MANN WIRELESS, LTD.

PROPOSAL

PUBLIC SAFETY RADIO SIGNAL LEVEL TESTING

For

BUNCOMBE COUNTY

BUNCOMBE COUNTY SCHOOLS
PREPARING STUDENTS FOR THEIR TOMORROW

FROM: MANN WIRELESS, LTD.

Date: 9/20/18

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Mann Wireless, Ltd., is pleased to present a quote to test public safety RF signals at 60 schools located in Buncombe County, North Carolina. A report with the findings will be provided to Vance Bell with Buncombe County Communications. The scope for the project will be to test 800 MHz County, 800 MHz City and the 700 MHz Statewide Viper system RF signal metrics throughout each building. The report will provide a pass or fail result after analyzing the RF data utilizing NFPA/IFC minimum requirements outlined below. The report will show RSSI (Receive Signal Strength Indicator) data mapped on the prints and specify areas of the building that meet and don't meet the minimum requirement. To accomplish this goal walk routes will be developed prior to testing. They will include hallways, stairwells, mechanical rooms, pump rooms and a limited amount of internal rooms. If the building doesn't meet the requirements a scope for a DAS (Distributed Antenna System) can be developed from this data. If the building meets the minimum requirements the report can be submitted to the School Board as proof of coverage. The cost for the RF data collection and reports to walk 60 buildings is $87,000 or $1,450 per school.

In the event buildings fail the test a survey will immediately follow to gather the data required to put together a design and firm quote. The cost of the survey and report will be credited if Buncombe County Schools utilizes Mann Wireless for the design and installation services.

Minimum Requirements from NFPA/IFC for signal level testing are as follows:

- A minimum strength of -95 dBm available in 90% of the area of each floor (inbound described).
- Critical areas, such as the fire command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, sprinkler sectional valve locations, and other areas deemed critical by the authority having jurisdiction, shall be provided with 99% floor area radio coverage.

Project Detail

The testing will be accomplished utilizing Anritsu's LMR Master Land Mobile Radio Modulation Analyzer (P25 compliant) for measuring public safety radio system performance. The integration of Anritsu's mapping tool along with the analyzer enables the collection of signal data (RSSI) in any environment. Mann Wireless will walk each building, gather the signal information, and display it on floor plans as part a comprehensive report describing the overall coverage detail of each building. In addition, a spread sheet with a pass/fail rating for each building at each location in an excel format will be provided for easy viewing.

Minimum signal levels of -95 dBm or better across 90% of the space will used as the signal level specification for the pass/fail as referenced in NFPA/IFC and in the section titled "Test Procedure" below.

Considerations and Assumptions

- Points of contact will be given for each location.
- If escorts are required, they will be provided at no cost to Mann Wireless.
- It is understood that the Engineer or Technician doing the test will have been through the background check as required by the school district.

Test Procedure

Section I - The test plan shall ensure testing throughout the buildings. Test procedures shall be in accordance with the following and as directed by the authority having jurisdiction.

Testing procedures shall be done on a grid system. A grid is overlaid onto a floor area to provide 20 grid cells. Grid cells are provided with definite minimum and maximum dimensions. For most buildings, using a minimum grid dimension of 20 ft and a maximum grid dimension of 80 ft will suffice to encompass the entire floor area. Where a floor exceeds 128,000 sq ft, which is the floor area that can be covered by the maximum grid dimension of 80 ft, the floor area shall be subdivided into sectors, each having an area of less than or equal to 128,000 sq ft, and that each sector will be tested individually with 20 grid cells in each sector. Signal strength measurements shall be taken at the center of each grid and shall be performed using standardized parameters as specified in Section II. Unless required uplink testing with a radio to check connections and audio quality will not be completed with this test.

Section II- Downlink measurements shall be made with the following standardized parameters:

- A calibrated spectrum analyzer with mapping tool.
- Receiving antennas of equal gain to the agency's standard portable radio antenna, oriented vertically, with a centerline between 3 ft and 4 ft above floor.
- A resolution bandwidth nearest the bandwidth of the channel under test.
- Levels recorded while walking an "X" pattern, with the center of the pattern located approximately in the center of each grid area.

Terms & Conditions

Mann Wireless is pleased to provide a quotation of **$ 87,000** for the RF Public Safety signal testing at 60 buildings. Mann Wireless anticipates the work would take approximately 5 weeks to complete. A mutually agreed upon schedule would be developed to meet project timelines. The report will be completed within 15 days of the final testing. Sales tax has not been included and will be additional

MANN WIRELESS, LTD.

TELECOMMUNICATIONS SYSTEMS
DESIGN, INTEGRATION AND
CONSULTING SERVICES

IN-BUILDING PUBLIC SAFETY RADIO SYSTEM SIGNAL ANALYIS REPORT

Oakleaf High School
4035 Plantation Oaks Blvd
Orange Park, FL 32065

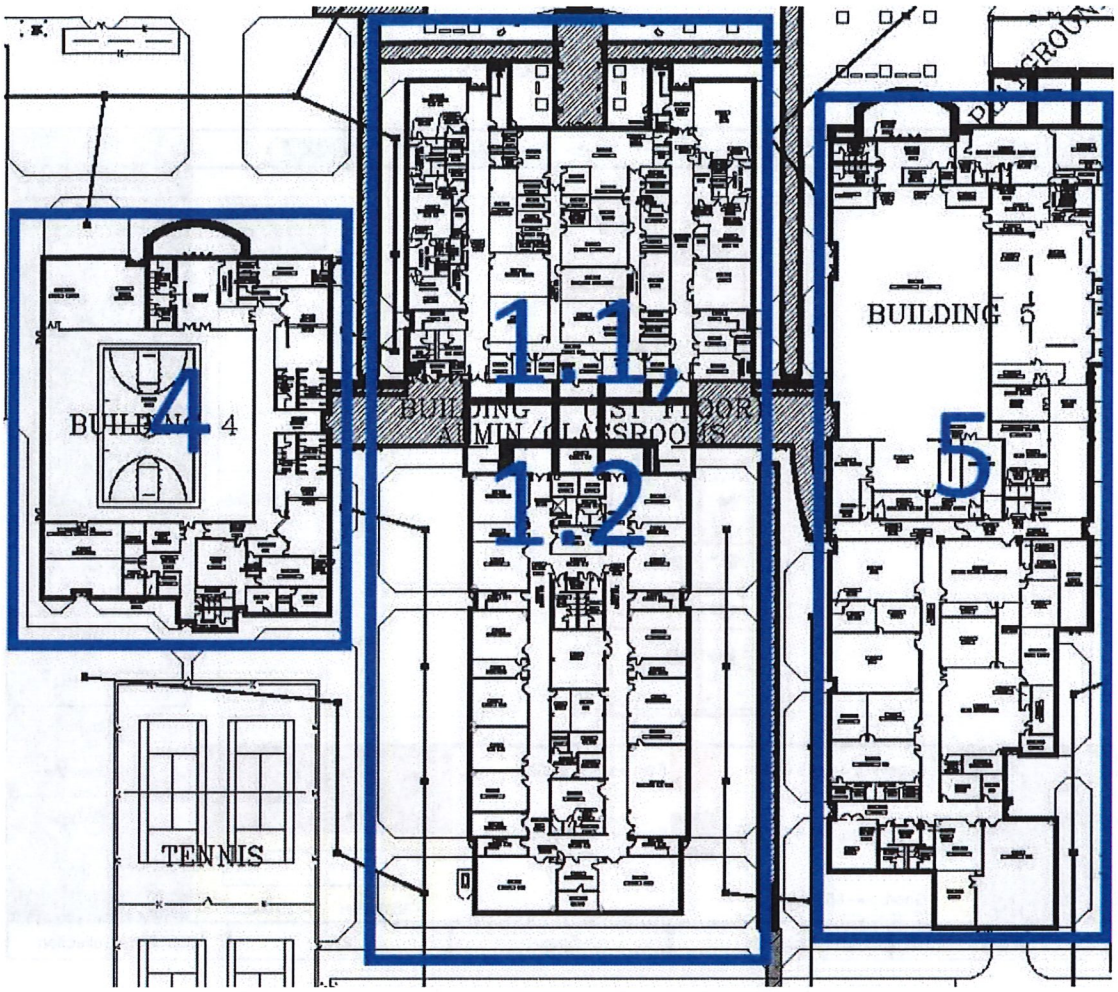
Name: Vincent Smarrelli
Title: RF Engineering Technologist
Location: Largo Florida
Phone: 727-216-6200
Email: vsmarrelli@mannwireless.com
Date: 7/14/2016
FL Low Voltage Lic # ES12000362

Introduction

Mann Wireless, Ltd. is pleased to present the report from the public safety signal test walk conducted on 7/7/2016. The objective of the walk was to document public safety radio received signal levels in each building. It is understood that the existing analog control channel was used to test levels. This will yield the same downlink RSSI result when the new system is on line as long as the donor antennas have equal or more gain, the repeaters have output power that is equal to or greater than and the same tower sites are utilized. The reason for this test was to fully understand the RF conditions in each building so when the county brings up their new radio system the building will have adequate RF coverage. The NFPA 72 24.5 metric requiring minimum signal levels of -95 dBm or better across 90% of each building was used as the pass fail value. Additionally, information necessary to complete an in-building system design and to develop a quotation if required was obtained. Mr. Jim Redington, with Motorola, requested the test and coordinated the survey.

Test Results

The building was walk tested to adequately determine public safety radio signal strengths throughout the interior. The test was conducted with an Anritsu LMR Master S412E spectrum analyzer tuned to control channel frequency 860.9625 MHz. Due to the layout of the buildings, the walk had to be divided into multiple sections. The breakdown of those sections are shown below.

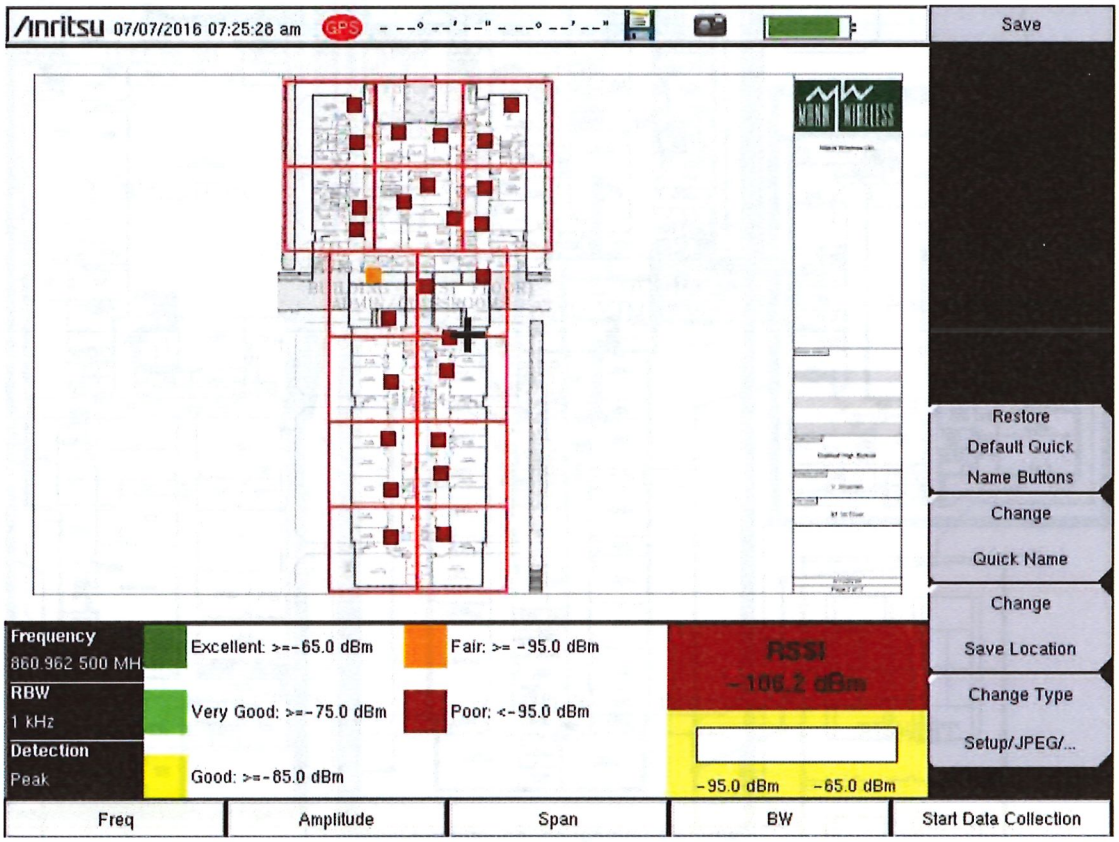


The test results concluded that several sections failed with signal strengths lower than the -95 dBm threshold. Signal data gathered during the walk test is listed below. Signal levels taken in green, yellow, and orange meet the minimum signal level requirment. Levels in red do not meet the minimum requirement of -95 dBm.

Passing Percentage Per Section

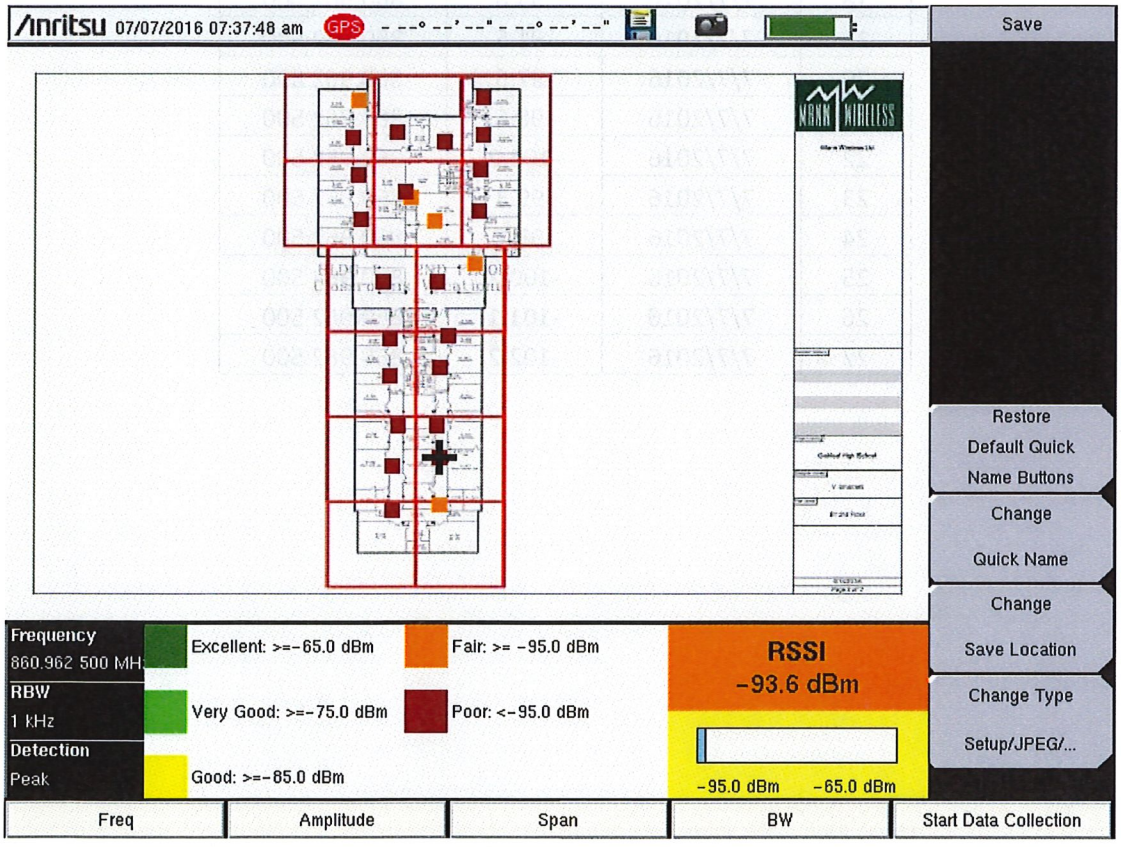
Building	% of Passing Signal Strength	Pass/Fail
1.1	7%	Fail
1.2	19%	Fail
4	0%	Fail
5	10%	Fail

Signal Levels



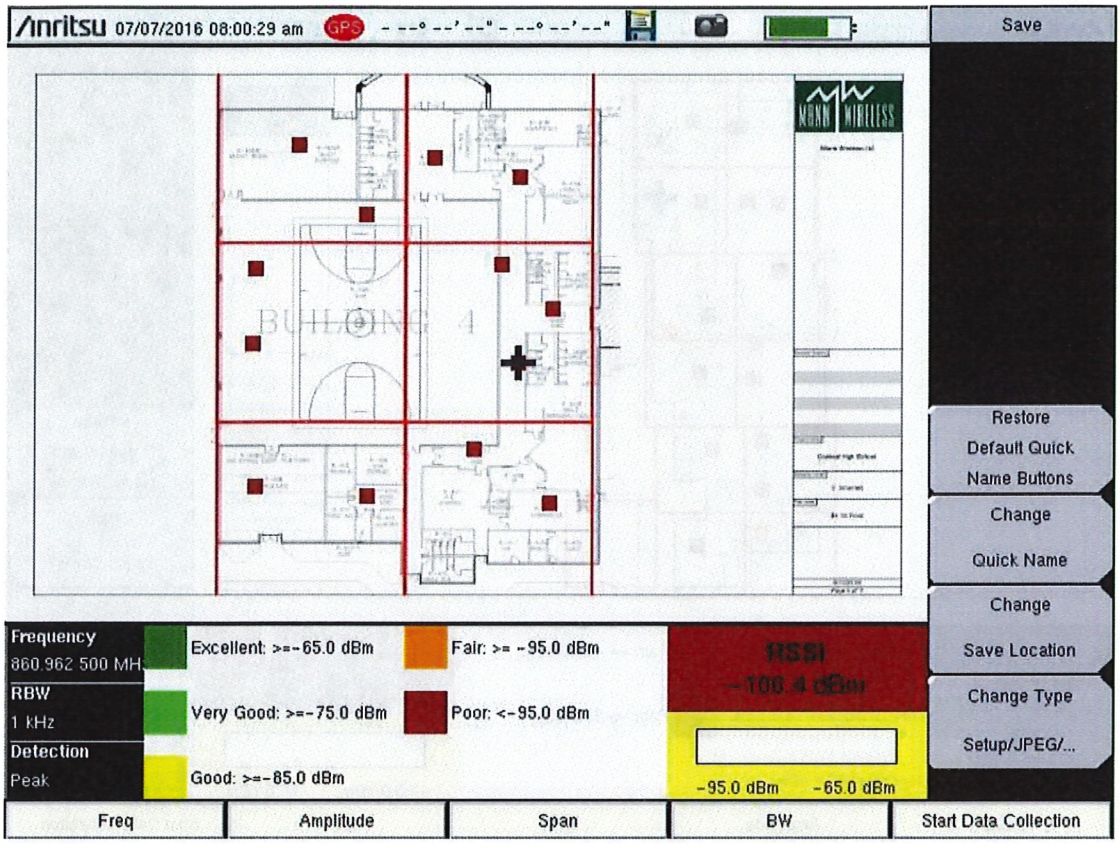
Section 1.1 (Building 1 Floor 1)			
Point #	**Date Collected**	**RSSI (dBm)**	**Frequency (MHz)**
1	7/7/2016	-96.6	860.962 500
2	7/7/2016	-99.2	860.962 500
3	7/7/2016	-97.5	860.962 500
4	7/7/2016	-101.6	860.962 500
5	7/7/2016	-94.9	860.962 500
6	7/7/2016	-107	860.962 500
7	7/7/2016	-87.8	860.962 500
8	7/7/2016	-111.2	860.962 500
9	7/7/2016	-107	860.962 500
10	7/7/2016	-101.8	860.962 500
11	7/7/2016	-122.8	860.962 500
12	7/7/2016	-100.1	860.962 500
13	7/7/2016	-109.3	860.962 500
14	7/7/2016	-116.2	860.962 500
15	7/7/2016	-105.9	860.962 500

16	7/7/2016	-100.5	860.962 500
17	7/7/2016	-108.8	860.962 500
18	7/7/2016	-112.7	860.962 500
19	7/7/2016	-110.2	860.962 500
20	7/7/2016	-107.8	860.962 500
21	7/7/2016	-111.6	860.962 500
22	7/7/2016	-101.6	860.962 500
23	7/7/2016	-104.5	860.962 500
24	7/7/2016	-107.6	860.962 500
25	7/7/2016	-100.5	860.962 500
26	7/7/2016	-100.1	860.962 500
27	7/7/2016	-103.4	860.962 500
28	7/7/2016	-110.3	860.962 500

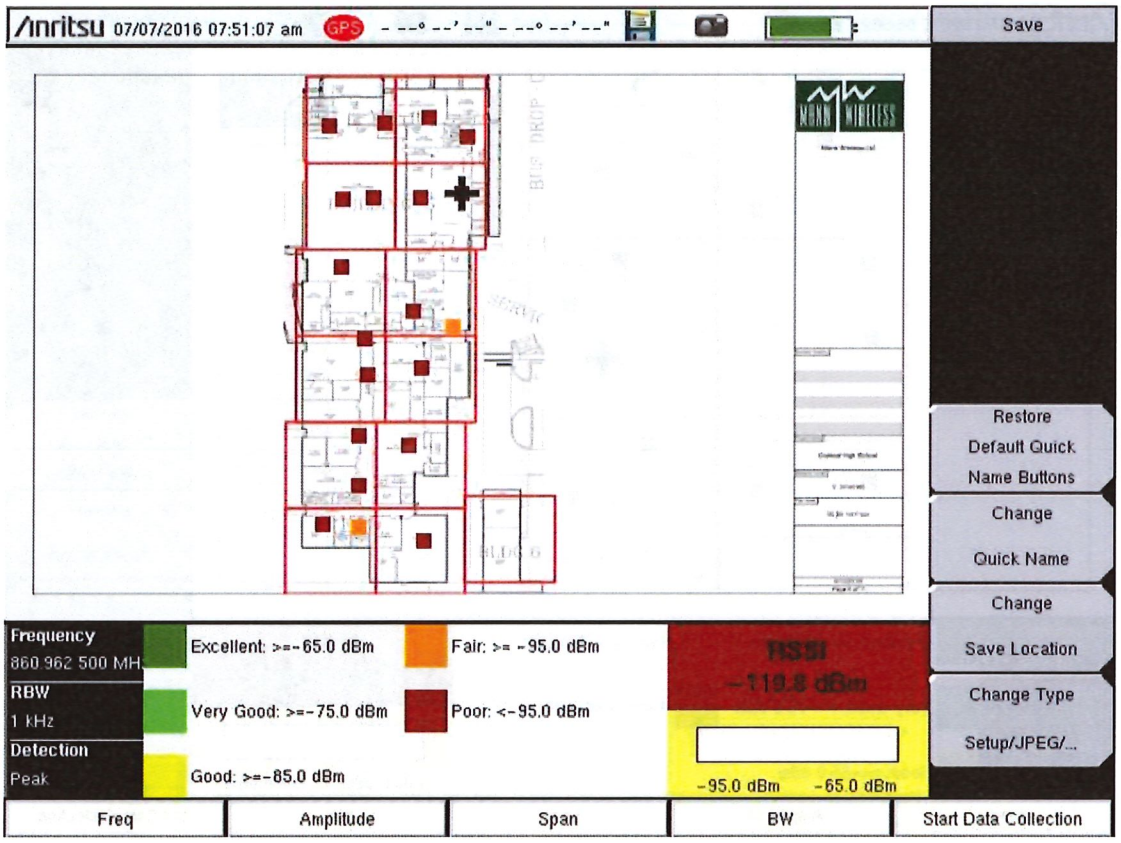


Section 1.2 (Building 1 Floor 2)			
Point #	**Date Collected**	**RSSI (dBm)**	**Frequency (MHz)**
1	7/7/2016	-93.8	860.962 500
2	7/7/2016	-97.7	860.962 500
3	7/7/2016	-95.1	860.962 500

4	7/7/2016	-96.3	860.962 500
5	7/7/2016	-107.5	860.962 500
6	7/7/2016	-104.1	860.962 500
7	7/7/2016	-95.6	860.962 500
8	7/7/2016	-104.4	860.962 500
9	7/7/2016	-108.2	860.962 500
10	7/7/2016	-101.9	860.962 500
11	7/7/2016	-91.8	860.962 500
12	7/7/2016	-99.1	860.962 500
13	7/7/2016	-108	860.962 500
14	7/7/2016	-107.9	860.962 500
15	7/7/2016	-107.5	860.962 500
16	7/7/2016	-98.5	860.962 500
17	7/7/2016	-106.9	860.962 500
18	7/7/2016	-94.8	860.962 500
19	7/7/2016	-91.5	860.962 500
20	7/7/2016	-97.6	860.962 500
21	7/7/2016	-98.6	860.962 500
22	7/7/2016	-102.2	860.962 500
23	7/7/2016	-99.3	860.962 500
24	7/7/2016	-93.7	860.962 500
25	7/7/2016	-100.2	860.962 500
26	7/7/2016	-101.1	860.962 500
27	7/7/2016	-102.2	860.962 500



Building 4			
Point #	**Date Collected**	**RSSI (dBm)**	**Frequency (MHz)**
1	7/7/2016	-116.9	860.962 500
2	7/7/2016	-122.4	860.962 500
3	7/7/2016	-122.5	860.962 500
4	7/7/2016	-104.6	860.962 500
5	7/7/2016	-96.7	860.962 500
6	7/7/2016	-115.8	860.962 500
7	7/7/2016	-100.1	860.962 500
8	7/7/2016	-101.8	860.962 500
9	7/7/2016	-111.4	860.962 500
10	7/7/2016	-112	860.962 500
11	7/7/2016	-121.3	860.962 500
12	7/7/2016	-116.6	860.962 500
13	7/7/2016	-119	860.962 500
14	7/7/2016	-97.8	860.962 500



Building 5			
Point #	**Date Collected**	**RSSI (dBm)**	**Frequency (MHz)**
1	7/7/2016	-87.1	860.962 500
2	7/7/2016	-108.1	860.962 500
3	7/7/2016	-101.3	860.962 500
4	7/7/2016	-104.8	860.962 500
5	7/7/2016	-102.3	860.962 500
6	7/7/2016	-104.5	860.962 500
7	7/7/2016	-95.4	860.962 500
8	7/7/2016	-93.5	860.962 500
9	7/7/2016	-97.6	860.962 500
10	7/7/2016	-99.9	860.962 500
11	7/7/2016	-99.8	860.962 500
12	7/7/2016	-120.5	860.962 500
13	7/7/2016	-109.2	860.962 500
14	7/7/2016	-102.4	860.962 500
15	7/7/2016	-106.6	860.962 500
16	7/7/2016	-95.5	860.962 500
17	7/7/2016	-107.2	860.962 500

18	7/7/2016	-114.3	860.962 500
19	7/7/2016	-109.7	860.962 500
20	7/7/2016	-110.7	860.962 500
21	7/7/2016	-105.3	860.962 500

Summary

Based on the data collected during the test, in-building signal enhancement for Public Safety radio services will be required. The areas requiring enhancement are as follows: buildings 1.1, 1.2, 4, and 5 will require enhancement.