Isotrope WIRELESS

Thinking outside the sphere

Initial Review of an Application for DRI Review of a Wireless Communication Facility at 145 Route 130, Sandwich, Massachusetts

April 26, 2017

Executive Summary

The primary conclusions of this report are in the form of requests for additional information from the applicant, tabulated below:

- Submit a copy of the FCC-mandated radio frequency energy Routine Evaluation.
- No inventory of all existing tall structures in the area was prepared. Please submit.
- The Forestdale School water tower was overlooked by T-Mobile. Evaluate its feasibility.
- No evidence of the relative differences in coverage improvements at lesser heights was provided to demonstrate the need for the proposed height. Following the recommendations below, provide alternative heights analysis.
- Coverage analysis was performed only for the least effective frequency band, 2100 MHz AWS. Provide coverage analysis as directed below for 700 MHz as well.
- The proposed location aligns with a "bore-sight view" from Quaker Meetinghouse Road. Alternative areas to locate on the proposed property are suggested for further consideration. These would not present a bore-sight view to the community.
- The nearby tree canopy height is not provided. Provide a reliable estimate for use with coverage analysis.
- Some technical questions about the drive test are provided below. Also, the CW drive test of proposed coverage is not normalized to the same metric as used on the computer-estimated coverage plots. Please resolve and report.
- There is no scan test of existing coverage to corroborate the computer-estimated plots.
- The visual impact study lacks a GIS-based visual impact map. Please provide, as explained below.
- Provide a description of the methodology of preparing the photosimulations.
- Noise is technically non-compliant based on the worst-case analysis, unless noise from intermittent operation of an electrical generator is exempt. The final installation might be compliant upon completion and testing, due to intervening vegetation and terrain. Consider what mitigation would be necessary if the final installation is not noise compliant.

Introduction

The Cape Cod Commission (the "Commission") engaged the services of Isotrope, LLC ("Isotrope") to provide technical support in the review of the above-captioned application for approval of a Development of Regional Impact at 145 Route 130 in Sandwich (the "Site"). The application by Eco-Site, Inc. ("Application") is for a new Telecommunications Tower ("Tower") and related personal wireless facilities at the Site. Collectively, these are addressed as a wireless communications facility ("WCF") in this report. Joining in the application is the personal wireless service provider, T-Mobile. T-Mobile intends to be the first tenant on the proposed Tower.

This report reviews technical aspects of the application with respect to the placement and construction of WCFs. Commission staff provide input to the proceeding on other environmental and regulatory aspects of the application. As always, advice of counsel is recommended particularly for personal wireless facility matters.

Use Variance

The applicant will be seeking a use variance from the Town of Sandwich, because the proposed development is not within the Sandwich Wireless Telecommunications Overlay District. The nearest locations within the district are 1.9 miles south (where T-Mobile already occupies a tower off Falmouth-Sandwich Road) and 1.8 miles north. T-Mobile has no facility in the nearest location to the north, but T-Mobile is located on the tower at 431 Route 130, about 2.5 miles north of the proposed site.

If, through this review process, it is determined that a WCF at or near the proposed Site is necessary for the provision of personal wireless services, it would not be practicable to serve this area from the nearest WCF district parcels because they are nearly 2 miles away. Evidence of need for a WCF in this area is explored below.

The applicant seeks a use variance to bylaw section 3820 Wireless Telecommunications Overlay District (and to the corresponding limitations in the Table of Uses). Section 3820 limits placement of new WCFs to the Overlay District. However, the remainder of the section 3800 Wireless Telecommunications Services bylaw is district-agnostic. In other words, should Sandwich elect to vary §3820 to allow a WCF outside the Overlay District, the remainder of the bylaw would appear to remain applicable, including the requirement to obtain a Special Permit and comply with the performance criteria and setbacks in the bylaw.

Dimensional Variance

The applicant seeks a dimensional variance for the height of the proposed Tower because it is in the R2 district and is not included in the overlay district. This height variance is requested, prudently, to ensure there is no ambiguity about the scope of the use variance. Arguably, a use variance would allow the use on the Site, and the rules for such a use allow certain tower heights above the normal district limits.

The height is proposed to be 135 feet above ground. DRI regulations and the town Zoning Bylaw allow heights of up to 150 feet in overlay districts. It might be sufficient to determine that if the Town grants a use variance for the Site, that the Site is effectively added to the overlay district. If so, then the proposal would be consistent with the least restrictive height criterion in the Commission's regulations. Otherwise, the proposed tower height would exceed the Commission's very restrictive threshold relating to building or tree-canopy heights. If it is determined the proposed Tower would not be effectively in the overlay district after grant of a use variance by the Town, then the Commission would consider whether to waive its building/tree-height-based restrictions to allow up to the requested 135 foot height.

The implications of the proposed height and alternatives are addressed below.

TCA

The Telecommunications Act of 1996 ("TCA") proscribes any decision that would have the effect of prohibiting the provision of personal wireless services. The applicant argues that a variance may be granted under federal auspices for this reason, even if the proposal cannot obtain variances under state law. This approach is consistent with our experience in other matters. We leave it to the town to decide with advice of its counsel.

DRI regulations also look to the TCA, by seeking evidence of claims of a gap in service and lack of better alternatives. These issues are addressed in sections below.

Setback

The proposed Tower is set back from property lines by distances that are greater than its height, which is consistent with the Sandwich WCF bylaw and the Commission's Technical Bulletin 97-001 (Rev 9/30/2010) (the "Bulletin").

Coverage Need

The application contains coverage analysis of the T-Mobile service using the 2100 MHz ("AWS") spectrum band. T-Mobile has frequencies in several bands. The lay person can imagine the radio frequency bands as analogous to colors of light. Each "color" licensed by T-Mobile can be used simultaneously at the same cell site. The AWS band is the highest frequency band licensed by T-Mobile. Coverage analysis based on this band is always the most pessimistic because higher frequency bands are significantly more affected by foliage and vegetation.

T-Mobile's lowest frequency band in use today is nominally at 700 MHz (the "700 MHz Band"). While this frequency has less capacity than T-Mobile's AWS licensed frequencies, the 700 MHz band is used to supplement coverage and obtain more penetration past the limitations of AWS

coverage at the cell edges. A full picture of T-Mobile coverage can only be obtained with the submission of 700 MHz coverage maps in addition to the 2100 MHz coverage maps.

The applicant should submit 700 MHz coverage analysis, including existing 700 MHz coverage as well as potential 700 MHz coverage from existing cell sites that have not been upgraded to 700 MHz service yet. Also note, that over the next couple of years, T-Mobile will be building out new 600 MHz frequencies recently acquired at FCC auction. This will significantly increase service available from its cell-sites by adding much more capacity in these vegetation-penetrating lower frequency bands. A coverage assessment of need must, therefore, include low frequency coverage in existing in the analysis of need and alternatives.

T-Mobile's coverage analysis in the AWS band shows that despite its limitations due to its high frequency, there is in-vehicle AWS coverage (yellow areas in the snapshot below) throughout Town of Sandwich. The proposed Site is in the center of the map, surrounded by yellow.

Once the 700 MHz analysis is provided by T-Mobile, we can provide a more detailed assessment of the claimed problem and the proposed solution.

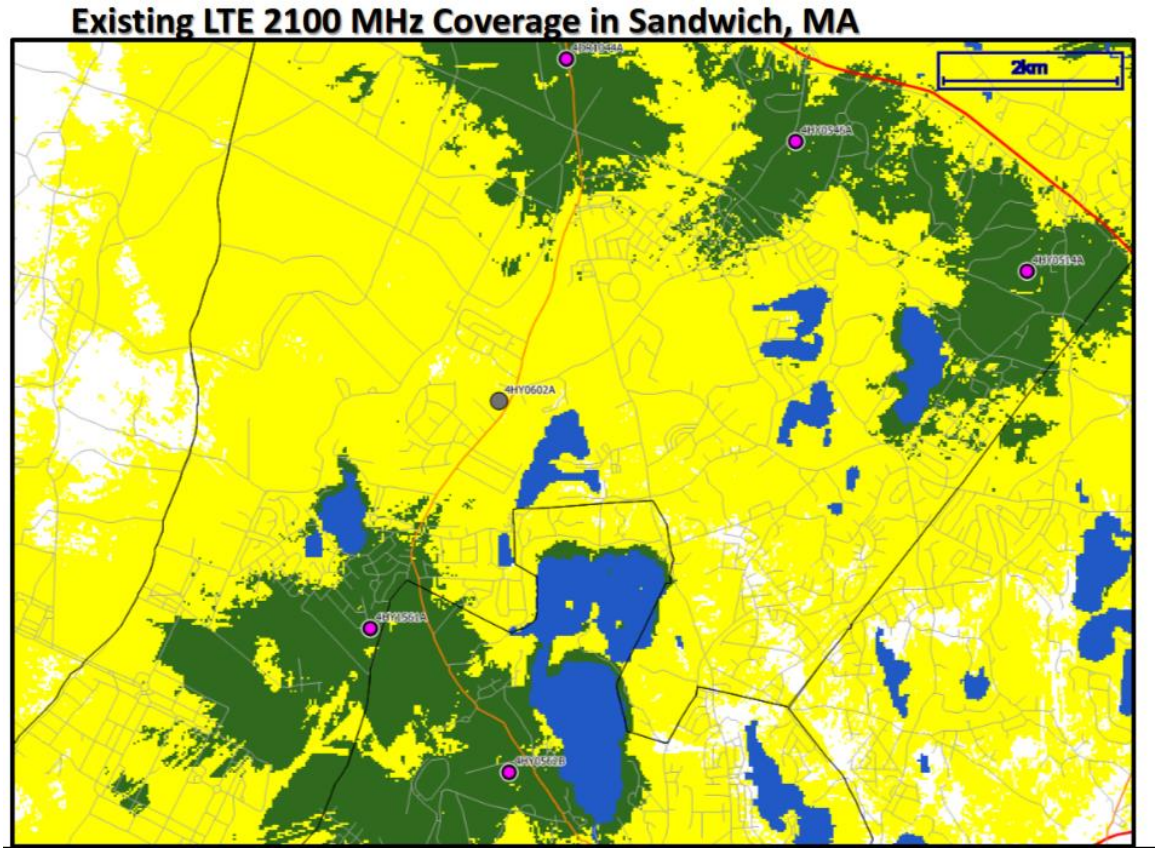


Figure 1 - T-Mobile Coverage Map of Current AWS Service

Coverage Solution Proposed

The proposed Tower will enhance T-Mobile coverage in the area near the Site. Additional analysis awaits submission of more information by the applicant.

CW Drive Test Results Need Adjustment

The applicant submitted a drive test map of the coverage that the proposed Tower would provide. This is called a "CW" drive test because the test signal is not a wireless base station signal but a test transmission using a "continuous wave." The CW drive test is performed with test gear that is not identical to the gear used by a real wireless network. To align the drive test results with expected performance, a "normalization" task is performed. The applicant appropriately applied a "correction factor" to the drive test data to compensate for the difference in power output of the test transmitter/antenna combination compared to a base station transmitter/antenna combination. However, the CW drive test maps do not use metrics consistent with the computer-estimated coverage maps.

The applicant's CW drive test maps include 700 MHz and AWS band coverage from the proposed Tower and height on two maps. Tthe CW drive tests were normalized to the full power of the transmitter (the result is called RSSI), while the computer coverage models are based on a component of the signal not operating at full power (called RSRP). The disparity between the CW drive test map power levels and the computer modeled power levels prevents a direct comparison between the two types of maps.

The CW drive test maps should be normalized to RSRP for the respective bands (and bandwidths). For example, typically, a 5 MHz bandwidth LTE channel in the 700 MHz band might have an RSRP that is 25 dB below the total power of the test signal. The drive test data should be normalized to this, and the signal level thresholds should be aligned with those used on the computer-estimated coverage maps.

No Scan Test Provided

The Bulletin recommends the demonstration of need include drive test data showing areas of coverage failure. While the applicant provided computer-estimated maps showing existing coverage in the area, there is no "Scan Test" data showing measurements of existing coverage. This information, if properly collected, normalized and documented, could verify the reliability of the computer-estimated coverage maps.

Height of Proposed Tower

The Bulletin calls for a demonstration that the proposed height is required. The application only contains T-Mobile coverage estimates from the proposed height. The applicant should prepare coverage analyses with the proposed T-Mobile facility at 100 ft and 80 ft above ground level and at the 10-feet-above-tree-canopy height. Tree canopy height should not be guessed, but

evaluated by a professional. Both frequencies should be modeled and presented consistently with the modeling at the proposed height.

Regional Policy Plan Minimum Performance Standard LU2.2 requires a demonstration of "the commitment of two or more co-locators into the design of the facility." The Commission is aware from experience that it is not always possible to propose a new tower with at least two committed carriers at the outset. The proposal is designed to accommodate the facilities of additional carriers. The proposal is also in a location that is distant from existing towers and existing overlay district locations. Based on the foregoing, it is likely that other carriers in the not-too-distant-future will find the proposed tower as useful to their network objectives as it will be for T-Mobile.

The optimal height of a tower at the Site is determined largely by 1) the coverage improvements in Sandwich obtained by T-Mobile at the finally established height, 2) the remaining space available to any carriers who would join the tower, and 3) the relative differences in visual impact, if any, at heights other than the proposed height.

Visual Impact of Proposed Tower and Alternatives

The application includes a photosimulation package. It would be helpful if the applicant provided a brief narrative of the methodology used to generate the photosimulations. Issues to be addressed in the execution of a photosimulation package include, without limitation, how the balloon height was established at the time a photo was taken, the focal length (35 mm film equivalent) used for each photo, how the focal length and distance to the target were modeled to produce an accurately scaled simulation.

We recommend the applicant supplement the photosimulation package with a viewshed analysis map. The cover sheet of the photosimulation package mentions in its disclaimer, among other things, "viewshed analysis maps." No viewshed analysis map was included in the package. It is helpful to not only rely on local knowledge to identify viewshed areas, but also to use mapping tools to illustrate bare-earth view potential and morphology-based view potential. For example, there were two locations that were requested for photography that were deemed to be inaccessible to the photographer. These are pond-side spots that could at least be included on a viewshed analysis map. The method for developing the viewshed map should be explained.

It is reassuring that from most viewpoints selected along public ways, the tower is not visible, at least with foliage present. However, photo number 2 uses an incorrect bearing to the tower site (232.92 degrees). It should have been approximately 272 degrees. The azimuth of the Site from photo #2 location is not across Peters Pond, as depicted on the photo. The camera was aimed in the wrong direction. Nevertheless, there is no need to correct this photo because the view in the correct azimuth is not across water or open land and is obstructed by nearby wooded land.

In a 1998 DRI hearing for a tower in Sagamore, we first used the term "bore-sight view" to describe the view of a tower when it is positioned in alignment with the cut (or bore) of a

roadway. As one drives or walks along the road, the tower is a dominant visual feature straight ahead in the break between the trees on either side of the road. Photos #10 and #11 along Quaker Meetinghouse Road before it joins Route 130 demonstrate a bore-sight view.

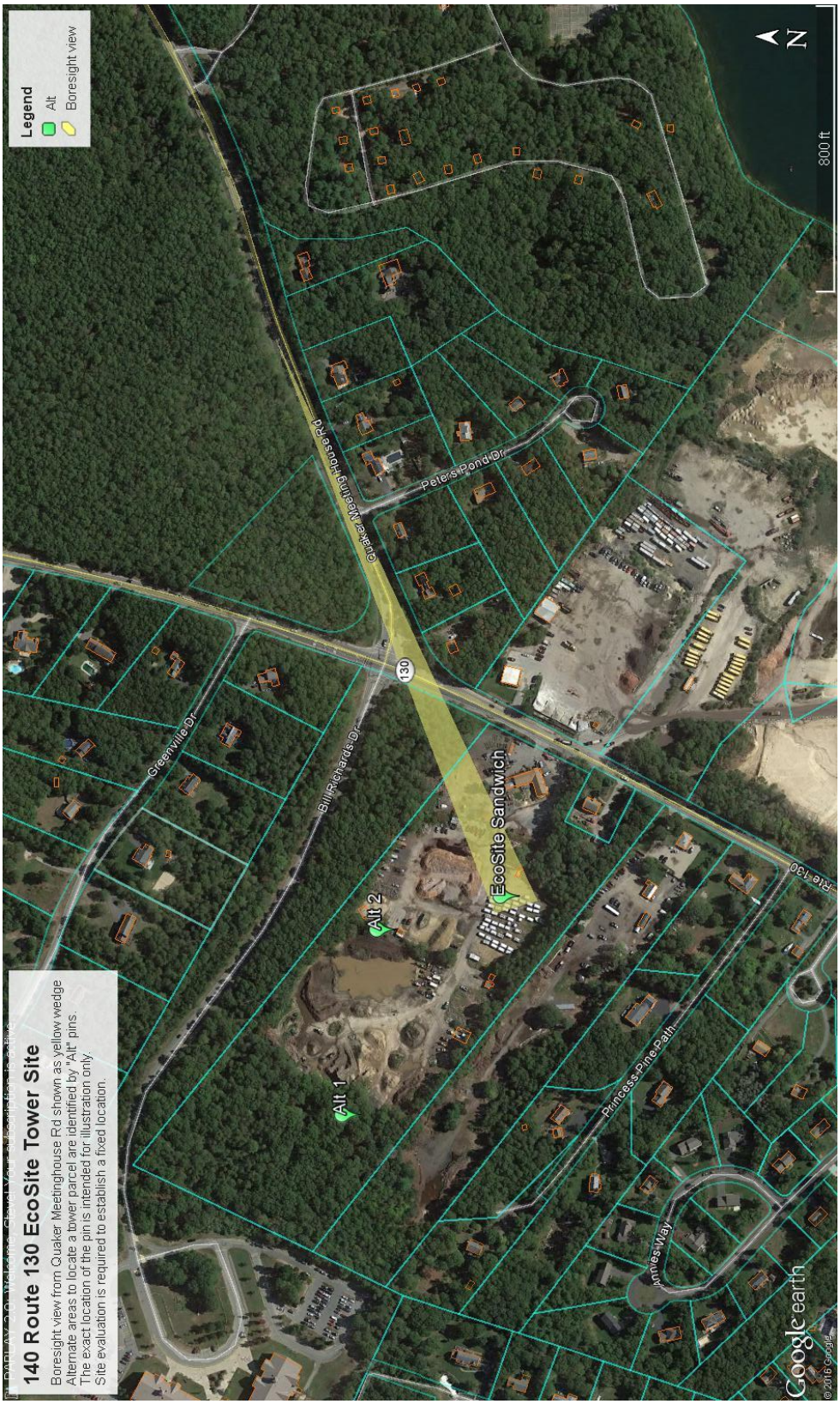
In the image below (next page) we have marked a wedge (yellow) illustrating the area within which the boresight view would be obtained on Quaker Meetinghouse Road. On the Site, we have marked two hypothetical locations (Alt 1 and Alt 2) as alternative spots for the proposed tower. These locations seem to be outside the bore-sight view area from Quaker Meetinghouse Road and do not appear to increase views from other streets. These hypothetical locations are not intended to be exact locations, but suggestions of general areas to locate.

Alternative Locations on Property

Alt 1 is toward the rear of the property where there is wooded space with no industrial activity. This potential location is near the edge of the woods, 1100 feet from Route 130. Alt 1 also probably has less visibility to the residences on Princess Pine Path (see photosimulations from locations 12 and 13). There might be some visibility to the Forestdale School, but the sightlines would cross nearly 500 feet of wooded buffer between the school grounds and the Alt 1 location.

If Alt 1 were pushed into the wooded area of the property, it would be in the best location to satisfy the Commission design standard of being “surrounded by buffers of dense tree growth and understory vegetation in all directions… The applicant’s proposed location is largely in an open area outfitted for industrial use. While the proposed location takes advantage of an intervening property to reduce visibility to Route 130, the Tower is aligned with the bore-sight view from Quaker Meetinghouse Road and the intersection with Route 130.

Alt 2 is more in the open than Alt 1 and might be more visible directly from the street frontage of the property. Alt 2 appears to be out of the bore-sight view from Quaker Meetinghouse Road, and generally less visible to the community than the proposed location. Alt 2 is not likely to provide any more screening of views from the back yards of Princess Pine Path, but it would be almost twice as far from those residential properties as the proposed location is.


Legend
Alt
Boresight view
N
800 ft
Quaker Meeting House Rd
Peters Pond Dr
130
Greenville Dr
Bill Richards Dr
EcoSite Sandwich
Alt 2
Alt 1
Princess Pine Path
Rte 130
Google earth
140 Route 130 EcoSite Tower Site
Boresight view from Quaker Meetinghouse Rd shown as yellow wedge
Alternate areas to locate a tower parcel are identified by 'Alt' pins.
The exact location of the pin is intended for illustration only.
Site evaluation is required to establish a fixed location.

Tower Height

Another consideration of alternatives on the proposed Site is the height of the Tower. In some cases, a visual impact analysis may suggest that reducing the height a certain amount would significantly reduce the visual impact. For example, a tower might protrude substantially above the visual horizon in an undesirable way, but a specific reduction of height might eliminate or mitigate the severity of the impact.

The photosimulations from Quaker Meetinghouse Road and from Princess Pine Path show nearly the full height of the Tower is exposed. A modest height reduction would not suddenly reduce the visibility of the tower, so there is no specific height to recommend as an alternative.

Additional information on the coverage from the proposed Tower at different heights is being requested. This information will inform the consideration of the coverage-versus-height-impact question.

Alternative Locations on Other Properties

The proposed Site is on a 17.7 acre parcel that is more than 500 feet wide and 1600 feet deep. It is in use for industrial purposes. The abutting properties on three sides are non-residential uses. One of these properties is the municipally owned Forestdale School on 44 acres abutting Joint Base Cape Cod. A tower on this parcel would potentially have less visibility overall to the community.

A water tower adjacent to the Forestdale School is owned and operated by the Sandwich Water District. It is approximately 102 feet tall. The Water District reports that AT&T and Sprint occupy the tower, in addition to public safety, and that there is room for more carriers. Electric primary power is delivered near the site, so there should be no issue obtaining power for a new facility. The water tower is less than half a mile from the proposed new Tower location.

The applicant's site acquisition specialist reported on a water tower on Georgia Rd, which is 1¾ miles from the proposed Tower. We agree that this site is too far from the coverage objective. However, because there is a water tower at Forestdale School that appears to have been overlooked by the applicant, the Affidavit of Site Acquisition Specialist might be incorrect when it says, "there are no existing strictures in the area with the height necessary to provide the needed coverage."

T-Mobile should explore the possibility of joining other carriers at the Forestdale water tower.

There are other large non-residential parcels in the area of the proposed WCF, which the applicant has addressed generally in the Affidavit of Site Acquisition Specialist. Regarding the other sites generally dismissed for being too far from the objective (such as at Jan Sebastian Drive), we agree. With respect to sites ruled out for other reasons, we leave that to others to determine the veracity of those claims.

The applicant's "Tower Inventory" is a tabulation of towers that T-Mobile occupies. The Bulletin requires an inventory of all towers and other tall structures in the area, not only the ones occupied by T-Mobile. The Forestdale School water tower would have been on such an inventory. The applicant should research other tall existing structures, if any, within about ¾ of a mile of the proposed Tower and report on the results.

Radio Frequency Energy Emissions

The applicant has not provided an analysis of the potential for human exposure to the radio frequency energy ("RFE") emissions of the proposed WCF. The RF Affidavit – Statement of Need includes a statement by the T-Mobile engineer that T-Mobile will comply with applicable health and safety standards. Under 47 CFR 1.1307, T-Mobile is required to perform a *Routine Evaluation* of the projected emissions of the proposed facility to verify it will be compliant with RFE exposure regulations. We recommend T-Mobile provide that Routine Evaluation for the record.

Noise

The RPP requires WCFs to generate no more than 50 dB[A] noise level at the property line. The applicant's worst-case analysis (free space propagation of noise with no attenuation by morphology) yields a potential noise level of 61 dBA at the nearest property line. Without addressing the actual attenuation due to objects in the environment, this estimate exceeds the noise level criterion. It is worth noting that this is the noise produced by the generator during weekly testing (weekday hours) when other noise-generating industrial activity is occurring on the property. The generator noise is temporary in nature. At most, the generator might be caused to run for a few days in the event of a major power interruption due to severe weather.

The noise level of the facility with generator could be tested after construction, and to the extent it does not satisfy the noise standard, further mitigation could be installed (such as a noise barrier partition/wall or enclosure, or improved muffler) prior to issuance of a certificate of use from the code official. Alternatively, consider whether the generator noise must meet the standard.

FAA Compliance

The applicant provided a Determination of No Hazard from the Federal Aviation Administration ("FAA"). The Determination process includes all relevant stakeholders in air traffic safety for a given area. The Determination is typically sufficient evidence of airspace safety compliance. Below, we provide notice of one additional consideration that does not appear to have been codified in local regulation.

In 2005, we participated in a Joint Land Use Study process involving the Commission, the towns of Bourne, Falmouth, Sandwich and Mashpee, and stakeholders at the Massachusetts Military Reservation (now the Joint Base Cape Cod). Our scope within that program was to assess air navigation issues and community impacts to determine if any further local regulation could improve neighborhood safety and quality of life with respect to air navigation. The report on this issue concluded that FAA Determinations of No Hazard are generally sufficient to ensure safe approaches and departures to/from the air base, but Coast Guard Search and Rescue operations would be made safer with additional local regulation:

> *For routine flight operations from MMR, the report recommends that the towns of Mashpee, Sandwich, Falmouth, and Bourne consider acting to protect navigable airspace by requiring FAA Determinations of No-Hazard or evidence of exemption from the determination process for all new structures throughout their communities. Local enforcement of that process will complete the circle of controlling unreasonably tall structures.*
>
> *The report also recommends that each of the four towns establish a 3,000-foot wide Search and Rescue ("SAR") Corridor District within which would be an absolute height limit of 100 feet above ground, even if FAA says a greater height is not hazardous. This will provide a degree of safety and path predictability to U.S. Coast Guard helicopter pilots when they must deviate from normal operational altitudes in emergencies during hostile weather. Structures in this district that exceed 60 feet in height would be required to be marked with a traditional red obstruction light, unless waived for good reason by the permit-granting authority.*

In Sandwich, the recommended SAR District area would have followed this Coast Guard SAR Route:

> *Heading north from the air station, Coast Guard helicopters leave runway 05 and follow Route 130 through Sandwich to the Mill Creek Wetlands to Cape Cod Bay.*

Being within 1500 feet of Route 130, the proposed Tower would be within the SAR zone and would exceed the proposed 100 ft height limit. A red obstruction light (not a beacon) would have been recommended to mark the Tower as an SAR aid to navigation. We are not aware of any action to adopt this district regulation in Sandwich. Mention of the JLUS findings in this report serves as administrative notice of the recommendation.

Conclusion

This concludes Isotrope's initial report on the application. After additional material is provided by the applicant, Isotrope will expand on presently incomplete topics. A summary of issues is provided in the Executive Summary at the front of this report.