

Television Post-Construction Reception Survey

Circle Square – Plots 2, 3, 4 and 14

September 2020

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ADMINISTRATION PAGE

Job Reference:	10172A
Date:	September, 2020
Author:	Kai Frolic
Telephone:	01787 319 001
Email:	kai@pagerpower.com

Reviewer:	Michael Sutton
Date:	September, 2020
Telephone:	01787 319 001
Email:	michael@pagerpower.com

Issue	Date	Detail of Changes
1	September, 2020	Initial issue

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

T: +44 (0)1787 319001 E: info@pagerpower.com W: www.pagerpower.com

EXECUTIVE SUMMARY

Report Purpose

The Circle Square building development in Manchester, UK, is underway with some plots having been completed. Planning conditions require assessment of the development's impact on terrestrial television reception in the surrounding area. Reception survey measurements have been undertaken in the development's shadow zone, where interference is the most likely. Specifically, the survey locations have considered the completed Plot 14 and the zones associated with plots 2, 3 and 4.

Wider Context

Numerous buildings have been constructed in Manchester City Centre which could affect coverage in general. In addition, the Winter Hill transmitter at the time of the survey had been recently changed due to works at the transmitter. Nevertheless, the effect of the most recent Circle Square development has been evaluated based on the survey data.

Conclusions

General

The overall reception quality and availability is consistent with previous survey data for this part of Manchester. The majority of multiplexes were received at all locations. A minority of multiplexes were not received, particularly at locations closest to the site itself. The Circle Square development as a whole is likely to be a contributor to the reduced channel availability, but not the sole cause.

Plot 14

All multiplexes were received with good picture and audio quality at all but one location in the Plot 14 shadow zone. The nearest location – at a range of approximately 0.3 km – did not receive three multiplexes.

It is not possible to conclude with certainty whether noticeable effects will have taken place as a result of the construction of Plot 14 specifically. A reduction in signal strength does not necessarily mean the viewed picture quality will change and the channel availability in close proximity to Plot 14 is somewhat variable. It is possible that no noticeable effects have occurred for receivers in the area. If interference is reported from residential locations within 500 metres of Plot 14 and within its shadow zone (see Section 4), the reported effects should be evaluated in the context of the survey results. It would be good practice to arrange for a local aerial installer to visit the reported interference location if the affected channels corresponded to one of the weaker multiplexes with a view to restoring this if possible. It is considered unlikely that this will be a requirement.

Plots 2, 3 and 4

Coverage was variable in the shadow zones for plots 2, 3 and 4, with disruption to a minority of multiplexes being apparent at longer distances than the adjacent Plot 14 shadow.

It is likely that plots 2, 3 and 4 have contributed to the reduction in recorded signal levels. It is possible that this has not resulted in noticeable effects for actual receivers. This is because:

- Other sources of coverage are available and frequently utilised such as satellite television.
- It is possible that solutions have already been implemented due to the variable signal in proximity to the city centre such as signal amplifiers.
- The precise positioning and elevation of the receiving aerial can make the difference between a multiplex showing good picture and showing bad picture.

If interference is reported from residential locations within 2 km of Plots 2, 3 and 4 and within their shadow zone (see Section 4), the reported effects should be evaluated in the context of the survey results. It would be good practice to arrange for a local aerial installer to visit the reported interference location if the affected channels corresponded to one of the weaker multiplexes with a view to restoring this if possible.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 48 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 INTRODUCTION

1.1 Report Purpose

The Circle Square building development in Manchester, UK, comprises multiple adjacent but distinct plots. This report relates to potential television interference from plots 2, 3 and 4 which are considered collectively and Plot 14 which is considered in isolation. The relevant planning condition is below:

(c) Assess the impact of the development on television signal reception within the potential impact area identified in above within one month of the practical completion of the development or before the development is first occupied, whichever is the sooner, and at any other time during the construction of the development if requested in writing by the City Council as local planning authority in response to identified television signal reception problems within the potential impact area. The study shall identify such measures necessary to maintain at least the pre-existing level and quality of signal reception identified in the survey carried out in (b) above. The measures identified must be carried out either before the building is first occupied or within one month of the study being submitted to the City Council as local planning authority, whichever is the earlier.

1.2 Development

Figure 1 on the following page¹ shows a site plan of Circle Square and highlights the relevant plots.

¹ Provided to Pager Power by Bruntwood, cropped and annotated.



Figure 1 Circle Square site plan

2 TERRESTRIAL TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

The television transmitter serving the area around the development is Winter Hill. This is based on its coverage area and the results of both surveys (which confirmed that the vast majority of household aerials are directed towards this transmitter).

During the baseline survey in 2016, Winter Hill broadcast main multiplexes on channels 50, 59, 54-, 58, 49 and 55. Local multiplexes were broadcast on channels 31, 37, 56 and 57.

More recently, there have been works on the Winter Hill transmitter and services have moved to different channels. At the time of the post-construction survey (7 September 2020), services were available on channels 21, 24, 27, 29, 31, 32, 34, 35, 37 and 55.

2.2 Terrestrial Television Transmitter Location

Figure 2 below² shows the location of the development relative to the transmitter.



Figure 2 Transmitter and development relative location

² Copyright © 2020 Google.

3 INTERFERENCE MECHANISMS

3.1 Technical Overview

Terrestrial television services are provided by means of electromagnetic waves in the Ultra High Frequency (UHF) range which propagate from land-based transmitters to receiving aerials. 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

3.2.1 Obstruction of the signal

This is caused by the building physically blocking the transmitted 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. The following is true for television signals:

- The highest losses (greatest interference) will be located immediately behind the development relative to the transmitter i.e. in the shadow zone.
- Losses near the edge of the shadow zone will be less significant due to diffraction effects (bending of the signal).

Ofcom has produced a document offering guidance on this issue. Relevant extracts from the documents are presented below.

"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 3 on the following page, taken from Section 3.2 of the Ofcom guidance regarding the effect of buildings on broadcast signals.

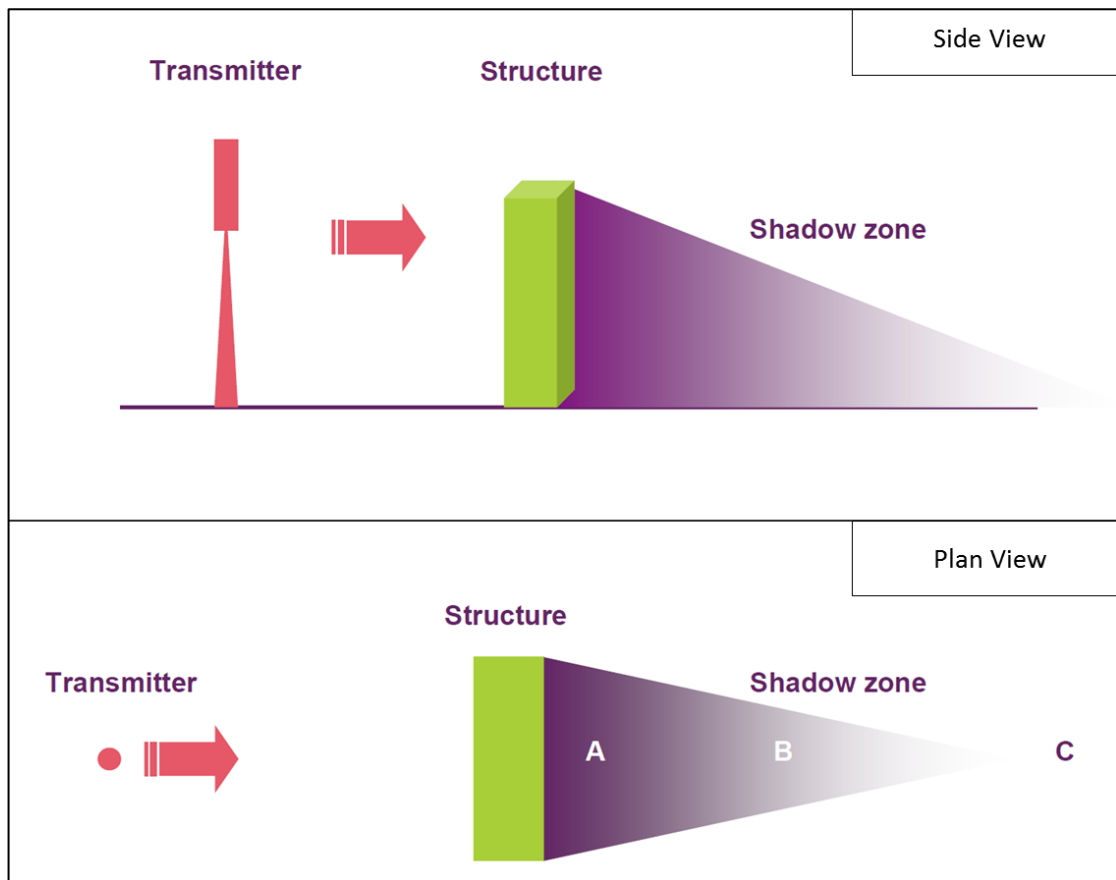


Figure 3 Diffraction loss zones

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

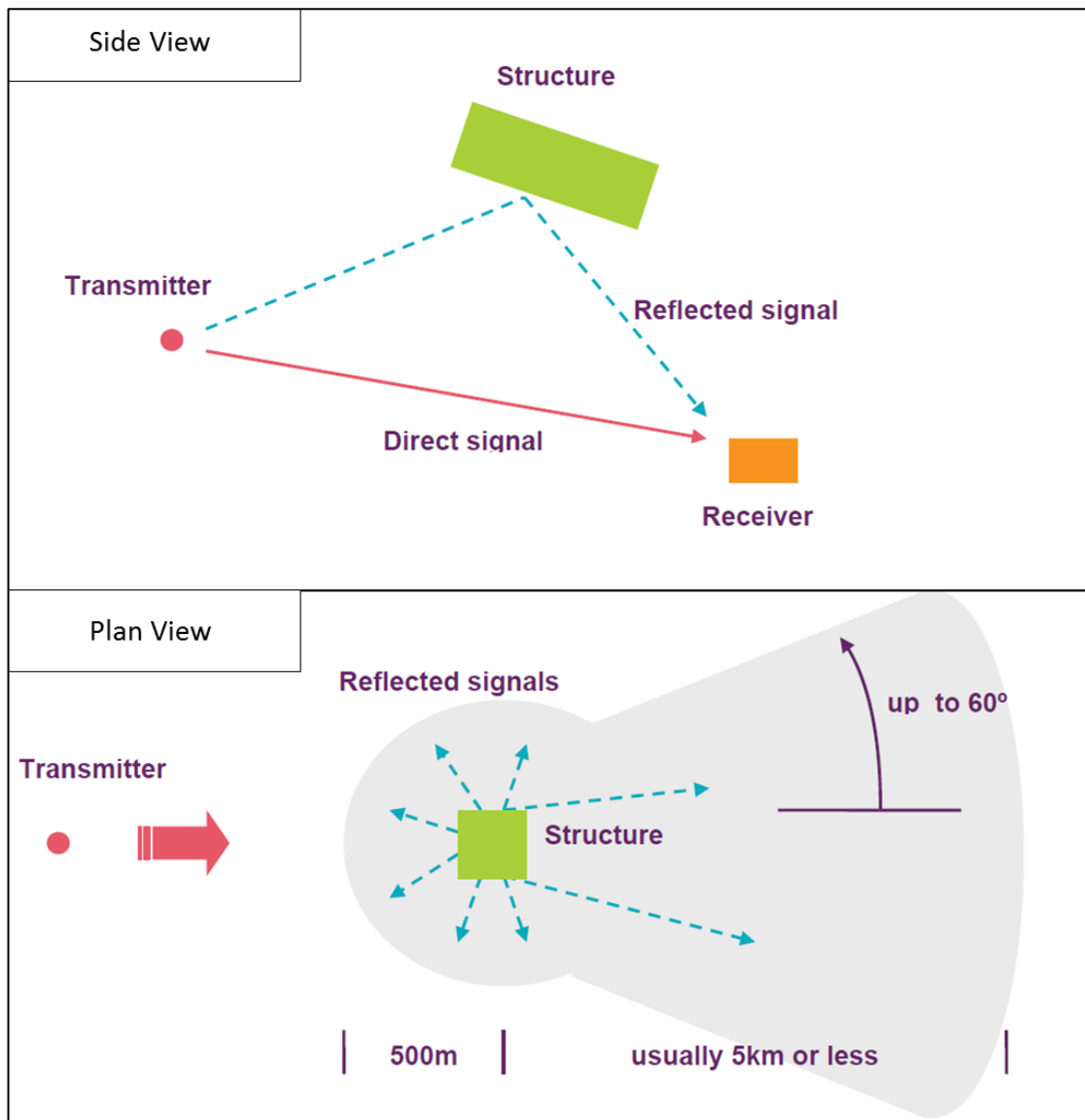


Figure 4 Diffraction loss zones

In practice, it is considered highly unlikely that reflections will have an effect for receivers in front of the Proposed Development 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.

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 effect if:

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

4.1 Locations

Figure 5 below³ shows:

- The shadow zone for the wider Circle Square development (Orange).
- The shadow zone for Plot 14 specifically (green).
- The surveyed locations (blue icons for Plot 14, pink icons for plots 2, 3 and 4).

It can be seen that some locations are marginally outside the zones as drawn, this was due to safe access limitations at the time of the survey⁴.

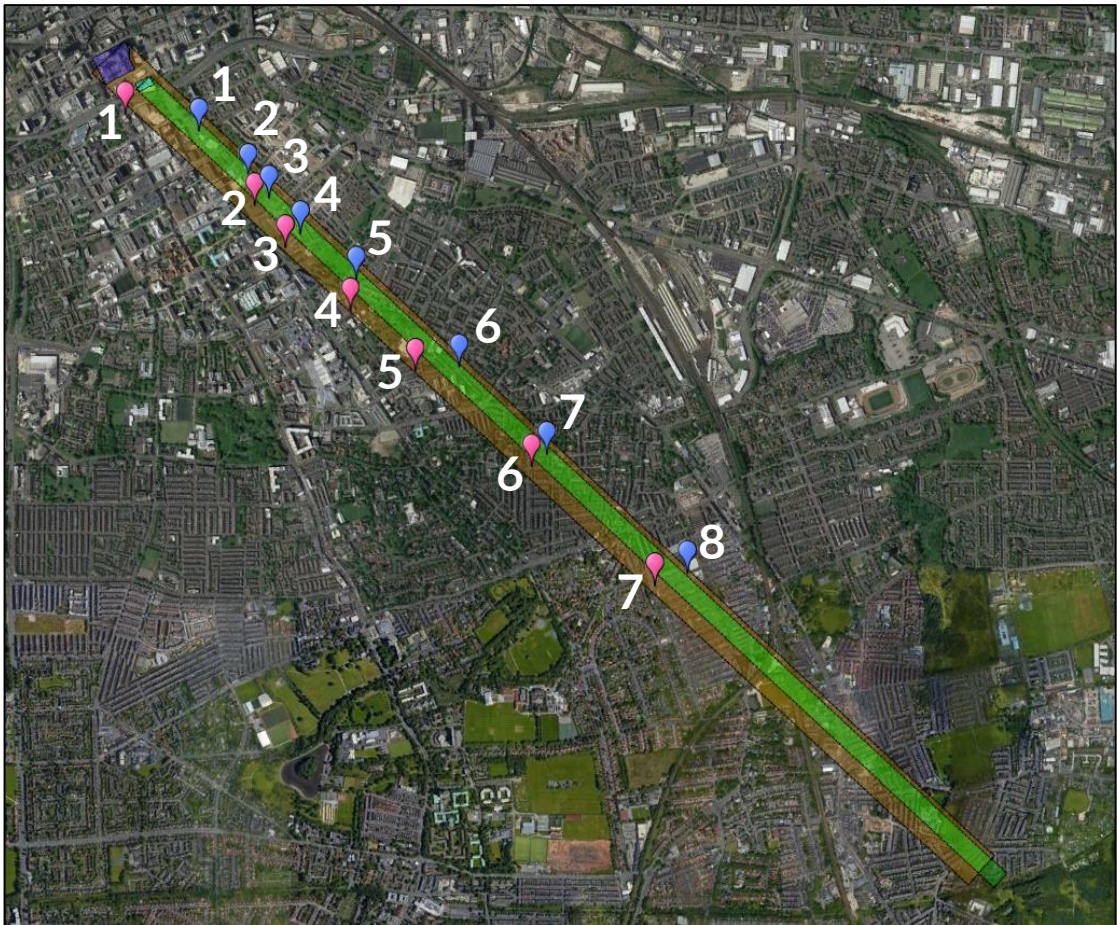


Figure 5 Survey locations

³ Copyright ©2020 Google, Landsat/Copernicus, CNES/Airbus.

⁴ Survey locations must be safe, publicly accessible and clear of any overhead obstructions such as trees or phone lines.

4.2 Survey Results

Tables 1 and 2 below summarise the survey results. Detailed measurements are presented in Appendix A. Survey photographs are shown in Appendix B.

Location	Approximate distance from development (km)	Results summary	Conclusions
1 (Plot 14)	0.3	Seven multiplexes were received with good picture and audio quality. Three multiplexes were not decoded, including two that appeared to be local channels broadcast at lower power.	One of the local channels in particular shows variable reliability in the city centre. The overall signal strength and channel availability is broadly consistent with historical measurements around this location. The development is likely a contributor to reduced signal strength at this location but may not be having a noticeable effect on receivers in the area.
2 (Plot 14)	0.6	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.
3 (Plot 14)	0.7	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.
4 (Plot 14)	0.9	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.
5 (Plot 14)	1.2	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.

Location	Approximate distance from development (km)	Results summary	Conclusions
6 (Plot 14)	1.8	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.
7 (Plot 14)	2.3	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.
8 (Plot 14)	3.1	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.

Table 1 Survey results – Plot 14

Location	Approximate distance from development (km)	Results summary	Conclusions
1 (Plots 2, 3 and 4)	0.2	Six multiplexes were received with good picture and audio quality. Four multiplexes were not decoded, including two that appeared to be local channels broadcast at lower power.	One of the local channels in particular shows variable reliability in the city centre. The overall signal strength and channel availability appears slightly reduced when compared with historical measurements around this location. The development is likely a contributor to reduced signal strength at this location, and may not be having a noticeable effect on receivers in the area.
2 (Plots 2, 3 and 4)	0.8	Seven multiplexes were received with good picture and audio quality. Two local multiplexes were not decoded, and one showed intermittent interference.	The overall signal strength and channel availability is broadly consistent with historical measurements around this location. The development is likely a contributor to reduced signal strength at this location but may not be having a noticeable effect on receivers in the area.
3 (Plots 2, 3 and 4)	1.0	Eight multiplexes were received with good picture and audio quality. Two multiplexes were not decoded including one that appeared to be local channels broadcast at lower power.	The overall signal strength and channel availability appears slightly reduced when compared with historical measurements around this location. The development is likely a contributor to reduced signal strength at this location, but may not be having a noticeable effect on receivers in the area.

Location	Approximate distance from development (km)	Results summary	Conclusions
4 (Plots 2, 3 and 4)	1.5	Nine multiplexes were received with good picture and audio quality. One local multiplex was not decoded.	The overall signal strength and channel availability appears slightly reduced when compared with historical measurements around this location. The development is likely a contributor to reduced signal strength at this location, but may not be having a noticeable effect on receivers in the area.
5 (Plots 2, 3 and 4)	1.8	Seven multiplexes were received with good picture and audio quality. Two local multiplexes were not decoded, and one showed intermittent interference.	The overall signal strength and channel availability appears significantly reduced when compared with historical measurements around this location – however at this range such differences are unlikely to be solely due to Circle Square. The development is likely a contributor to reduced signal strength at this location, but may not be having a noticeable effect.
6 (Plots 2, 3 and 4)	2.5	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.
7 (Plots 2, 3 and 4)	3.2	All multiplexes were received with good picture and audio quality.	The development was not found to be having a noticeable effect on receivers in the area because all channels remain available.

Table 2 Survey results – Plots 2, 3 and 4

4.3 Conclusions

4.3.1 Plot 14

Plot 14 is likely to be contributing to the reduction in signal strength caused by buildings in the city centre.

Overall, it is judged that the effects of Plot 14 are unlikely to be noticeable for receivers, because the vast majority of multiplexes showed good picture and audio quality at all survey locations.

If interference to local multiplexes was to be reported in the shadow zone for Circle Square within approximately 500m of the building, the reported effects should be evaluated in the context of the survey results. It would be good practice to arrange for a local aerial installer to visit the reported interference location if the affected channels corresponded to one of the weaker multiplexes. The zone in which interference reports should be considered the most carefully is illustrated in Figure 6 below⁵.

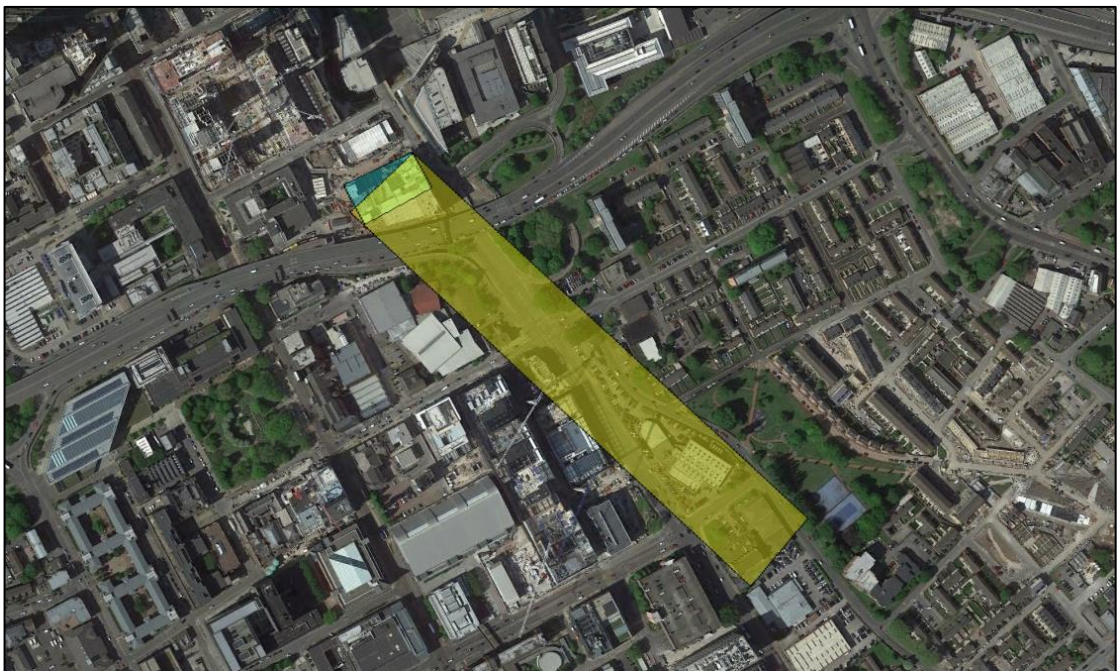


Figure 6 Zone of interest for interference reports (plot 14)

It is considered unlikely that such reports will be raised because noticeable effects are not predicted.

⁵ Copyright © 2020 Google.

4.3.2 Plots 2, 2 and 4

Plots 2, 3 and 4 are likely to be contributing to the reduction in signal strength caused by buildings in the city centre.

Overall, it is judged that the effects of these plots may be noticeable for receivers since channel availability was reduced further in the shadow zone for these plots than for the adjacent shadow zone for Plot 14. Nevertheless, it is also possible that this has not resulted in noticeable effects for actual receivers because:

- Other sources of coverage are available and frequently utilised such as satellite television.
- It is possible that solutions have already been implemented due to the variable signal in proximity to the city centre such as signal amplifiers.
- The precise positioning and elevation of the receiving aerial can make the difference between a multiplex showing good picture and showing bad picture.
- Developments in the city centre in recent years have contributed to a cumulative reduction in signal strength, see Figure 7 below⁶.

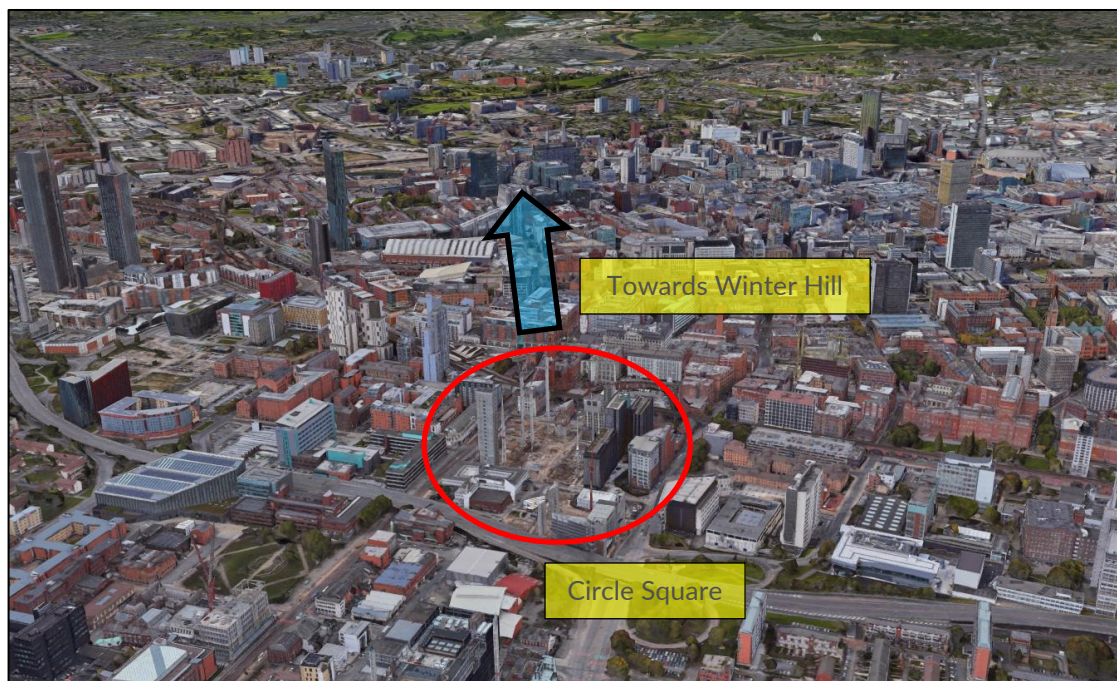


Figure 7 Overview of cumulative developments

⁶ Copyright © 2020 Google.

If interference to local multiplexes was to be reported in the shadow zone for Circle Square within approximately 2 km of the building, the reported effects should be evaluated in the context of the survey results. It would be good practice to arrange for a local aerial installer to visit the reported interference location if the affected channels corresponded to one of the weaker multiplexes. The zone in which interference reports should be considered the most carefully is illustrated in Figure 8 below⁷.



Figure 8 Zone of interest for interference reports (plots 2, 3 and 4)

⁷ Copyright © 2020 Google.

APPENDIX A DETAILED SURVEY RESULTS

Location 1 – Plot 14

GPS Coordinates: SJ 84640 97117				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	26.1 ± 0.2	-	-	-
24 That's TV	32.4 ± 0.3	1e-7	Fine	Fine
27	30.9 ± 0.2	-	-	-
29 5 Star	44.5 ± 0.2	5e-7	Fine	Fine
31 Sky News	49.6 ± 0.2	2e-8	Fine	Fine
32 BBC 2	48.9 ± 0.3	1e-8	Fine	Fine
34 ITV	47.3 ± 0.2	1e-8	Fine	Fine
35 Channel 4 HD	49.8 ± 0.2	1e-8	Fine	Fine
37 Yesterday	48.6 ± 0.2	1e-8	Fine	Fine
55	-	-	-	-

Notes: Horizontally Polarized (HP) Ultra-High Frequency (UHF) aeriels directed towards Winter Hill was observed at some distance.

Location 2 – Plot 14

GPS Coordinates: SJ 84850 96923				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21 Tiny pop	28.1 ± 0.2	5e-4	Fine	Fine
24 That's TV	32.6 ± 0.1	1e-8	Fine	Fine
27 Pop max	31.6 ± 0.2	1e-8	Fine	Fine
29 CCXTV	52.1 ± 0.2	1e-8	Fine	Fine
31 4Music	52.7 ± 0.2	1e-8	Fine	Fine
32 BBC 1 NW	52.2 ± 0.2	1e-8	Fine	Fine
34 ITV	51.1 ± 0.2	1e-8	Fine	Fine
35 BBC 2 HD	55.2 ± 0.2	1e-8	Fine	Fine
37 Yesterday	54.0 ± 0.2	1e-8	Fine	Fine
55 CBeebies HD	41.6 ± 0.2	1e-9	Fine	Fine

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 3 – Plot 14

GPS Coordinates: SJ 84939 96830				
Channel	Signal Strength (dB μ V)	BER	Picture Quality	Audio Quality
21 Tiny pop	27.7 $\pm$ 0.2	2e-3	Fine	Fine
24 Tiny pop	36.7 $\pm$ 0.2	1e-8	Fine	Fine
27 Sony +1	32.8 $\pm$ 0.2	1e-8	Fine	Fine
29 5 USA	55.4 $\pm$ 0.2	1e-8	Fine	Fine
31 4Music	53.5 $\pm$ 0.2	1e-8	Fine	Fine
32 BBC 2	50.4 $\pm$ 0.2	1e-8	Fine	Fine
34 ITV 4	49.9 $\pm$ 0.1	1e-8	Fine	Fine
35 BBC 2 HD	47.6 $\pm$ 0.2	1e-8	Fine	Fine
37 Yesterday	50.1 $\pm$ 0.2	1e-8	Fine	Fine
55 BBC News HD	39.4 $\pm$ 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 4 – Plot 14

GPS Coordinates: SJ 85073 96678				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21 Tiny pop	28.4 ± 0.2	2e-3	Fine	Fine
24 Tiny pop	38.6 ± 0.2	1e-8	Fine	Fine
27 Pop max	36.4 ± 0.2	1e-8	Fine	Fine
29 5 Star	52.4 ± 0.1	3e-8	Fine	Fine
31 Sky News	51.1 ± 0.2	2e-8	Fine	Fine
32 BBC 1 NW	45.8 ± 0.2	1e-8	Fine	Fine
34 ITV 4	47.5 ± 0.4	3e-8	Fine	Fine
35 Channel 5 HD	47.3 ± 0.2	1e-8	Fine	Fine
37 Yesterday	53.2 ± 0.2	1e-8	Fine	Fine
55 BBC News HD	42.6 ± 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 5 – Plot 14

GPS Coordinates: SJ 85311 96483				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21 Tiny pop	28.6 ± 2	1e-8	Fine	Fine
24 Tiny pop	43.3 ± 0.1	1e-8	Fine	Fine
27 Clubland	39.2 ± 0.2	1e-8	Fine	Fine
29 5 Star	60.8 ± 0.2	1e-8	Fine	Fine
31 4Music	60.5 ± 0.2	1e-8	Fine	Fine
32 BBC 2	60.3 ± 0.2	1e-8	Fine	Fine
34 ITV 4	60.8 ± 0.2	1e-8	Fine	Fine
35 Channel 4 HD	62.5 ± 0.2	1e-8	Fine	Fine
37 Ideal World	62.0 ± 0.2	1e-8	Fine	Fine
55 BBC News HD	44.5 ± 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 6 – Plot 14

GPS Coordinates: SJ 85750 96107				
Channel	Signal Strength (dB μ V)	BER	Picture Quality	Audio Quality
21 Tiny pop	33.1 $\pm$ 0.2	1e-8	Fine	Fine
24 That's TV	44.3 $\pm$ 0.3	1e-8	Fine	Fine
27 Sony +1	33.7 $\pm$ 0.2	3e-8	Fine	Fine
29 5 Star	64.5 $\pm$ 0.2	1e-8	Fine	Fine
31 Sky News	67.2 $\pm$ 0.2	1e-8	Fine	Fine
32 BBC 2	65.8 $\pm$ 0.2	1e-8	Fine	Fine
34 ITV	63.9 $\pm$ 0.2	1e-8	Fine	Fine
35 BBC 1 HD	64.6 $\pm$ 0.2	1e-8	Fine	Fine
37 Yesterday	65.5 $\pm$ 0.2	1e-8	Fine	Fine
55 QVC HD	52.3 $\pm$ 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards the Winter Hill transmitter were observed.

Location 7 – Plot 14

GPS Coordinates: SJ 86124 95733				
Channel	Signal Strength (dB μ V)	BER	Picture Quality	Audio Quality
21 Tiny pop	31.3 $\pm$ 0.2	6e-8	Fine	Fine
24 Tiny pop	46.8 $\pm$ 0.2	1e-8	Fine	Fine
27 Sony +1	35.4 $\pm$ 0.2	1e-8	Fine	Fine
29 CCXTV	66.0 $\pm$ 0.2	1e-8	Fine	Fine
31 4Music	66.7 $\pm$ 0.2	1e-8	Fine	Fine
32 BBC 2	65.5 $\pm$ 0.2	1e-8	Fine	Fine
34 ITV 4	65.8 $\pm$ 0.2	1e-8	Fine	Fine
35 BBC 2 HD	67.4 $\pm$ 0.2	1e-8	Fine	Fine
37 Ideal World	66.4 $\pm$ 0.1	1e-8	Fine	Fine
55 BBC News HD	54.3 $\pm$ 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards the Winter Hill transmitter were observed.

Location 8 – Plot 14

GPS Coordinates: SJ 86723 95224				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21 Tiny pop	39.2 ± 0.2	1e-8	Fine	Fine
24 Tiny pop	50.9 ± 0.2	1e-8	Fine	Fine
27	45.3 ± 0.2	1e-8	Fine	Fine
29 CCX TV	69.2 ± 0.2	1e-8	Fine	Fine
31 4Music	70.1 ± 0.2	1e-8	Fine	Fine
32 BBC 2	69.9 ± 0.2	1e-8	Fine	Fine
34 ITV	69.3 ± 0.2	1e-8	Fine	Fine
35 BBC 1 HD	71.8 ± 0.1	1e-8	Fine	Fine
37 Ideal World	72.1 ± 0.1	1e-8	Fine	Fine
55 QVC HD	59.6 ± 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards the Winter Hill transmitter were observed.

Location 1 – Plots 2, 3 and 4

GPS Coordinates: SJ 84326 97189				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	25.5 ± 0.2	-	-	-
24 That's TV	28.8 ± 0.2	2e-3	Fine	Fine
27	27.4 ± 0.2	-	-	-
29 5 Star	38.8 ± 0.2	1e-8	Fine	Fine
31 Sky News	37.6 ± 0.2	1e-3	Fine	Fine
32 BBC 1 NW	37.5 ± 0.5	6e-5	Fine	Fine
34 ITV 2	38.1 ± 0.3	4e-6	Fine	Fine
35	38.3 ± 0.3	-	-	-
37 Yesterday	41.7 ± 0.3	1e-8	Fine	Fine
55 BBC News HD	31.9 ± 0.3	-	-	-

Notes: Aerials were not observable at the survey location.

Location 2 – Plots 2, 3 and 4

GPS Coordinates: SJ 84877 96798				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21 Tiny pop	35.2 ± 0.2	-	-	-
24 That's TV	40.2 ± 0.2	1e-8	Fine	Fine
27 Pop max	36.2 ± 0.2	-	-	-
29 5 Star	50.9 ± 0.2	1e-8	Fine	Fine
31 Dave	52.2 ± 0.2	1e-8	Fine	Fine
32 BBC 2	51.8 ± 0.2	1e-8	Fine	Fine
34 ITV +1	52.2 ± 0.2	1e-8	Fine	Fine
35 BBC 2 HD	53.1 ± 0.2	1e-8	Fine	Fine
37 Ideal World	52.6 ± 0.2	1e-8	Fine	Fine
55 BBC News HD	39.2 ± 0.2	1e-8	Intermittent	Intermittent

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 3 – Plots 2, 3 and 4

GPS Coordinates: SJ 85009 96618				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21	30.3 ± 0.1	-	-	-
24	34.2 ± 0.1	3e-8	Fine	Fine
27 Pop max	31.5 ± 0.1	-	-	-
29 5 USA	41.1 ± 0.2	9e-5	Fine	Fine
31 4Music	45.8 ± 0.2	4e-7	Fine	Fine
32 BBC 2	44.3 ± 0.2	7e-7	Fine	Fine
34 ITV	42.9 ± 0.4	5e-8	Fine	Fine
35 Channel 4 HD	45.1 ± 0.2	1e-8	Fine	Fine
37 Yesterday	45.3 ± 0.2	2e-7	Fine	Fine
55 BBC News HD	32.0 ± 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 4 – Plots 2, 3 and 4

GPS Coordinates: SJ 85073 96678				
Channel	Signal Strength (dBμV)	BER	Picture Quality	Audio Quality
21 Tiny pop	27.2 ± 0.1	-	-	-
24 That's TV	31.8 ± 0.2	1e-8	Fine	Fine
27 Clubland	34.6 ± 0.2	2e-8	Fine	Fine
29 5 USA	51.8 ± 0.2	1e-8	Fine	Fine
31 Sky News	49.3 ± 0.2	1e-8	Fine	Fine
32 BBC 2	49.5 ± 0.3	1e-8	Fine	Fine
34 ITV	48.2 ± 0.2	1e-8	Fine	Fine
35 BBC 2 HD	46.9 ± 0.2	1e-8	Fine	Fine
37 Yesterday	46.5 ± 0.2	2e-7	Fine	Fine
55 BBC News HD	36.3 ± 0.2	1e-9	Fine	Fine

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 5 – Plots 2, 3 and 4

GPS Coordinates: SJ 85311 96483				
Channel	Signal Strength (dB μ V)	BER	Picture Quality	Audio Quality
21	26.1 $\pm$ 0.2	-	-	-
24 That's TV	32.5 $\pm$ 0.2	1e-8	Fine	Fine
27	28.7 $\pm$ 0.2	-	-	-
29 5 USA	54.2 $\pm$ 0.2	1e-8	Fine	Fine
31 4Music	57.4 $\pm$ 0.2	1e-8	Fine	Fine
32 BBC 1 NW	57.9 $\pm$ 0.2	1e-8	Fine	Fine
34 ITV 3	54.3 $\pm$ 0.2	1e-8	Fine	Fine
35 BBC 2 HD	53.3 $\pm$ 0.2	1e-8	Fine	Fine
37 Ideal World	54.7 $\pm$ 0.2	1e-8	Fine	Fine
55 CBeebies HD	35.2 $\pm$ 0.4	1e-8	Intermittent	Intermittent

Notes: HP UHF aerials directed towards Winter Hill were observed.

Location 6 – Plots 2, 3 and 4

GPS Coordinates: SJ 85750 96107				
Channel	Signal Strength (dB μ V)	BER	Picture Quality	Audio Quality
21 Tiny pop	31.5 $\pm$ 0.2	1e-8	Fine	Fine
24 That's TV	44.0 $\pm$ 0.2	1e-8	Fine	Fine
27 Clubland	38.2 $\pm$ 0.2	1e-8	Fine	Fine
29 CCX TV	62.1 $\pm$ 0.2	1e-8	Fine	Fine
31 4Music	63.7 $\pm$ 0.2	1e-8	Fine	Fine
32 BBC 2	62.9 $\pm$ 0.2	1e-8	Fine	Fine
34 ITV 3	62.0 $\pm$ 0.2	1e-8	Fine	Fine
35 ITV HD	63.2 $\pm$ 0.2	1e-8	Fine	Fine
37 Yesterday	62.4 $\pm$ 0.2	1e-8	Fine	Fine
55 CBeebies HD	43.9 $\pm$ 0.3	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards the Winter Hill transmitter were observed.

Location 7 – Plots 2, 3 and 4

GPS Coordinates: SJ 86124 95733				
Channel	Signal Strength (dB μ V)	BER	Picture Quality	Audio Quality
21 Tiny pop	34.2 $\pm$ 0.2	1e-8	Fine	Fine
24 That's TV	48.0 $\pm$ 0.2	1e-8	Fine	Fine
27	42.3 $\pm$ 0.2	1e-8	Fine	Fine
29 5 Star	65.7 $\pm$ 0.2	1e-8	Fine	Fine
31 Pick	67.7 $\pm$ 0.2	1e-8	Fine	Fine
32 BBC 2	66.3 $\pm$ 0.2	1e-8	Fine	Fine
34 ITV 3	64.1 $\pm$ 0.2	1e-8	Fine	Fine
35 BBC 2 HD	65.5 $\pm$ 0.1	1e-8	Fine	Fine
37 Yesterday	66.1 $\pm$ 0.2	1e-8	Fine	Fine
55 QVC HD	55.2 $\pm$ 0.2	1e-8	Fine	Fine

Notes: HP UHF aerials directed towards the Winter Hill transmitter were observed.

APPENDIX B SURVEY PHOTOGRAPHS

Location 1 – Plot 14



Location 2 – Plot 14



Location 3 – Plot 14



Location 4 – Plot 14



Location 5 – Plot 14



Location 6 – Plot 14



Location 7 – Plot 14



Location 8 – Plot 14



Location 1 – Plots 2, 3 and 4



Location 2 – Plots 2, 3 and 4



Location 3 – Plots 2, 3 and 4



Location 4 – Plots 2, 3 and 4



Location 5 – Plots 2, 3 and 4



Location 6 – Plots 2, 3 and 4



Location 7 – Plots 2, 3 and 4





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

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