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Baseline Television Signal Survey
&
Television Reception Impact Assessment

Brazennose House

CHANGE HISTORY

Issue	Date	Details of Changes	
1.0	21/07/2017	Working draft	
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Contents Page

Executive Summary

1 - Introduction **7**

2 - The Mechanisms of Interference to Television Broadcast Services **8**

3 - Available Television Broadcast Services in the Study Area **13**

4 - Description of Pre-construction (Baseline) Television Reception Conditions **15**

5 - Predicted Impacts and Effects **19**

6 - Suitable Mitigation Measures **22**

7 - Evaluation of Residual Effects after Mitigation **23**

8 - Conclusions **24**

Appendix **25**

Television Transmission Frequencies

Signal Measurements

Understanding Signal Levels & an Overview of BER, CBER, CNR and MER measurements and definitions in Layman's Terms

The Post Digital Switchover Signal Freeview Signal

Survey Equipment

References

Planning Policies

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GTech Surveys Limited

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

In addition to these broadcast services, we review and prepare ES & EIA Telecommunications Chapters and documents, liaising with telecommunication providers, and advising developers with respect to associated Section 106 (Town and Country Planning Act 1990) and Section 75 (Town and Country Planning Act 1997, Scotland) agreements and other planning conditions. We also verify television transmitter coverage and performance and are actively involved with the current UK Digital Television Upgrade project, working with Digital UK, Ofcom, Arqiva and at800.

GTech Surveys is a Consultant Member of the Confederation of Aerial Industries and the RDI - the digital sectors professional body and trade organisation. More information about the Confederation of Aerial Industries and CAI consultants can be found on their website - www.cai.org.uk. Only professional broadcast engineers undertake our fully insured products and services. For more information about the current projects we are working on and the companies we work with, visit our TV Reception Surveys, Projects & Clients webpage at - www.gtechsurveys.co.uk.

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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 broadcast services from the proposed Brazennose House development in Manchester. Under MCC planning guidance, any development over four storeys requires a TV reception impact assessment. Further guidance can be found in this document; "*Full and Outline Planning Applications Is Your Application Valid?*", MCC, December 2010. The requirement states,

"If the development involves a building of height (over four storeys), a television reception survey will be required. Although the digital switchover has now taken place, a TV reception survey is still required as digital signal can also be affected by tall buildings."

Additionally, national requirements under (The National Planning Policy Framework, March 2012 (Department for Communities and Local Government)) states that;

44. Local planning authorities should not impose a ban on new telecommunications development in certain areas, impose blanket Article 4 directions over a wide area or a wide range of telecommunications development or insist on minimum distances between new telecommunications development and existing development. They should ensure that:

they have evidence to demonstrate that telecommunications infrastructure will not cause significant and irremediable interference with other electrical equipment, air traffic services or instrumentation operated in the national interest; and

they have considered the possibility of the construction of new buildings or other structures interfering with broadcast and telecommunications services.

Condition 25 of Application number: 111805/FO/2016/C1 states;

Studies containing the following with regard to television reception in the area containing the site shall be submitted to and approved in writing by the City Council as local planning authority:

a) Measure the existing television signal reception within the potential impact area, as defined in the submitted Radio and TV Reception Impact Assessment, before development commences. The work shall be undertaken either by an aerial installer registered with the Confederation of Aerial Industries or by a body approved by the Office of Communications, and shall include an assessment of the survey results obtained.

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b) Assess the impact of the development on television signal reception within the potential impact area identified in (a) above within one month of the practical completion of the development and at any other time during the construction of the development if requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the survey carried out in (a) above.

Reason: To provide an indication of the area of television signal reception likely to be affected by the development to provide a basis on which to assess the extent to which the development during construction and once built will affect TV reception and to ensure that the development at least maintains the existing level and quality of TV signal reception, pursuant policies DM1 and SP1 of the Core Strategy.

Subsequently, this report has been produced to assist with the planning application and to provide the baseline data to assist with any further studies. Accordingly, impacts to the reception of analogue terrestrial television, digital terrestrial television (Freeview) and digital satellite television services (such as Freesat and Sky), have been assessed.

Analogue television services were switched off throughout the Manchester area and the Granada TV region during 2009, so no impacts can now occur to the reception of analogue services.

Whilst widespread interference is not expected to the reception of Freeview services due to the favorable lack of dense residential properties in any signal shadow areas, the proposed development may cause some signal attenuation to small areas to the immediate southeast of the site, however this is unlikely due to the only minor changes in massing. In those areas, the attenuating factor of the building may cause a reduction in signals levels and thus a reduction in received signal quality. Should disruption occur, the betterment of receiving antennas should restore the reception of DTT services. DTT is more commonly known as ‘Freeview’.

The use of tower cranes and the Proposed Development itself is likely to cause disruption to the reception of digital satellite television services in areas in the immediate north of the site, within 74.7m. Here, the use of tower cranes and the proposed development could obscure the receive dishes’ views of the southern skies, resulting in interference. If this does occur, the repositioning of the signal receive dishes to locations without an obscured line of sight view to the serving satellites would restore all services. If this were not possible (an unlikely outcome) the use of DTT receiving equipment would offer any affected viewer an alternative source of digital television broadcasts.

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Overall, the findings and conclusions drawn in this study, mirror those of the earlier work undertaken; TV Reception Survey Report by Taylor Bros Installations (Bolton) Ltd dated 10th September 2015, their reference 10209/Rev1. This report provides the pre-construction reception conditions within the study area.

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This report follows the following structure:

Chapter 1 introduces the work

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

Chapter 3 provides a description of available television services in the study area

Chapter 4 provides a description of the pre-construction television reception conditions around the proposed development

Chapter 5 describes the predicted impacts of the proposed development upon television broadcast reception before any mitigation measures are applied

Chapter 6 identifies any suitable mitigation circumstances and measures for any affected property

Chapter 7 contains an evaluation of the residual effects following mitigation

Chapter 8 is the conclusion

This study was undertaken in July 2017 to investigate whether the proposed development could cause interference to local television broadcast reception. The report also details the baseline reception conditions for future reference.

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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 Brazennose House development, and identifies what effects the proposed development may have on the reception of television 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 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 form 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 broadcast service reception for local residents.

The effects on 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.

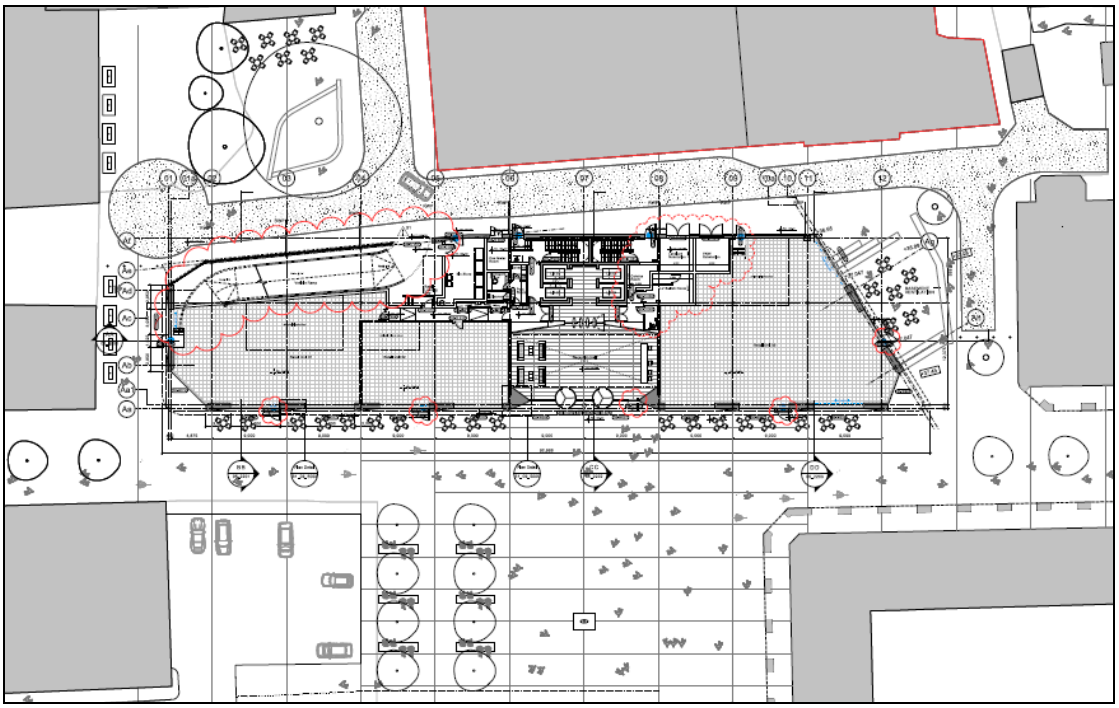

Figure 1 - The Location of the Proposed Development

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2 - The Mechanisms of Interference to Television Broadcast Services

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’ (usually affects terrestrial analogue television only). 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.

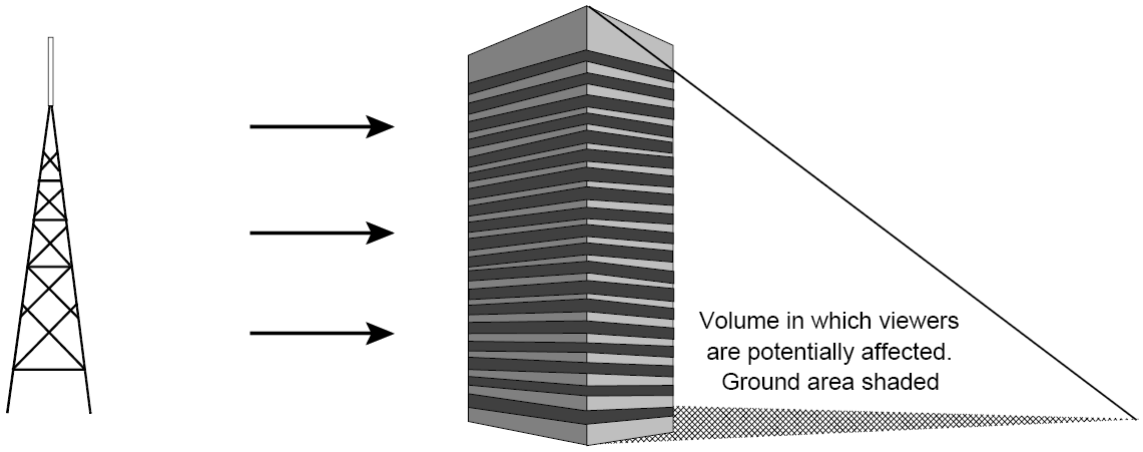

Figure 2 - Affected area in the ‘shadow’ zone behind the structure

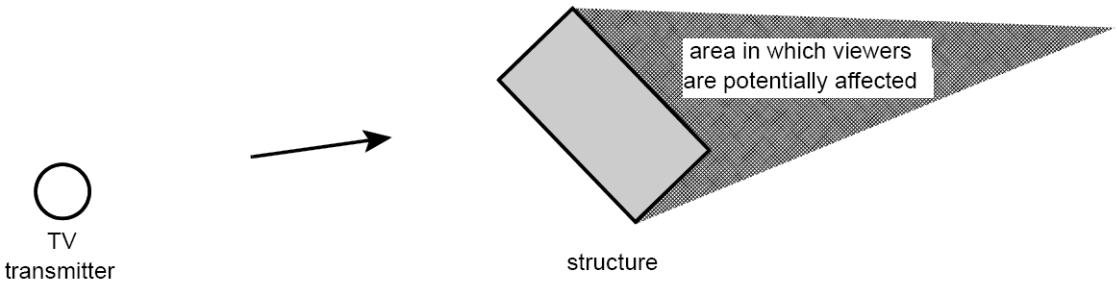

Figure 3 - Plan view of the ‘shadow’ zone

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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 250 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. 5 km) 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. Analogue television reception is more likely to be affected than digital terrestrial reception, which is more robust due to the technical makeup of the digital signal.

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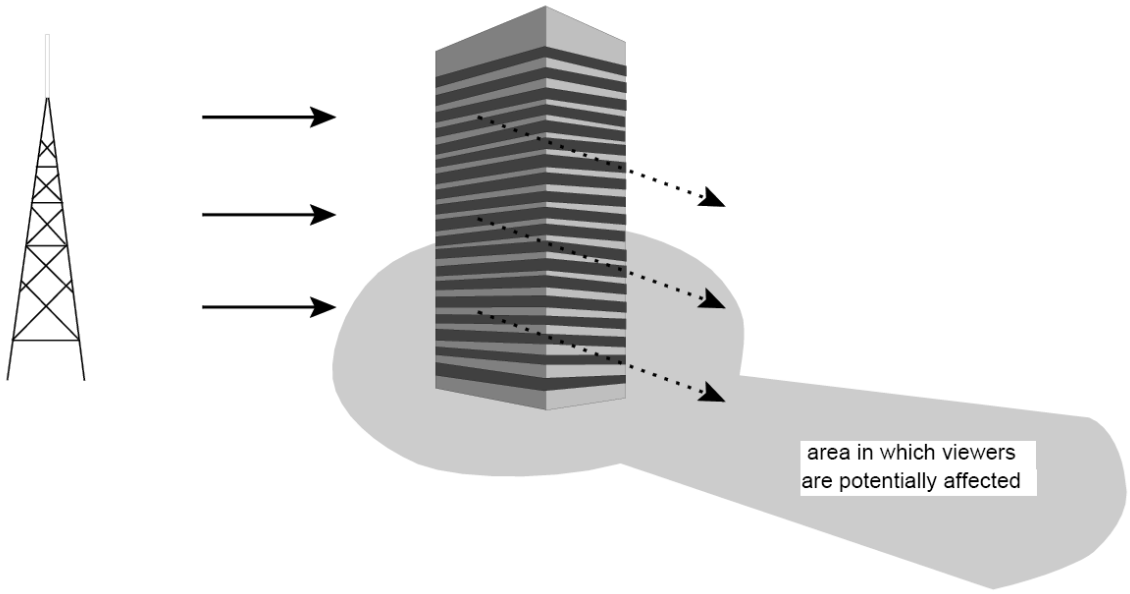

Figure 4 - Affected areas in the ‘reflected’ zone of the structure

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 second image appearing on the viewer’s screen, displaced from the first. This type of interference is known as ‘ghosting’. If the reflecting signal is complex, several ‘ghost’ images can result.

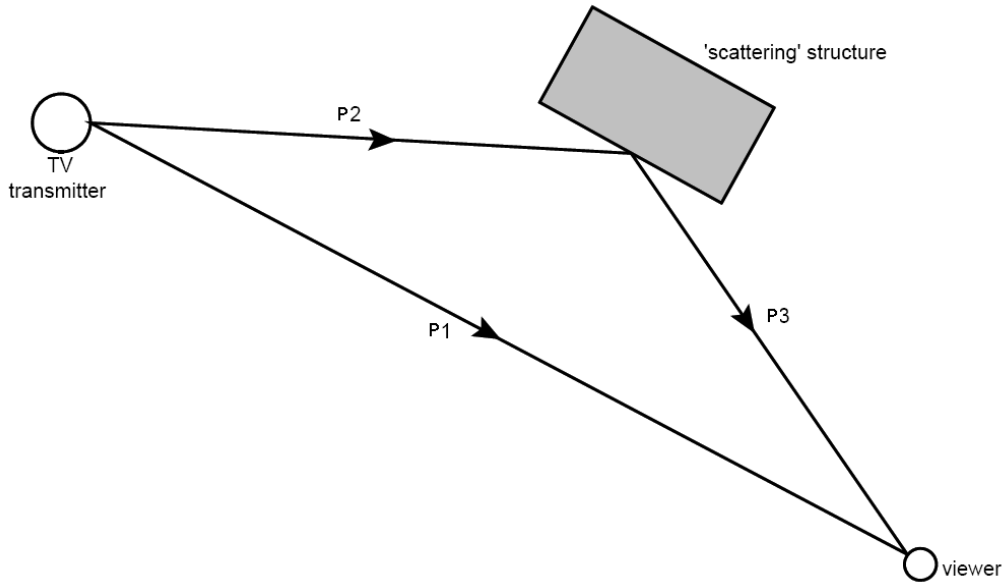

Figure 5 - Direct and Indirect Signal Paths

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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. This is shown in Figure 6.

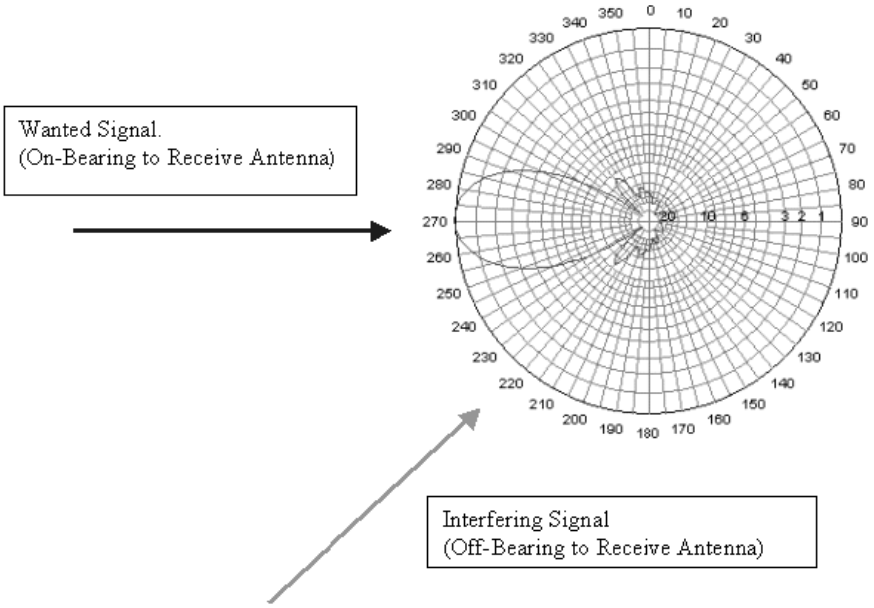

Figure 6 - Typical Domestic Television Receive Antenna Response

Digital Terrestrial Television (DTT) - Freeview

Analogue television is susceptible to many forms of interference. One of the disadvantages analogue systems have is that once the signal has been corrupted, the information contained within the signal is also disrupted and consequently, is evident upon viewer's screens in the form of interference.

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 the types of interference encountered by analogue television broadcast networks. 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. Technical information regarding the Freeview signal can be found in the Appendix - *The Post Digital Switchover Signal Freeview Signal*.

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

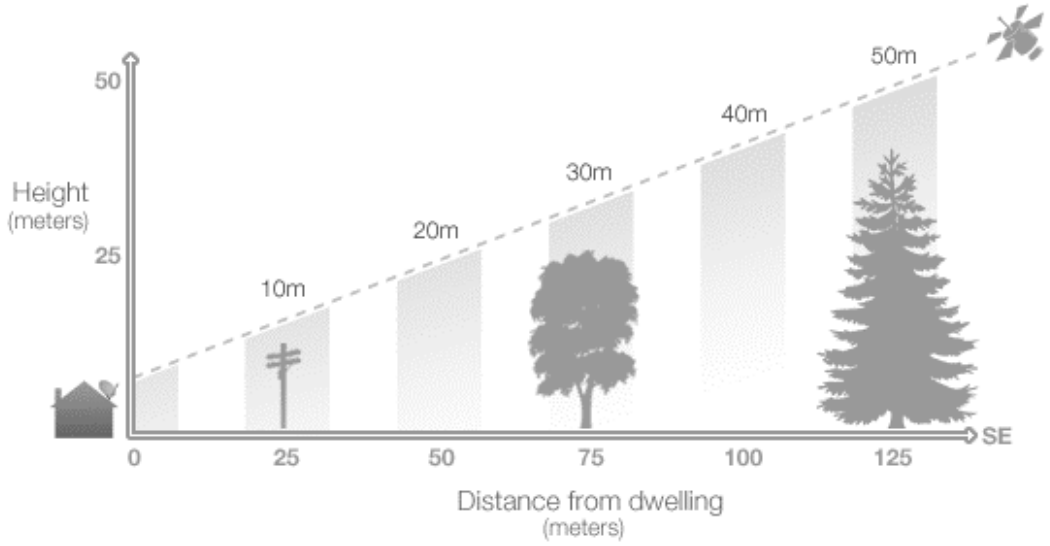

Figure 7 - Typical Clearance Distances and Obstruction Heights for Interference Free Satellite Television Reception

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3 - Available Television 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 Granada television region during 2009. Up to date technical information regarding the Granada TV region and Winter Hill transmitter group switchover, can be found on the Digital UK website -

http://www.digitaluk.co.uk/mytvregion/granada

Digital Terrestrial Television (DTT) - Freeview

The study area is served by DTT services from the Winter Hill transmitter

Transmitter	*TV Region*	*Grid Reference*	*Distance (km)*	*Bearing°*
Winter Hill	Granada	SD 66053 14463	24	312

The Winter Hill transmitter is shown with respect to the proposed development in Figure 8. Technical transmission information for each service at the aforementioned transmitter site is detailed in Table A, found in the Appendix - *Television Transmission Frequencies*.

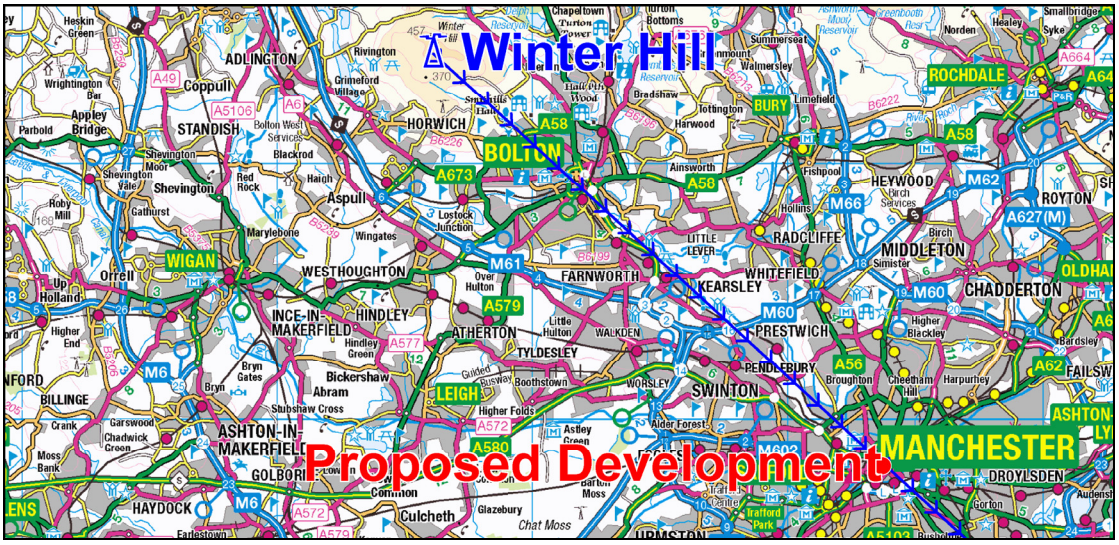

Figure 8 - The Location of the Winter Hill Transmitter, the Proposed Development and the direction of the incoming DTT signals at the site

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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 22.9 degrees are required at this latitude. Optimal receive dish azimuths are 143.8 degrees with respect to true north.

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4 - Description of Baseline (pre-construction) Television Reception Conditions & Survey Method

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 southeast. These locations can be seen in Figure 9 and the measurements are detailed in Table B, found in the Appendix - *Signal Measurements*. Additionally, investigations were carried out in all areas where previous survey work has been undertaken. These are identified in Figure 10. In particular, the following data was recorded:

- Field strength and technical signal measurements of DTT transmissions from the Winter Hill transmitter

- Viewing preference (choice of television transmitter) of residents in all areas visited

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*.

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Survey Results and Observations

In general, building use around the proposed development is mainly for commercial use. All signal receive antenna systems are mounted on rooftops, ensuring optimal reception conditions. All terrestrial television antennas are directed towards the Winter Hill transmitter. 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 Winter Hill transmitter. At most locations, received signal levels were well in excess of recommended minimum amounts and the technical quality of received signals was found to be good[1]. At locations nearer existing tall structures, received signal levels were found to be reduced. Overall, DTT services currently provide good coverage and service throughout the study area.

Digital Satellite Television - Freesat & Sky

During the survey, it was noted that approximately 20% of households in the survey area (of which there are very few) had satellite signal receiving equipment in place.

[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 dBµV. 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 dBµV. 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 dBµV. 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 dBµV.

Technical information regarding the Freeview signal can be found in the Appendix - *Understanding Signal Levels & an Overview of BER, CBER, CNR and MER measurements and definitions in Layman's Terms*

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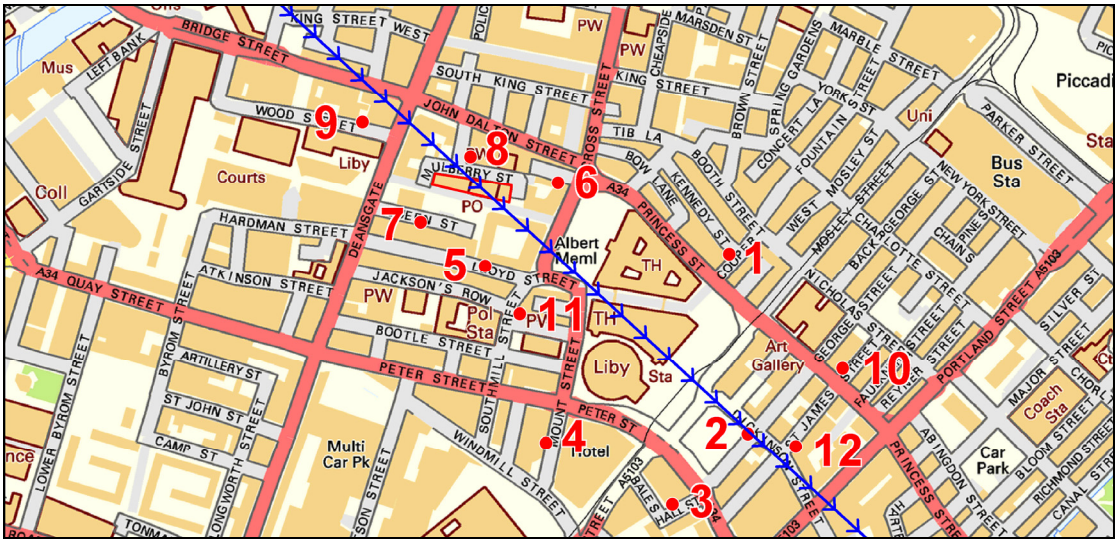

Figure 9 - Surveyed Locations. The blue arrow indicates the direction of the incoming DTT signals from Winter Hill

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Figure 10 – Previously Surveyed Locations.

KEY

Proposed Development

1 Test Point Position showing local television aerial direction

Potential Impact Zone For Satellite TV Reception

Potential Impact Zone For Terrestrial TV Reception

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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 Granada 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

Digital television services are much less affected by signal reflections. However, the proposed development has the potential to cause signal attenuation to properties located to the immediate southeast of the site, in the general area delineated in Figure 10. Whilst it is understood that there are no typical two storey residential properties located in this area, there are a number of commercial properties that do utalise some sort of terrestrial antenna system to receive Freeview transmissions. The additional attenuation cause by the proposed development would not cause widespread disruption, but reduce the reliability of the received signals. Considering the overall change in massing with respect to the proposed development and the existing building, any changes in signal coverage are expected to be insignificant*.

* - 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.

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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 74.7m to the immediate north-northwest from the tallest building's base. This shadow zone extends in a northwesterly direction (324 degrees with respect to north) and is shown in Figure 10. As there are dishes located in this area, potential impacts exist through signal shadowing. Mitigation will be required.

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 and the lack of typical two storey residential properties to the immediate southeast of the site (within any signal shadow zones), the proposed development will not cause widespread disruption to the reception of DTT services. However, signal attenuation may occur in some localised areas to the immediate southeast of the site.

Digital Satellite Television - Freesat & Sky

The areas within 74.7m to the immediate northwest of the site would be in the signal shadow zone created by all aspects of the Proposed Development. During the survey, it was noted that there may be satellite dishes located in these areas. The use of tower cranes during construction could also cause interference to received signals in these locations.

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Broadcast platform	Area(s) of predicted interference	Risk of interference	Antenna protection (Chapter 2)	Alternative good digital reception / mitigation
Analogue TV	None possible	Not possible	N/A	N/A
DTT (Freeview)	Highly localised small areas to the immediate southeast of the site	Possible but unlikely	N/A	Antenna betterment and / or repositioning
Digital Satellite TV (Freesat & Sky)	74.7m to the NNW	Possible but unlikely	N/A	Antenna repositioning

Table 1 - Summary of Predicted Interference

Predicted Effects - Conclusions

- Interference to analogue television service reception would not be possible

- Widespread interference to DTT service reception is not expected. However, the reception of some services may be impaired in a very small area to the immediate southwest of the site. If interference does occur, the betterment of antennas should restore all reception problems. If this is required, it is advised that a registered antenna installer undertakes all required work. This is detailed further in Chapter 6.

- The proposed development and the use of tower cranes could cause reception issues for the reception of satellite services in areas within 74.7m to the immediate north and northwest of the site. Repositioning signal receive antennas (satellite dishes) to locations where views of the south-eastern skies are no longer obscured would restore services for any affected user. If this is required, it is advised that a registered antenna installer undertakes all required work. This is detailed further in Chapter 6. Additionally, the use of DTT receiving equipment would also offer viewers alternative sources of broadcasts, however this is unlikely to be required due to the ease of relocating satellite dishes

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6 - Mitigation Circumstances & Measures

For any affected digital satellite television user to the northwest of the site, relocating satellite dishes to different locations where views to the southeast horizon are no longer obscured would restore the reception of services. Affected digital satellite television viewers could use DTT reception equipment to restore services.

For any affected Freeview television user to the immediate southeast of the site, betterment of receiving antennas should restore the reception of services.

It is recommended that all antenna work (antenna betterment, dish moving, relocating etc.) is undertaken by a registered installer (CAI accredited) and any system components used must be CAI benchmarked. More information regarding the Confederation of Aerial Industries & Registered Digital Installers can be found on the following websites -

The CAI's Website - http://www.cai.org.uk/index.php

The CAI's benchmarking scheme ensures that the cables and antennas have passed minimum requirements for the use of DTT and digital satellite television reception. The use on non-benchmarked products in an antenna system would degrade overall performance and effectiveness of the system, increasing the risk from interference. More information on CAI benchmarked products can be found on the CAI's website -

http://www.cai.org.uk/information/benchmarking-scheme/benchmarking-scheme

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7 - Evaluation of Residual Effects after Mitigation

Once any antenna work is undertaken and the reception of services has been restored, no long-term residual effects exist.

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8 - Conclusions

A desktop study and baseline reception survey have been performed to assess the possible effects and impacts on the reception of television broadcast services from the proposed Brazennose House development. The study has focused on the reception of 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 Granada TV region during 2009.

Digital Terrestrial Television (DTT)

Whilst widespread interference is not expected to the reception of Freeview services due to the favorable lack of dense residential properties in any signal shadow areas, the proposed development may cause some signal attenuation to small areas to the immediate southeast of the site. In those areas, the attenuating factor of the building may cause a reduction in signals levels and thus a reduction in received signal quality. Should disruption occur, the betterment of receiving antennas should restore the reception of DTT services. DTT is more commonly known as ‘Freeview’.

Digital Satellite Television - Freesat & Sky

The use of tower cranes and the Proposed Development itself is likely to cause disruption to the reception of digital satellite television services in areas in the immediate north of the site, within 74.7m. Here, the use of tower cranes and the proposed development could obscure the receive dishes’ views of the southern skies, resulting in interference. If this does occur, the repositioning of the signal receive dishes to locations without an obscured line of sight view to the serving satellites would restore all services. If this were not possible (an unlikely outcome) the use of DTT receiving equipment would offer any affected viewer an alternative source of digital television broadcasts.

Overall, the findings and conclusions drawn in this study, mirror those of the earlier work undertaken; TV Reception Survey Report by Taylor Bros Installations (Bolton) Ltd. dated 10th September 2015, their reference 10209/Rev1.

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APPENDIX

Television Transmission Frequencies

Signal Measurements

Understanding Signal Levels & an Overview of BER, CBER, CNR and MER measurements and definitions in Layman's Terms

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Television Transmission Frequencies

Digital TV Multiplex	Multiplex Operator	UHF Channel Number *	Channel Frequency Fc (MHz) **	Transmitter Power (kW)
BBC A	BBC	50	706.000	100.0
D3&4	Digital 3 & 4	59	778.000	100.0
BBC B - HD	BBC	54-	737.866	100.0
SDN	SDN	58	770.000	100.0
Arqiva A	Arqiva	49	698.000	100.0
Arqiva B	Arqiva	55	746.000	100.0
COM7 - HD	Arqiva	31	554.000	25.7
COM8 - HD	Arqiva	37	602.000	22.6

Table A - Winter Hill 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 Fc = 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.

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

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Signal Measurements

Measurement Point Number	Channel	50	59	54	58	49	55	31	37
	Frequency	706.00	778.00	738.00	770.00	698.00	746.00	554.00	602.00
	Service	BBC A	D3&4	BBC B -	SDN	Arqiva A	Arqiva B -	COM7	COM8
1	FS	78.5	83.4	78.0	73.1	80.9	70.2	63.5	67.6
	CSI	28.1	23.4		25.8	29.7	25.1		
	MER	31.7	28.4		30.3	28.9	28.7		
2	FS	75.5	86.1	81.1	72.8	76.2	83.5	69.9	63.5
	CSI	25.6	31.9		26.4	24.1	25.6		
	MER	28.1	29.3		32.1	32.2	31.2		
3	FS	74.4	81.7	83.8	70.5	84.3	84.9	72.1	67.6
	CSI	20.3	26.2		30.9	27.1	25.9		
	MER	31.3	31.9		30.4	31.4	31.2		
4	FS	72.5	79.4	77.7	80.8	75.1	80.9	61.4	60.0
	CSI	29.4	29.0		26.0	26.3	23.4		
	MER	29.2	30.7		30.5	29.5	32.6		
5	FS	70.3	89.6	77.5	83.1	74.7	76.9	67.4	65.6
	CSI	29.7	33.7		25.1	32.2	27.1		
	MER	31.9	30.2		32.8	31.2	31.9		
6	FS	87.0	74.9	80.1	71.4	77.7	73.7	63.4	65.1
	CSI	26.6	24.9		28.9	27.1	29.5		
	MER	31.2	31.0		31.0	29.8	31.6		
7	FS	78.4	89.8	73.1	75.6	77.9	88.6	62.5	64.0
	CSI	26.0	25.9		28.4	25.1	27.4		
	MER	32.5	29.9		31.4	31.2	29.8		
8	FS	81.8	87.9	85.8	87.6	88.6	79.7	68.8	64.9
	CSI	26.0	30.0		29.4	33.1	31.4		
	MER	32.3	32.7		30.4	30.2	31.8		
9	FS	79.2	83.6	71.6	75.6	81.4	88.4	65.7	55.3
	CSI	24.3	29.8		28.3	26.2	24.9		
	MER	32.1	31.2		30.4	27.0	31.5		
10	FS	81.0	75.4	79.3	80.6	82.4	86.2	67.7	66.0
	CSI	29.4	28.9		29.3	25.0	26.3		
	MER	32.6	32.3		29.9	32.2	31.1		
11	FS	77.9	84.2	82.3	81.8	78.7	65.3	60.9	65.2
	CSI	25.1	28.3		23.2	23.2	25.6		
	MER	32.1	30.9		29.3	30.5	31.2		
12	FS	85.2	69.0	77.3	85.8	81.9	79.9	68.0	59.4
	CSI	24.6	27.3		27.4	26.2	22.5		
	MER	32.1	31.0		31.9	32.1	31.8		

Table B - Field Strength Measurements of Winter Hill Digital Television Services

Key -

Frequencies listed are in MHz
Field strength (FS) values are indicated in dBμV/m
CSI Channel Status Information (%)
MER Modulation Error Ratio (dB)

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Signal Level

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 dBµV (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 dBµV	50 dBµV (see notes)

Table 1 – Recommended Terminated Signal Levels*

(1) The 50 dBµV 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

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An Overview of, BER, CBER, CNR and MER measurements and definitions in Layman's Terms

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.

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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 –

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

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

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Calculation of Received Field Strength

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

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

where -

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

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2nd Generation Terrestrial - The World's Most Advanced Digital Terrestrial TV System

What is DVB-T2?

DVB-T2 is the world's most advanced digital terrestrial transmission (DTT) system, offering more robustness, flexibility and at least 50% more efficiency than any other DTT system. It supports SD, HD, mobile TV, or any combination thereof.

Background

DVB-T is the most widely adopted and deployed DTT standard. Since its publication in 1997, over 70 countries have deployed DVB-T services and 45 more have adopted DVB-T. This well-established standard benefits from massive economies of scale and very low receiver prices.

Due to the European analogue switch-off and increasing scarcity of spectrum, DVB drew up Commercial Requirements for a more spectrum-efficient and updated standard. DVB-T2 easily fulfils these requirements, including increased capacity, robustness and the ability to reuse existing reception antennas. The first version was published in 2009 (EN 302 755) and the latest update in 2011 included the T2-Lite subset for mobile and portable reception (BlueBook A122).

How does it work?

Like its predecessor, DVB-T2 uses OFDM (orthogonal frequency division multiplex) modulation with a large number of sub-carriers delivering a robust signal, and offers a range of different modes, making it a very flexible standard. DVB-T2 uses the same error correction coding as used in DVB-S2 and DVB-C2: LDPC (Low Density Parity Check) coding combined with BCH (Bose-Chaudhuri-Hocquengham) coding, offering a very robust signal. The number of carriers, guard interval sizes and pilot signals can be adjusted, so that the overheads can be optimised for any target transmission channel.

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The key new technologies in DVB-T2 are:

- Multiple Physical Layer Pipes allow separate adjustment of the robustness of each delivered service within a channel to meet the required reception conditions (for example in-door or roof-top antenna). It also allows receivers to save power by decoding only a single service rather than the whole multiplex of services.
- Alamouti coding is a transmitter diversity method that improves coverage in small-scale single-frequency networks.
- Constellation Rotation provides additional robustness for low order constellations.
- Extended interleaving, including bit, cell, time and frequency interleaving.
- Future Extension Frames (FEF) allow the standard to be compatibly enhanced in the future.

As a result, DVB-T2 can offer a much higher data rate than DVB-T OR a much more robust signal. For comparison, the two bottom rows show the maximum data rate at a fixed C/N ratio and the required C/N ratio at a fixed (useful) data rate.

	DVB-T	**DVB-T2** (new / improved options in red)
FEC	Convolutional Coding+Reed Solomon 1/2, 2/3, 3/4, 5/6, 7/8	LDPC + BCH 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, 256QAM
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
FFT Size	2k, 8k	1k, 2k, 4k, 8k, 16k, 32k
Scattered Pilots	8% of total	1%, 2%, 4%, 8% of total
Continual Pilots	2.6% of total	0.35% of total
Bandwidth	6, 7, 8 MHz	1.7, 5, 6, 7, 8, 10 MHz
Typical data rate (UK)	24 Mbit/s	40 Mbit/s
Max. data rate (@20 dB C/N)	29 Mbit/s	47.8 Mbit/s
Required C/N ratio (@22 Mbit/s)	16.7 dB	8.9 dB

Sourced from

http://www.dvb.org/technology/fact_sheets/DVB-T2_Factsheet.pdf

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Survey Equipment

Survey Vehicle

Survey Vehicle 1 aka ‘Mozart’ – Ford Tourneo, Moondust Silver

Field Strength Measurements for Digital and Analogue Television Broadcasts

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 – CSA Radiation Systems International

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.

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

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Planning Polices

National Planning Polices

National Planning Policy Framework, March 2012 (Department for Communities and Local Government)

With regards to telecommunications, the National Planning Policy Framework states as an objective in section 5 that,

5. Supporting high quality communications infrastructure

42. Advanced, high quality communications infrastructure is essential for sustainable economic growth. The development of high-speed broadband technology and other communications networks also plays a vital role in enhancing the provision of local community facilities and services.

43. In preparing Local Plans, local planning authorities should support the expansion of electronic communications networks, including telecommunications and high-speed broadband. They should aim to keep the numbers of radio and telecommunications masts and the sites for such installations to a minimum consistent with the efficient operation of the network. Existing masts, buildings and other structures should be used, unless the need for a new site has been justified. Where new sites are required, equipment should be sympathetically designed and camouflaged where appropriate.

44. Local planning authorities should not impose a ban on new telecommunications development in certain areas, impose blanket Article 4 directions over a wide area or a wide range of telecommunications development or insist on minimum distances between new telecommunications development and existing development. They should ensure that:

they have evidence to demonstrate that telecommunications infrastructure will not cause significant and irremediable interference with other electrical equipment, air traffic services or instrumentation operated in the national interest; and

they have considered the possibility of the construction of new buildings or other structures interfering with broadcast and telecommunications services.

Planning Policy Guidance 8: Telecommunications (23 August 2001) was replaced by this framework.

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The UK's terrestrial television network is a highly complex engineering system and is 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 transmissions and services at the time of the survey, GTech Surveys Limited cannot assume that any part of the television 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 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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