

ENGINEERING EXHIBIT

Incentive Auction Channel Reassignment

Request for Special Temporary Authorization

prepared for

WGBH Educational Foundation

WGBH-TV Boston, MA

Facility ID 72099

Ch. 5 34 kW 363 m

WGBH Educational Foundation (“*WEF*”) is the licensee of digital television station WGBH-TV, Facility ID 72099, Boston, MA. Reassignment of WGBH-TV from UHF Channel 19 to low-band VHF Channel 5 was specified in the *Incentive Auction Closing and Channel Reassignment Public Notice* (“*CCRPN*”, DA 17-317, released April 13, 2017). WGBH-TV was assigned to make the transition to Channel 5 at phase 4 and commenced operation on Channel 5 on the phase 4 completion date of August 2, 2019. This statement supports *WEF*’s request for Special Temporary Authority (“*STA*”) to increase WGBH-TV’s effective radiated power (“*ERP*”) on Channel 5.

WGBH-TV is now licensed (file# 0000080062) to operate on Channel 5 at 6.7 kW ERP with a nondirectional antenna at 363 meters height above average terrain (“*HAAT*”). This ERP/*HAAT* combination exceeds the 5.6 kW ERP maximum allowed for the antenna *HAAT* of 363 meters permitted by §73.622(f)(6)(ii), but complies with §73.622(f)(5) where the maximum ERP may be exceeded in order to provide the same geographic coverage area as the largest station in the market. Therefore the licensed operation at 6.7 kW ERP and 363 m *HAAT* represents the maximum facility achievable for WGBH-TV under §73.622 for a low band VHF digital television station in Zone I.

Since transitioning to Channel 5 on the phase 4 completion date, WGBH-TV has received numerous phone calls, emails, and social media contacts regarding reception problems, as described elsewhere in the STA request.

Problems with digital low-band VHF reception experienced by other stations have been widely publicized since the digital transition in 2009. It has been established that indoor reception is difficult for digital low band VHF stations such as WGBH-TV due to the longer wavelength signal's inability to readily pass through buildings (the windows are smaller than the wavelength size), the ineffectiveness of many indoor antennas (many of which were designed to emphasize the shorter wavelengths for UHF reception), and high levels of manmade and environmental noise.¹

WEF was a winning bidder in the incentive auction, which resulted in WGBH-TV's reassignment from UHF Channel 19 to low band VHF Channel 5. In the incentive auction proceeding, the FCC acknowledged that reception of low band VHF channels "is often difficult due to increased signal interference caused by the higher levels of ambient noise from electronic devices operating on or near the low VHF frequency range."² The FCC stated that "we adopt the proposal to afford favorable consideration to post-incentive auction requests for waivers of the VHF power and height limits for winning UHF-to-VHF bidders that may be necessary to resolve coverage problems on their new channels. ... Thus, we will consider such waiver requests on a case-by-case basis after the winning bidder has completed construction of its VHF facilities and determined that its viewers are experiencing reception problems. We will afford such requests favorable consideration and grant them where possible."³

¹ The FCC stated that "our initial assessment that the low VHF channels are less suitable for DTV service because of high levels of atmospheric and man-made noise" (§50); and "We noted that TV operations on the lower VHF channels 2-6 are subject to a number of technical penalties, including higher ambient noise levels due to leaky power lines, vehicle ignition systems, and other impulse noise sources and interference to and from FM radio service." (§82) *Advanced Television Systems and Their Impact upon the Existing Television Broadcast Service*, Sixth Report and Order, MM Docket 87-268, FCC 97-115, released April 21, 1997.

² "Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions", GN Docket 12-268, Report and Order, released June 2, 2014 (R&O), para 369.

³R&O, para 371.

The proposed STA is consistent with the FCC's stated requirements for waiver to utilize an ERP in excess of the normal VHF power and height limit for a band change reassigned station. WGBH-TV's operation on Channel 5 with the maximum compliant ERP/HAAT facility has quickly resulted in significant numbers of viewer reception problem reports.

The proposal would allow WGBH-TV to operate with its licensed antenna at 34 kW ERP to aid reception. The proposed 34 kW ERP is the same as that authorized for several other low band VHF stations⁴ which have been granted waiver of the §73.622 VHF power and height limits. The proposed STA would increase WGBH-TV's power by 7.05 dB over the licensed 6.7 kW ERP operation. The power increase would be accomplished by adding more power amplifiers to the transmitter.

According to the ATSC,⁵ field tests "have shown that the minimum decodable signal levels are well above those planned for." For low band VHF Channel 2, ATSC reports that the required signal strength is at least 12 dB higher than the FCC's specified value of 28 dB μ for service. An IEEE Transactions⁶ report regarding the planning factors concludes that there is a "shortfall of at least ... 10 dB in the low VHF range." Therefore, the 7.05 dB power increase requested herein for WGBH-TV should not be considered as an expansion of signal, but rather to provide better service within its principal community and other areas in the vicinity of Boston. For all practical consideration, any area of expanded coverage contour is not expected to actually receive reliable service for the reasons described above.

The FCC has acknowledged that low band VHF digital stations suffer from the inability to provide service replication on those channels. In ET Docket 10-235, the FCC described in part the challenges faces by low band VHF stations such as WMDE (FCC 10-196 at para. 42-

⁴See WPVI-TV (34 kW ERP, Ch. 6, file# BLCDT-20111019ACJ, Facility ID 8616, Philadelphia PA), WDPN-TV (34 kW ERP Ch. 2, file# 0000074950, Facility ID 1283, Wilmington, DE), and WACP (34 kW ERP, file# 0000035741, Facility ID 189358, Atlantic City, NJ).

⁵"Performance Assessment of the ATSC Transmission System, Equipment and Future Directions" Advanced Television Systems Committee (ATSC), April 12, 2001 Revision 1.0.

⁶"*Planning Factors for Fixed and Portable DTTV Reception*" Oded Bendov, Yiyang Wu, Charles W. Rhodes, and John F.X. Browne," IEEE Transactions of Broadcasting, Vol. 50, No. 3, September 2004.

45)⁷ and sought comments on increased maximum power limits for VHF stations to help overcome reception problems. The FCC's June 23, 2010 "Broadcast Engineering Forum"⁸ discussed the practical factors related to a 20 dB power increase for low band VHF stations. The amount of power increase (20 dB) was not an issue or in dispute during the forum, rather the forum addressed the practical issues in implementing a 20 dB power increase to aid low band VHF reception. In the forum, it was clear that a substantial power increase would be needed to make low band VHF stations viable.

Figure 1 supplies a map that demonstrates compliance with §73.625(a)(1) regarding coverage of the entire principal community. Interference study per FCC OET Bulletin 69⁹ shows that the proposal complies with the 0.5 percent limit of new interference caused to pertinent nearby post-auction full service and Class A television stations and reassignments as required by §73.616. The interference study output report is provided as Table 1, showing that no interference to any other relevant station is predicted.

Regarding RF exposure, calculations per FCC OET Bulletin Number 65 (considering 30 percent antenna relative field in downward elevations) show that the signal density near the tower at two meters above ground level attributable to the proposed facility is $1.6 \mu\text{W}/\text{cm}^2$, which is 0.8 percent of the general population/uncontrolled maximum permitted exposure limit. This is below the five percent threshold limit described in §1.1307(b) regarding sites with multiple emitters, categorically excluding the applicant from responsibility for taking any corrective action in the areas where the proposal's contribution is less than five percent. The applicant will coordinate exposure procedures with all pertinent stations and will reduce power

⁷"*Innovation in the Broadcast Television Bands: Allocations, Channel Sharing and Improvements to VHF*," Notice of Proposed Rulemaking, ET Docket 10-235, FCC 10-196, released November 30, 2010.

⁸"*FCC Announces June 25 Broadcast Engineering Forum*," News Release, June 9, 2010.

⁹FCC Office of Engineering and Technology Bulletin number 69, *Longley-Rice Methodology for Evaluating TV Coverage and Interference*, February 6, 2004 ("OET-69"). This analysis employed the FCC's current "TVStudy" software with the default application processing template settings, 2 km cell size, and 1 km terrain profile increment. Comparisons of various results of this computer program (run on a Mac processor) to the FCC's implementation of TVStudy show excellent correlation.

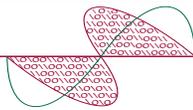
or cease operation as necessary to protect persons having access to the site, tower, or antenna from RF electromagnetic field exposure in excess of FCC guidelines.

List of Attachments

Figure 1 Proposed STA Coverage Contours
Table 1 TVStudy Analysis of Proposal

Chesapeake RF Consultants, LLC

Joseph M. Davis, P.E. September 4, 2019
207 Old Dominion Road Yorktown, VA 23692 703-650-9600



Chesapeake RF Consultants, LLC
 Radiofrequency Consulting Engineers
 Digital Television and Radio

Figure 1
Proposed STA Coverage Contours
WGBH-TV Boston, MA
Facility ID 72099
Ch. 5 34 kW 363 m

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September, 2019

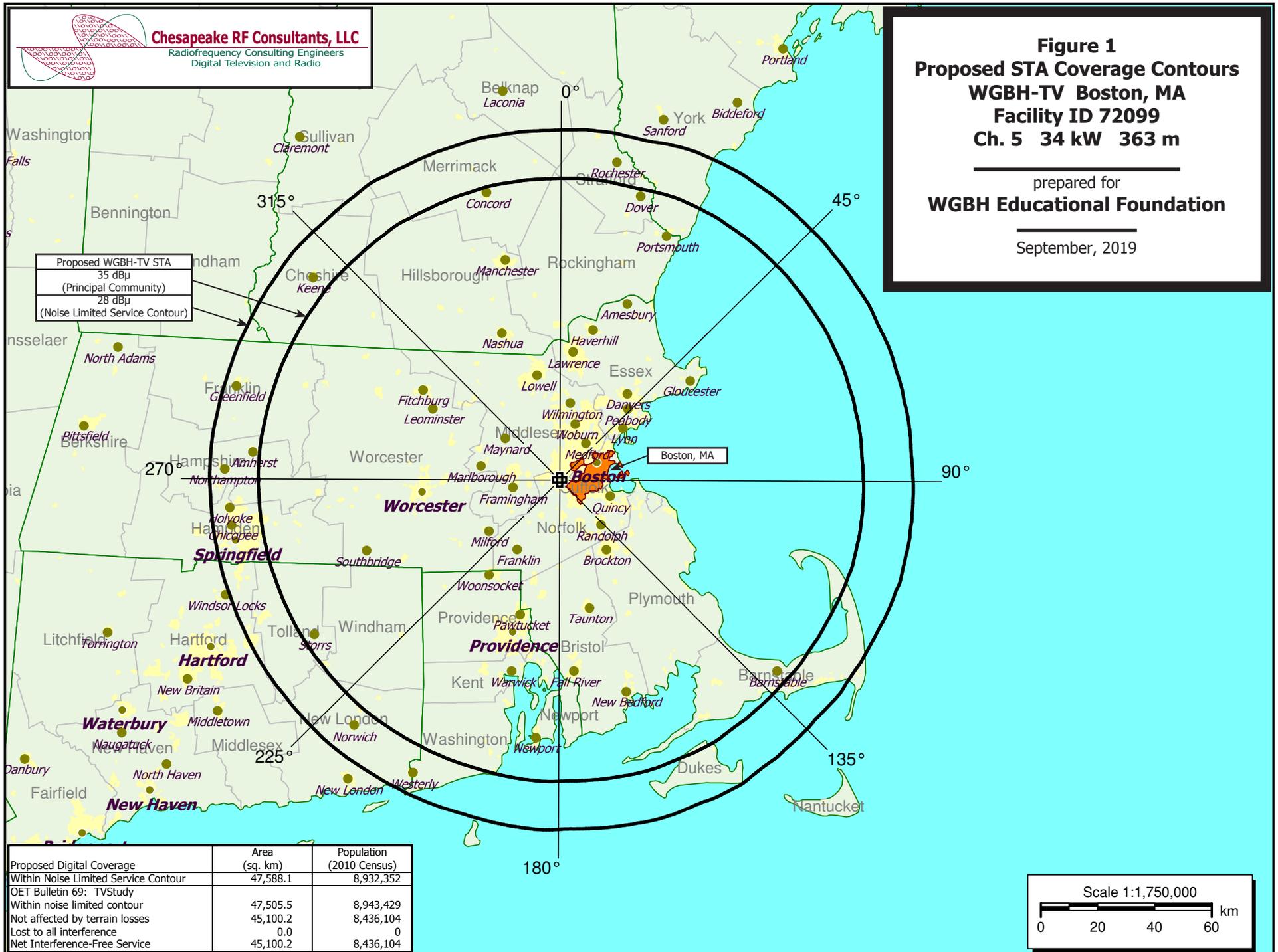


Table 1 WGBH-TV TVStudy Analysis of Proposal
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tvstudy v2.2.5 (4uoc83)
 Database: localhost, Study: WGBH-TV 34kW_, Model: Longley-Rice
 Start: 2019.09.04 09:07:57

Study created: 2019.09.04 09:07:57

Study build station data: LMS TV 2019-09-04

Proposal: WGBH-TV D5 DT APP BOSTON, MA
 File number: WGBH-TV 34kW
 Facility ID: 72099
 Station data: User record
 Record ID: 2846
 Country: U.S.
 Zone: I

Search options:
 Baseline record excluded if station has CP

Stations potentially affected by proposal:

IX	Call	Chan	Svc	Status	City, State	File Number	Distance
No	WRGB	D6	DT	LIC	SCHENECTADY, NY	BMLCDT20110816AAF	231.7 km
No	WRGB	D6	DT	APP	SCHENECTADY, NY	BLANK0000035659	231.7

No non-directional AM stations found within 0.8 km

Directional AM stations within 3.2 km:
 WUNR 1600 L DA1 D BROOKLINE, MA BMML20090211ADN
 WUNR 1600 L DA1 N BROOKLINE, MA BMML20090211ADN
 WXKS 1200 L DA2 D NEWTON, MA BMML20110217ADC
 WXKS 1200 L DA2 N NEWTON, MA BMML20110217ADC
 WRCA 1330 L DA2 D WATERTOWN, MA BMML20090202CEX
 WRCA 1330 L DA2 N WATERTOWN, MA BMML20090202CEX

Record parameters as studied:

Channel: D5
 Latitude: 42 18 10.70 N (NAD83)
 Longitude: 71 13 4.90 W
 Height AMSL: 406.3 m
 HAAT: 362.7 m
 Peak ERP: 34.0 kW
 Antenna: Omnidirectional
 Elev Pattn: Generic
 Elec Tilt: 1.00

28.0 dBu contour:

Azimuth	ERP	HAAT	Distance
0.0 deg	34.0 kW	358.6 m	122.7 km
45.0	34.0	383.3	124.3
90.0	34.0	376.0	123.7
135.0	34.0	362.5	122.9
180.0	34.0	351.3	122.3
225.0	34.0	354.3	122.5
270.0	34.0	357.7	122.6
315.0	34.0	358.2	122.7

ERP exceeds maximum
 ERP: 34.0 kW ERP maximum: 5.61 kW

**Proposal 13.00 dBu contour crosses Canadian border, coordination required
 Distance to Canadian border: 302.1 km

Distance to Mexican border: 2960.7 km

Conditions at FCC monitoring station: Belfast ME
 Bearing: 35.2 degrees Distance: 294.0 km

Proposal is not within the West Virginia quiet zone area

Conditions at Table Mountain receiving zone:
 Bearing: 276.7 degrees Distance: 2833.9 km

Table 1 WGBH-TV TVStudy Analysis of Proposal
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Study cell size: 2.00 km
 Profile point spacing: 1.00 km

Maximum new IX to full-service and Class A: 0.50%
 Maximum new IX to LPTV: 2.00%

 Interference to proposal scenario 1

	Call	Chan	Svc	Status	City, State	File Number	Distance
Desired:	WGBH-TV	D5	DT	APP	BOSTON, MA	WGBH-TV 34kW	

	Service area	Terrain-limited	IX-free	Percent IX
47505.5	8,943,429	45100.2	8,436,104	45100.2 8,436,104 0.00 0.00