RF DRIVE TEST SURVEY RESULTS

SUBMITTED BY:

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SUBMITTED TO:

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Department of Information Technology
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Introduction

In accordance with the Town of Jamestown Information Technology's Project Requirements and Scope for an RF (Radio Frequency) survey of existing coverage for areas surrounding the potential tower locations on Cedar Lane and North Main Road. The Cellular Benchmark data for existing coverage for Verizon Wireless, AT&T Mobility, T-Mobile & Sprint was collected via a drive test by Mod Data Tech Inc (Mod). The drive test was performed on September 17, 2019. Dewberry Engineers Inc. (Dewberry) & Mod have prepared the following report of our findings.

Wireless Telecommunications

Today there are four major carriers: Verizon, AT&T, T-Mobile and Sprint. All four carriers own multiple frequencies. These frequencies range from 600MHz to 5GHz now. Low frequencies can travel farther distances and can penetrate walls far better than higher frequencies. The difference between 850MHz and 1900MHz is approximately 7dB, which means that 1900MHz is less one quarter the power of 850MHz. Also, higher frequencies can handle more data than the lower frequencies because higher frequencies have more cycles per second than the higher frequencies due to wavelength.

These frequencies are divided into bands, the bands range in bandwidth from 2.5MHz to 20MHz. With LTE-Advanced, non-contiguous frequencies will be able to be put together for higher bandwidths. 5G will be raising the standard to include higher bandwidths. The more bandwidth, the more data that can be transferred at a time, but the higher the bandwidth, the lower the power output. Wider bandwidth also spreads the available power over a greater part of the frequency spectrum, reducing the effective radiated power which in turn impacts on signal to noise ratio over a given path, i.e. less bandwidth = more signal = longer path but lower speed. This is why the carrier utilizes multiple frequencies on their networks.

Besides frequency range and bandwidth power, Technology affects power output. 2G used a large portion of the channel since the majority was voice and limited data. With 3G, the carrier needed to accommodate more data so they began using CDMA and WCDMA for more bandwidth utilization, but this meant that more of the channel would be used, which meant less power output. LTE came in and now uses even less power, but in turn, the technology does have a much higher sensitivity which means that less power is needed.

Carriers are working to deploy 5G technology which will be utilizing a more advanced LTE than we use today. 5G will be utilizing millimeter wave which includes 30 GHz to 300 GHz as well as Massive MIMO (Multiple Input Multiple Output) which currently uses 2x2 MIMO, but will be going to 4x4 and possible more in different capacity environments. Utilizing these higher frequencies and more bandwidth will greatly reduce output power. Which would require a higher concentration of antenna closer to the user including indoors. 5G standards are still in development and equipment will take time to come to market.

Frequency Spectrum

Frequency allocation is always changing. The levels that are seen today may not be the same levels tomorrow. The carriers are moving frequencies around for better resource utilization as well as technology advancement. Currently many areas have already phased out 2G. 3G is also used less and less now. Most carriers are only pushing 3G on a single frequency band and are moving their frequencies to LTE. 3G is being used as more of a backup, as well to accommodate users and equipment that may still use 3G. Also, there have been additions of frequency purchases recently. T-Mobile has purchased 600MHz and is currently rolling it out in many of its markets. Sprint has the 2600 band which they are also integrating into there system.

Drive Test Set Up

PCtel Scanner Equipment was utilized to perform the collection using a GPS antenna to place data points along the route. All cellular signal was collected in the area for the four major carriers.

PCtel is the leading Scanner equipment for Cellular data collection and is used by the major carriers referenced herein.

Collected Frequencies

This is the list of the frequencies that were collected that are reviewed in this report. Please note that more than one channel may have been collected on the same frequency band.

Verizon Wireless	T-Mobile
700 MHz	700 MHz
1900 MHz	1900 MHz
2100 MHz	2100 MHz
AT&T Mobility	**Sprint**
700 MHz	1900 MHz
1900 MHz	2600 MHz

Radio Frequency Data Collection KPI (Key Performance Indicator)

- **RSRP**: (Reference Signal Receive Power) is the average power of Resource Elements (RE) that carry cell specific Reference Signals (RS) over the entire bandwidth in LTE.
- **RSRQ**: (Reference Signal Received Quality) indicates the quality of the received reference signal. Optimal levels are values > -15.0 dB.
- **CINR**: (Carrier-to-interference plus Noise Ratio) is the ratio of the RF Carrier power to the summation of the average interference power from the other cells and background noise. Low SINR means bad quality and slower speeds.

RSRP Levels Utilized

The RSRP levels used in this report to categorize coverage levels are summarized in the below table.

RSRP Value	Coverage Level
> -75.0 dBm	Very Strong (In-Building)
-75.0 to -90.0 dBm	Strong (In-Building)
-90.0 to -100.0 dBm	Good (In-Vehicle)
-100.0 to -110.0 dBm	Fair (Outdoor)
-110.0 to -115.0 dBm	Poor (Minimal Outdoor)
< -115.0 dBm	No Coverage

Drive Test Data Processing

The data collected during the drive tests consists of geographical information and associated signal levels at each location. Dewberry inserted the drive-test data for each band analyzed into ArcMAP and categorized the data based on RSRP readings values that were recommended by Mod Data Tech Inc. Then, a separate data set was created for each band, showing only data with 'Indoor' Coverage (RSRP > -90.0 dBm). Next, Dewberry determined that the area driven for the drive test included parcels from Tax Maps 1-7, and 14-16. The parcels on these tax maps were isolated to determine the total number of parcels analyzed in the drive test. Finally, the parcels within 150' from where 'indoor' coverage was recorded were counted to determine the total parcels "covered" for each Band analyzed. It should be noted that coverage measured in the right of way is not necessarily a good indication of coverage levels in larger parcels where elevation and terrain may vary. These parcels counts should only be considered approximations used to illustrate the general coverage levels in the area.

Existing Coverage Summary

- The area that was driven has (10) ten existing oDAS (Outdoor Distributed Antenna System) nodes which are utilized by AT&T Mobility & Verizon Wireless. Additionally, there is a water tank on Howland Ave. where each carrier has an existing site.
- The coverage in the area analyzed for each carrier was best for low band, 700 MHz LTE. However, the only carrier with greater than 50% of parcels covered in this band was Verizon Wireless.
- Bands with the lowest coverage levels were Verizon Wireless 1900 MHz LTE, AT&T Mobility 1900 MHz LTE and T-Mobile 2100 MHz LTE.
- For other frequency bands, the most consistent coverage was found in the neighborhoods along Seaside Drive.
- The majority of the area analyzed has poor coverage outdoors and almost no coverage indoors.

A table summarizing the number of parcels within 150' of RSRP measurements of -90.0 dBm or greater covered for each carrier and band is found below.

Carrier	Frequency Band	Parcels with Coverage (Of 2100 Total)
Verizon Wireless	700 MHz	1100
	1900 MHz	100
	2100 MHz	540
AT&T Mobility	700 MHz	1000
	1900 MHz	170
T-Mobile	700 MHz	600
	1900 MHz	350
	2100 MHz	25
Sprint	1900 MHz	450
	2600 MHz	300

Based on the results of the drive test and the approximate number of parcels covered by each carrier, there is a generally poor coverage for all carriers on the northern half of the island. Adding an additional cellular coverage on the island would be recommended for all carriers, especially in the higher frequency bands where the coverage is generally poor.

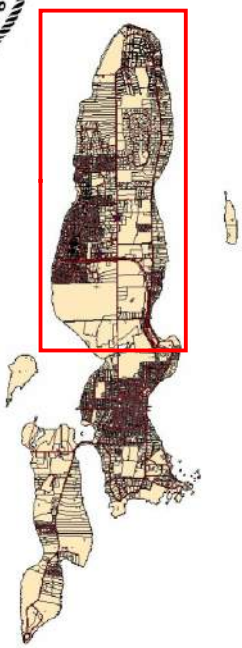
Attachment A

Drive Test Coverage Maps

October 8, 2019

Jamestown, RI

Existing Cellular Coverage



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155 Park Ave.
Cranston, RI 02905

Legend

- Potential Tower Location
- Existing oDAS Node

VZW 700 mHz LTE

RSRP (dBm)

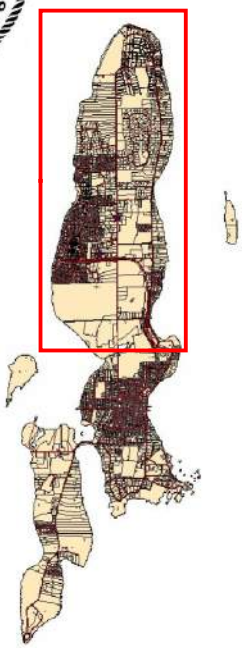
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

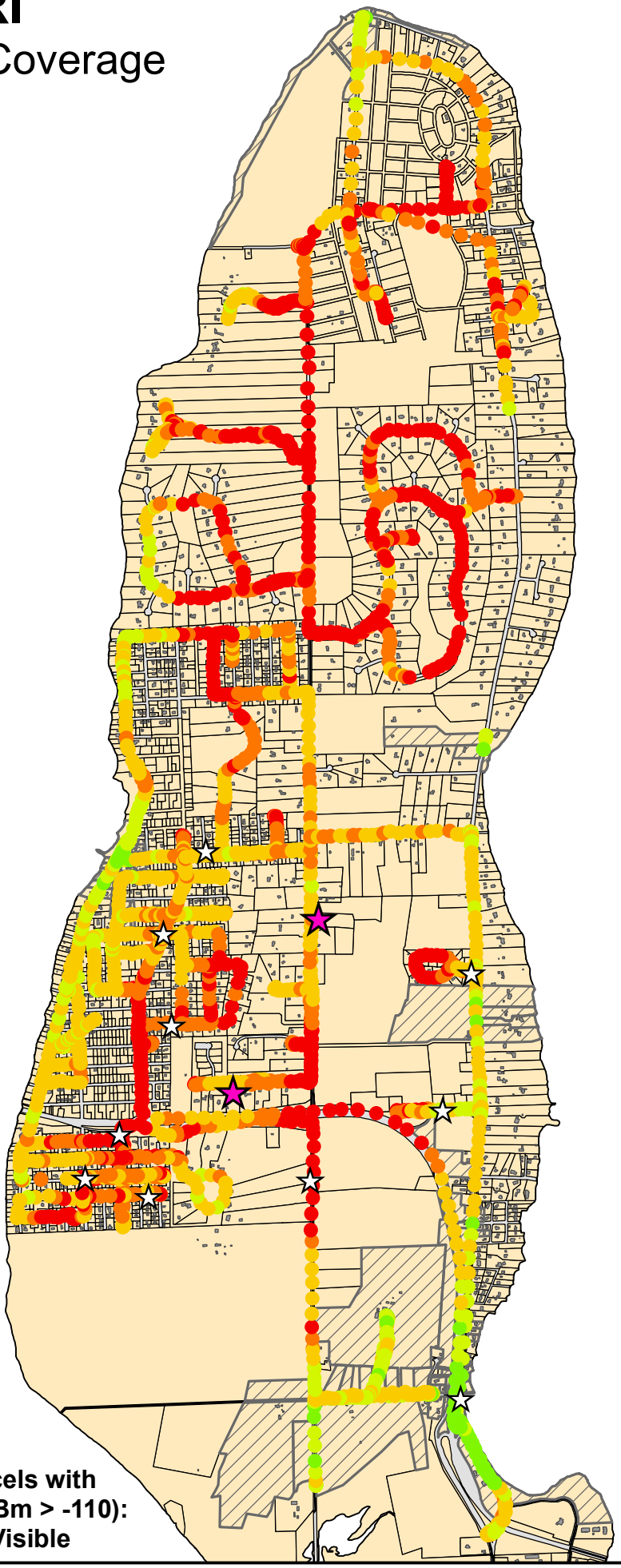
0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 1100 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage





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Legend

- Potential Tower Location
- Existing oDAS Node

VZW 1900 mHz LTE

RSRP (dBm)

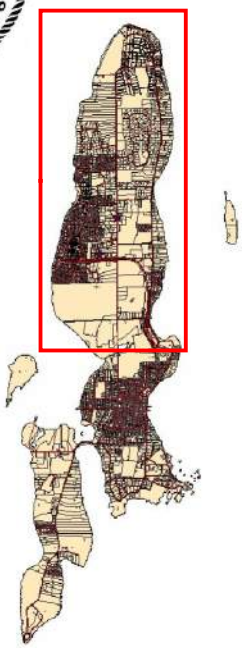
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

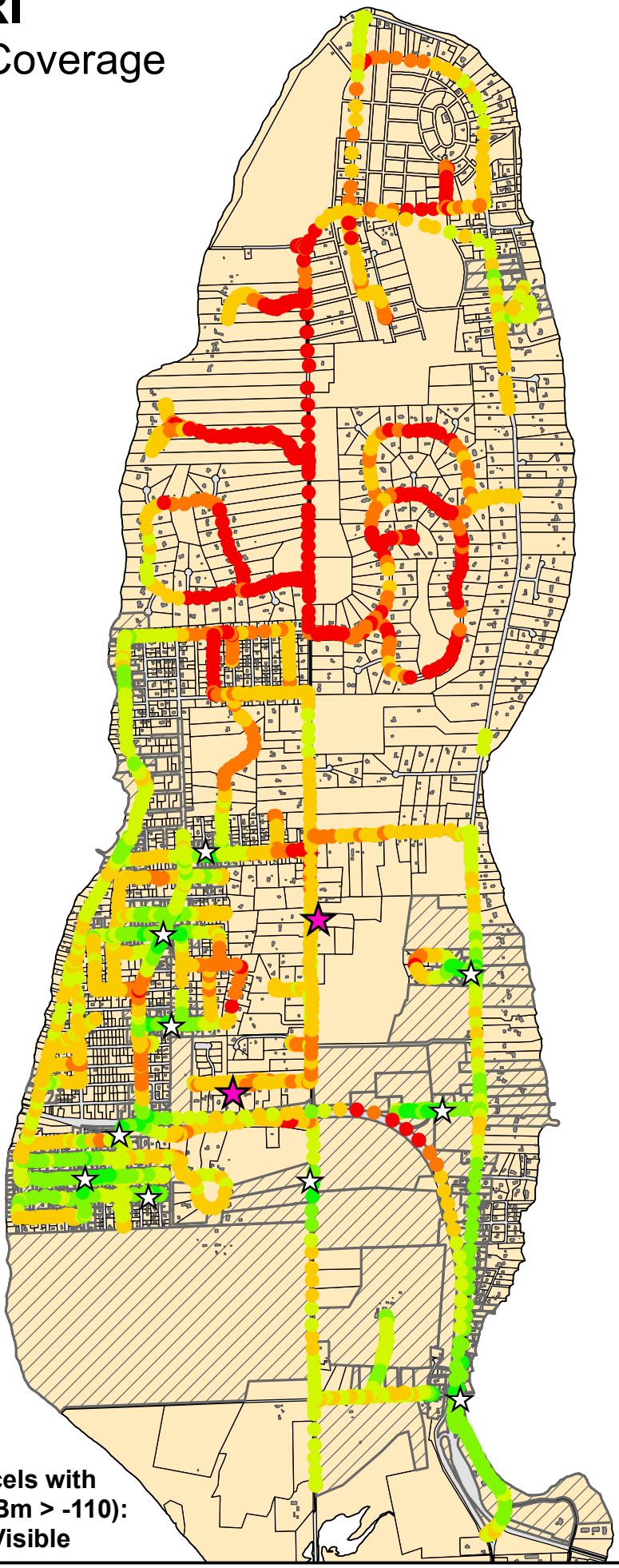
0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 100 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage





Approx. Parcels with Coverage (dBm > -110): 540 of 2100 Visible

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Legend

- Potential Tower Location
- Existing oDAS Node

VZW 2100 mHz LTE

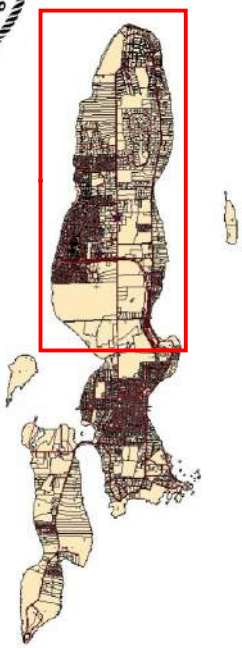
RSRP (dBm)

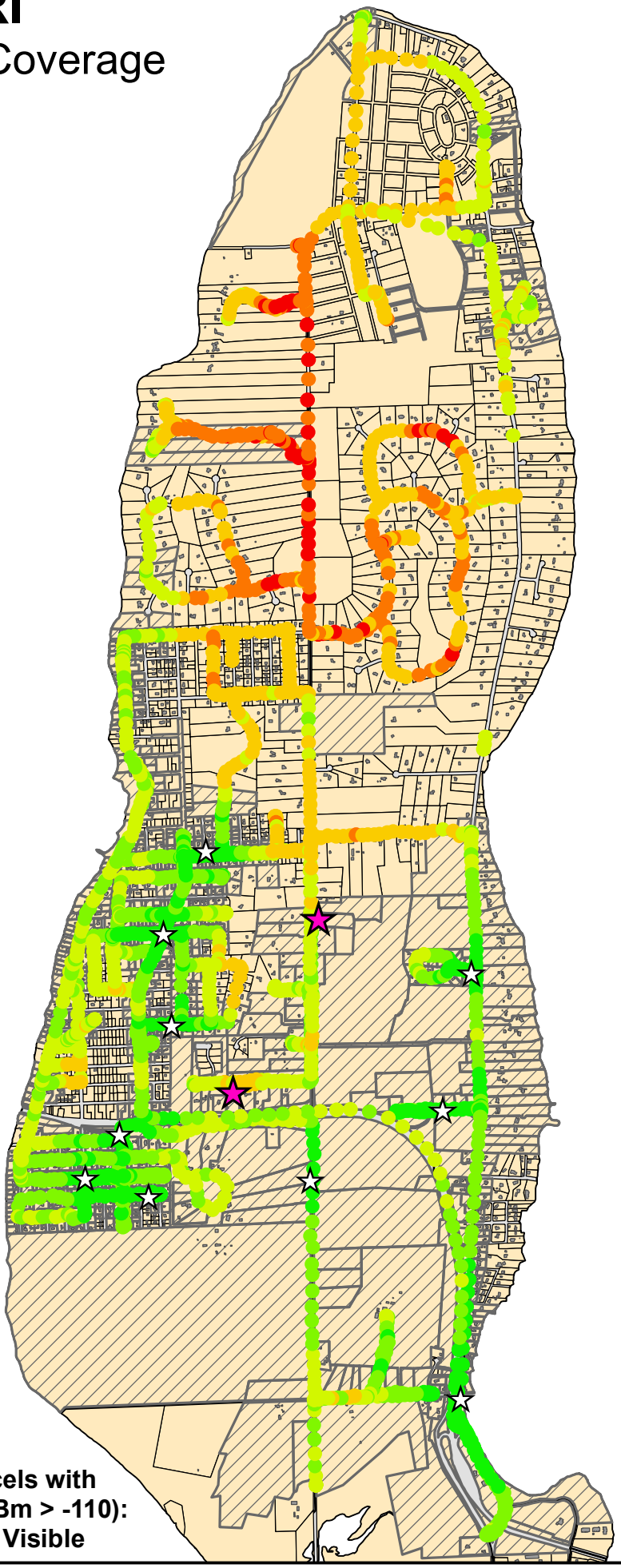
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

0 750 1,500 3,000 4,500 Feet

Jamestown, RI

Existing Cellular Coverage





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Legend

- Potential Tower Location
- Existing oDAS Node

ATT 700 mHz LTE

RSRP (dBm)

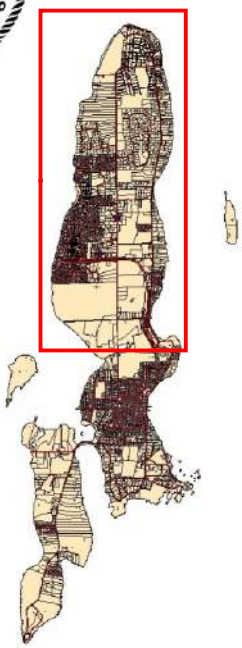
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

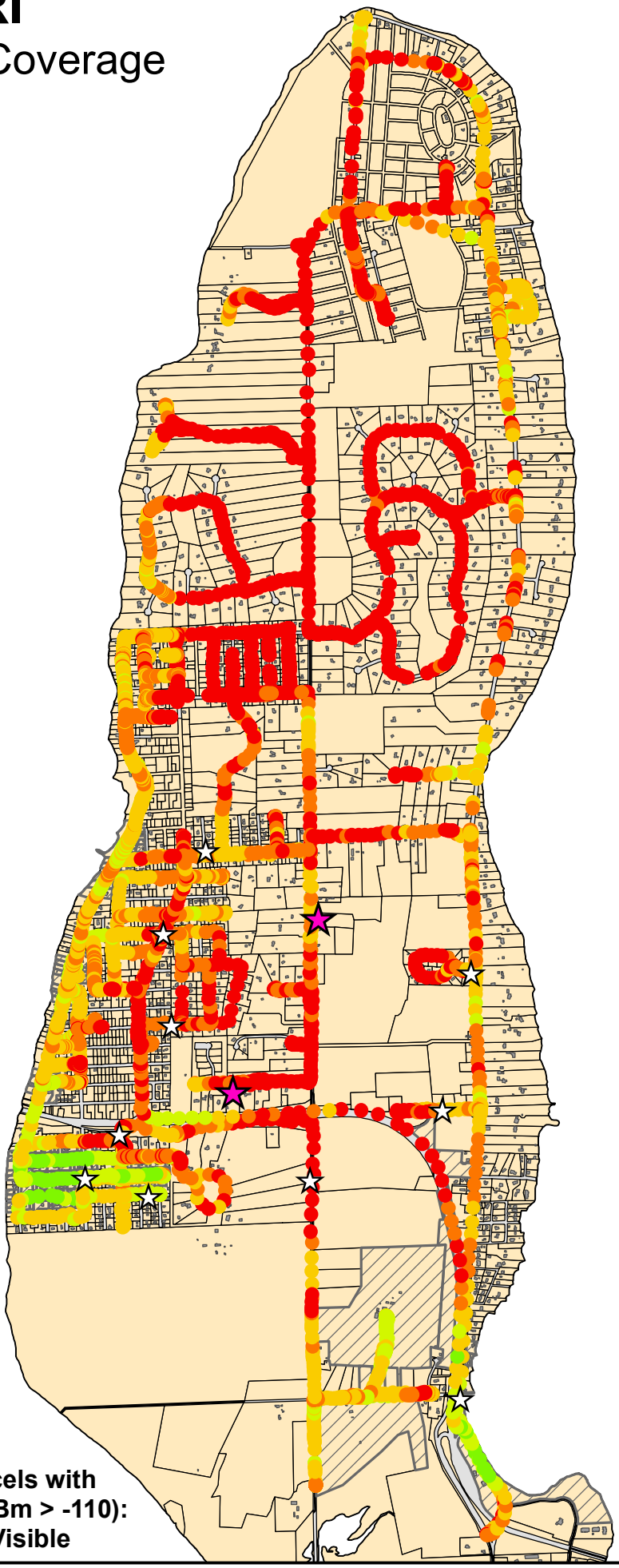
0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 1000 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage





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Legend

- Potential Tower Location
- Existing oDAS Node

ATT 1900 mHz LTE

RSRP (dBm)

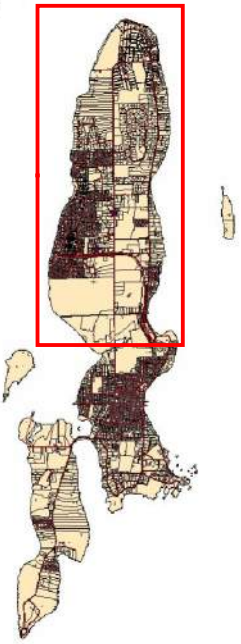
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 170 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage



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Legend

- Potential Tower Location

T-Mobile 700 mHz LTE

RSRP (dBm)

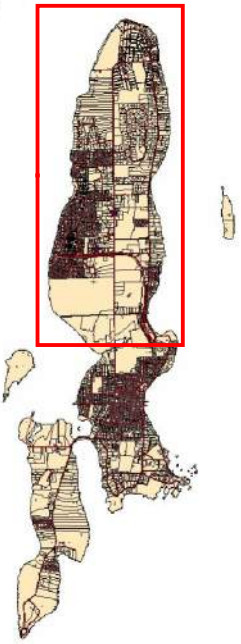
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

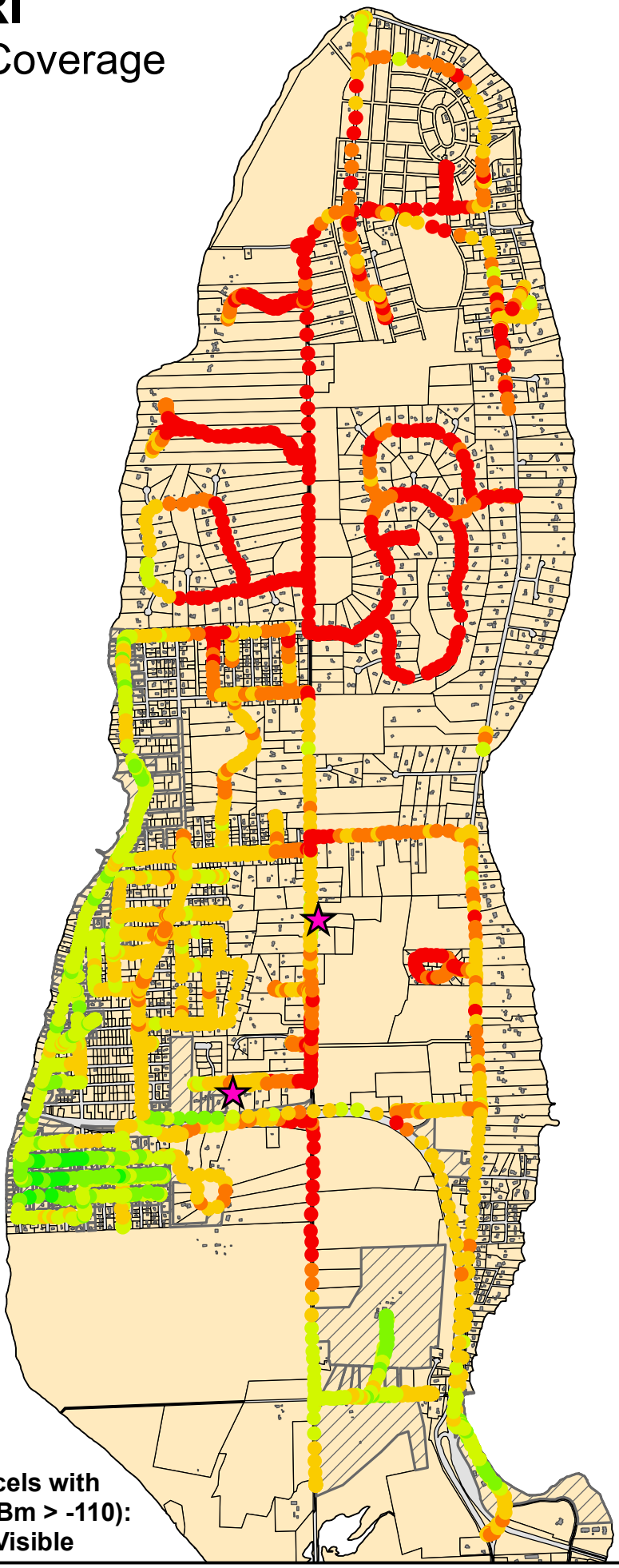
0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 600 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage





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Legend

- Potential Tower Location

T-Mobile 1900mHz LTE

RSRP (dBm)

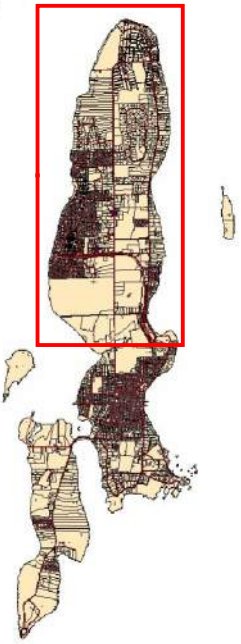
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

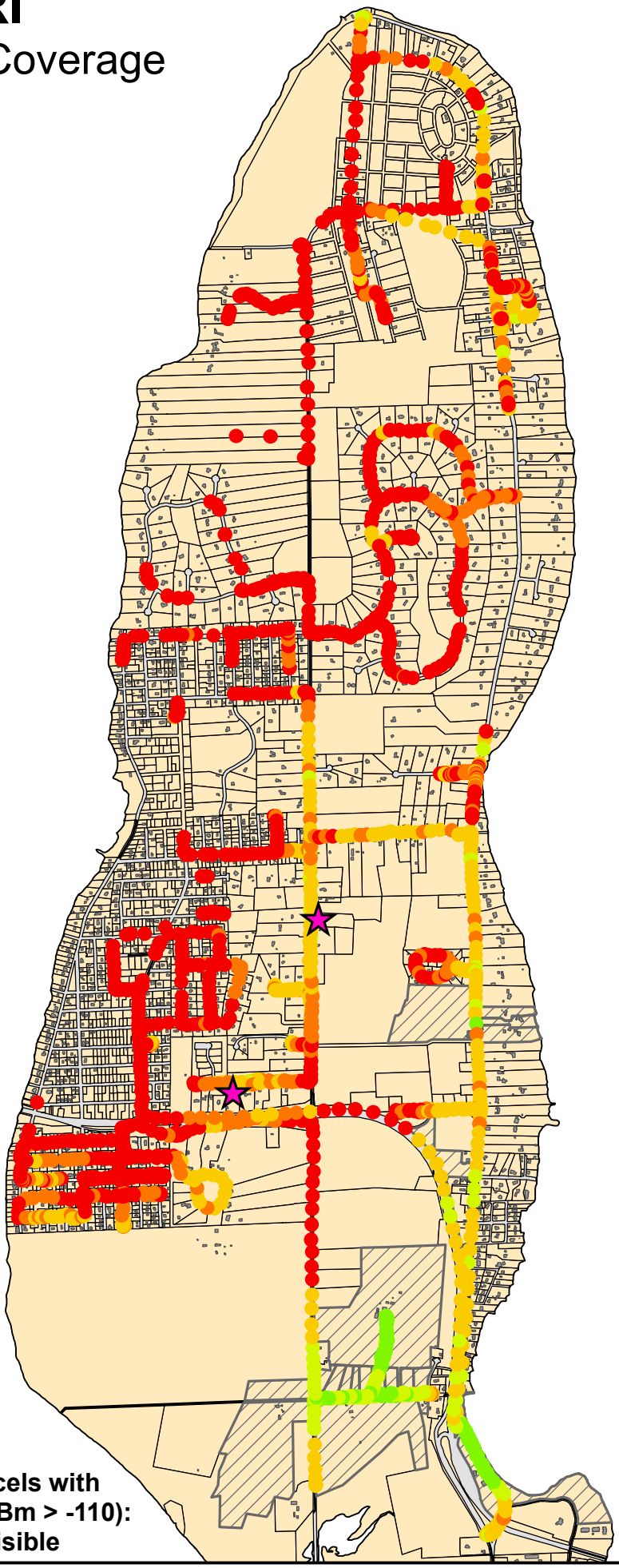
0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 350 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage





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Legend

- Potential Tower Location

T-Mobile 2100 mHz LTE

RSRP (dBm)

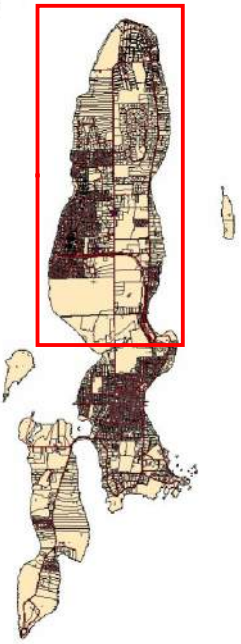
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

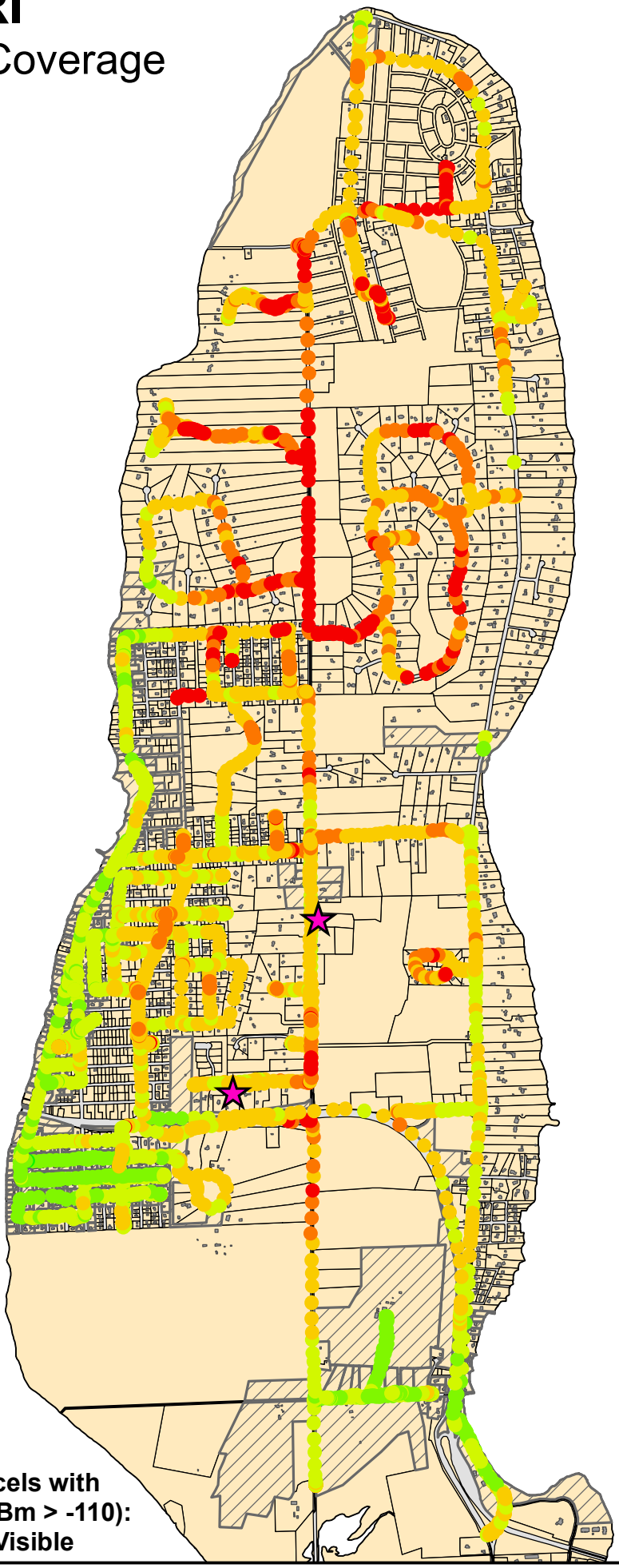
0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 25 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage





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Legend

- Potential Tower Location

Sprint 1900 mHz LTE

RSRP__d_Bm

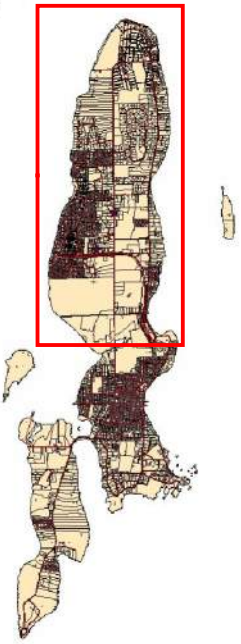
- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

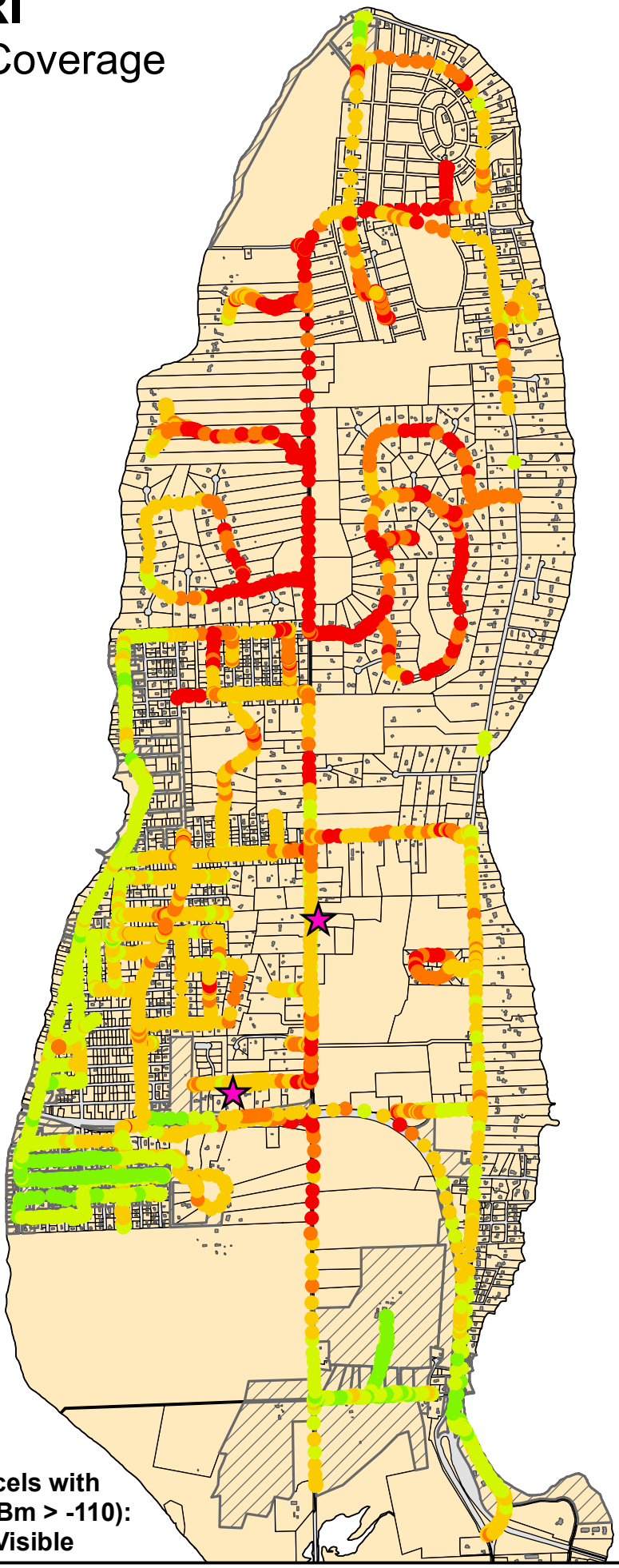
0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 450 of 2100 Visible

Jamestown, RI

Existing Cellular Coverage





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MOD DATA TECH INC.

155 Park Ave.
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Legend

- Potential Tower Location

Sprint 2600 mHz LTE

RSRP_Domin

- [MIN, -115] (Poor)
- (-115, -110]
- (-110, -100]
- (-100, -90]
- (-90, -75]
- (-75, MAX] (Good)
- Parcel Covered

0 750 1,500 3,000 4,500 Feet

Approx. Parcels with Coverage (dBm > -110): 300 of 2100 Visible