

# Wireless Expertise, LLC

January 7, 2022

## Preliminary report – wireless coverage from existing towers

To: Ordinance Committee  
Town of Cape Elizabeth  
320 Ocean House Rd  
Cape Elizabeth, Maine 04107

Report produced for: WIMA contract signed 6Dec2021

This report details a wireless network coverage study, the inputs to the study as well as the results. This is a baseline study to determine where to focus efforts on providing wireless coverage solutions for uncovered parts of the town of Cape Elizabeth. This report outline is as follows:

- Wireless network coverage objectives
- Wireless networks to model and frequency bands
- Towers modeled
- Coverage studies performed
- Where coverage is needed
- Supplemental files included with this report

### **Wireless network coverage objectives**

This part of the document is somewhat technical, which I apologize in advance for. In order to determine if there are coverage gaps, it's important to define what "coverage" is. Currently, all commercial wireless networks use 4G/LTE technology. The legacy 2G and 3G networks have either been shut down or are going through the shut down process. LTE and it's "5G" successor are both built on the same wireless technology referred to as "OFDMA." For the reason, LTE coverage criteria carry forward to 5G and use a similar signal strength measurement called RSRP. I can provide references to these technical parameters and their derivation, if needed.

When designing LTE coverage, the following typical thresholds for RSRP are used:

- The minimum outdoor coverage level is -115 dBm, but it isn't reliable at this level. You can probably send and receive text messages, but data will be slow to nonexistent and voice calls would be unreliable.
- The typical minimum service level is -105 dBm, which makes for reliable text, call and data sessions, but not with significant data speed nor with indoor coverage guarantees.
- Typical residential structures lose 10 to 20 dB of signal level indoors vs. outdoors, so residential indoor service tends to require a minimum of -90 dB of RSRP

### **Wireless networks to model and frequency bands**

Wireless carriers use licensed frequency bands to transmit and receive LTE signals to and from users of the network. The FCC has sold licenses in two bands for 4G/LTE service, the low band which is from 600 to 900 MHz (just above where terrestrial UHF TV is broadcast) and the mid band which is from 1700 to 2600 MHz, which is at the high end of the UHF band, with propagation properties similar to microwave radio. 5G service added high band frequency bands, which are above 6 GHz and provide significant capacity increases over the low and mid band frequencies but

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at a cost of considerable losses when trying to penetrate signals through foliage (trees), making them impractical for residential wireless service in a heavily wooded town like Cape Elizabeth. As a rule of thumb, the higher the frequency, the shorter the range, due to higher losses bending around obstacles (hills and buildings) and foliage (tree) absorption losses.

I was hoping to use the 600 - 900 MHz low-band spectrum to model all four carriers, but only AT&T, Verizon and US Cellular have licensed spectrum in those bands. T-Mobile/Sprint only has spectrum from 1700 - 2600 MHz (mid bands). The other three carriers also have licensed spectrum the low bands, but the majority of all carriers' bandwidth and capacity are in the mid bands, which is where high bandwidth services are being optimized for, so it is wisest to model and design coverage using the mid bands.

### Towers modeled

Here's the summary of the available wireless tower sites in Cape Elizabeth and bordering towns. The information includes address, coordinates (latitude and longitude in WGS-84) and height:

- 180' self-support at Transfer Station, 8 Dennison Drive, Cape Elizabeth  
43.5858, -70.2431
- Portland Water District 80' water tower at 11 Avon Road, Cape Elizabeth  
43.5798, -70.2148
- 180' pole at 95 Bowery Beach Rd. 43.5729, -70.2455
- 180' guyed tower at 14 Strout Road. 4 carriers already on tower 135' to 175'  
43.6006, -70.2497
- 150' guyed tower at 1128 Highland Ave, South Portland. 43.6079, -70.2814
- 100' tower at 208 Pleasant Hill Rd in Scarborough. 43.5904, -70.2961
- Other potential collocation available in Cape Elizabeth (per 8Dec2021 telecon with Maureen): Potential new build pole at Fort Williams' old fire station. 43.6233, -70.212 60' to 80' new build pole?

I assumed that all wireless carriers could or would collocate on all of the available towers in the area and I located antennas at the 80% height level on towers for the wireless coverage simulation in order to accommodate for multiple antennas needed at various levels down from the top of the tower.

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## Coverage studies performed

I analyzed the predicted coverage from the four wireless carriers (Verizon, AT&T, US Cellular and T-Mobile/Sprint) in the 1.7 to 2.5 GHz "mid band" that wireless carriers have most of their spectrum holdings and have prioritized 5G deployments. T-Mobile/Sprint doesn't have any "low band" (700 to 900 MHz) spectrum that provides better coverage, but none of the wireless carriers has sufficient spectrum in the low bands to offer robust LTE or 5G services and data rates, so a more conservative approach was taken by modeling coverage in the more commonly used, but higher, mid frequency bands.

The coverage analysis requires a sophisticated computer CAD capability to predict radio coverage. The CAD tool needs to be able to use high resolution and up to date terrain and land cover data. I used Google Network Planner to model the coverage from the towers in Cape Elizabeth. Google Network Planner runs in the cloud on massively parallel computing platforms that provide quick, but sophisticated radio coverage models and it uses Google's high resolution geo database that has a 1 meter resolution and includes the heights of not only the terrain, but what is on the terrain (trees and buildings).

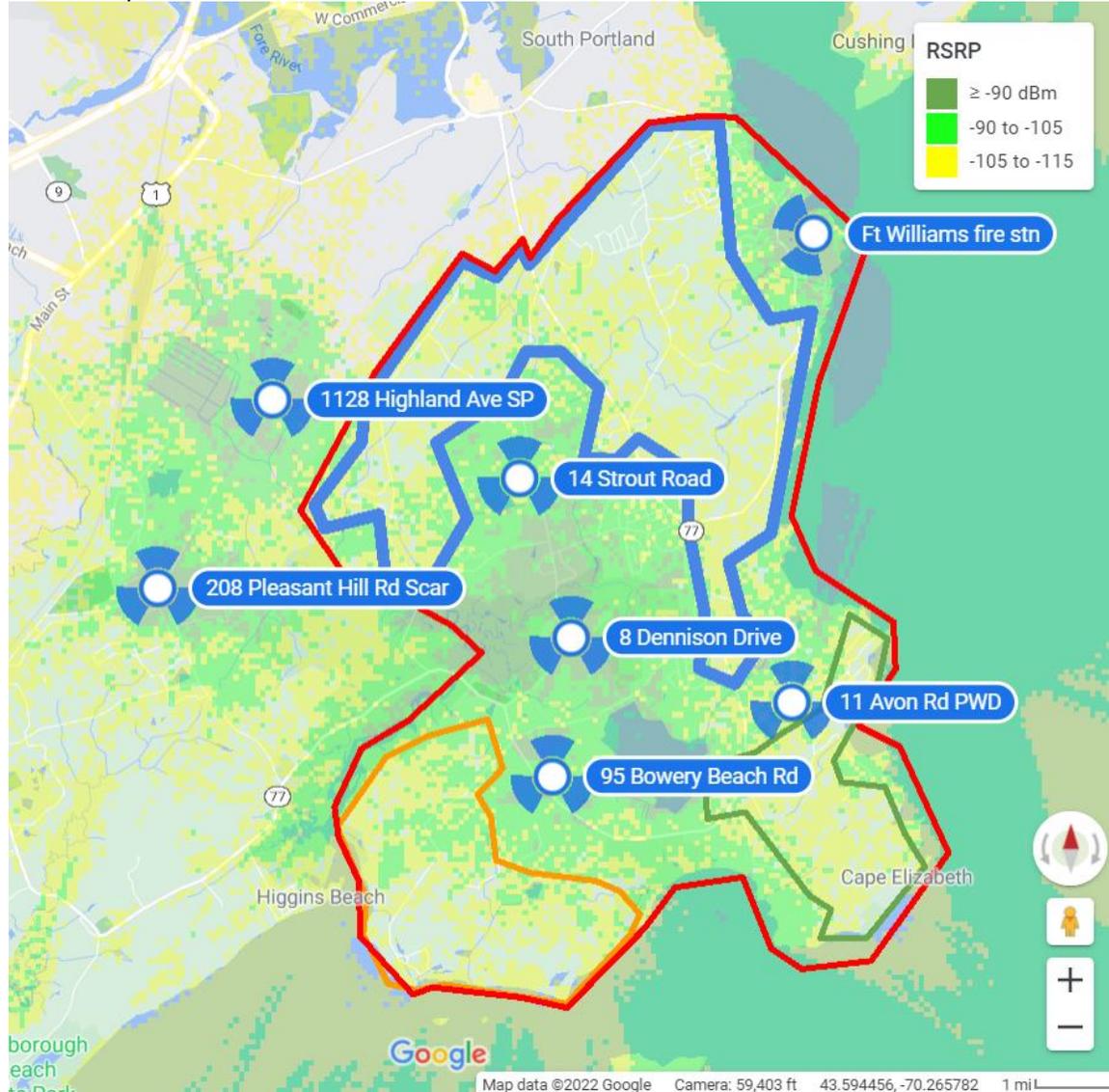
Below is an example of a wireless path profile from the tower on 14 Strout Road to the Cape Elizabeth Town Hall



This plot shows the tower on the left and the Cape Elizabeth Town Hall as the gray building on the right. The signal path passes over the roof of the Pond Cove Elementary School and the Thomas Memorial Library (the old 2-room schoolhouse building that I attended 4<sup>th</sup> grade in 1972/73) as well as through the tops of some trees that are across Scott Dyer Road from the school. This plot is to demonstrate the level of detail that is used to predict radio coverage.

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Below is the result of the radio coverage simulation in Google Network Planner of the towers in or near to Cape Elizabeth:



The dark green color is where in-building coverage can be guaranteed with reasonable confidence, the light green color is where reliable outdoor or in-car wireless service can probably be achieved and the yellow color is where marginal service, at best, can be provided. No color (transparent) is for no coverage. The red boundary is the Cape Elizabeth town line. This plot has been exported to a Google Earth KMZ file that is included with this report.

## **Where coverage is needed**

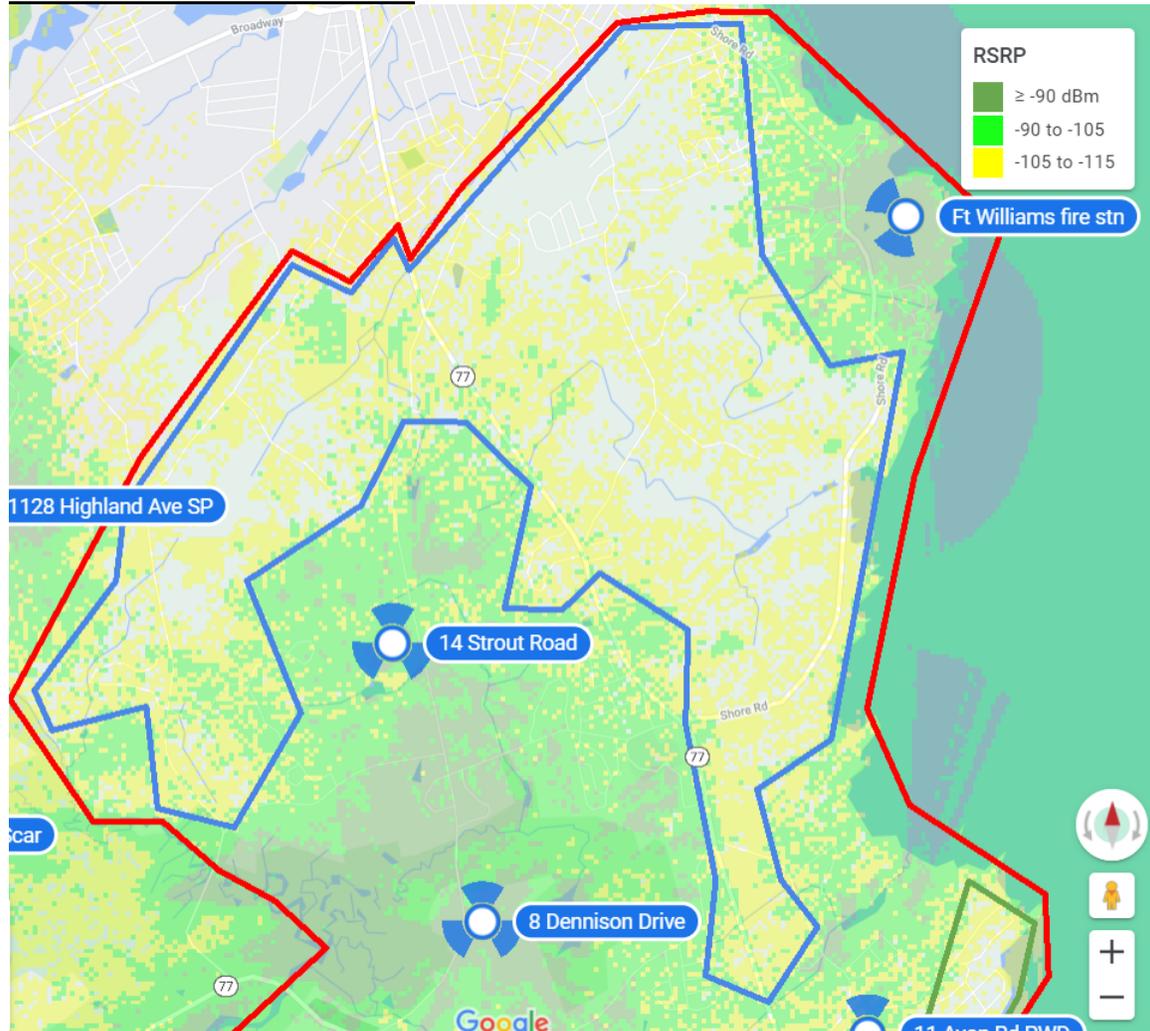
As can be seen in the above map, there are three areas in Cape Elizabeth that require wireless coverage enhancements:

- Mitchell Road and Shore road area (the light blue boundary)
- Broad Cove and Hunts Point (the dark green boundary)
- The Sprague properties (the orange boundary).

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Below are zoomed in coverage map details for the three areas that require wireless service:

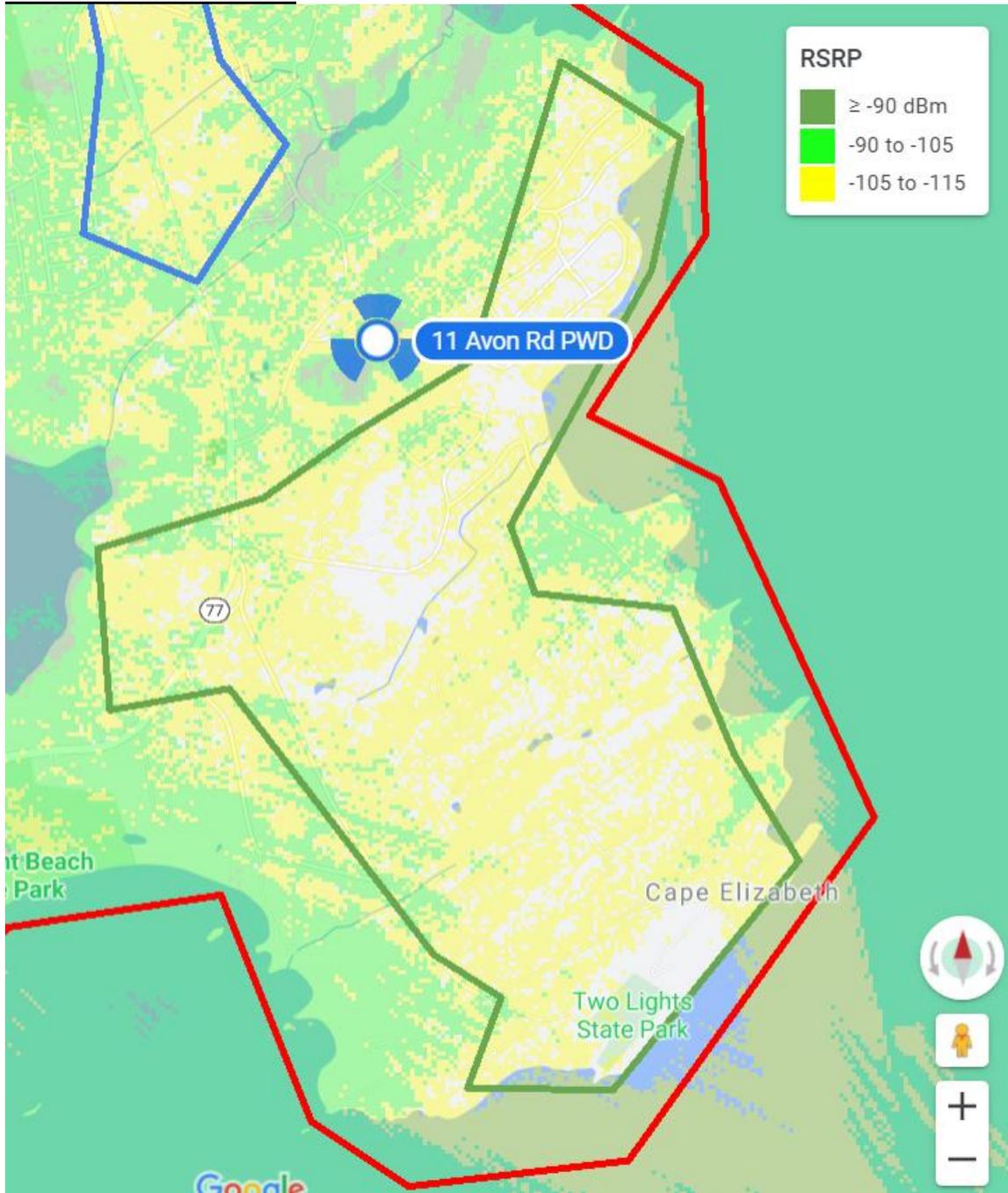
## Mitchell Road and Shore road area



The main roads to cover are SR-77 from the SP town line, Sawyer & Eastman Roads (left side of map), Mitchell Road (upper portion) as well Shore Road (eastern portion). The residential neighborhoods that these roads serve also need to be covered.

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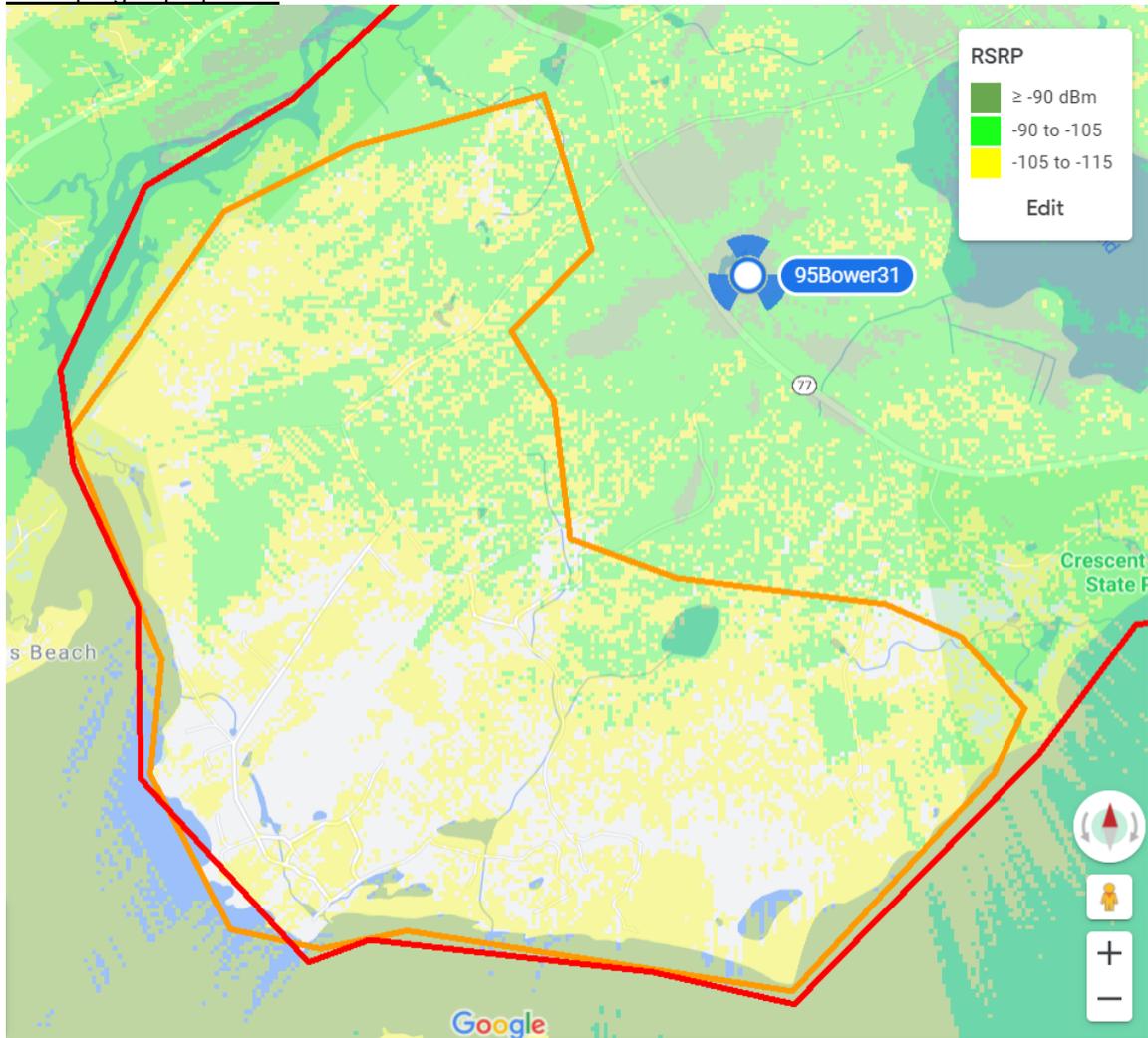
## Broad Cove and Hunts Point



This includes Two Lights Road from SR-77 to the ocean, Broad Cove Road, Hunts Point Road, Hannaford Cove Road and Two Lights Road as well as the residential areas that border these roads.

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## The Sprague properties



This is mostly rural farmland and a series of homes along the coastline that is located south of SR-77, west of Crescent Beach SP and the Spurwink River. This is mostly large private land holdings, so permitting and budgeting will likely be different from the other two areas, which are more populated and accessible to the public.

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## **Supplemental files included with this report**

The following data files are included with this report. These files can be opened in Google Earth (a free and easy to use program that can be downloaded from <https://www.google.com/earth/versions/>) or a GIS program, such as ArcGIS, MapInfo or QGIS (which is free but has a steep learning curve):

1. Wireless coverage prediction map for Cape Elizabeth (Cape\_Eliz\_existing\_coverage\_RSRR.kmz). The plot legend is as follows:
  - Dark green - good coverage and data service including indoors
  - Light green - outdoor acceptable coverage and data service. Indoor coverage is unlikely.
  - Poor coverage - Outdoor only.
2. The locations of the towers used in the analysis (Cape\_Elizabeth\_Towers.kml)
3. Boundary files, including
  - My attempt at a Cape Elizabeth town boundary (Cape Elizabeth Town boundary.kml)
  - Boundary of poor coverage area covering Mitchell Road and Shore Road as well as surrounding neighborhoods. (Mitchell Road and Shore Road.kml)
  - Boundary of poor coverage area covering Broad Cove and Hunts Point as well as surrounding neighborhoods. (Broad Cove and Hunts Point.kml)
  - Boundary of poor coverage area covering the Sprague properties (Sprague Properties.kml)

I look forward to discussing this report with you during the Ordinance Committee meeting at 7 PM on January 12. Once I have received your feedback on the coverage requirements, I can start the next phase, which will be determining the best siting alternatives for wireless facilities that can provide coverage without adverse aesthetic impacts.