

# **Town of Cumberland, ME**

## *Public Safety Radio System*

### Report on Radio Coverage

Final  
Revised August 31, 2021

## **Executive Summary**

CDCG recently undertook radio coverage analysis to determine if the recent radio maintenance work completed has returned the radio system to optimum performance. While there is no data regarding the state of the system prior to this work, initial predictive coverage maps generated did not correlate with known conditions experienced by the system users.

Upon completion of the maintenance work, both subjective and predictive analyses was undertaken in an attempt to portray present coverage conditions and to validate the predictive mapping tool.

The outcome of the test show that predictive and subjective data do corollate, allowing prediction maps to portray current coverage conditions with confidence, and that the current system is providing optimum coverage.

## **Purpose**

The purpose of the radio test was to verify that the recent system preventative maintenance work, which corrected system faults, and replaced several defective antennas, has improved system performance.

While we do not know what difference in coverage before and after the corrective actions were completed, we do know that we can conduct testing, model the existing system, and compare the results with predictive coverage maps.

## **Performance Testing**

CDCG has conducted signal testing using subjective analysis. This was done to keep the level of effort minimal, but collecting sufficient data to determine the end result with a high level of certainty.

Based on the review of predictive Talkout and Talkback coverage maps, several random locations were selected for portable communications. Each of these locations were visited and a coverage voice test was conducted. A total of 24 test point were evaluated.

Circuit Merit [CM] voice testing was used. CM testing is based on human evaluation of audio quality of a message. The evaluation is centered on the relative degree of speech versus noise [speech-to-noise ratio]. Each transmission is rated numerically from 1 to 5.

The numerical CM selected during the test is based on the following criteria:

|      |                |                                                                |
|------|----------------|----------------------------------------------------------------|
| CM-1 | Unsatisfactory | Unusable, presence of speech barely or not discernible         |
| CM-2 | Poor           | Message readable with difficulty, requires frequent repetition |
| CM-3 | Satisfactory   | Message readable but occasional repetition needed due to noise |
| CM-4 | Good           | Message readable but with noticeable noise                     |

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CM-5    Excellent

Message readable and noise is negligible

CM-3 is considered minimum acceptable communications for Public Safety.

While CM is subjective, it is shown that multiple assessors typically concur when evaluating the same transmission.

CM testing was conducted with a Fire Department portable radio communicating with Cumberland County Dispatch. Both talkout and talkback voice messages were evaluated and tabulated. The worst case of talkout/talkback was used to evaluate the level of CM communications at the test point.

Moreover, the receiver voting function was monitored to identify which receive-only sites received the test portable transmissions, and which site was voted for re-broadcast.

Calculated signal strength from the maps were also used to determine measured and subjective analysis of the Circuit Merit values.

Data Table-A shows the results of this test.

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**Table-A**  
**Cumberland, ME Subjective Coverage Test Data Results**

| V = Voted                             |     |         |          |           | R = Received  |          | X = Dead       |          |
|---------------------------------------|-----|---------|----------|-----------|---------------|----------|----------------|----------|
|                                       |     |         |          |           | Circuit Merit |          | Average signal |          |
| Test Point                            | FAA | FD West | Chebeque | Town Hall | Subjective    | Expected | Talkout        | Talkback |
| 1                                     | V   |         |          |           | 2             | 3        | -96            | -106     |
| 2                                     | V   |         |          |           | 3             | 3        | -70            | -106     |
| 3                                     | V   | R       | R        |           | 2             | 3        | -71            | -102     |
| 4                                     | V   | R       | R        |           | 3             | 3        | -87            | -101     |
| 5                                     | V   |         | R        |           | 3             | 3        | -90            | -102     |
| 6                                     | V   | R       | R        | R         | 1             | 3        | -93            | -102     |
| 7                                     | V   |         | R        |           | 2             | 4        | -91            | -99      |
| 8                                     | V   | R       |          |           | 2             | 4        | -75            | -96      |
| 9                                     | V   | R       | R        |           | 2             | 3        | -92            | -101     |
| 11                                    | V   |         | R        |           | 1             | 4        | -71            | -98      |
| 12                                    | V   |         | R        |           | 4             | 3        | -78            | -101     |
| 13                                    | X   | X       | X        | X         | 0             | 3        | -80            | -103     |
| 14                                    | V   |         |          |           | 2             | 2        | -89            | -110     |
| 15                                    | V   |         | R        | R         | 4             | 4        | -85            | -99      |
| 16                                    | R   |         |          | V         | 4             | 4        | -75            | -98      |
| 20                                    | V   |         | R        |           | 4             | 4        | -91            | -98      |
| 27                                    | R   |         | V        | R         | 3             | 3        | -96            | -109     |
| 29                                    | V   |         |          | R         | 3             | 3        | -84            | -107     |
| 31                                    |     | R       | V        |           | 3             | 3        | -77            | -107     |
| 40                                    | V   |         | R        | R         | 3             | 3        | -78            | -101     |
| 41                                    | V   |         | R        | R         | 3             | 3        | -79            | -101     |
| 17                                    |     | 0       | 3        | 1         |               |          |                |          |
| # times voted                         |     |         |          |           |               |          |                |          |
| Test not counted                      |     |         |          |           |               |          |                |          |
| 23                                    | R   |         | V        |           |               |          | -84            | -108     |
| 25                                    |     |         |          |           | 4             | 3        | -80            | -102     |
| 26                                    |     |         |          |           | 3             | 3        | -78            | -101     |
|                                       |     |         |          |           | 2.7           | 3.2      |                |          |
| ave expected/subjective circuit merit |     |         |          |           |               |          |                |          |

## Coverage Maps

Coverage maps were used to select the 24 test locations. Additional points were planned but the test was cut short due to unavailability of the voting system monitoring at the FAA site. However, we conclude that sufficient data was collected for the analysis.

The attached coverage maps, one each for talkout and talkback, identifies the locations as well as the test results.

## **Results**

### **Voting System**

#### Voting system review

1. The FAA site received most of the transmissions [22]; the voting comparator selected this site 17 times.

While the site is experiencing a high degree of radar interference on its receiver, its height above average terrain [HAAT] is 316'; appears to enable the receiver to receive from many locations within the town. Note that the Town Hall site that has a HAAT of 4', thus having limited receive range.

2. The Chebeague site [HAAT 291'] received transmissions 14 times and was voted 2 times
3. The CFD Station-2 [HAAT 100'] received the signal 6 times but was never voted
4. The Town Hall [HAAT 4'] site received 7 times and was voted 1 time

It seems that the voting system is operating normally as most transmissions have multiple sites receiving portable transmissions.

### **Circuit Merit Testing**

The evaluation of CM testing, based on the results shown in Table-A, analyzed both the subjective and expected CM based on receive signal level calculations. The average of all CM for both the subjective and predictive data is approximately CM-3, which is the minimum acceptable communications.

Worst case talkout/talkback CM between portable and dispatch was selected at each test point.

### **Test Maps**

Two test maps [Figure #1 and #2] were developed, one for Talkout and one for Talkback. The map shows where reliable coverage is expected [WHITE]. The area shown in RED identifies locations in Cumberland where there is a 50/50 chance of having signal levels sufficient to provide a successful two-way message. GRAY areas show location of no coverage.

Furthermore, each of the test points on the map has the test results associated with that point. For an example, test location #6 on the maps has the following nomenclature: 6 – 1 / FWCT.

The first # is the testpoint number location; the second # is the CM. The letter designations [FWCT] represents how many sites have received the portable transmission: F = FAA; CFD West = W; C = Chebeague; and T = Town Hall.

## Conclusions

The tests endeavored to determine if the recent system maintenance work completed improved the overall town wide coverage performance.

Our assessment is based on empirical hypothesis by means of comparing predictive data by using subjective probabilities to corroborate the validity of the coverage model.

The results show that both subjective and predictive data are within the expected ranges. This achieves two objectives:

- 1] The analysis intuitively points to the probability that the system performance is working optimally
- 2] The use of coverage prediction maps depicting future coverage can be considered reliable.

## Follow up Information

The following questions and answers provides additional information regarding issues in this report.

1. Executive Summary: “the current system is providing optimum coverage.” Can you explain that optimum coverage means “the best this system can provide,” and that this is very different from the system providing adequate or excellent coverage?

**The current radio system appears to be providing the level of service expected for the existing system design.**

**Note: the system audit conducted by RCM showed two bad antennas needing replacement, and that two RF links had audio issues. These are critical components that would affect coverage and should be noticeable by the users.**

***The Town [PD & FD] confirms that post-PM, the coverage issues in the most problematic areas have persisted, and have not noticed any difference in coverage***

2. Performance Testing: Can you explain what talkout and talkback mean? Can you define “portable communications” as that of a body-worn portable radio at hip level (or wherever it was)?

**The portable communications coverage maps are based on a handheld portable worn at the hip level using a speaker-mic.**

**Talkout is the dispatch talking to a portable**

**Talkback is a portable talking to dispatch**

3. Can you explain what “receiver voting function,” “receive-only sites,” and “selected for re-broadcast” means?

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**Receiver voting function:** this is voting equipment [voter] located at the FAA site; it receives audio from three remote receive-only sites [no transmitter] located at the Town Hall, CFD West, and Chebeague. The voter looks at audio from all of the receive sites; selects the best audio, and feeds that audio to the transmitter for re-broadcast [repeater function].

4. The readers of this document need to be able to understand what “voted, received,” and “dead” mean

**‘Voted’ means that the voting equipment received audio from multiple remote sites and selected the best audio to feed the repeater transmitter.**

**‘Received’ means that the Voter received audio from a remote site but did not select that audio for re-broadcast.**

5. Is it appropriate to have a conclusion that the quality of radio coverage is poor, based on your testing? This is an important message (if appropriate) for our decisionmakers.

**Audio in the white area is reliable audio accepted by the public safety community based on the TSB88 standard. [95%, reliability with audio quality of DAQ-3.0].**

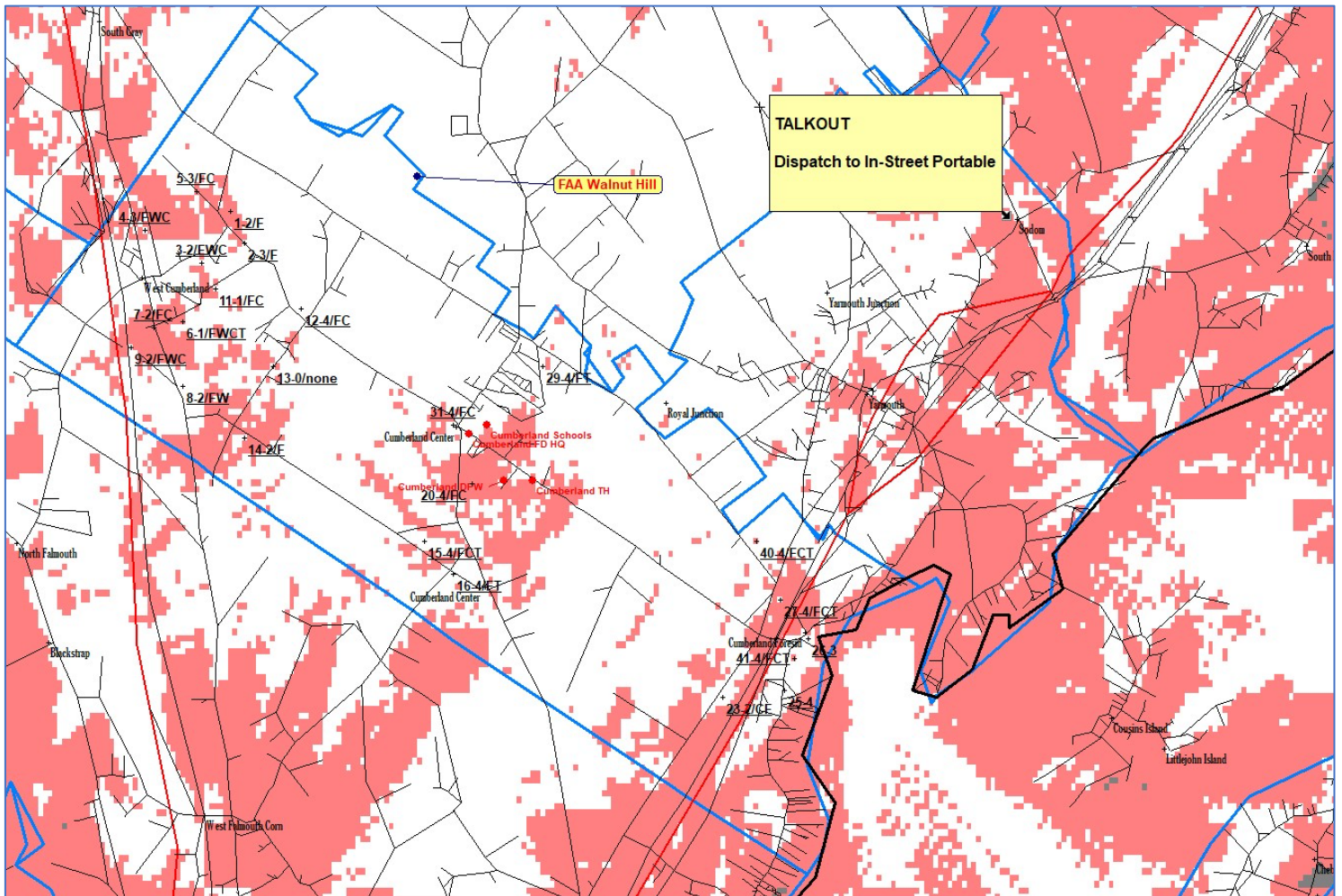
**Audio in the red areas is considered poor and not acceptable; thus, in theory, less red within the town borders means better coverage.**

6. Is it appropriate to include a note that the Police Department has provided anecdotal information that the Talkback coverage map is inaccurate, specifically, there are areas on Route 100 on the west side of town where it is frequently not possible for officers to communicate with dispatch from their portables?

**Yes, we can add that language.**

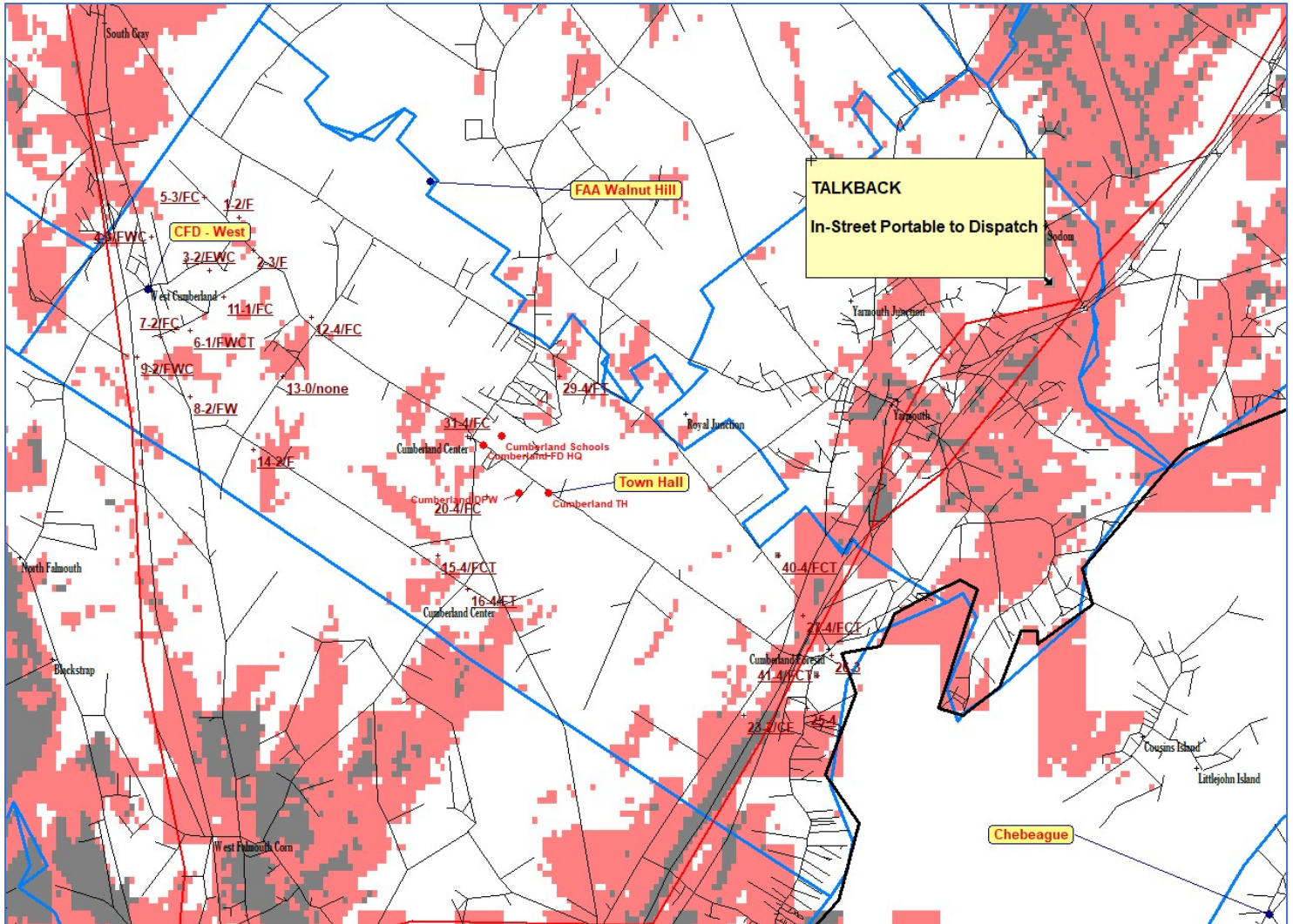
**Note: has this been confirmed since the antennas were replaced, and the radio links repaired?**

**Figure-1**  
**TALKOUT – Dispatch to Portable**  
**Test Locations and Results**  
**White = In-Street, On-Hip Portable**  
**Red = 50% chance of successful communication**  
**Gray = No Coverage**





**Figure-2**  
**TALKBACK – Portable to Dispatch**  
**Test Locations and Results**  
**White = In-Street, On-Hip Portable**  
**Red = 50% chance of successful communication**  
**Gray = No Coverage**



I affirm that the data collected and analyzed in this document are true and correct to the best of my information, knowledge, ability and belief.

*Normand H. Boucher*  
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