

Television and Radio Baseline Survey and Report

No.3 Circle Square

Bruntwood SciTech

June 2022

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ADMINISTRATION PAGE

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to investigate the potential impact of the proposed No.3 Circle Square building development upon terrestrial television and radio reception in the surrounding area. The proposed development is located on Brancaster Road in central Manchester.

The proposed development will introduce a new tall structure into the area, which could interact with wireless terrestrial television signals and cause interference in the surrounding area. This report produces the results of a television and radio baseline survey along with a prediction of the expected impact.

Findings

Television

- The proposed development is within the coverage area for the Winter Hill television transmitter. The baseline survey confirmed it was the main transmitter serving the area.
- 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 the 16th of May 2022 to confirm the relevant transmitter and record the signal quality.
- The average terrestrial signal strength is good in the proposed development shadow zone for the main multiplexes and moderate on average for the local (lower power) multiplexes.
- Negative effects upon signal strength are most likely at locations close to the proposed development i.e. within 1km of the proposed development and within its shadow zone.
- A small number of two to three-storey properties are located within approximately 330m of the proposed development. The signal strength within this range was recorded as moderate for the main multiplexes, and therefore, interference is possible. Satellite dishes are present on these properties. Beyond this distance, significant effects are not predicted due to the current signal strength.

Radio

- The area surrounding the proposed development receives radio services from numerous transmitters, including Winter Hill. The strength and quality of the signal from Winter Hill near the proposed development are variable.
- Degradation of the radio signal at close range to the proposed development is possible. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

Mitigation

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.

Mitigation measures should be installed if reported effects are found to be attributable to the proposed development. Solutions are likely to be readily available if required, the most common options are presented in Section 6.

No requirement for pre-emptive mitigation has been identified.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 51 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

Pager Power has been commissioned to investigate the potential impact of the proposed No.3 Circle Square building development upon terrestrial television and radio reception in the surrounding area. The proposed development is located on Brancaster Road in central Manchester.

The proposed development will introduce a new tall structure into the area, which could interact with wireless terrestrial television signals and cause interference in the surrounding area. This report produces the results of a television and radio baseline survey along with a prediction of the expected impact.

1.2 Proposed Development Details

The proposed development site plan is shown in Figure 1¹ below.

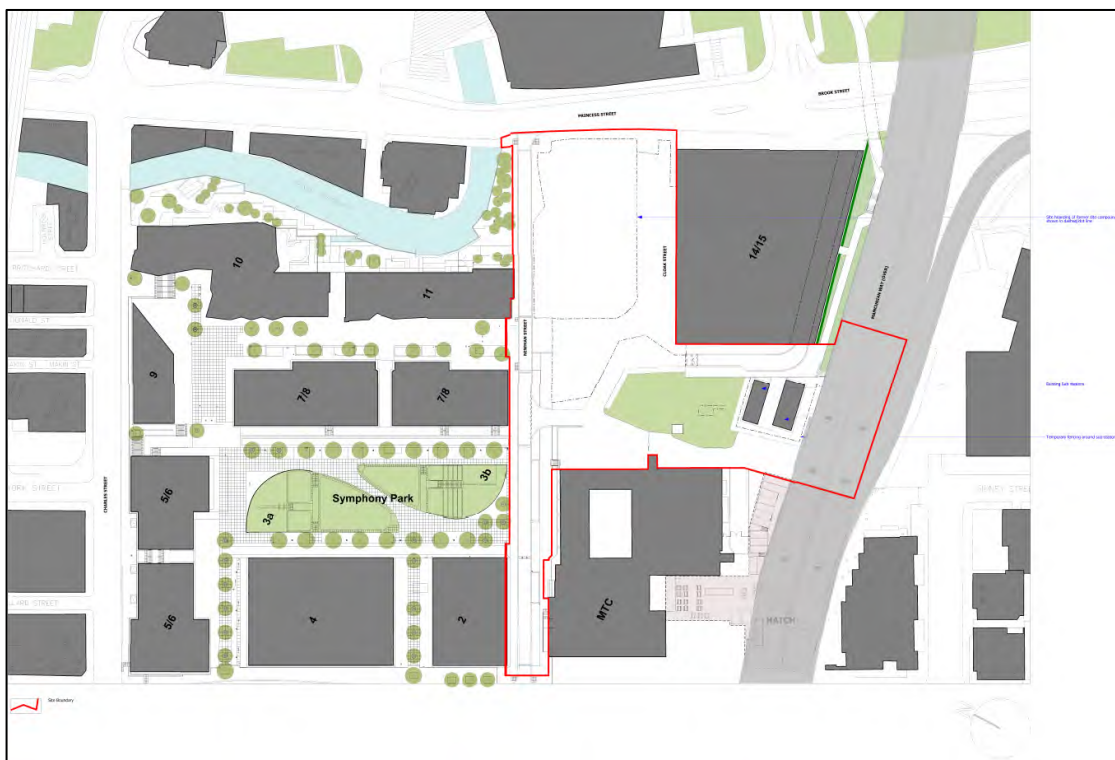


Figure 1 Proposed development site plan

¹ Source: 0256-CS3-BAR-03-XX-DR-A-05-0002_P01.pdf (copped)

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 25km northwest of the proposed development. The Winter Hill transmitter serves the area around the development.

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

2.2 Winter Hill Main Transmitter

The main Winter Hill transmissions are shown in Table 1 below.

	Public (PSB)			Commercial (COM)		
Service	BBC A	Digital 3&4	BBC B	SDN	Arqiva A	Arqiva B
Channel	32	34	35	29	31	37
Power	100 kilo-Watts (kW)					

Table 1 Winter Hill main transmissions

Additional Winter Hill transmissions are shown in Table 2 below.

	Local Multiplexes		
Service	LTVmux	Glmux	Arqiva C
Channel	24	27	55
Power	2 kW	1 kW	23 kW

Table 2 Winter Hill additional transmissions

² Source: Ofcom

Radio transmissions are shown in Table 3 below.

	Digital				FM
Service	CE Manchester	Digital One	Bauer Central Lancashire	BBC National DAB	Various Services
Frequency	220.352 MHz	222.064 MHz	223.936 MHz	225.648 MHz	88.6 – 105.4 MHz
Power	0.25 kW	10 kW	1.5 kW	10 kW	Max 5 kW

Table 3 Winter Hill radio transmissions

2.3 Radio Transmissions

Radio services in the UK are broadcast from a variety of main and local transmitters. Services are currently broadcast as both analogue and digital transmissions and in many cases are broadcast from television transmitter towers.

Receivers are typically mobile or portable devices with omnidirectional aerials. Though transmissions from Winter Hill have been assessed, the relevant transmitter is dependent on the receiver's exact position and the radio channel that is being received. Because of this radio signals tend to be more robust compared to television signals.

3 BUILDINGS AND TELEVISION INTERFERENCE

3.1 Technical Overview

3.1.1 Television

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.

3.1.2 Radio

Radio services are also received from fixed transmitters, much like terrestrial television signals. However, radio services are typically available from numerous transmitters, particularly in a dense urban environment. Services can be digital or analogue.

The quality of the received signal is dependent on its strength and the level of interference, although radio services are typically more robust to interference than television signals.

3.2 Interference mechanisms

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

3.2.1 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 2 below³, taken from Section 3.2 of an Ofcom paper⁴ regarding the impact of buildings on broadcast signals.

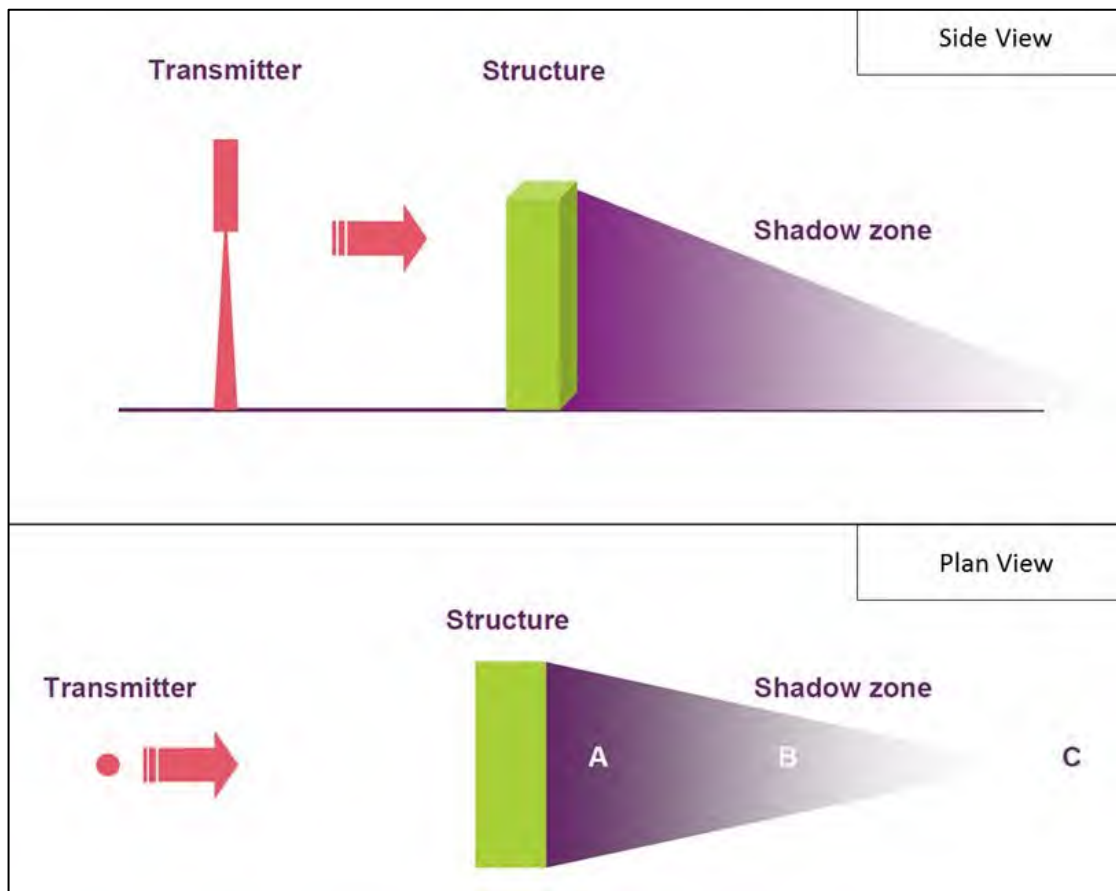


Figure 2 Diffraction loss zones

3.2.2 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.

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

⁴ Reference as above.

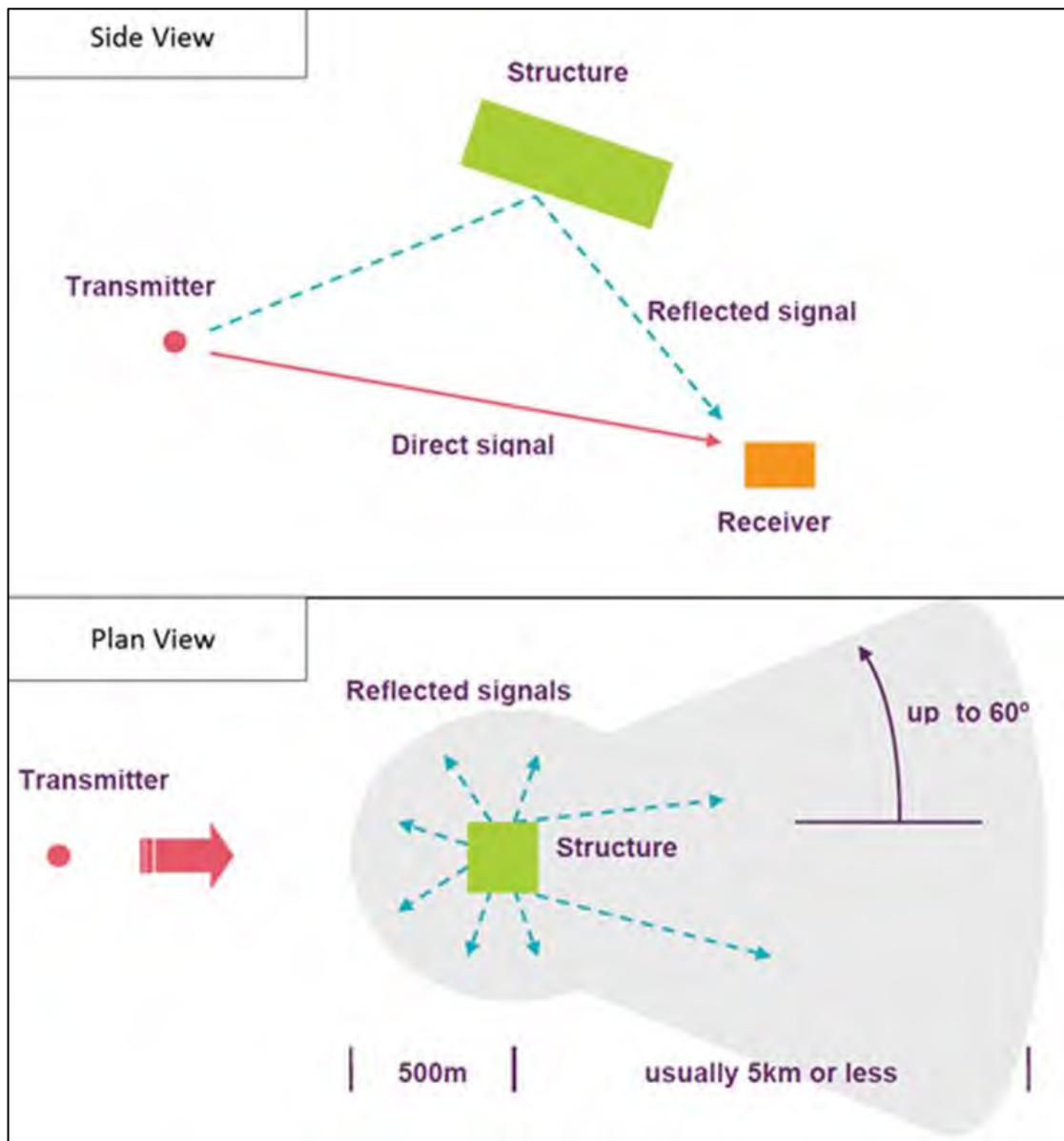


Figure 3 Reflection zones

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.

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.

3.3 Radio Interference

There is less specific guidance for radio interference within the Ofcom guidance. The following information is given:

Although reports of new structures causing problems to radio reception are rare, the possibility of difficulties cannot be ruled out entirely. Broadcast radio (FM, AM and DAB digital radio) are transmitted on lower frequencies than those used by terrestrial TV signals. Lower frequency signals tend to pass through obstructions more easily than the higher frequency TV signals, and diffraction effects also become more significant at lower frequencies. Both these factors will tend to lessen the impact of new structures on radio reception.

Strong signal reflections will reduce the quality of FM reception leading to fluttering noises or sound distortion. In contrast, the signal format used for DAB digital radio is designed to offer high levels of robustness in difficult conditions and it is not materially affected by reflections. FM and DAB reception can be affected where a structure blocks signals and both may cease to function if signals are reduced below a certain threshold.

It is Pager Power's experience that reported interference to radio services is significantly less common than reported interference to television services. Potential impacts on radio have nevertheless been considered within the analysis.

4 TECHNICAL ASSESSMENT

4.1 Potential Interference Areas

The shadow and reflection zones have been defined based on the geometry 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 below shows the potential interference areas associated with the proposed development.

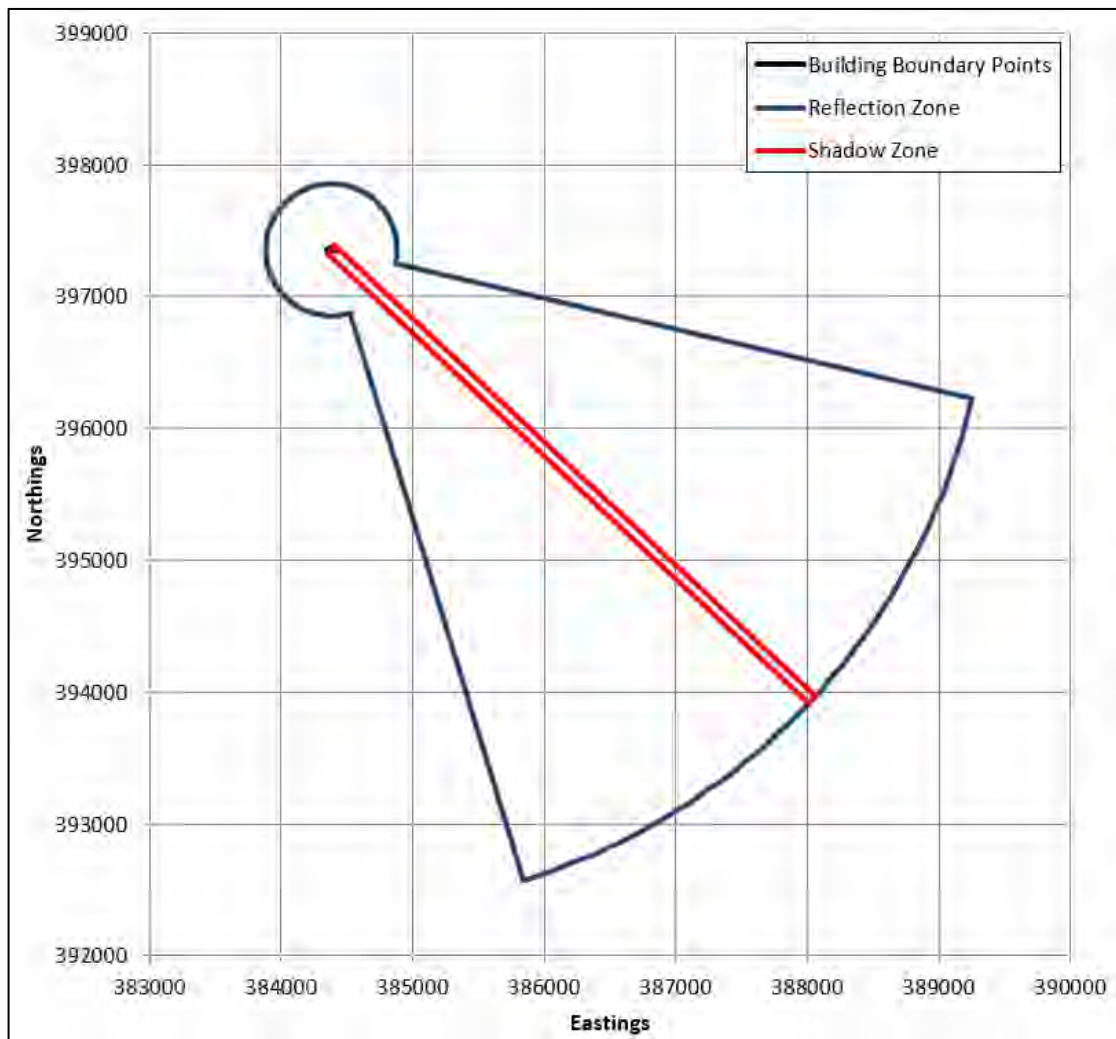


Figure 4 Interference areas

Figure 5 below shows the interference zones overlaid onto an aerial image of the area.



Figure 5 Interference zones map

4.2 Potential Diffraction Issues – Terrestrial Television

The shadow zone passes over urban areas that contain commercial and residential buildings. Areas closest to the proposed development are at the highest risk of experiencing television interference. This is typically limited to 1km based on Pager Power's assessment experience. Dwellings and multi-storey flats are located within 1km of the proposed development shadow zone.

4.3 Potential Reflection Issues – Terrestrial Television

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

The predicted coverage of the Winter Hill transmitter is generally good in the surrounding area. Interference due to reflections are most likely when:

- The receiving aerial is unobstructed by existing obstacles.
- The reflected signal path via the proposed development is unobstructed.
- The angle between the reflected signal via the proposed development and the direct signal would be small.

Interference is most likely if all of the above criteria are met. Interference is least likely if none of the above criteria are met.

In practice it is unlikely that all of the above criteria would be met for the proposed development. In particular, locations that are below radio line of sight from the transmitter are unlikely to have

an unobstructed path to the proposed development, due to their relative heights. Impacts due to reflections are considered unlikely.

4.4 Interference Areas – Radio Services

Due to the number of potential transmitters and the nature of most radio receivers (mobile), the potential interference areas are less well defined than for television services. In general terms, interference is more likely at small distances (within a few hundred metres) from the building.

5 TELEVISION AND RADIO BASELINE SURVEY

5.1 Overview

The purpose of a baseline survey is to establish current 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 (for television).
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.
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 the 16th of May 2022.

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 with Table 4 below.

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

Table 4 *Signal strength categories*

5.2 Survey Locations

Figures 7 and 8 on the following pages shows the survey locations overlaid onto aerial photography. The proposed development location and the shadow zone are also shown. 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. More readings were carried out closer to the proposed building. This is because interference is generally more likely the closer the location is to the obstruction. Television measurements were taken at survey locations 1 to 9. Radio measurements were taken at survey locations 1, north (N), east (E), and west (W).



Figure 6 Survey locations



Figure 7 Survey locations within 1km

5.3 Survey Results (Television)

A summary of the television survey results is presented in Table 5 below. 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	Average: 39.6 (Moderate) Main TV MUX: 42.7 (Moderate) Local TV MUX: 33.6 (Low)	No aerials were observed on the survey; however, a review of the available imagery indicates that there is an HP⁶ UHF⁷ aerial directed towards the Winter Hill transmitter and multiple satellite dishes located on the three-storey building adjacent to location 1. All main multiplexes displayed fine⁸ picture and audio quality, an average of moderate signal strength and signal fluctuations of less than or equal to 0.5dB. One local multiplex displayed fine picture and audio quality. Two local multiplexes did not decode. An average of low signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 183 metres from the proposed development. A three-storey building is located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. Based on the current signal quality and height of identified aerial relative to the proposed development, interference is possible.

⁶ Horizontally Polarised

⁷ Ultra-High Frequency

⁸ The picture temporarily dropped out initially for Channel 35 (BBC B) possibly due to weather conditions during the survey.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
2	Average: 40.3 (Moderate) Main TV MUX: 43.4 (Moderate) Local TV MUX: 34.0 (Low)	Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of moderate signal strength and signal fluctuations of less than or equal to 0.4dB. One local multiplex displayed fine picture and audio quality. Two local multiplexes did not decode. An average of low signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 277 metres from the proposed development. A small number of two-storey dwellings are located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. Based on the current signal quality and height of identified aerials relative to the proposed development, interference is possible.
3	Average: 43.8 (Moderate) Main TV MUX: 47.9 (Good) Local TV MUX: 35.5 (Moderate)	No UHF aerial or satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of good signal strength and signal fluctuations of less than or equal to 0.2dB. Two local multiplexes displayed fine picture and audio quality. One local multiplex did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 535 metres from the proposed development. Multi-storey flats and commercial property are located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. Significant effects are not predicted due to the height or presence of any aerials in the area.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
4	Average: 45.7 (Good) Main TV MUX: 50.1 (Good) Local TV MUX: 36.9 (Moderate)	Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of good signal strength and signal fluctuations of less than or equal to 0.3dB. All local multiplexes displayed fine picture and audio quality, an average of moderate signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 700 metres from the proposed development. Predominately two-storey dwellings are located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. This could depend on the relative height of the building development and any receiving aerials. Based on the current signal quality, significant effects are not predicted.
5	Average: 50.7 (Good) Main TV MUX: 55.9 (Very good) Local TV MUX: 40.3 (Moderate)	Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of very good signal strength and signal fluctuations of less than or equal to 0.2dB. All local multiplexes displayed fine picture and audio quality, an average of moderate signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 930 metres from the proposed development. Predominately two-storey dwellings are located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. This could depend on the relative height of the building development and any receiving aerials. Based on the current signal quality, significant effects are not predicted.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	Average: 49.9 (Good) Main TV MUX: 54.7 (Good) Local TV MUX: 40.3 (Moderate)	Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of good signal strength and signal fluctuations of less than or equal to 0.2dB. Two local multiplexes displayed fine picture and audio quality. One local multiplex did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 1.26km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable. Interference is unlikely.
7	Average: 57.3 (Very good) Main TV MUX: 63.3 (Very good) Local TV MUX: 45.5 (Good)	Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of very good signal strength and signal fluctuations of less than or equal to 0.1dB. All local multiplexes displayed fine picture and audio quality, an average of good signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 1.84km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable. Interference is unlikely.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
8	Average: 65.2 (Very good) Main TV MUX: 71.0 (Very good) Local TV MUX: 53.6 (Good)	Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of very good signal strength and signal fluctuations of less than or equal to 0.2dB. All local multiplexes displayed fine picture and audio quality, an average of good signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 3.27km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable. Interference is unlikely.
9	Average: 60.3 (Very good) Main TV MUX: 66.2 (Very good) Local TV MUX: 48.5 (Good)	Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality, an average of very good signal strength and signal fluctuations of less than or equal to 0.1dB. All local multiplexes displayed fine picture and audio quality, an average of good signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 4.9km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable. Interference is unlikely.

Table 5 Television baseline survey results

5.4 Survey Results (Radio)

Two of the four digital radio services showed very good signal strength at close range to the proposed development. Two digital radio services did not decode. FM services showed moderate to very good signal strength. Detailed results are shown in Appendix A.

Overall, some degradation of the radio signal at close range to the proposed development is possible. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

6 MITIGATION

6.1 Mitigation Requirement

If an adverse effect on television or radio services occurs and is attributable to the proposed development, mitigation may be required.

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.
- A combination of the above.
- Replacing terrestrial reception equipment with satellite reception equipment or cable.

Mitigation options for radio include:

- Re-tuning the radio.
- Relocation of the radio.
- Upgrading the aerial or the radio itself.
- Provision of an external aerial for receiving radio services.

6.2 Recommended Options

6.2.1 Television

If interference were to occur for a small number of dwellings it is likely that installation of satellite television receiver 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.

It is also possible that the television services could be supplied by an alternate transmitter in the surrounding area.

6.2.2 Radio

The most appropriate solution if radio services at residences are affected may be provision of a new radio or an external aerial.

6.3 Recommended Process

It is possible that no adverse effects will occur due to the current reception quality in the surrounding area and the scarcity of residential receptors at a low height in the immediate shadow zone.

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

7.1.1 Television

- The proposed development is within the coverage area for the Winter Hill television transmitter. The baseline survey confirmed it was the main transmitter serving the area.
- 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 the 16th of May 2022 to confirm the relevant transmitter and record the signal quality.
- The average terrestrial signal strength is good in the proposed development shadow zone for the main multiplexes and moderate on average for the local (lower power) multiplexes.
- Negative effects upon signal strength are most likely at locations close to the proposed development i.e. within 1km of the proposed development and within its shadow zone.
- A small number of two to three-storey properties are located within approximately 330m of the proposed development. The signal strength within this range was recorded as moderate for the main multiplexes, and therefore, interference is possible. Satellite dishes are present on these properties. Beyond this distance, significant effects are not predicted due to the current signal strength.

7.1.2 Radio

- The area surrounding the proposed development receives radio services from numerous transmitters, including Winter Hill. The strength and quality of the signal from Winter Hill near the proposed development are variable.
- Degradation of the radio signal at close range to the proposed development is possible. The effects are unlikely to be noticeable in practice due to the variability of services in an urban environment.

7.2 Mitigation

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.

Mitigation measures should be installed if reported effects are found to be attributable to the proposed development. Solutions are likely to be readily available if required, the most common options are presented in Section 6.

No requirement for pre-emptive mitigation has been identified.

APPENDIX A – DETAILED SURVEY RESULTS

Radio Location North

Coordinates: Lon: -2.23714, Lat: 53.47398				
Radio				
Frequency	Service	Signal Strength (dBμV)	Typical Fluctuation (dBμV)	Audio
220.352 MHz	CE Manchester	23	0.2	DND ⁹
222.064 MHz	Digital One	63.8	0.6	Fine
223.936 MHz	Bauer Central Lancashire	23.5	0.2	DND
225.648 MHz	BBC National DAB	63.0	0.5	Fine
88-106 MHz	Various FM	39.8	0.1	Fine

Radio Location East

Coordinates: Lon: -2.23442, Lat: 53.47396				
Radio				
Frequency	Service	Signal Strength (dBμV)	Typical Fluctuation (dBμV)	Audio
220.352 MHz	CE Manchester	24.9	0.4	DND
222.064 MHz	Digital One	75.8	0.6	Fine
223.936 MHz	Bauer Central Lancashire	25.0	0.3	DND
225.648 MHz	BBC National DAB	76.5	0.4	Fine
88-106 MHz	Various FM	41.7	0.1	Fine

⁹ Did not decode.

Radio Location West

Coordinates: Lon: -2.23800, Lat: xxx 53.47252				
Radio				
Frequency	Service	Signal Strength (dBμV)	Typical Fluctuation (dBμV)	Audio
220.352 MHz	CE Manchester	23.0	0.2	DND
222.064 MHz	Digital One	62.7	0.3	Fine
223.936 MHz	Bauer Central Lancashire	23.8	0.2	DND
225.648 MHz	BBC National DAB	65.5	0.3	Fine
88-106 MHz	Various FM	59.2	0.1	Fine

Location 1

Coordinates: Lon: -2.23497, Lat: 53.47124					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	33.5 +/- 0.2	2.2×10^{-3}	Fine	Fine
27	Glmux	32.7 +/- 0.2	DND	-	-
29	SDN	43.0 +/- 0.2	7.5×10^{-5}	Fine	Fine
31	Arqiva A	43.3 +/- 0.2	1×10^{-4}	Fine	Fine
32	BBC A	42.2 +/- 0.2	3×10^{-5}	Fine	Fine
34	Digital 3&4	40.9 +/- 0.4	3.4×10^{-4}	Fine	Fine
35-	BBC B	42.8 +/- 0.5	1×10^{-7}	Fine ¹⁰	Fine
37	Arqiva B	43.7 +/- 0.2	2×10^{-5}	Fine	Fine
55	Arqiva C	34.7 +/- 0.1	DND	-	-

Notes: No aerials observed on survey; however, a review of the available imagery indicates that there is a HP UHF aerial directed towards the Winter Hill transmitter and multiple satellite dishes located on the three-storey building adjacent to location 1.

¹⁰ Picture dropped out initially possibly due to weather conditions during survey.

Coordinates: Lon: -2.23497, Lat: 53.47124				
Radio				
Frequency	Service	Signal Strength (dBμV)	Typical Fluctuation (dBμV)	Audio
220.352 MHz	CE Manchester	23.1	0.2	DND
222.064 MHz	Digital One	62.7	0.3	Fine
223.936 MHz	Bauer Central Lancashire	22.8	0.3	DND
225.648 MHz	BBC National DAB	60.4	0.3	Fine
88-106 MHz	Various FM	42.5	0.2	Fine

Location 2

Coordinates: Lon: -2.23330, Lat: 53.47091					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	34.4 +/- 0.1	1.5×10^{-5}	Fine	Fine
27	Glmux	33.0 +/- 0.1	DND	-	-
29	SDN	44.0 +/- 0.2	2.5×10^{-5}	Fine	Fine
31	Arqiva A	42.8 +/- 0.4	1.3×10^{-4}	Fine	Fine
32	BBC A	44.8 +/- 0.1	1.2×10^{-5}	Fine	Fine
34	Digital 3&4	43.4 +/- 0.1	4.5×10^{-7}	Fine	Fine
35-	BBC B	43.0 +/- 0.2	1×10^{-8}	Fine	Fine
37	Arqiva B	42.2 +/- 0.2	3×10^{-5}	Fine	Fine
55	Arqiva C	34.7 +/- 0.1	DND	-	-

Notes: Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 3

Coordinates: Lon: -2.23052, Lat: 53.46930					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	34.5 +/- 0.1	4x10 ⁻⁷	Fine	Fine
27	Glmux	33.2 +/- 0.1	DND	-	-
29	SDN	49.0 +/- 0.2	1x10 ⁻⁸	Fine	Fine
31	Arqiva A	47.0 +/- 0.2	3x10 ⁻⁸	Fine	Fine
32	BBC A	47.9 +/- 0.2	1x10 ⁻⁸	Fine	Fine
34	Digital 3&4	49.0 +/- 0.1	1x10 ⁻⁸	Fine	Fine
35-	BBC B	47.4 +/- 0.2	1x10 ⁻⁸	Fine	Fine
37	Arqiva B	47.2 +/- 0.1	1x10 ⁻⁸	Fine	Fine
55	Arqiva C	38.8 +/- 0.1	1x10 ⁻⁸	Fine	Fine

Notes: No UHF aerial or satellite dishes were observed.

Location 4

Coordinates: Lon: -2.22880, Lat: 53.46825					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	36.2 +/- 0.1	1×10^{-8}	Fine	Fine
27	Glmux	34.5 +/- 0.2	2.2×10^{-3}	Fine	Fine
29	SDN	52.7 +/- 0.2	1×10^{-8}	Fine	Fine
31	Arqiva A	51.2 +/- 0.2	1×10^{-8}	Fine	Fine
32	BBC A	51.1 +/- 0.1	1×10^{-8}	Fine	Fine
34	Digital 3&4	51.0 +/- 0.2	1×10^{-8}	Fine	Fine
35-	BBC B	48.4 +/- 0.3	1×10^{-8}	Fine	Fine
37	Arqiva B	46.0 +/- 0.1	1.5×10^{-7}	Fine	Fine
55	Arqiva C	40.1 +/- 0.1	1×10^{-8}	Fine	Fine

Notes: Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 5

Coordinates: Lon: -2.22629, Lat: 53.46689					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	39.3 +/- 0.2	1x10 ⁻⁸	Fine	Fine
27	Glmux	38.2 +/- 0.1	1x10 ⁻⁸	Fine	Fine
29	SDN	55.7 +/- 0.2	1x10 ⁻⁸	Fine	Fine
31	Arqiva A	58.0 +/- 0.1	1x10 ⁻⁸	Fine	Fine
32	BBC A	57.4 +/- 0.2	1x10 ⁻⁸	Fine	Fine
34	Digital 3&4	55.1 +/- 0.1	1x10 ⁻⁸	Fine	Fine
35-	BBC B	55.2 +/- 0.1	1x10 ⁻⁸	Fine	Fine
37	Arqiva B	54.0 +/- 0.2	1x10 ⁻⁸	Fine	Fine
55	Arqiva C	43.4 +/- 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 6

Coordinates: Lon: -2.22279, Lat: 53.46482					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	38.0 +/- 0.1	1x10 ⁻⁸	Fine	Fine
27	Glmux	34.0 +/- 0.1	DND	-	-
29	SDN	50.8 +/- 0.1	1x10 ⁻⁸	Fine	Fine
31	Arqiva A	54.4 +/- 0.1	1x10 ⁻⁸	Fine	Fine
32	BBC A	54.1 +/- 0.1	1x10 ⁻⁸	Fine	Fine
34	Digital 3&4	56.7 +/- 0.2	1x10 ⁻⁸	Fine	Fine
35-	BBC B	55.8 +/- 0.1	1x10 ⁻⁸	Fine	Fine
37	Arqiva B	56.3 +/- 0.1	1x10 ⁻⁸	Fine	Fine
55	Arqiva C	48.8 +/- 0.2	1x10 ⁻⁸	Fine	Fine

Notes: Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 7

Coordinates: Lon: -2.21618, Lat: 53.46138					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	45.8 +/- 0.1	1x10 ⁻⁸	Fine	Fine
27	Glmux	37.3 +/- 0.1	1x10 ⁻⁸	Fine	Fine
29	SDN	64.0 +/- 0.1	1x10 ⁻⁸	Fine	Fine
31	Arqiva A	64.6 +/- 0.1	1x10 ⁻⁸	Fine	Fine
32	BBC A	64.3 +/- 0.1	1x10 ⁻⁸	Fine	Fine
34	Digital 3&4	63.0 +/- 0.1	1x10 ⁻⁸	Fine	Fine
35-	BBC B	62.2 +/- 0.1	1x10 ⁻⁸	Fine	Fine
37	Arqiva B	61.6 +/- 0.1	1x10 ⁻⁸	Fine	Fine
55	Arqiva C	53.3 +/- 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 8

Coordinates: Lon: -2.20015, Lat: 53.45281					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	53.8 +/- 0.1	1x10 ⁻⁸	Fine	Fine
27	Glmux	47.2 +/- 0.1	1x10 ⁻⁸	Fine	Fine
29	SDN	71.3 +/- 0.1	1x10 ⁻⁸	Fine	Fine
31	Arqiva A	71.4 +/- 0.1	1x10 ⁻⁸	Fine	Fine
32	BBC A	70.6 +/- 0.2	1x10 ⁻⁸	Fine	Fine
34	Digital 3&4	70.6 +/- 0.1	1x10 ⁻⁸	Fine	Fine
35-	BBC B	70.9 +/- 0.2	1x10 ⁻⁸	Fine	Fine
37	Arqiva B	70.9 +/- 0.1	1x10 ⁻⁸	Fine	Fine
55	Arqiva C	59.9 +/- 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

Location 9

Coordinates: Lon: -2.18264, Lat: 53.44255					
Television					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	47.0 +/- 0.2	1x10 ⁻⁸	Fine	Fine
27	Glmux	44.7 +/- 0.1	1x10 ⁻⁹	Fine	Fine
29	SDN	65.9 +/- 0.1	1x10 ⁻⁸	Fine	Fine
31	Arqiva A	65.6 +/- 0.1	1x10 ⁻⁸	Fine	Fine
32	BBC A	65.9 +/- 0.1	1x10 ⁻⁸	Fine	Fine
34	Digital 3&4	66.0 +/- 0.1	1x10 ⁻⁸	Fine	Fine
35-	BBC B	65.7 +/- 0.1	1x10 ⁻⁸	Fine	Fine
37	Arqiva B	68.1 +/- 0.1	1x10 ⁻⁸	Fine	Fine
55	Arqiva C	53.9 +/- 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Multiple HP UHF aerial directed towards the Winter Hill transmitter was observed.
Multiple satellite dishes were observed.

APPENDIX B – SURVEY PHOTOGRAPHS

Location North



Location East



Location West



Location 1



Location 2



Location 3



Location 4



Location 5



Location 6



Location 7



Location 8



Location 9





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