

GTech Surveys Limited

Land to the Rear of 24 Stone Street,
Gravesend, Kent, DA11 0NP

Planning Condition 17

Television and Radio Reception
Impact Assessment

CHANGE HISTORY

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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 desktop-based study and baseline signal survey have been performed to assess the possible effects and impacts on the reception of television and radio broadcast services from the proposed Land to the rear of 24 Stone Street development and identifies what effects the Proposed Development may have on the reception of television and radio broadcast services. This report has been prepared for the applicant to discharge the following planning condition (17) associated with the Proposed Development;

Radio Waves

Prior to the commencement of development an assessment of the impacts of the development on radio, television and satellite reception in the vicinity of the site, including appropriate mitigation if necessary, shall be submitted to and approved, in writing, by the Local Planning Authority. Any identified mitigation works shall be carried out in full prior to first occupation of the phase to which the effects relate.

Reason

In the interest of residential amenity by adequately mitigating any adverse effects of the development on the living conditions of nearby residents and in accordance with Policy CS19 of Gravesham Core Strategy (2014).

Due to the existing excellent coverage and lack of receptors in any theoretical signal shadow zone, the Proposed Development is not expected to impact the reception of digital terrestrial television (DTT) services. DTT is commercially known as Freeview.

The Proposed Development has the ability to cause interference to the reception of digital satellite television services (such as Freesat and Sky) in areas to the immediate northwest of the Site, up to 35m from the base of the proposed building. However, as there are no satellite dishes / receptors located in this area, no interference effects will be realised.

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 unlikely to cause any interference to the reception of any television or radio broadcast platform. As no interference is expected, no mitigation measures are required to restore the optimal reception of any broadcast service. This report provides the existing level and quality of broadcast signal reception in the survey area and can be used to discharge the associated planning condition (17).

1 - Introduction

This report outlines the findings of a reception impact assessment and pre-construction signal reception survey to determine the viewing preference of receptors located around the proposed Land to the rear of 24 Stone Street development and identifies what effects the Proposed Development may have on the reception of television and radio broadcast services. This report has been prepared for the applicant to discharge the following planning condition (17) associated with the Proposed Development;

Radio Waves

Prior to the commencement of development an assessment of the impacts of the development on radio, television and satellite reception in the vicinity of the site, including appropriate mitigation if necessary, shall be submitted to and approved, in writing, by the Local Planning Authority. Any identified mitigation works shall be carried out in full prior to first occupation of the phase to which the effects relate.

Reason

In the interest of residential amenity by adequately mitigating any adverse effects of the development on the living conditions of nearby residents and in accordance with Policy CS19 of Gravesham Core Strategy (2014).

Figure 1 shows the location of the Site.

The Proposed Development comprises of the demolition of outbuildings, excavation of soil to form a lower ground and upper ground floor B1 use, unloading bay and refuse areas with construction floors 1 to 4 providing a total of 3no. one bedroom self-contained flats and 11no. two bedroom self-contained flats and associated external works. Figure 1 shows the location of the application site.



Figure 1 - The Location of the Site

The Assessment

A desktop study was first undertaken, based on broadcast transmission information, plans of the Proposed Development and maps of the area. The relevant TV and radio 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 and radio transmitter were then used to predict the potential effects upon television and radio 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.

This study was undertaken to investigate whether the Proposed Development could cause interference to local television and radio broadcast reception. The effects on VHF (FM) radio, digital terrestrial television and digital satellite television service reception are discussed. The report also details the baseline reception conditions for future reference. 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 - The Mechanisms of Interference to Television and Radio 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'. 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.

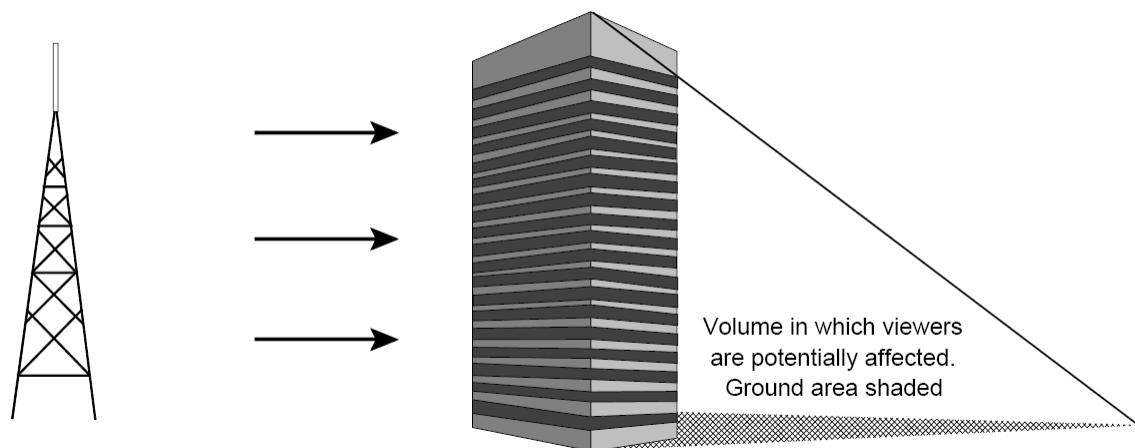


Figure 2 - Affected area in the 'shadow' zone behind the structure

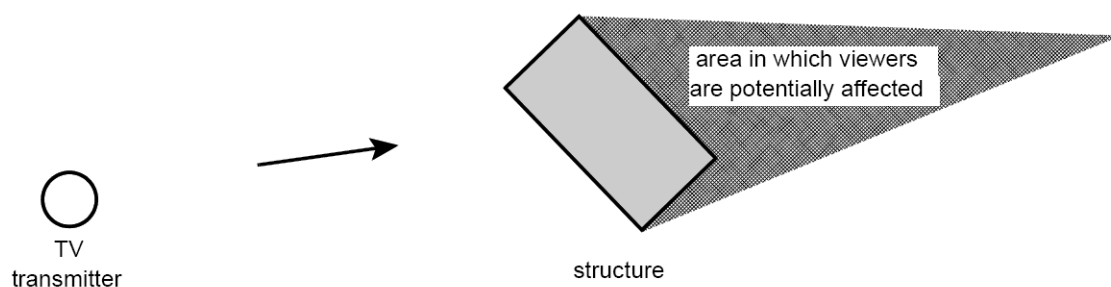


Figure 3 - Plan view of the 'shadow' zone

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 can be severe and, in some cases, almost total if existing reception conditions are poor.

ii. Further away from the structure (e.g. beyond 25 to 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.

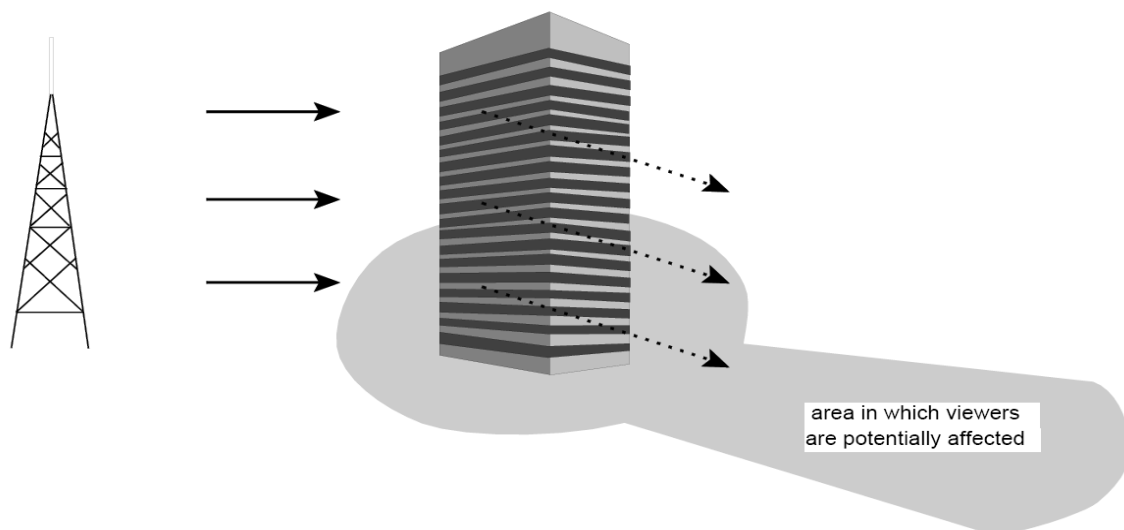


Figure 4 - Affected areas in the 'reflected' zone of the structure

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.

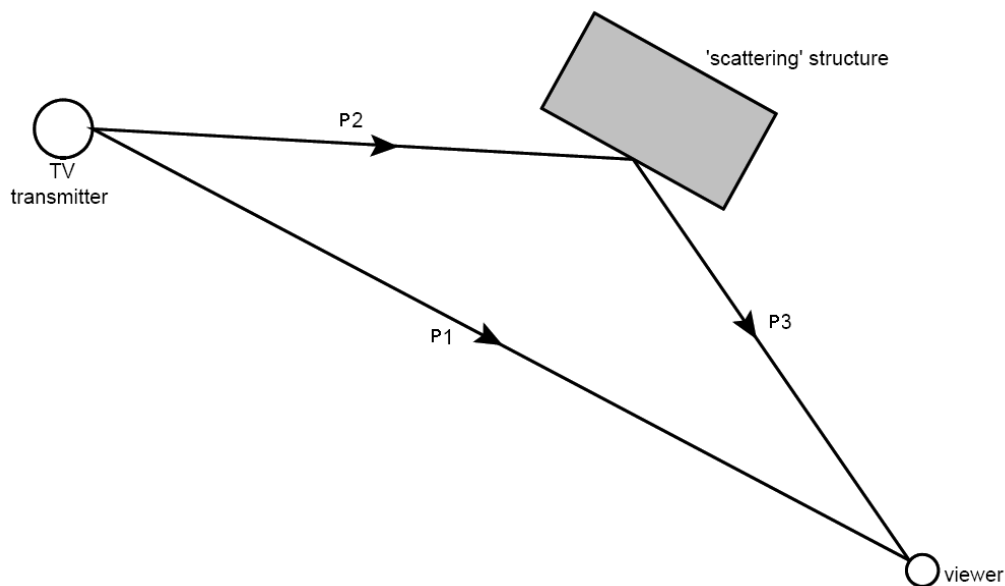


Figure 5 - Direct and Indirect Signal Paths

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 southeastern horizon.

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.

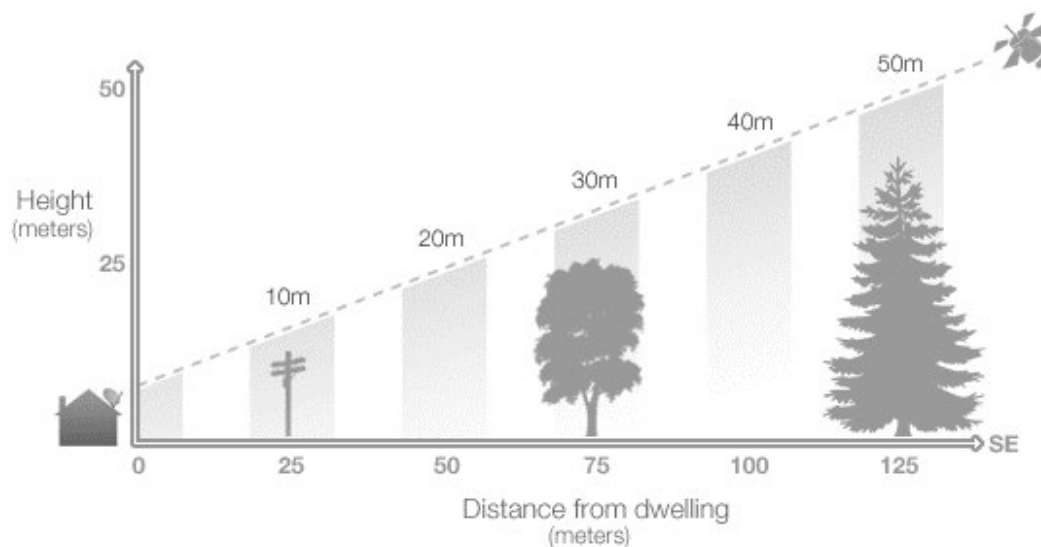


Figure 6 - Typical Clearance Distances and Obstruction Heights for Interference Free Satellite Television Reception

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 to 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 new structure in an already cluttered urban environment will disrupt the reception of radio services.

3 - Available Television and Radio Broadcast Services

Digital Terrestrial Television (DTT) - Freeview

The area around the Site is no longer served by analogue television transmissions due to the completed Digital Television Switchover. All analogue services were switched off in the London television region during 2012. The area is only served by DTT services from the Crystal Palace transmitter (NGR TQ 33940 71220), 31km away on a bearing of 264 degrees with respect to true north of the Site.

The transmitter is shown with respect to the Site in Figure 7. Technical transmission information for each DTT service emanating from the Crystal Palace transmitter site is detailed in Table A, found in the Appendix - *Television Transmission Frequencies*.

Up to date technical information regarding the London TV region and Crystal Palace transmitter can be found on the Digital UK website¹.

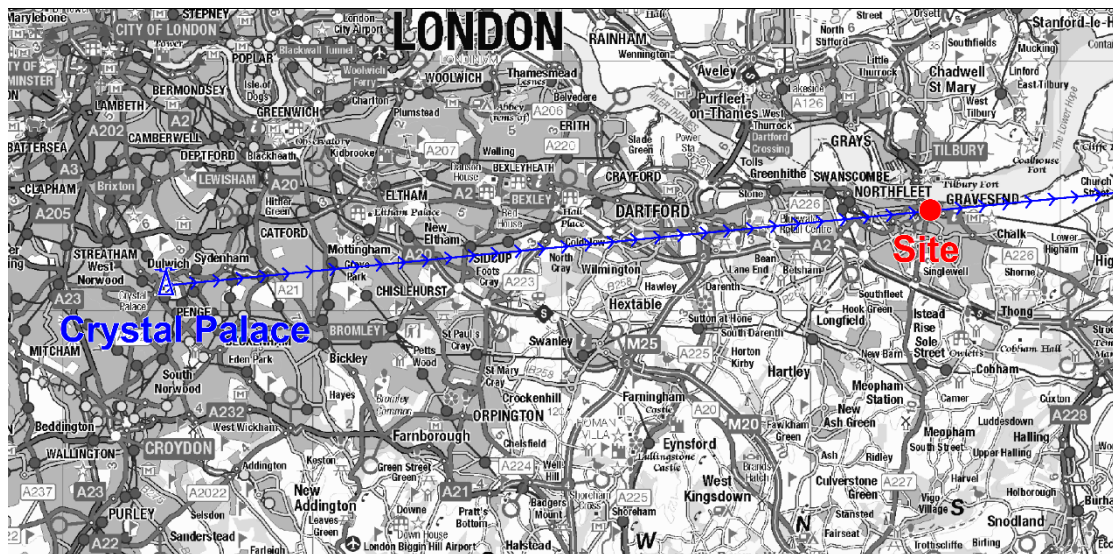


Figure 7 - Locations of the Crystal Palace DTT transmitter and the Site. The blue arrow indicates the direction of the incoming DTT signals from the Crystal Palace Transmitter at the Site

1 - <http://www.digitaluk.co.uk>

Non-Terrestrial Television Services (Digital Satellite Television)

Digital satellite television services are provided by geo-stationary earth orbiting satellites positioned above the equator. For the optimum reception of all satellite services, all receiving dishes must be positioned on the highest part of a rooftop as possible to ensure views to the sky's southeast horizon are free from other local skyline building clutter.

For the reception of the 28.2 degrees east ASTRA satellite cluster (Freesat and Sky services), dish elevations of 25.6 degrees are required at this latitude. Optimal receive dish azimuths are 146.0 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 Wrotham transmitter (NGR TQ 5950 6040) and the Crystal Palace transmitter (TQ 33940 71220).

Technical transmission information for each radio service at the aforementioned transmitter site is detailed in Table B in the Appendix - *VHF (FM) Radio Transmission Frequencies*.

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 site to fully evaluate any potential effects. In this study, measurements were undertaken up to one kilometre from the Site, however, the survey mainly focused around the Site and areas to the immediate northwest and east - the areas where any predicted (modelled) interference may occur. These are identified in Figure 8, and the measurements are detailed in Tables C and D, found in the Appendix - *Signal Measurements*. The following data was recorded:

- Field strength and technical signal measurements of DTT transmissions from the main 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

All television measurements were carried out using a UHF log-periodic receive antenna. 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. During the survey, no assessment was made of reception conditions within viewers' homes. Equipment details are detailed in the Appendix - *Survey Equipment*.

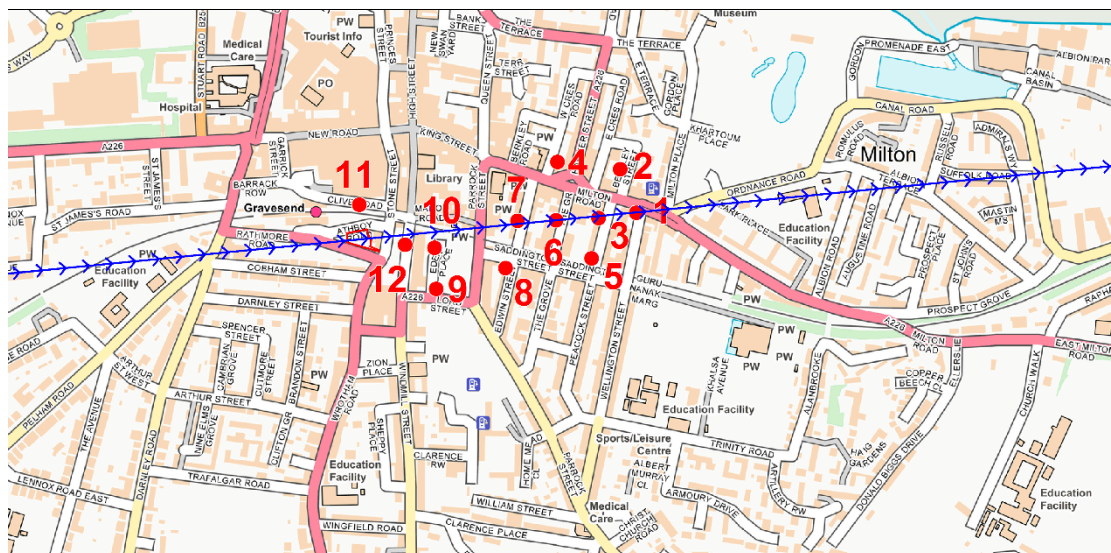


Figure 8 - Surveyed Locations. The blue arrows indicate the direction of the incoming DTT signals from Crystal Palace transmitter. The Site is delineated in red

Survey Results and Observations

In general, building use around the Site is mainly for car parking, transportation (rail), residential and commercial use. There are a number of open public areas near to the Site.

Digital Terrestrial Television (DTT) - Freeview

DTT services were available at all surveyed locations from the Crystal Palace 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 good². DTT services currently provide good coverage and service throughout the study area. All terrestrial television antennas are directed towards the Crystal Palace transmitter, which is expected as Crystal Palace is the region's main DTT transmitter.

Digital Satellite Television - Freesat & Sky

Due to building use in the study area, a high number of satellite dishes were noted to be installed on residential properties near to the Site. Additional dishes may be mounted on rooftops or at the rear of buildings, not visible from street level or public roads. No existing interference has been identified for any satellite television platform.

VHF (FM) Radio

VHF (FM) radio reception conditions were deemed to be good³ throughout the study area. In-car reception was deemed to be good at all locations. This is due to the proximity of the Wrotham high-power radio transmitter with respect to the Site.

2 - Signal levels as specified by the CAI - Association for Audio Visual Professionals Code of Practice (COP) For the Installation of Aerials/Antennas & Receiving Equipment in the Single Dwelling Unit CAI COP 2: September 2022

Additional technical information regarding the Freeview signal can be found in the Appendix - *An Overview of Signal Measurements*

3 - Minimum Recommended Field Strengths for Acceptable Levels of VHF (FM) Radio Service

Monophonic audio - 40 dBµV/m

Stereophonic audio (excellent quality) - 54 dBµV/m

Source - https://www.ofcom.org.uk/data/assets/pdf_file/0013/54310/annex-f.pdf

5 - Predicted Impacts and Effects

Methodology

To assess the effects of the Proposed Development upon television and radio 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 and radio 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. The predicted effects on television and radio broadcast reception are discussed below and summarised in Table 1.

N.B. Receptors are considered to be domestic dwellings where TV is watched as an amenity. Places where TV is part of a commercial offering, such as hotels, public houses, offices and shops, are not considered to be receptors. This differentiation has been consistently used by relevant UK government agencies (currently Ofcom) since the inception of television services in England. The sensitivity of the receptors will vary with their use of TV services but experience shows that many high-use receptors will be highly sensitive.

Digital Terrestrial Television (DTT) - Freeview

Widespread interference is not expected to occur due to the existing good coverage in the study area, the lack of receptors located in any theoretical signal shadow area, the existing good coverage in the study area and the robust nature of the DTT signal with respect to unwanted signal interaction. As no interference is expected, no mitigation measures to restore DTT reception are required.

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 trigonometry, the approximate maximum height of each proposed building and the angle and orientation of the incoming satellite signals, theoretical signal shadow zones for the 28.2E ASTRA satellite cluster are as indicated;

Element	Max. Signal Shadow Length (m)
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Proposed Structure	35
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This area extends in a north-northwesterly direction (326 degrees with respect to true north) from the proposed building's base. However, interference is not expected to occur because there are no satellite dishes located in this theoretical signal shadow area.

VHF (FM) Radio

Modelling VHF (FM) radio interference in a cluttered urban environment is not possible due to the number of constantly changing variables. VHF(FM) broadcast radio reception is robust throughout Gravesend, evident by the survey results and signal availability with a typical car radio. Whilst any new development or structure will change local radio signal propagation and reception characteristics, due to the technical methods involved with encoding and receiving these transmissions, good reception will remain possible. Furthermore, as the reliance on VHF (FM) radio reception decreases due to the uptake of DAB receivers in cars⁴, and online streaming in properties, any possible impact effects are further reduced. Overall, the Proposed Development is not expected to impact the reception of VHF (FM) radio broadcasts.

⁴ - The Road Vehicles (Approval) Regulations 2020 came into force on 1 September 2020 and has implemented the provisions of the EU Directive covering the compulsory fitment of digital radio in passenger cars and buses that come fitted with a radio.

Broadcast platform	Area(s) of predicted interference	Risk of interference & reasoning	Mitigation
DTT (Freeview)	Non-identified	No because coverage is robust and there are no receptors located in any at signal reduction areas	Not required
Digital Satellite TV (Freesat and Sky)	Up to 35m to the northwest from the base of the proposed development	No because there are satellite dishes located in any signal shadow areas	Not required
VHF(FM) Radio	Non-identified	No because coverage is robust	Not required

Table 1 - Summary of Predicted Interference

Predicted Effects - Conclusions

No interference to the reception of DTT (Freeview) services is expected

The Proposed Development is not expected to cause any interference to the reception of digital satellite television services such as Freesat and Sky

The Proposed Development is not expected to affect VHF(FM) radio reception

6 - Mitigation Measures

Planning condition (17) requests the identification of appropriate mitigation should interference be expected;

Radio Waves

Prior to the commencement of development an assessment of the impacts of the development on radio, television and satellite reception in the vicinity of the site, including appropriate mitigation if necessary, shall be submitted to and approved, in writing, by the Local Planning Authority. Any identified mitigation works shall be carried out in full prior to first occupation of the phase to which the effects relate.

However, as no interference to the reception of any television or radio broadcast platform has been identified, no mitigation measures are required to restore optimal broadcast service reception.

7 - Conclusions

A desktop-based study and baseline signal survey have been performed to assess the possible effects and impacts on the reception of television and radio broadcast services from the proposed Land to the rear of 24 Stone Street development and identifies what effects the Proposed Development may have on the reception of television and radio broadcast services. This report has been prepared for the applicant to discharge the following planning condition (17) associated with the Proposed Development;

Radio Waves

Prior to the commencement of development an assessment of the impacts of the development on radio, television and satellite reception in the vicinity of the site, including appropriate mitigation if necessary, shall be submitted to and approved, in writing, by the Local Planning Authority. Any identified mitigation works shall be carried out in full prior to first occupation of the phase to which the effects relate.

Reason

In the interest of residential amenity by adequately mitigating any adverse effects of the development on the living conditions of nearby residents and in accordance with Policy CS19 of Gravesham Core Strategy (2014).

Consequently, the assessment has focused on the reception of VHF (FM) radio and the two television broadcast platforms that could possibly be impacted by the Proposed Development - digital terrestrial television (DTT) and digital satellite television services.

Digital Terrestrial Television (DTT) - Freeview

Due to existing excellent coverage, robust nature of the DTT signal in the survey area and the lack of receptors in any theoretical signal shadow area, the Proposed Development is not expected to have any adverse effect upon the reception of Freeview television services.

Digital Satellite Television - Freesat & Sky

Due to lack of viewers (receptors) in any theoretical signal shadow zone, the Proposed Development will not cause any interference to local digital satellite television reception.

VHF(FM) Radio

Due to the existing good coverage and robust technical nature of the broadcast radio network with respect to building-generated signal interference, the Proposed Development is not expected to affect the reception of VHF(FM) radio services.

Overall, the Proposed Development is unlikely to cause any interference to the reception of any television or radio broadcast platform. As no interference is expected, no mitigation measures are required to restore the reception of any broadcast platform. This report details the existing level and quality of radio and television signal reception within the survey area and can be used to discharge the associated planning condition.

APPENDIX

Television Transmission Frequencies

VHF (FM) Radio Transmission Frequencies

Signal Measurements

An Overview of Signal Measurements

Survey Equipment

Calculation of Received Field Strength

References

Mapping Data

Television Transmission Frequencies

Digital TV Multiplex	Multiplex Operator	UHF Channel Number ⁵	Channel Frequency Fc (MHz) ⁶	Transmitter Power (kW)
BBC A	BBC	23	490.000	200.00
D3&4	Digital 3 & 4	26	514.000	200.00
BBC B - HD	BBC	30-	545.833	200.00
SDN	SDN	25	506.000	200.00
Arqiva A	Arqiva	22	482.000	200.00
Arqiva B	Arqiva	28-	529.833	200.00

Table A - Crystal Palace Digital Terrestrial Television Services

Public Service Broadcaster (PSB) Digital Multiplexes

Commercial (COM) Digital Multiplexes

VHF (FM) Radio Transmission Frequencies

Service	Frequency (MHz)	Transmitter Power (kW)
BBC Radio 1	98.8	62.5
BBC Radio 2	89.1	125.0
BBC Radio 3	91.3	125.0
BBC Radio 4	93.5	125.0

Table B - VHF (FM) Radio Services

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

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

6 - 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

Signal Measurements

Measurement Point Number	Channel Frequency Service	23 490.00 BBC A	26 514.00 D3&4	30 545.83 BBC B -	25 506.00 SDN	22 482.00 Arqiva A	28 529.83 Arqiva B -
1	FS	86.0	93.4	97.3	98.6	97.2	99.5
	CSI	22.8	20.8	-	18.2	19.5	20.2
	MER	30.0	32.2	-	32.6	30.1	31.5
2	FS	97.9	90.9	95.2	99.7	95.0	96.0
	CSI	20.3	21.1	-	19.4	19.6	22.2
	MER	30.1	30.9	-	32.0	32.0	31.9
3	FS	94.6	99.2	95.1	98.4	91.0	97.2
	CSI	21.4	22.3	-	18.3	19.2	21.8
	MER	32.0	29.8	-	30.7	31.2	30.7
4	FS	103.5	99.6	94.6	94.7	96.7	99.0
	CSI	21.9	18.9	-	19.6	22.0	18.8
	MER	32.3	31.9	-	32.0	30.6	31.8
5	FS	95.8	95.3	93.6	98.0	95.9	98.4
	CSI	23.5	22.8	-	21.0	17.7	19.3
	MER	31.0	32.6	-	30.0	31.5	31.2
6	FS	97.0	96.0	95.0	98.2	92.1	95.5
	CSI	18.2	18.9	-	22.5	18.5	20.8
	MER	31.9	31.4	-	30.8	31.5	31.4
7	FS	98.1	95.2	91.0	92.0	98.4	99.6
	CSI	22.4	21.7	-	19.9	17.5	23.6
	MER	30.7	31.5	-	32.1	31.4	32.8
8	FS	99.8	95.0	87.9	88.9	93.4	97.2
	CSI	17.2	18.8	-	21.1	23.4	20.8
	MER	30.2	32.3	-	29.5	31.0	32.3
9	FS	98.0	97.6	94.1	96.6	98.0	96.0
	CSI	18.0	22.2	-	23.5	19.1	23.2
	MER	31.1	31.6	-	32.9	28.9	31.7
10	FS	94.0	94.1	94.4	99.4	94.5	92.7
	CSI	21.6	23.7	-	18.5	19.6	20.0
	MER	29.9	33.1	-	32.5	32.5	31.5
11	FS	96.0	92.8	95.0	95.2	95.0	96.0
	CSI	21.7	23.1	-	18.3	21.8	22.8
	MER	32.0	29.9	-	31.9	32.0	32.1
12	FS	95.9	96.9	96.2	97.1	99.9	96.7
	CSI	21.5	22.8	-	17.7	21.5	20.6
	MER	31.4	30.2	-	32.2	29.6	30.9

Table C - Technical Measurements of Crystal Palace DTT 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		64.6	62.9	67.8	66.6
2		64.6	66.3	63.2	61.3
3		65.4	62.4	67.9	62.1
4		70.0	59.6	67.9	67.5
5		69.2	60.3	70.2	71.1
6		67.1	66.1	69.1	68.7
7		64.0	69.2	70.0	65.9
8		69.5	67.2	69.5	70.0
9		67.3	67.3	62.4	65.9
10		66.3	69.3	70.8	67.3
11		62.9	63.8	64.6	60.4
12		63.3	69.4	71.5	67.1

Table D - Measurements of VHF(FM) Radio Services

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 (a maximum signal level of 70 dB μ V and a minimum signal level of 50 dB μ V). 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. For satisfactory reception of digital signals, it is important the signals applied to the receiver are within these ranges. These maximum and minimum levels define a so-called window of operation for the receiver.

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. 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.

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 performance⁷. 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.

⁷ - J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002

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))

**Amphenol JAYBEAM**

468-860 MHz

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.
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LPU/Rx
V-Pol or H-Pol | Log Periodic | 70° | 7.9 dBd



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

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 – see *Calculation of Received Field Strength*

Calculation of Received Field Strength

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

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

where -

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

References

The building information found in Chapter 2 was sourced from the following Ofcom documents.

Mapping Data

This report includes mapping and mapping data provided by Ordnance Survey (OS), under the terms of the Open Government Licence, OS data Crown copyright and database copyright (2023).

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

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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.

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