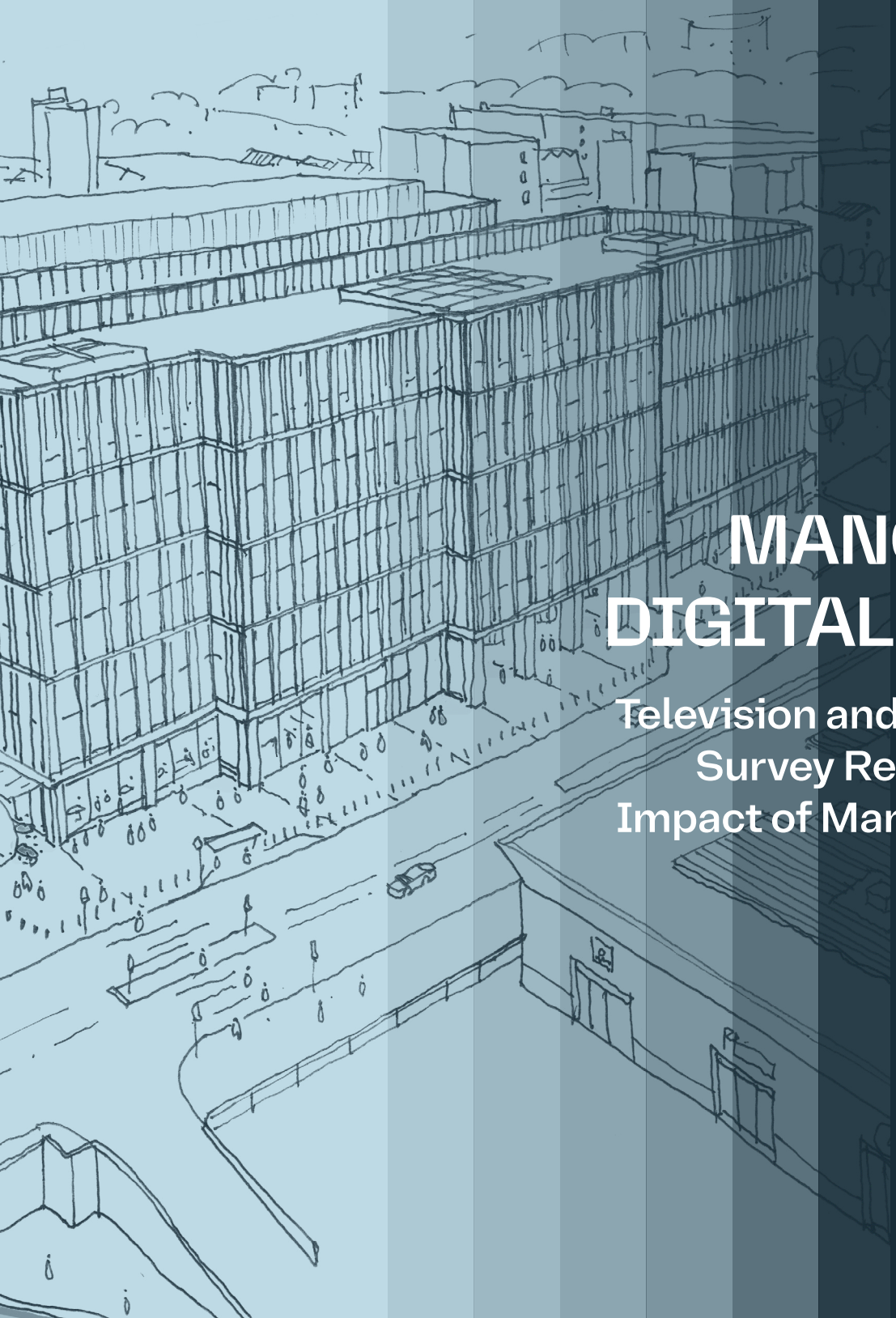
Government Property Agency

AtkinsRéalis



MANCHESTER DIGITAL CAMPUS

Television and Radio Baseline Survey Report – Potential Impact of Manchester Digital Campus

NOVEMBER 2024

PAGERPOWER
Urban & Renewables

Television and Radio Baseline Survey Report – Potential Impact of Manchester Digital Campus

AtkinsRéalis on behalf of the Government Property Agency

October 2024







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ADMINISTRATION PAGE

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Issue	Date	Detail of Changes
1	August 2024	Initial issue
2	October 2024	Administrative revisions

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to investigate the potential impact upon terrestrial television and radio reception in the surrounding area of a proposed new civil service office campus development, located in Manchester city centre. The proposed development is to be located east of Great Ancoats Street and north of Old Mill Street and comprises two buildings. This report serves as a baseline to establish current terrestrial television and radio signal strength and reception quality along with a prediction of the expected impact.

Findings

Terrestrial Television

- Residences in the area surrounding the proposed development receive television services from the Winter Hill transmitter. The strength and quality of the signal in the residential areas in the proposed development's shadow zone ranged from 'low' to 'very good';
- The strength and quality of the signal in the city centre was typically good, however, taller aerials in this area may exist atop tall buildings, which are predicted to receive better signal strength than surveyed. If any low-level receiving aerials are utilised within close proximity to the proposed development, degradation of terrestrial television reception quality may be experienced;
- Residences at greater distances from the proposed development utilising taller receiving aerials or with a strong current signal strength are unlikely to experience noticeable impacts in practice.

Radio

- The area surrounding the proposed development receives radio services from the numerous transmitters. The strength and quality of the signal from Winter Hill near the proposed development is generally good with no signs of interference;
- Some degradation of the radio signal at close range to the proposed development is likely. 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 59 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 investigate the potential impact upon terrestrial television and radio reception in the surrounding area of a proposed building development located in Manchester city centre. The proposed development is to be located east of Great Ancoats Street and north of Old Mill Street and comprises two buildings. This report serves as a baseline to establish current terrestrial television and radio signal strength and reception quality along with a prediction of the expected impact.

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

1.2 Assessment Parameters

This proposed development red line boundary[1] is shown in Figure 1 below.

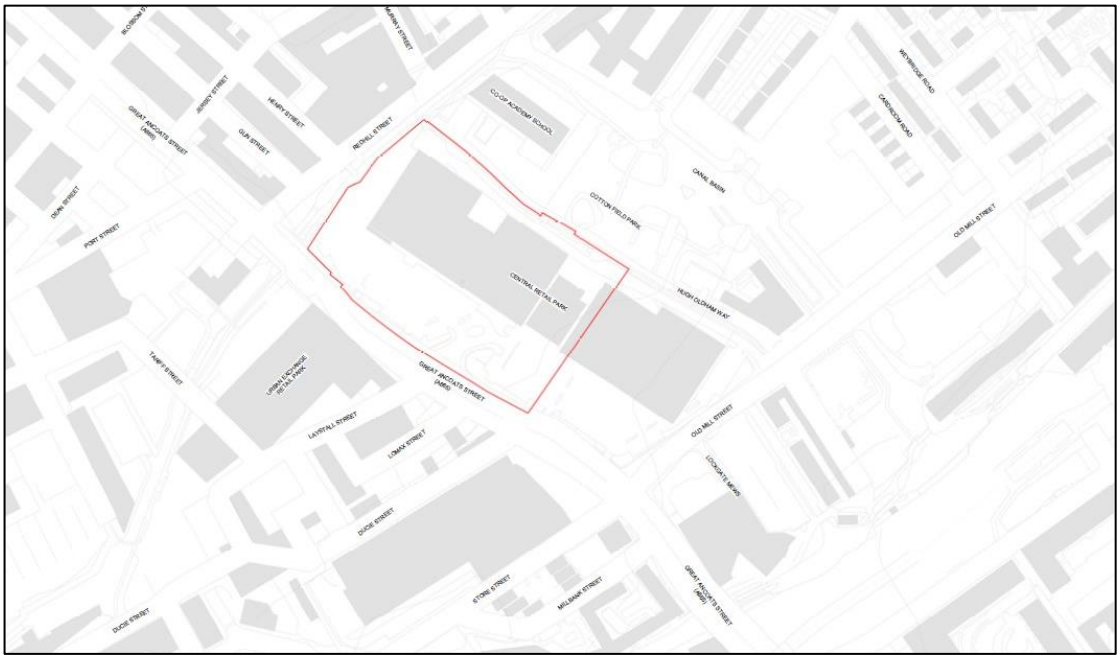


Figure 1 *Proposed development masterplan*

The corner coordinates for each building have been extrapolated from the site drawing and are presented in Appendix A.

[1] Source: MDCX-ATR-XX-00-DR-A-021000-P01-4 Site Location Plan.pdf (cropped)

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24.8km 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 below[2].

2.2 Winter Hill Main Transmitter

The main Winter Hill television 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 TV transmissions provided in Manchester are shown in Table 2 below.

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

Table 2 *Winter Hill additional transmissions*

[2] Source: Ofcom

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. Although 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. Therefore, radio signals tend to be more robust compared to television signals.

Radio transmissions from Winter Hill are shown in Table 3 below.

	Digital			FM
Service	SDL National	Digital One	BBC National DAB	Various Services
Frequency	216.65MHz	220.352MHz	225.648MHz	88.8 – 105.8MHz
Power	20kW	8.7kW	10kW	Max 4 kW

Table 3 *Winter Hill radio transmissions*

3 BUILDINGS AND INTERFERENCE MECHANISMS

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 Television Interference Mechanisms

There are two ways that buildings can cause interference to television reception, these are described in the following sub-sections.

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 southwest 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 below[3], taken from Section 3.2 of an Ofcom paper[4] regarding the impact of buildings on broadcast signals.

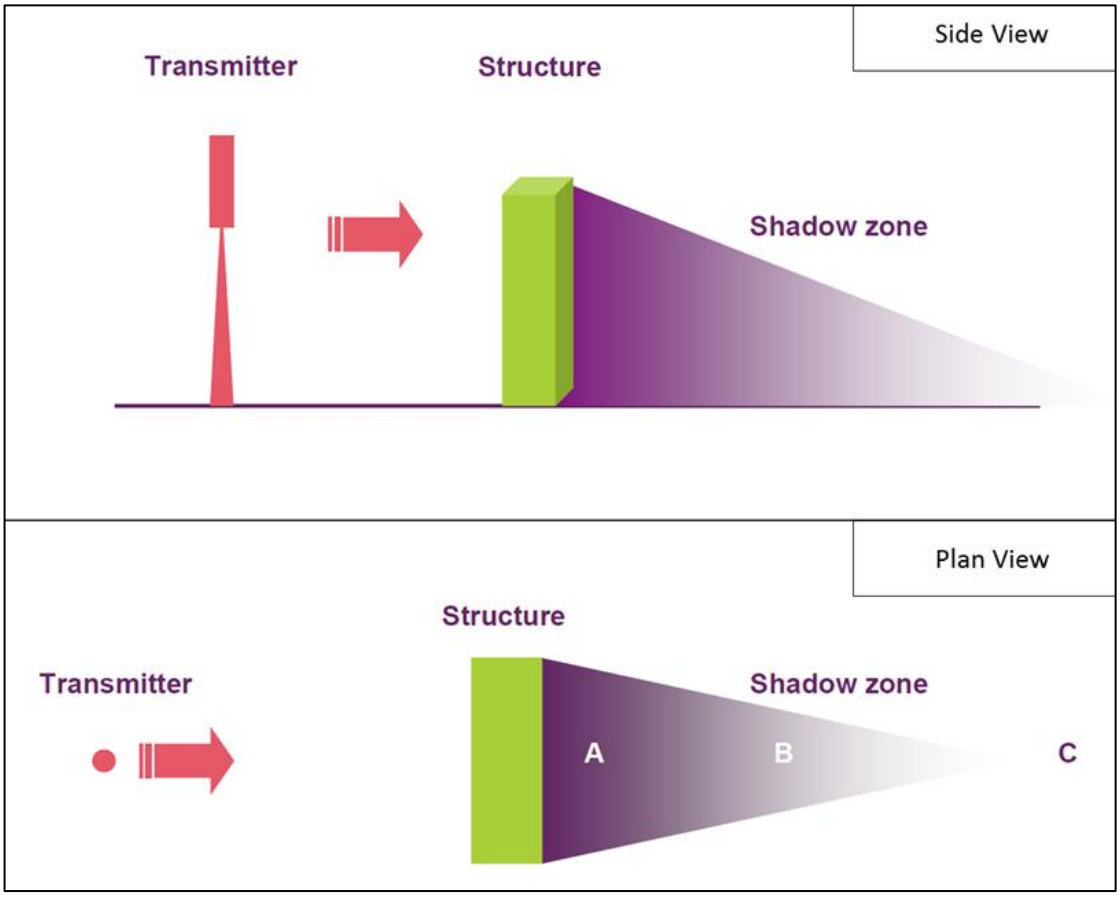


Figure 2 *Diffraction loss zones*

[3] Source: Ofcom (2009): Tall Structures and their impact on broadcast and other wireless services.
[4] Reference as above.

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 below (taken from Section 3.3 of the Ofcom document referenced above) illustrates this effect.

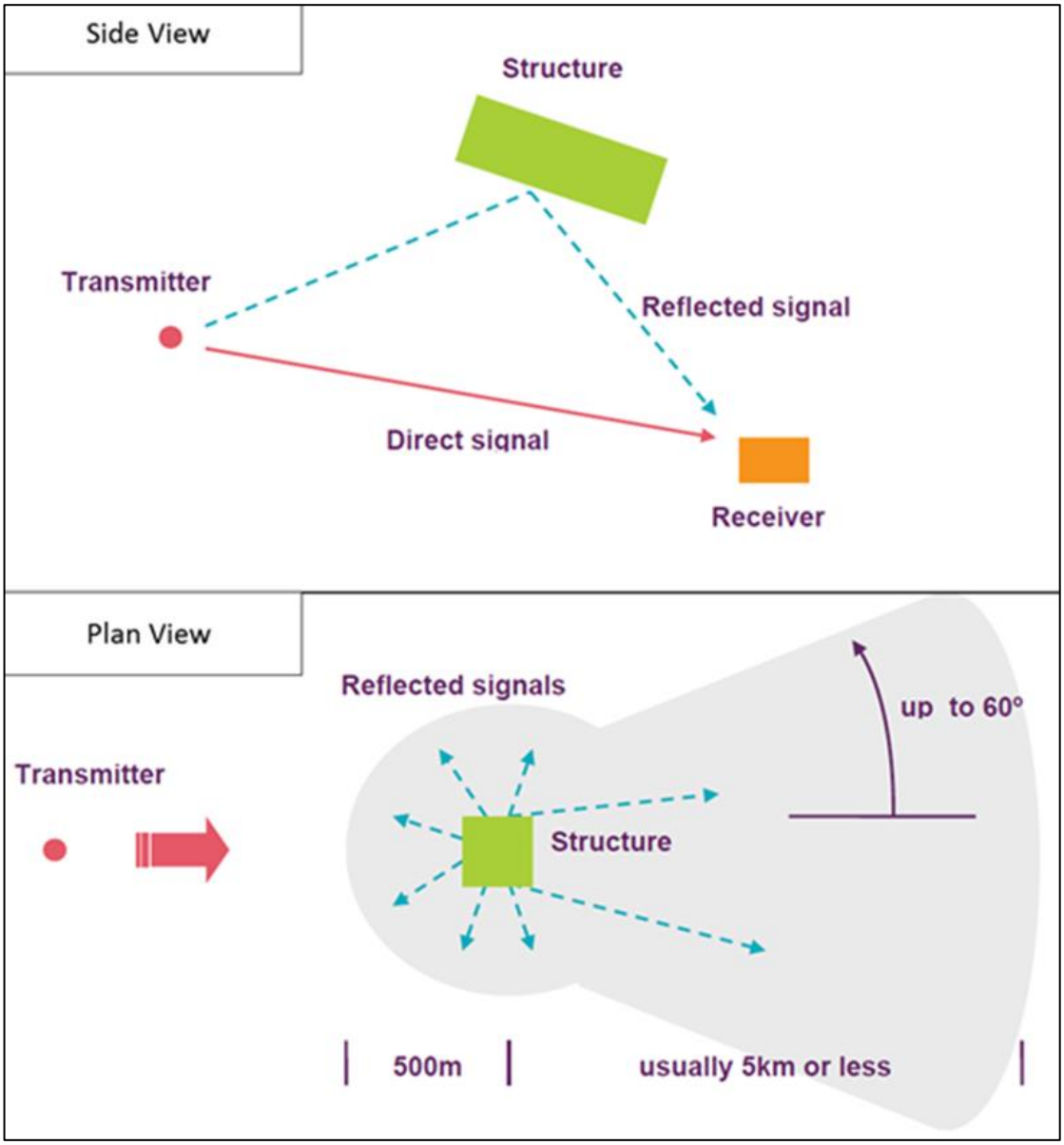


Figure 3 *Reflection zones*

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 degrees[5].

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 Mechanisms

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 for the sake of completeness.

[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.

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

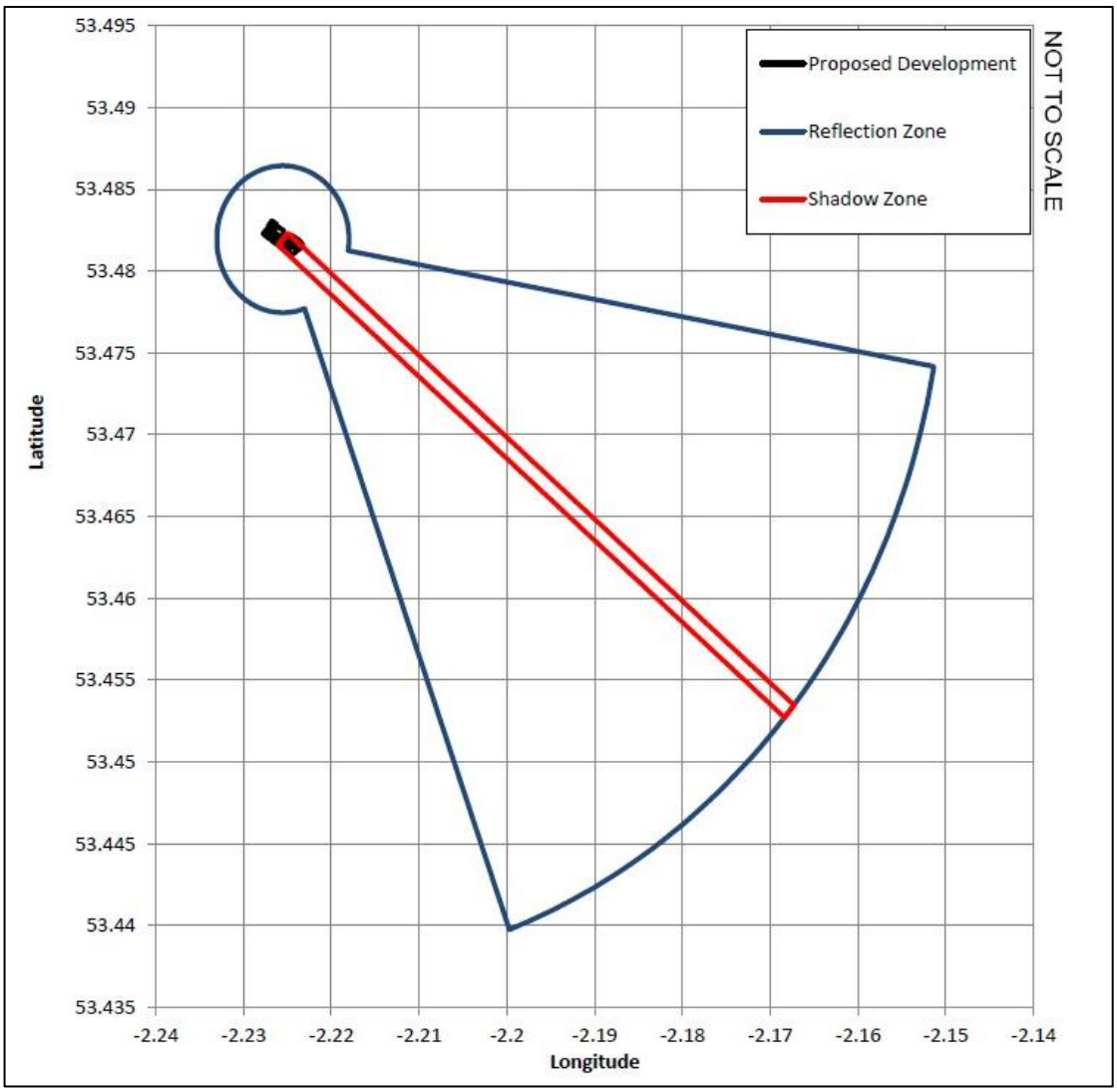


Figure 4 *Interference areas*

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

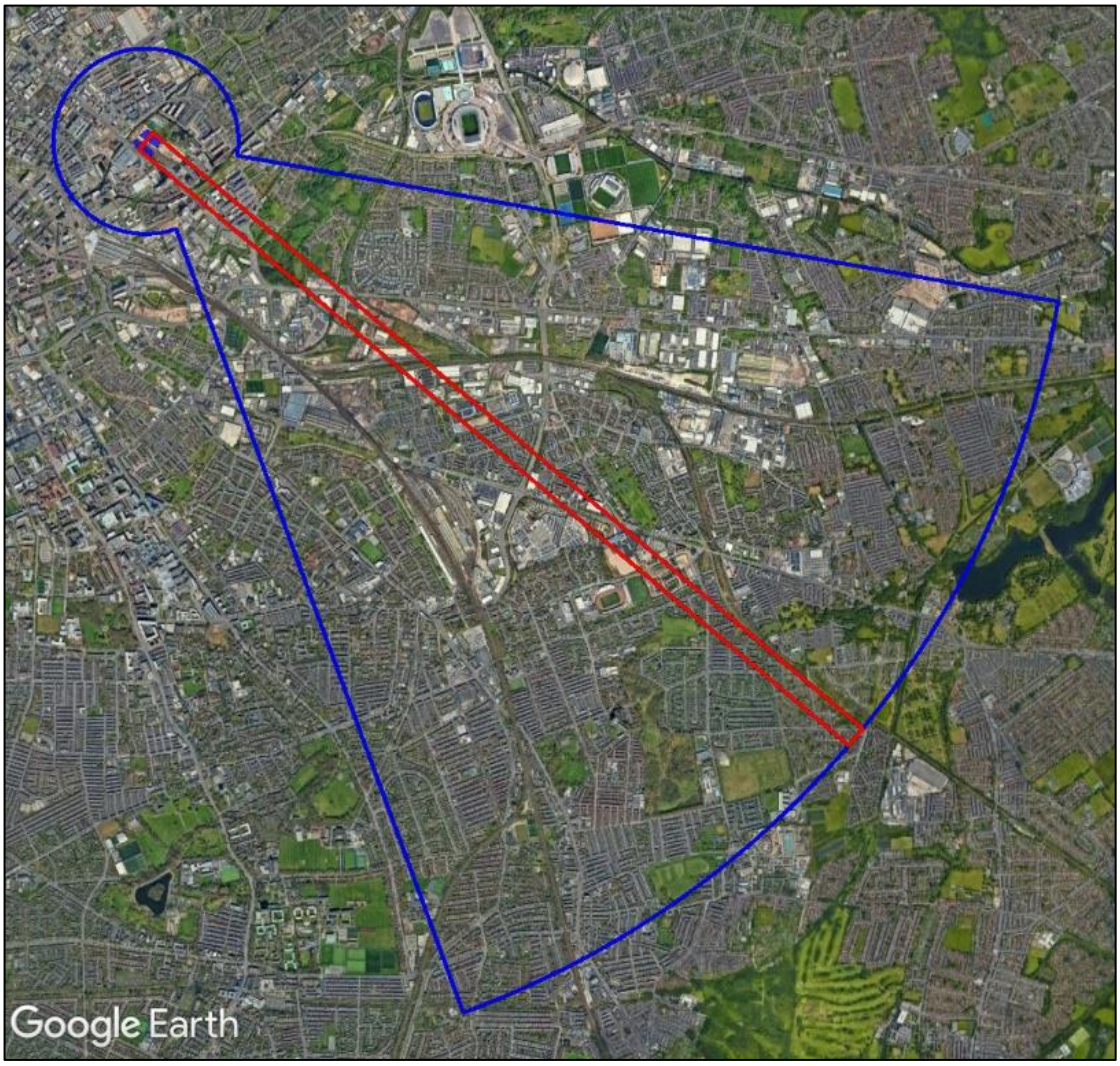


Figure 5 *Interference zones map*

4.2 Potential Diffraction Issues – Terrestrial Television

Urban areas closest to the proposed development are at the highest risk of experiencing television interference. The shadow zone passes over urban areas that contain residential properties and tall buildings, some of which appear to be blocks of flats.

The shadow zone passes over some sections of non-residential areas, including parks and green areas. No diffraction issues are predicted in these areas as no television services will be required.

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 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 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 from the building.

As this assessment has considered the radio transmissions from Winter Hill, and survey locations around the site where not possible, the interference areas are consistent with the television service interference areas.

5 TELEVISION AND RADIO BASELINE SURVEY

5.1 Overview – Television Services

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 21st of June 2024, and baseline radio reception survey was undertaken on the 19th of August 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 4 below.

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

Table 4 *Television signal strength categories*

5.2 Survey Locations

Locations were selected considering potential 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.

Figure 6 below shows the survey locations overlaid onto aerial photography. The interference zones are also shown. Radio measurements were taken at survey locations 1 to 3 due to their proximity to the proposed development.

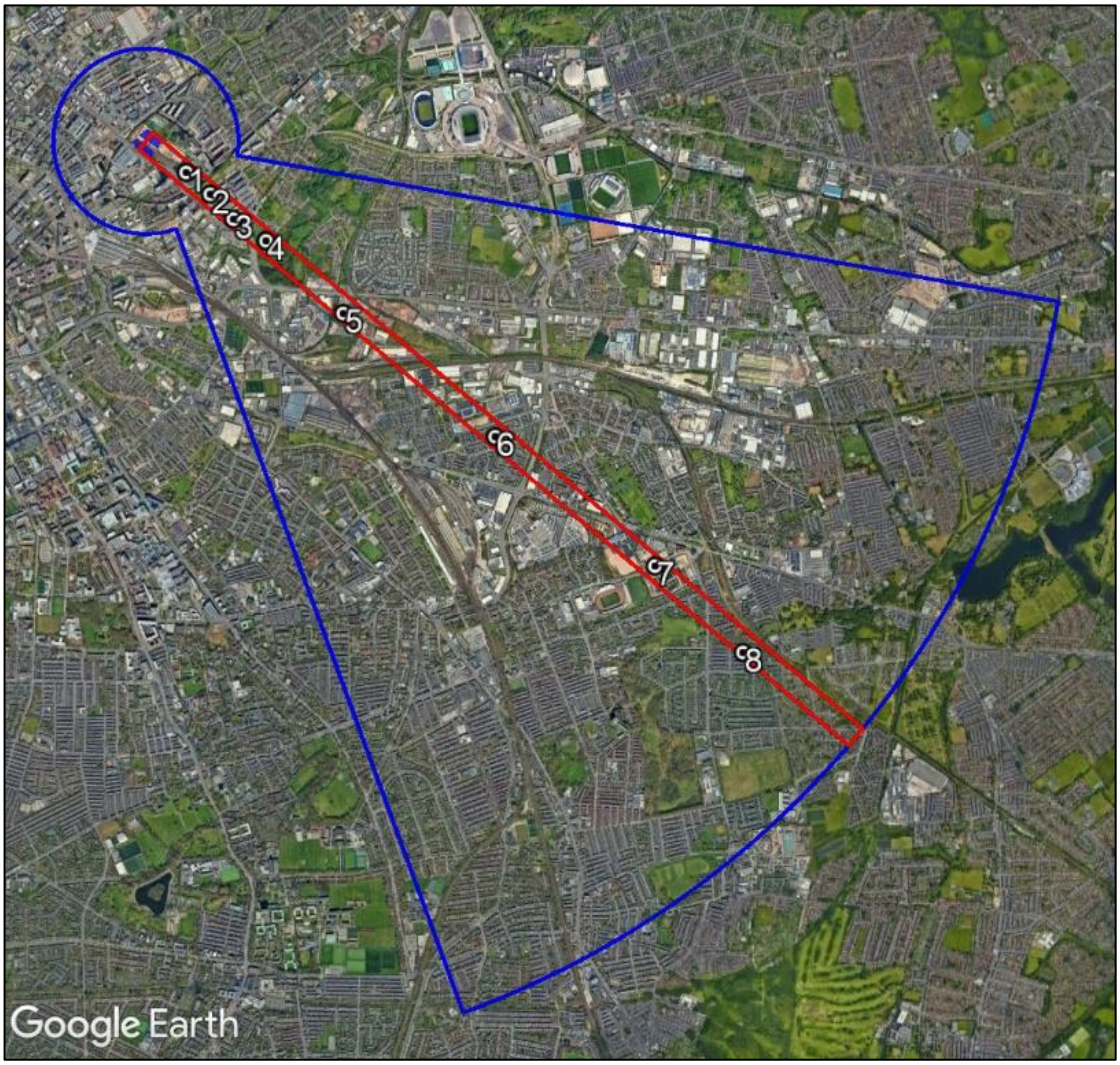


Figure 6 *Survey locations*

5.1 Survey Results

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: 50.2 (Good) Main TV MUX: 54.9 (Good) Local TV MUX: 36.0 (Moderate)	No satellite dishes or aerials were observed. It is possible satellite dishes and aerials are located on top of the nearby buildings that are not visible from the ground. All main multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.5dB. One local multiplex displaced fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.2dB. One local multiplex did not decode.	The survey location was within 250m of the proposed development and within its shadow zone. Predominately multistorey flats and/or commercial property at this survey location. A reduction in signal strength is possible based on the proximity to the development. Effects are not predicted to be experienced in practice due to the height (or existence) of any aerials in the area.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
2	Average: 59.4 (Very Good) Main TV MUX: 65.3 (Very Good) Local TV MUX: 41.9 (Moderate)	No satellite dishes or aerials were observed. It is possible more satellite dishes and aerials are located on top of the nearby buildings that are not visible from the ground. 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 0.3dB. Both local multiplex displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.1dB.	The survey location was within 400m of the proposed development and within its shadow zone. Predominately multistorey flats and/or commercial property at this survey location. A reduction in signal strength is possible based on the proximity to the development. Effects are not predicted to be experienced in practice due to the very good signal strength and height (or existence) of any aerials in the area.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
3	Average: 37.7 (Moderate) Main TV MUX: 41.6 (Moderate) Local TV MUX: 25.8 (Low)	No satellite dishes or aerials were observed. It is possible more satellite dishes and aerials are located on top of the nearby buildings that are not visible from the ground. Best signal was found when facing the aerial west. The signal recorded at 10m in height from the survey is potentially affected by diffraction caused by the existing tall buildings adjacent to this location. Four multiplexes displayed fine picture and audio quality. The other two main multiplexes did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.3dB. Both local multiplexes did not decode. An average of low signal strength and signal fluctuations of less than or equal to 0.2dB.	The survey location was within 600m of the proposed development and within its shadow zone. Predominately multistorey flats and/or commercial property at this survey location. A reduction in signal strength is possible based on the proximity to the development. Effects are not predicted to be experienced in practice due to the height (or existence) of any aerials in the area.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
4	Average: 32.8 (Low) Main TV MUX: 35.4 (Moderate) Local TV MUX: 25.2 (Low)	Multiple raised horizontally polarised (HP) Ultra-High Frequency (UHF) aerials, orientated towards the Winter Hill transmitter, were observed at this location. Multiple satellite dishes were observed. All main multiplexes did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.4dB. Both local multiplexes did not decode. An average of low signal strength and signal fluctuations of less than or equal to 0.3dB.	The survey location was within 800m of the proposed development and within its shadow zone. Predominately low-rise residential properties and undeveloped land at this survey location. A reduction in signal strength is possible based on the proximity to the development, particularly for the local multiplexes.
5	Average: 57.8 (Very Good) Main TV MUX: 62.7 (Very Good) Local TV MUX: 43.2 (Moderate)	No satellite dishes or aerials were observed. It is possible that reception is not required at this location due to the commercial nature of land use. 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. Both 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.	The survey location was approximately 1.35km from the proposed development. Predominately commercial properties at this survey location. 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.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	Average: 64.9 (Very Good) Main TV MUX: 70.6 (Very Good) Local TV MUX: 47.7 (Good)	One HP UHF aerial, orientated towards the Winter Hill transmitter, was observed at this location. 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. Both 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.	The survey location was approximately 2.4km from the proposed development. Predominately low-rise residential properties at this survey location. 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.
7	Average: 67.9 (Very Good) Main TV MUX: 72.6 (Very Good) Local TV MUX: 54 (Good)	No satellite dishes or aerials were observed. It is possible that aerials are within lofts given existing signal strength. 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 0.4dB. Both 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.	The survey location was approximately 3.5km from the proposed development. Predominately low-rise residential properties at this survey location. 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.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
8	Average: 69.2 (Very Good) Main TV MUX: 74.7 (Very Good) Local TV MUX: 52.7 (Good)	Multiple HP UHF aerials, orientated towards the Winter Hill transmitter, were observed at this location. 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 0.3dB. Both 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.	The survey location was approximately 4.2km from the proposed development. Predominately low-rise residential properties at this survey location. 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.

Table 5 *Television baseline survey results*

5.2 Survey Results (Radio)

All three digital radio services showed good to moderate signal strength at close range to the proposed development. FM services were variable but were mainly of 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 likely. 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 terrestrial 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 Terrestrial 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 likely that no adverse effects will occur due to the current reception quality in the surrounding area, as well as the height of the observed aerials and scarcity of residential properties 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

Terrestrial Television

- Residences in the area surrounding the proposed development receive television services from the Winter Hill transmitter. The strength and quality of the signal in the residential areas in the proposed development's shadow zone ranged from 'low' to 'very good';
- The strength and quality of the signal in the city centre was typically good, however, taller aerials in this area may exist atop tall buildings, which are predicted to receive better signal strength than surveyed. If any low-level receiving aerials are utilised within close proximity to the proposed development, degradation of terrestrial television reception quality may be experienced;
- Residences at greater distances from the proposed development utilising taller receiving aerials or with a strong current signal strength are unlikely to experience noticeable impacts in practice.

Radio

- The area surrounding the proposed development receives radio services from the numerous transmitters. The strength and quality of the signal from Winter Hill near the proposed development is generally good with no signs of interference;
- Some degradation of the radio signal at close range to the proposed development is likely. 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 – this is most likely to be within a few hundred metres of the proposed development and within its shadow zone. Solutions are likely to be readily available if required.

No requirement for pre-emptive mitigation has been identified.

APPENDIX A – DETAILED SURVEY RESULTS

Location 1

Coordinates: Lon: -2.223287, Lat: 53.480937					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	39.8 ± 0.1	$1x10^{-8}$	Fine	Fine
27	G-MAN	32.3 ± 0.2	Did Not Decode (DND)	-	-
29	SDN	53.2 ± 0.2	$1x10^{-8}$	Fine	Fine
31	Arqiva A	55.9 ± 0.3	$1x10^{-8}$	Fine	Fine
32	BBC A	54.3 ± 0.1	$1x10^{-8}$	Fine	Fine
34	D3&4	56.5 ± 0.2	$1x10^{-8}$	Fine	Fine
35	BBC B	55.3 ± 0.2	$1x10^{-8}$	Fine	Fine
37	Arqiva B	54.3 ± 0.5	$1x10^{-8}$	Fine	Fine

Notes: High rise flats, any aerials are likely to be on the top of the buildings.

Radio				
Frequency	**Block**	**Service**	**Signal Strength (dBμV)**	**Typical Fluctuation (dBμV)**
216.9 MHz	11A	SDL National	42.0	1
222.05 MHz	11D	Digital One	76.0	1
225.65 MHz	12B	BBC National DAB	69.0	1
102.15 MHz	N/A	Capital	81.5	1
97.8 MHz	N/A	Radio X	80.0	1
106.15 MHz	N/A	XS Manc	78.0	3

Location 2

Coordinates: Lon: -2.221329, Lat: 53.479884					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	45.0 ± 0.1	$1x10^{-8}$	Fine	Fine
27	G-MAN	38.8 ± 0.1	$1x10^{-8}$	Fine	Fine
29	SDN	66.0 ± 0.2	$1x10^{-8}$	Fine	Fine
31	Arqiva A	65.5 ± 0.2	$1x10^{-8}$	Fine	Fine
32	BBC A	65.9 ± 0.3	$1x10^{-8}$	Fine	Fine
34	D3&4	65.0 ± 0.2	$1x10^{-8}$	Fine	Fine
35	BBC B	64.6 ± 0.1	$1x10^{-8}$	Fine	Fine
37	Arqiva B	64.8 ± 0.2	$1x10^{-8}$	Fine	Fine

Notes: No aerials or satellite dishes observed.

Radio				
Frequency	**Block**	**Service**	**Signal Strength (dBμV)**	**Typical Fluctuation (dBμV)**
216.9 MHz	11A	SDL National	53	1
222.05 MHz	11D	Digital One	68	1
225.65 MHz	12B	BBC National DAB	65.5	0.5
102.15 MHz	N/A	Capital	77.0	3
97.8 MHz	N/A	Radio X	66.6	0.1
106.15 MHz	N/A	XS Manc	66.5	3

Location 3

Coordinates: Lon: -2.219454, Lat: 53.478676					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	26.3 ± 0.2	DND	-	-
27	G-MAN	25.3 ± 0.2	DND	-	-
29	SDN	41.7 ± 0.2	DND	-	-
31	Arqiva A	40.5 ± 0.2	DND	-	-
32	BBC A	41.6 ± 0.1	$1x10^{-5}$	Fine	Fine
34	D3&4	43.6 ± 0.1	$1x10^{-8}$	Fine	Fine
35	BBC B	41.7 ± 0.3	$1x10^{-8}$	Fine	Fine
37	Arqiva B	41.0 ± 0.1	$2x10^{-4}$	Fine	Fine

Notes: High rise flats, any aerials are likely to be on the top of the buildings. Best signal was found with the aerial pointing further west.

Radio				
Frequency	**Block**	**Service**	**Signal Strength (dBμV)**	**Typical Fluctuation (dBμV)**
216.9 MHz	11A	SDL National	33	0.5
222.05 MHz	11D	Digital One	62	1
225.65 MHz	12B	BBC National DAB	52	1.5
102.15 MHz	N/A	Capital	50	4
97.8 MHz	N/A	Radio X	55	2
106.15 MHz	N/A	XS Manc	49.4	0.5

Location 4

Coordinates: Lon: -2.216808, Lat: 53.477630					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	25.4 ± 0.2	DND	-	-
27	G-MAN	25.0 ± 0.3	DND	-	-
29	SDN	36.4 ± 0.3	DND	-	-
31	Arqiva A	36.9 ± 0.3	DND	-	-
32	BBC A	36.3 ± 0.3	DND	-	-
34	D3&4	34.6 ± 0.2	DND	-	-
35	BBC B	34.3 ± 0.2	DND	-	-
37	Arqiva B	33.9 ± 0.4	DND	-	-

Notes: Multiple HP aerials orientated towards Winter Hill observed – they appear to be raised suggesting services may be difficult to receive in this location. Multiple satellite dishes observed.

Location 5

Coordinates: Lon: -2.210538, Lat: 53.474118					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	46.5 ± 0.1	$1x10^{-8}$	Fine	Fine
27	G-MAN	39.9 ± 0.2	$8x10^{-5}$	Fine	Fine
29	SDN	63.2 ± 0.1	$1x10^{-8}$	Fine	Fine
31	Arqiva A	64.0 ± 0.1	$1x10^{-8}$	Fine	Fine
32	BBC A	63.1 ± 0.1	$1x10^{-8}$	Fine	Fine
34	D3&4	62.1 ± 0.1	$1x10^{-8}$	Fine	Fine
35	BBC B	62.2 ± 0.2	$1x10^{-8}$	Fine	Fine
37	Arqiva B	61.6 ± 0.2	$1x10^{-8}$	Fine	Fine

Notes: Immediate surroundings are commercial buildings so no aerials or satellite dishes observed. Best signal was found when aerial orientated west.

Location 6

Coordinates: Lon: -2.198217, Lat: 53.468160					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	51.0 ± 0.1	$1x10^{-8}$	Fine	Fine
27	G-MAN	44.4 ± 0.1	$1x10^{-8}$	Fine	Fine
29	SDN	69.6 ± 0.1	$1x10^{-8}$	Fine	Fine
31	Arqiva A	70.8 ± 0.2	$1x10^{-8}$	Fine	Fine
32	BBC A	70.1 + 0.2	$1x10^{-8}$	Fine	Fine
34	D3&4	72.4 ± 0.2	$1x10^{-8}$	Fine	Fine
35	BBC B	70.3 ± 0.2	$1x10^{-8}$	Fine	Fine
37	Arqiva B	70.6 ± 0.1	$1x10^{-8}$	Fine	Fine

Notes: One HP aerials orientated towards Winter Hill observed. Multiple satellite dishes observed.

Location 7

Coordinates: Lon: -2.185250, Lat: 53.461902					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	57.2 ± 0.1	$1x10^{-8}$	Fine	Fine
27	G-MAN	50.8 ± 0.2	$1x10^{-8}$	Fine	Fine
29	SDN	73.6 ± 0.1	$1x10^{-8}$	Fine	Fine
31	Arqiva A	72.2 ± 0.2	$1x10^{-8}$	Fine	Fine
32	BBC A	71.6 ± 0.3	$1x10^{-8}$	Fine	Fine
34	D3&4	72.5 ± 0.4	$1x10^{-8}$	Fine	Fine
35	BBC B	72.8 ± 0.2	$1x10^{-8}$	Fine	Fine
37	Arqiva B	73.1 ± 0.1	$1x10^{-8}$	Fine	Fine

Notes: No aerials observed, they could be in the lofts given the strong signal strength. No satellite dishes observed due to being on the north side of the houses.

Location 8

Coordinates: Lon: -2.178123, Lat: 53.457720					
Television					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	L-MAN	54.9 ± 0.1	$1x10^{-8}$	Fine	Fine
27	G-MAN	50.5 ± 0.1	$1x10^{-8}$	Fine	Fine
29	SDN	74.7 ± 0.1	$1x10^{-8}$	Fine	Fine
31	Arqiva A	75.0 ± 0.2	$1x10^{-8}$	Fine	Fine
32	BBC A	75.2 ± 0.3	$1x10^{-8}$	Fine	Fine
34	D3&4	75.0 ± 0.2	$1x10^{-8}$	Fine	Fine
35	BBC B	74.1 ± 0.2	$1x10^{-8}$	Fine	Fine
37	Arqiva B	74.3 ± 0.3	$1x10^{-8}$	Fine	Fine

Notes: Multiple HP aerials orientated towards Winter Hill and satellite dishes observed.

APPENDIX B – SURVEY PHOTOGRAPHS

Location 1



Location 2



Location 3



Location 4



Location 5



Location 6



Location 7



Location 8



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