

Television Post-Construction Survey Report

Mobility Hub, Manchester

Bowmer + Kirkland Limited

November 2024

PLANNING SOLUTIONS FOR:

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ADMINISTRATION PAGE

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to undertake a post-construction terrestrial television reception survey for the Mobility Hub development located in Ancoats, Manchester. The development consists of a multi-story car parking facility with a maximum altitude¹ of 29.275m above ground level (agl).

This report presents the results of the original baseline reception survey (completed in March 2021), and the post-construction reception survey (completed in October 2024). The post-construction survey was completed so that comparisons, between the baseline and post-construction cases, could be made to determine whether there has been a significant impact upon terrestrial television signal in the surrounding area. Survey measurements were taken in the development's shadow zone and the original locations were revisited as best as possible. This assessment has been undertaken based on guidance produced by Ofcom.

Conclusions

Overall, the average signal strength across the surveyed locations increased between measurements of the baseline and post-construction readings. Considering readings within 1km of the development (the immediate shadow zone), a minor reduction in average signal strength was observed, however the main channels retained a "Very Good" strength, and local channels retained "Moderate" strength. The decrease is not considered significant and all channels maintained a fine quality of picture and audio. Readings taken beyond 1km observed an increase in signal strength between baseline and post-construction readings.

Therefore, significant interference, associated with the development was observed. Mitigation is not expected to be necessary for the development.

¹ Source: 45306-BUT-ZZ-ZZ-DR-A-2012-West Elevation (8).pdf
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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 60 countries within Europe, Africa, America, Asia and Oceania.

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 undertake a post-construction terrestrial television reception survey for the Mobility Hub development located in Ancoats, Manchester. The development consists of a multi-story car parking facility with a maximum altitude² of 29.275m above ground level (agl).

This report presents the results of the original baseline reception survey (completed in March 2021), and the post-construction reception survey (completed in October 2024). The post-construction survey was completed so that comparisons, between the baseline and post-construction cases, could be made to determine whether there has been a significant impact upon terrestrial television signals in the surrounding area. Survey measurements were taken in the development's shadow zone and the original locations were revisited as best as possible. This assessment has been undertaken based on guidance produced by Ofcom.

1.2 Development Details

The corner coordinates³ of the development are shown in Figure 1 below.

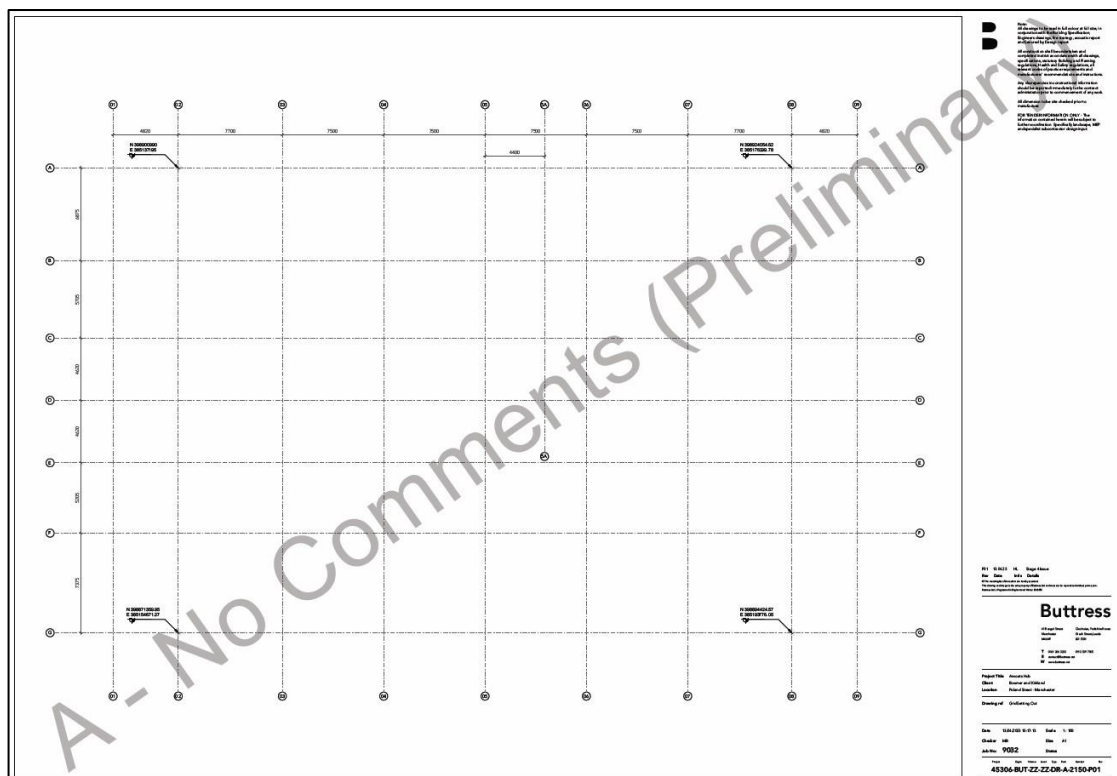


Figure 1 Corner coordinates of development

² Source: 45306-BUT-ZZ-ZZ-DR-A-2012-West Elevation (8).pdf

³ Source: 45306-BUT-ZZ-ZZ-DR-A-2150-Grid Setting Out.pdf

A building outline has been extrapolated from the corner coordinates and is shown in blue, overlaid upon aerial imagery, in Figure 2 below.



Figure 2 Building outline, overlaid upon aerial imagery

Figure 3 below shows Streetview imagery (dated July 2024) of the development nearing completion.

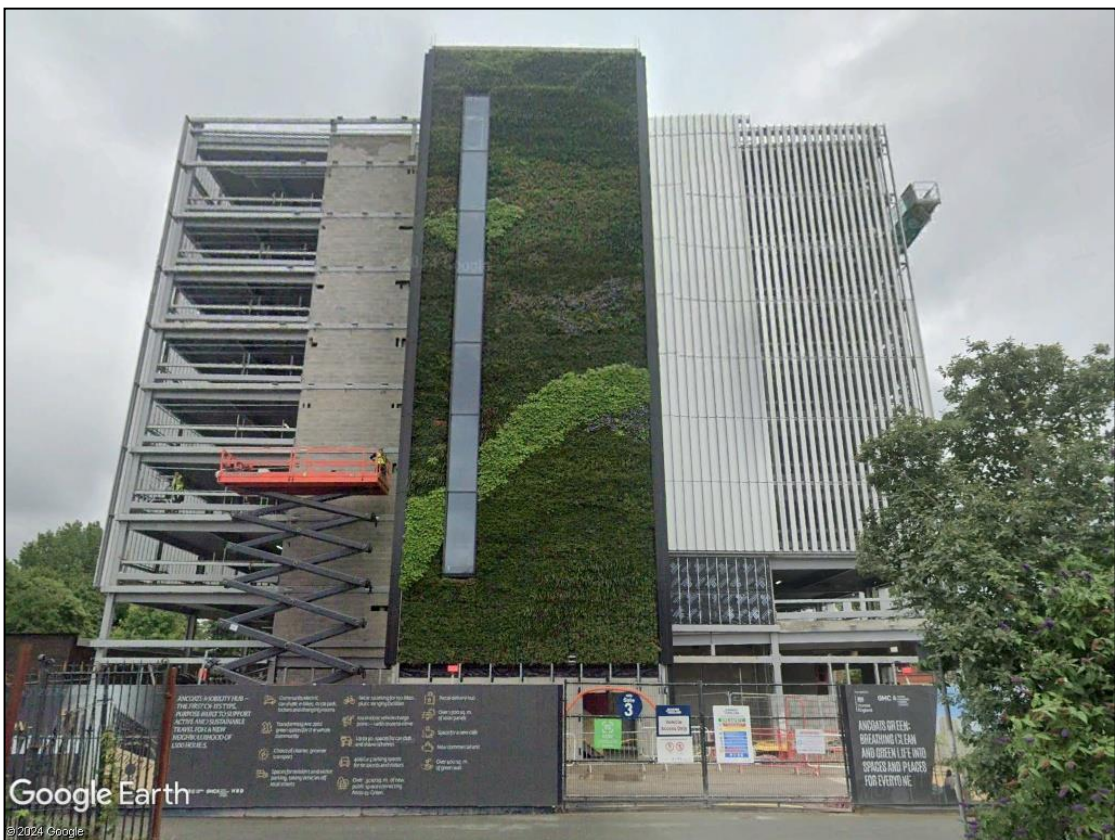


Figure 3 Streetview imagery of constructed development

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 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. The transmitter information is presented below⁴.

2.2 Winter Hill Main Transmitter

Channels 21 and 55 (which were surveyed during the baseline survey) are no longer providing services. All other channels remain the same as the baseline survey.

2.2.1 Baseline Survey Channels

The channels broadcast by Winter Hill during the baseline survey are presented in Tables 1 and 2 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

	Local Multiplexes			
Service	COM 4	LTVmux	Glmux	COM 7
Channel	21	24	27	55
Power	3 kW	2 kW	1 kW	25.7kW

Table 2 Winter Hill additional transmissions (local multiplexes)

⁴ Source: Ofcom

2.2.2 Post-Construction Survey Channels

The channels broadcast by Winter Hill during the post-construction survey are presented in Tables 3 and 4 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 3 Winter Hill main transmissions

	Local Multiplexes	
Service	LTVmux	Glmux
Channel	24	27
Power	2 kW	1 kW

Table 4 Winter Hill additional transmissions (local multiplexes)

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.

3.2 Interference Mechanisms

There are two ways that buildings can cause interference to television 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 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 4 on the following page⁵, taken from Section 3.2 of an Ofcom paper⁶ regarding the impact of buildings on broadcast signals.

⁵ Source: Ofcom (2009): Tall Structures and their impact on broadcast and other wireless services.

⁶ Reference as above.

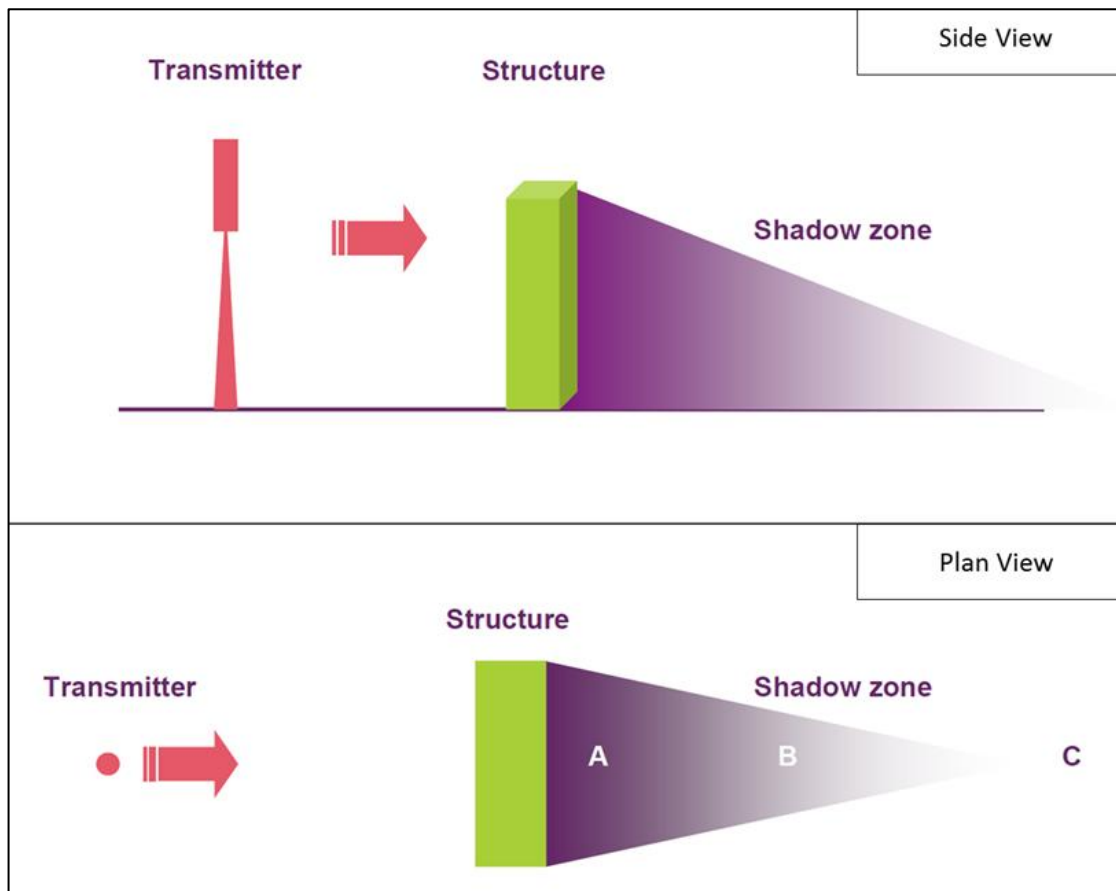


Figure 4 Diffraction loss zones

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

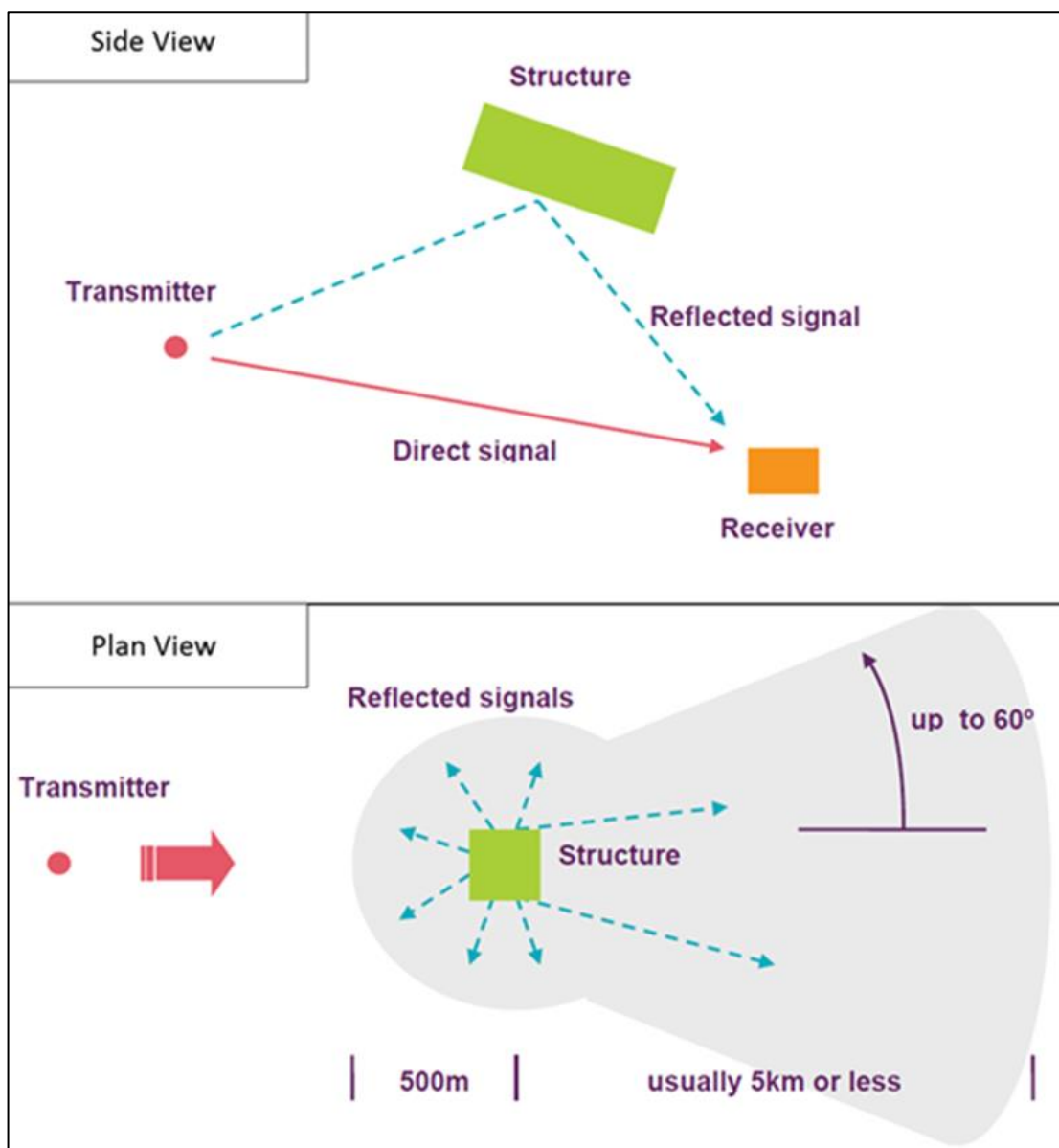


Figure 5 Reflection zones

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 degrees⁷.

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.

⁷ 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.

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

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 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 4 in the previous section. Figure 6 below shows the potential interference areas associated with the development.

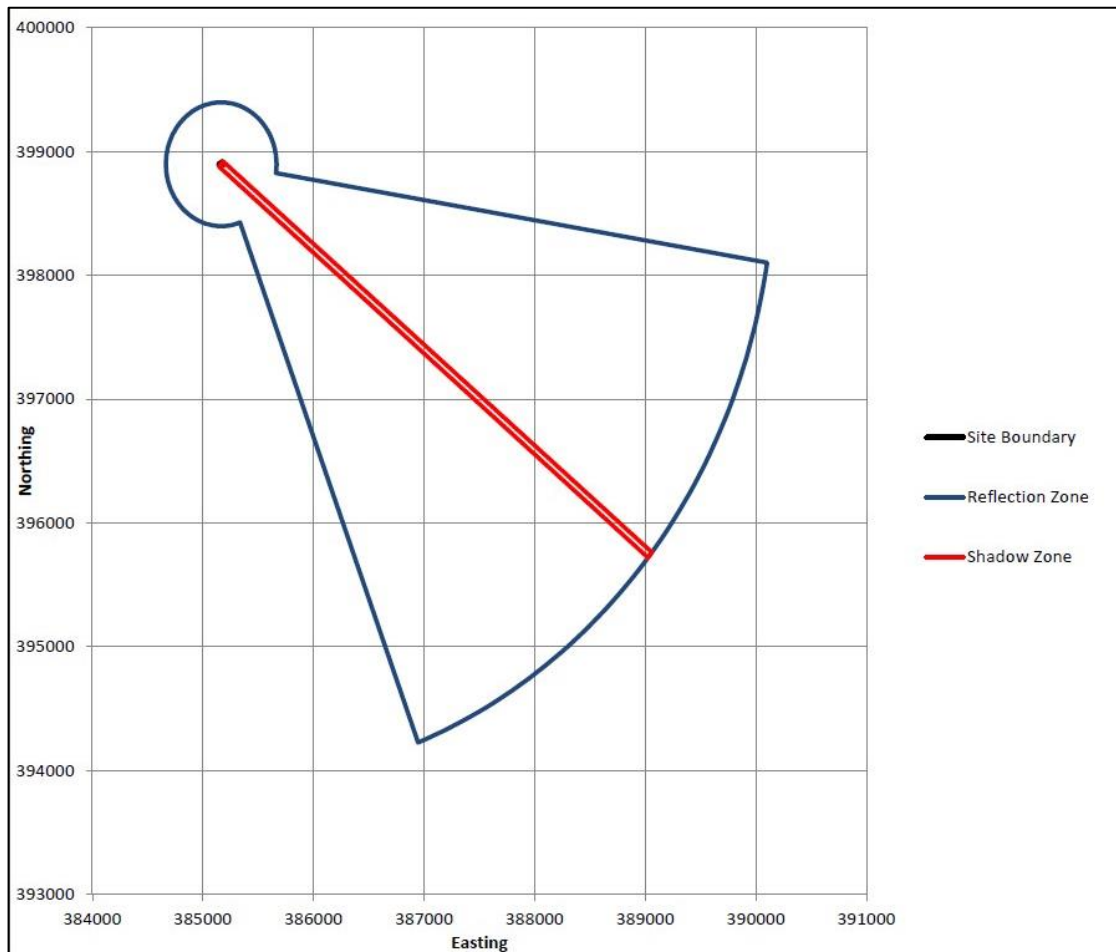


Figure 6 Interference areas

Figure 7 below shows the interference zones overlaid onto aerial imagery.



Figure 7 Interference zones map

4.2 Potential Diffraction Issues

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

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.

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 development is unobstructed;
- The angle between the reflected signal via the development and the direct signal is 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 development. In particular, locations that are below radio line of sight from the transmitter are unlikely to have an unobstructed path to the development, due to their relative heights. Impacts due to reflections are considered unlikely.

5 TELEVISION BASELINE AND POST-CONSTRUCTION SURVEY

5.1 Overview

The purpose of the baseline survey was to establish signal strength and quality in the area before the development was built. The baseline reception 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.

The post-construction survey has been completed so that comparisons, between the old baseline and the new baseline, could be made to determine whether there has been a significant impact upon terrestrial television signals in the surrounding area. A baseline television reception survey was undertaken for the development on the 5th March 2021. The post-construction survey was undertaken for the development on the 14th of October 2024.

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 5 below.

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

Table 5 *Signal strength categories*

5.2 Survey Locations

Figure 8 on the following pages show the survey locations overlaid onto aerial photography. The proposed development location and the shadow zone are also shown. The survey locations chosen for the baseline survey were revisited as best as possible for the post-construction survey⁸. The locations below show the actual survey locations.

⁸ Safe and available access influenced the specific position on the day. Post-construction survey locations are within 40m of the baseline survey locations.

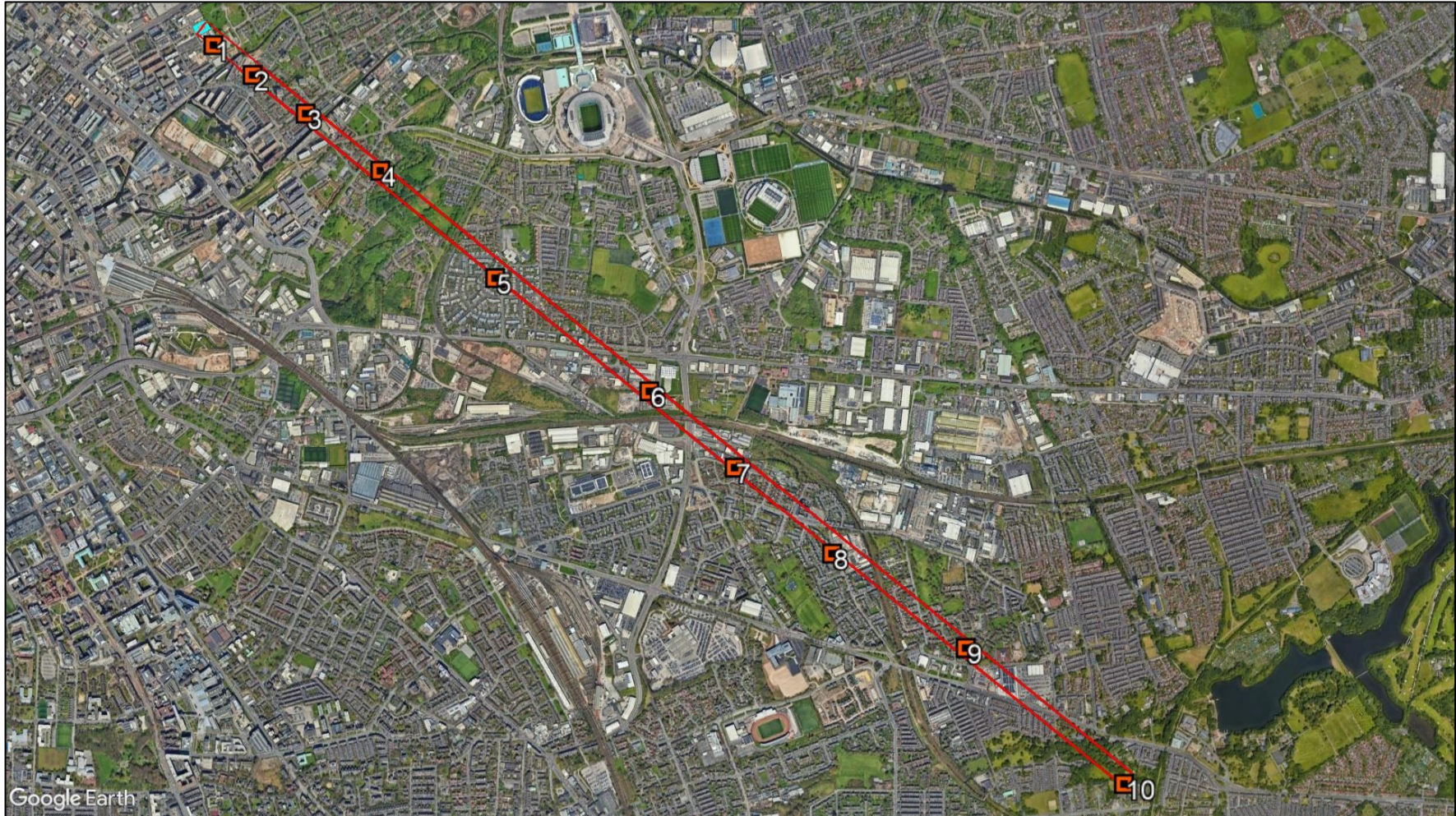


Figure 8 Survey locations

5.3 Survey Results

Full post-construction survey results are shown in Appendix A. Post-construction survey photographs are shown in Appendix B. Full baseline surveys results and survey photographs are shown in Appendixes C and D respectively.

A summary of the television survey results is presented in Table 6 below and on the following pages.

Survey Location	Baseline Average Measured Signal Strength (dB)	Post-Construction Average Measured Signal Strength (dB)	Remarks
1	<p>Average: 53.1 (Good)</p> <p>Main TV MUX: 61.0 (Very Good)</p> <p>Local TV MUX: 41.3 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p>	<p>Average: 58.5 (Very Good)</p> <p>Main TV MUX: 63.1 (Very Good)</p> <p>Local TV MUX: 44.7 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p>	<p>A reduction in the average multiplex signal strength was not observed.</p> <p>There are no dwellings currently present at this location and therefore it is unlikely that terrestrial television interference would be experienced.</p> <p>Considering the signal strength and quality of picture and audio, significant interference associated with the development, was not observed.</p>

Survey Location	Baseline Average Measured Signal Strength (dB)	Post-Construction Average Measured Signal Strength (dB)	Remarks
2	<p>Average: 53.3 (Good)</p> <p>Main TV MUX: 60.8 (Very Good)</p> <p>Local TV MUX: 42.2 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>Average: 51.6 (Good)</p> <p>Main TV MUX: 56.1 (Very Good)</p> <p>Local TV MUX: 38.1 (Moderate)</p> <p>All main multiplexes displayed fine picture and audio quality, with signal fluctuations of less than or equal to 0.3dB.</p> <p>One local multiplexes displayed fine picture and audio quality. The remaining local multiplex displayed intermittent picture quality and fine audio quality, with signal fluctuations of less than 0.2dB.</p>	<p>A minor reduction in the average main and local multiplex signal strength was observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, significant interference associated with the development, was not observed.</p>

Survey Location	Baseline Average Measured Signal Strength (dB)	Post-Construction Average Measured Signal Strength (dB)	Remarks
3	<p>Average: 62.7 (Very Good)</p> <p>Main TV MUX: 70.0 (Very Good)</p> <p>Local TV MUX: 51.7 (Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>Average: 50.8 (Good)</p> <p>Main TV MUX: 54.6 (Good)</p> <p>Local TV MUX: 39.7 (Moderate)</p> <p>All main multiplexes, and three local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.3dB and no signs of interference.</p> <p>One local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB. One local multiplex did not decode at this location.</p>	<p>A reduction in the average main and local multiplex signal strength was observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, significant interference associated with the development, was not observed.</p>

Survey Location	Baseline Average Measured Signal Strength (dB)	Post-Construction Average Measured Signal Strength (dB)	Remarks
4	<p>Average: 42.5 (Moderate)</p> <p>Main TV MUX: 48.8 (Good)</p> <p>Local TV MUX: 33.2 (Low)</p> <p>All main multiplexes, and three local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p> <p>One local multiplex did not decode at this location.</p>	<p>Average: 44.3 (Moderate)</p> <p>Main TV MUX: 48.7 (Good)</p> <p>Local TV MUX: 30.9 (Low)</p> <p>All main multiplexes, and three local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p> <p>One local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.3dB. One local multiplex did not decode at this location.</p>	<p>A minor reduction in the average main and local multiplex signal strength was observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, significant interference associated with the development, was not observed.</p>
5	<p>Average: 53.2 (Good)</p> <p>Main TV MUX: 61.2 (Very Good)</p> <p>Local TV MUX: 41.3 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>Average: 60.2 (Very Good)</p> <p>Main TV MUX: 65.6 (Very Good)</p> <p>Local TV MUX: 43.9 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p>	<p>A reduction in the average multiplex signal strength was not observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, and distance from the development, significant interference associated with the development, was not observed.</p>

Survey Location	Baseline Average Measured Signal Strength (dB)	Post-Construction Average Measured Signal Strength (dB)	Remarks
6	<p>Average: 52.3 (Good)</p> <p>Main TV MUX: 59.4 (Very Good)</p> <p>Local TV MUX: 41.6 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p>	<p>Average: 69.8 (Very Good)</p> <p>Main TV MUX: 74.9 (Very Good)</p> <p>Local TV MUX: 54.7 (Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>A reduction in the average multiplex signal strength was not observed.</p> <p>There are no dwellings currently present at this location and therefore it is unlikely that terrestrial television interference would be experienced.</p> <p>Considering the signal strength and quality of picture and audio, and distance from the development, significant interference associated with the development, was not observed.</p>
7	<p>Average: 61.6 (Very Good)</p> <p>Main TV MUX: 70.1 (Very Good)</p> <p>Local TV MUX: 48.8 (Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>Average: 65.4 (Very Good)</p> <p>Main TV MUX: 69.7 (Very Good)</p> <p>Local TV MUX: 52.5 (Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>A reduction in the average multiplex signal strength was not observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, and distance from the development, significant interference associated with the development, was not observed.</p>

Survey Location	Baseline Average Measured Signal Strength (dB)	Post-Construction Average Measured Signal Strength (dB)	Remarks
8	<p>Average: 63.2 (Very Good)</p> <p>Main TV MUX: 71.0 (Very Good)</p> <p>Local TV MUX: 51.3 (Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>Average: 69.9 (Very Good)</p> <p>Main TV MUX: 73.1 (Very Good)</p> <p>Local TV MUX: 60.4 (Very Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p>	<p>A reduction in the average main multiplex signal strength was not observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, and distance from the development, significant interference associated with the development, was not observed.</p>
9	<p>Average: 57.7 (Very Good)</p> <p>Main TV MUX: 65.6 (Very Good)</p> <p>Local TV MUX: 45.8 (Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.1dB and no signs of interference.</p>	<p>Average: 66.7 (Very Good)</p> <p>Main TV MUX: 72 (Very Good)</p> <p>Local TV MUX: 50.9 (Good)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p>	<p>A reduction in the average main multiplex signal strength was not observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, and distance from the development, significant interference associated with the development, was not observed.</p>

Survey Location	Baseline Average Measured Signal Strength (dB)	Post-Construction Average Measured Signal Strength (dB)	Remarks
10	<p>Average: 54.6 (Good)</p> <p>Main TV MUX: 62.5 (Very Good)</p> <p>Local TV MUX: 42.8 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.2dB and no signs of interference.</p>	<p>Average: 56.1 (Very Good)</p> <p>Main TV MUX: 60.2 (Very Good)</p> <p>Local TV MUX: 43.7 (Moderate)</p> <p>All main and local multiplexes displayed fine picture and audio quality, with signal fluctuations of less than 0.3dB and no signs of interference.</p>	<p>A minor reduction in the average main multiplex signal strength not observed.</p> <p>A number of dwellings are present which are circa two to three storeys in height. Considering the signal strength and quality of picture and audio, and distance from the development, significant interference associated with the development, was not observed.</p>

Table 6 Television survey results

5.4 Survey Results Conclusions

Overall, the average signal strength across the surveyed locations increased between measurements of the baseline and post-construction readings. Considering readings within 1km of the development (the immediate shadow zone), a minor reduction in average signal strength was observed, however the main channels retained a “Very Good” strength, and local channels retained “Moderate” strength. The decrease is not considered significant and all channels maintained a fine quality of picture and audio. Readings taken beyond 1km observed an increase in signal strength between baseline and post-construction readings.

Therefore, significant interference, associated with the development was observed. Mitigation is not expected to be necessary for the development.

6 MITIGATION

6.1 Mitigation Requirement

Mitigation is not expected to be required for the development. Common options are shown below for reference. The most effective form of mitigation is dependent on the specific impact.

Mitigation options 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, internet television, or cable.

6.2 Recommended Options

In general, if interference occurs for a small number of dwellings, it is likely that the installation of a satellite television receiver would be the most suitable option. Whereas, 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.

6.3 Recommended Process

Any reported television interference within the immediate shadow should be investigated by means of a reception measurement. Based upon findings of this report, mitigation is not expected to be required.

7 CONCLUSIONS

7.1 Conclusions

Overall, the average signal strength across the surveyed locations increased between measurements of the baseline and post-construction readings. Considering readings within 1km of the development (the immediate shadow zone), a minor reduction in average signal strength was observed, however the main channels retained a “Very Good” strength, and local channels retained “Moderate” strength. The decrease is not considered significant and all channels maintained a fine quality of picture and audio. Readings taken beyond 1km observed an increase in signal strength between baseline and post-construction readings.

Therefore, significant interference, associated with the development was observed. Mitigation is not expected to be necessary for the development.

APPENDIX A – POST-CONSTRUCTION SURVEY RESULTS

Location 1

GPS Coordinates: 53.48597, -2.22418				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	46.2 ± 0.2	1x10 ⁻⁸	Fine	Fine
27	43.3 ± 0.2	1x10 ⁻⁶	Fine	Fine
29	65.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	66.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	64.5 ± 0.2	1x10 ⁻⁸	Fine	Fine
34	62.6 ± 0.2	1x10 ⁻⁸	Fine	Fine
35	61.1 ± 0.2	1x10 ⁻⁸	Fine	Fine
37	59.4 ± 0.1	8x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised Ultra High Frequency (UHF) aerials directed towards the Winter Hill transmitter were observed at this location.

Location 2

GPS Coordinates: 53.48486, -2.22171				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	39.5 ± 0.2	1x10 ⁻⁷	Fine	Fine
27	36.8 ± 0.2	1x10 ⁻³	Intermittent	Fine
29	56.9 ± 0.3	4x10 ⁻⁸	Fine	Fine
31	55.7 ± 0.3	3x10 ⁻⁸	Fine	Fine
32	57.8 ± 0.2	1x10 ⁻⁸	Fine	Fine
34	54.5 ± 0.3	1x10 ⁻⁷	Fine	Fine
35	58.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	53.2 ± 0.2	5x10 ⁻⁵	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 3

GPS Coordinates: 53.48340, -2.21833				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	41.4 ± 0.2	1x10 ⁻⁸	Fine	Fine
27	38.0 ± 0.1	DND ⁹	DND	DND
29	55.9 ± 0.2	4x10 ⁻⁸	Fine	Fine
31	53.3 ± 0.3	3x10 ⁻⁶	Fine	Fine
32	53.9 ± 0.2	1x10 ⁻⁸	Fine	Fine
34	55.2 ± 0.2	1x10 ⁻⁸	Fine	Fine
35	54.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	54.6 ± 0.2	3x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

⁹ Did not decode.

Location 4

GPS Coordinates: 53.48126, -2.21364				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	30.6 ± 0.2	1x10 ⁻³	Fine	Fine
27	31.2 ± 0.1	DND	DND	DND
29	47.2 ± 0.2	1x10 ⁻⁶	Fine	Fine
31	44.0 ± 0.2	6x10 ⁻⁵	Fine	Fine
32	46.9 ± 0.2	4x10 ⁻⁸	Fine	Fine
34	51.4 ± 0.2	1x10 ⁻⁸	Fine	Fine
35	53.3 ± 0.3	1x10 ⁻⁸	Fine	Fine
37	49.9 ± 0.2	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 5

GPS Coordinates: 53.47720, -2.20633				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	47.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
27	40.0 ± 0.2	1x10 ⁻⁸	Fine	Fine
29	65.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	66.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	66.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	66.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	64.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	64.6 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 6

GPS Coordinates: 53.47294, -2.19658				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	56.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
27	52.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	74.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	75.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	75.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	75.2 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	74.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	74.0 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: No horizontally or vertically polarised aerials or satellite dishes were observed at this location.

Location 7

GPS Coordinates: 53.47007, -2.19118				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	55.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
27	49.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	70.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	70.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	70.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	69.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	69.5 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	68.6 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 8

GPS Coordinates: 53.46684, -2.18502				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	62.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
27	58.5 ± 0.2	1x10 ⁻⁸	Fine	Fine
29	74.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	74.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	73.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	74.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	71.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	70.3 ± 0.1	4x10 ⁻⁹	Fine	Fine

Notes: No horizontally or vertically polarised aerials were observed, satellite dishes were observed at this location.

Location 9

GPS Coordinates: 53.46330, -2.17660				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	52.8 ± 0.2	1x10 ⁻⁸	Fine	Fine
27	49.0 ± 0.2	1x10 ⁻⁸	Fine	Fine
29	71.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	72.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	72.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	72.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	72.5 ± 0.2	1x10 ⁻⁸	Fine	Fine
37	71.5 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 10

GPS Coordinates: 53.45820, -2.16664				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
24	45.0 ± 0.2	1x10 ⁻⁸	Fine	Fine
27	42.4 ± 0.2	1x10 ⁻⁸	Fine	Fine
29	62.2 ± 0.2	1x10 ⁻⁸	Fine	Fine
31	62.8 ± 0.2	1x10 ⁻⁸	Fine	Fine
32	62.7 ± 0.2	1x10 ⁻⁸	Fine	Fine
34	61.0 ± 0.2	1x10 ⁻⁸	Fine	Fine
35	56.7 ± 0.3	1x10 ⁻⁸	Fine	Fine
37	56.1 ± 0.2	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

APPENDIX B – POST-CONSTRUCTION SURVEY PHOTOGRAPHS

Location 1



Location 2



Location 3



Location 4



Location 5



Location 6



Location 7



Location 8



Location 9



Location 10



APPENDIX C – BASELINE SURVEY RESULTS

Location 1

GPS Coordinates: 53.48607, -2.22444				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	31.5 ± 0.2	1x10 ⁻⁶	Fine	Fine
24	43.0 ± 0.2	1x10 ⁻⁷	Fine	Fine
27	41.6 ± 0.1	1x10 ⁻⁷	Fine	Fine
29	60.9 ± 0.2	1x10 ⁻⁸	Fine	Fine
31	62.6 ± 0.2	1x10 ⁻⁸	Fine	Fine
32	62.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	60.5 ± 0.2	1x10 ⁻⁸	Fine	Fine
35	59.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	60.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	49.2 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised Ultra High Frequency (UHF) aerials directed towards the Winter Hill transmitter were observed at this location.

Location 2

GPS Coordinates: 53.48485, -2.22183				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	32.1 ± 0.1	5x10 ⁻⁷	Fine	Fine
24	45.6 ± 0.1	1x10 ⁻⁷	Fine	Fine
27	35.1 ± 0.1	1x10 ⁻⁴	Fine	Fine
29	53.5 ± 0.1	2.4x10 ⁻⁸	Fine	Fine
31	66.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	65.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	58.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	54.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	66.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	56.0 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 3

GPS Coordinates: 53.48374, -2.21831				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	42.2 ± 0.1	1x10 ⁻⁸	Fine	Fine
24	54.4 ± 0.1	1x10 ⁻⁷	Fine	Fine
27	52.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	68.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	71.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	70.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	68.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	69.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	70.8 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	58.1 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 4

GPS Coordinates: 53.48123, -2.21366				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	27.5 ± 0.5	DND	DND	DND
24	29.0 ± 0.1	7x10 ⁻⁴	Fine	Fine
27	31.7 ± 0.1	5x10 ⁻⁶	Fine	Fine
29	47.5 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	49.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	48.5 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	49.3 ± 0.1	1x10 ⁻⁷	Fine	Fine
35	49.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	48.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	44.7 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 5

GPS Coordinates: 53.47722, -2.20633				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	32.9 ± 0.1	1x10 ⁻⁷	Fine	Fine
24	43.4 ± 0.1	1x10 ⁻⁷	Fine	Fine
27	39.5 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	59.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	62.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	61.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	60.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	61.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	62.5 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	49.5 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 6

GPS Coordinates: 53.47297, -2.19621				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	31.7 ± 0.1	5x10 ⁻⁶	Fine	Fine
24	43.5 ± 0.2	1x10 ⁻⁷	Fine	Fine
27	40.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	60.2 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	61.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	60.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	57.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	57.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	59.9 ± 0.2	1x10 ⁻⁸	Fine	Fine
55	50.8 ± 0.2	1x10 ⁻⁸	Fine	Fine

Notes: No horizontally or vertically polarised aerials or satellite dishes were observed at this location.

Location 7

GPS Coordinates: 53.47002, -2.19086				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	38.5 ± 0.1	1x10 ⁻⁸	Fine	Fine
24	51.9 ± 0.1	1x10 ⁻⁷	Fine	Fine
27	47.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	69.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	71.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	70.5 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	69.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	69.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	70.9 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	57.3 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 8

GPS Coordinates: 53.4669, -2.18493				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	40.7 ± 0.1	1x10 ⁻⁷	Fine	Fine
24	54.4 ± 0.1	1x10 ⁻⁷	Fine	Fine
27	50.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	69.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	71.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	71.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	70.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	71.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	72.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	60.0 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: No horizontally or vertically polarised aerials were observed, satellite dishes were observed at this location.

Location 9

GPS Coordinates: 53.46322, -2.17628				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	34.8 ± 0.1	1x10 ⁻⁷	Fine	Fine
24	51.6 ± 0.1	1x10 ⁻⁷	Fine	Fine
27	47.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	66.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	66.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	66.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
34	64.4 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	64.7 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	65.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	49.8 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

Location 10

GPS Coordinates: 53.45823, -2.16657				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	32.1 ± 0.1	1x10 ⁻⁷	Fine	Fine
24	45.9 ± 0.1	1x10 ⁻⁷	Fine	Fine
27	42.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
29	63.0 ± 0.1	1x10 ⁻⁸	Fine	Fine
31	63.6 ± 0.1	1x10 ⁻⁸	Fine	Fine
32	64.1 ± 0.2	1x10 ⁻⁸	Fine	Fine
34	61.2 ± 0.1	1x10 ⁻⁸	Fine	Fine
35	61.1 ± 0.1	1x10 ⁻⁸	Fine	Fine
37	62.3 ± 0.1	1x10 ⁻⁸	Fine	Fine
55	51.1 ± 0.1	1x10 ⁻⁸	Fine	Fine

Notes: Elevated horizontally polarised UHF aerials directed towards the Winter Hill transmitter and satellite dishes were observed at this location.

APPENDIX D – BASELINE SURVEY PHOTOGRAPHS

Location 1



Location 2



Location 3



Location 4



Location 5



Location 6



Location 7



Location 8



Location 9



Location 10





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