

GTech Surveys Limited

Television and Radio Reception Impact Assessment

Station Hill, Reading

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GTech Surveys Limited

GTech Surveys Limited is a Midlands based broadcast and telecommunications consultancy conducting projects throughout the entire UK. We undertake mobile phone network, television and radio reception surveys (pre- and post-construction signal surveys), conduct broadcast interference and reception investigations, and support telecommunications planning work for wind energy developers, construction companies, architects, broadcasters and Local Planning Authorities.

In addition to radio interference modelling services and television reception surveys, we produce EIA and ES Telecommunications Chapters (also known as an 'Electronic Interference Chapter'); satisfying the requirements of Part 5, Regulation 18 (Parts 5a and 5b) of The Town and Country Planning EIA Regulations 2017. We peer review ES and EIA work, liaising with telecommunications providers (Arqiva, BT etc.) and advise developers with respect to associated Section 106 (Town and Country Planning Act 1990) and Section 75 (Town and Country Planning (Scotland) Act 1997) agreements.

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Executive Summary

A baseline (pre-construction) signal survey and reception impact assessments have been undertaken to determine the potential effects on the local reception of television and radio broadcast services from the proposed Station Hill development, Plots E & F, and to accompany applications for Reserved Matters Approval. Planning condition (12), associated with the scheme states;

- (a) Concurrently with the submission of Reserved Matters for any buildings, a report demonstrating that those buildings will not cause undue interference to television and radio (and other broadcasting services) reception shall be submitted to and approved in writing by the Local Planning Authority.*
- (b) If such a scheme does indicate undue interference, the report shall also set out the mitigation measures required.*
- (c) The development of the relevant Plot(s) shall thereafter be carried out and retained in accordance with the approved mitigation measures save to the extent that the Local Planning Authority approves any variation(s) to the approved details.*

The report is specifically prepared to discharge Condition 12 of the Outline Planning Permissions for Station Hill in respect of Plot E and Plot F, and to detail the baseline television signal reception data to assist with any further studies. Accordingly, impacts to the reception of VHF(FM) radio, analogue terrestrial television, digital terrestrial television (Freeview) and digital satellite television services (such as Freesat and Sky), have been assessed.

Analogue Television

Analogue television services were switched off throughout the region during 2012, so no impacts can now occur to the reception of analogue services.

Digital Terrestrial Television (Freeview)

Due to existing robust coverage and the lack of viewers in any theoretical signal shadow zone, the proposed development is unlikely to cause any interference to the reception of digital terrestrial television services such as Freeview.

Digital Satellite Television (Freesat / Sky)

Due to the lack of viewers in any theoretical signal shadow zones, the proposed development is unlikely to have any adverse effect on the reception of digital satellite television services such as Sky and Freesat.

VHF(FM) Radio

The proposed development is unlikely to adversely impact the reception of VHF(FM) radio broadcasts due to the existing good coverage in the Survey Area and the technology used to encode and decode radio signals.

Overall, the proposed development is expected to have a neutral effect on the reception of television or radio services. No mitigation measures are required because no interference is thought to exist. This report can be used to discharge any condition on the same basis as that for Planning Condition 12 (a) set out earlier.

Reading Borough Council (RBC) have previously discharged a similar condition for the wider Station Hill development, which includes Plot F (ref. 151548), and that this report confirms the conclusions of that previous assessment.

This study was undertaken in September 2020 to investigate whether the proposed development could cause interference to local television and radio broadcast reception. The report also details the baseline reception conditions for future reference.

1 - Introduction

This report outlines the findings of a comprehensive study and pre-construction signal reception survey to determine the viewing preference of residents located around the proposed Station Hill development in Reading and identifies what effects the proposed development may have on the reception of television and radio broadcast services.

A desktop study was first undertaken, based on broadcast transmission information, plans of the proposed development and maps of the area. The relevant TV signal survey area for the proposed development was identified and a site visit was then subsequently conducted to establish the baseline television and radio reception conditions. Modelling techniques and field assessments of viewers' choice of television transmitter were then used to predict the potential effects upon television broadcast reception in the area. The impacts from the proposed development are consequently analysed, and together with various mitigation options, conclusions are drawn on the overall effects of the proposed development on television and radio broadcast service reception for local residents.

The effects on VHF (FM) radio, analogue terrestrial television, digital terrestrial television and digital satellite television service reception are discussed. The report also details the baseline reception conditions for future reference. Figure 1 shows the location of the proposed development.

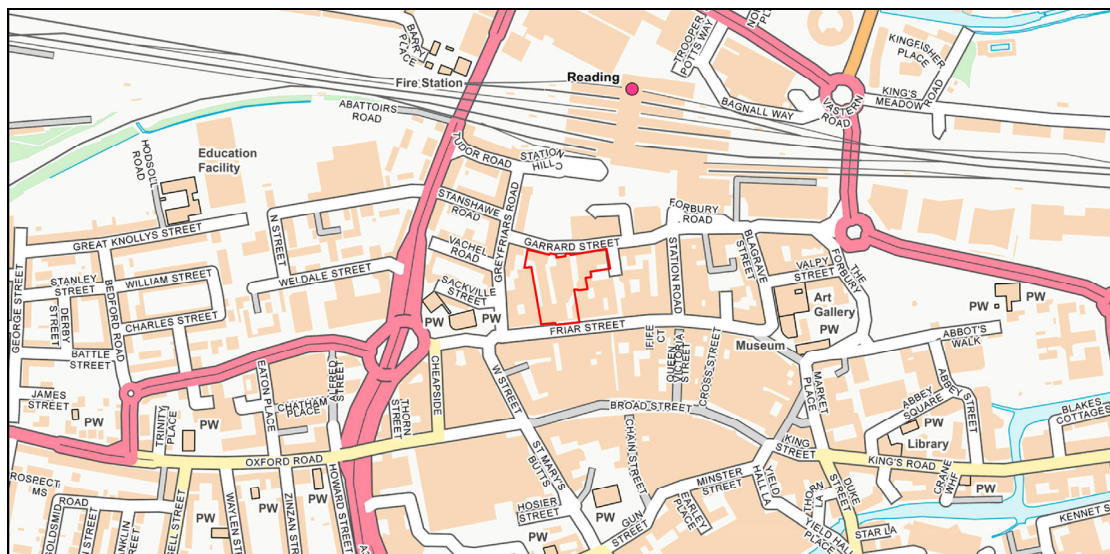


Figure 1 - The Application Boundary of the Proposed Development

This report follows the following structure:

Chapter 1 introduces the work

Chapter 2 discusses the different forms of structure generated television and radio interference and how these can impact the reception of different television and radio broadcast platforms

Chapter 3 describes the available television and radio services in the survey area

Chapter 4 describes the pre-construction television and radio reception conditions around the Site

Chapter 5 describes the predicted impacts of the Proposed Development upon television and radio broadcast reception before any mitigation measures are applied

Chapter 6 describes any suitable mitigation measures for any affected TV viewer or radio listener

Chapter 7 presents the conclusion

2 - Television and Radio Interference Mechanisms

Terrestrial Television Services

Any structure will produce two zones of potential disruption to television reception. One zone is where the development creates a 'shadow' (affects all television broadcast platforms) and the other where it gives rise to a 'reflection'. At the frequencies used for broadcasting, the processes of creating a 'shadow' or a 'reflection' are somewhat more complicated than with visible light but thinking of the problem in these terms is still a helpful way of approaching the matter.

Signal 'Shadowing' Effects

In the area behind the structure, the television transmitter is effectively screened from the viewer and the strength of the signal is reduced - Figures 2 and 3.

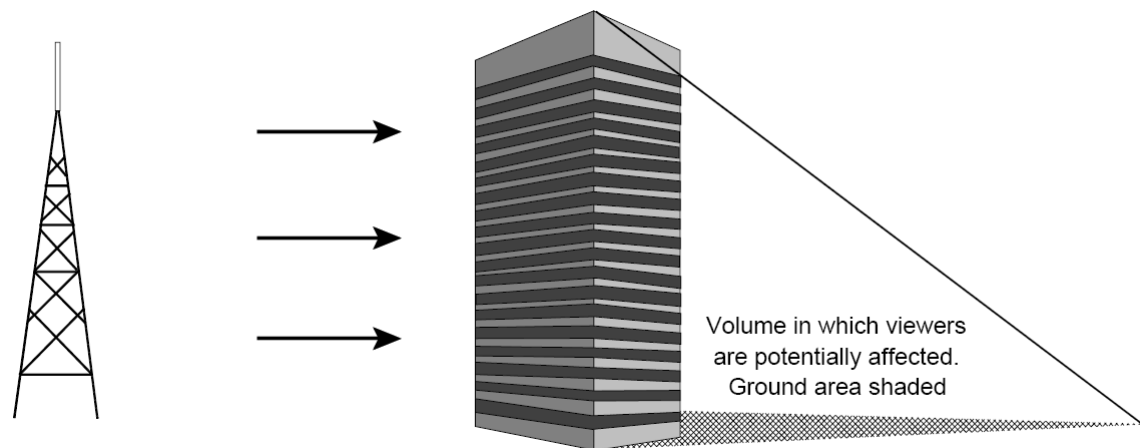


Figure 2 - Affected area in the 'shadow' zone behind the structure

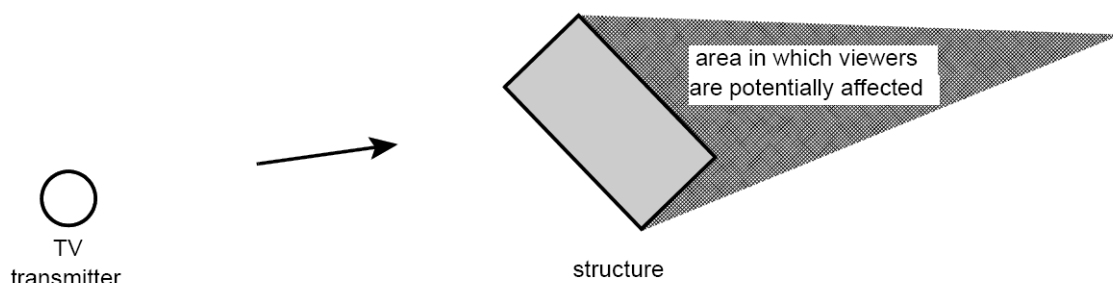


Figure 3 - Plan view of the 'shadow' zone

Television signals do not create such a 'hard' shadow as visible light, and for the purposes of explanation, a 'shadow' zone must be considered which is divided into three sub-zones.

i. Within a few tens of metres from a solid structure, over the region where optical view of the transmitter is lost, the reduction in signal strength is critically dependent on the specific design and composition of the structure. For most brick and concrete buildings, the reduction is severe and, in some cases, almost total.

ii. Further away from the structure (e.g. beyond 50 metres, but this varies depending on its size) the limit of the 'shadow' zone and signal reduction are determined by diffraction at the edges of the structure and reflection off surrounding structures. The simple condition of whether or not a location has an optical view of the transmitter is not enough to classify the potential interference zone adequately. In general, the effect is that the signal appears to bend around the sides of the structure; the shadow zone reduces in size and the signal strength is reduced by much less than simple ray optics would suggest.

iii. Even further away from the structure (e.g. 250m) complex multiple reflections and diffraction, caused by structures in the locality, may result in the 'shadow' zone becoming almost non-existent, against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal as presented to the television receiver.

Signal 'Reflection' Effects

The second zone of potential interference is produced by 'reflection' or 'scattering' of the incident signal, see Figure 4.

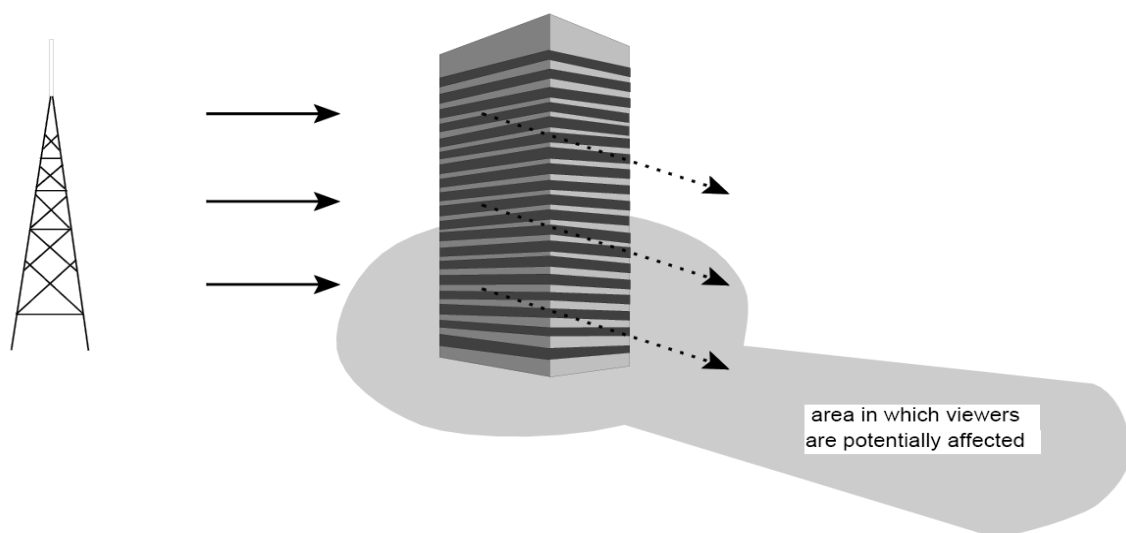


Figure 4 - Affected areas in the 'reflected' zone of the structure

Consider Figure 5, the direct signal travels a distance P1 to the viewer, whilst the signal reflected from the structure travels slightly further, distance (P2 + P3). Although travelling at the speed of light, the different path lengths can mean that one signal arrives with a significant delay relative to the other. This results in a degradation in signal quality.

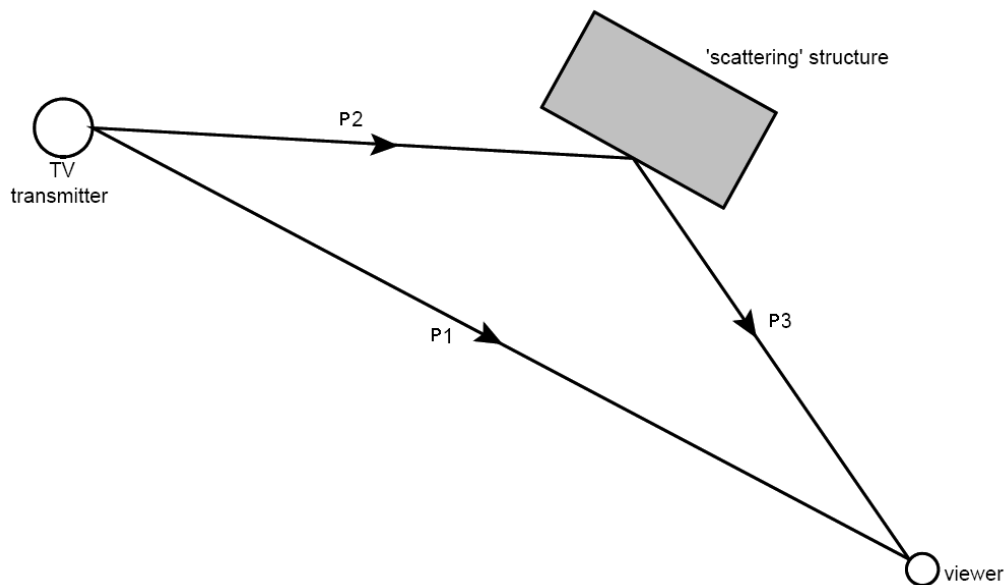


Figure 5 - Direct and Indirect Signal Paths

To avoid interference, it is necessary to ensure that the ratio of wanted signal along the direct path (P1) to the unwanted signal along indirect paths (P2+P3) is sufficiently high. Domestic TV receiving antennas generally have a significant directional response to incoming signals, which means that the antenna may discriminate against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal, as presented to the television receiver.

Digital Terrestrial Television (DTT) - Freeview

The digital television broadcast platform offers many advantages over older analogue broadcast technologies. Due to the way picture signals are encoded and broadcast, digital television offers a much more resilient platform against interference. The construction of digital signals ensures that they are much more impervious to the effects of interference from indirect secondary reflections, which consequently ensures good quality and coherent data stream integrity at the receiver, resulting in an interference free picture. Disruption to DTT services is normally caused by a poor quality receiving antenna system or locally generated wideband electrical noise. Signal blocking caused by buildings can also degrade received signal quality.

Digital Satellite Television Services - Freesat & Sky

Digital satellite television services are provided by geo-stationary earth orbiting satellites positioned above the equator. To ensure good reception of digital satellite television services, satellite receive antennas (satellite dishes) are normally positioned away from trees and other clutter and are orientated to face the southern (south southeast) skies.

Disruption to digital satellite television services is normally caused by an obstruction on the line of sight from the satellite to the receive antenna e.g. a tall building or tall trees. Adverse weather can also influence reception. In the United Kingdom, Freesat and Sky services come from the 28.2 degrees east ASTRA satellite cluster.

Figure 6 below shows typical clearance distances and obstruction heights for interference free satellite television reception.

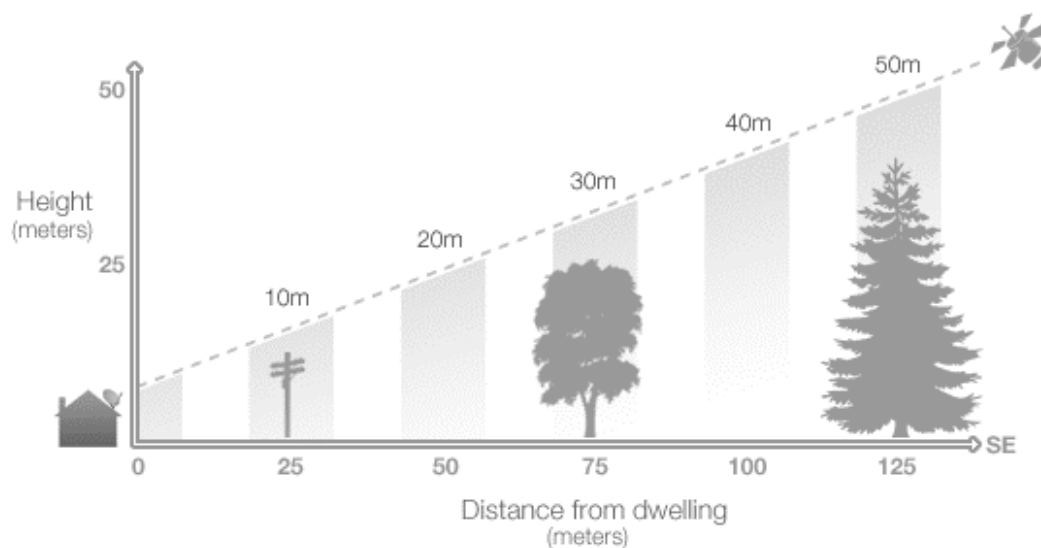


Figure 6 - Typical Clearance Distances and Obstruction Heights for Interference Free Satellite Television Reception

VHF (FM) Radio

VHF (FM) radio services are broadcast from similar structures as terrestrial television services. Many things can cause radio interference, however simple remedies exist that can quickly reduce the effects. Most reception problems on FM radio are caused either by a weak signal or by some kind of interference.

Radio transmission signals will reflect into 'shadow' areas and also reflect from structures to cause 'multi-path' effects. The effect of multiple signals is to create zones of signal cancellation and signal enhancement. This is often demonstrated by the need to carefully position portable radio receivers for good reception or the fluctuation in signal quality whilst listening VHF (FM) broadcasts in a vehicle. Due to the wavelength of the VHF (FM) signal (at 100 MHz, the wavelength is 3 metres) zones of interference can quickly and easily physically move around as the interference is generated from the sum interaction of all incoming signals. Consequently, prediction of VHF (FM) interference is not practically possible due to the complex interaction of reflected signals with wanted signals, the design of radio receivers and radio signal propagation characteristics.

Buildings rarely cause radio interference but there is little that can be done during the design stage to reduce any adverse effects. Due to the lower frequencies in use for radio transmission (with respect to television services) and the methods by which the radio signals are encoded, it is very unlikely that a structure in an already cluttered urban environment will disrupt radio services.

3 - Available Television and Radio Broadcast Services

Terrestrial Television Services

Analogue Terrestrial Television and the Digital Television Switchover

The area around the proposed development is no longer served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in the Meridian television region during 2012.

Digital Terrestrial Television (DTT) - Freeview

The study area is served by DTT services (Meridian TV region) from the Hannington transmitter (grid reference SU 52740 56807), on a bearing of 227° and 27km away.

The transmitter is shown with respect to the proposed development in Figure 7. Technical transmission information for each service at the aforementioned transmitter site is detailed in Table A, found in the Appendix - *Television Transmission Frequencies*.

Up to date technical information regarding the Meridian TV region and Hannington transmitter group switchover, can be found on the Digital UK website - <http://www.digitaluk.co.uk>

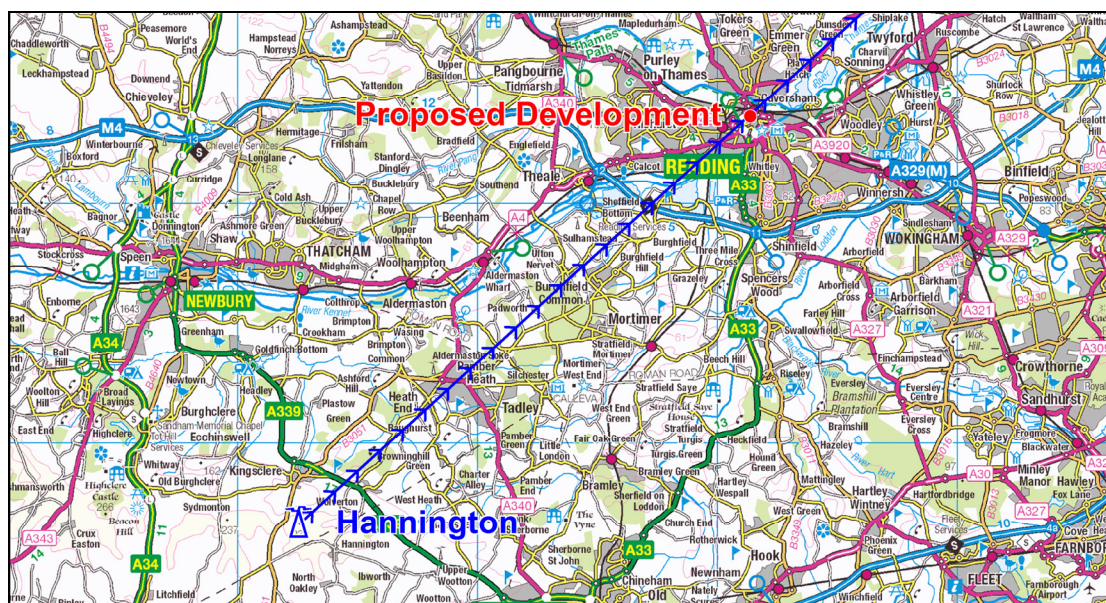


Figure 7 - The Location of the Hannington Transmitter, the Proposed Development and the direction of the incoming DTT signals at the site

Non-Terrestrial Television Services (Digital Satellite Television)

For the reception of the 28.2 degrees east ASTRA satellite cluster (Freesat and Sky services), dish elevations of 25.1 degrees are required at this latitude. Optimal receive dish azimuths are 144.5 degrees with respect to true north.

VHF (FM) Radio

The areas around the proposed development are served by VHF (FM) radio services of;

BBC Radio 1, 2, 3, and 4 from the Guildford transmitter (NGR SU 97500 48600) and Wrotham transmitter (NGR TQ 59500 60400)

Technical transmission information for each radio service at the aforementioned transmitter sites are detailed in Tables B and C in the Appendix. The locations of these transmitters and the development are shown in Figure 8.

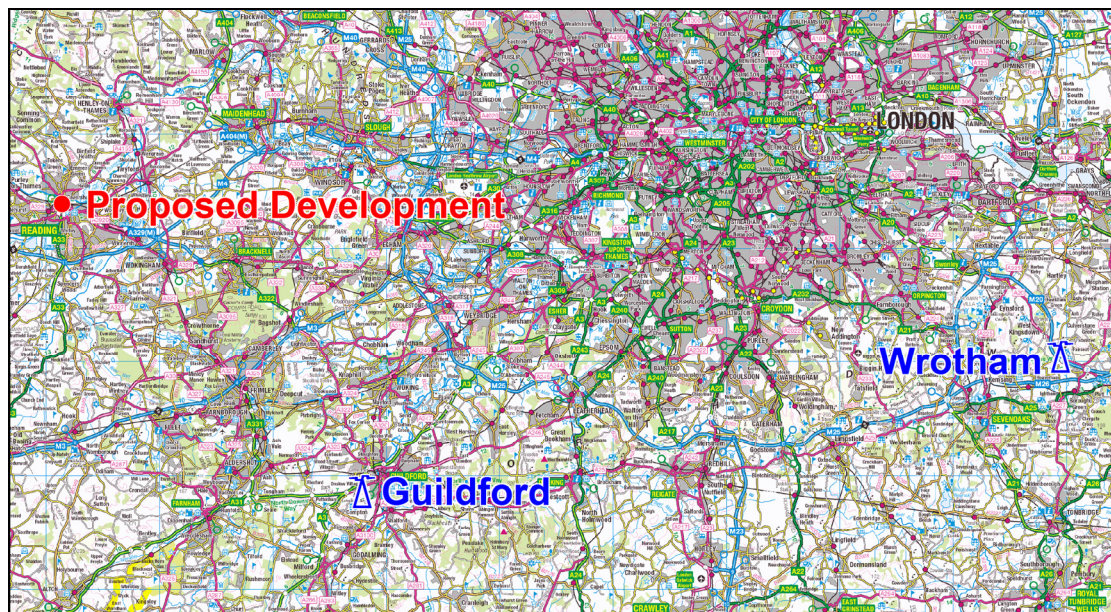


Figure 8 - Locations of the main regional and local VHF (FM) transmitters and the proposed development

4 - Survey Methodology & Description of Baseline

Due to the complex nature of television interference in cluttered urban environments, field investigations must be undertaken in the general area around a development site to fully evaluate any potential effects. In this study, field measurements were undertaken up to three kilometres away from the development site, however, the study mainly focused around the site and areas to the immediate northeast. Additionally, investigations are carried out in all areas where predicted (modelled) interference may occur. These are identified in Figure 9, and the measurements are detailed in Tables D and E, found in the Appendix - *Signal Measurements*. In particular, the following data was recorded:

- Field strength and technical signal measurements of DTT transmissions from the serving transmitter
- Viewing preference (choice of television transmitter) of residents in all areas visited
- Field strengths of VHF (FM) radio transmissions from the serving transmitter

VHF (FM) radio field strength measurements were taken with a resonant half wavelength folded dipole antenna at 2 metres AGL, industry standard height for such work.

All television measurements were carried out using a UHF log-periodic receive antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receive height of 10 metres AGL (above ground level), industry standard height for such work.

During the survey, no assessment was made of reception conditions within viewers' homes. Equipment details are detailed in the Appendix - *Survey Equipment*.

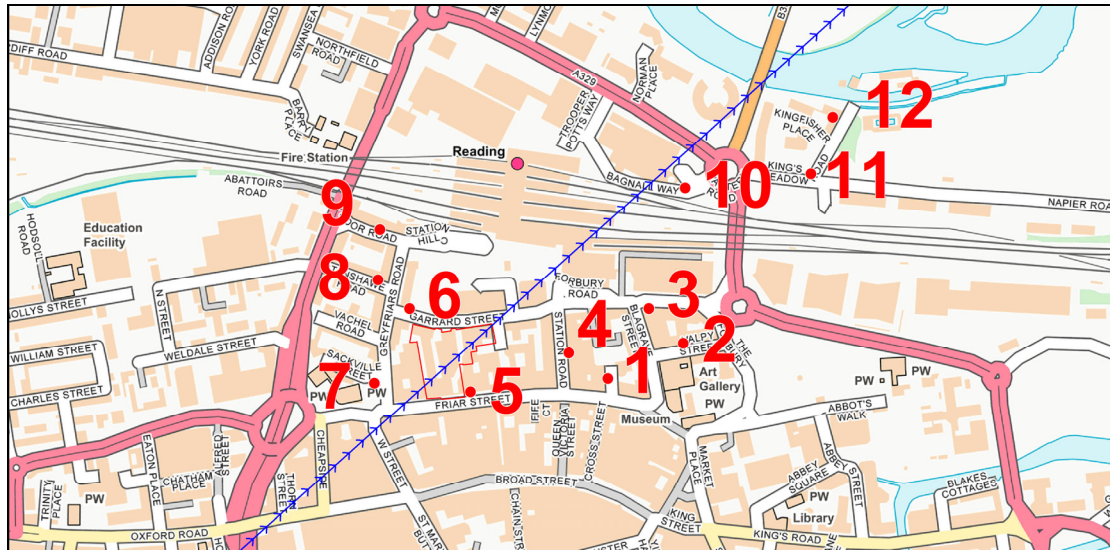


Figure 9 - Surveyed Locations. The blue arrows indicate the direction of the incoming DTT signals from the Hannington transmitter

Survey Results and Observations

In general, building use around the proposed development is a mix of residential and commercial but mainly commercial use. All signal receive antenna systems are mounted on rooftops, ensuring optimal reception conditions. All terrestrial television antennas are directed towards the Hannington transmitter. To the immediate north and northeast of the site, the effects of slight signal attenuation are evident and the existing taller buildings around Station Road, Station Hill and Garrard Street are likely to be the cause. No existing interference has been identified for any satellite television platform.

Analogue Terrestrial Television

Due to the completed Digital Television Switchover, analogue television signals are no longer available in the study area.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Hannington transmitter. At all locations, received signal levels were in excess of recommended minimum amounts and the technical quality of received signals was found to be good¹. DTT services currently provide good coverage and service throughout the study area, however the influence of existing high and tall buildings on reception conditions is evident at some locations.

Digital Satellite Television - Freesat & Sky

During the survey, it was noted that approximately 30% of households in the survey area had satellite signal receiving equipment in place, however these were only noted to be in residential areas, further away from the site.

VHF (FM) Radio

VHF (FM) radio reception conditions were deemed to be good throughout the study area. In-car reception was deemed to be good at all locations. This is due to the proximity of the serving radio transmitters with respect to the study area.

¹ - Signal levels as specified by -

- *The Digital TV Group - Digital TV Group R-Book 5, 2005 Edition*
- *The Digital TV Group - UK Digital TV Receiver Recommendations, Version 1.4, dated 18 June 2008*
- *The UK Collaboration Centre for Innovation in Digital Media Technology - R-Book 6, 2015*

The BBC A and D3&4 multiplexes operate with 64QAM modulation, coding rate 2/3 & 8K FFT. A minimum recommended signal level at the receiver is 50 dB μ V. Minimum recommended MER levels are 23dB.

The SDN, Arqiva A and Arqiva B multiplexes operate with 64QAM modulation, coding rate 3/4 & 8K FFT. A minimum recommended signal level at the receiver is 50 dB μ V. Minimum recommended MER levels are 25dB.

The BBC HD, COM 7 and COM 8 multiplexes operate using the DVB-T2 standard - 256QAM modulation, coding rate 2/3 & 32K FFT. A minimum recommended signal level at the receiver is 50 dB μ V. Minimum recommended MER levels are 26dB.

The Local TV multiplex operates using QPSK modulation, coding rate 3/4 & 8K FFT. A minimum recommended signal level at the receiver is 50 dB μ V.

Technical information regarding the Freeview signal can be found in the Appendix - *An Overview of, BER, CBER, CNR, MER and Signal Level Measurements*

5 - Predicted Impacts and Effects

Methodology

To assess the effects of the proposed development upon television broadcast service reception, the structures were considered to create interference to services in the immediate areas around the site, in signal reflection areas and in the signal shadow zones. These methods, used in conjunction with broadcast transmission information, development plans, maps of the study area and modelling techniques, contribute towards predicting the potential effects upon television broadcast reception in the study area.

The field survey then investigated the areas identified as being at risk of interference and assessed all available services and the transmitter viewing preferences of residents in order to determine if the computed risk is practically valid. The collected data was finally used to determine what actual risks exist and what viable solutions are available to minimise any adverse effects.

Predicted Effects from Modelling

Analogue Terrestrial Television

Due to the completed Digital Television Switchover in the Meridian TV region, analogue television signals are no longer available in the area. Consequently, interference would not be possible to analogue television services.

Digital Terrestrial Television - Freeview

Widespread interference is not expected to occur due to the existing good coverage in the study area. Whilst the addition of several tall buildings will alter reception conditions, the dominating factor of the existing tall structures on reception will not change. New buildings and structures will change the reception environment, but due to the orientation of incoming signals and the lack of sensitive receptors in any theoretical signals shadow area, DTT / Freeview services are not expected to be impacted by the proposed development.

* - Modelling parameters assume that all installed antenna systems are mounted at least 10m AGL and installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and substandard installations will be more prone to the effects of interference from external sources.

Digital Satellite Television - Freesat and Sky

Tall structures, trees and buildings can disrupt digital satellite television reception by causing obstructions on the line of sight to the signal receive dish from the serving satellite. This is discussed further in Chapter 2.

Using the mathematical tangent function and based on the height of the proposed tallest element of the scheme and the angle and orientation of the incoming satellite signals, theoretical signal shadow zones for the 28.2E ASTRA satellite cluster are up to 98m to the immediate north-northwest from the base of the tallest part of the proposed development. This shadow zone extends in a northwesterly direction (324.5 degrees with respect to north).

Predicted Effects Considering Survey Findings

The predicted effects are discussed below and summarised in Table 1.

Analogue Terrestrial Television

Now that Digital Television Switchover has occurred in the region, analogue television signals are no longer available in the area. Consequently, no interference is possible to the reception of analogue television services.

Digital Terrestrial Television - Freeview

Due to the existing good coverage, the lack of sensitive receptors in any theoretical impact area and more dominating effect of the existing buildings on reception conditions, the proposed development is unlikely to adversely affect the reception of DTT services.

Digital Satellite Television - Freesat & Sky

The theoretical signal shadow zone has been calculated as being within 98m from the base of the tallest element of the proposed development in a north-northwesterly direction. As there are no low-level mounted satellite dishes located in this area, no interference can occur to the reception of digital satellite television services.

VHF (FM) Radio

The proposed development is not expected to impact the reception of VHF (FM) radio broadcasts.

Broadcast platform	Area(s) of predicted interference	Risk of interference	Mitigation
Analogue TV	Not possible	No	N/A
DTT (Freeview)	None identified primarily due to the existing good coverage and dominance of other existing local tall and wide structures	Unlikely	Not required
Digital Satellite TV (Freesat & Sky)	Within 98m to the immediate north northwest from the base of tallest part of the proposed development	No, because there are no satellite dishes located in this area	Not required
VHF (FM) Radio	None identified	No	N/A

Table 1 - Summary of Predicted Interference

Predicted Effects - Conclusions

Interference to analogue television service reception would not be possible

Interference to DTT service reception is not expected

The proposed development could cause interference to digital satellite reception within 98m to the immediate northwest of the site. However, as there are no dishes located in this theoretical signal shadow area, no interference will occur to digital satellite television reception

The proposed development is not expected to affect VHF(FM) radio reception

6 - Mitigation Measures

As specified in Planning Condition 12 (b);

If such a scheme does indicate undue interference, the report shall also set out the mitigation measures required.

However, as no interference has been predicted to either the reception of radio or terrestrial television services such as Freeview, or digital satellite television services such as Freesat and Sky, no mitigation measures are required to restore reception.

7 - Conclusions

A desktop-based study and baseline reception survey have been performed to assess the possible effects and impacts on the reception of television and radio broadcast services from the proposed Station Hill development in Reading. A planning condition (12), associated with the scheme states;

- (a) Concurrently with the submission of Reserved Matters for any buildings, a report demonstrating that those buildings will not cause undue interference to television and radio (and other broadcasting services) reception shall be submitted to and approved in writing by the Local Planning Authority.*
- (b) If such a scheme does indicate undue interference, the report shall also set out the mitigation measures required.*
- (c) The development of the relevant Plot(s) shall thereafter be carried out and retained in accordance with the approved mitigation measures save to the extent that the Local Planning Authority approves any variation(s) to the approved details.*

The study has focused on the reception of VHF(FM) radio and the three television broadcast platforms that could possibly be impacted by the proposed development - analogue terrestrial television, digital terrestrial television and digital satellite television services.

Analogue Terrestrial Television

Due to the completed Digital Television Switchover, it is now not possible for the proposed development to impact analogue terrestrial television reception, as all analogue television transmissions were switched off throughout the area and the Meridian TV region during 2012.

Digital Terrestrial Television (DTT)

Whilst the proposed development will alter local reception conditions, widespread interference to DTT service reception is not expected. This is due to the existing good coverage noted throughout the survey area and the lack of reception issues caused by the existing tall and wide buildings located around the site. Furthermore, there are no viewers located in any signal shadow areas.

Digital Satellite Television - Freesat & Sky

The proposed development will not affect the reception of digital satellite television services because no viewers are located in any theoretical impact areas.

VHF(FM) Radio

The proposed development is not expected to affect the reception of VHF(FM) radio services.

Overall, it is considered that the proposed development will not cause any reception interference to radio, or any terrestrial or satellite television services. As no interference is expected, no mitigation measures are required. This report can be used to discharge Planning Condition 12.a.

APPENDIX

Television and Radio Transmission Frequencies

Signal Survey Measurements

An Overview of Signal Measurements

Calculation of Received Field Strength

Survey Equipment

References

Mapping Data

Television and Radio Transmission Frequencies

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	45	666.000	50.0
D3&4	Digital 3 & 4	42	642.000	50.0
BBC B - HD	BBC	39	618.000	50.0
SDN	SDN	40	626.000	25.0
Arqiva A	Arqiva	43	650.000	25.0
Arqiva B	Arqiva	46	674.000	25.0
COM7 - HD	Arqiva	55	746.000	27.0

Table A - Hannington Digital Terrestrial Television Services

Public Service Broadcaster (PSB) Digital Multiplexes
Commercial (COM) Digital Multiplexes

* - The nominal channel frequency, Fc (in Megahertz) of the multiplex can be calculated using $F_c = 8n + 306$, where 'n' is the UHF channel number.

** - Digital multiplexes with a "+" or "-" sign operate with a frequency offset making the channel frequency + or - 167 kHz.

Analogue FM Service	Frequency (MHz)
BBC Radio 1	98.9
BBC Radio 2	89.1
BBC Radio 3	91.3
BBC Radio 4	93.5

Table A - Wrotham VHF (FM) Radio Services

Analogue FM Service	Frequency (MHz)
BBC Radio 1	97.7
BBC Radio 2	88.1
BBC Radio 3	90.3
BBC Radio 4	92.5

Table C - Guildford VHF (FM) Radio Services

Information correct at time of writing. Information provided by DigitalUK and Arqiva

Signal Survey Measurements

Measurement Point Number	Channel Frequency Service	45	42	39	40	43	46	55
		666.00	642.00	618.00	626.00	650.00	674.00	746.00
		BBC A	D3&4	BBC B -	SDN	Arqiva A	Arqiva B -	COM7
1	FS	85.8	80.6	80.8	77.3	81.7	88.2	68.9
	CSI	23.7	20.3		29.6	23.4	20.5	
	MER	30.1	30.3		28.8	30.1	30.8	
2	FS	83.0	80.3	78.9	83.0	80.7	85.2	68.0
	CSI	23.4	21.3		23.2	23.3	21.5	
	MER	30.6	29.4		28.2	32.0	31.1	
3	FS	83.5	79.7	83.2	91.0	90.1	92.5	80.3
	CSI	23.3	25.9		20.5	20.6	26.2	
	MER	30.3	31.8		30.0	29.8	31.3	
4	FS	89.1	90.0	87.5	82.4	84.3	95.2	80.2
	CSI	24.5	27.0		26.1	19.8	30.1	
	MER	30.2	28.1		30.4	31.4	29.1	
5	FS	90.0	90.9	79.2	75.5	86.4	76.0	70.2
	CSI	22.6	21.8		21.0	25.2	22.0	
	MER	27.3	30.2		28.3	28.3	30.3	
6	FS	85.5	81.1	87.5	88.3	85.1	82.5	70.3
	CSI	22.3	23.3		24.4	22.1	20.4	
	MER	29.8	28.5		30.6	29.2	31.1	
7	FS	84.9	80.5	79.6	77.4	91.2	87.8	68.2
	CSI	24.0	21.2		29.8	23.8	21.9	
	MER	30.8	31.0		29.3	31.3	31.4	
8	FS	82.4	79.5	80.7	89.5	80.3	84.7	68.0
	CSI	23.7	24.3		23.4	23.9	28.2	
	MER	30.7	30.8		28.4	32.1	31.1	
9	FS	83.0	78.9	83.2	82.0	89.1	86.4	79.2
	CSI	24.5	25.6		21.8	20.3	27.4	
	MER	30.5	32.0		30.3	30.7	31.3	
10	FS	88.8	89.1	86.7	82.2	84.1	95.4	79.7
	CSI	25.7	27.3		25.9	20.5	30.7	
	MER	31.0	28.0		31.3	30.8	28.7	
11	FS	88.3	76.0	79.6	75.0	85.7	68.3	69.1
	CSI	23.7	21.8		17.5	25.6	28.9	
	MER	28.5	30.8		28.6	28.4	30.4	
12	FS	85.9	81.4	86.3	87.4	84.4	81.9	69.6
	CSI	22.2	23.7		24.3	22.0	21.0	
	MER	30.5	29.1		31.0	29.8	31.9	

Table D - Field Strength Measurements of Hannington Digital Television Services

Frequencies listed are in MHz

Field strength (FS) values are indicated in dB μ V/m

CSI Channel Status Information (%)

MER Modulation Error Ratio (dB)

Location	Service	Radio 1	Radio 2	Radio 3	Radio 4
1		62.6	68.5	69.8	54.4
2		64.2	82.4	65.2	65.7
3		54.1	67.5	48.4	59.9
4		61.7	63.0	63.4	68.4
5		64.1	62.7	58.5	72.3
6		62.9	67.6	64.1	66.8
7		62.3	65.5	64.9	63.0
8		63.9	65.3	63.4	58.0
9		64.6	57.2	64.6	63.4
10		60.4	58.0	67.3	62.0
11		60.4	69.3	64.3	57.5
12		66.2	66.8	64.1	63.5

Table E - Field Strength Measurements VHF (FM) Radio Services

Frequencies listed are in MHz

Field strength (FS) values are indicated in dB μ V/m

An Overview of Signal Measurements

The first and easiest parameter to check is signal level (also referred to as amplitude or terminated signal strength). In many cases this gives a good indication of the available decoding margin, or the extent of any shortfall.

At the receiver input, the terminated level of a DTT signal is measured in the usual units of dB μ V (see Table 1, Recommended Terminated Signal Levels) and the relative levels will vary from one transmitter to another. It is helpful to understand that the level of a DTT signal represents the total power of all the carriers in the Coded Orthogonal Frequency Division Multiplexing (COFDM) signal and not the level of each individual COFDM carrier.

	Max Signal Level	Min Signal Level
DTT	70 dB μ V	50 dB μ V (see notes)

Table 1 – Recommended Terminated Signal Levels*

(1) The 50 dB μ V figure applies where the set top box (STB) or integrated digital TV (idTV) is the first item in the radio frequency (RF) distribution chain (this is the normal arrangement and is strongly recommended). A 5dB higher level is necessary to take into account the typical low gains and high noise figures for any satellite receiver or video cassette recorder (VCR), either operating or in standby mode, used ahead of the STB or idTV.

(2) The recommended signal levels in Table 1 are measured at the outlet plate except where a satellite receiver or VCR is used ahead of the STB or idTV, in which case they are measured at the input to the STB or idTV. They assume a minimum C/N (carrier-to-noise ratio) requirement, including a satisfactory margin, of 23dB for 64-QAM rate 2/3.

(3) These levels are recommendations and should be used only as a guide. Individual installations may need more or less signal level in order to achieve an acceptable decoding margin, depending on the particular system configuration.

For satisfactory reception of digital signals, it is important the signals applied to the receiver are within the ranges shown in Table 1.

These maximum and minimum levels define a so-called window of operation for the receiver.

** - Recommended Terminated Signal Levels at the Receiver input*

Source information – “The Digital TV Group - Digital TV Group R Book 2”, 2002 Edition

Common practice dictates that in order to measure the quality of a received DTT signal we have to look at one or more of the following parameters: Bit-Error Rate (BER), Channel BER (CBER), Carrier-to-Noise Ratio (CNR) and Modulation Error Ratio (MER). The Channel State Information (CSI) feature available in DTT measurement equipment is a very valuable tool providing additional insight into the quality of reception in a typical domestic or professional DTT installation.

Using the BER alone is an ill-advised “hit-or-miss” strategy because of the 'cliff-edge effect' characteristic of any digital TV system. A BER reading below the reference quasi error free (QEF) value of 2×10^{-4} might wrongly lead us to conclude that the receiving conditions are satisfactory.

However, the BER provides a very narrow signal measurement range. Even for vanishingly small BER readings, a small drop in the level of received DTT signal can push the DTT receiver over the digital cliff edge beyond the point of system failure. The CBER is closely related to the BER providing a wider signal measurement range. Depending on the type(s) of unknown disturbance(s) affecting our DTT installation (noise, co-channel or adjacent PAL, co-channel DTT, etc.), the CBER corresponding to the reference QEF BER of 2×10^{-4} varies between 4 and 7 in 100 [1]. Unfortunately, the CBER is not a reliable indicator of how far the digital cliff edge is.

DTT engineers need a tool with a wide measurement range that solves the shortcomings of the BER and CBER. This measurement tool should provide some estimate of the noise margin of the DTT installation. A first candidate comes to mind: CNR or, alternatively, its sibling the MER.

The CNR is defined as the ratio of the average RF power of the DTT signal to the power of the noise present in the UHF channel. Similarly, the MER is defined as the ratio of the average power of the DTT signal to the average power of the constellation errors. It can therefore be used to give a more direct indication of decoding margin when, as is often the case, there is co-channel interference as well as noise in the channel. The higher the MER value, the **better** the reception conditions. Our measurement equipment provides a maximum MER measurement value of up to 35 dB.

In situations where there is no multipath propagation so that the channel frequency response remains reasonably flat, CNR and MER are in principle the same thing. In practice, the accuracy of the measured CNR is limited by the noise floor of the measurement equipment and by the presence of other disturbances on adjacent UHF channels. Likewise, both the receiver's noise floor and other issues resulting from its practical implementation degrade the MER estimate.

Channel State Information (CSI)

Some flavour of CSI is used internally by all commercial DTT receivers to achieve the recommended target system performance. The CSI counts the effect of both the noise present in the channel and the shape of the transmission channel itself. In other words, the CSI gives a measure of the reliability of the received DTT signal. We measure the average of the CSI across the UHF channel occupied by the DTT signal. The higher the percentage value of CSI, the **less** reliable DTT reception is.

As explained, the CSI can be used as a means to measure the noise margin in a DTT installation. Let us call CSI_{QEF} the percentage CSI measured at the point where the measurement equipment displays the reference QEF BER. The noise margin in dB is then approximately given by –

$$\text{NM (dB)} = \frac{\text{CSI}_{\text{QEF}} - \text{CSI}}{2.6}$$

This empirical approximation represents a good estimate for NM below 8dB. The CSI alone, on the other hand, has a wider measurement range, providing meaningful results for NM of up to 15dB.

Source information – J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002

Calculation of Received Field Strength

The Field Strength (dB μ V/m) is derived from the Terminated Level (dB μ V) as measured at the input of the Promax measurement receiver in the survey vehicle.

Field Strength (dB μ V/m) = Terminated Level (dB μ V) – Aerial Gain (a) + Dipole Factor (b) + Feeder Loss (c)

where -

Dipole Factor (to matched load)	(b)	$20\text{Log}(\frac{2\pi}{\lambda})$ Where λ = Transmission Wavelength (m)
Feeder Loss	(c)	3 dB
Aerial Gain (dB _{dipole})	(a)	10 dB

Survey Equipment

1 x Promax Prolink 4C Premium – Serial Number PK4COPAB11B / 060419030005 Running firmware version 2.47

1 x Sony Wide screen CRT Reference Receiver KV–16TIU – Serial Number 4014480

1 x Professional Broadcast Wideband Log Periodic 8 element antenna – Amphenol Jaybeam (details below)

All RF cables, interconnects and systems of professional quality and calibrated to determine feeder losses and antenna gains. These are factored into the results, providing accurate descriptions of actual field strength values at 10m AGL for each surveyed location – see *Calculation of Received Field Strength*



Amphenol
JAYBEAM

468-860 MHz

LPU/Rx

V-Pol or H-Pol | Log Periodic | 70° | 7.9 dBd

A Log Periodic antenna designed for UHF Broadcast, TETRA and Cellular communications applications. This antenna is often used in a stacked array to form a rugged, high power, extended range antenna. Produced to the highest quality standards, these robust antenna designs will insure reliable operation in harsh environmental conditions.

Replace "x" with desired model number option.

Electrical Characteristics		
Frequency band	468-860 MHz	
Model number options (x)	Model Number LPU/R-N LPU/R-7/16	Connector type N-Female 7/16-DIN Female
Polarization	Vertical or Horizontal	
Horizontal beamwidth	70°	
Gain	7.9 dBd	
Impedance	50Ω	
VSWR	<1.3:1	
Maximum power	250 W	
Connector type	see model number options above	
Lightning protection	DC grounded	
Mechanical Characteristics		
Materials	Aluminium Alloy	
Dimensions (Length x Width)	1210 x 320 mm	47.6 x 12.6 in
Weight without bracket	3.5 kg	7.7 lbs
Mounting Options		
Mounting	Mounting bracket included to fit 38-50 mm dia. pipe.	





Technical Specification for an Amphenol Jaybeam Professional Broadcast Wideband Log Periodic 8-Element Antenna

References

The building information found in Chapter 2 was sourced from the following Ofcom document –

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

Mapping Data

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The UK's terrestrial television and radio networks are highly complex engineering systems and are constantly being modified, re-designed, upgraded and maintained. The reception conditions detailed in this report were those prevailing at the time of the survey in the study area. Engineering work at transmitter sites, weather conditions and the time of the year will influence the quality and coverage of terrestrial services and their susceptibility to interference. Whilst every effort was made to accurately measure and assess the available television and radio transmissions and services at the time of the survey, GTech Surveys Limited cannot assume that any part of the television or radio broadcast network or transmission from any transmitter was operating in required specification or correctly to any design criteria. The signal measurements undertaken during the survey work were used to define the possible impacts to television and radio reception for this project. Although best practice has been applied in understanding the potential impacts, due to the complex nature of the subject, GTech Surveys Limited is not accountable in anyway whatsoever if unpredicted impacts occur at any location anywhere in the study area.

Modelling parameters assume that all installed UHF antenna systems are mounted at least 10m AGL and installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and poor quality installations will be more prone to the effects of interference from external sources and as such, reception conditions to installations with the aforementioned characteristics have not been accounted for in any impact modelling. Consequently, properties with such installations may be prone to interference effects that have not been identified. Such installations are commonly found in camping and caravan parks, on bungalows and properties where it is not possible to attach an antenna to the exterior roof. Antennas mounted in lofts are also more prone to interference effects arising from the signal attenuation caused by roofing materials. Again, reception conditions to properties with the aforementioned antenna installation characteristics have not been accounted for in any impact modelling and as such, properties with these installations may be prone to interference effects that have not been identified.

Digital terrestrial television (Freeview) coverage may vary as a result of engineering works or any frequency changes authorised by Ofcom. We advise that consumers always check future reception predictions (<http://www.digitaluk.co.uk/coveragechecker/>) before buying TV equipment. GTech Surveys Limited, Ofcom and Digital UK are not responsible for household TV reception arrangements.

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