully modeled in the calculations during Monte Carlo simulations. Due to all the advantages of Monte Carlo simulations using a traffic map compared to a fix load in the cells table and carrying out a static analysis, the guideline is that on Monte Carlo simulations are to be used for AT&T's LTE designs.

Once the project configuration is completed, traffic density map imported and configured into the project and pathloss generated, Monte Carlo simulations can then be run. All the designs in Atoll will be evaluated based on Monte Carlo simulations only and the pre-defined prediction studies. All LTE designs using Atoll should be based on the following Monte Carlo simulations settings.

Iterative simulation runs when looking at different design options:

- Number of simulations: 5
- Max DL Traffic Load: 100%
- Max UL Traffic Load: 100%
- Global Scaling Factor: *This is market dependent and is derived following the process in the next section*
- Maximum number of Iterations: 100
- DL Traffic Load Convergence Threshold: 5%
- UL Traffic Load Convergence Threshold: 5%
- UL Noise Rise Convergence Threshold: 1 dB

Final simulation run leading to LTE design certification:

- Number of simulations: 20
- Max DL Traffic Load: 100%
- Max UL Traffic Load: 100%
- Global Scaling Factor: *This is market dependent and is derived following the process in the next section*
- Maximum number of Iterations: 100
- DL Traffic Load Convergence Threshold: 2%
- UL Traffic Load Convergence Threshold: 2%
- UL Noise Rise Convergence Threshold: 0.5 dB

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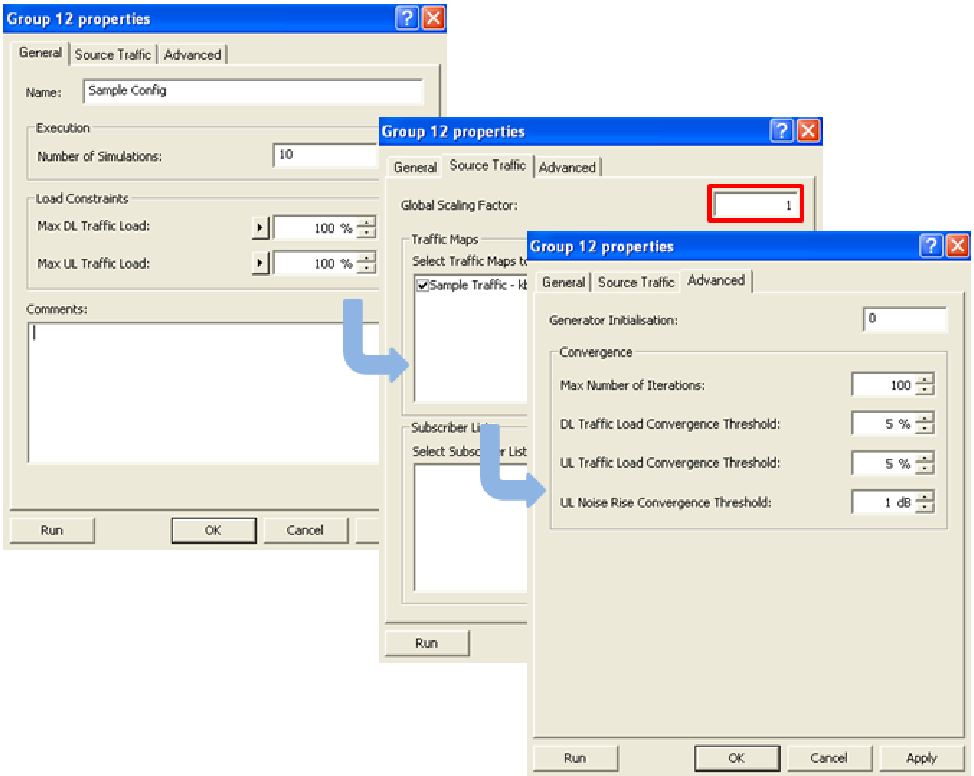

Figure 30 : LTE Monte Carlo Simulation Settings (Representative Sample)

5.5 Determining the Global Scaling Factor for LTE Designs

Since the UMTS HS traffic density map is being used as the foundation for the LTE design analysis, a key step needed in the process is to determine the global scaling factor to be used in the design once the data is imported into the LTE project. The steps below explain how this is accomplished.

<u>Information Needed:</u>

- UMTS HS Data Forecast - That is, Traffic Map from UMTS Project (*.bil Export)
- Downlink Cell Aggregate Throughput Commitment. For the purpose of the traffic scaling, the following values should be used.
- Aggregate DL Cell Throughput:
  - 13.4 Mbps for 10 MHz BW
  - 6.7 Mbps for 5 MHz BW
- Cell Edge throughput requirement of:
  - 1.0 Mbps for 10 MHz BW
  - 500 kbps for 5 MHz BW

The key assumption here is to estimate the approximate number of users per cell based on the cell edge throughput requirement and aggregate cell downlink throughput. This works out to be as follows:

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- Approximate number of users per cell = 13.4 (for 10 MHz BW)
- Approximate number of users per cell = 13.4 (for 5 MHz BW)

Having established the approximate number of users per cell, the traffic density map will then be looked at in relationship to how the LTE services are configured. In this case, FTP is being looked at.

1. Import UMTS *.bil traffic density map into LTE as LTE Traffic map
2. Set the traffic properties by assigning 100% of the imported traffic density map to the FTP Service configured in the LTE project (for Data Only Design)
3. Apply indoor/outdoor distribution - that is 75% and 100% depending on clutter type (see Section 4.9)
4. Make sure only the baseline transmitters in the LTE project are active.
5. Run **1** baseline Monte Carlo simulation (Number of Simulations = 1) to obtain the number of LTE users linked to the FTP service (Request only – not the served users). The single simulation is used here for the calibration of the traffic map only
6. Obtain number of active cells in the network from the same results of the single Monte Carlo simulation. Make sure that during this step, either NO focus zone exists in the project or the focus zone is set identically to the computation zone (LTE design polygon). This is to ensure that the cells under consideration are the active cells in the entire design area.
7. Calculate Average Number of LTE users Per Cell = [Total LTE Users (Request)]/[Number of active cells]
8. Scaling Factor = [13.4]/ [Average Number of LTE users Per Cell]

This market specific scaling factor forms the basis for all the LTE designs (and subsequent simulations) for that market associated with the particular UMTS *.bil file.

IMPORTANT: This scaling factor shall be considered the “Maximum Load” point for design efforts. That is, if the “Scaling Factor” from step 8 above is ***Y***, then the Global Scaling Factor (GSF) used in simulations would be set to ***Y*** for any simulation runs requiring the "Maximum load". Note that depending on the UMTS HS traffic volume, ***Y*** can result in either a scaling up or a scaling down of the source data to getting the average of 13.4 users per cell in the LTE design polygon. Due to the profile of the UMTS HS data, some cells may show higher than the 13.4 users while others may show lower than 13.4 users as the input demand. However, the average across the design polygon will be about 13.4.

Note: Scaling factor and supporting material used in its calculation must be reviewed by the HQ RAN Design Review team and approved as part of the Pre-Design check (Section 6) before it is used for design optimization of the LTE designs.

5.6 Predefined Prediction Studies Settings

As part of the LTE designs various prediction studies are required to facilitate the review of the designs and to judge the quality of the network designs. All the predictions studies that are specified as part of the design KPIs have been pre-configured for use in the projects. The pre-configured prediction studies ensure that all studies are generated consistently across all LTE projects.

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The pre-configured prediction studies are as shown below and is made up of the baseline set of prediction studies as well as the optimized view of the design which should be used once the design options have been utilized to bring out the best LTE network configuration.

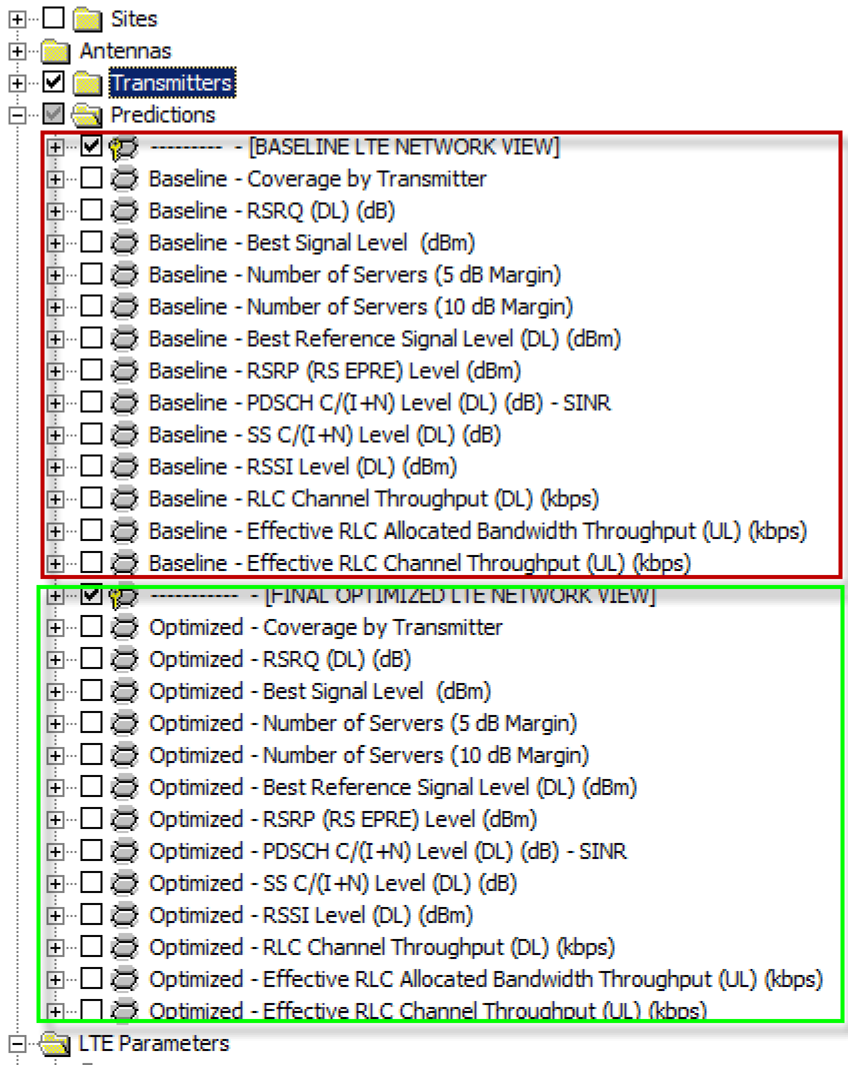

Figure 31 : Pre-defined LTE Network Prediction Studies (Representative Sample)

The prediction studies configuration file (LTE_Predictions.cfg) is located at F:\GlobalData\LTE Parameters.

All the statistics for the prediction studies and Monte Carlo results that lead towards the design review and cluster certificates should be carried out on a cluster by cluster basis or on a super cluster basis. For clarity, the following definitions and process should be used to establish the cluster and super clusters to be used during the design process.

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5.7 Clusters, Super Clusters, Computation and Focus Zone Definitions

This section of the document gives the definitions of some key polygons that will be used during the course of the LTE designs.

5.7.1 Clusters

Per Attachment H, an E-UTRAN Cluster is defined as all Products, including but not limited to Cell Sites and E-UTRAN Network Elements within a geographic zone defined by the contiguous coverage area of a group of adjacent cell sites including the greater of ten (10) cell sites or thirty (30) sectors without exceeding thirty (30) cell sites or ninety (90) sectors as defined by AT&T.

For the purpose of the LTE design and to establish the cluster boundaries at the start of the design, using the baseline network design, an average of a group of twenty (20) adjacent cell sites within a geographic area providing contiguous coverage is used. Note the following:

- The defined cluster should not be changed for the life of the design. Once the clusters are established, AT&T shall have the right to add additional sites within the cluster or remove sites as part of the design optimization towards achieving the end goal of an efficient LTE network design.
- The sum of the areas of the individual clusters within an LTE polygon must equal that of the LTE polygon. No overlap is allowed between clusters.
- For LTE polygons with less than a group of 20 adjacent cells sites in a geographic area, the cluster is made up of all the cells sites in the LTE polygon. This is defined as a small cluster.
- The Pre-launch KPI GNG Drive process will use the cluster definitions as used in the design process. That is, Drive clusters are identical to design clusters.

Locking down the polygon to the average group of twenty (20) adjacent cell sites within a geographic area ensures that as sites are added or removed in the cluster, we stay within the original definition of a cluster as outlined in Attachment H.

5.7.2 Cluster Boundaries

Cluster boundaries must be defined and developed in ATOLL for any LTE polygon with more than one cluster. The general rules for cluster boundaries are:

- Cluster boundaries along the outer edge of the LTE polygon should follow the approved LTE polygon boundary.
- Where two (or more) clusters abut to one another within the same LTE polygon, the cluster boundary along the cluster edges should follow the best server profile of the cells within each cluster.

Cluster boundaries should be saved as *.agd files in ATOLL and given file names to clearly identify the market and cluster.

5.7.3 Super Cluster

A “Super Cluster” is defined as a contiguous LTE service area covered by 2 to 4 contiguous clusters. For the LTE designs, the classification of a “Super Cluster” is based on the size of the

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market and the number of baseline sites in the LTE polygon. Note that even when super clusters are utilized, the individual clusters must still be defined.

The table below summarizes how statistics should be computed and cluster certificates generated based on market size.

Number of Sites in LTE Polygon	Statistics and Cluster Certificates	Statistics and Design Certificates based on:
Up to 100	N/A – use Clusters only	Cluster Level
>100 up to 200	2 Clusters per Super Cluster	Super Cluster (40 sites typical)
> 200 up to 400	3 Clusters per Super Cluster	Super Cluster (60 sites typical)
> 400	4 Clusters per Super Cluster	Super Cluster (80 sites typical)

All clusters and super clusters must be jointly created by the LTE RF Design team and the AT&T market and approved by the HQ RAN Design Review team before they are used for statistics generation.

5.7.4 Computation Zone

The computation zone is used to define the area where Atoll carries out calculations. When you create a computation zone, Atoll carries out the calculation for all transmitters that are active, filtered and whose propagation zone intersects a rectangle containing the computation zone. Therefore, it takes into consideration transmitters that are both inside and outside the computation zone if they have an influence within the computation zone. Additionally, the computation zone defines the area within which the coverage prediction results will be displayed.

For all the initial LTE designs, the LTE design polygon (see section 2.7) should be set as the computation zone.

5.7.5 Focus Zone

The focus zone is used to define an area in Atoll on which statistics can be extracted and on which reports are made. It is important not to confuse the computation zone (defined in section 5.7.4) with the focus. The focus zone only defines the area taken into consideration when generating reports and results. Atoll bases the statistics on the area covered by the focus zone.

- If no focus zone is defined, Atoll will use the computation
- By using a focus zone you can select the areas of coverage predictions or other calculations on which you want to generate reports and results.

For all the LTE designs, when statistics and reports are being generated, focus zones used will be based on the cluster and super cluster boundary criteria outlined in sections 5.7.1, 5.7.2 and 5.7.3 above. The sum of the individual focus zones must equal the computation zone.

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6. LTE Design Evaluation Process

The goals of the LTE design specifically calls for the LTE designs to achieve the following:

- Provide outstanding service to the customer
- Maximize the efficiency of deployed network resources
- Provide an efficient inter-technology overlay LTE network

These goals can only be achieved when particular attention is paid in every aspect of the LTE design by the LTE Design engineer. To this end, the design evaluation process has been divided into four categories namely: LTE polygon, site, cluster and network performance evaluations.

The following reviews and checks are mandatory and must be scheduled with the HQ RAN Design reviewer responsible for the specific LTE design market:

Milestone	Review and Prerequisites:
LTE Design Kickoff and Polygon Evaluation	*Purpose*: • Review the initial baseline ATOLL file (baseline simulations not required at this point) as ready for RF design team to start design work. • Review LTE Design Polygon • Establish LTE Design Project Plan (including timelines for deliverables) *Prerequisites*: a) LTE ATOLL file conversion complete b) HS Traffic file built and exported
LTE Pre-Design Review	*Purpose:* • To establish the correct foundation for the LTE designs *Prerequisites:* a) Scaling Factor Review b) Cluster and Super-Cluster Definitions
LTE Optimized Design Review	*Purpose:* • Review the output of the LTE optimized design *Prerequisites:* • LTE Design Optimized completed, Design KPIs generated and all optimized design output ready.
LTE Constructible Optimized Design Review	*Purpose:* • Review the output of the Constructible Optimized Design *Prerequisites:* • All C&E feedback incorporated into design • Design optimization after C&E feedback completed • All constructible optimized design output ready

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6.1.1 LTE Polygon Evaluation

The LTE polygon is to be used to drive most of the decisions as to where LTE service is desired. As a result, it is extremely important that the polygon is carefully reviewed to make sure that no "smart" border issues exist. The following includes but not limited to the items that should be taken into consideration when reviewing the LTE polygon:

- ✓ LTE polygon boundaries relative to AT&T key customer account locations
- ✓ LTE polygon boundaries relative to convention centers
- ✓ LTE polygon boundaries relative to shopping malls
- ✓ LTE polygon boundaries relative to University campuses
- ✓ LTE polygon boundaries relative to major Airports
- ✓ LTE polygon boundaries relative to major sporting venues
- ✓ LTE polygon boundaries relative to major high traffic road intersections
- ✓ LTE polygon boundaries relative to existing extremely high carried data volume sites on the UMTS network
- ✓ LTE polygon boundaries relative to downtown urban areas

The use of Google Earth and feedback from the local market (market knowledge) can greatly facilitate the review process. All issues identified must be brought to the attention of the HQ RAN design review team within the first five (5) business days of the start of the LTE design for each market. The issues with the polygons will then be routed to the FNP team for resolution.

Evaluation Milestone: Reviewed at Kickoff and Polygon Evaluation Meeting

6.1.2 Individual Site Performance Evaluation

This stage of the evaluation looks at each site in the design with the aim of achieving the following:

- ✓ Verification of location of site relative to its intended service area (traffic centers). Having a site as close as possible to the users and demand center will yield the following benefits:
  - maximizes resource efficiency by having all the transmitters/cells of the site uniformly distributed to carry the load of the intended service area
  - users will be using the network resources in a more efficient manner
  - since the users are closer to the site, in-building users will experience a much better in-building service due to the improved pathloss between the eNode-B and the users
  - Reduction of dominance issues (number of servers) in the demand areas as a result of the presence of a dominant server in the area.
  - Less interference in the area where the users are thereby resulting in good signal quality (RSRQ) and SINR

- ✓ Verification of antenna selection (antenna type, vertical and horizontal beamwidth, gain, etc.) choices on a transmitter by transmitter bases
- ✓ Verification of azimuths of the transmitters relative to the intended service area
- ✓ Verification of the coverage footprint of every transmitter on the site
- ✓ Verification of the radiation center (antenna height)
- ✓ Hardware configuration (feeders, RH location, TMA choice, etc.)
- ✓ Number of configured transmitters on the site
- ✓ Azimuth separation between transmitters of the same site

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Evaluation Milestone: Reviewed at Optimized Design Review and Constructible Optimized Design Reviews.

The following subsections emphasize and provide further guidance on some of the evaluation items not covered elsewhere in this document.

6.1.2.1 Azimuth Separation between Transmitters (Sectors)

A minimum Azimuth separation/Isolation between transmitting antennas on the site must be maintained. The minimum separation between the sectors of adjacent transmitters of the same site should be calculated as follows (based on an interlocking grid 3 sector configuration on a site covering 360^o:

[360^o /(Number of Sectors)] +/- [30/(Number of Sectors)]^o

The table below summarizes the separation between sectors and its relationship to the number of sectors on the site:

Number of Sectors on Site	Azimuth Separation Between Sectors
3	120^o +/- 10^o
4	90^o +/- 8^o
5	72^o +/- 6^o
6	60^o +/- 5^o

Initially, most of the sites in the LTE network will be configured for three sectors (transmitters). In this case, the general rule for the separation between sectors is governed by:

Separation between Sectors (Transmitters) = 120^o +/- 10^o

All designs will be reviewed to make sure that this rule is closely followed.

6.1.2.2 Antenna Selection Rules and Maintaining Separation Between Sectors

Selecting the correct antenna and maintaining the separation between sectors while making sure coverage/capacity is not compromised goes hand-in-hand. The following equation has been used to establish the separation between sectors based on the horizontal beamwidth of antennas on two sectors.

Derived Separation = Max ($\theta_{sector1}$, $\theta_{sector2}$) + 0.5* ($\theta_{sector1}$+ $\theta_{sector2}$) (degrees)

Where **θ** is the horizontal beamwidth of the antenna

For a 3-sectored interlocking grid design, taking into consideration the choices of antennas in the AT&T approved antenna, proper antenna selection can be carried out. The table that follows gives the guidance on antenna selection so as to meet the spacing requirements 120^o +/- 10^o. The following diagram illustrates the relationship between antenna horizontal beamwidth and azimuth separation between sectors of a typical site separated by 120^o.

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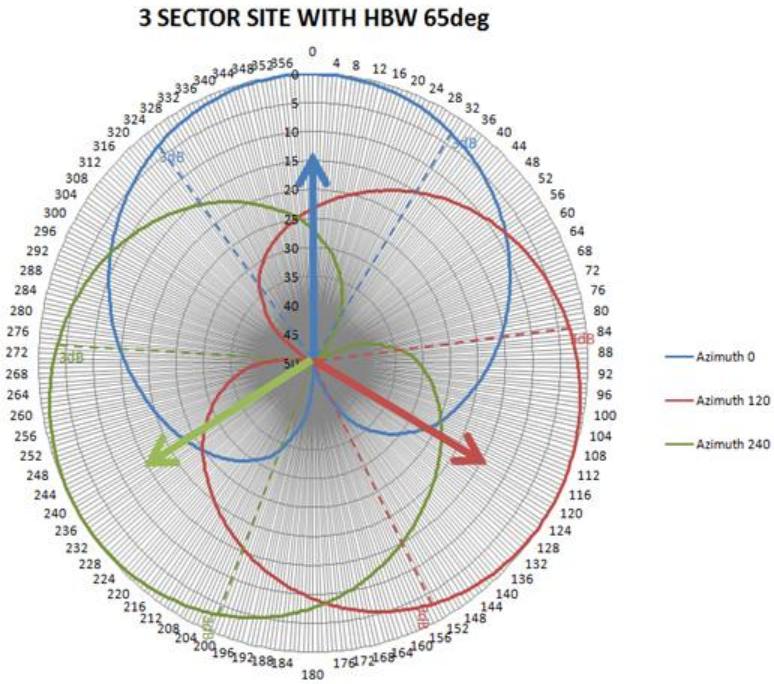

Figure 32 : Depiction of Antenna HBW with for Three Sectors with 65 degrees with Required Azimuth Sector Separation

Sometime due to coverage or capacity concern, two antennas (azimuth separation) may be close to each other. This results in an excessive overlap between some of the sectors on the site as well as capacity and coverage loss in the network. The diagram below illustrates this undesired configuration - excessive separation between some of the sector on the site and not enough separation on between the other sectors.

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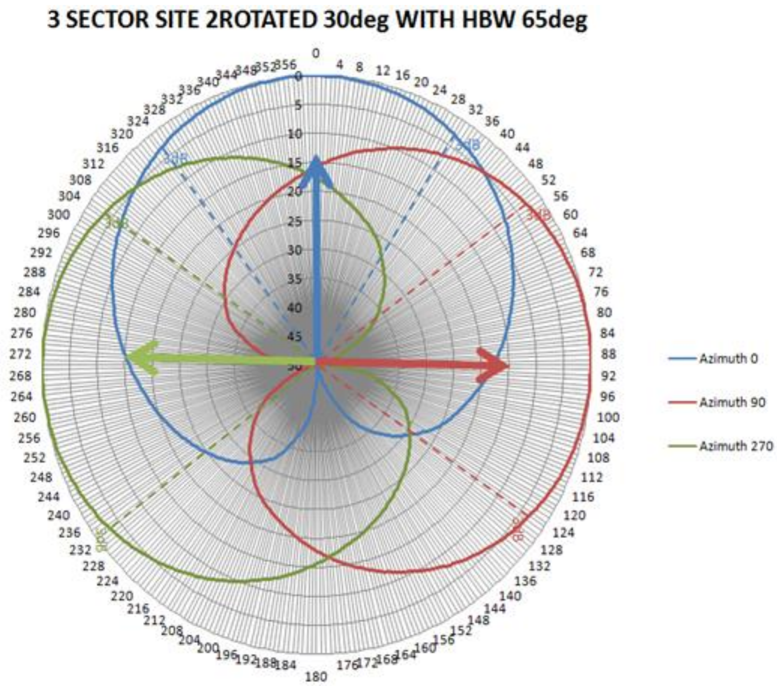

Figure 33 : Depiction of Antenna HBW with for Three Sectors with 65 degrees with Undesired Azimuth Sector Separation

The tables below show two examples (for 3-sectored and 4-sectored sites) of the derived azimuth separation between any two sectors of a site. Note that the tables are based on the precise HBW values of the antennas at the different supported frequencies. Only the HBW of the antennas in the current approved antenna list is considered here.

Derived Separation for a 3-Sectored Site with 120° +/- 10°

$\theta_{sector2}$ (Degrees) across; $\theta_{sector1}$ (Degrees) down

	52	56	60	61	63	65	67	68	69	71	73	83	85	88	89
52	104.0	110.0	116.0	117.5	120.5	123.5	126.5	128.0	129.5	132.5	135.5	150.5	153.5	158.0	159.5
56	110.0	112.0	118.0	119.5	122.5	125.5	128.5	130.0	131.5	134.5	137.5	152.5	155.5	160.0	161.5
60	116.0	118.0	120.0	121.5	124.5	127.5	130.5	132.0	133.5	136.5	139.5	154.5	157.5	162.0	163.5
61	117.5	119.5	121.5	122.0	125.0	128.0	131.0	132.5	134.0	137.0	140.0	155.0	158.0	162.5	164.0
63	120.5	122.5	124.5	125.0	126.0	129.0	132.0	133.5	135.0	138.0	141.0	156.0	159.0	163.5	165.0
65	123.5	125.5	127.5	128.0	129.0	130.0	133.0	134.5	136.0	139.0	142.0	157.0	160.0	164.5	166.0
67	126.5	128.5	130.5	131.0	132.0	133.0	134.0	135.5	137.0	140.0	143.0	158.0	161.0	165.5	167.0
68	128.0	130.0	132.0	132.5	133.5	134.5	135.5	136.0	137.5	140.5	143.5	158.5	161.5	166.0	167.5
69	129.5	131.5	133.5	134.0	135.0	136.0	137.0	137.5	138.0	141.0	144.0	159.0	162.0	166.5	168.0
71	132.5	134.5	136.5	137.0	138.0	139.0	140.0	140.5	141.0	142.0	145.0	160.0	163.0	167.5	169.0
73	135.5	137.5	139.5	140.0	141.0	142.0	143.0	143.5	144.0	145.0	146.0	161.0	164.0	168.5	170.0
83	150.5	152.5	154.5	155.0	156.0	157.0	158.0	158.5	159.0	160.0	161.0	166.0	169.0	173.5	175.0
85	153.5	155.5	157.5	158.0	159.0	160.0	161.0	161.5	162.0	163.0	164.0	169.0	170.0	174.5	176.0
88	158.0	160.0	162.0	162.5	163.5	164.5	165.5	166.0	166.5	167.5	168.5	173.5	174.5	176.0	177.5
89	159.5	161.5	163.5	164.0	165.0	166.0	167.0	167.5	168.0	169.0	170.0	175.0	176.0	177.5	178.0

Figure 34 : Choices of Antenna Horizontal Beamwidth and Impact to Minimum Separation on 3-Sectored Sites

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Derived Separation for a 4-Sector Site with 90° +/- 8°

$\theta_{sector2}$ (Degrees) across; $\theta_{sector1}$ (Degrees) down

	52	56	60	61	63	65	67	68	69	71	73	83	85	88	89
52	104.0	110.0	116.0	117.5	120.5	123.5	126.5	128.0	129.5	132.5	135.5	150.5	153.5	158.0	159.5
56	110.0	112.0	118.0	119.5	122.5	125.5	128.5	130.0	131.5	134.5	137.5	152.5	155.5	160.0	161.5
60	116.0	118.0	120.0	121.5	124.5	127.5	130.5	132.0	133.5	136.5	139.5	154.5	157.5	162.0	163.5
61	117.5	119.5	121.5	122.0	125.0	128.0	131.0	132.5	134.0	137.0	140.0	155.0	158.0	162.5	164.0
63	120.5	122.5	124.5	125.0	126.0	129.0	132.0	133.5	135.0	138.0	141.0	156.0	159.0	163.5	165.0
65	123.5	125.5	127.5	128.0	129.0	130.0	133.0	134.5	136.0	139.0	142.0	157.0	160.0	164.5	166.0
67	126.5	128.5	130.5	131.0	132.0	133.0	134.0	135.5	137.0	140.0	143.0	158.0	161.0	165.5	167.0
68	128.0	130.0	132.0	132.5	133.5	134.5	135.5	136.0	137.5	140.5	143.5	158.5	161.5	166.0	167.5
69	129.5	131.5	133.5	134.0	135.0	136.0	137.0	137.5	138.0	141.0	144.0	159.0	162.0	166.5	168.0
71	132.5	134.5	136.5	137.0	138.0	139.0	140.0	140.5	141.0	142.0	145.0	160.0	163.0	167.5	169.0
73	135.5	137.5	139.5	140.0	141.0	142.0	143.0	143.5	144.0	145.0	146.0	161.0	164.0	168.5	170.0
83	150.5	152.5	154.5	155.0	156.0	157.0	158.0	158.5	159.0	160.0	161.0	166.0	169.0	173.5	175.0
85	153.5	155.5	157.5	158.0	159.0	160.0	161.0	161.5	162.0	163.0	164.0	169.0	170.0	174.5	176.0
88	158.0	160.0	162.0	162.5	163.5	164.5	165.5	166.0	166.5	167.5	168.5	173.5	174.5	176.0	177.5
89	159.5	161.5	163.5	164.0	165.0	166.0	167.0	167.5	168.0	169.0	170.0	175.0	176.0	177.5	178.0

Figure 35 : Choices of Antenna Horizontal Beamwidth and Impact to Minimum Separation on 4-Sectored Sites

From the above tables, it can be seen that to maintain the required separation and also control the amount of overlap between sectors, the following guidelines should be used in choosing the antennas (HBW) for use on any site.

Antenna HBW Choice ≈ 0.5 x Required Separation between Sectors

From the above analysis, it is clear that only antennas with a horizontal beamwidth of 69° or less from the approved antenna list should be used in most cases for the LTE designs with a standard 3-sector site configuration. For a 4-sectored interlocking grid design, the best and only antenna that can currently be used (based on what is available on the approved antenna list) is one with a maximum of 52° of horizontal beamwidth.

As a result, the use of any antenna with a HBW equal to or greater than 70° for a 3-sectored site must be pre-approved by the HQ RAN Design Review team prior to its use on the site for any LTE design activity.

Five (5) and (6) sectored sites will require much narrower horizontal beamwidth antennas that are not currently available on the approved antenna list. The use of the currently available wide horizontal beamwidth antennas on the approved antenna list is not allowed for the LTE designs due to the performance degradation that will be caused as a result of larger sector overlaps. The diagram below illustrates the need for a narrower HBW antenna when higher order sectors are considered in the design.

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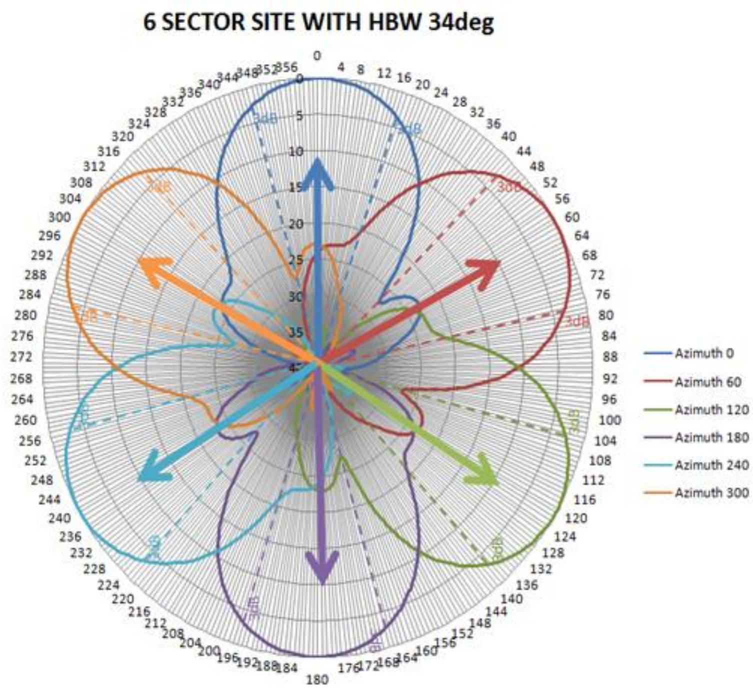

Figure 36 : Illustration of 6-Sectored Site with narrower HBW Antennas

When the narrower horizontal beamwidth antennas are made available, guidance on their use for higher order sectors will be made available.

6.1.2.3 Downtilt Evaluation

Downtilt should be used to reduce inter-cell interference and help in confining the signal of each transmitter to its own intended service area. It is therefore important to carry out a verification of the tilts on all the transmitters while also taking into consideration the vertical beamwidth of the antenna used on the transmitter.

The image below depicts how the tilt on a transmitter should be selected with the intended service area of the site taken into consideration.

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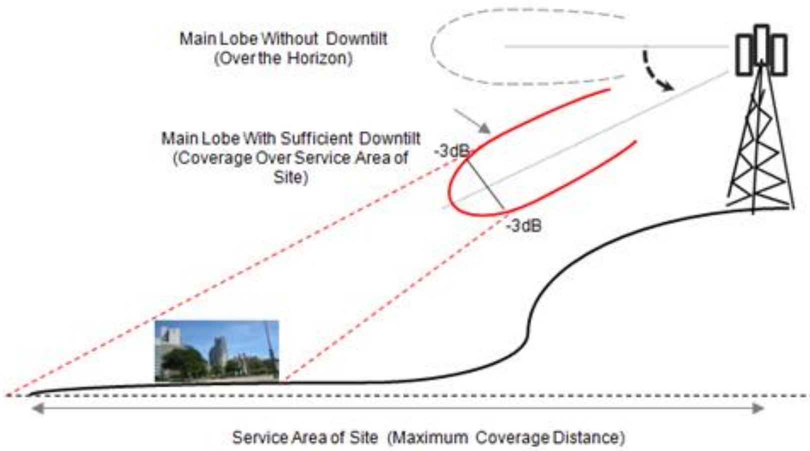

Figure 37 : Depiction of tilt against the intended service area of the site.

The tilt on the site should be selected in such a way that the upper 3 dB point of the main lobe across the plane of the coverage falls over the maximum intended service area of the site. On an even plane, the tilt value that will achieve this criterion is half of the vertical beamwidth of the antenna. Without sufficient tilt on the transmitter's antenna, it is very likely that the coverage of the site will not be contained. As a result, it is extremely important that all the tilts of all the transmitters be reviewed to make sure that coverage is contained within the expected service area of the sites. Further guidance on tilts is as follows:

- ✓ Electrical downtilt should be used as it produces a relatively even coverage in the azimuth plane.
- ✓ If the design calls for the maximum electrical tilt capability of the antenna to be used, then a mechanical tilt should be applied to the transmitter so as to always allow 2^{o} of electrical tilt for use if needed during Go/No-Go optimization or BAU.
- ✓ When using both mechanical and electrical tilt care should be taken not exceed 2 degrees of mechanical without considering blooming (backlobe gain increasing).
- ✓ All transmitters with total downtilt 12^{o} (700 MHz) and 6^{o} (AWS) must be flagged and further evaluation carried out on the following:
    - o Carried load/capacity analysis
    - o Inter-site distance with neighbors (cluster evaluation step)
    - o Effective radiation center of site
    - o Antenna choice with particular attention to vertical beamwidth

Evaluation Milestone: Reviewed at Optimized Design Review and Constructible Optimized Design Reviews.

6.1.3 Individual Cluster Performance Evaluation

This step of the evaluation will make sure that the site to site performance in the cluster is evaluated for an optimum LTE network configuration and performance across the entire cluster where LTE demand exists. The following should be evaluated:

Evaluation Milestone: Reviewed at Optimized Design Review and Constructible Optimized Design Reviews.

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- Evaluation of inter-site distance between the sites in the cluster to make sure that in a cluster of uniform demand, the sites are uniformly configured to form an even interlocking grid. Review dominance, RSRQ, SINR as shown in Figures 34, 35, and 36.
- Evaluation of the overall location and number of sites in the cluster with respect to the traffic density map to give an indication on the quality of the design.
- Radiation center evaluation (site height) to make sure that in a cluster with similar properties (demand, morphology, etc.), the difference between the radiation centers of the sites is as small as possible.
- Coverage containment evaluation to make sure that the coverage from one transmitter should not be stronger than -110 dBm beyond the first tier of the neighboring sites.
- Evaluation of the main lobe of antennas from one site should be pointing to the null of the neighboring sites. The mean beam of one antenna should not be pointing to the main beam of a different site. If this criterion is not met and the LTE performance in the area is degraded as a result, the cluster's design will be void. The ideal configuration is as depicted on the figure below.

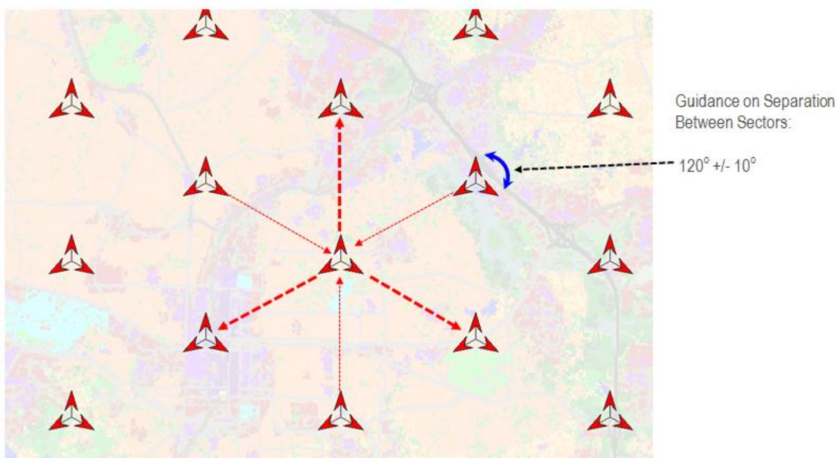

Figure 38 : Depiction of Interlocking Grid Configuration

- Carried load balancing evaluation to make sure that the optimized transmitters in the cluster should result in a fairly uniform carried load (resource block utilization, etc.) on the sites. Load balancing used here refers specifically to the cell eNode-B level only and not core entities such as the MME, etc. The goal of load balancing is to spread user traffic across system radio resources in order to provide quality end-user experience and performance. Massively uneven carried load on the cells would point to a sub-optimal design and corrective measures with design optimization must therefore be carried out.
- Evaluation of the LTE design KPIs is carried out at this stage of the process (see section 1.2 for the LTE design KPIs).

Evaluation Milestone: Reviewed at Optimized Design Review and Constructible Optimized Design Reviews

The figures below illustrate some of the issues with dominance and signal quality when an inefficient network configuration exists.

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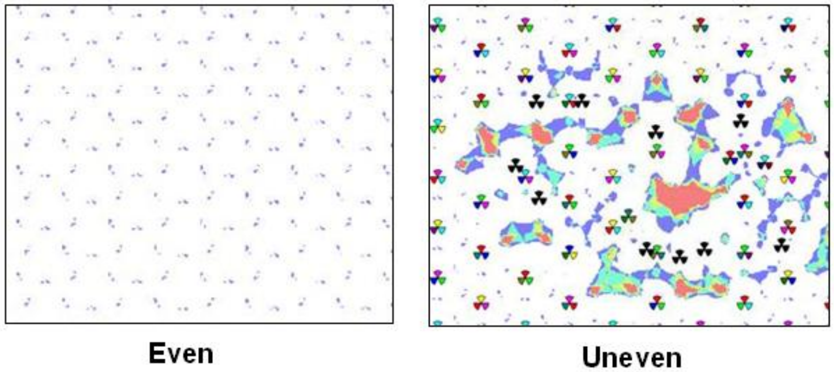

Figure 39 : Demonstration of Dominance Issues in the Network with Uneven Site Placement

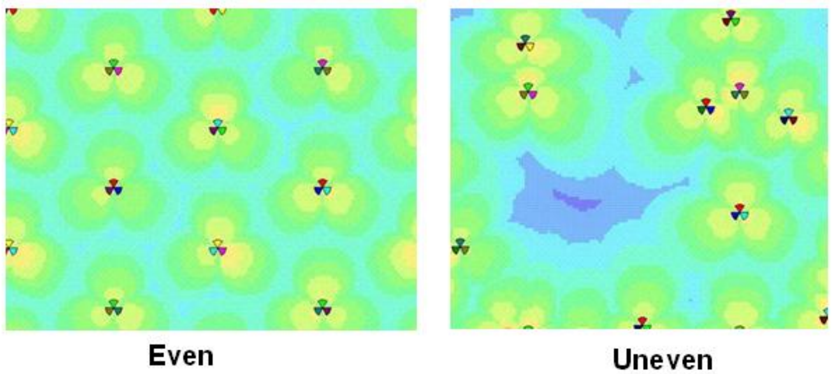

Figure 40 : Demonstration of Signal Quality (RSRQ) in the Network with Uneven Site Placement

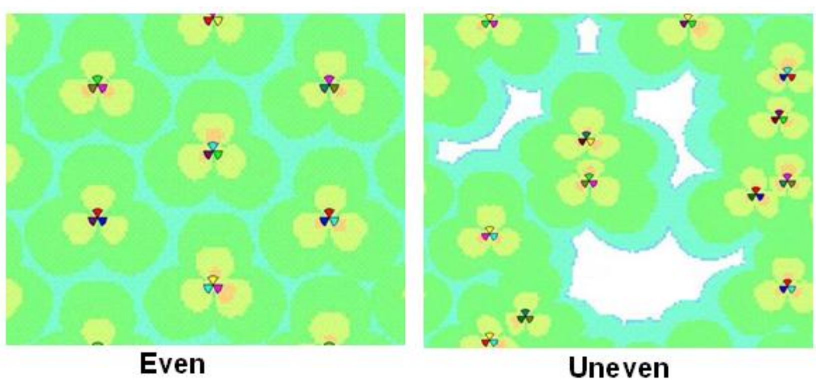

Figure 41 : Demonstration of SINR in the Network with Uneven Site Placement

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6.1.4 Network Performance Evaluation

This step of the process basically looks at the inter-cluster performance to make sure that there is no performance discontinuity as one goes from cluster to cluster. Additional network-wide deign KPIs are also provided here and are further evaluated against the individual cluster performance. The inter-cluster performance should not be less than those of the individual clusters.

Evaluation Milestone: Reviewed at Optimized Design Review and Constructible Optimized Design Reviews

6.1.5 Inter-technology Network Evaluation

While most of the evaluation steps have focused on the LTE network it is important for the LTE design engineer to evaluate the output of the various LTE network design views against those of the existing technology (GSM and UMTS) networks in order to provide an efficient inter-technology overlay LTE network.

In "Attachment H", provisions are made on how the comparison is going to be carried out during the GNG KPI drives. At the LTE design phase, the following process should be used in carrying out the evaluation between the LTE network design views with the existing UMTS or GSM network for review. The idea here is to have the relevant material that can be used during the design evaluation to ensure that consistent LTE end-user performance will exist when the LTE network is deployed without unnecessary transitions between technologies. Hence, the deliverable from this section will be used in conjunction with the other LTE design KPIs to establish the overall quality of the design.

The steps outlined in this process will help towards:

a. The bin-by-bin comparison of two signal level grid files from Atoll
b. The generation of a delta grid file that shows the bin-by-bin difference (in dB) between the two grid files

Note:
The process is only to be used at the different LTE design phases prior to live network data becoming available. Additionally, the process does not account for link budget differences or technology differences.

In order to use the process, the following input data and tools are required:

<u>Project Data:</u>

1. LTE Design View Project Grid Files (Created by LTE Design Engineer). One grid file is needed for each LTE design view: - Baseline, optimized and constructible optimized views.
2. UMTS and GSM Grid Files (Supplied by the market) using the existing UMTS and GSM on-air sites only and network configuration.

<u>Tools Needed:</u>

1. Atoll Best Signal Export Add-in: Used to generate the grid files
2. MapInfo with Vertical Mapper Installed: Used to process the grid files and generate a delta grid

With the Atoll project file configured so that only the transmitters relating to the specific scenario (LTE Network View, UMTS on-Air or GSM on-Air), the steps below should be followed:

a) Open the Atoll project file of interest
b) Import the LTE polygon as the reference focus zone for grid file export

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c) Import the LTE polygon as a filter zone in the Atoll projects
d) Activate the on-air sites and deactivates any other site (UMTS and GSM grids only)
e) Click the "Best Signal Export" icon in the Toolbar in Atoll to open the Best Signal Export add-in dialog
f) Set "Attributes" to "None" except when you are working with a filtered transmitters set
g) Configure the "*Best Signal Export*" as follows:
   - Activate "Calculate Invalid Pathloss Matrices"
   - Min Reception (dBm) : -98 dBm *(or as desired)*
   - Max Number of Servers/bin : 1
   - Set Max Signal Difference (dB) : 1
   - Grid Resolution (m): 90 *(or as desired)*
   - Output format: Vertical Mapper Files (*.grc *.grd)

This configuration is as depicted on the Atoll configuration screen illustrated below.

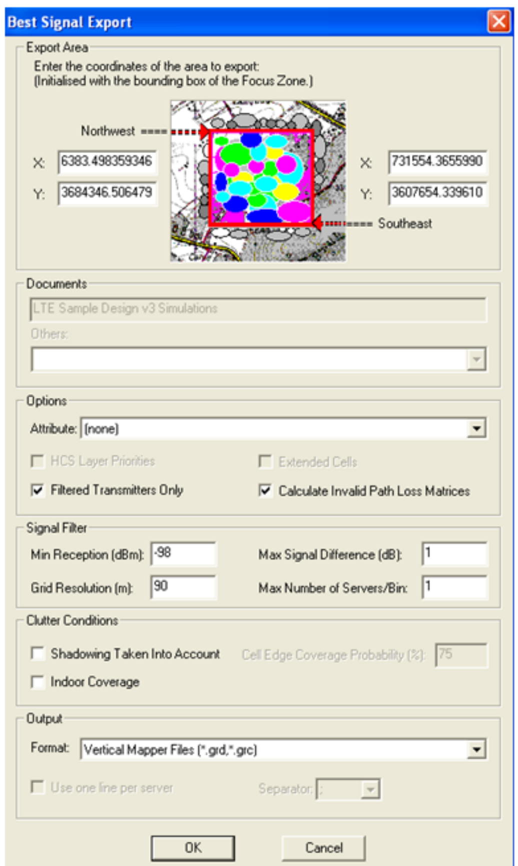

Figure 42 : Atoll Best Signal Export Configuration Screen

h) Click on "OK"
i) Select a destination folder, file name and click on "Save".

This process should be repeated when a grid file is being created for any of the LTE Network design views. The following naming convention should be appended to each of the exported grid files to ease the review process:

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○ GSM On-Air Grid File:	GSM_Export
○ UMTS On-Air Grid File:	UMTS_Export
○ LTE Baseline Network View:	LTE Baseline_Export
○ LTE Optimized Network View:	LTE Optimized_Export
○ LTE Constructible Optimized Network View:	LTE Const_Opt_Export

Out of the files exported from Atoll, only the following set of files are needed for the import into MapInfo/Vertical Mapper for the comparative analysis.

- xxx-signals-0.grd
- xxx-signals-0.tab

As an example, if comparison is being carried out between a UMTS network configuration and an LTE network configuration, two set of files should be available for comparison (example shown below).

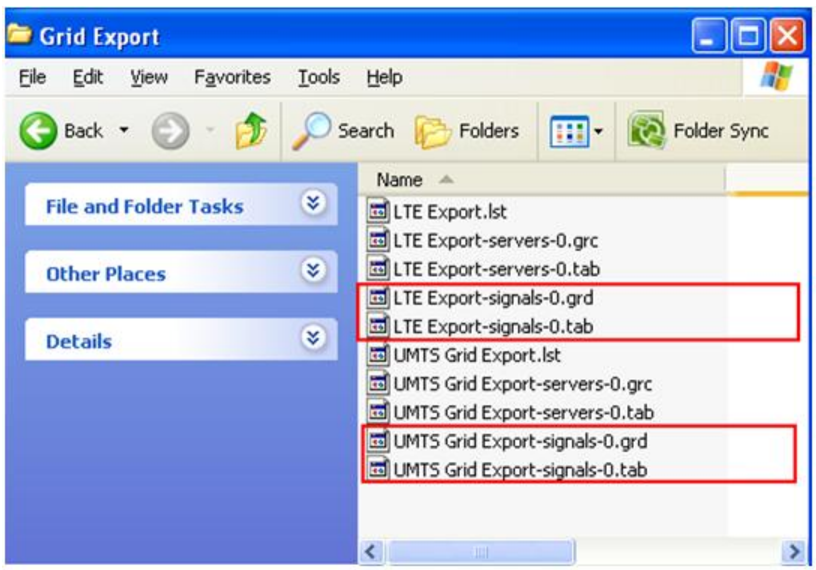

Figure 43 : Sample of Grid Files for Use in Comparative Analysis (Representative Sample)

The following steps should then be used to compare the grid files.

1. Launch MapInfo/Vertical Mapper
2. Browse to the folder with the grid files and select all the *.tab files for import into Vertical Mapper
   – The two grid layers should open and be visible on the screen
3. Open the Vertical Mapper Grid Manager (Vertical Mapper -> Show Grid Manager)
   – The two grid files should be shown in the grid manager and should be enabled (checked)

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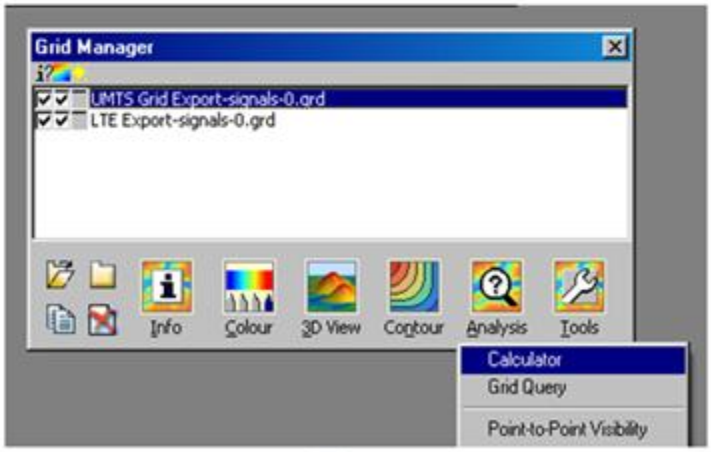

Figure 44 : Launching the Vertical Mapper Grid Calculator

4. Select "Analysis" then "Calculator"

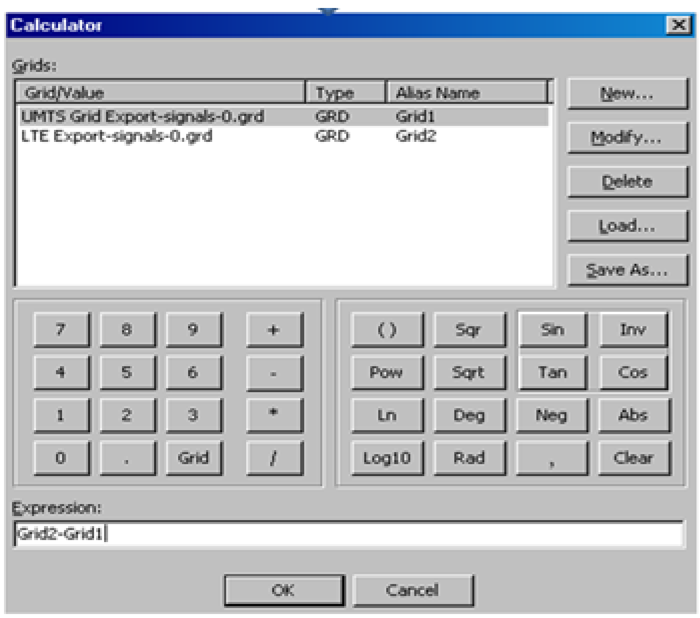

Figure 45 : Using the Vertical Mapper Grid Calculator for Delta Analysis

5. Within the "calculator" double-click on the first grid
6. Select "-", that is (minus)
7. Double-click on the second grid (Expression should now read something like: Grid12–Grid1). That is UMTS – GSM.
8. Select "OK" and confirm the save by clicking "OK" again
   – The results (delta) grid is then calculated and the third grid appears in the Vertical Mapper grid manager
   – This is the bin-by-bin delta between the two layers
9. Use the grid query to show areas where the delta is greater than a pre-defined threshold

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10. Select the results grid and click on the “Info” button within the grid manager to generate histograms of the delta
    – Legends to the delta plot can be generated using the “Colour” key

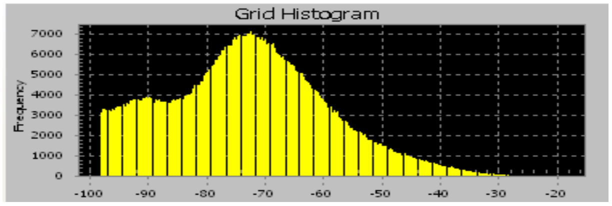

Figure 46 : Sample Grid Delta Histogram (Representative Sample)

The complete process is as illustrated using the pictorial flow below:

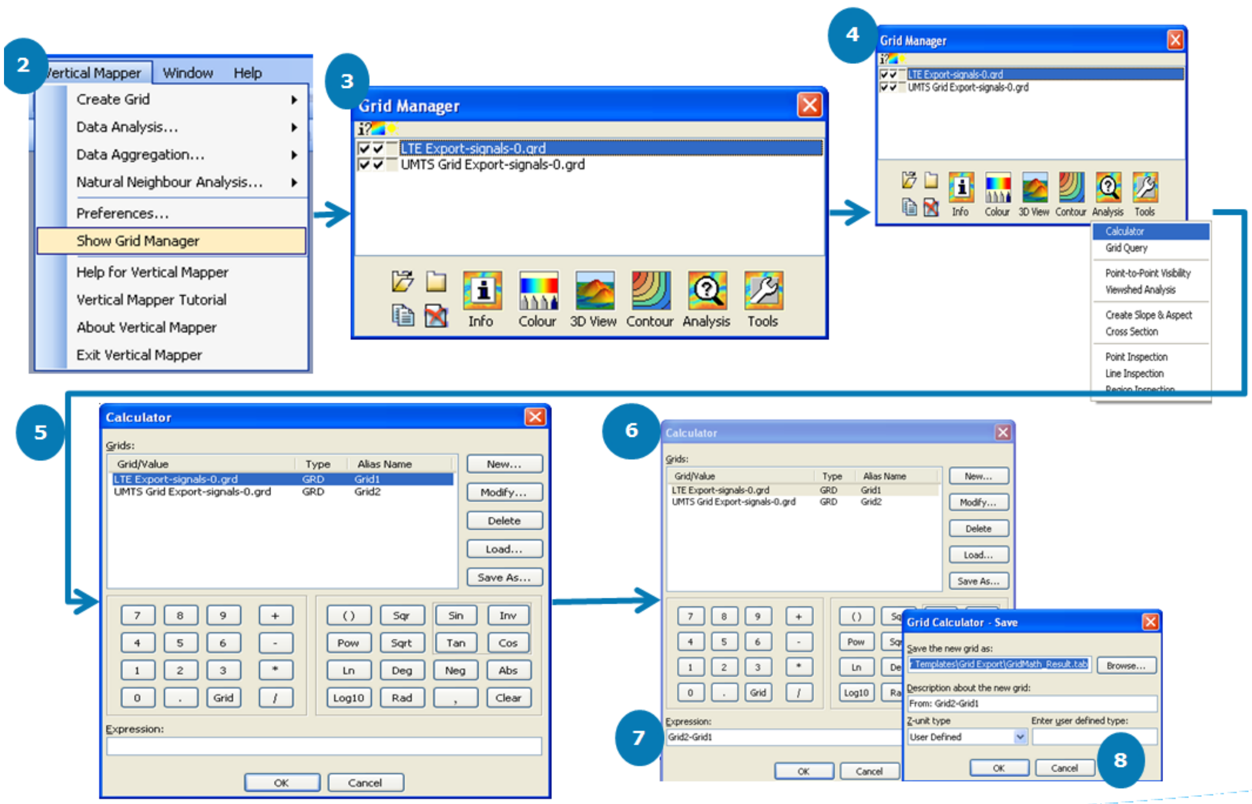

Figure 47 : Comparative Grid Analysis Pictorial Process Flow

The result of the delta analysis is then generated and new grid file appears in the Vertical Mapper grid manager. The next step is to carry out a grid query on the resultant grid to show areas where LTE coverage is 3dB weaker than that for UMTS. Note that if UMTS coverage is weaker than -98 dBm or UMTS does not exist in the area, a GSM grid file applies.

The pictorial flow below shows the example of the comparison with UMTS.

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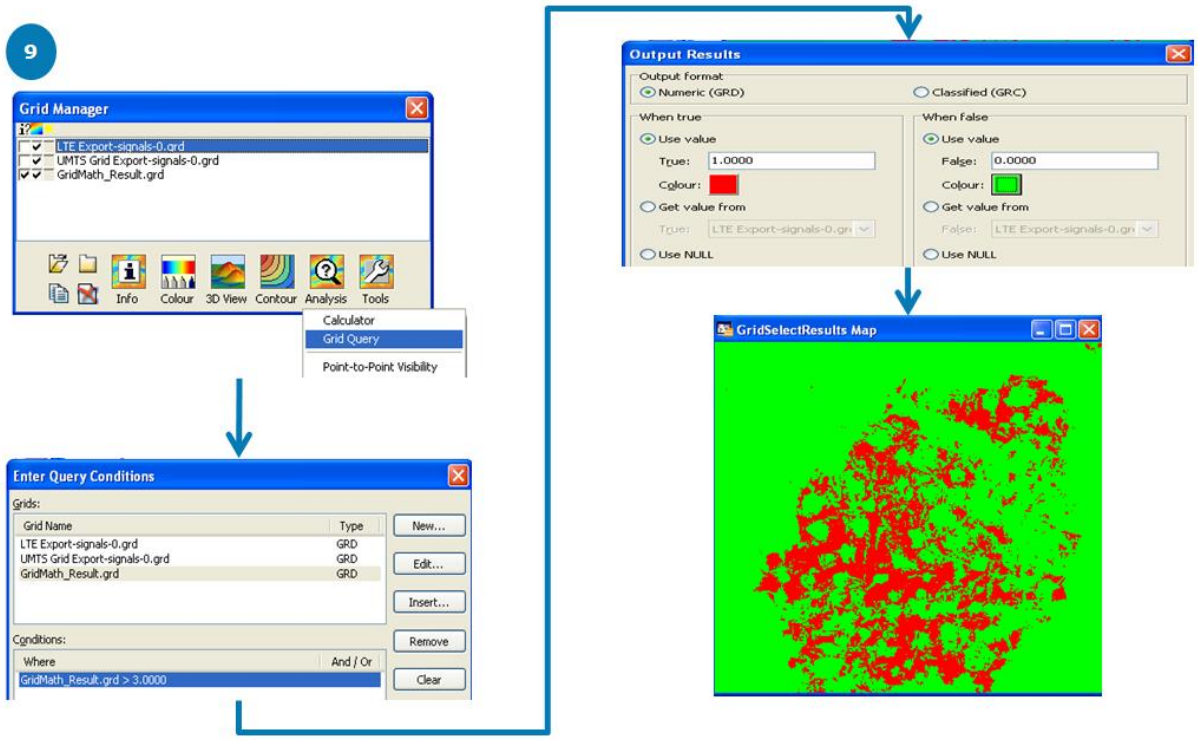

Figure 48 : LTE vs. UMTS Coverage Comparison with Areas where LTE is 3 dB Weaker than UMTS shown in Red

These comparative views should be evaluated in every phase of the LTE network design. This will give the first indication of the interaction between LTE and the other existing deployed technologies.

Evaluation Milestone: Baseline, Optimized and Constructible Optimized Design Review

6.1.6 LTE Design Exit Criteria

The LTE design exit criteria are met once all the design evaluation steps are successfully completed on the Constructible Optimized Network Design.

Evaluation Milestone: Constructible Optimized Design Review

A summary of the steps outlined above is as depicted in the following high level flow-chart.

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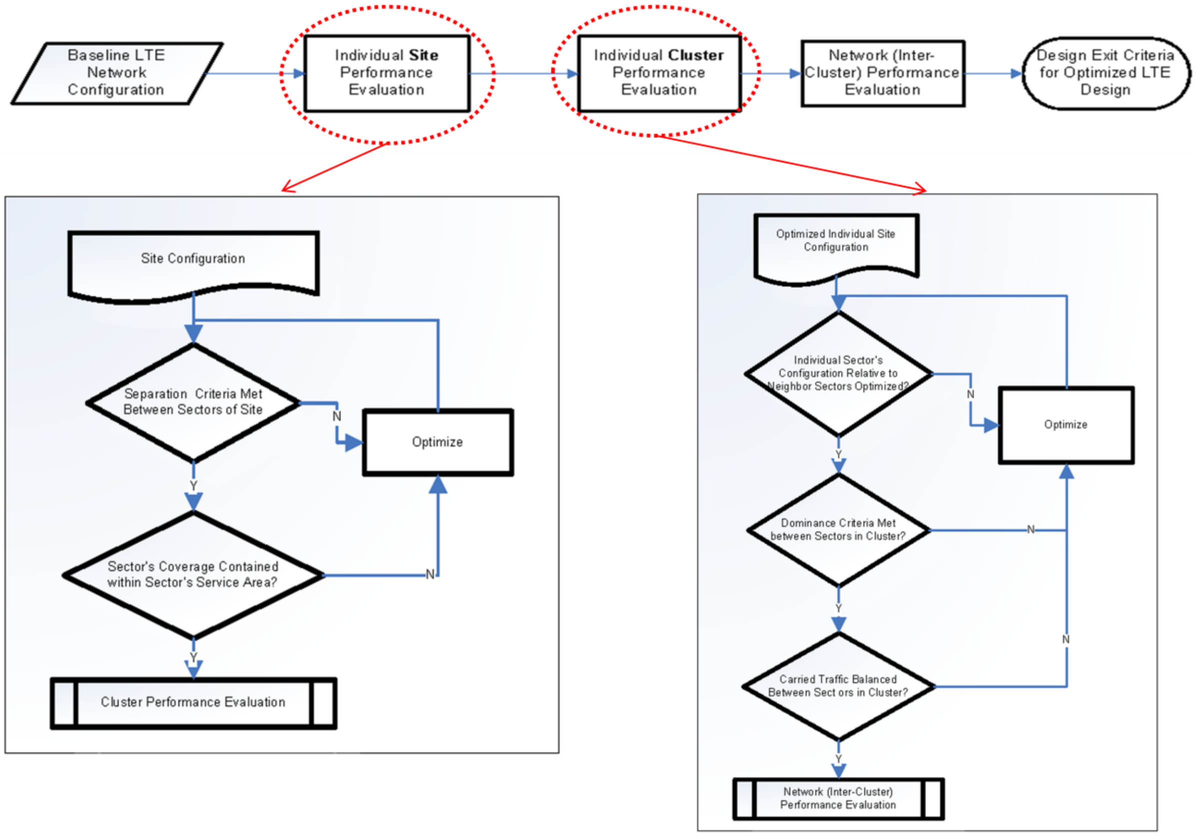

Figure 49 : LTE Design Evaluation Process

To aid the design process and to facilitate the evaluation processes outlined, the Arieso LTE ACP tool should be used. The detail process on the use of the Arieso ACP for LTE design optimization is covered in the LTE ACP process document.

Once an LTE RF network design is successfully completed and approved, some of the required outputs such as the neighbor relationship files and physical cell ID plan required for the network configuration should then be generated. The process for use in generating the neighbor plan and the physical cell ID is covered in the "e-UTRAN Neighbor List and Physical Cell ID Planning" section of this document.

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7. E-UTRAN Neighbor List and Physical Cell ID Planning

The scope of the first release on SON (Release 8) includes two key 3GPP functions namely:

1. Automatic Neighbor Relation (ANR)
2. Automatic Physical Cell ID (PCI) Assignment

However, it is important to provide an initial set of neighbor relations and PCI plan to the system following a successful LTE RF network planning exercise before some of the benefits on ANR kicks in. This section of the guidelines focuses on the standard process to be used for the initial E-UTRAN neighbor list and physical cell ID planning from Atoll.

7.1 Neighbor List Planning

The automatic neighbor allocation algorithm in Atoll should be used in creating the initial neighbor relationships for LTE. The process below should be used.

- Right Click on *Transmitters -> Cells -> Neighbors -> Automatic Allocation*

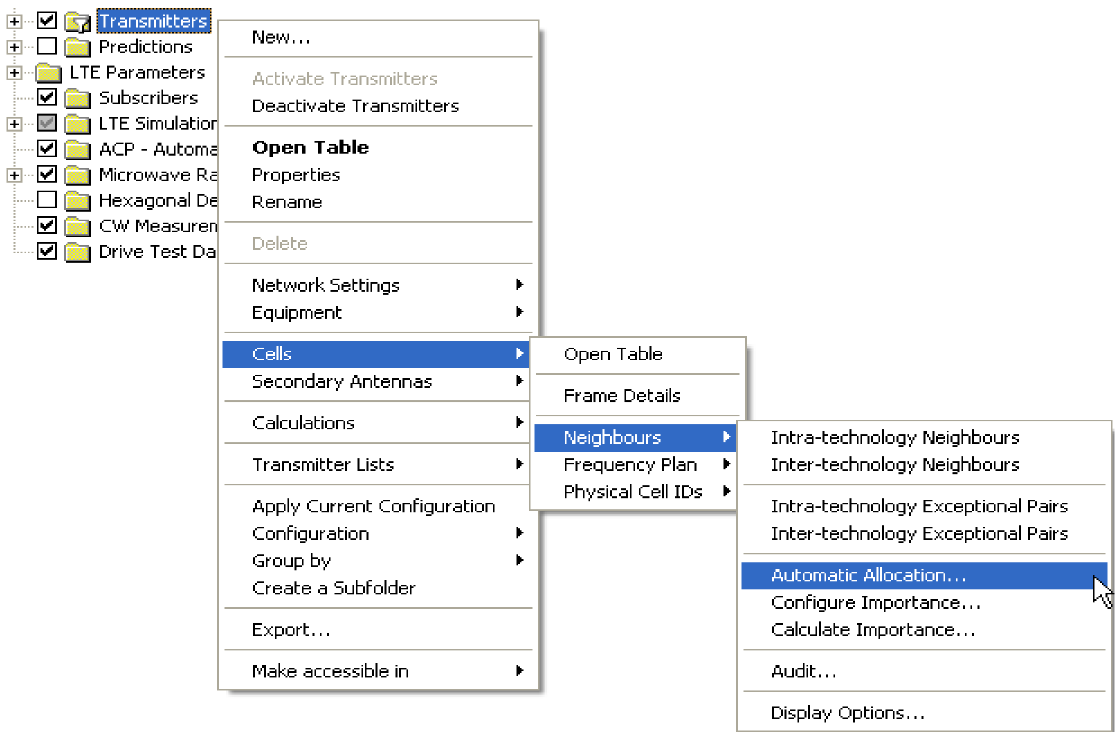

Figure 50 : Using Atoll's Automatic Allocation Module of Neighbors Relations Planning

Use the settings shown below to set up the automatic allocation of the neighbors for the initial network configuration. Using the settings as shown below will result in:

- The best initial network plan after which SON features will kick in for neighbor additions and removals.

The coverage conditions should be set as follows:

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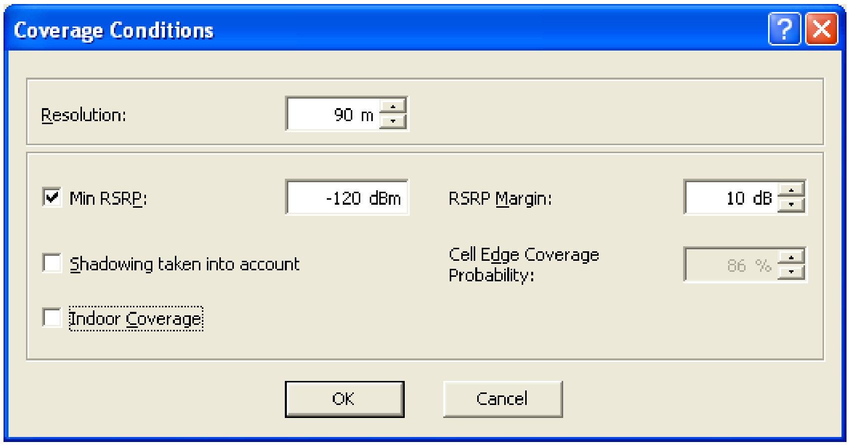

Figure 51 : Setting the Coverage Conditions for Neighbor Relations Planning

Resolution: 90m
Min RSRP: Checked
Min RSRP value: -120 dBm.
Value based on worst case scenario from link budget (cell edge RSRP values for a rural
RSRP Margin: 10 dB
Shadowing: Unchecked
Indoor Coverage: Unchecked to ensure worst case scenario

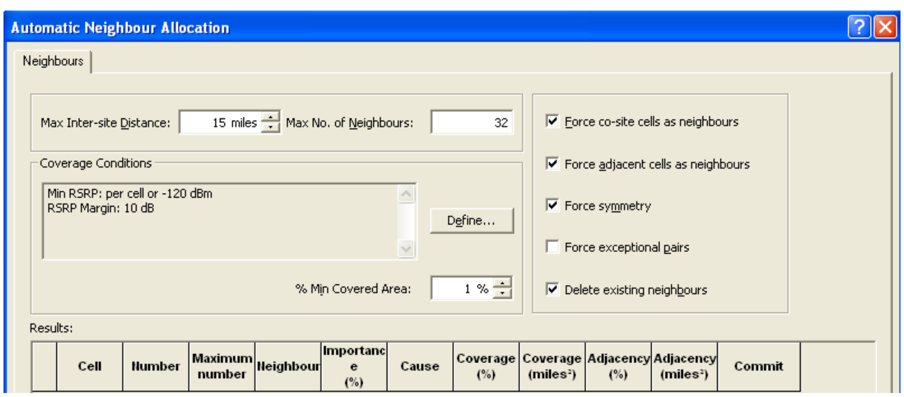

Figure 52 : Setting the Automatic Neighbor Allocation Algorithm in Atoll

The remainder of the configuration should be set as follows:

Max Inter-site Distance: 15 miles
Max No. of Neighbors: 32
% Min Coverage Area: 1%
Force co-site cells as neighbors: Checked
Force adjacent cells as neighbors: Checked
Force symmetry: Checked

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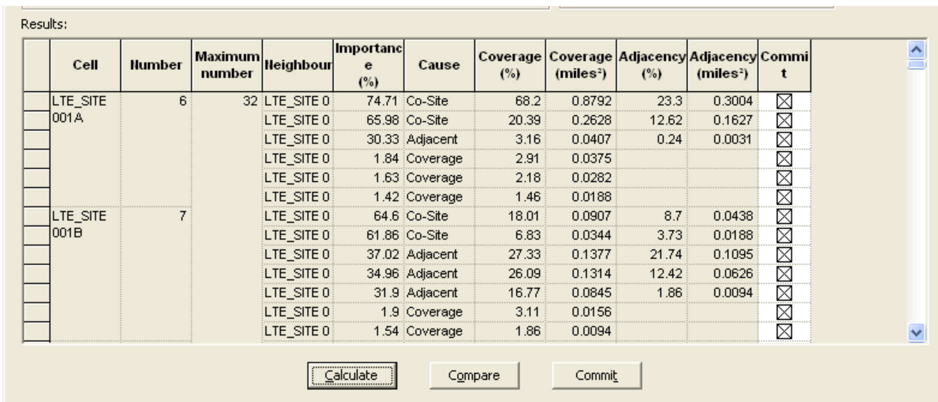
Delete existing neighbors: Checked (since this is the initial neighbor list, it must be checked to ensure the database is cleaned of neighbors prior to the automatic allocation.

Once the setup is completed click on "Calculate" to start the automatic neighbor allocation process. This will generate the LTE neighbor relations as shown below in the results view.



Results:

Cell	Number	Maximum number	Neighbour	Importance (%)	Cause	Coverage (%)	Coverage (miles²)	Adjacency (%)	Adjacency (miles²)	Commit
LTE_SITE 001A	6	32	LTE_SITE 0	74.71	Co-Site	68.2	0.8792	23.3	0.3004	☒
			LTE_SITE 0	65.98	Co-Site	20.39	0.2628	12.62	0.1627	☒
			LTE_SITE 0	30.33	Adjacent	3.16	0.0407	0.24	0.0031	☒
			LTE_SITE 0	1.84	Coverage	2.91	0.0375			☒
			LTE_SITE 0	1.63	Coverage	2.18	0.0282			☒
			LTE_SITE 0	1.42	Coverage	1.46	0.0188			☒
LTE_SITE 001B	7		LTE_SITE 0	64.6	Co-Site	18.01	0.0907	8.7	0.0438	☒
			LTE_SITE 0	61.86	Co-Site	6.83	0.0344	3.73	0.0188	☒
			LTE_SITE 0	37.02	Adjacent	27.33	0.1377	21.74	0.1095	☒
			LTE_SITE 0	34.96	Adjacent	26.09	0.1314	12.42	0.0626	☒
			LTE_SITE 0	31.9	Adjacent	16.77	0.0845	1.86	0.0094	☒
			LTE_SITE 0	1.9	Coverage	3.11	0.0156			☒
			LTE_SITE 0	1.54	Coverage	1.86	0.0094			☒

Calculate Compare Commit

Figure 53 : Sample View of Generated Neighbor Relations in Atoll

Click on "Commit" to save the generated Neighbor Relations into the Atoll project file.

The neighbor relations can be audited by using the Atoll audit tool. This is accessed as depicted below.

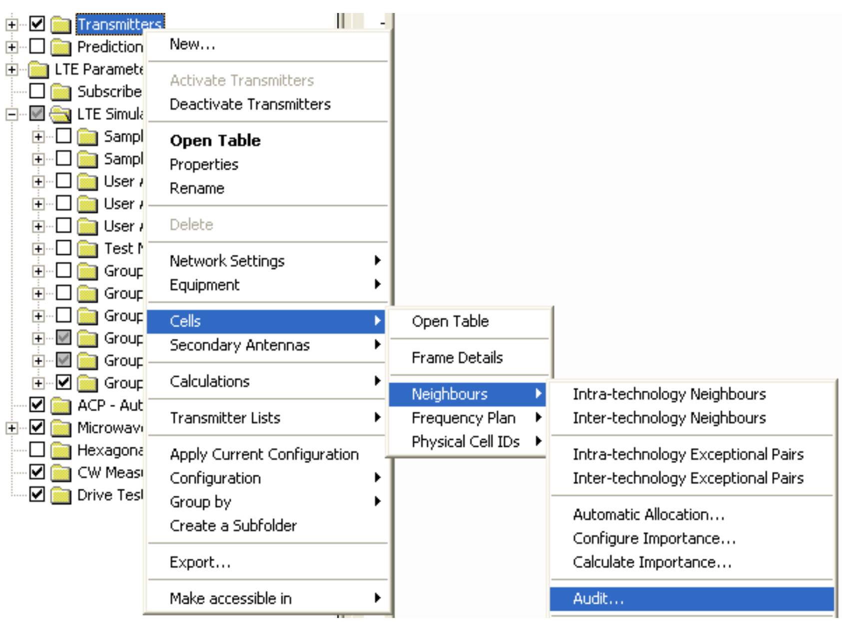


Figure 54 : Accessing the Neighbor Relations Audit Tool in Atoll

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Set the Neighbor audit as shown below and select "Run". The idea about the audit is to identify issues associated with the neighbors so that correct measures could be taken.

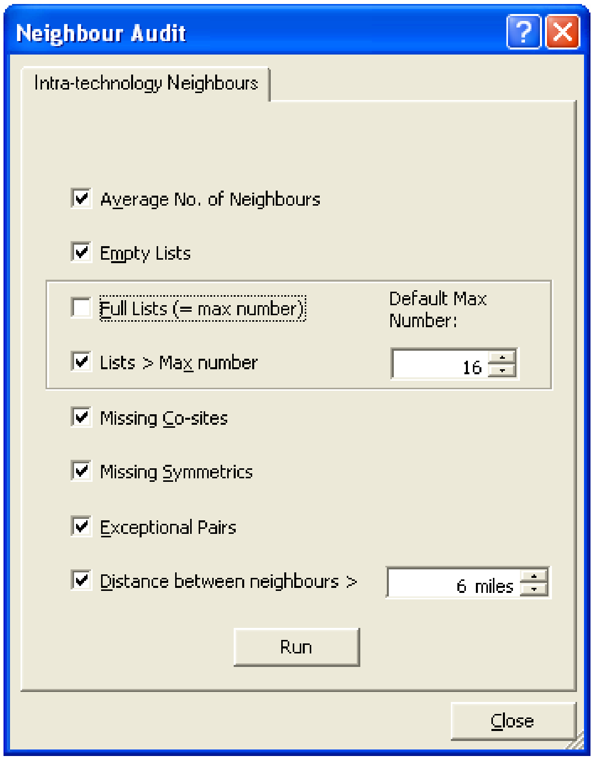

Figure 55 : Neighbor Relations Audit Tool Settings in Atoll

Clicking "Close" in the Atoll Event Viewer will display the results of the audit (example shown below.

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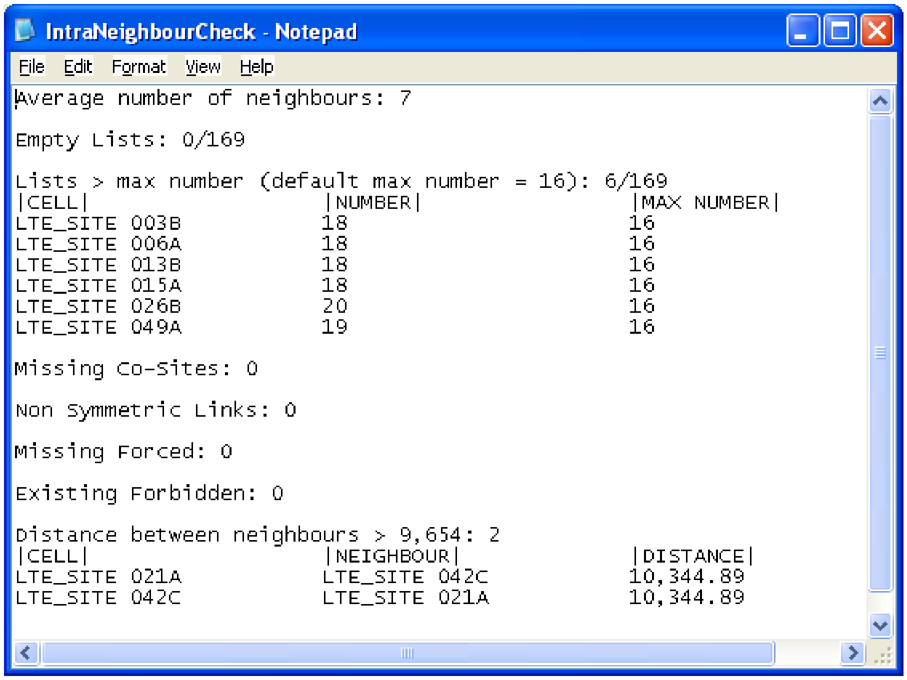

Figure 56 : Sample View of Neighbor relations Audit results

Once all issues have been addressed, the neighbors can then be exported from the neighbors table for system configuration. This is done by opening the neighbors table and exporting the neighbor relations.

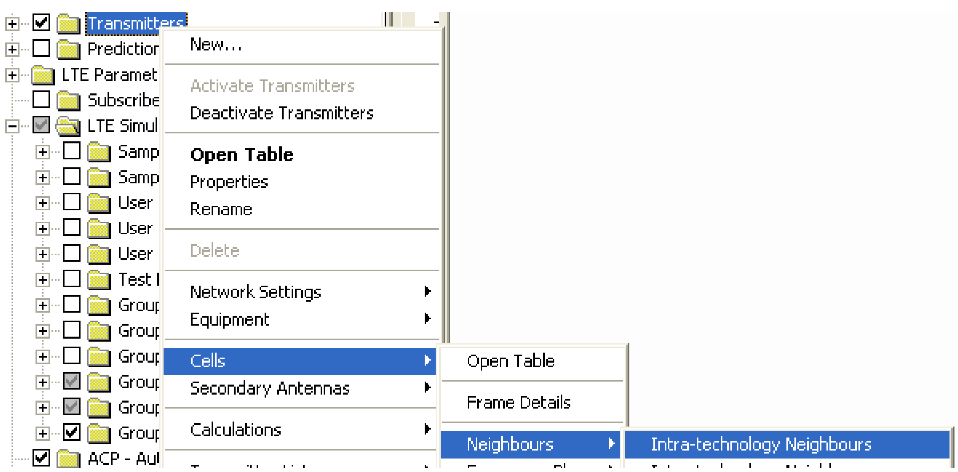

Figure 57 : Accessing E-UTRAN the Neighbor Relations Table

With the Intra-technology neighbors table open, either click on the table and select export or directly select all, copy and paste the neighbor relations into Excel to feed the neighbor relations configuration.

Cell	Number	Neighbour	Distance (miles)	Symmetry	Type	Reason (automatic allocation)
LTE_SITE 001A	6	LTE_SITE 001B	0	☒	auto (computed)	Co-Site
		LTE_SITE 001C	0	☒	auto (computed)	Co-Site
		LTE_SITE 015A	1.566	☒	auto (computed)	Coverage
		LTE_SITE 016B	2.658	☒	auto (computed)	Coverage
		LTE_SITE 056B	0.786	☒	auto (computed)	Coverage
		LTE_SITE 056C	0.786	☒	auto (computed)	Adjacent
LTE_SITE 001B	7	LTE_SITE 001A	0	☒	auto (computed)	Co-Site
		LTE_SITE 001C	0	☒	auto (computed)	Co-Site
		LTE_SITE 038A	1.038	☒	auto (computed)	Adjacent
		LTE_SITE 056B	0.786	☒	auto (computed)	Adjacent
		LTE_SITE 056C	0.786	☒	auto (computed)	Coverage
		LTE_SITE 062A	1.733	☒	auto (computed)	Adjacent
		LTE_SITE 062C	1.733	☒	auto (computed)	Coverage
LTE_SITE 001C	16	LTE_SITE 001A	0	☒	auto (computed)	Co-Site
		LTE_SITE 001B	0	☒	auto (computed)	Co-Site
		LTE_SITE 015A	1.566	☒	auto (computed)	Adjacent
		LTE_SITE 016B	2.658	☒	auto (computed)	Adjacent
		LTE_SITE 017B	2.223	☒	auto (computed)	Symmetric
		LTE_SITE 017C	2.223	☒	auto (computed)	Symmetric
		LTE_SITE 036B	3.532	☒	auto (computed)	Symmetric
		LTE_SITE 038A	1.038	☒	auto (computed)	Adjacent
		LTE_SITE 041B	2.494	☒	auto (computed)	Adjacent
		LTE_SITE 041C	2.494	☒	auto (computed)	Adjacent
		LTE_SITE 054A	1.593	☒	auto (computed)	Coverage
		LTE_SITE 054B	1.593	☒	auto (computed)	Adjacent
		LTE_SITE 054C	1.593	☒	auto (computed)	Coverage
		LTE_SITE 055A	3.541	☒	auto (computed)	Symmetric
		LTE_SITE 056A	0.786	☒	auto (computed)	Adjacent
		LTE_SITE 056C	0.786	☒	auto (computed)	Adjacent

Figure 58 : Sample View of E-UTRAN Neighbor relations in the Neighbor's Table

This process completes the neighbor relations planning in Atoll. The next step is to carry out the physical cell identity planning.

7.2 Physical Cell Identity (PCI) Planning

This section provides a method to be used for the planning the LTE Physical Cell ID in Atoll. It is important to note that the Physical Cell IDs are to be planned only after the network is design-optimized using the radio network planning tool with RF dominance established and the design exit criteria met.

By using Atoll for the PCI planning, it takes the propagation environment into consideration to reduce the possibility of Physical Cell ID conflicts which is usually the case when physical cell IDs are planned without consideration for the propagation environment. The process to be used here accomplishes the following:

- Prevents cells with the same Physical Cell ID from overlapping
- Takes into consideration the neighbor cell relationships in the assignment of Physical Cell IDs
- Provides a method for reserving codes for use with new LTE sites in the network to avoid a total re-plan of the Physical Cell ID

7.2.1 Overview of Physical Cell IDs

The function of Physical Cell IDs in LTE is similar to that of scrambling codes in UMTS. The Physical Cell ID is unique with the area served by any transmitter. When conflicts (duplicates) in Physical Cell IDs occur within the serving area of the cells, performance issues will occur that will have a massive impact not only to how network resources are utilized but also lead to a degradation of the end user experience of the LTE network. The following is a brief highlight on Physical Cell IDs.

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- The cell identity is a global cell ID that is used to identify the cell from an OAM perspective.
- The physical cell identity has a range of 0 to 503 (total of 504 PCIs) and it is used to scramble the data to help the UE separate information from the different cells.
- The Physical Cell ID determines the primary and secondary sync signal sequence.
- Primary Synchronization Signal ID (PSS ID) is in the range from 0 to 2
- Secondary Synchronization Signal ID (SSS ID) is in the range from 0 to 167. This is what constitutes the physical layer cell identity groups.
- Physical Cell ID = PSS ID + 3*SSS ID

The complete Physical Cell ID table and their relationship to PSS ID and SSS ID are as shown at the end of the physical cell ID planning section of this document.

The goal of the Physical Cell ID planning process outlined here is to automatically assign both the PSS ID and SSS ID to cells in the network and automatically compute their corresponding Physical Cell IDs without causing potential conflicts in the serving areas of the cells.

7.2.2 Prerequisites for the Physical Cell ID Planning

The following prerequisites must be met before any physical cell ID planning is initiated

- All the sites, transmitters and cells to be considered for planning must have been properly configured in the Atoll LTE project
- The correct vendor specific parameters must have been used for all the configuration
- Design-optimization must have been carried out in the project and the project reviewed and approved by OEM vendor and HQ
- The project must reflect that configuration that has been approved for implementation in the field

7.2.3 Creating Neighbor Relationships for Physical Cell ID Planning

The automatic neighbor allocation algorithm in Atoll should be used in creating the neighbor relationships for use in the physical cell ID planning.

- Right Click on *Transmitters -> Cells -> Neighbors -> Automatic Allocation*

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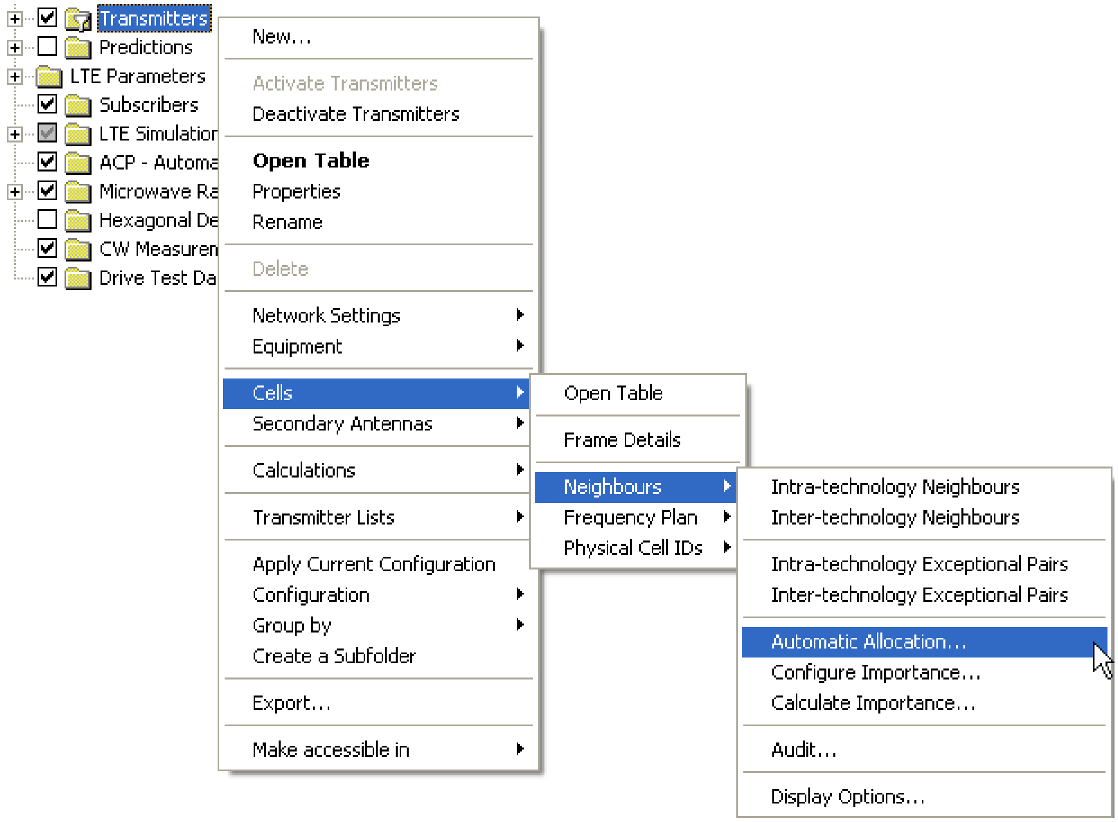

Figure 59 : Using Atoll's Automatic Allocation Module of Neighbors Planning

Use the settings shown below to set up the automatic allocation of the neighbors. Using the settings as shown below will result in:

- The capture of all the possible LTE neighbors in the network
- Avoiding conflicts in Physical Cell ID allocation when the neighbor relationships is used for Physical Cell ID planning
- The neighbor list created here is only for Physical Cell ID generation and is not to be used as the neighbor list for the deployed LTE system. Here, the neighbor list needs to be artificially large to generate the best Physical Cell ID plan. Neighbor list will be managed by SON.

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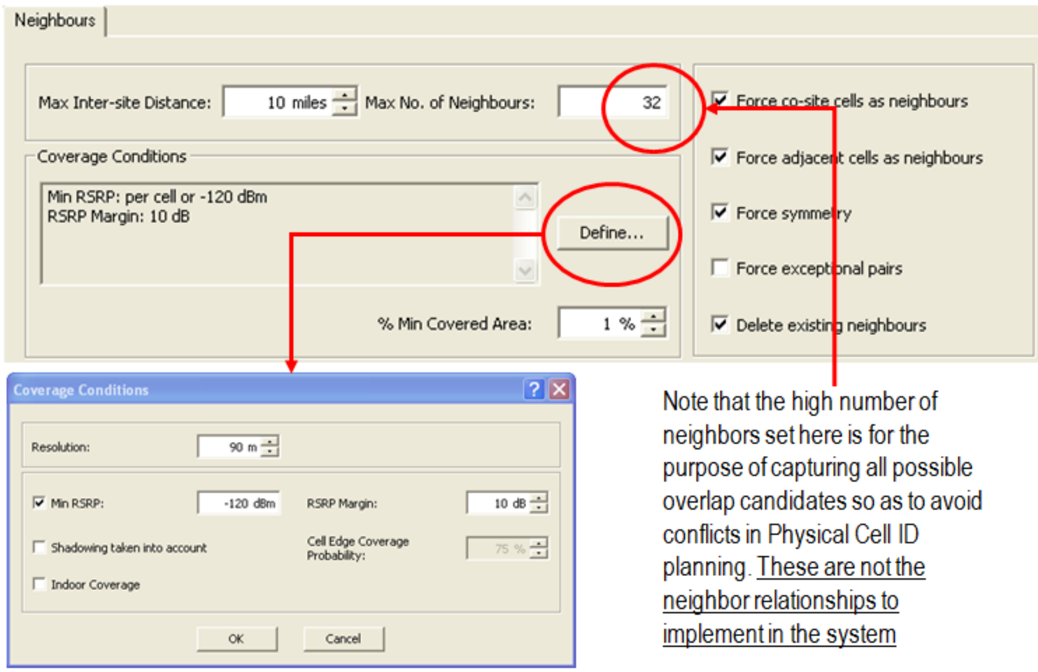

Figure 60 : Neighbor List Generation for the Purpose of Physical Cell ID Planning

After completing the setup, the automatic neighbor allocation algorithm should be run ("Calculate") and the results committed to the LTE project.

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Figure 61 : Setting up the Automatic Neighbors Allocation for Use with Physical Cell IDs Planning

Clicking on “Calculate” will initiate the automatic neighbor allocation computation

After completing the setup, the automatic neighbor allocation algorithm should be run and the results committed to the LTE project for the purpose of Physical Cell ID planning only.

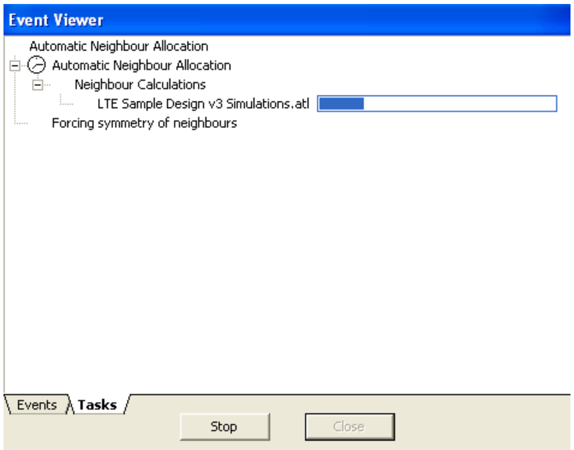
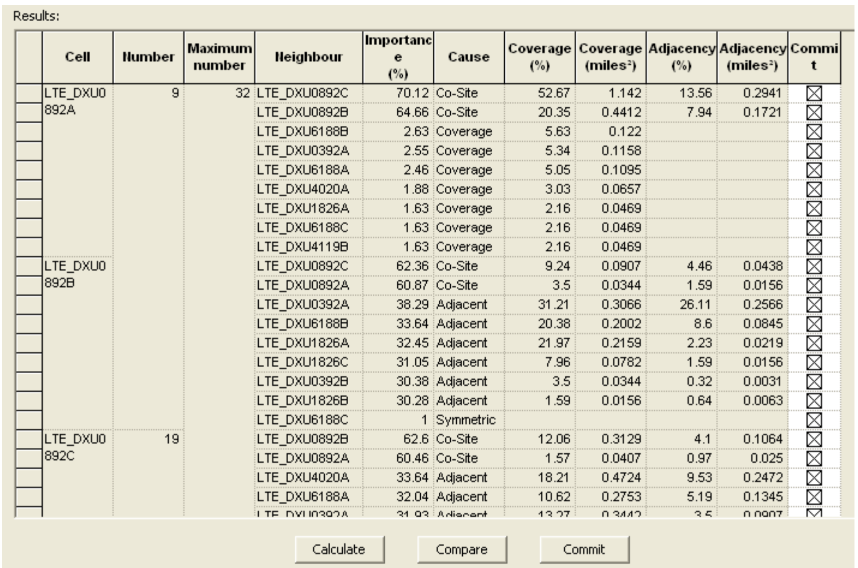


Figure 62 : Neighbors Planning Progress Status in Atoll

When the run is complete, the close button becomes enabled. Click on the close button to view the generated neighbor list.



Results:

Cell	Number	Maximum number	Neighbour	Importance (%)	Cause	Coverage (%)	Coverage (miles²)	Adjacency (%)	Adjacency (miles²)	Commit
LTE_DXU0892A	9	32	LTE_DXU0892C	70.12	Co-Site	52.67	1.142	13.56	0.2941	☒
			LTE_DXU0892B	64.66	Co-Site	20.35	0.4412	7.94	0.1721	☒
			LTE_DXU6188B	2.63	Coverage	5.63	0.122			☒
			LTE_DXU0392A	2.55	Coverage	5.34	0.1158			☒
			LTE_DXU6188A	2.46	Coverage	5.05	0.1095			☒
			LTE_DXU4020A	1.88	Coverage	3.03	0.0657			☒
			LTE_DXU1826A	1.63	Coverage	2.16	0.0469			☒
			LTE_DXU6188C	1.63	Coverage	2.16	0.0469			☒
			LTE_DXU4119B	1.63	Coverage	2.16	0.0469			☒
LTE_DXU0892B			LTE_DXU0892C	62.36	Co-Site	9.24	0.0907	4.46	0.0438	☒
			LTE_DXU0892A	60.87	Co-Site	3.5	0.0344	1.59	0.0156	☒
			LTE_DXU0392A	38.29	Adjacent	31.21	0.3066	26.11	0.2566	☒
			LTE_DXU6188B	33.64	Adjacent	20.38	0.2002	8.6	0.0845	☒
			LTE_DXU1826A	32.45	Adjacent	21.97	0.2159	2.23	0.0219	☒
			LTE_DXU1826C	31.05	Adjacent	7.96	0.0782	1.59	0.0156	☒
			LTE_DXU0392B	30.38	Adjacent	3.5	0.0344	0.32	0.0031	☒
			LTE_DXU1826B	30.28	Adjacent	1.59	0.0156	0.64	0.0063	☒
			LTE_DXU6188C	1	Symmetric					☒
LTE_DXU0892C	19		LTE_DXU0892B	62.6	Co-Site	12.06	0.3129	4.1	0.1064	☒
			LTE_DXU0892A	60.46	Co-Site	1.57	0.0407	0.97	0.025	☒
			LTE_DXU4020A	33.64	Adjacent	18.21	0.4724	9.53	0.2472	☒
			LTE_DXU6188A	32.04	Adjacent	10.62	0.2753	5.19	0.1345	☒
			LTE_DXU0392A	31.93	Adjacent	13.27	0.3442	3.5	0.0907	☒

Calculate Compare Commit

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Figure 63 : Sample Results of Generated Neighbors in Atoll

Click on “Commit” to save the automatically generated neighbor list to the project and “Close” the automatic allocation window. At this point, the generated neighbor relationships can be used for the physical cell ID planning.

With the neighbor relationships in the system established, the automatic physical cell ID allocation algorithm in Atoll can now be used for proper Physical Cell ID planning.

- The pre-requisite for using the algorithm is that the neighbor list relationships have been established and committed (saved) into the project
- Start the algorithm by right-clicking on *Transmitters -> Cells -> Physical Cell IDs -> Automatic Allocation*

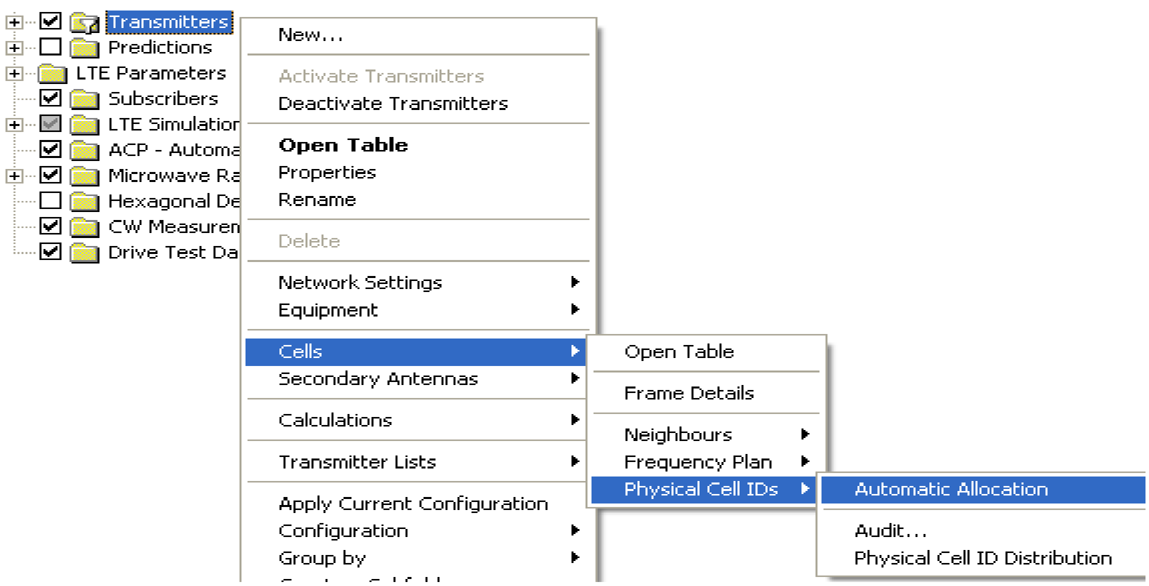

Figure 64 : Using Atoll's Automatic Allocation Module of Physical Cell IDs

Launching the “Automatic Allocation” will bring up the configuration screen for the generation of the physical cell ID as shown below.

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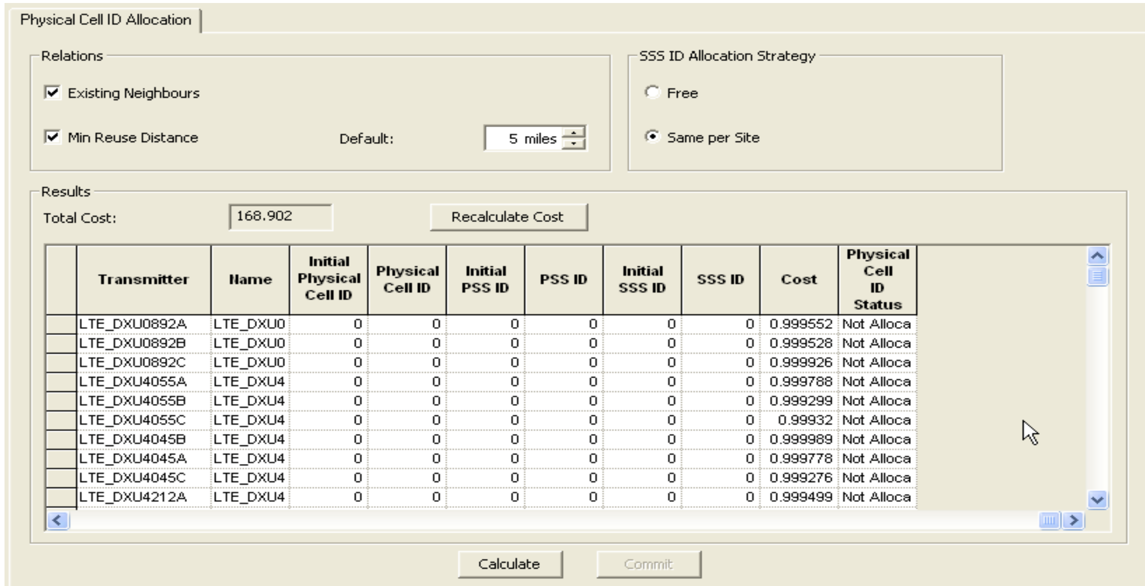

Figure 65 : Physical Cell ID Planning Setup

Use the settings below to set up the automatic allocation of the physical cell IDs. By using these settings and the pre-established neighbor relationships, all physical cell ID conflicts are avoided.

<u>Existing Neighbors - Enabled:</u>
This enables the use of the neighbors saved in the project for the physical cell ID planning.

<u>Min Reuse Distance - Enabled:</u>
The minimum distance acts as an additional check to make sure that after the neighbor list has been considered, Physical Cell IDs are only re-used after the specified min distance. Note that this is an optional step as a much wider distance was used for the neighbor list generation which is used for the physical cell ID planning.

<u>SSS ID Allocation Strategy - Same per Site:</u>
Using the same SSS ID per site allows for better management and trouble shooting in the network. This is applicable when we have a maximum of three sectors per site. It also allows for optimal synchronization times in the system.

Once all the setup above has been completed click on "Calculate" to initiate the Physical Cell ID allocation planning. This will bring up the cost status in the event viewer as shown below.

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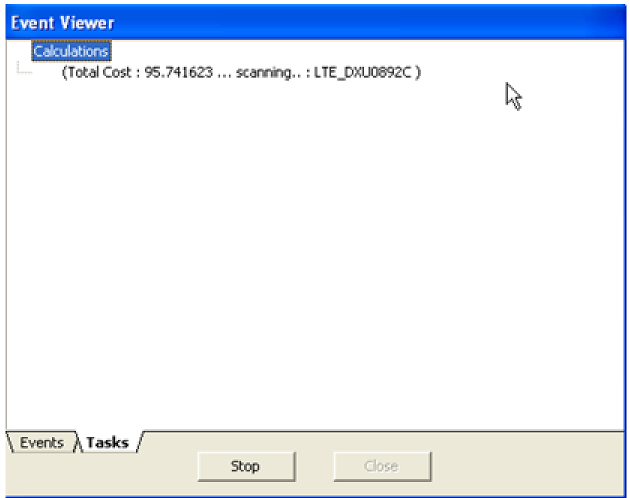
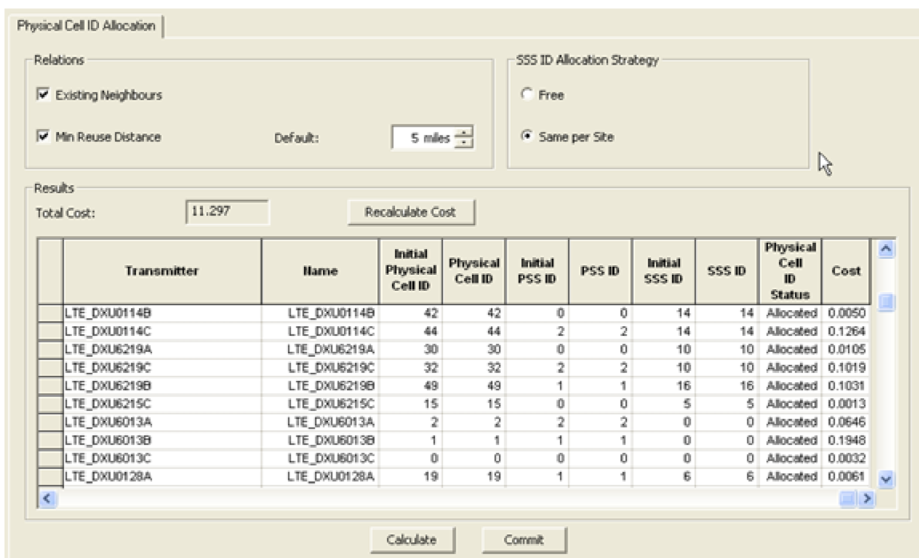


Figure 66 : Progress Status Indicating Cost for Physical Cell ID Allocation

When the run is complete, the close button becomes enabled. Click on the close button to view the generated physical cell ID plan.



Transmitter	Name	Initial Physical Cell ID	Physical Cell ID	Initial PSS ID	PSS ID	Initial SSS ID	SSS ID	Physical Cell ID Status	Cost
LTE_DXU0114B	LTE_DXU0114B	42	42	0	0	14	14	Allocated	0.0050
LTE_DXU0114C	LTE_DXU0114C	44	44	2	2	14	14	Allocated	0.1264
LTE_DXU6219A	LTE_DXU6219A	30	30	0	0	10	10	Allocated	0.0105
LTE_DXU6219C	LTE_DXU6219C	32	32	2	2	10	10	Allocated	0.1019
LTE_DXU6219B	LTE_DXU6219B	49	49	1	1	16	16	Allocated	0.1031
LTE_DXU6215C	LTE_DXU6215C	15	15	0	0	5	5	Allocated	0.0013
LTE_DXU6013A	LTE_DXU6013A	2	2	2	2	0	0	Allocated	0.0646
LTE_DXU6013B	LTE_DXU6013B	1	1	1	1	0	0	Allocated	0.1948
LTE_DXU6013C	LTE_DXU6013C	0	0	0	0	0	0	Allocated	0.0032
LTE_DXU0128A	LTE_DXU0128A	19	19	1	1	6	6	Allocated	0.0061

Figure 67 : Generated Physical Cell ID Plan in Atoll

Click on "Commit" to save the automatically generated physical cell IDs to the project. This populates the cells table of the project with the generated physical cell IDs. The cells table with the populated physical cell ID will look like the example below.

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Transmitter	Name	Active	Layer (Lowest Layer = Highest Priority)	Frequency Band	Physical Cell ID	PSS ID	SSS ID	Physical Cell ID Status
LTE_DXU0055A	LTE_DXU0055A	☒	0	700 FDD - 10 MHz	39	0	13	Allocated
LTE_DXU0055B	LTE_DXU0055B	☒	0	700 FDD - 10 MHz	41	2	13	Allocated
LTE_DXU0055C	LTE_DXU0055C	☒	0	700 FDD - 10 MHz	40	1	13	Allocated
LTE_DXU0114A	LTE_DXU0114A	☒	0	700 FDD - 10 MHz	43	1	14	Allocated
LTE_DXU0114B	LTE_DXU0114B	☒	0	700 FDD - 10 MHz	42	0	14	Allocated
LTE_DXU0114C	LTE_DXU0114C	☒	0	700 FDD - 10 MHz	44	2	14	Allocated
LTE_DXU0128A	LTE_DXU0128A	☒	0	700 FDD - 10 MHz	19	1	6	Allocated
LTE_DXU0128B	LTE_DXU0128B	☒	0	700 FDD - 10 MHz	20	2	6	Allocated
LTE_DXU0128C	LTE_DXU0128C	☒	0	700 FDD - 10 MHz	18	0	6	Allocated
LTE_DXU0167A	LTE_DXU0167A	☒	0	700 FDD - 10 MHz	50	2	16	Allocated
LTE_DXU0167B	LTE_DXU0167B	☒	0	700 FDD - 10 MHz	48	0	16	Allocated
LTE_DXU0167C	LTE_DXU0167C	☒	0	700 FDD - 10 MHz	49	1	16	Allocated
LTE_DXU0208A	LTE_DXU0208A	☒	0	700 FDD - 10 MHz	20	2	6	Allocated
LTE_DXU0208B	LTE_DXU0208B	☒	0	700 FDD - 10 MHz	18	0	6	Allocated
LTE_DXU0208C	LTE_DXU0208C	☒	0	700 FDD - 10 MHz	19	1	6	Allocated
LTE_DXU0273A	LTE_DXU0273A	☒	0	700 FDD - 10 MHz	40	1	13	Allocated
LTE_DXU0273B	LTE_DXU0273B	☒	0	700 FDD - 10 MHz	21	0	7	Allocated

Figure 68 : Atoll Cell's Table with Sample Physical Cell ID Plan

A geographic view of the Physical Cell ID, PSS ID or SSS ID plan can be viewed as depicted below through the use of the following steps.

Right-click on *Transmitters -> Properties -> Display* and set the properties as follows:

- Display Type: Discrete Values
- Field: Cells:Physical Cell ID
- Label: Cells:Physical Cell ID

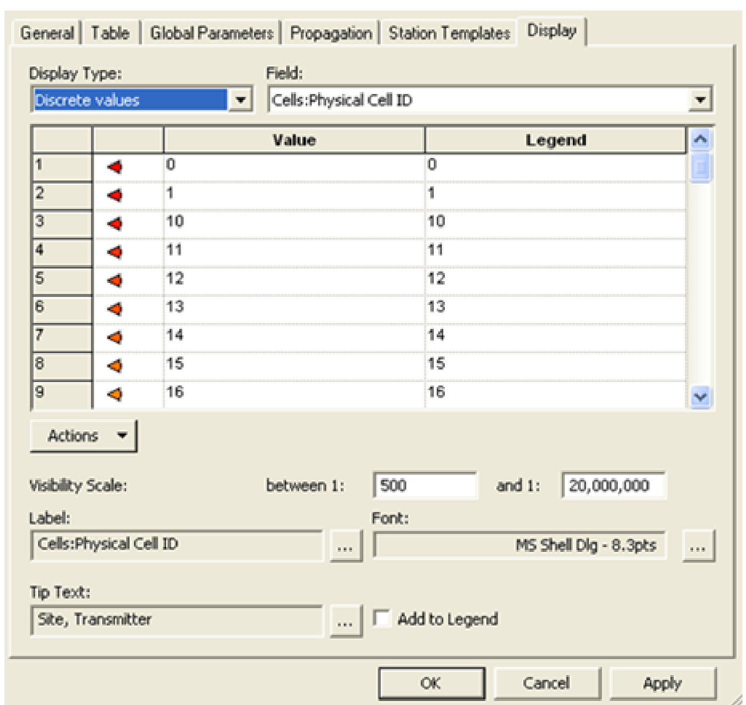

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Figure 69 : Setting Physical Cell ID Display Properties in Atoll

Upon clicking on “Apply” or “OK” the plan on the plan will be displayed on the map window as shown below.

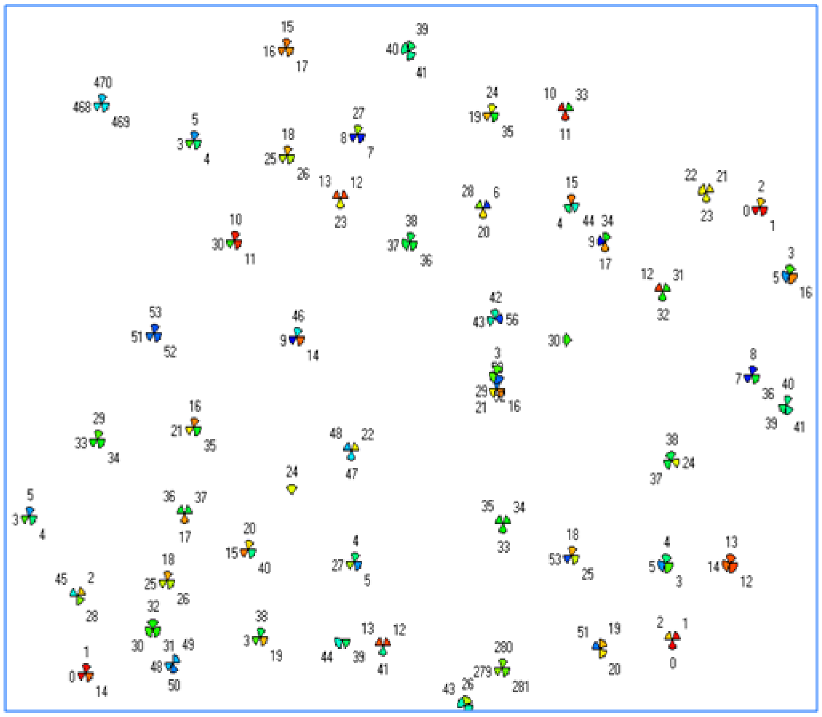

Figure 70 : Geographic Depiction of Physical Cell ID Plan

Once all sanity checks and audits have been completed to make sure that the plan was successfully generated, it should then be exported from the cells table to feed the implementation configuration files.

7.2.4 Physical Cell ID table and their relationship to PSS ID and SSS ID

For reference, the complete Physical Cell ID table and their relationship to PSS ID and SSS ID are as shown on the table below.

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Primary Synchronization Signal ID (PSS ID)
Secondary Synchronization Signal ID (SSS ID)
Physical Cell ID

SSS ID	PSS ID 0	PSS ID 1	PSS ID 2
0	0	1	2
1	3	4	5
2	6	7	8
3	9	10	11
4	12	13	14
5	15	16	17
6	18	19	20
7	21	22	23
8	24	25	26
9	27	28	29
10	30	31	32
11	33	34	35
12	36	37	38
13	39	40	41
14	42	43	44
15	45	46	47
16	48	49	50
17	51	52	53
18	54	55	56
19	57	58	59
20	60	61	62
21	63	64	65
22	66	67	68
23	69	70	71
24	72	73	74
25	75	76	77
26	78	79	80
27	81	82	83
28	84	85	86
29	87	88	89
30	90	91	92
31	93	94	95
32	96	97	98
33	99	100	101
34	102	103	104
35	105	106	107
36	108	109	110
37	111	112	113
38	114	115	116
39	117	118	119
40	120	121	122
41	123	124	125
42	126	127	128
43	129	130	131
44	132	133	134
45	135	136	137
46	138	139	140
47	141	142	143
48	144	145	146
49	147	148	149
50	150	151	152
51	153	154	155
52	156	157	158
53	159	160	161
54	162	163	164
55	165	166	167
56	168	169	170
57	171	172	173
58	174	175	176
59	177	178	179
60	180	181	182
61	183	184	185
62	186	187	188
63	189	190	191
64	192	193	194
65	195	196	197
66	198	199	200
67	201	202	203
68	204	205	206
69	207	208	209
70	210	211	212
71	213	214	215
72	216	217	218
73	219	220	221
74	222	223	224
75	225	226	227
76	228	229	230
77	231	232	233
78	234	235	236
79	237	238	239
80	240	241	242
81	243	244	245
82	246	247	248
83	249	250	251
84	252	253	254
85	255	256	257
86	258	259	260
87	261	262	263
88	264	265	266
89	267	268	269
90	270	271	272
91	273	274	275
92	276	277	278
93	279	280	281
94	282	283	284
95	285	286	287
96	288	289	290
97	291	292	293
98	294	295	296
99	297	298	299
100	300	301	302
101	303	304	305
102	306	307	308
103	309	310	311
104	312	313	314
105	315	316	317
106	318	319	320
107	321	322	323
108	324	325	326
109	327	328	329
110	330	331	332
111	333	334	335
112	336	337	338
113	339	340	341
114	342	343	344
115	345	346	347
116	348	349	350
117	351	352	353
118	354	355	356
119	357	358	359
120	360	361	362
121	363	364	365
122	366	367	368
123	369	370	371
124	372	373	374
125	375	376	377
126	378	379	380
127	381	382	383
128	384	385	386
129	387	388	389
130	390	391	392
131	393	394	395
132	396	397	398
133	399	400	401
134	402	403	404
135	405	406	407
136	408	409	410
137	411	412	413
138	414	415	416
139	417	418	419
140	420	421	422
141	423	424	425
142	426	427	428
143	429	430	431
144	432	433	434
145	435	436	437
146	438	439	440
147	441	442	443
148	444	445	446
149	447	448	449
150	450	451	452
151	453	454	455
152	456	457	458
153	459	460	461
154	462	463	464
155	465	466	467
156	468	469	470
157	471	472	473
158	474	475	476
159	477	478	479
160	480	481	482
161	483	484	485
162	486	487	488
163	489	490	491
164	492	493	494
165	495	496	497
166	498	499	500
167	501	502	503

Figure 71 : Physical Cell ID table and their relationship to PSS ID and SSS ID

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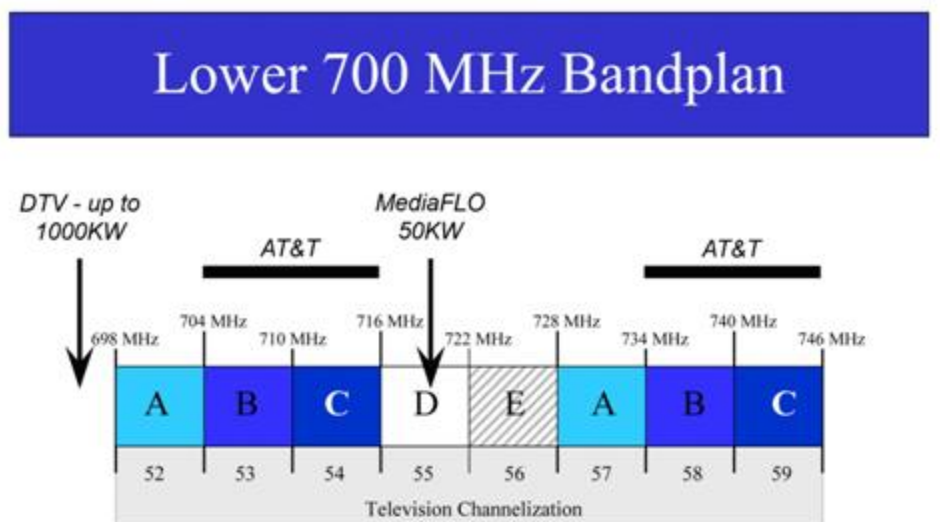
8. MediaFlo Coexistence with the AT&T LTE Network

MediaFLO is a mobile digital TV service owned and operated by Qualcomm. This service is marketed as FloTV and is also marketed through both AT&T and Verizon as a mobile TV service and is available on some handsets. Their license area is the entire US and it operates in the 700 MHz band adjacent to the AT&T licensed band.

MediaFLO transmitters do not occupy an entire 6 MHz channel. The AT&T LTE equipment also does not occupy the entire channel. Additionally, the LTE receive and transmit frequencies are being deployed with a bit of an offset from the center of our assigned channels in order to provide some additional guard band between the two services. The diagram below shows where they are (55) relative to the AT&T uplink (53, 54).



Block	Frequencies (MHz)	Bandwidth	Pairing	Geographic Area Type	No. of Licenses
A	698-704, 728-734	12 MHz	2 x 6 MHz	700 MHz EAG	6
B	704-710, 734-740	12 MHz	2 x 6 MHz	700 MHz EAG	6
C	710-716, 740-746	12 MHz	2 x 6 MHz	MSA/RSA	734
D	716-722	6 MHz	unpaired	700 MHz EAG	6
E	722-728	6 MHz	unpaired	700 MHz EAG	6

Figure 72 : MediaFlo Channel Relative to AT&T Uplink Channels

The potential for interference exists between the two technologies despite the guard band. This document covers the steps necessary to avoid or at least minimize this potential degradation. There are cases with LTE interfering with the operation of MediaFLO but those are not covered.

8.1 Interference modes

There are two primary interference modes where MediaFLO can have an impact to the LTE network.

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8.1.1 Out of Band Emissions (OOBE)

Out of band emissions, also called spurious emissions, is energy appearing outside of the transmitters licensed spectrum. In this case it refers to MediaFLO signal which is out of their band but in "our" band. This type of interference has to be filtered at the transmitter or MediaFLO end. We cannot filter this interference at the LTE receiver since it falls within our uplink receive band.

MediaFLO has installed a 6 pole filter at all of their transmitter sites which reduces this interference type to level considerably lower than required by the FCC. Any interference which does reach our receivers falls into the upper end of our uplink band and deceases rapidly.

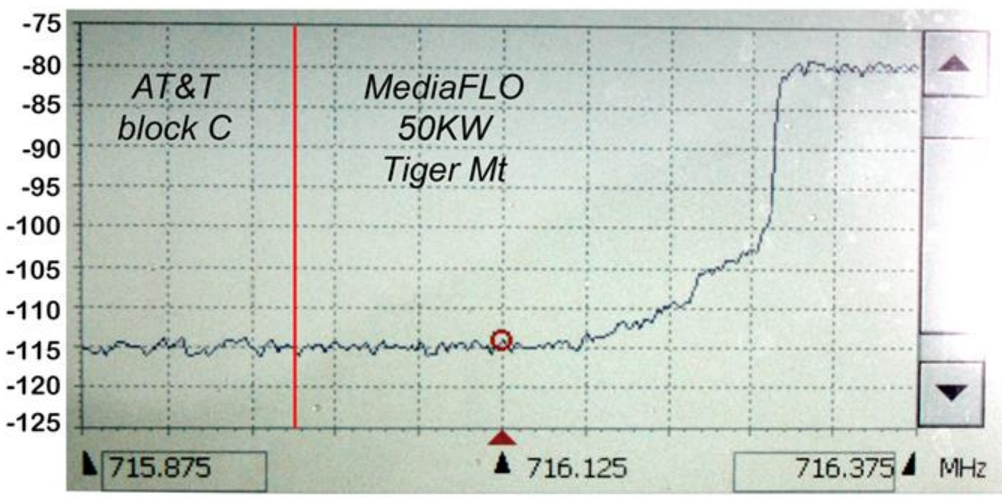

Figure 73 : Depiction of OOBE and MediaFlo

8.1.2 Desense and Blocking

Receiver desense and blocking can occur when a very strong signal is present at the receiver or first active component in the receiver chain. The signal does not have to appear within the receiver passband to cause this problem. A&P has included substantial filtering in the vendor requirements which should make this an unlikely problem.

Both Alcatel/Lucent and Ericsson have told us that their respective equipment will operate with a composite input signal of -6 dBm with 1 dB of degradation or less. 1 dB refers to the expected increase in the noise floor and is the defacto standard that has been used as a benchmark for "interference."

Desense refers to a situation where the offending off frequency signal is causing the receiver to operate in a degraded way. Normally, this would mean that radio paths at the limits of the link budget would no longer operate.

Blocking is a complete disabling of the receiver. Internally generated IM products or an amplifier going into saturation are the result.

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8.2 LTE Equipment

The LTE equipment vendors have included filtering in their receivers that will allow operation in close proximity to MediaFLO in most cases. There are likely to be exceptions.

The total power of the entire MediaFLO spectrum must be -6 dBm or less after the feeder but before any filters or LNA's. This type of measurement is made with a spectrum analyzer but it is important to have it set up correctly. This is discussed in a later section.

8.2.1 1 dB Noise Floor Degradation

A degradation of the thermal noise floor by 1dB is a standard method for determining interference. The presense of an interfering signal that is 6 db below the noise floor will cause the noise floor to rise by 1 dB. This 'standard' has been adopted for MediaFLO to LTE interference.

8.2.2 Receiver desense - rule of thumb for MediaFLO -> LTE

Rule-of-thumb 1: *A composite signal level of -6 dBm or less from MediaFLO measured before any filters, LNA's or the LTE receiver is required for <= 1 dB noise floor degradation due to receiver desense.*

8.3 MediaFLO

MediaFLO transmitters operate at up to 50 KW EIRP and transmit antennas are typically > 300' AGL. In situations where antennas are lower, the power level is also lower.

8.3.1 Spectral mask

The actual MediaFLO measured transmit spectrum is shown below. This is the output of one of their transmitters without any additional filtering. The signal is relatively flat over a 5 MHz bandwidth and drops by just under 40 dB at the edge of their 6 MHz channel.

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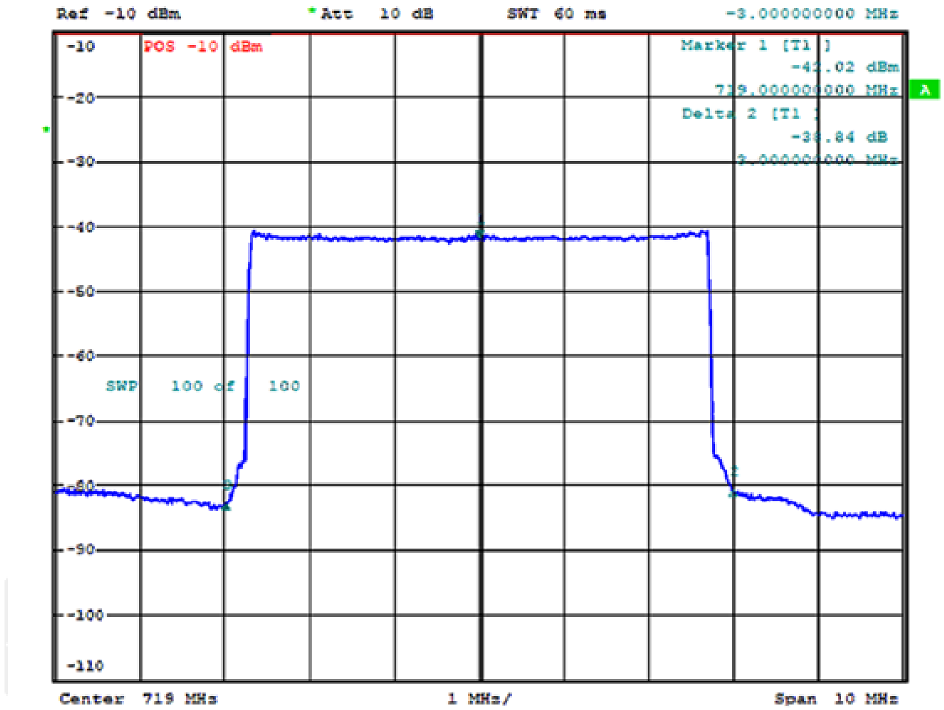

Figure 74 : Actual MediaFlo Measured Transmit Spectrum

8.3.2 Normal configuration

MediaFLO transmit sites are all equipped with a 6 pole bandpass filter which provides an additional ~60 dB of filtering at the edge of the MediaFLO 6 MHz channel. These filters are present at all MediaFLO sites. The combination of the MediaFLO transmitter and the bandpass filter provides an attenuation of OOBE of -100 dB. The filter bandpass is shown below:

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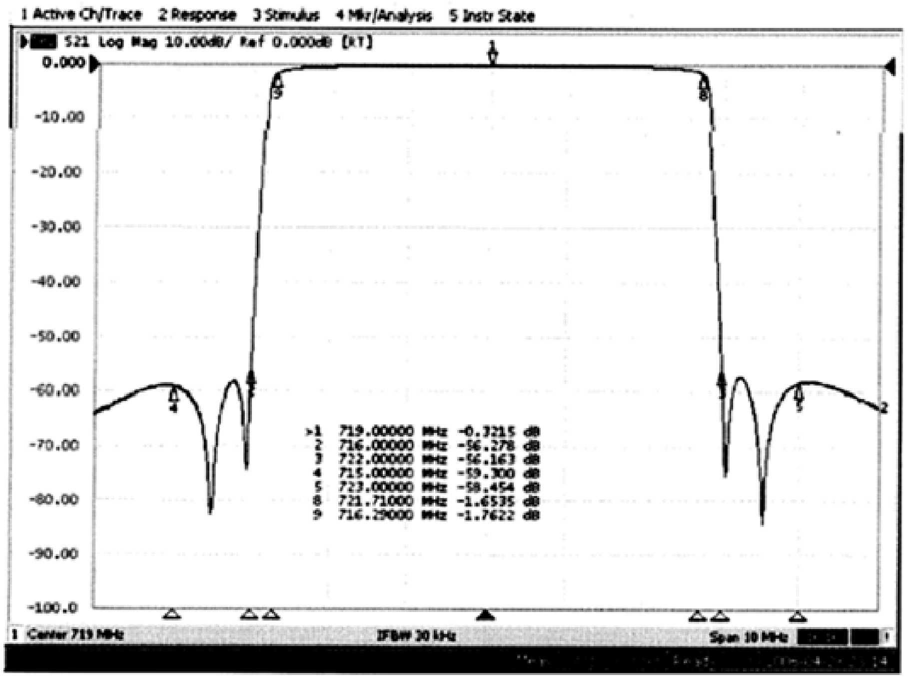

Figure 75 : Filter Bandpass of MediaFlo Transmit Sites

8.3.3 Required path loss for 1 dB noise rise

Based upon the measured MediaFLO spectrum and the amount of filtering provided by their bandpass filter, a required path loss value can be calculated. An assumption has been made that 15 dB of antenna pattern isolation will be possible. This is the total amount of isolation from transmit and receive antenna patterns and is below maximum gain. This value would drop to 0 dB if the antennas were pointing directly at each other.

Term	Value	Units	Notes
OOBE TX Power:	-47	dBm/100 kHz	Out of band emissions
TX ant gain - line loss:	14	dBi	Typical MediaFLO
TX EIRP:	-33	dBm/100 kHz	
TX EIRP (4.5 Mhz)	-16	dBm/4.5 MHz	Adjusted to bandwidth
RX ant gain - line loss	12	dBi	LTE - maximum
Ant pattern isolation	15	dB	Antenna pattern discrimination
Total RX gain	-3	dB	Total RX antenna gain/loss from cable, antenna pattern
eNode B noise figure:	3	dB	
eNode B noise floor (4.5 MHz)	-105	dBm	Noise floor adjusted for noise figure
Req'd pathloss for 1 dB noise rise	-92	dB	

OOBE ref carrier @ band edge	-100		MediaFLO TX + filter
Max receive OOBE / 4.5 MHz	-111	dBm/4.5 MHz	For 1 dB noise rise
MediaFLO main envelope	-11	dBm/ 4.5 MHz	MediaFLO envelope measurement for this OOBE

Figure 76 : MediaFlo – Required Pathloss Calculation

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8.3.4 OOBE – Rule-of-thumb MediaFLO -> LTE

Based upon the standard MediaFLO transmitter configuration, LTE equipment noise figure and using 1 dB noise rise as the reference, the measured MediaFLO signal needs to be -11 dBm/4.5 MHz RBW or less.

Rule-of-thumb 2: *A composite signal level of -11 dBm/4.5 MHz or less from MediaFLO measured before any filters, LNA's or the LTE receiver is required for <= 1 dB noise floor degradation due to out of band emissions.*

8.4 Isolation Requirements – Overall

There are two requirements which need to be met in order to achieve 1 dB or less noise rise from MediaFLO. If the MediaFLO signal measured at the LTE site (before filtering, amplifiers) is -11 dBm/4.5 MHz or less, both interference cases are satisfied. This is the ideal situation and is likley to occur in the vast majority of cases. There may be cases where the MediaFLO signal measurement is between -6 dBm and -11 dBm in which case the receiver desense case is met but noise rise due to OOBE will occur. If additonal isolation can be achieved through antenna selection, azimuth or tilt and it doesn't come at the expense of needed coverage, the problem can be avoided altogether. Since the OOBE from MediaFLO rolls off from their emission edge, this noise rise will only affect our portion of the spectrum closest to them.

8.4.1 Measuring the MediaFLO spectrum

Measurement of the MediaFLO spectrum requires an understanding of the limtiations and settings of spectrum analyzers. The signal levels that are being measured will generally require additonal attenuation to be switched in. This is usually an automatic function in the analyzer when a high input level is sensed. The measurements given in the rules-of-thumb are for a 4.5 MHz resolution bandwidth. It is very important to know the resolution bandwidth when measurements are made. The table below shows these values adjusted for different resolution bandwidths (RBW's):

Equivalent measurements

RBW	Desense limit	OOBE limit
4.5 MHz	-10.0	-11.0
1 MHz	-16.5	-17.5
100 KHz	-26.5	-27.5
30 KHz	-31.8	-32.8
10 KHz	-36.5	-37.5
1 KHz	-46.5	-47.5
1 Hz	-76.5	-77.5

Figure 77 : Spectrum Analyzers – Adjusted Values for Different Resolution Bandwidths

8.4.2 Antenna pattern isolation

Obtaining isolation with the horizontal antenna pattern is more difficult than with the vertical pattern. MediaFLO is nearly always omnidirectional and LTE antennas are much broader in horizontal plane than in the vertical plane. There also sigicant differences in the vertical pattern for antennas with the same horizontal beamwidth but different antenna gain. The diagrams below give an example of antenna isolation for both H and V planes:

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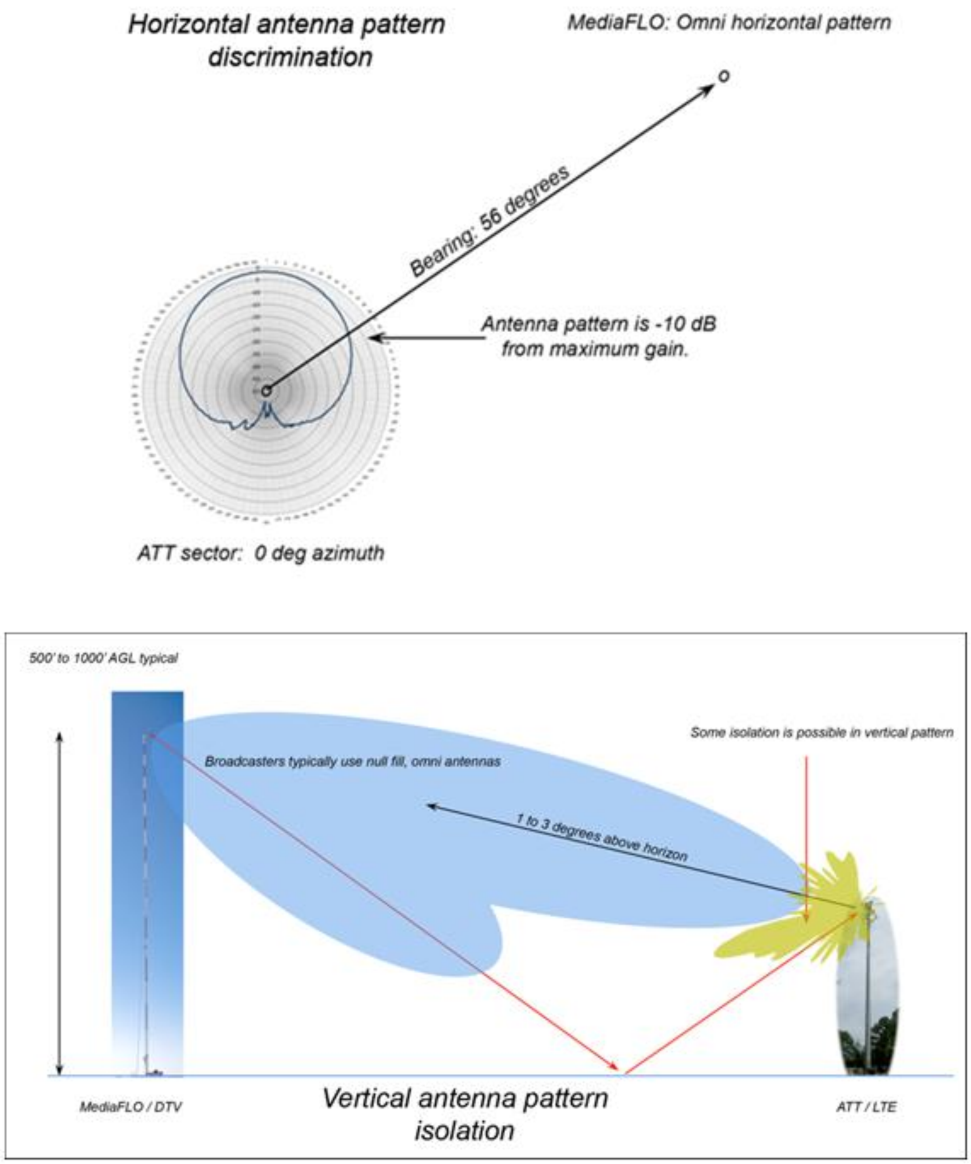

Figure 78 : Example of Antenna Isolation for both H and V Planes

8.4.3 Rule-of –thumb antenna isolation requirement

Rule-of-thumb 3: If a separation distance of 1.25 km or more exists between MediaFLO and LTE antennas AND if there is 15 dB of antenna pattern isolation, there will no degradation to LTE.

The distance increases quickly as antenna pattern isolation decreases. The table below shows the amount of antenna isolation that needs to be obtained for a given distance based upon free space path loss at 700 MHz. Keep in mind that there is likely to be an unobstructed view

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between the MediaFLO sites and a large portion of the LTE sites so free space path loss is not out of the question.

Distance (ft)	Path loss dB	Ant pat Iso needed
100	-63.2	43.3
200	-69.2	37.3
300	-72.7	33.8
400	-75.2	31.3
500	-77.1	29.4
600	-78.7	27.8
700	-80.1	26.4
800	-81.2	25.3
900	-82.2	24.3
1000	-83.2	23.3
2000	-89.2	17.3
3000	-92.7	13.8
4000	-95.2	11.3
5000	-97.1	9.4
6000	-98.7	7.8
7000	-100.1	6.4
8000	-101.2	5.3
9000	-102.2	4.3
10000	-103.2	3.3

Figure 79 : Rule-of–thumb Antenna Isolation Requirement

8.4.4 Antenna Selection

Small antennas are often selected because of their lower visual impact or for zoning and lease requirements. This comes at a cost however. For an antenna pattern of a given horizontal bandwidth but different gain, the higher gain antenna will have a narrower vertical beamwidth. Higher gain antennas are larger (longer) but provide more potential for isolation between MediaFLO and LTE sites.

8.4.5 LTE Carrier Positioning

This section describes the recommended LTE receive filter center frequency for the 10 MHz and 5 MHz allocations. MediaFLO is centered at 719 MHz with 5.4 MHz occupied bandwidth.

For 10 MHz carrier, a 1 MHz offset from the nominal 9 MHz occupied bandwidth is recommended → the UL center frequency is 709 MHz.

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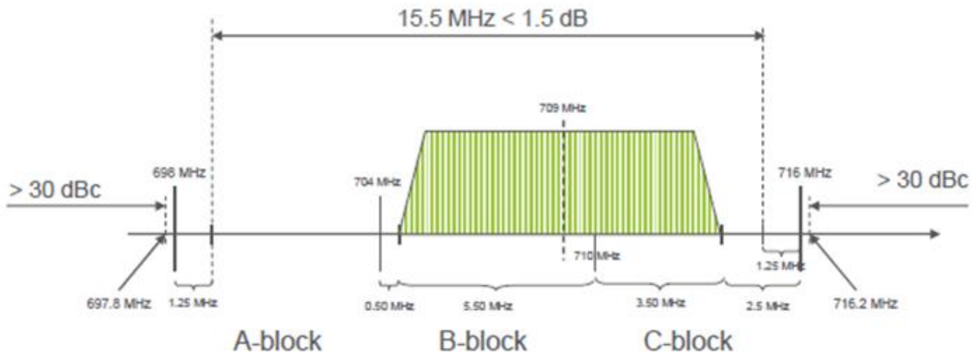

Figure 80 : MediaFlo – LTE Carrier Positioning (10 MHz)

For 5 MHz carrier → the UL center frequency is 712.5 MHz.

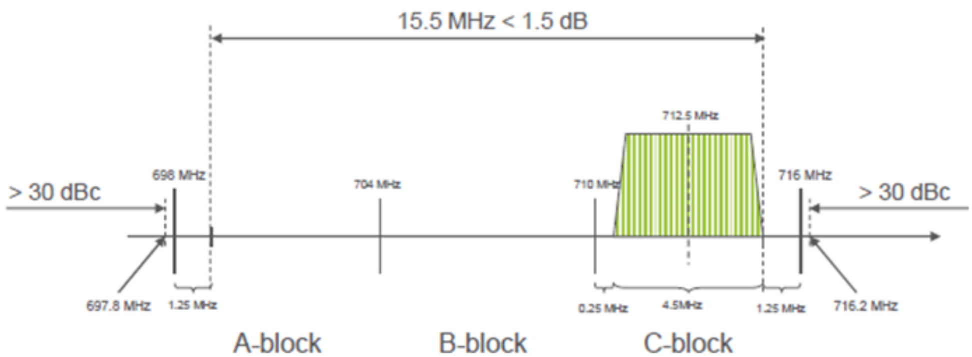

Figure 81 : MediaFlo – LTE Carrier Positioning (5 MHz)

In all of the above cases, the downlink center frequency would be 30 MHz higher than the uplink.

8.4.6 PUCCH Over-Dimensioning

The Physical Uplink Control Channel (PUCCH) carries uplink control information. The resource blocks (RB) reserved for these channels are allocated at the edge of the supported LTE bandwidth. In the case of MediaFlo interference in Channel 55 (downlink) to the LTE base station in Channel 53/54 (uplink) may cause harmful interference to the PUCCH, so certain precautions on guard bands are required.

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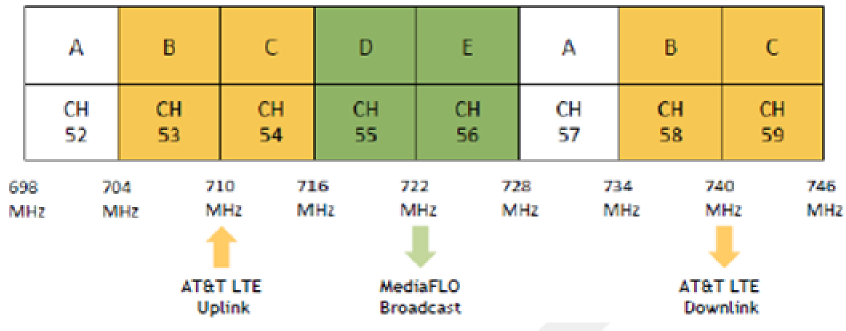

Figure 82 : Depiction of MediaFlo Broadcast Channel towards PUCCH Over-Dimensioning

Over-dimensioning the PUCCH is an alternative solution to this problem for LTE sites in the vicinity of MediaFlo. Over-dimensioning means moving the PUCCH (resource blocks) symmetrically towards the middle of channel, i.e., lead to additional guard bands. PUCCH over-dimensioning will not be available during initial launch of LTE, but will be available in the future LTE release.

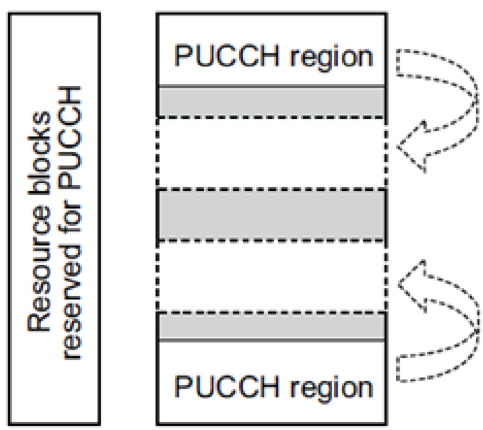

Figure 83 : Depiction of PUCCH Over-Dimensioning as an Alternative Solution for LTE Sites in the Vicinity of MediaFlo.

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9. LTE Design Deliverables

This section of the document outlines all the design deliverables required as part of the LTE design and also an estimated phase during which the deliverables must be provided.

Initial LTE Baseline RF Design Phase

In this phase of the design, the deliverables are:

1. Scoping RFDS delivered using the AT&T approved RFDS template.
2. Review results of the LTE design polygon evaluation against "smart" borders
3. LTE Atoll Project Conversion Completed and Audited
4. Traffic Density Map (Demand Map) to be used for LTE simulations

Initial LTE RF Design Phase

In this “Best Possible RF Design” phase of the design, the deliverables are:

1. Cluster polygons with a breakdown of the sites in each polygon
2. LTE design analysis results - PowerPoint document with prediction studies and Statistics comparing the "Baseline Network View" with the "Optimized Network View"
3. Atoll *.atl file containing the following:
   i. "Baseline Network View" with the "Optimized Network View" results
   ii. Linked traffic density map with saved traffic import configuration
   iii. Saved Monte Carlo simulation results
   iv. Saved LTE polygons
4. Antenna breakdown and tilt analysis spreadsheet
5. Revised RFDS reflecting the AT&T approved RFDS template.
6. Optimized Network Review Meeting.
7. Comparison between LTE Coverage and existing UMTS Coverage using the best possible optimized LTE design

Constructible LTE RF Design Phase

Based on C&E feedback and cost-benefit analysis, the deliverables are:

1. LTE design analysis results - PowerPoint document with prediction studies and Statistics comparing the "Baseline Network View", "Optimized Network View" and "Constructible Optimized Network View"
2. Atoll *.atl file containing the following:
   i. "Baseline Network View" with the "Optimized Network View" results
   ii. Linked traffic density map with saved traffic import configuration
   iii. Saved Monte Carlo simulation results
   iv. Save LTE polygons
3. Antenna breakdown and tilt analysis spreadsheet
4. Completed LTE design checklist
5. Delivery of Atoll *.atl files to the vendor for certification
6. Comparison between LTE Coverage and existing UMTS Coverage using the constructible optimized LTE design
7.

Final LTE RF Design Phase

In this DFCD phase of the design, the deliverables are:

1. Final (Implementable) RFDS delivered using the AT&T approved RFDS template.

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2. Cluster Certificates which includes but not limited to:
    - Final LTE design results - prediction studies and statistics
    - Final breakdown of sites in each cluster
    - Table with antenna selection, tilts, azimuths and heights per transmitter in the cluster
3. e-UTRAN Neighbor Relationships
4. Physical Cell ID assignments
5. LTE Design Punchlist
6. Completed Data Translations

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Appendix 1: Clutter Class Descriptions

The 38/39 Clutter Class description (2008 Vintage) is as provided below:

Class Name	Class Description
Core Urban	Areas of closely spaced tall buildings or skyscrapers associated with a city's central business district. Buildings in this category typically exhibit heights greater than 20m.
Dense Urban	High-density building clusters. May include variable height buildings of 10m to 20m typically associated with dense economic activity and high-rise apartments.
Urban	Urban areas consisting of mixed commercial and multi-family residential structures. May include variable height buildings of 5m to 15m, including hotels, hospitals, and office buildings.
Commercial /Industrial	Areas that include buildings with large footprints (e.g., warehouses, shopping centers), obvious industrial activities (e.g., manufacturing facilities, ports), or extractive land uses (e.g., quarries, strip mines). Structures in these areas are typically 5m to 15m in height.
Suburban, few trees	Residential areas in cities with populations greater than 100,000 people, and with population densities greater than 2,500 people per sq. mile. Suburban areas in close proximity to the greater metropolitan area consist of both single and multi-family dwellings approximately 5m to 15m in height. These areas have relatively few mature trees and can include dense residential building blocks, apartment complexes, and newly constructed residential communities.
Suburban with trees	Residential areas in cities with populations greater than 100,000 people, and with population densities greater than 2,500 people per sq. mile. Suburban areas in close proximity to the greater metropolitan area consist of both single and multi-family dwellings approximately 5m to 15m in height. These areas have many mature trees, sometimes forming or nearly forming a closed canopy.
Residential, few trees	Residential areas outside of 100,000 (population) urban areas with population densities of 1,000 to 2,500 people per sq. mile. Residential areas consist of both single and multi-family dwellings that are approximately 5m to 15m in height. These areas have relatively few mature trees and can include dense residential building blocks, apartment complexes, and newly constructed residential communities.
Residential with trees	Residential areas outside of 100,000 (population) urban areas with population densities of 1,000 to 2,500 people per sq. mile. Residential areas consist of both single and multi-family dwellings that are approximately 5m to 15m in height. These areas have many mature trees, sometimes forming or nearly forming a closed canopy.

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Rural, few trees	Low-density residential areas (fewer than 1,000 people per sq. mile) separate from metropolitan areas. These areas are primarily comprised of individual houses approximately 5m in height with few trees, separated by yards or other vegetation. This class may also contain small towns and villages.
Rural with trees	Low-density residential areas (fewer than 1,000 people per sq. mile) separate from metropolitan areas. These areas are primarily comprised of individual houses approximately 5m in height with mature trees, separated by yards or other vegetation. This class may also contain small towns and villages.
Convention Centers	Convention centers in major cities. These structures typically have large footprints and are 10m to 20m in height.
Major Stadium	Stadiums and arenas for major sports teams (professional and major college). Primarily basketball and football stadiums, these structures typically hold between 20,000 and 100,000 people.
Minor Stadium, Amusement Park, Fairgrounds	Smaller stadiums, coliseums, amusement parks and fairgrounds.
Hotel/Casino	LAS VEGAS ONLY. This class contains major hotels and casinos in Las Vegas, NV. Typical heights range from 10m to over 25m.
Schools: K-12	K-12 schools, as designated by US Census data.
University / College	Universities, colleges, community colleges, and technical schools.
Airport Runway	Runways and tarmac areas of airports classified by the FAA as Major Commercial or Major Commercial Reliever airports.
Airport Terminal	Terminal buildings of airports classified by the FAA as Major Commercial or Major Commercial Reliever airports. Typical airport terminal areas are 5m to 15m in height
Airport Building	Hangars, maintenance, and other buildings at airports classified by the FAA as Major Commercial or Major Commercial Reliever airports. Typical airport buildings are 5m to 15m in height.
Airports - Rural	Airport runways, terminals, and associated buildings of airports classified by the FAA as Non-Commercial. This class includes rural airports, airstrips, and airbases.
Primary Roads	Major interstate freeways and expressways, typically greater than 15m wide with elevated ramps and controlled ramp access.
Secondary Roads	Major intrastate highways, typically 5m to 15m wide with traffic light controlled intersections and direct access to residential and commercial areas.
Tertiary Roads	Assorted connector roads and major commercial roads, typically 5m to 15m wide with traffic light controlled intersections and direct access to residential and commercial areas.

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Other Paved / Impervious	Parking lots, small streets, and other flat ground-surface impervious surfaces within the urban environment.
Golf Courses / Parks / Urban Recreation	Recreational areas within the urban environment, including golf courses, parks and urban recreational grasslands.
Open In Urban	Open areas within the urban environment including empty lots, grass fields, or open industrial areas.
Open In Suburban-Residential	Open areas within the suburban and residential environment including empty lots, grass fields, or open industrial areas.
Open - Rural	Areas of open land with little or no vegetation outside the Urban-Suburban environment.
Grassland / Rangeland	Vegetated areas of mixed non-agricultural grassland, rangeland, and scattered low scrub vegetation less than 1m in height.
Cultivated Cropland	Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation less than 2m accounts for 75-100% of land cover.
Scrub Vegetation	Vegetated areas of open rangeland and mixed low scrub vegetation, typically 2m – 5m in height.
Shrubland / Woodland	Areas characterized by natural vegetation generally less than 6m tall, with individuals or clumps not touching to interlocking. Includes both evergreen and deciduous species of shrubs, young trees, and mixed trees or shrubs with mixed herbaceous understory ground cover.
Deciduous Forest	Areas dominated by trees generally greater than 6m in height where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal changes.
Coniferous Forest	Areas dominated by trees generally greater than 6m in height where 75 percent or more of the tree species maintain their leaves all year. Canopy is never without green foliage.
Mixed Forest	Areas dominated by trees generally greater than 6m in height where neither deciduous nor evergreen species represent more than 75 percent of the cover present.
Forested Wetland	Areas of wooded or forested vegetated land that is frequently or seasonally inundated with standing water. Vegetation structures are typically comprised of mixed coniferous and deciduous trees of 6m to 20m in height.
Wetland	Areas of open or vegetated land frequently inundated with water or containing shallow standing water. Vegetation is typically less than 6m in height.
Inland Water	Areas of water including rivers, ponds, lakes, and reservoirs.
Sea Water	Areas of open water including oceans, bays, and estuaries.

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AT&T Mobility Spectrum LLC ("AT&T")
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Philadelphia CMA 4, Block B
Exhibit 1

Build-Out Demonstration and Engineering Justification
Build Performance: 48%

AT&T Mobility Spectrum LLC, a subsidiary of AT&T Mobility LLC ("AT&T"), is licensed to operate a lower 700 MHz system on Block B in the Philadelphia CMA. AT&T is a national wireless provider of voice and data services, as demonstrated at http://www.att.com/shop/wireless.html#fbid=RX7GTlpbqsR. Maps identifying AT&T's voice and data coverage (which is not segregated by spectrum band) can be found at http://www.wireless.att.com/coverageviewer/#?type=voice. Section 27.14(g) of the Federal Communication Commission ("Commission") rules requires lower 700 MHz Block A, B, and E licensees to provide signal coverage and offer service over at least 35% of the service area for this license (the "Licensed Area") (a) no later than June 13, 2013, or (b) within four years of an initial license grant after June 13, 2009. The authorization for this license was granted on or before June 13, 2009, and thus, the build-out deadline is June 13, 2013. Section 27.14(k) of the Commission's rules require licensees to demonstrate compliance with this performance benchmark by filing a construction notification no later than 15 days after the build-out deadline.

Build Showing

The Licensed Area extends over 3359 square miles (after excluding any Government Lands where AT&T does not provide coverage). AT&T serves with a signal level sufficient to provide coverage and offer service within 1612 square miles of that Licensed Area. Therefore, as of the date of this filing, AT&T is covering and offering service in 48% of the Licensed Area. A coverage map providing a visual representation of the areas where AT&T provides coverage and service is included with this performance showing. The level of coverage and service may increase through the deployment of additional facilities before the build-out deadline. The calculations and methodology described below provide the engineering justification to support AT&T's build performance showing.

Signal Level

AT&T is deploying the long term evolution ("LTE") air interface within its lower 700 MHz network. AT&T defines the signal level sufficient to provide coverage and offer service in its LTE network as a minimum of -90 dBm for both 5 MHz x 5 MHz deployments (B block only) and 10 MHz x 10 MHz (B and C blocks combined) deployments. This -90 dBm signal level corresponds to the "total" Reference Signal ("RS") power, which is related to the more commonly specified Reference Signal Received Power ("RSRP"). Table 1 demonstrates the relationship between the RS and the RSRP. RSRP is measured on a per Resource Element ("RE") basis where the latter corresponds to a single orthogonal frequency-division multiplexing ("OFDM") sub-carrier with 15 kHz bandwidth. To convert to total RS power the RSRP per RE must be multiplied by the total number of of REs allocated to RSs. Thus, although RSRP per RE is 3 dB lower for a 10 MHz x 10 MHz deployment than for a 5 MHz x 5 MHz deployment, there are twice as many REs or sub-carriers allocated to RSs for a 10 MHz x 10 MHz deployment, effectively offsetting the 3 dB difference in power per RE. This analysis assumes equal total transmit power for a 5 MHz x 5 MHz deployment and a 10 MHz x 10 MHz deployment.

Table 1. Derivation of RSRP per RE from total RS power.

Parameter	5x5 MHz	10x10 MHz	Comment
Total RS power, dBm	-90	-90	Summation of power of all REs that carry RSs
Terminal loss, dB	-5	-5	Typical terminal antenna gain at lower 700 MHz. This loss must be included since it is not included in the total RS power calculation.
Service body loss, dB	-1	-1	Typical body loss for data card. This loss must be included since it is not included in the total RS power calculation.
Total RS power at Rx antenna port, dBm	-96	-96	Summation of above quantities
Number of REs allocated to RS in dB	17	20	In OFDM symbols that carry the RS 50 REs are allocated for 5 MHz and 100 REs are allocated for 10 MHz
RSRP per RE, dBm	-113	-116	Total power at RX antenna port divided by number of REs allocated to RS. In dBs subtract the number of REs.

The resulting DownLink ("DL") throughput that can be supported based upon the above total RS and RSRP per RE is a function of the Signal to Interference plus Noise Ratio ("SINR") on the Physical Downlink Shared Channel ("PDSCH"), and the number of Resource Blocks ("RBs") allocated to a user. For a LTE network, a RB is defined as 12 REs in the frequency dimension and 7 OFDM symbols in the time dimension, corresponding to a time duration of 0.5 milliseconds ("ms"). An RB-pair spans what is referred to as a sub-frame, which is 1 ms in duration, and is the smallest interval over which data can be scheduled. Table 2 calculates the received SINRs for a 5 MHz x 5 MHz deployment and for a 10 MHz x 10 MHz deployment, and the resulting number of RBs required to support at least 1 and 2 Mbps, respectively.

As shown in Table 2, the SINR is the ratio of the received PDSCH signal power over the summation of the interference plus noise, where all entities are calculated on a per RE basis. The PDSCH per RE is equal to the RSRP per RE, even though AT&T's LTE deployments use a 3 dB RS power boost since at the cell edge, which is the area of interest, the transmit diversity mode is enabled for the PDSCH, which implies that the same data is transmitted in both transmit paths (spatial multiplexing is not enabled). The effect of this at the terminal receiver is a factor of two power combining gain for the PDSCH, which offsets the 3 dB RS power boost. The RSRP does not realize this power combining gain since to prevent serving cell RS-to-RS interference at the receiver, the REs carrying RSs in transmit path 1 are different from the REs carrying RSs in transmit path 2.

The interference calculated is due solely to the RS interference from the other cells where the interfering RSRP levels are assumed to be the same as the serving cell; -113 dBm for 5 MHz x 5 MHz deployments and -116 dBm for 10 MHz x 10 MHz deployments. These latter values are suitably adjusted by the cell geometry (also referred to as the Carrier to Interference Ratio), and other factors, including multiplication by the ratio of the total number of REs used for RS in a sub-frame to the total number of REs per sub-frame. This latter factor converts the RS interference from an instantaneous power level to an average power level over the sub-frame. The interference term does not include any interference due to the PDSCH in other cells, which is consistent with the assumption of a zero data loading condition.

The resultant SINRs, including a conservative implementation margin of 3 dB, are shown in Table 2 as 1.8 and 0.5 dB for 5 MHz x 5 MHz deployments and 10 MHz x 10 MHz deployments, respectively. Link level performance curves are then used to determine the resulting bit rates per RB for each SINR, which are shown as 0.132 and 0.109 Mbps, respectively for the link level assumptions stated. Thus, to support at least 1 Mbps in 5 MHz x 5 MHz deployments will require 8 RBs, and to support at least 2 Mbps in 10 MHz x 10 MHz deployments will require 19 RBs. Since there are 25 and 50 total RBS for 5 MHz x 5 MHz deployments and 10 MHz x 10 MHz deployments the above throughputs are supported. Since RB allocations are in integer values, the values calculated by dividing the target throughputs by the bit rate per RB are rounded up to the next highest integer. Thus, the actual throughputs turn out to be slightly greater than the target values. If less RBs are allocated, the throughput is decreased, and conversely, if more RBs are allocated, the throughput is increased. As the load increases in the network, the throughput will decrease, but this can be offset somewhat by allocating more RBs up to the maximum available. In addition, there is nothing to preclude allocating all of the available RBs to a given user particularly in initial deployments with no or very light loading. In Monte Carlo simulations using the Atoll RF planning tool, it was shown that in a couple of representative markets with 1 to 2 users randomly distributed in each sector corresponding to a relatively low load that the resulting user throughput for a 5 MHz channel bandwidth was in the range of 1.7 to 2 Mbps at an RSRP per RE = PDSCH per RE = -113 dBm. These simulations assumed that the users had access to all of the available RBs. An approximate doubling of this throughput is estimated for a 10 MHz x 10 MHz deployment.

Table 2 also calculates the total PDSCH signal power for the RB allocations shown to be -93.2 and -92.4 dBm respectively for 5 MHz x 5 MHz deployments and 10 MHz x 10 MHz deployments. These values represent the actual signal power that the terminal receiver has to work with to recover the transmitted data stream. Although it is often convenient to do calculations on a per RE basis, the receiver processes the total signal power.

AT&T Mobility Spectrum LLC (“AT&T”)
Call Sign WQJU425
Philadelphia CMA 4, Block B
Exhibit 1

Attachment I

Table 2. Derivation of SINR, number of RBs required and total PDSCH power.

Parameter	5 MHz	10 MHz	Comment
Received average power of PDSCH per RE, dBm	-113	-116	PDSCH per RE is equal to RSRP per RE since 3 dB RS power boost is countered by 3 dB power combining gain of PDSCH when in transmit diversity mode at cell edge.
Receive thermal noise power per RE, dBm	-122.2	-122.2	Calculated in the RE bandwidth of 15 kHz with a 10 dB terminal noise figure.
Interference power per RE, dBm	-119.8	-122.8	In this analysis the interference is restricted to the RS interference from other cells assuming (1) a 95th percentile cell geometry value of -2.2 dB; (2) an instantaneous to average power conversion factor of about -11.7 dB, and (3) RSRP values before adjustment of -113 and -116 dBm for 5 and 10 MHz.
“Interference plus Noise” per RE, dBm	-117.8	-119.5	Linear addition of interference and noise
Received SINR, dB	4.8	3.5	PDSCH per RE – “Interference plus Noise” per RE
Implementation margin, dB	3	3	Margin to account for any additional losses not considered
Received SINR with implementation margin, dB	1.8	0.5	Received SINR – implementation margin
Bit rate per RB, Mbps	0.132	0.109	Key link level assumptions include: (1) MIMO mode = transmit diversity; (2) Extended Pedestrian A (EPA) channel model with 5 Hz Doppler frequency; and (3) maximum of 4 HARQ transmissions.
Number of RBs required	8	19	Number of RBs required to support at least 1 and 2 Mbps. Since allocations are in integer number of RBs the respective values calculated by dividing the throughputs by the bit rate per RB are rounded up to the next highest number
Actual throughput supported, Mbps	1.06	2.07	Bit rate per RB times number of RBs
Number of REs allocated to PDSCH in dB	19.8	23,.6	8*12 = 96 REs for 5 MHz, 19*12 = 228 REs for 10 MHz.
Total received PDSCH signal power, dBm	-93.2	-92.4	Summation of PDSCH per RE and number of REs allocated to PDSCH

AT&T Mobility Spectrum LLC ("AT&T")
Call Sign WQJU425
Philadelphia CMA 4, Block B
Exhibit 1

Attachment I

Coverage and Service Area Prediction Tool
The distance to contours for each lower 700 MHz site is calculated using network design and analysis propagation models. These propagation models are based on the COST-231 Hata model, defined as follows:

$$L = 46.3 + 33.9\log(f) - 13.82\log(H_{\mathbf{b}}) - a(H_{\mathbf{m}}) + [44.9 - 6.55\log(H_{\mathbf{b}})]\log(d) + C$$

where

$$a(H_{\mathbf{m}}) = (1.1\log(f) - 0.7)H_{\mathbf{m}} - (1.56\log(f) - 0.8)$$

Calculation of Geographic Area of Licensed Area and Coverage/Service
AT&T calculates its build performance under Commission rule 27.14(g) (i.e. where AT&T provides coverage and offers service) using the formula,

$$\frac{\text{Covered Licensed Area (sq mi)}}{\text{Modified Licensed Area (sq mi)}}$$

where:

- Licensed Area = The number of square miles within the licensed service area as generated by Alteryx, a data compiling, analysis, and reporting tool that can conduct spatial calculations, including distances in square miles between set boundaries. Lands owned by tribal governments and lands held by the Federal Government in trust or for the benefit of a recognized tribe are included in the Licensed Area.
- Covered Licensed Area = The total geographic area within the Licensed Area where AT&T provides coverage and offers service.
- Modified Licensed Area = The Licensed Area minus the geographic area within the Licensed Area that is Government Lands where AT&T does not provide coverage and offer service.
- Government Lands=Areas that are owned or administered by Federal Government agencies and entities and areas that are owned or managed by States, as explained by Commission Order.[1] The geographic area (sq. mi) comprising Government Lands was generated based on data from NationalAtlas.com for Federal lands and from the State Parks files in StreetPro for State lands. For this license, Government Lands were excluded from the Licensed Area.

[1] *See* Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, WT Docket No. 06-150, *Second Report and Order* at 67 (2007).

Conclusion

Using the methodologies above, AT&T calculates that it provides coverage and offers service in excess of the 35% performance benchmark as follows:

Calculation	% Licensed Area Covered
1612 sq. mi / 3359 sq. mi	48%

December 7, 2016

Ms. Carmelisa Morales
Planning Department
San Mateo County
455 County Center, 2nd Floor
Redwood City, CA 94063

Re: **<u>ExteNet Response to Appeal of 10/20 Zoning Officer Approval</u>**

Applicant:	**ExteNet Systems (California) LLC ("ExteNet")**
County Planning No.:	**PLN2016-00216**
ExteNet Site ID:	**SW-CA-LAHONDA-ATT Node 61G**
Nearest Site Address:	**Public Right-of-Way near 231 Cuesta Real**

Dear Ms. Morales,

This letter and attachments are in response to the Appeal of ExteNet's proposed public right-of-way facility approved at the San Mateo County Zoning Officer's October 20th hearing. As a brief introduction in response to the Appellant's claim that we are a "subcontractor of AT&T," ExteNet actually owns the proposed facility through which AT&T will transmit its signal. ExteNet is a distributed network provider, a member of the Northern California Joint Pole Association and a telephone corporation licensed in California pursuant to certificate of public convenience and necessity utility number U-6959-C. ExteNet uses existing telephone pole locations to host miniature, modern telephone facilities – the most appropriate existing infrastructure available that has been used for over a century to host telephone equipment.

Our responses are as follows:

1. **ExteNet's propagation maps and alternative site analysis exceed the County's requirement for technical information and other justifications explaining why co-location is not feasible.**

Appellant alleges that ExteNet's propagation maps and alternative site analysis fail to provide adequate technical information in support of its showing that co-location is not viable at an existing wireless facility within a 2.5 mile radius.

The applicable San Mateo County Code Section 6512.5(B)(11) is as follows:

> *Identification of existing wireless telecommunication facilities within a 2.5-mile radius of the proposed location of the new wireless telecommunication facility, and an explanation of why co-location on these facilities, if any, is not feasible. This explanation shall include such technical information and other justifications as are necessary to document the reasons why co-location is not a viable option. The applicant shall provide a list of all existing structures considered as alternative to the proposed location. The applicant shall also provide a written explanation why the alternatives considered were either unacceptable or infeasible.*

The County Code does not specify what "technical information and other justifications" are "necessary to document the reasons why co-location is not a viable option." However, the propagation maps and alternative site analysis supporting ExteNet's application are standard for such Planning applications, and were deemed to be sufficient by those most familiar with such applications: Planning Staff and the Zoning Officer. Although drive test information is proprietary, we have obtained special permission to release the attached propagation maps that have been updated to include the specific radio frequency coverage thresholds. These propagation maps are based on actual drive test data. Even if the original materials are deemed on appeal to be inadequate then the attached supporting information exceeds the County's requirements. It conclusively shows the existing macro antenna facility located at 155 Sears Ranch Road cannot be used to close AT&T's significant gap in coverage.

Appellant's demand for more technical data is a distraction from the time, place and manner restrictions (and associated aesthetic regulations) within the County's purview pursuant to California Public Utilities Code Section 7901. ExteNet is not a transmitting carrier but is a telephone corporation licensed to operate in the public right-of-way irrespective of coverage provided. Nevertheless, ExteNet has provided an abundance of technical information to honor the Appellant's request, exceeding County and State requirements. ExteNet's ongoing good-faith cooperation should not be used to its detriment in support of this appeal.

2. **Appellant's anecdotal showing of existing 4G LTE coverage fails to prove AT&T lacks a significant gap in coverage.**

Appellant argues that adequate 4G LTE coverage exists in the area around ExteNet's proposed facility, and that the existence of such coverage means ExteNet's Zoning Officer approval should be overturned.

First, Appellant fails to show how this coverage argument is connected in any way to the County's approval findings or to the County Code. Without any connection to the County Code or Zoning Officer's findings, Appellant's argument is irrelevant and should be disregarded.

Also, Appellant cites the existence of another carrier's coverage as proof that AT&T's coverage is adequate. Governing courts and the FCC have rejected the "one provider" argument in favor of the "own coverage rule" that each carrier is entitled to provide overlapping coverage to an area.[1] As stated above, ExteNet is entitled to deploy its facilities in the public right-of-way irrespective of coverage, but even if Appellant's anecdotal coverage evidence is factual (which it is not), Appellant fails to assert an argument that can legally be used to overturn ExteNet's land use approval.

ExteNet's propagation maps and alternative site analysis show that a significant coverage gap exists, that the gap cannot be adequately filled by co-locating at the Sears Ranch Road site, and that we are using the least intrusive means to fill this service gap. Exhibit 3 of the attached RF statement demonstrates that there is an existing 4G LTE service coverage gap. When determining that Node 61G is the least intrusive location, Applicant formally evaluated 18 alternative node locations and informally evaluated many more that are well outside the area that might reasonably be able to fill the service gap. Exhibit 4 of the attached RF statement is a propagation map showing the proposed 4G LTE coverage for the existing nodes in conjunction with proposed. Node 61G increases the green shaded areas depicting an acceptable level of in-building service coverage.

Any blue or yellow colored area depicted in the attached maps portrays inadequate service coverage and constitutes a service coverage gap. The proposed location for Node 61G increases the in-building coverage while minimizing yellow "in-vehicle" coverage. Most significantly, the proposed location significantly decreases the blue shaded area depicting a signal strength range that fails to provide a consistently acceptable level of service.

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[1] MetroPCS, Inc. v. City & Cnty. Of S. F., 400 F.3d 715, 733 (9th Cir. 2005) ("[W]e elect to . . . formally adopt the First Circuits rule that a significant gap in service (and thus an effective prohibition of service) exists whenever a provider is prevented from filling a significant gap in *its own* service coverage.); Petition for Declaratory Ruling to Clarify Provisions of Section 332(c)(7)(B), 24 FCC Rcd. 13994, 14016-17 (2009) ("[W]e conclude that under the better reading of the statute, this limitation of State/local authority applies not just to the first carrier to enter into the market, but also to all subsequent entrants.")

3. **Appellant fails to show that an adequate signal is propagated or could be propagated from Sears Ranch Road.**

Appellant argues that because the Sears Ranch Road site is adequate for Verizon, it should be adequate for AT&T.

As stated above, ExteNet is entitled to deploy its facilities in the public right-of-way irrespective of coverage, but no case can be made to support the appeal even considering Appellant's coverage arguments.

Assuming that the Appellant's anecdotal coverage model accurately depicts Verizon's signal levels, AT&T relies on different frequencies and different technologies that do not result in the same propagation as Verizon. Furthermore, the existing Verizon coverage is not necessarily adequate – as presented by Appellant's own supporters who testified at the Zoning Officer hearing that there was not a consistent signal in La Honda. Even if adequate coverage could be provided from the Sears Ranch Road site, Appellant's argument does not take into consideration the increased height that would need to be added to the tree-pole there, rendering it a much more intrusive solution than ExteNet's current proposal at the existing telephone pole. ExteNet's proposal blends in with the surrounding trees and existing utility infrastructure without imposing any view impact to the surrounding community.

For all of these reasons we respectfully request for the appeal to be denied and for ExteNet's land use approval to be affirmed. As this application seeks authority to install a wireless telecommunication facility, the FCC's Shot Clock Order[2] requires the county to issue its final decision on ExteNet's application within 150 days. Feel free to contact me if you have any questions. Thank you.

Best Regards,
EXTENET SYTEMS (CALIFORNIA) LLC

Matthew S. Yergovich
External Relations Director

[2] *See* Petition for Declaratory Ruling to Clarify Provisions of Section 332(c)(7)(B), WT Docket No. 08-165, Declaratory Ruling, 24 F.C.C.R. 13994 (2009).

ExteNet Systems (California) LLC
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AT&T Mobility Radio Frequency Statement
Small Cell Node 61G: Utility Pole in Public Right-of-Way
231 Cuesta Real, La Honda, CA

I am the AT&T radio frequency (RF) engineer assigned to the proposed wireless telecommunications facility (“Node 61G”), which is a Small Cell Node to be located on a new utility pole in the public right-of-way near 231 Cuesta Real, La Honda (the “Property”). Based on my personal knowledge of the Property and with the AT&T’s wireless network, as well as my review of AT&T’s records with respect to the Property and its wireless telecommunications facilities in the surrounding area, I have concluded that the work associated with this permit request is needed to close a service coverage gap in the area surrounding the Property.

The service coverage gap is caused by inadequate infrastructure in the area. AT&T’s existing facilities do not adequately serve its customers in the desired area, nor address rapidly increasing data usage. Moreover, 4G LTE service coverage has not yet been fully deployed in this area. To remedy this service coverage gap, AT&T needs to construct a new wireless telecommunications facility.

AT&T uses industry standard propagation tools to identify the areas in its network where signal strength is too weak to provide reliable in-building service quality. This information is developed from many sources including terrain and clutter databases and propagation modeling that simulates signal propagation in the presence of terrain and clutter variation. AT&T designs and builds its network to ensure customers receive reliable in-building service quality.

Exhibit 1 to this Statement is a map of the existing 3G UMTS service coverage in the area at issue. It represents service coverage provided by existing AT&T sites. The green shaded areas depict areas within a signal strength range that provide acceptable in-building service coverage. In-building coverage means customers are able to place or receive a call on the ground floor of a building. The yellow shaded areas depict areas within a signal strength range that provide acceptable in-vehicle coverage. In this area, an AT&T customer should be able to successfully place or receive a call within a vehicle. The blue shading depicts areas within a signal strength range in which a customer might have difficulty receiving a consistently acceptable level of service. The quality of service experienced by any individual can differ greatly depending on whether that customer is indoors, outdoors, stationary, or in transit. Any area in the blue or yellow category is considered inadequate service coverage and constitutes a service coverage gap.

Exhibit 2 represents service coverage in the vicinity of the Property if the Node 61G antennas are placed as proposed in the application. As shown by this map, placement of Node 61G closes the significant 3G service coverage gap in the area immediately surrounding the Property.

In addition to these 3G wireless service gap issues; AT&T is in the process of deploying its 4G LTE service in La Honda with the goal of providing the most advanced personal wireless experience available to residents of the City. 4G LTE is capable of delivering speeds up to 10 times faster than industry-average 3G speeds. LTE technology also offers lower latency, or the processing time it takes to move data through a network, such as how long it takes to start downloading a webpage or file once a customer has sent the request. Lower latency helps to improve the quality of personal wireless services. In addition, LTE uses spectrum more efficiently than other technologies, offering more capacity to carry data traffic and services and to deliver a better overall network experience.

Exhibit 3 is a map that depicts 4G LTE service in the area surrounding the Property, and it shows a significant 4G LTE service coverage gap in the area. Exhibit 4 shows that after Node 61G is on air, 4G LTE service is available both indoors and outdoors in the area. This is important not only in providing 4G LTE to residents of La Honda, but also allows customers to be migrated from UMTS to LTE and thus reducing 3G traffic, and mitigating 3G traffic congestion during peak usage periods.

I have a Bachelor of Engineering Honors degree in Electronics, and I have worked as a radio frequency design engineer in the wireless communications industry for over 8years.

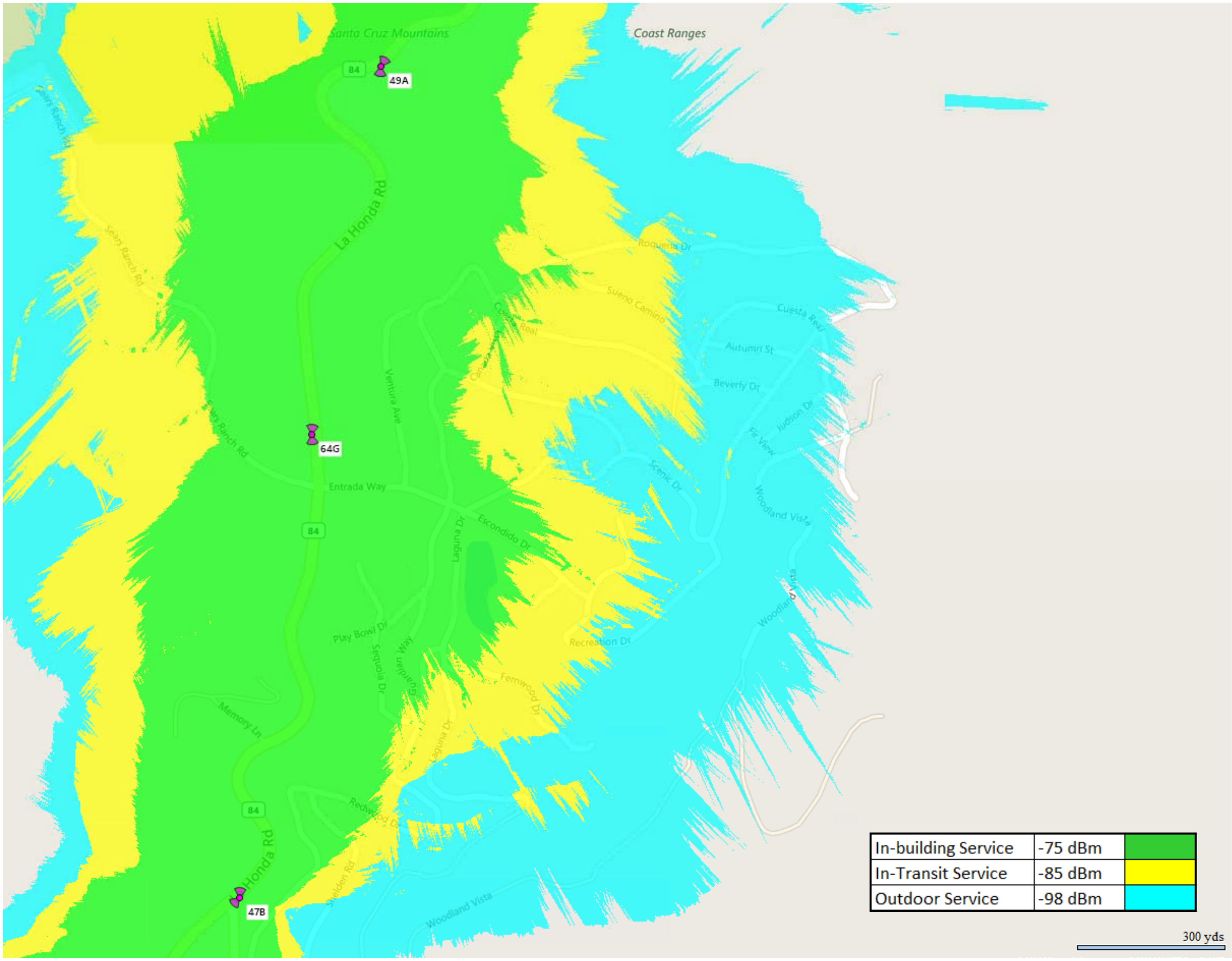
Brian Williams
Brian Williams

November 22, 2016

Attachment K

AT&T 3G UMTS Existing Coverage – without Node 61G

Exhibit 1



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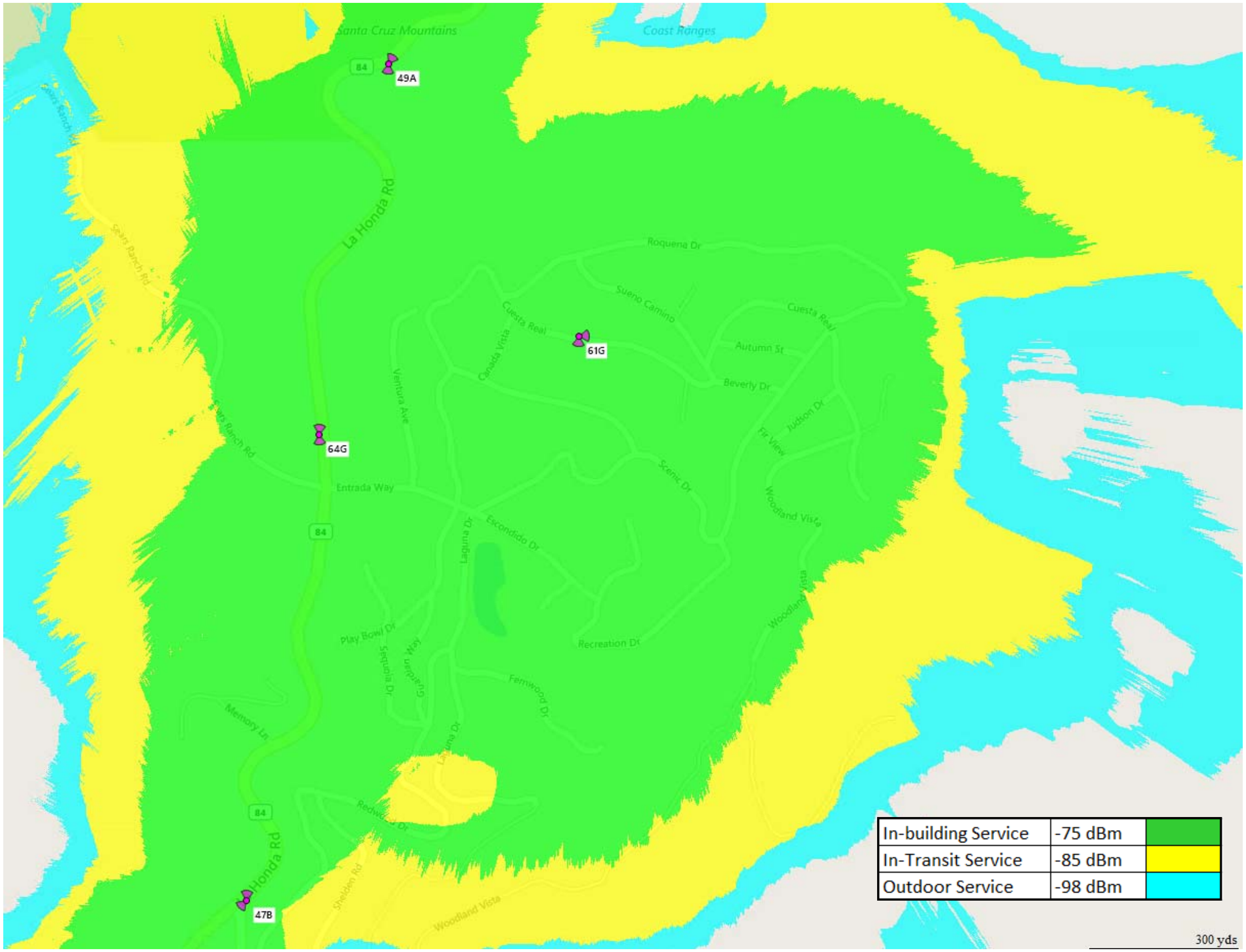
Attachment K

AT&T 3G UMTS Existing Coverage – With Node 61G

Exhibit 2



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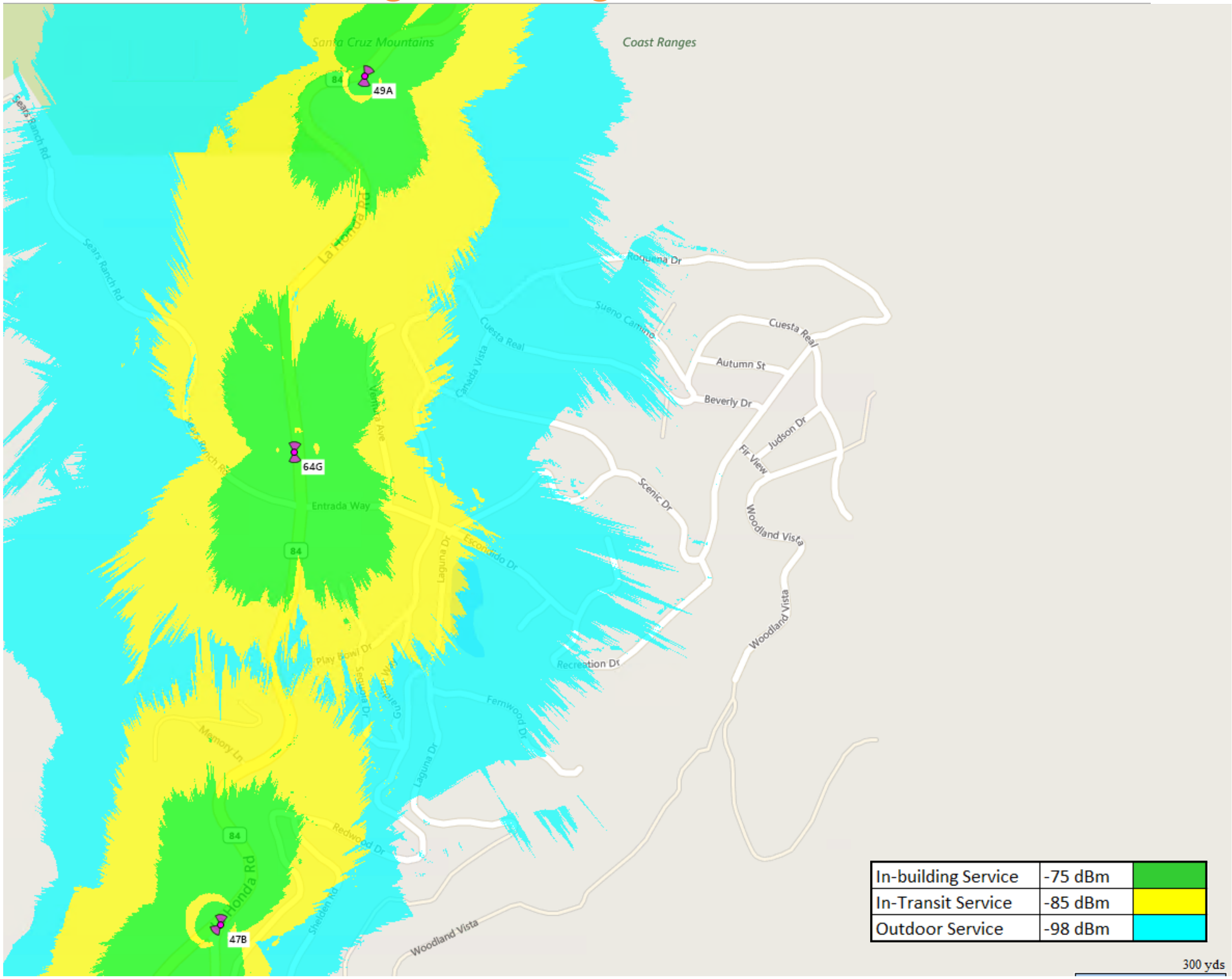
Attachment K

AT&T 4G LTE Existing Coverage – without Node 61G

Exhibit 3



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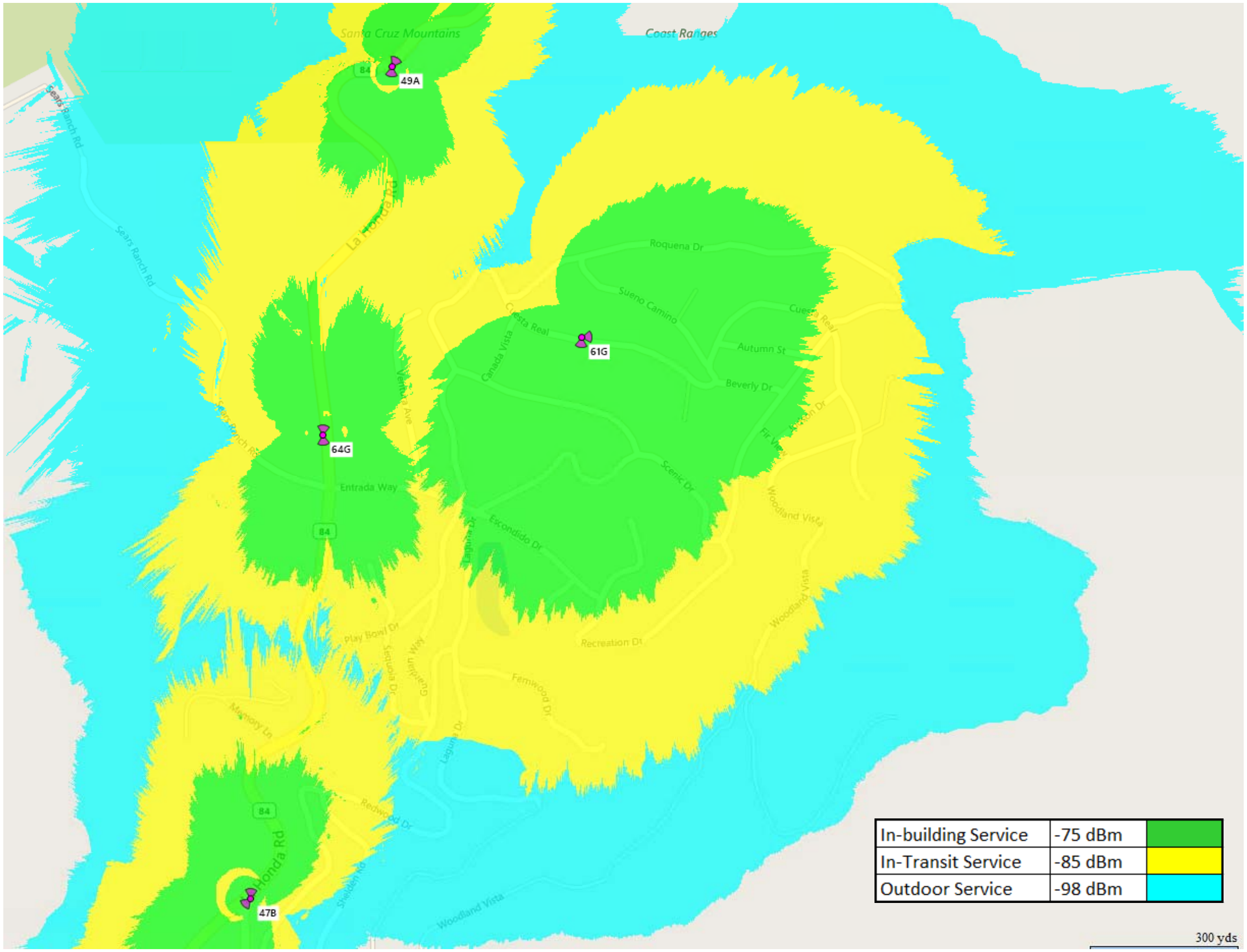
Attachment K

AT&T 4G LTE Existing Coverage – With Node 61G

Exhibit 4



In-building Service	-75 dBm	
In-Transit Service	-85 dBm	
Outdoor Service	-98 dBm	

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Attachment K