Report to

Greater Washington Educational

Telecommunications Association

(WETA)

Regarding Potential Impact on Land Mobile Operations in the Washington, DC area Caused by WETA Moving from Channel 27 to Channel 14 and other Related Repacking Considerations

June 6, 2017

Prepared by:

Meintel, Sgrignoli, & Wallace, LLC
1282 Smallwood Drive
Suite 372
Waldorf, Maryland 20603
(202) 251-7589

ENGINEERING REPORT FOR WETA CHANNEL 14 AT WASHINGTON, DC

BACKGROUND

As part of the FCC's Incentive Auction and TV Band Repacking process, WETA has been reassigned from its existing Channel 27 to Channel 14. Channel 14 is the lowest channel in the UHF Television Band and occupies the spectrum 470-476MHz. Channel 14 is adjacent to Land Mobile (LM) operations that are licensed in the frequency band of 464-470MHz. Concerns about interference to LM operations by TV transmission on Channel 14 prompted a study of the potential interference and other issues related to the assignment of Channel 14 to WETA.

It is noted that the Spectrum Act provides that the Commission *"shall make all reasonable efforts to preserve, as of February 22, 2012, the coverage area and population served of each broadcast television licensee, as determined using the methodology described in OET Bulletin 69 of the Office of Engineering and Technology of the Commission." § 1452(b)(2).* As shown in this Report, there are extraordinary adverse consequences from assigning WETA to Channel 14.

LAND MOBILE STUDY AND ANALYSIS

Based upon information contained in the FCC's Universal Licensing System (ULS) there are 2,136 active licenses on frequencies between 464 and 470 MHz within 100 km of the WETA transmitter site with 10,964 different frequencies and/or locations.

A study was performed to predict which of the above noted LM licenses and facilities are likely to be impacted by the proposed operation on Channel 14 by WETA. The results of that study indicate the 1,046 of the 2,136 licenses will be potentially impacted with 4,662 of their facilities being potentially affected.

LAND MOBILE OPERATIONS IMPACTS FROM CHANNEL 14 OPERATIONS	
Land Mobile Licenses within 100KM	**2,136**
Frequencies/Locations within 100KM	**10,964**
Licenses with Predicted Impacts within 100KM	**1,046**
Facilities with Predicted Impacts within 100KM	**4,662**

The engineering study that was undertaken looked at two different interference impacts from the Channel 14 operations to the LM operations.

The first interference impact is due to out of band emissions from Channel 14 on the land mobile frequency. In general, this interference mechanism is the out-of-band emission (OOBE) from the Channel 14 transmission in the lower adjacent frequencies that acts like "co-channel" noise to the LM operations. In essence, the intermodulation products from the DTV transmitter that are not removed by the DTV Mask Filter become co-channel noise to the LM receiver.

In order to prevent impairment to LM receivers, FCC Rules Section 73.687(e)(4)(ii) indicates that the field strength of the out of band DTV signal on the land mobile frequency at the land mobile receive location cannot exceed 17.0 dBμV/m.

The DTV field strength on the land mobile frequency is determined by the following process:

1. Compute the DTV field strength on the DTV channel at the land mobile site. For this study the calculation was made using the standard method used by the FCC for computing interfering DTV field strength, the Longley-Rice propagation model using the statistical F(50,10) criteria (50% of the locations, 10% of the time).

2. Adjust the field strength predicted in step 1 above based on the standard DTV out-of-band emission mask. This mask is defined in FCC Rules Section 73.622(h)(1). The power level of emissions on frequencies outside the authorized channel of operation must be attenuated no less than the following amounts below the average transmitted power within the authorized channel.

a) In the first 500 kHz from the channel edge the emissions must be attenuated no less than 47 dB.
b) More than 6 MHz from the channel edge, emissions must be attenuated no less than 110 dB.
c) At any frequency between 0.5 and 6 MHz from the channel edge, emissions must be attenuated no less than the value determined by the following formula:

$$\text{Attenuation in dB} = -11.5(\Delta f + 3.6);$$

Where: Δf = frequency difference in MHz from the edge of the channel.

3. The signal is then further reduced to take into account the fact that the DTV signal is measured in a 500 kHz bandwidth: whereas, 73.687(e)(4)(ii) requires determination be made for a 30 kHz bandwidth. This adjustment amounts to an additional attenuation of 12.22 dB.

For example, a DTV in band (Channel 14 – lower edge 470 MHz) field strength is predicted to be 100 dBμV/m at the land mobile site and the land mobile frequency is 467.5 MHz.

*DTV mask filter attenuation is: 11.5 * ((470.0 – 467.5) + 3.6) = 70.15 dB*

DTV Field Strength on Land Mobile frequency equals

100.0 – 70.15 – 12.22 = 17.63 dBμV/m

In this case interference to the land mobile signal is likely since the DTV signal is 0.63 dB above the allowable 17.0 dBμV/m.

The second potential interference impact to LM operations is the desensitization of the land mobile receiver by the high in-band DTV signal. "Brute-Force" overload is caused when the very high signal from the DTV transmitter causes the AGC (Automatic Gain Control) in the LM receiver to fully attenuate the incoming signals (both desired and undesired) as the receiver senses a very high received signal level. This AGC action causes "desensitization" of the LM receiver (also known as "receiver desense").

The prediction of the likelihood of this type of desensitization interference involves a determination as to whether power from the DTV signal is above the noise floor (typically -120 dBm) of the land mobile receiver. This determination needs to be made, not at just the site of the land mobile receiver, but at the receiver itself; therefore, additional factors must be taken into consideration.

These additional factors include the gain of the land mobile receive antenna (typically 6 dB) and the line loss between the antenna and the receiver (typically 2 dB). In addition to these there is filtering within the receiver designed to attenuate the out of band signal and that rejection capability is typically about ~80dB. There is also the measurement bandwidth adjustment discussed above that further reduces the signal by an additional 12.22 dB

For example, using the same DTV 100 dBμV/m field strength from the previous example the potential for interference would be determined as follows:

100.0 + 6.0(LM antenna gain) – 2.0 (LM line loss) = 104 dBμV/m

104.- 80.0 (LM receiver out-of-band rejection capability) = 24.0 dBμV/m

*24.0 – 12.22 (M*easurement bandwidth adjustment) = 11.78*.0 dBμV/m*

Converting the 11.78 dBμV/m field strength to power = -116.7 dBm

In this example, interference would be expected since the power of the DTV signal at the land mobile receiver (-116.7 dBm) is greater than the receiver noise floor (-120.0 dBm). (This would equate to a loss of sensitivity of approximately 3.3 dB).

It is noted that a third potential impact would be the intermodulation within the receiver tuner caused by very large incoming signals that the AGC does not attenuate. Active preamplifiers and poorly-designed tuners are particularly susceptible to intermodulation due to high incoming undesired signals

POTENTIAL LM IMPACT AREAS AND LM LICENSEES

Attached to this report in **Appendix 2** is a map showing the land mobile licensed locations where interference is predicted to occur. It should, however, be noted that, in the case of mobile operations, interference could occur at various other locations as the mobile units travel throughout the Washington DC metropolitan area.

Appendix 2 details the predicted impact to the individual licenses and their specific frequencies. As noted previously, there are approximately 1,046 potentially impacted licensees and approximately 4,662 potentially impacted facilities.

POTENTIAL IMPACT TO LM PUBLIC SAFETY AND HEALTH OPERATIONS

The results of the LM study show that some of the potentially impacted licensees are Public Safety operations including Campus Police Departments at several very large Universities and Colleges as well as several large Hospitals and large Medical Centers. Obviously, any impacts to Public Health and Safety operations would be undesirable.

Consequently, an alternative channel assignment should be made to WETA in order to avoid any potential impacts to these important Public Health and Safety operations.

ANTENNA POLARIZATION

In performing this LM study no adjustments were made for cross polarization. This is the additional isolation provided when the transmit and receive antennas have a different polarization. Typically land mobile operations use vertically polarized antennas; whereas; historically television transmit antennas have been horizontally polarized.

However, television licensees are permitted to use circular or elliptical polarization wherein varying amounts of vertical polarization (up to 100% for circular) is added. This type of operation has become more common place due to increase use of indoor DTV receive antennas as well as the need to overcome challenging urban reception environments and/or terrain.

In the case of WETA, it is anticipated that full circular polarization will be needed to provide adequate coverage of the Washington market due to the low power (dipole-adjusted) assigned to its new operation on Channel 14.

Consequently, the impact to LM operations from the increased power density due to Circular Polarization of the WETA signal will also need to be considered when analyzing LM interference impacts.

Furthermore, as discussed below, it is believed that the interference to LM operations from the existing LPTV station on Channel 14 is limited due to the fact that the station transmits a horizontally polarized only signal which limits its power density due to single horizontal-only polarity of the existing LPTV antenna.

FCC LAND MOBILE PROTECTION REQUIREMENTS FOR T-BAND

The FCC has long recognized the potential for interference to land mobile operations in spectrum adjacent to that utilized by television broadcasting. Specific television channels between 14 and 20 have been allocated by the FCC for land mobile use in several large markets. (Washington DC CH17 & CH18)

In order to protect the land mobile usage, FCC Rules Section 73.623(e) prohibits allocation of digital television on adjacent channels within 176 km of the land mobile allocation (250 km for co-channel).

Given that the FCC's own rules require protection for adjacent land mobile operations and, therefore, preclude the use of Channels 16 and 19 in the Washington, DC area due to this protection, it is nonsensical not to require the same LM protection for the land mobile operations adjacent to Ch. 14 (i.e., the 464-470 MHz LM band.) If the LM protections set forth in Section 73.623(e) were applied to use of Channel 14, those protections would have completely precluded the use of Channel 14 in Washington DC.

POTENTIAL INTERMODULATION EFFECTS

The current WETA Channel 27 transmitter facility is shared with five other television stations within the Washington DC area. The WETA Channel 27 transmitter is combined with two other UHF stations (three stations total – with a small channel spread) that share a common UHF panel antenna. Based on shared repack information from the other stations, one of those stations will be changing channels pursuant to the repack; and the other station will be staying on its existing channel, which will result in a large channel spread (New Repack Channels: 14, 33, 35).

The potential for intermodulation products (Passive Intermodulation) caused in the combiner and other passive components by the mixing of these three channels is very high. We have not been able to find an example of a Channel 14 DTV station operating in a combined situation with other channels. WETA's channel assignment, therefore, puts the station in uncharted territory for its repack. There is no reason to believe Ch. 14 will work in WETA's current combiner situation.

Thus, given the complexity of resolving potential intermodulation and mixing products that would potentially fall within the LM band or other services, it is reasonable to assume that the Channel 14 operation may not be able to operate as a combined station. If that is the case, WETA's Ch. 14 would need to be relocated in order to operate with a single station antenna and filter system in order to eliminate the possibility of any intermodulation issues. See discussion below regarding WETA relocation issues.

To reiterate, at this time, we are unaware of any examples of Channel 14 stations being successfully combined with multiple other stations while maintaining protection to LM frequencies. There is simply no precedent for this approach.

ANTENNA CONSIDERATIONS

In an effort to understand potential transmission facility options, WETA undertook an RF Sweep of the existing Chesapeake Street Combined Antenna system and transmission line. The results of this testing indicate that operation on Channel 14 will be problematic in the current state of the system. And, modifications to the system in order to obtain acceptable RF performance of the transmission line and antenna will require painstaking and time consuming RF optimization as well as potentially requiring the replacement of many components.

A particularly difficult challenge related to the antenna and transmission line is that this is a shared site with two other UHF TV stations; two other VHF TV stations, and three other FM radio stations. The work to optimize the performance of the antenna and transmission line requires that those other stations cease transmissions from the tower in order to not overload the test equipment used for the optimization process as well as RFR Safety compliance for the tower workers.

Consequently, the optimization work may require the construction of a separate interim or auxiliary facility for all tenant stations to operate for a few weeks while this process is completed. However, the interim facilities for the other stations would not be covered by current guidelines from the Broadcaster Reimbursement Fund and may not be possible.

COMBINER LIMITATIONS

The channel assignments for the other stations that are combined into the common antenna used by WETA are channel 33 and 35. The frequency spread required to build a combiner that would work on both Channel 14 and 33/35 could be problematic. Given the limits on waveguide sizes for channels in the 30's – it would be extremely difficult, if not impossible, to build a combiner for these channels along with Channel 14 using standard waveguide sizes (WR1800 and WR1500).

Consequently, a custom waveguide size would need to be fabricated in order to accommodate the wide frequency "spread" of the three channels to be combined. The consequence of a custom waveguide size would be increased costs and long delivery time required to fabricate this custom made waveguide. Additionally, replacement parts and components will not be "off-the-shelf" and will require custom made parts for repairs in the future.

BUILDING SPACE LIMITATIONS

The existing Chesapeake Street transmitter site used by WETA and shared with four other TV stations has extremely limited space available to keep current operations on-air while building out a new combiner and transmitters. The required Ch. 14 filter is approximately 18 feet by 27 feet (see a drawing of a Channel 14 filter in **Appendix 1**). This filter is in addition to the three channel combiner that would be needed to combine the three UHF channels at the transmitter site into the common antenna.

Thus, the requirement to add an additional lower-sideband filter for Channel 14 operations by WETA would be an impossible task given the limited floor and building space available at the

current licensed site. WETA could be forced to move to another transmitter site in order to construct the proposed Channel 14 facilities.

RELOCATING WETA ON CHANNEL 14

WETA is a tenant on the existing tower and antenna system in Washington, DC. If WETA were required to move to another location in order to have a single channel antenna and transmission system (to eliminate intermodulation issues), there are few, if any, tower options for WETA. The previous analog transmitter site (River Road) is no longer capable of housing the transmitter and filter as no building space is available at that site. Additionally rigging at that tower will be highly problematic as all the property surrounding the tower has been sold to other entities.

The other towers in Northwest Washington are near their structural capacities and are unlikely to be able to accommodate a very large Channel 14 antenna and transmission line in addition to the existing station antenna, interim facilities, and new Repack Channel antennas and transmission lines for the existing stations on those structures. Furthermore, since Channel 14 has an adjacent channel DTV station on Channel 15, in order to be co-located to eliminate interference to the existing Channel 15 facility (WFDC), WETA would be required to near-co-locate in the Northwest Washington, DC area (within 1-2 miles of WFDC).

Consequently, if WETA were required to operate with a single channel antenna and transmission line system, there would be no place to relocate the WETA facilities. Additionally, if necessary work to the antenna for a Channel 14 assignment requires that WETA move from the existing tower, WETA is also faced with finding tower space in a location that can accommodate the Channel 14 filter.

LOST POTENTIAL – DISTRIBUTED TRANSMISSION SYSTEM & ATSC 3.0

WETA is contemplating the construction of a Distributed Transmission System (DTS) to enhance its service in the Washington area and to compensate for its lower power as compared to other full power TV stations in the Washington DC market. The deployment of DTS transmitters at various locations in the area would further exacerbate the potential interference to land mobile operations in that the DTV field strengths would be higher throughout the coverage area.

This Channel 14 restriction would preclude WETA from being able to deploy a DTS which it would be able to do with a different channel assignment. In addition to this limitation, a Channel 14 assignment will preclude WETA from making full use of ATSC 3.0 when it becomes available to broadcasters in the future. Consequently, the Channel 14 assignment to WETA impairs the station significantly from its existing situation.

LM RELOCATION AND SETTLEMENT COSTS

In the past, TV Stations using Channel 14 (analog or digital) have relocated Land Mobile stations and equipment to new frequencies in situations where LM interference cannot be mitigated or resolved. TV Stations have undertaken such relocations pursuant to private commercial agreements (settlement agreements) in which the TV Station on Channel 14 paid the licensee of the LM station to agree to move to new frequencies at the expense of the TV station. And, in

some cases, additional monetary compensation was required to induce or compensate the LM licensees to agree to such an arrangement.

In this case, the potential relocation costs as well as the inducement/settlement payments to LM licensees to allow relocation of their facilities may involve a very large sum. Given the 4,662 LM facilities potentially impacted by WETA, we calculate that a budget of $30-$40Million dollars may be required in order to induce and relocate those facilities to new frequencies/band.

WETA submits that this expense would need to be reimbursed from the FCC Repack Reimbursement fund. However, the FCC has made it clear that all disbursements from the fund would need to occur prior to the 39 month deadline. But, in this case, the expenses are likely to accrue for years after the station begins operations on Channel 14. In all likelihood, it would take 5-8 years before all Ch. 14 and LM issues were resolved, all affected LM stations relocated, and the accounting of reimbursement funds completed.

SCHEDULE AND PHASE ASSIGNMENT ISSUES

WETA has been assigned to Phase 4 of the FCC's phased transition. Given the timing for Phase 4, the immense scope of the potential LM interference issues and other technical issues associated with the buildout of a new Channel 14 station, as well as the sheer number of LM stations involved, WETA would certainly not be able to be on the air on Channel 14 by its Phase 4 transition deadline. Absent extraordinary relief, under the FCC's phase transition plan, WETA would be required to cease operations on its current Channel 27 facilities at the Phase 4 deadline, regardless of whether Channel 14 could eventually meet its LM protection obligations or not. Moreover, the impact on and uncertainty surrounding WETA's Channel 14 operations spill over to the other TV stations in its combined antenna operation as well as the other TV stations sharing its transmission facility. Thus, multiple stations in the market would be disrupted by WETA's Channel 14 issues.

Forcing WETA to build and operate a Channel 14 transmission facility would most certainly force the station to operate at substantially reduced power or perhaps even go off the air while LM and other interference issues are resolved. Furthermore, actual testing of the Channel 14 interference to LM in WETA's coverage area would not be possible until the completion of the Phase 3 stations transition deadline, leaving WETA with insufficient time and opportunity to engineer another transmission facility arrangement once the predicted interference becomes actual interference to LM. Forcing this expansive LM engineering project to be completed in an expedited fashion during Phase 4 -- with no time prior the end of Phase 3 to conduct testing -- is a completely unworkable time frame and will adversely affect the FCC's planned phased transition in the market.

In all likelihood, WETA would be forced off the air (or forced to operate at substantially reduced power) for some months or years until the LM testing is complete and the station would be able to resume over the air operations on Channel 14. In the meantime, WETA would lose its MVPD carriage, its higher-than-average over the air audience, viewer funding and membership, as well as its place in the market as the premiere PBS station.

WETA is concerned that once the 39 month reimbursement window closes, all financial burdens associated with the ongoing mitigation and resolution of interference issue would be transferred to this nonprofit and noncommercial educational public broadcaster.

EXISTING LPTV CHANNEL 14

There is an existing Low Power TV station on Channel 14 (WWTD-LD) in the Washington, DC market that is being displaced by the WETA assignment on Channel 14.

In that this LPTV station has been operating on Channel 14, the implication is that this station is not causing any problems: therefore, there would not be a problem with WETA operating on Channel 14. In view of this, a study was undertaken to explain why the WETA operation is much more likely to cause interference.

It has been determined that WWTD-LD is authorized to operate with an effective radiated power (ERP) of 15 kW using a directional antenna. On the other hand, WETA's new facility has been given an ERP of 53.8 kW, 3.6 times (5.6 dB) the WWTD-LD power and would utilize a non-directional antenna.

The existing WWTD-LD antenna is a horizontally-polarized only antenna. As noted above, the lack of a vertical component or full circular polarization would limit the existing power density of WWTD-LD and further limit its interference impact to LM operations.

In addition, the WETA antenna center of radiation height above mean sea level (RCAMSL) is 327 meters; whereas, the RCAMSL of WWTD-LD is only 242 meters, 85 meters (279 feet) lower then WETA.

An evaluation of the predicted field strength of WWTD-LD, at the same locations where WETA is predicted to potentially to cause interference to land mobile operations, indicated that the WWTD-LD field strength averaged 8.1 dB less than WETA. Therefore, exchanging the WETA facility for that of WWTD-LD is not an equivalent facility with regard to the potential for interference to land mobile. The WETA facility would have at least 8.1dB more signal in those same locations when compared to WWTD-LD and therefore more likely to cause harmful interference.

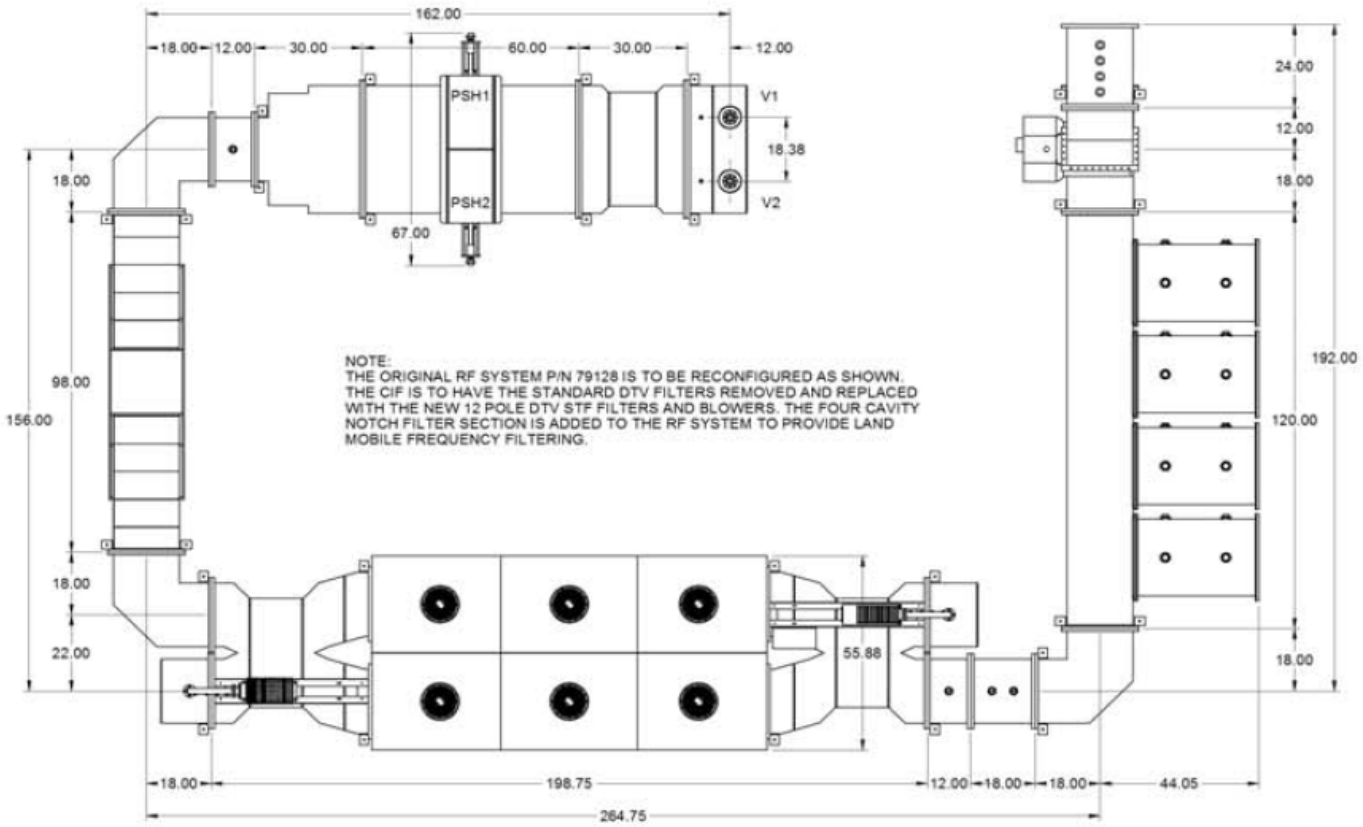
CONCLUSION

For all the forgoing considerations, it is clear that WETA is unable to construct facilities on Channel 14.

An alternative channel assignment for the WETA facility would be the best technical solution while also being the most expedient solution.

APPENDIX 1

CHANNEL 14 MASK FILTER



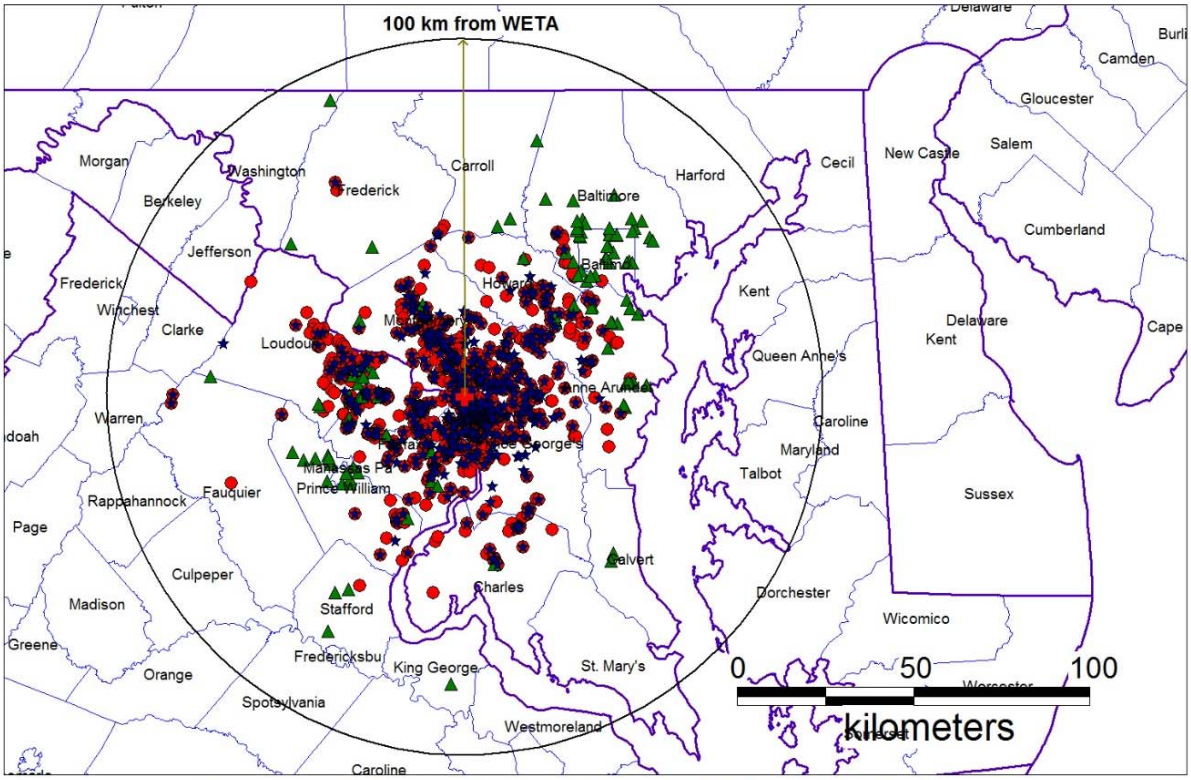
THE ORIGINAL RF SYSTEM WAS P/N 79128 FOUND ON DRAWING D-95850

18 Feet

27 Feet

APPENDIX 2

Map showing land mobile locations where interference is predicted to occur



Potential Land Mobile Impacted by WETA Washington, DC Channel 14 within 100 km
WETA Field Strength Predicted Using F(50/10) - Only Land Mobile Between 464 and 470 MHz were Considered
Blue = Potential Points for both Out of Band and Overload IX
Red = Potential Points for Overload IX Only
Green = Potential Points for Out of Band IX Only