

**Final Report for  
WLAJ-TV LLC  
Television Station WLAJ, Channel 14  
Lansing, MI**

**Concerning Lower Adjacent Channel Out-of-Band-  
Emissions from WLAJ into Land Mobile Operations  
below TV Channel 14**

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**Prepared by:**

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## **INTRODUCTION and BACKGROUND**

This report has been prepared for WLAJ-TV LLC, licensee of television station WLAJ, licensed to serve Lansing, MI. WLAJ was assigned channel 14 in the outcome of the FCC's Broadcast Spectrum Incentive Auction. WLAJ holds a construction permit, FCC File Number 0000034828, to construct its post-auction facility on channel 14. Pertinent authorized technical parameters can be found in Table 1 of this report.

In the construction permit authorization that was granted the following condition must be met: *"During equipment tests, authorized by Section 73.1610 of the Commissions Rules, the permittee shall take adequate measures to identify and substantially eliminate objectionable interference which may be caused to existing land mobile radio facilities in the 460 to 470 MHz band. Documentation that objectionable interference will not be caused to existing land mobile radio facilities shall be submitted along with the request for Program Test Authority. Program tests shall not be commenced under Section 73.1620(a) of the Commissions Rules and may only be started after specific authority is granted by the Commission. An application for a license must be filed within 10 days after the start of program tests."*

When WLAJ filed its construction permit application it requested to relocate the station 32 km to the northeast of its current licensed location. The FCC's software tool for analyzing interference into other authorized or pending broadcast stations, TVStudy, reported the following failure into Land Mobile Services.

*\*\*\*Proposal fails distance check to land mobile station: Detroit MI ch.15, 115.8 km"*

The authorized relocation of the WLAJ transmitter site falls short of the distance separation of 176 km as specified in the FCC rules by 60.2 km<sup>1</sup> to protect Land Mobile ("LM") operations.

MSW was retained to study the predicted impact that WLAJ operations may have on both active authorized Land Mobile facilities above and below channel 14 and released its report on December 13, 2018 to WLAJ. **The conclusion of that initial study showed that no LM operations would be adversely impacted by WLAJ operating on channel 14 in terms of either interference or LM receiver desensitization ("overload").**

The initial study focused on a circular area with a radius of 250 km and a center point being the transmitter site coordinates as stated in WLAJ's construction permit and shown in Appendix 1 of this report. The primary purpose of this part of the study was focused on LM operations below channel 14.

The study also focused on a circular area with a radius of 176 km and a center point as defined in the FCC rules for Detroit, MI <sup>2</sup>, also shown on the map in Appendix 1, operating on channel 15. No LM facilities were located inside this circular area operating on channel 15 according to the FCC's Universal Licensing System ("ULS") database.

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<sup>1</sup> See 47 C.F.R. § 73.623(e)

<sup>2</sup> See 47 C.F.R. § 73.623(e) table for the coordinates of the Detroit, MI, area for Land Mobile operations

WLAJ has now completed its construction of the authorized facility and is ready to file for Program Test Authority. In preparation of that filing, MSW performed a follow up study based on the as-built technical data to determine if the combined filter and transmitter response would continue to protect LM facilities from Out-of-Band Emissions ("OOBE") as stated in the initial report. This report discusses the results of the follow up study.

## **SCOPE OF STUDY AND METHODOLOGY**

This follow up study consisted of analyzing interference and overload into currently authorized LM facilities using the as-built transmitter and filter OOBE response data. A list of potentially impacted LM facilities was created from the ULS database by searching for all active and licensed LM facilities within a culling distance of 250 km from the relocated television station. The area studied is shown in Appendix 1 along with all LM operations found operating below TV channel 14, shown in Appendix 2.

For authorized mobile LM operations a study was conducted inside a circular area defined by the radius of operation for the mobile LM facility as authorized. If no radius was defined a default radius of 48 km was used. The center point used was the coordinates of the LM operation as authorized. The circular area was divided into 1 km/side cells and calculations were made at the geographic center of each cell. A pass/fail determination was made for each cell for both interference and overload as calculated from the television station. After analyzing all cells within the circular area the number of failures was compared to the total number of cells analyzed. If the total number of failures was at or under 2% of the total area the amount of interference or overload was considered de minimis and the facility was considered to have passed.

Most all LM operations use vertical antenna polarization. With WLAJ proposing the use of horizontal only polarization, LM stations would typically experience further reduction of interference and/or overload by 15 to 20 dB. A conservative value of 8 dB of antenna cross polarization discrimination was utilized in this study for LM operations not indicating the use of horizontal, circular or elliptical polarization.

## **STUDY PARAMETERS**

The parameters used for WLAJ and LM operations are shown in Tables 1 and 2, respectively. For the individual studies to each LM location the actual parameters were used as shown in the station's authorization. If actual parameters were not shown on the authorization then default parameters were used.

**Table 1 - Parameters for television station WLAJ**

Parameter	Value
Analyzed Station	WLAJ (Authorized CP)
Channel	14
Latitude (NAD83)	42-41-19.0
Longitude (NAD83)	84-22-35.0
Height of Antenna Center of radiation (AMSL)	560.0 m
ERP	950 kW
Antenna Type	Non-Directional
Antenna Pattern Relative Field per Azimuth Bearing	Calculated
Polarization	H
Elevation Pattern	Real
Electrical Tilt	0.75 degree
Antenna Pattern Relative Field per Depression Angle	Calculated
Post-transmitter Filter Type Proposed	12-Section

**Table 2 - Parameters for Land Mobile Stations**

Parameter	Value
Antenna Type	Omni-directional
Frequency (MHz)	Per Authorization
Bandwidth	Per Authorization
Height of Antenna Center of radiation (AMSL)*	FB=10.0 m, MO=2.5 m
Polarization*	V
Receive Antenna Gain*	FB=11.0 dBd, MO=0.0 dBd
Antenna Pattern Relative Field per Azimuth Bearing	1.0
Antenna Pattern Relative Field per Depression Angle	1.0
Receive Line Loss	FB=2.0 dB, MO=0.0 dB
Receiver Noise Floor	-120.0 dB
Receiver Out of Band Rejection	80.0

\* FB=Fixed Base, MO=Mobile. If parameter is not shown in authorization then the default value is used.

Table 3 shows the parameters used for the Irregular Terrain Model in calculating the WLAJ OOB signal strength into each LM facility found within the 250 km radius.

This study analyzed the impact into LM operations in the 460 to 470 MHz band and TV channel 15. Similar to the initial study, there were no LM facilities reported on channel 15 inside the 250 km radius on the follow up study.

**Table 3 – Parameter settings utilized in Land Mobile Study**

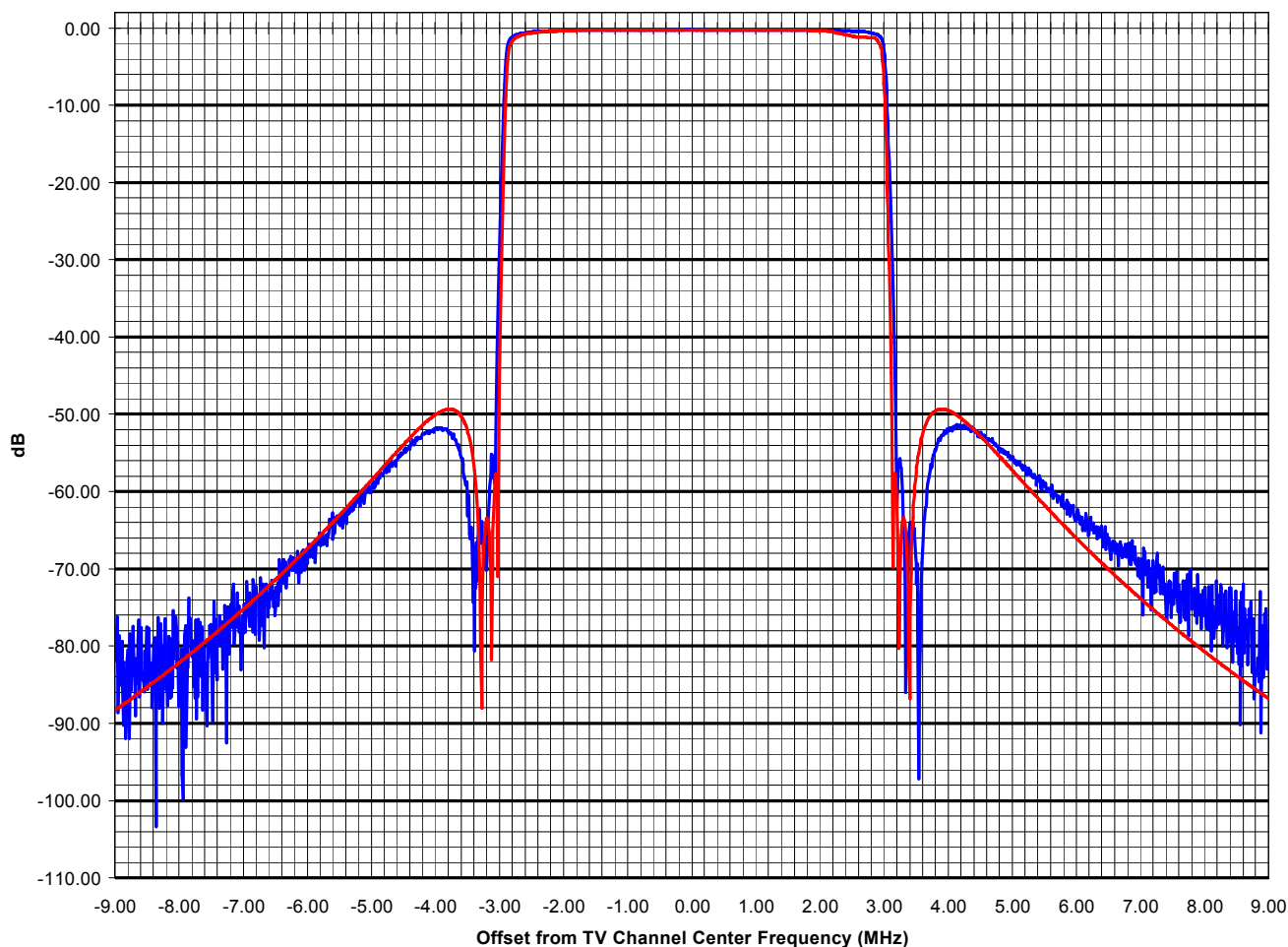
Parameter	Value
Study Radius	250.00 km
Study Centerpoint Latitude (NAD 83)	42-41-19.0 N
Study Centerpoint Longitude (NAD 83)	84-22-35.0 W
Cross Polarization Discrimination Factor	8.0 dB
Study cell size	1.0 km/side
Study Path Distance Increment	0.1 km
Terrain Database	1 arc second
Location Variability	50 %
Time Variability	10 %
Confidence	50 %
Ground Permittivity	15.0
Ground Conductivity	0.005 S/m
Surface Refractivity	301.0 N-units PPM
Longley-Rice Mode ‡	1
Climate Code	5 Continental Temperate
Utilize Land Use/Land Clutter in analysis	False
FCC interference criteria per Section 73.687(e)(4)(ii)	17.0 dBuV/m

‡ 1 - Individual mode used for authorized LM facility studies

## **POST-TRANSMITTER FILTER COMPARISONS**

The utilization of a 12-Section post-transmitter filter is a key component in reducing OOB from WLAJ into LM facilities. The plot below is a comparison the OOB response of the Model 12-Section Filter used in the initial Land Mobile study to that of the as-built filter data received from the filter manufacturer. The as-built filter closely tracks that of the model with increased attenuation near the lower TV channel 14 band edge.

**Channel 14 Transmitter Post-Filter Response Comparison**

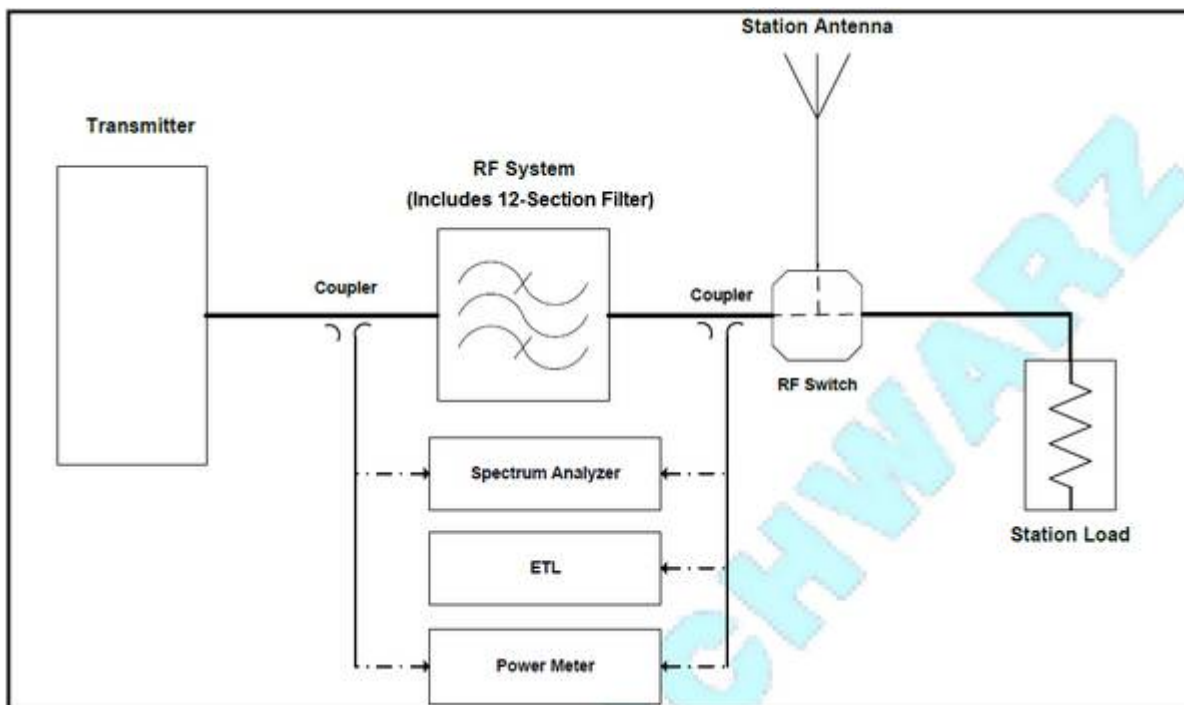


**Red: Model 12-Section Filter used for the initial Land Mobile Study**

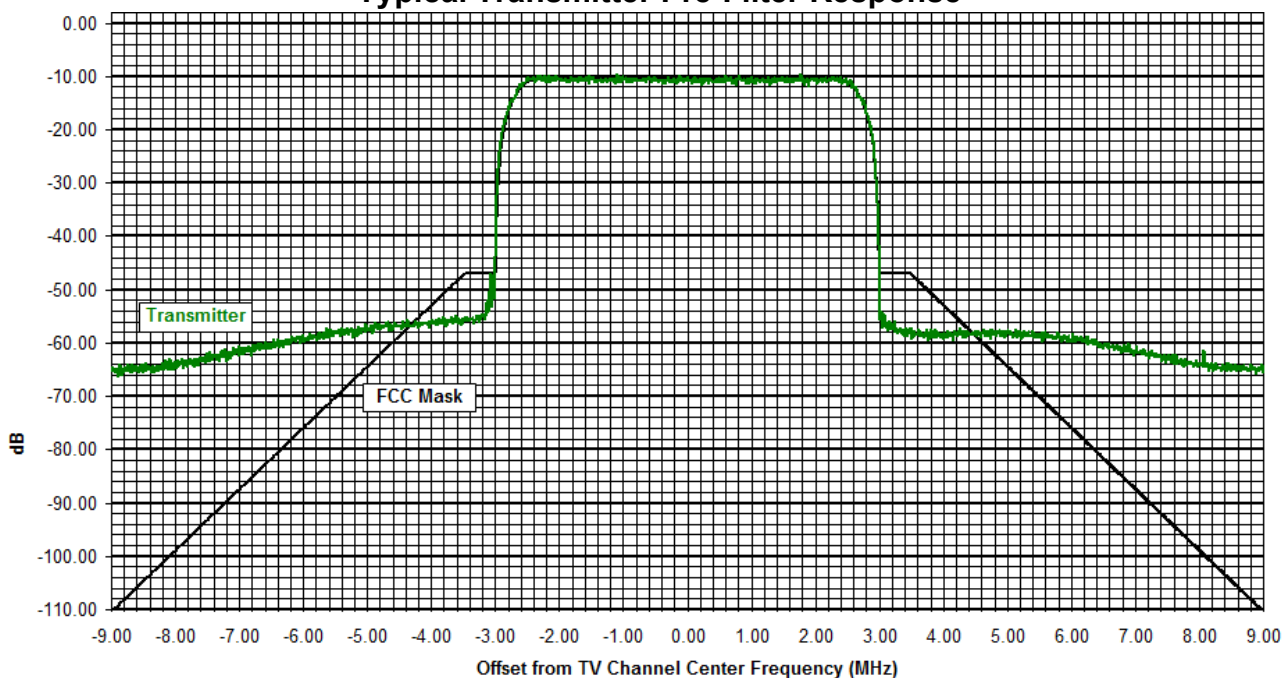
**Blue: As-Built 12-Section Filter Response obtained from the Manufacturer**

## TRANSMISSION SYSTEM BLOCK DIAGRAM

Below is a block diagram of the RF transmission path. The diagram shows the measurement points (Couplers) used for the transmitter proof of performance. The parameters used for this LM study were based on a typical OOB response of the transmitter, pre-filter, and the as-built response of the 12-Section Filter with the output of the filter connected to the antenna.

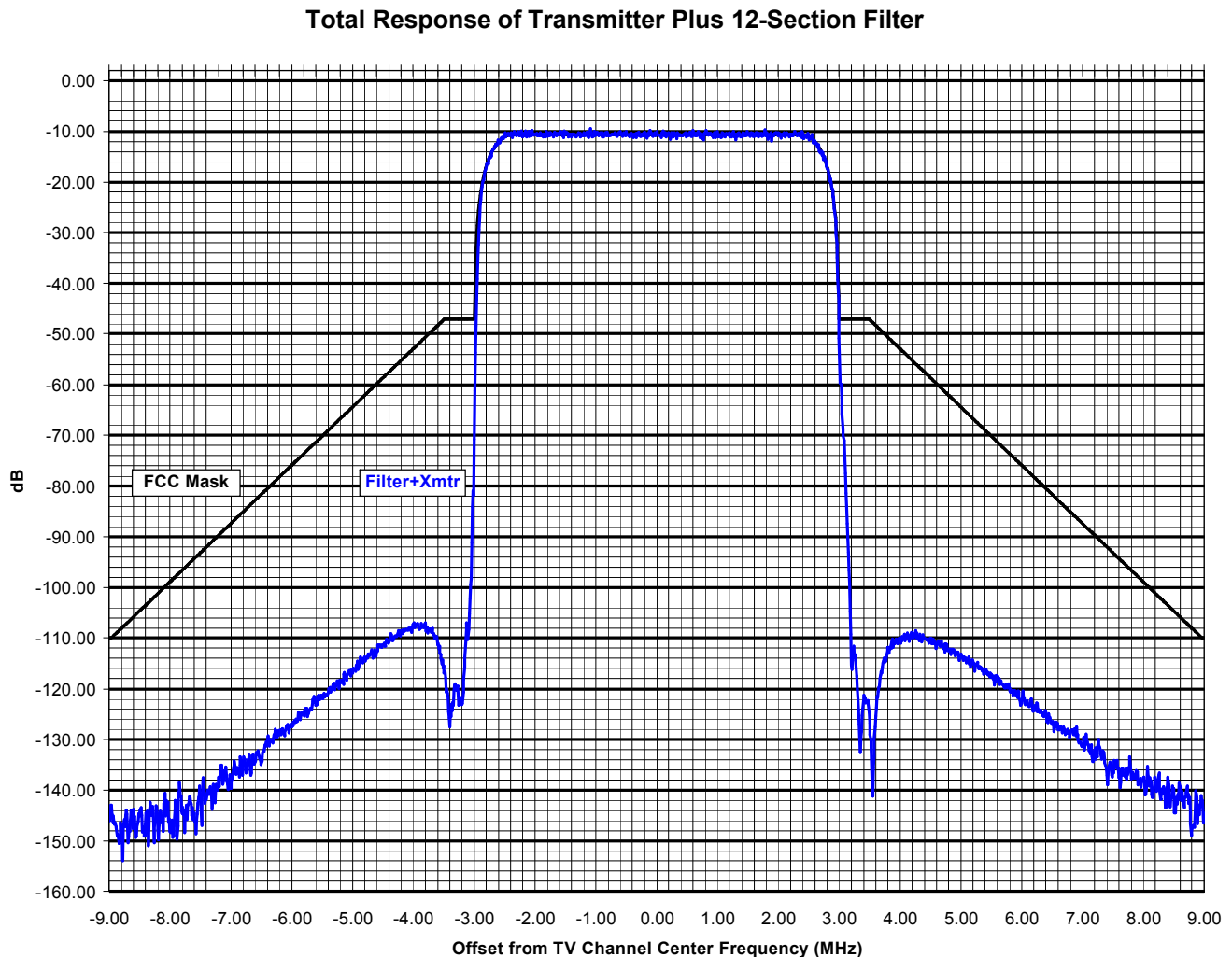


**Typical Transmitter Pre-Filter Response**



## TOTAL OUT OF BAND EMISSIONS RESPONSE

Below is a plot of the transmitter, pre-filter, response added to that of the as-built 12-Section Filter. The plot includes an overlay of the FCC “Mask.” Note the increased attenuation near the TV channel 14 band edge (-3.00 MHz Offset which is 470 MHz).



**Black: FCC DTV Emission Mask per §73.622(h)(1) of the Rules**

**Blue: Combined Response of the Transmitter plus As-Built 12-Section Filter**



## **TRANSMITTER SYSTEM PERFORMANCE DATA ANALYSIS & RESULTS**

The as-built 12-Section post-transmitter filter response was obtained from the filter manufacturer and compared to the model filter used in the initial MSW study released in a report dated December 13, 2018. It was determined that the as-built filter response closely correlated with the response of the model filter used in the initial study.

The transmitter proof of performance data was found to closely correlate to the typical response data of the model transmitter as furnished to MSW earlier from the manufacturer.

A verification study, similar to the initial study, was performed using the response of the as-built filter and the typical pre-filter response of the transmitter. The results of this latest study confirmed that no interference is predicted into LM facilities caused by the Out-of-Band Emissions from WLAJ operating on TV Channel 14.

Table 7 below shows a high level summary of the results for current licensed LM stations. This data has been updated using a more current database of Land Mobile stations from that used in the initial study. This interference study included all Land Mobile operations between 460 to 470 MHz.

**Table 7 – Statistics from the Analysis of Current Licensed LM facilities**

Item	Value	Call Sign
LM Authorizations Found below TV Channel 14	5,048	-
LM Authorizations Found on TV Channel 15	0	
LM Locations Studied	29,304	-
Closest LM Frequency to WLAJ Band Edge	469.9813 MHz	WQDF658
Closest LM Fixed Base Facility	3.2 km	WQCG634
Lowest IX Margin to Fixed Base:	33.3 dB	WQAA520
Stations Predicted to Experience Interference	0	-
Worst Overload Margin	-6.8 dB	WQLQ960
Stations Predicted to Experience Overload	1	WQLQ960

WQLQ960 shows predicted overload. This is a fixed base station located 12.9 km from WLAJ and operates on 463.775 MHz. Due to the physical distance and frequency spacing from the channel 14 band edge, overload is unlikely. If, however, there are any reports of overload, pre-receiver filtering should resolve the issue.

It is noted that 24 LM facilities were found on channel 14 within 250 km of WLAJ. These, however, are within the Chicago, IL, LM operational area with the closest being 189.9 km away. WLAJ is 283.2 km from the Chicago, IL, LM center point and meets the spacing requirement. These facilities, therefore, were not included in this report.

Appendix 3 of this report is a list showing the 30 LM facilities with the lowest predicted interference margin. A complete list of all 29,304 LM facilities analyzed is available upon request.

## **CONCLUSION**

MSW examined the as-built response of the post-transmitter filter and the results of the transmitter proof of performance taken by a representative of the manufacturer. The results of this data was used to conduct a follow up study to determine the impact to LM facilities below channel 14 and those on channel 15 inside the Detroit, MI, LM operational area.

The following conclusions were reached from the follow up study.

1. Based on information received from the manufacturer and transmitter proof of performance, a 12-Section post-transmitter filter was installed and is properly functioning in the transmitter RF chain.
2. The as-built 12-Section post-transmitter filter measured data closely correlates to the model filter data utilized in the initial study performed by MSW.
3. The out-of-band transmitter pre-filter response was examined and found to correlate with typical transmitter response data obtained from the manufacturer.
4. No LM facilities were found operating inside the Detroit, MI, LM channel 15 operational area within 250 km of the WLAJ transmitter location.
5. The results of this follow up study indicate that WLAJ should protect Land Mobile operations as predicted in the MSW initial study.

As another step to ensure LM operations will not be adversely impacted by WLAJ operating on TV channel 14 MSW was contracted to send notification to all Land Mobile operators within the area studied.

This follow up study conducted by MSW was based on the ITM prediction model. Actual field conditions including, but not limited to, propagation conditions, errors and omissions in the FCC database, active and passive intermodulation products and LM receiver characteristics may affect the actual results in the field and are considered outside the control of MSW.

This study was performed using defined locations extracted from the FCC ULS database (e.g. geographical coordinates and well defined boundaries, such as radius and center point). The FCC database base contains hundreds of authorizations for itinerant users that are authorized over the entire country, states, counties and other wide areas. It is impractical to attempt to analyze those operations without knowing the specific location of a receiver if and when they are deployed in the area studied.

MSW stands ready to answer any questions regarding this report and to assist WLAJ in responding to any issues that may be reported from LM operators.

## **CERTIFICATION**

The undersigned author of this report, Joseph L. Snelson, Jr., is a Certified Professional Broadcast Engineer (CPBE) as recognized by the Society of Broadcast Engineers and possesses over 49 years of experience in Broadcast Engineering including Television signal analysis, propagation, coverage and interference prediction. He is a contract employee of Meintel, Sgrignoli and Wallace, LLC, Broadcast Television & Radio Engineers, and was assigned to identify the impact of WLAJ, transmitting on television channel 14, may have on authorized Land Mobile facilities operating in the upper and lower adjacent bands to channel 14.

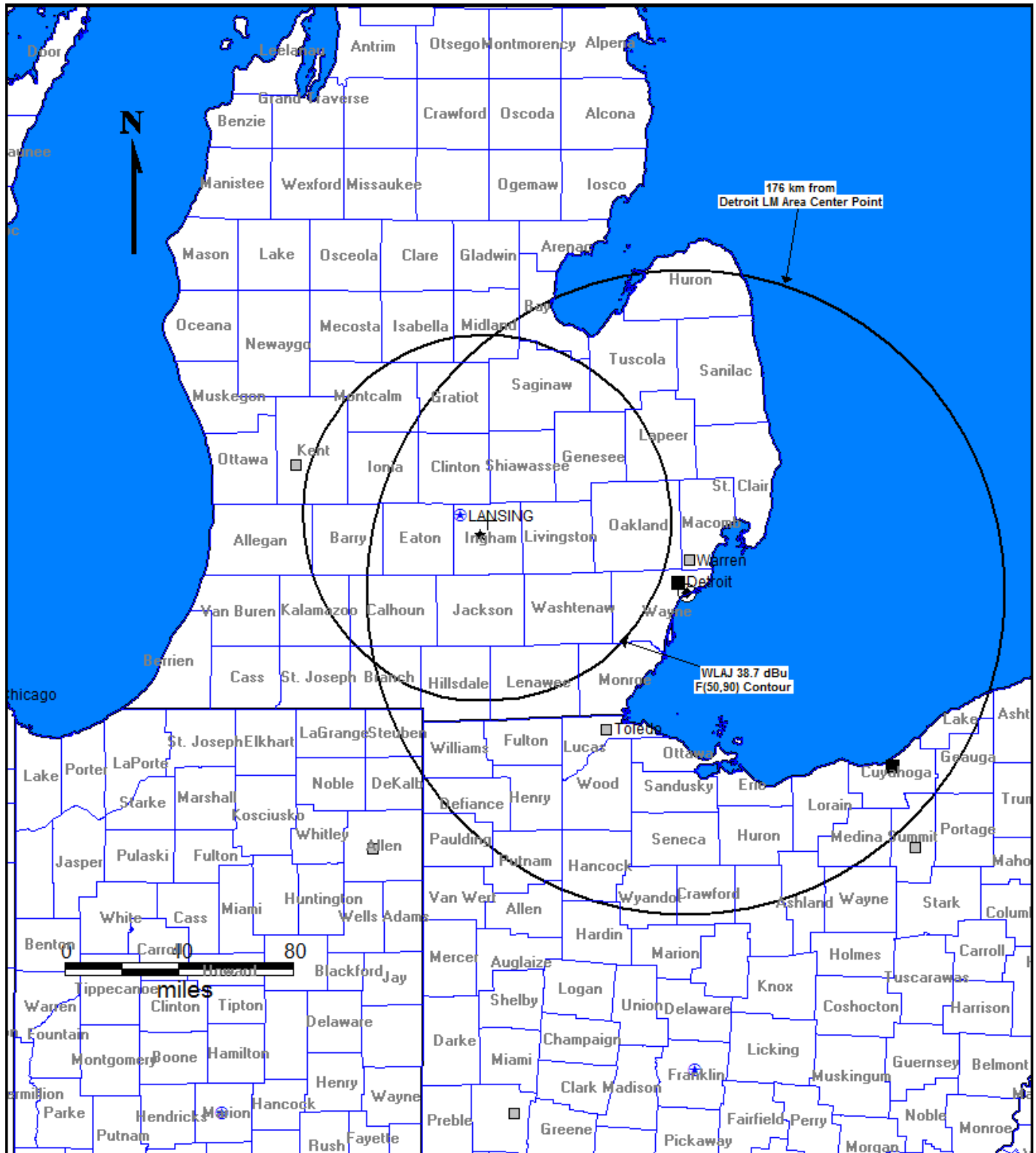
The undersigned hereby certifies that all statements made in this report are true and correct to the best of his own knowledge except, where noted, when data or information has been supplied by others, which he believes to be correct.



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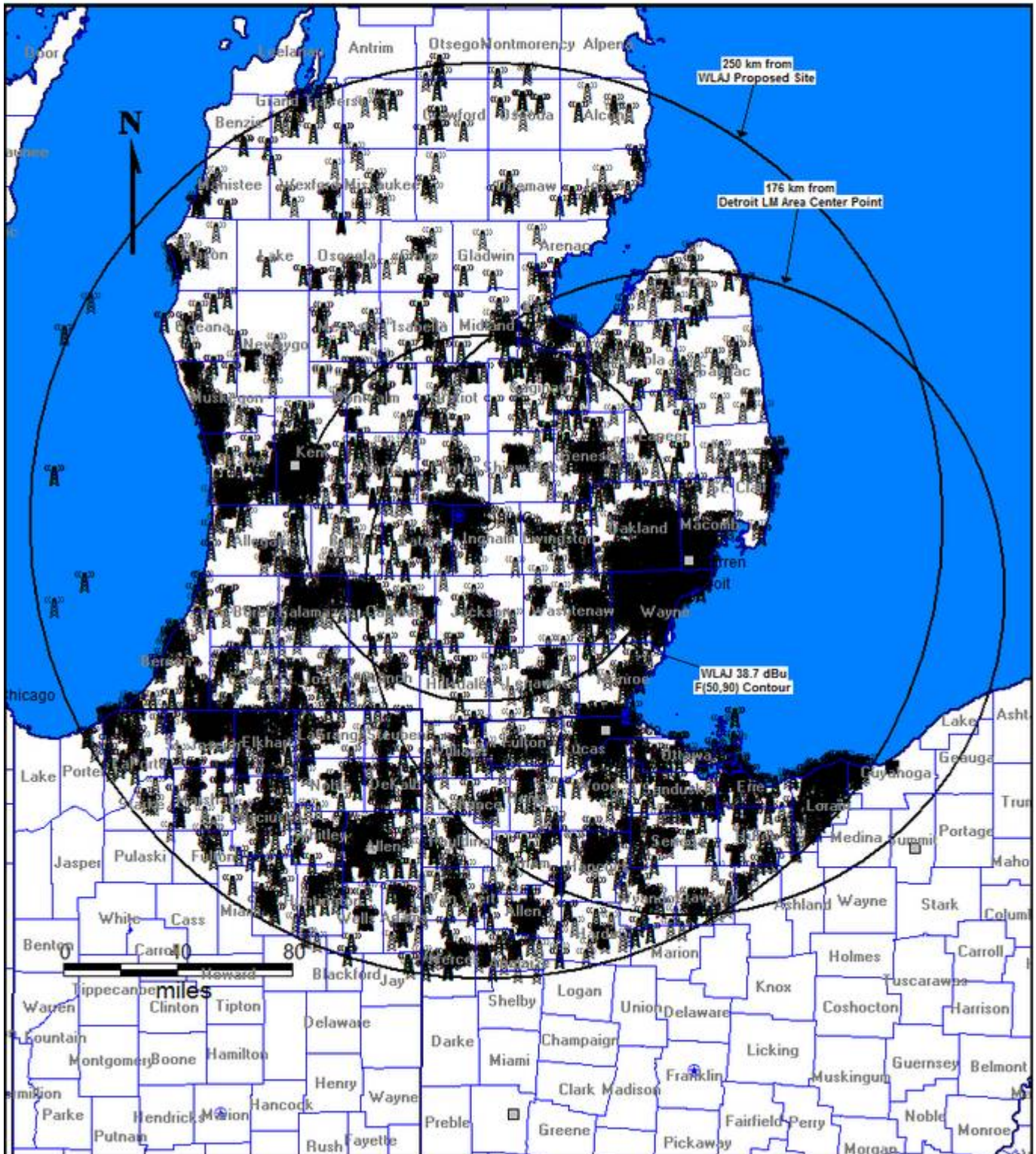
# **APPENDIX 1** **Detroit, MI, Ch. 15 Land Mobile 176 km Adjacent Channel Protected Contour** **WLAJ, Channel 14, Lansing, MI, Coverage Contour**





## APPENDIX 2

Land Mobile Stations below Ch 14 within 250 km of WLAJ  
 Detroit, MI, Ch. 15 Land Mobile 176 km Adjacent Channel Protected Contour  
 WLAJ, Channel 14, Lansing, MI, Coverage Contour



### APPENDIX 3

#### Land Mobile Stations with Lowest Interference Margin

#### Lowest 30 out of 29,304

Freq Mhz	Call Sign	Svc Code	Svc Cls	DTV->LM Dist km	DTV->LM Az deg	Ant Pol	HAAT m	HAGL m	Gain dB	BW khz	IX Mgn dB	OL Mgn dB
469.9750	WQBQ851	IG	MO	13.9	291.4	V				7.6	11.2	12.1
469.9750	WNWL465	IG	MO	21.5	273.9	V				7.6	14.4	15.3
469.9625	WQUS358	YG	MO6	19.4	262.3	V				4.0	20.7	18.5
469.9750	KUP365	IG	MO	97.1	242.7	V				11.0	29.5	>20.0
469.9750	KJU508	IG	MO	56.9	214.6	V				11.0	30.4	>20.0
469.9250	WQAA520	IG	FX1	27.2	285.2	V	-6.2	6.1	6.0	7.6	33.3	13.1
469.1375	KD24041	IG	MO	13.8	291.5	V				16.0	34.3	8.6
469.1625	KD24041	IG	MO	13.8	291.5	V				16.0	34.7	8.6
469.2125	KD24041	IG	MO	13.8	291.5	V				16.0	34.7	8.6
469.0875	KD24041	IG	MO	13.8	291.5	V				16.0	34.8	8.6
469.9250	WQSH887	IG	MO	22.2	341.4	V				11.2	34.9	14.6
469.0250	WQFV936	IG	MO	10.7	296.7	V				11.2	35.0	9.1
468.8125	KD24041	IG	MO	13.8	291.5	V				16.0	35.1	8.6
468.8875	KD24041	IG	MO	13.8	291.5	V				16.0	35.1	8.6
468.8375	KD24041	IG	MO	13.8	291.5	V				16.0	35.2	8.6
469.9750	KQT986	IG	MO	78.9	86.6	V				11.2	35.2	>20.0
469.9750	WQDI200	IG	MO	65.8	61.9	V				11.2	35.6	>20.0
468.7625	KD24041	IG	MO	13.8	291.5	V				16.0	36.1	8.6
469.0625	WQUV416	IG	MO	15.7	274.8	V				11.2	36.1	10.8
469.1875	WQUV416	IG	MO	15.7	274.8	V				11.2	36.2	10.8
469.0375	WQUV416	IG	MO	15.7	274.8	V				11.2	36.3	10.8
469.2250	WPCH396	IG	MO	14.7	291.3	V				11.2	36.5	10.6
469.1375	WQUV416	IG	MO	15.7	274.8	V				11.2	36.5	10.8
469.0375	WQYJ799	IG	MO	7.5	298.0	V				7.6	36.6	11.1
469.8750	WQY661	IG	MO	13.3	277.4	V				11.2	36.6	11.5
469.1500	WQIU437	IG	MO	9.2	296.4	V				7.6	36.8	11.0
469.0375	WRCQ538	IG	MO	11.1	236.9	V				7.6	36.8	11.3
469.8750	WNGX343	IG	MO	8.8	277.5	V				11.2	36.8	11.7
469.0125	WQUV416	IG	MO	15.7	274.8	V				11.2	36.9	10.8
469.1625	WQUV416	IG	MO	15.7	274.8	V				11.2	36.9	10.8

**Notes:**

1. Mobile analysis performed within a defined area of operation from mobile LM coordinates
2. Mobile Distance/Azimuth is to the cell with the lowest margin
3. Lowest mobile interference and/or overload margins are shown
4. 48 km radius used for mobile area of operation if not specified in authorization
5. Default parameters used for mobile where no height or antenna gain is given