

Television Baseline Survey Report

Crown Street Phase 2

December, 2019

PLANNING SOLUTIONS FOR:

- Solar
- Telecoms
- Railways
- Defence
- Buildings
- Wind
- Airports
- Radar
- Mitigation

www.pagerpower.com



ADMINISTRATION PAGE

Job Reference:	9669C
Date:	November, 2019
Author:	Kai Frolic
Telephone:	01787 319001
Email:	kai@pagerpower.com

Reviewer:	Danny Scrivener
Date:	November, 2019
Telephone:	01787 319 001
Email:	danny@pagerpower.com

Issue	Date	Detail of Changes
1	November, 2019	Initial issue
2	December, 2019	Second issue – administrative revisions and additional explanatory text

Confidential: The contents of this document may not be disclosed to others without permission.

Copyright © 2019 Pager Power Limited

Pager Power Limited, Stour Valley Business Centre, Sudbury, CO10 7GB

T:01787 319 001 **E:**info@pagerpower.com **W:**www.pagerpower.com

EXECUTIVE SUMMARY

Overview

This report pertains to Phase 2 of the Crown Street development in Central Manchester. The proposal will cause tall structures to be introduced into the area – which could interact with wireless terrestrial television signals and cause interference.

Report Purpose

This report presents the results of the Television Baseline Reception Survey, undertaken to investigate the potential impact of the Proposed Development upon television signals in the surrounding area.

Results

- The Proposed Development is within the coverage area for the Winter Hill television transmitter.
- Any interference would be due to shadowing effects i.e. the weakening of the transmitted signal due to the physical presence of the buildings.
- A site survey was undertaken on 20 November 2019 to confirm the relevant transmitter and record the signal quality.
- Terrestrial coverage is generally good in the surrounding area. Existing tall buildings may already attenuate signals from Winter Hill, particularly at lower levels.
- It is possible that there will be no impact on television signals due to the Proposed Development because small/moderate losses may not result in noticeable interference in the context of the surrounding area. Any impacts would most likely be in the shadow zone within one kilometre of the Proposed Development.

Recommendation

Any reported television interference should be investigated by means of a reception measurement.

Mitigation

Technical mitigation solutions have been identified for implementation if an impact occurs. The most likely options, in the event a mitigation requirement transpires, would be:

- Replacement of receiving aerial with a more directional or higher gain aerial.
- Replacement of terrestrial reception equipment with satellite reception equipment or cable.

Mitigation measures should only be installed if reported effects are found to be attributable to the Proposed Development. There is no reason to install pre-emptive mitigation due to the distinct possibility that no noticeable effects will occur.

LIST OF CONTENTS

Administration Page	2
Executive Summary	3
Overview	3
Report Purpose	3
Results	3
Recommendation	3
Mitigation	3
List of Contents	4
List of Figures	6
List of Tables	6
About Pager Power	7
1 Background	8
1.1 Introduction	8
1.2 Site Boundary	8
2 Television Transmitter Details	9
2.1 Relevant Transmitter	9
2.2 Winter Hill Main Transmitter	9
3 Buildings and Television Interference	10
3.1 Technical Overview	10
3.2 Obstruction of the Signal	10
3.3 Reflection of the Signal	11
4 Technical Assessment	14
4.1 Potential Interference Areas	14
4.2 Potential Diffraction Issues	15
4.3 Potential Reflection Issues	15
5 Television Baseline Survey	16
5.1 Overview	16

5.2	Survey Locations	17
5.3	Survey Results.....	18
6	Mitigation	22
6.1	Mitigation Requirement	22
6.2	Mitigation Options	22
6.3	Recommended Options	22
6.4	Recommended Process	22
7	Conclusions.....	23
7.1	Findings	23
	Appendix A – Detailed Survey Results	24
	Appendix B – Survey Photographs.....	28
	Location 1	28
	Location 2	29
	Location 3	30
	Location 4	31
	Location 5	32
	Location 6	33
	Location 7	34

LIST OF FIGURES

Figure 1 Site boundary.....	8
Figure 2 Diffraction Loss Zones.....	11
Figure 3 Diffraction Loss Zones.....	12
Figure 4 Interference areas.....	14
Figure 5 Survey locations	17

LIST OF TABLES

Table 1 Winter Hill main transmissions.....	9
Table 2 Winter Hill additional transmissions.....	9
Table 3 Television signal strength categories	16
Table 4 Baseline survey results	21

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 46 countries within Europe, Africa, America, Asia and Australasia.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 BACKGROUND

1.1 Introduction

A television baseline reception survey has been completed for the proposed Crown Street Phase 2 development in central Manchester.

The Proposed Development will introduce tall structures into the area – this could interact with wireless terrestrial television signals and cause interference in the surrounding area. This report produces the results of the baseline survey along with a prediction of the expected impact.

1.2 Site Boundary

The Site boundary is shown in Figure 1 below¹.

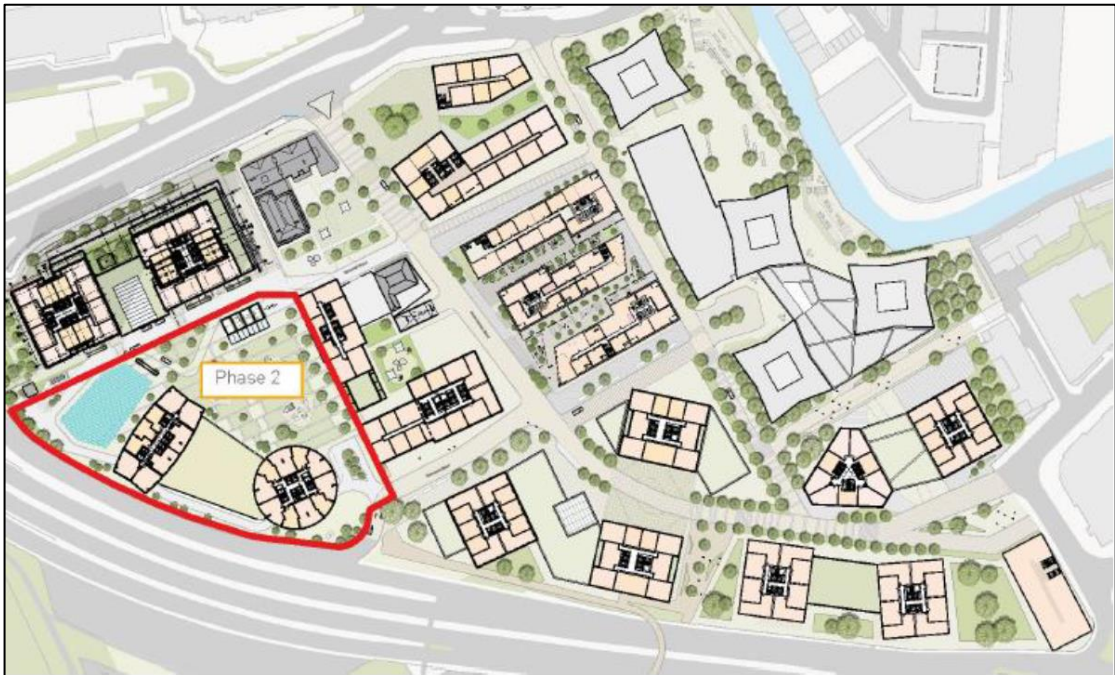


Figure 1 Site boundary

¹ Source: Renaker Build Limited.

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

A comprehensive search of transmitter and coverage maps revealed that the Winter Hill transmitter serves the area around the Proposed Development.

Digital television services are broadcast via Ultra High Frequency (UHF) signals; no analogue television signals are broadcast. The transmitter information is presented below².

2.2 Winter Hill Main Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24.2km northwest of the Proposed Development (published coordinates SD66051446). The main digital services provided are shown in Table 1 below.

	Public (PSB)			Commercial (COM)		
Service	BBC A	Digital 3&4	BBC B	SDN	Arqiva A	Arqiva B
Channel	50	59	54-	58	49	55
Power	100 kilo-Watts (kW)					

Table 1 Winter Hill main transmissions

Additional Winter Hill transmissions are shown in Table 2 below.

	Local Multiplexes			
Service	COM 7	COM8	LM/LL/LPR	GIM
Channel	31	37	56	57
Power	25.7 kW	22.6kW	2 kW	1 kW

Table 2 Winter Hill additional transmissions

² Source: Ofcom

3 BUILDINGS AND TELEVISION INTERFERENCE

3.1 Technical Overview

Terrestrial television services are provided by means of UHF radio waves which propagate from transmitters to receiving aerials which then relay the signal to a television set.

The quality of the image and sound on a television set is dependent on both the strength of the signal received directly from the transmitter (carrier signal) and the strength of any interference signals from other sources.

To achieve good quality reception an aerial must receive a strong carrier signal but weak interference signals.

There are two ways that buildings can cause interference to television reception, these are described below.

3.2 Obstruction of the Signal

This is caused by the building physically blocking the transmitted television signal, reducing the strength of the carrier signal in the shadow of the building. In the case of Winter Hill transmissions, this would affect residences to the southeast of the Proposed Development. Specifically:

- The highest losses (greatest interference) will be located immediately behind the building;
- Losses near the edge of the shadow zone will be less significant due to diffraction effects (bending of the signal).

The Ofcom document states that:

"In general, there will be three 'zones' behind the structure:

Zone A - close behind the structure (typically a few tens of metres) there may be a large reduction in signal level with a possible complete loss of reception

Zone B - further away (typically a few hundred metres) the signal reduction is less severe and the shadow will be smaller as diffraction effects partially fill in the shadow. Depending on the size of the structure, some locations could still lose reception completely

Zone C - some distance away (1-5km) the shadow will effectively have disappeared."

The zones mentioned are illustrated in Figure 2³ on the following page, taken from Section 3.2 of an Ofcom paper⁴ regarding the impact of buildings on broadcast signals.

³ Source: Ofcom (2009): Tall Structures and their impact on broadcast and other wireless services.

⁴ Reference as above.

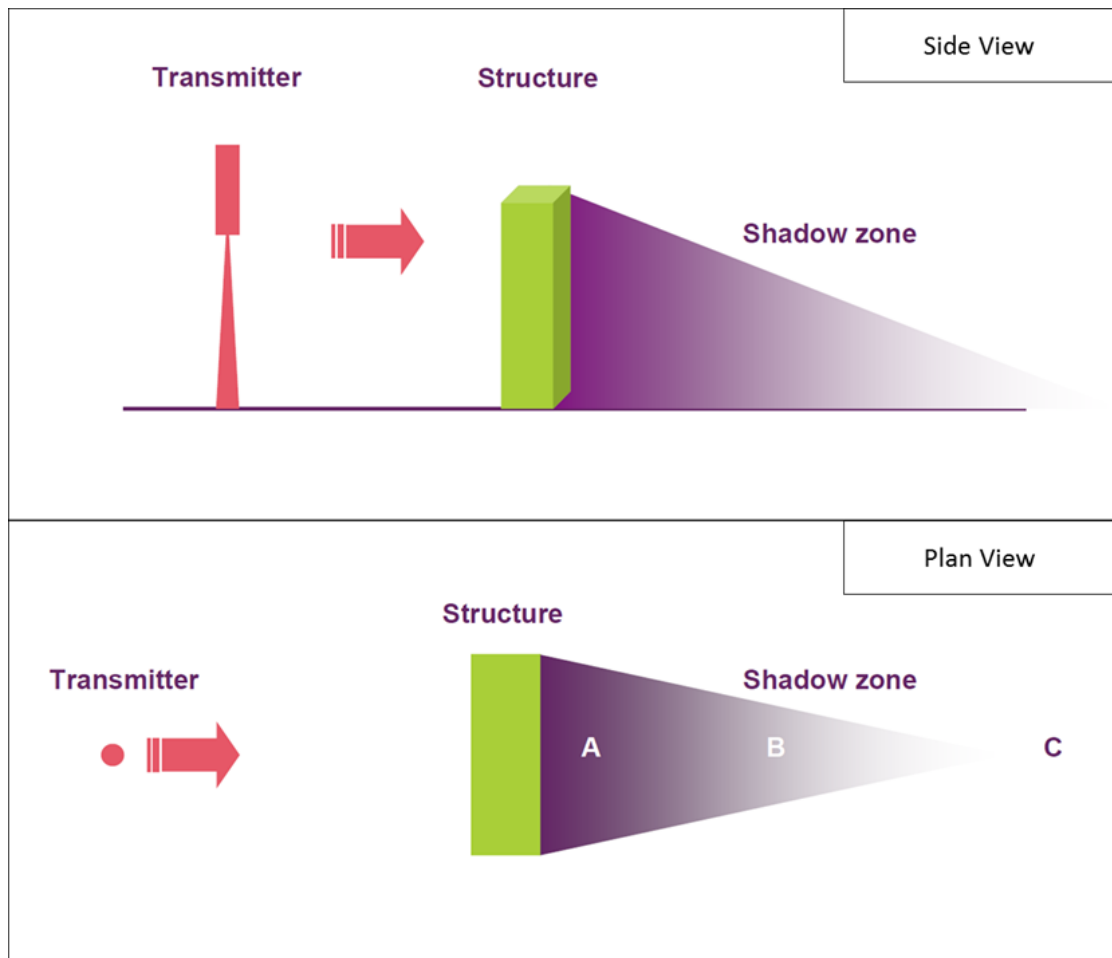


Figure 2 Diffraction Loss Zones

3.3 Reflection of the Signal

For large developments with straight edges, the transmitted signal can be reflected by the building itself. This causes an effect known as 'multipath interference' whereby the signal is received twice by an aerial at different times. The direct signal arrives first because it has a shorter distance to travel.

Figure 3 on the following page (taken from Section 3.3 of the Ofcom document referenced above) illustrates this effect.

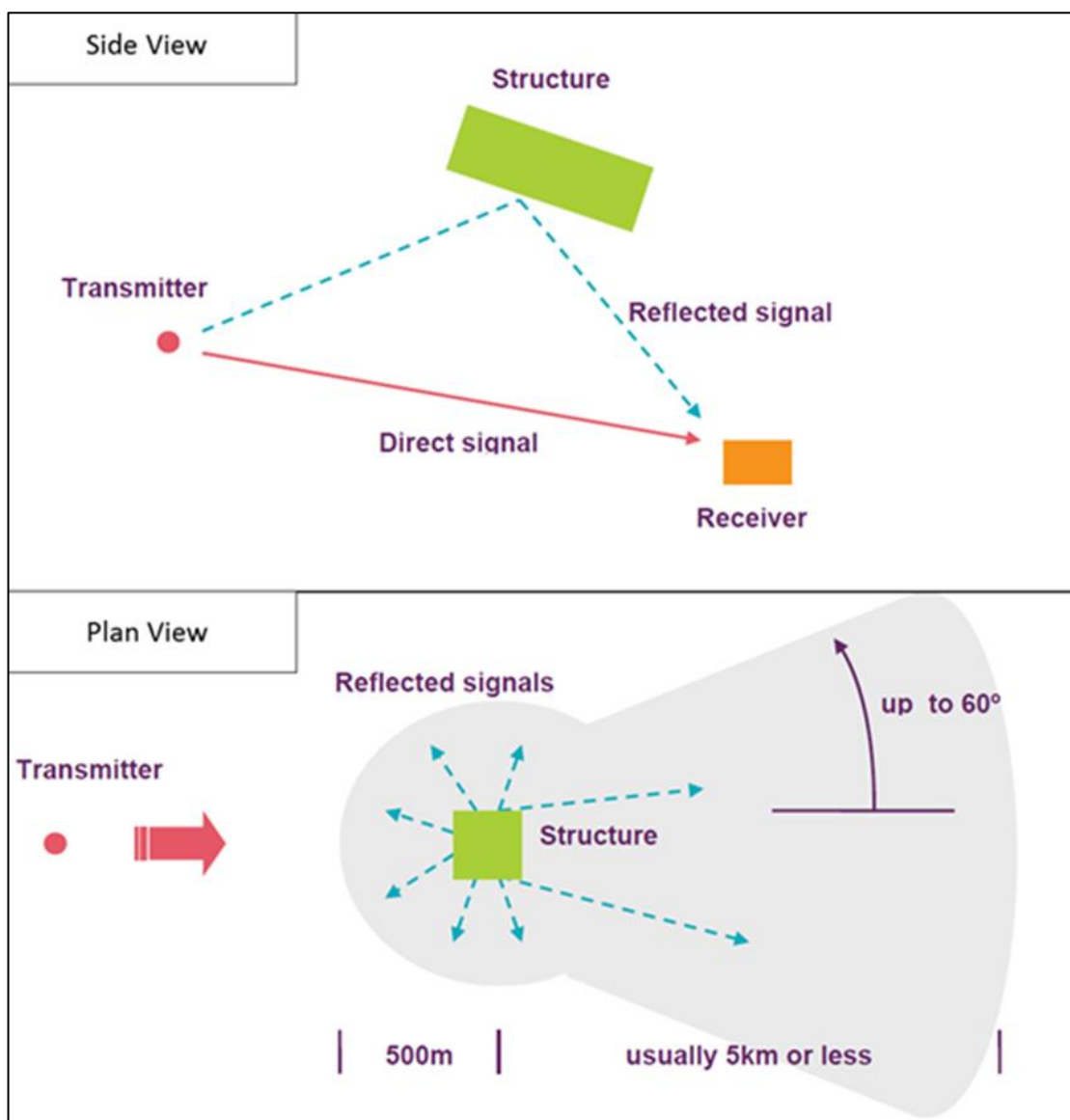


Figure 3 Diffraction Loss Zones

In practice, it is considered highly unlikely that reflections will have an effect for receivers in front of the building or on either side when viewed from the location of the transmitter. For digital transmissions in particular, it is unlikely that issues will occur if the angle between the direct signal and the reflected signal is more than 30 degrees⁵.

⁵ This is known to be the angle that Arqiva considers when safeguarding its Television Re-Broadcast Links with regard to reflections from wind turbines – whilst wind turbines cause issues that are different to buildings this particular issue is similar for the two.

The reflection zone has been constructed in accordance with the Ofcom approach, however the angle considered is 30 degrees rather than 60 degrees. This is in order to represent a more realistic scenario for digital transmissions.

No location can be affected by both diffraction (shadowing) and direct reflections.

Reflection issues are most likely to cause a noticeable impact if:

- The direct signal from transmitter to receiver is weak (e.g. obstructed by terrain or buildings);
- The reflected signal from the building is strong (e.g. clear radio line of sight from the transmitter to the building and the building to the receiver).

The worst-case scenario is for both of the above conditions to be satisfied. The best-case scenario is for neither of the above conditions to be satisfied.

4 TECHNICAL ASSESSMENT

4.1 Potential Interference Areas

Figure 4 below shows the potential interference areas associated with the Proposed Development.

These have been defined based on the geometry of the potential interference zones as set out in the previous section. Both zones extend to a distance of 5km beyond the Proposed Development location in accordance with the Ofcom guidance.

In the case of the shadow zone, this has been modelled as having straight sides in order to be conservative. In actuality due to diffraction effects the zone would have a more triangular shape as shown in Figure 2 in the previous section.

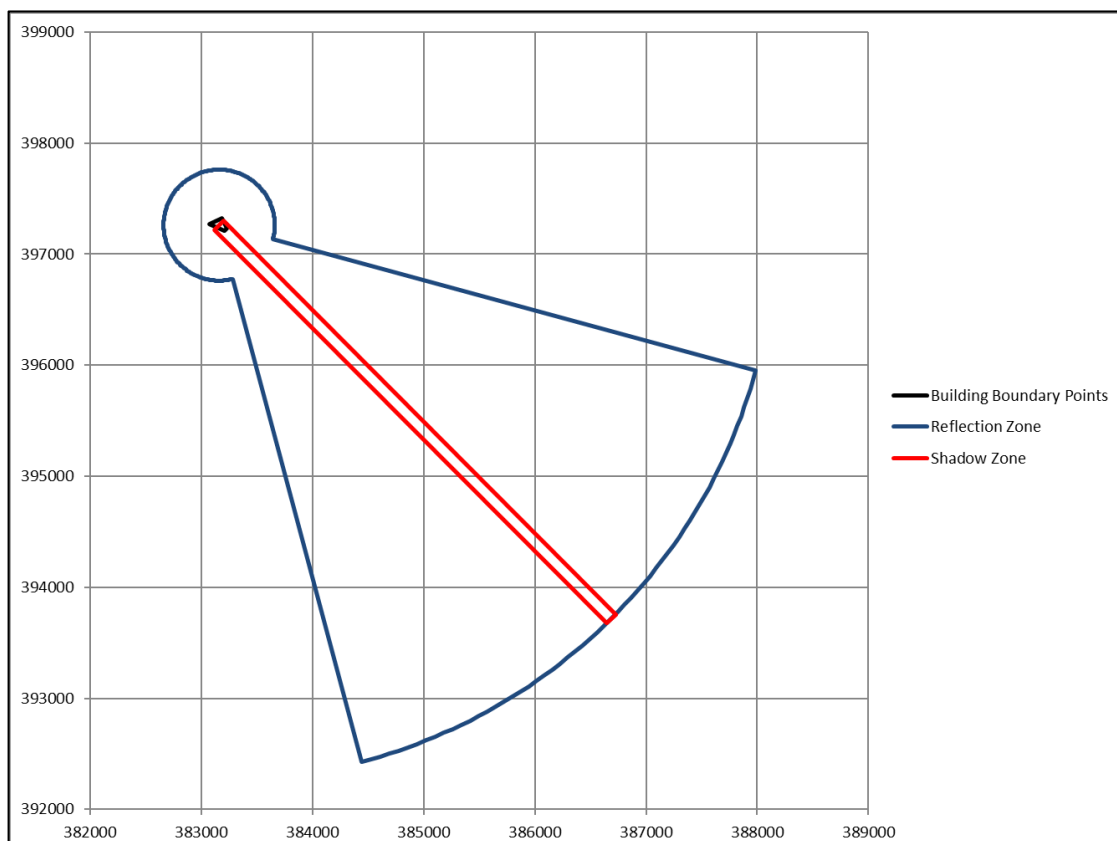


Figure 4 Interference areas

4.2 Potential Diffraction Issues

It can be seen that the shadow zone passes over areas that are mostly urban containing high and low-rise residential developments. Areas closest to the Proposed Development are at the highest risk of experiencing television interference.

4.3 Potential Reflection Issues

Reflection effects are most likely if the transmitter does not have direct radio line of sight to the receiving aerial.

Based on bare-earth terrain, the Winter Hill transmitter has coverage below ten metres for the populated areas within the reflection zone. This means that any receivers that have a low signal strength are likely to be affected by existing obstructions. For interference to occur due to reflections, the following criteria would need to be met:

- The receiving aerial would be already obstructed by a building or other existing obstacle;
- The reflected signal path via the Proposed Development would have to be relatively unobstructed;
- The angle between the reflected signal via the Proposed Development and the direct signal would have to be small.

In practice it is unlikely that all of the above criteria would be met. Impacts due to reflections are considered unlikely.

5 TELEVISION BASELINE SURVEY

5.1 Overview

The purpose of a baseline survey is to establish current television signal strength and quality in the area. The baseline survey serves three purposes these are:

1. It confirms which transmitter is serving most homes in the areas surveyed;
2. It provides an indicator regarding the likelihood of interference. If current signals are of good quality, minor degradation is less likely to have a noticeable effect; and
3. It allows a 'before and after' comparison to be made in the event that a complaint is received.

A baseline television reception survey was undertaken for the Proposed Development on 20 November 2019.

Survey measurements were taken using Pager Power's custom survey vehicle with a wideband UHF aerial extended to a height of 10 metres above ground level. This was connected to television analyser to record the signal strength and stability.

The strength of the recorded signals is categorised in accordance within Table 3 below.

Average Signal Strength (dB)	Subjective Signal Strength Definition
<35	Low
35-45	Moderate
45-55	Good
55+	Very Good

Table 3 Television signal strength categories

5.2 Survey Locations

Figure 5 below⁶ shows the survey locations overlaid onto aerial photography. The Proposed Development's location and the shadow zone are also shown. Locations were selected considering residential areas within the building's shadow zone. The locations are deliberately spaced close together nearest the proposed development, as this is the area where effects would generally be the most likely and multiple measurements within a relatively short distance could be the most relevant. Survey locations were chosen pre-survey (within the shadow zone) however safe and available access influenced the specific position on the day. The locations below show the actual survey locations.

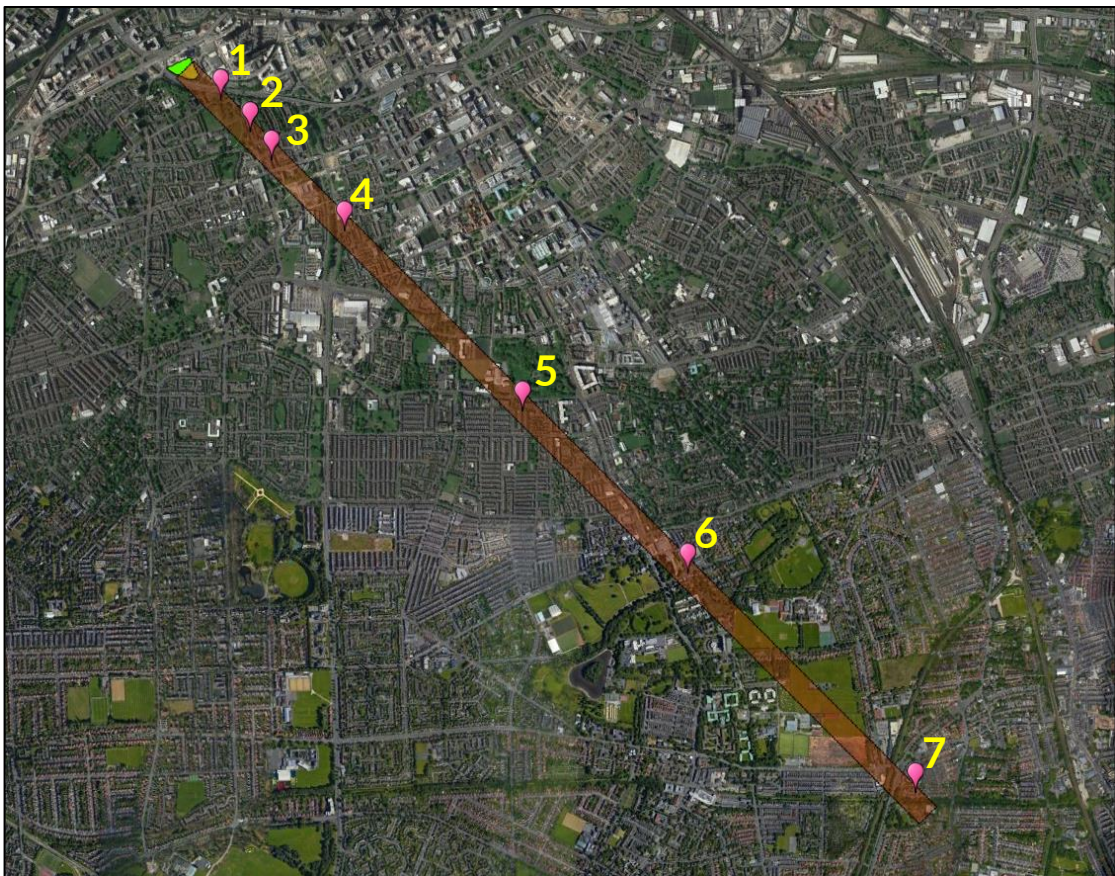


Figure 5 Survey locations

⁶ Copyright © 2019 Google.

5.3 Survey Results

An overview of the survey results is presented in Table 4 below whilst the full survey results are shown in Appendix A. Survey photographs are shown in Appendix B.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
1	Main TV MUX: 45 (Moderate) Local TV MUX: 37 (Moderate)	Aerials were not observed at this survey location. One main and two local multiplexes were not received at this location. Another local multiplex showed intermittent interference. The remaining multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference.	The survey location is within 200m of the closest of the Proposed Development. Effects are possible based on the proximity to the Proposed Development. This could depend on the relative height of the building development and any receiving aerials.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
2	Main TV MUX: 60 (Very Good) Local TV MUX: 44 (Moderate)	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. The survey aerial was not at its maximum height due to trees at the survey location. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location.	The survey location is within 400m of the closest of the Proposed Development. The existing signal strength is high, particularly for the main multiplexes, however effects are possible at this range.
3	Main TV MUX: 51 (Good) Local TV MUX: 41 (Moderate)	Horizontally polarised aerials directed towards the Winter Hill transmitter and many satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. Two local multiplexes were not decoded at this location.	The survey location is approximately 500 m of the closest of the Proposed Development. It is possible that the signal will be affected at this range, which could be noticeable for the channels of moderate strength.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
4	Main TV MUX: 47 (Good) Local TV MUX: 39 (Moderate)	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. Two local multiplexes were not decoded at this location.	The survey location is more than 1 km from the Proposed Development. It is unusual for significant signal degradation to manifest itself at ranges of more than 1 km. Significant interference is unlikely, however the possibility cannot be ruled out, particularly for the weakest multiplexes.
5	Main TV MUX: 58 (Very Good) Local TV MUX: 38 (Moderate)	Horizontally polarised aerials directed towards the Winter Hill transmitter and many satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location.	It is unlikely that significant losses would be experienced at this location (approximately 2.2km from the Proposed Development) considering the existing signal strength and distance. Impacts are unlikely.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	Main TV MUX: 70 (Very Good) Local TV MUX: 52 (Good)	Horizontally polarised aerials directed towards the Winter Hill transmitter and satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location.	It is unlikely that noticeable losses would occur at the outer extremities (3.3 km) of the shadow zone. No interference is predicted.
7	Main TV MUX: 68 (Very Good) Local TV MUX: 50 (Good)	Horizontally polarised aerials directed towards the Winter Hill transmitter and some satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 1dB and no signs of interference. One local multiplex was not decoded at this location.	It is unlikely that noticeable losses would occur at the outer extremities (4.8 km) of the shadow zone. No interference is predicted.

Table 4 Baseline survey results

6 MITIGATION

6.1 Mitigation Requirement

If an adverse effect on television services occurs and is attributable to the Proposed Development, mitigation will be required.

6.2 Mitigation Options

The most effective form of mitigation is dependent on the specific impact. Common options are shown below.

Mitigation options for television include:

- Replacement of receiving aerial with a more directional or higher gain aerial.
- Repositioning the receiving aerial so that the received signal is stronger.
- Directing the receiving aerial to an alternative transmitter that covers the area and retuning the television accordingly.
- Upgrading antenna cabling and connections.
- Installation of signal amplifiers.
- Development of a bespoke local solution using a receiving aerial some distance from the dwelling.
- Replacing terrestrial reception equipment with satellite reception equipment, cable or provision via the internet.

6.3 Recommended Options

If interference were to occur for a small number of homes, it is likely that installation of satellite television would be the most suitable option.

If effects are experienced for dwellings with poor quality or low receiving aerials, the best option may be to upgrade and/or elevate the existing aerial.

6.4 Recommended Process

It is possible that no adverse effects will occur due to the current reception quality in the majority of the surrounding area.

It is therefore recommended to investigate any reports of interference in order to determine whether these are attributable to the Proposed Development. If this is found to be the case, mitigation can be applied.

There is no reason to install pre-emptive mitigation.

7 CONCLUSIONS

7.1 Findings

- Residences in the area surrounding the Proposed Development receive television services from the Winter Hill transmitter. The strength and quality of the signal is variable, in part due to existing developments in the city centre.
- The Proposed Development will introduce tall structures that will have a shadowing effect to the southeast.
- Receiving aerials in the Proposed Development's shadow, within approximately one kilometre, may experience degradation of terrestrial television reception quality.
- Receptors at greater distances are unlikely to experience noticeable impacts in practice.
- In the event that effects are reported, it is recommended that a reception measurement is undertaken (post-construction) to investigate the likely cause of the interference.
- If mitigation is required, provision of alternative receiving equipment such as a satellite dish or cable television is likely to be most appropriate solution.
- No requirement for pre-emptive mitigation has been identified.

APPENDIX A – DETAILED SURVEY RESULTS

Location 1 (GPS Coordinates: SJ 83331 97119 +/- 30 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	41.1 ± 1.5	0%	Intermittent interference	Intermittent interference
37	COM8	52.9 ± 0.4	5x10 ⁻⁸	Good	Good
49	Arqiva A	49.4 ± 0.4	5x10 ⁻⁸	Good	Good
50	BBC A	51.0 ± 0.4	1x10 ⁻⁸	Good	Good
54-	BBC B	42.8 ± 0.5	0%	Good	Good
55	Arqiva B	36.6 ± 1.5	-	-	-
56	LM/LL/LPR	25.7 ± 0.2	-	-	-
57	GIM	27.4 ± 0.2	-	-	-
58	SDN	42.8 ± 0.5	2x10 ⁻⁷	Good	Good
59	Digital 3&4	44.7 ± 0.8	2x10 ⁻⁸	Good	Good

Notes: UHF aerials were not observed at this location. The survey aerial was screened by a nearby tree.

Location 2 (GPS Coordinates: SJ 83470 96964 +/- 18 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	54.4 ± 0.2	0%	Good	Good
37	COM8	61.6 ± 0.2	1x10 ⁻⁸	Good	Good
49	Arqiva A	63.5 ± 0.2	1x10 ⁻⁸	Good	Good
50	BBC A	64.1 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	61.3 ± 0.3	0%	Good	Good
55	Arqiva B	55.6 ± 0.1	0%	Good	Good
56	LM/LL/LPR	25.7 ± 0.2	-	-	-
57	GIM	32.9 ± 0.3	2x10 ⁻⁶	Good	Good
58	SDN	58.9 ± 0.2	1x10 ⁻⁸	Good	Good
59	Digital 3&4	57.7 ± 0.3	1x10 ⁻⁸	Good	Good

Notes: UHF aerials directed towards the Winter Hill transmitter were observed. The survey aerial was not fully erected due to a tree at the survey location.

Location 3 (GPS Coordinates: SJ 83572 96829 +/- 9 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	52.3 ± 0.2	0%	Good	Good
37	COM8	55.9 ± 0.2	1x10 ⁻⁸	Good	Good
49	Arqiva A	54.5 ± 0.3	1x10 ⁻⁸	Good	Good
50	BBC A	55.1 ± 0.3	1x10 ⁻⁸	Good	Good
54-	BBC B	52.4 ± 0.3	0%	Good	Good
55	Arqiva B	46.9 ± 0.3	0%	Good	Good
56	LM/LL/LPR	25.6 ± 0.2	-	-	-
57	GIM	30.4 ± 0.2	-	-	-
58	SDN	48.9 ± 0.3	5x10 ⁻⁸	Good	Good
59	Digital 3&4	49.2 ± 0.3	1x10 ⁻⁸	Good	Good

Notes: UHF aerials directed towards the Winter Hill transmitter and many satellite dishes were observed.

Location 4 (GPS Coordinates: SJ 83918 96492 +/- 25 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	47.3 ± 0.2	0%	Good	Good
37	COM8	55.6 ± 0.3	1x10 ⁻⁸	Good	Good
49	Arqiva A	50.2 ± 0.2	1x10 ⁻⁸	Good	Good
50	BBC A	51.0 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	50.3 ± 0.2	0%	Good	Good
55	Arqiva B	40.6 ± 0.2	0%	Good	Good
56	LM/LL/LPR	25.7 ± 0.2	-	-	-
57	GIM	28.6 ± 0.2	-	-	-
58	SDN	45.2 ± 0.3	1x10 ⁻⁵	Good	Good
59	Digital 3&4	44.0 ± 0.2	8x10 ⁻⁸	Good	Good

Notes: UHF aerials directed towards the Winter Hill transmitter and many satellite dishes were observed.

Location 5 (GPS Coordinates: SJ 84764 95635 +/- 19 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	47.3 ± 0.3	0%	Good	Good
37	COM8	47.0 ± 2.0	1x10 ⁻⁸	Good	Good
49	Arqiva A	62.1 ± 0.3	1x10 ⁻⁸	Good	Good
50	BBC A	61.3 ± 0.3	1x10 ⁻⁸	Good	Good
54-	BBC B	60.3 ± 0.2	0%	Good	Good
55	Arqiva B	53.0 ± 0.3	0%	Good	Good
56	LM/LL/LPR	25.7 ± 0.2	-	-	-
57	GIM	33.3 ± 0.2	1x10 ⁻⁸	Good	Good
58	SDN	56.7 ± 0.2	1x10 ⁻⁸	Good	Good
59	Digital 3&4	55.3 ± 0.3	1x10 ⁻⁸	Good	Good

Notes: UHF aerials directed towards the Winter Hill transmitter and many satellite dishes were observed.

Location 6 (GPS Coordinates: SJ 85548 94864 +/- 13 ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	67.2 ± 0.2	0%	Good	Good
37	COM8	73.0 ± 0.2	1x10 ⁻⁸	Good	Good
49	Arqiva A	74.2 ± 0.2	1x10 ⁻⁸	Good	Good
50	BBC A	74.6 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	72.7 ± 0.2	0%	Good	Good
55	Arqiva B	65.3 ± 0.3	0%	Good	Good
56	LM/LL/LPR	26.5 ± 0.2	-	-	-
57	GIM	41.8 ± 0.2	1x10 ⁻⁸	Good	Good
58	SDN	68.3 ± 0.3	1x10 ⁻⁸	Good	Good
59	Digital 3&4	66.3 ± 0.3	1x10 ⁻⁸	Good	Good

Notes: UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed.

Location 7 (GPS Coordinates: SJ 86626 93822 +/- 11ft)					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
31	COM7	58.6 ± 0.2	0%	Good	Good
37	COM8	70.9 ± 0.1	1x10 ⁻⁸	Good	Good
49	Arqiva A	71.2 ± 0.1	1x10 ⁻⁸	Good	Good
50	BBC A	72.4 ± 0.2	1x10 ⁻⁸	Good	Good
54-	BBC B	71.0 ± 0.1	0%	Good	Good
55	Arqiva B	61.6 ± 0.1	0%	Good	Good
56	LM/LL/LPR	26.3 ± 0.1	-	-	-
57	GIM	42.9 ± 0.1	1x10 ⁻⁸	Good	Good
58	SDN	65.4 ± 0.2	1x10 ⁻⁸	Good	Good
59	Digital 3&4	64.1 ± 0.1	1x10 ⁻⁸	Good	Good

Notes: UHF aerials directed towards the Winter Hill transmitter and some satellite dishes were observed.

APPENDIX B – SURVEY PHOTOGRAPHS

Location 1



Location 2



Location 3



Location 4



Location 5



Location 6



Location 7





Pager Power Limited
Stour Valley Business Centre
Sudbury
Suffolk
CO10 7GB

Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com