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Urban & Renewables

Television Baseline Survey Report

NOMA GP Ltd

2&3 Angel Square

July 2024

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ADMINISTRATION PAGE

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Issue	Date	Detail of Changes
1	24th of May 2022	Initial issue
2	30th of May 2022	Minor Amendments
3	9th of July 2024	Minor Material Amendment - New plant screen

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been commissioned to investigate the potential impact of the proposed Angel Square 2&3 building development upon terrestrial television reception in the surrounding area. The proposed development will comprise two tall building plots and is located at Angel Street, Manchester, UK.

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

Updated Proposed Development Details

In July 2024, Pager Power has been provided with new design details for 2 Angel Square due to a new plant screen resulting in a minor material amendment to the planning application. The overall maximum altitude of the building plot for 2 Angel Square is now 104.7m above mean sea level. The assessment considered a previous maximum altitude for 2 Angel Square at 105.9m above mean sea level. Therefore, the assessment results are conservative and the report conclusions remain.

Results

- The proposed development is within the coverage area for the Winter Hill television transmitter. The baseline survey confirmed it was the main transmitter serving the area.
- Any interference would be due to shadowing effects i.e. the weakening of the transmitted signal due to the physical presence of the buildings.
- A site survey was undertaken on the 16th of May 2022 to confirm the relevant transmitter and record the signal quality.
- The average terrestrial signal strength is very good in the proposed development shadow zone for the main multiplexes and moderate on average for the local (lower power) multiplexes[1].
- Negative effects, due to the proposed development, upon signal strength are most likely at locations close to the proposed development, typically within 1km of the proposed development and within its shadow zone. Multi-storey flats and/or commercial property are located adjacent to this location. A reduction in signal strength is possible based on

[1] Excluding survey location 5a where no services were received possibly due to existing obstructions in the form of trees and tall buildings.

the proximity to the proposed development. Significant effects are not predicted due to the height or presence of any aerials in the area.

- A small number of two storey properties are located approximately 1.6km to 1.7km of the proposed development. The signal strength within this range was recorded as moderate for the main multiplexes for one of two locations[2] surveyed within this range. No services were received at the other location. A reduction in signal strength is possible based on the proximity to the proposed development. Based on the current signal quality and height of identified aerial relative to the proposed development, interference is possible. Multiple satellite dishes are present on these properties. Beyond this distance, significant effects are not predicted due to the current signal strength.

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.

[2] Locations 5a and 5b. Adjacent survey location 5b received an average of moderate signal strength.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 51 countries within Europe, Africa, America, Asia and Australasia.

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

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

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

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

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

1 BACKGROUND

1.1 Introduction

Pager Power has been commissioned to investigate the potential impact of a proposed building development upon terrestrial television reception in the surrounding area. The proposed development will introduce tall new structures into the urban environment, which could interact with broadcast signals, causing interference. The interference zones have been modelled in accordance with Ofcom guidance (Section 3) and a baseline reception survey has been undertaken within potentially affected areas (Sections 4 and 5).

1.2 Proposed Development Details

The proposed development site plan is shown in Figure 1[3] below.

Figure 1 *Proposed development site plan*

[3] Source: 947-CPA-ZZ-00-DR-A-SK200-P06-Lower Ground Floor GA Plan.pdf (copped)

1.3 Proposed Development Boundary – Aerial image

The development boundary (red line) and site footprint (blue) for the proposed development overlaid on aerial imagery is shown in Figure 2 below.

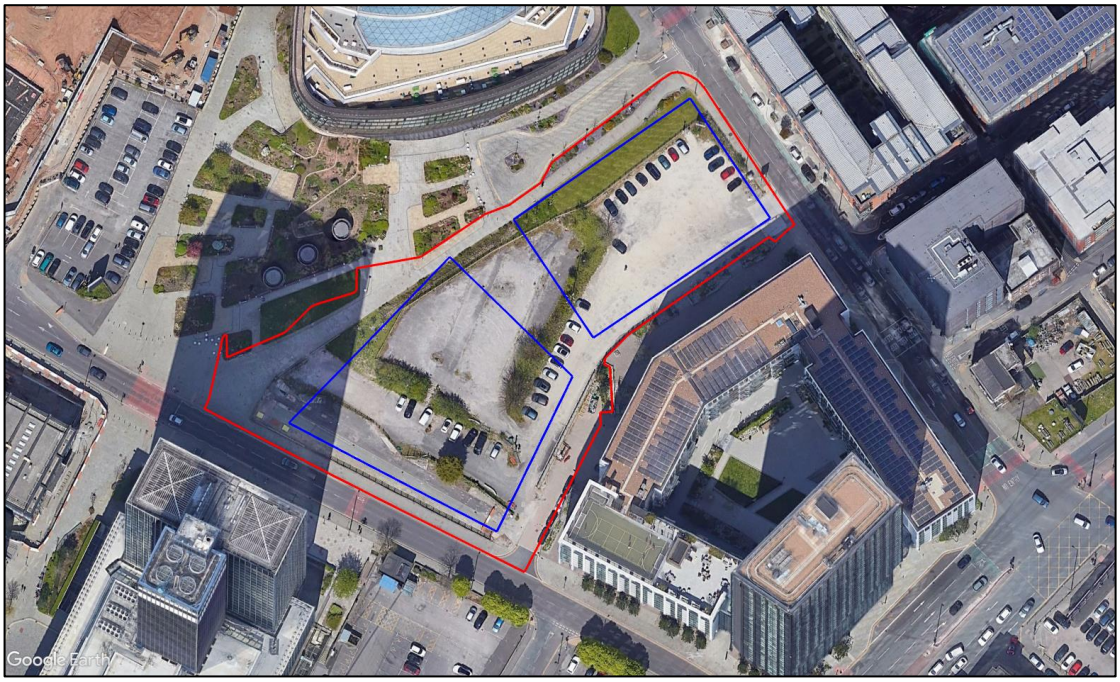


Figure 2 *Proposed development boundary overlaid on aerial imagery*

2 TELEVISION TRANSMITTER DETAILS

2.1 Relevant Transmitter

Winter Hill is one of the UK's main television transmitters located approximately 24km northwest of the proposed development. The Winter Hill transmitter serves the area around the development.

Digital television services are broadcast via Ultra High Frequency (UHF) signals; no analogue television signals are broadcast. Digital and FM radio services are also broadcast. The transmitter information is presented below[4].

2.2 Winter Hill Main Transmitter

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

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

Table 1 *Winter Hill main transmissions*

Additional Winter Hill transmissions are shown in Table 2 below.

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

Table 2 *Winter Hill additional transmissions*

[4] Source: Ofcom

3 BUILDINGS AND TELEVISION INTERFERENCE

3.1 Technical Overview

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

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

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

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

3.2 Obstruction of the Signal

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

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

The Ofcom document states that:

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

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

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

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

The zones mentioned are illustrated in Figure 3 on the following page[5], taken from Section 3.2 of an Ofcom paper[6] 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.

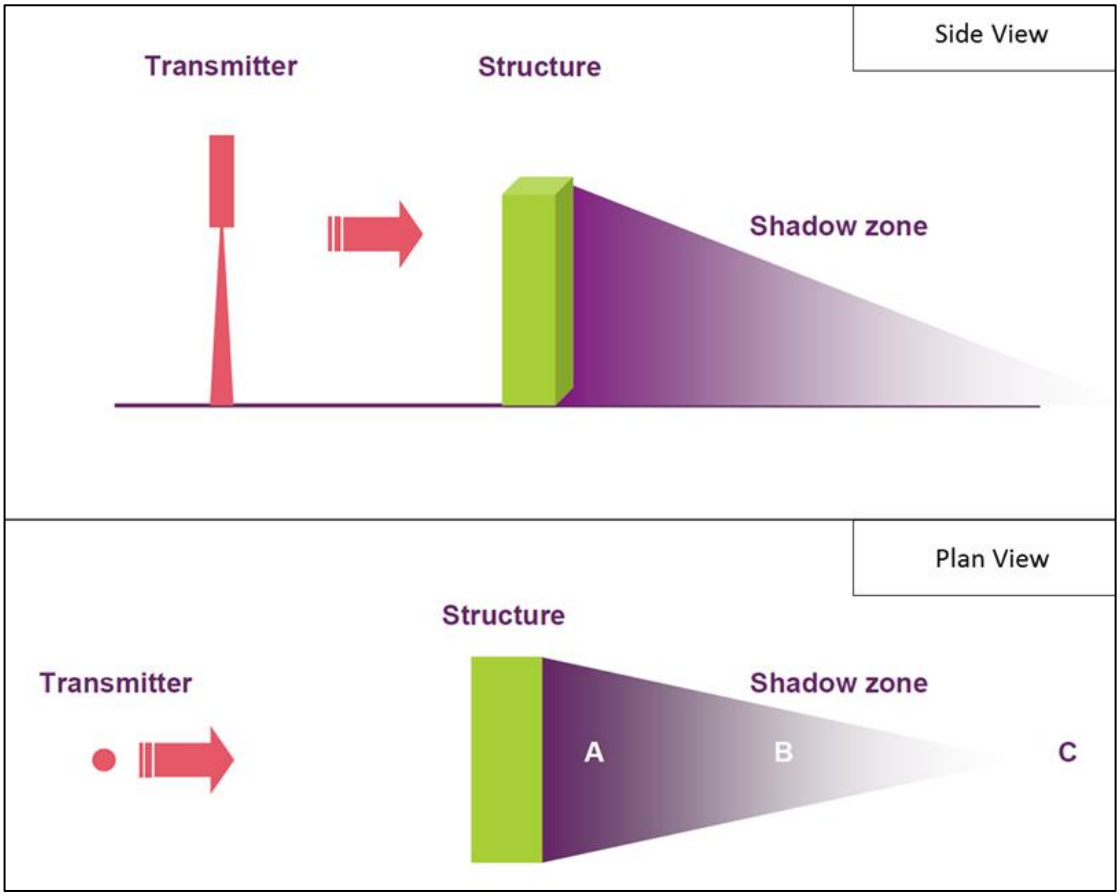


Figure 3 *Diffraction loss zones*

3.3 Reflection of the Signal

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

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

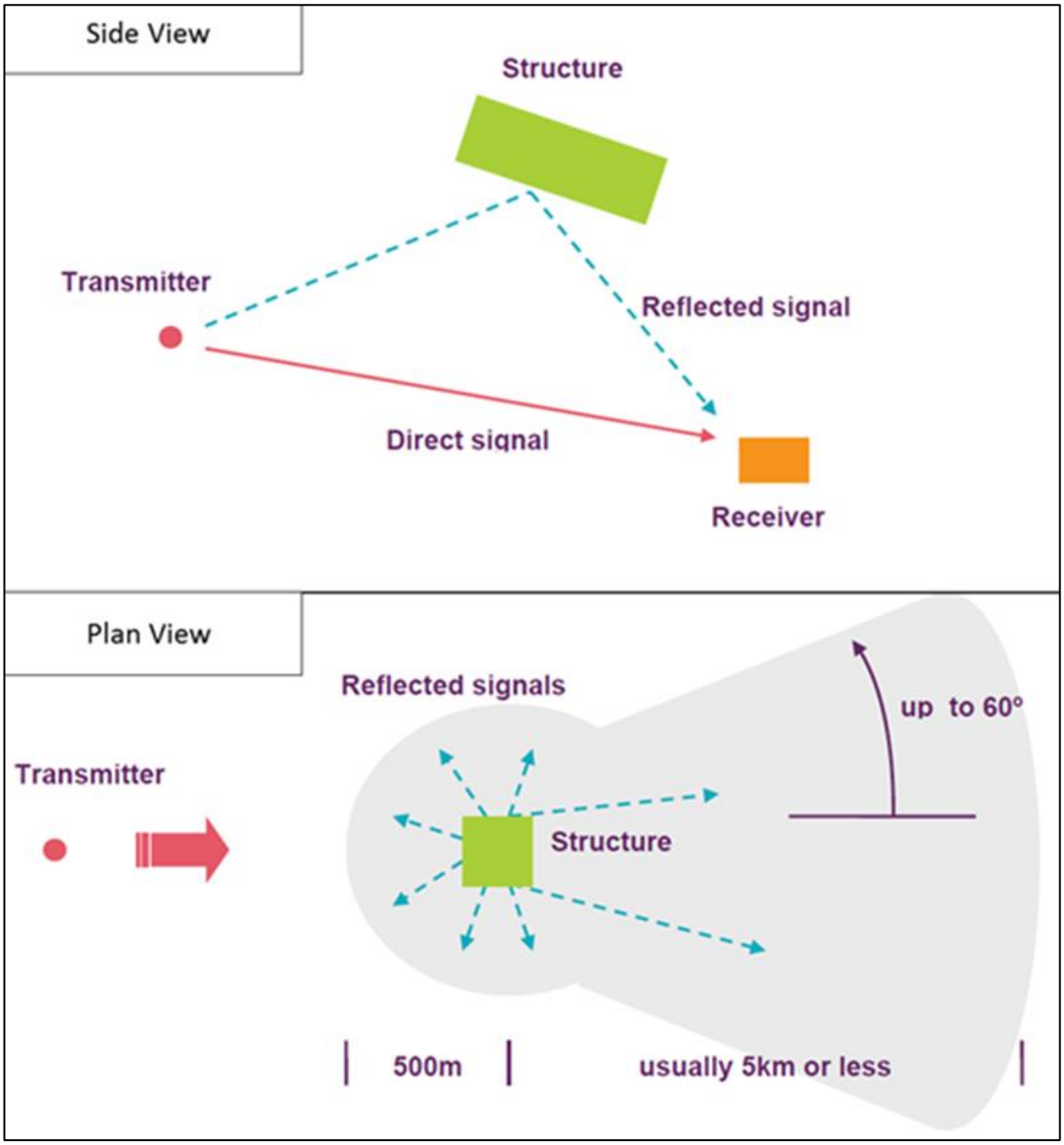


Figure 4 *Reflection zones*

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[7].

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.

[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.

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 5 below shows the potential interference areas associated with the proposed development[8].

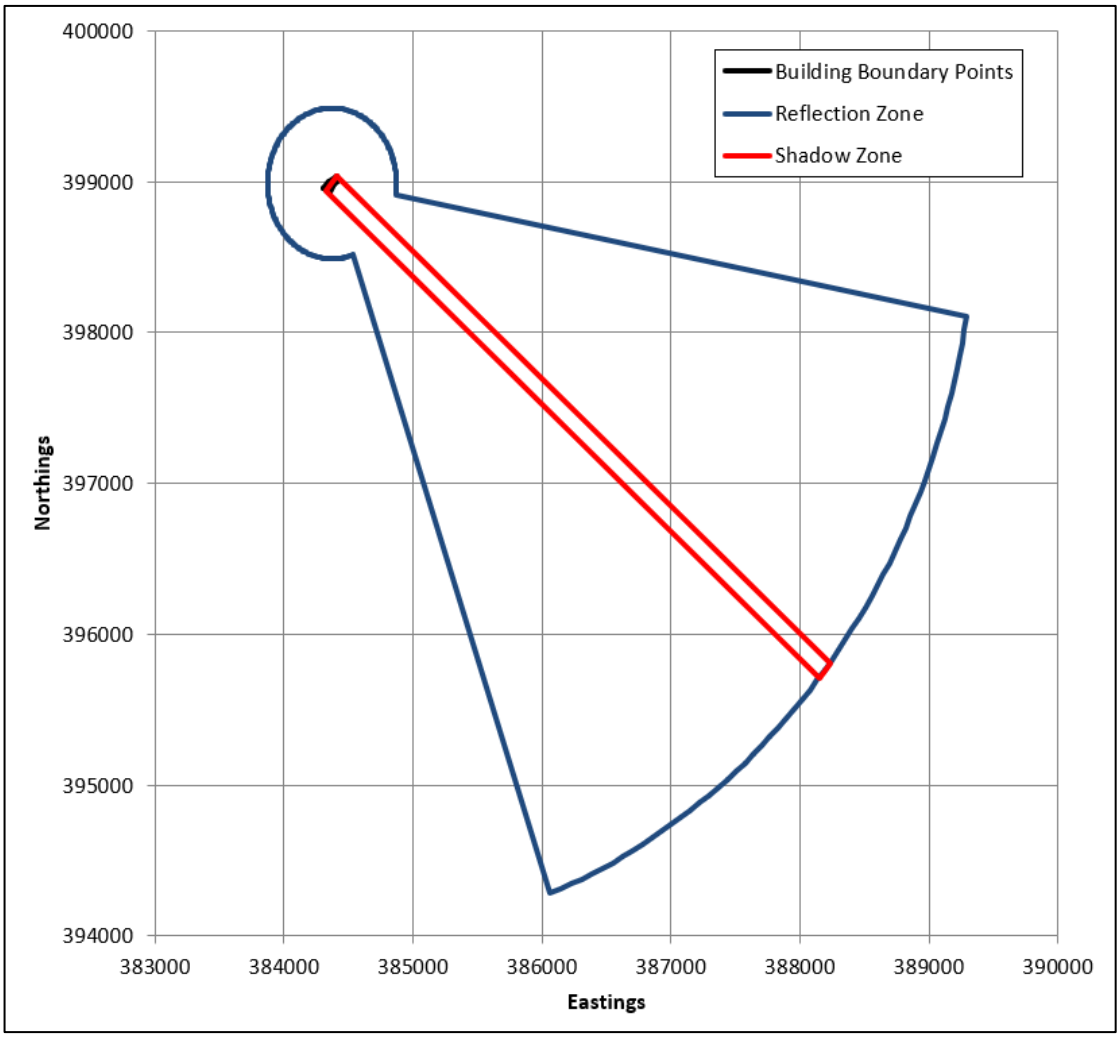


Figure 5 *Interference areas*

[8] The cumulative footprint of the proposed development has been considered.

Figure 6 below shows the interference zones overlaid onto an aerial image of the area.

Figure 6 *Interference zones map*

4.2 Potential Diffraction Issues – Terrestrial Television

The shadow zone passes over urban areas that contain multi-storey flats, commercial buildings, and/or typical 2-storey residential dwellings. Areas closest to the proposed development are at the highest risk of experiencing television interference. This is typically limited to 1km based on Pager Power's assessment experience. Multi-storey flats and/or commercial buildings are mostly located within 1km of the proposed development shadow zone. Beyond this distance 2-storey dwellings are present.

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 proposed development is unobstructed.
- The angle between the reflected signal via the proposed development and the direct signal would 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.

5 TELEVISION 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 16th of May 2022.

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

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

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

Table 3 *Television signal strength categories*

5.2 Survey Locations

Figure 7 below shows the survey locations overlaid onto aerial photography. The proposed development location and the shadow zone are also shown. Survey locations were chosen pre-survey (within the shadow zone) however safe and available access influenced the specific position on the day. Survey location 1 was chosen in front of the proposed development to consider the signal strength which may be affected by existing obstructions and not that of the proposed development. Furthermore, it provides a good a like for like comparison for a post-construction survey (if appropriate) to determine if effects are attributable to the proposed development.

No access was available at or near to this survey location 4 and therefore no recording was undertaken at this location. For survey location 5a, no services were available (discussed further in the following section); however, they were available at the nearby survey location 5b. Survey locations are more closely grouped nearer the proposed development because interference is generally more likely the closer the location is to the obstruction. Radial white icons represent television survey locations.

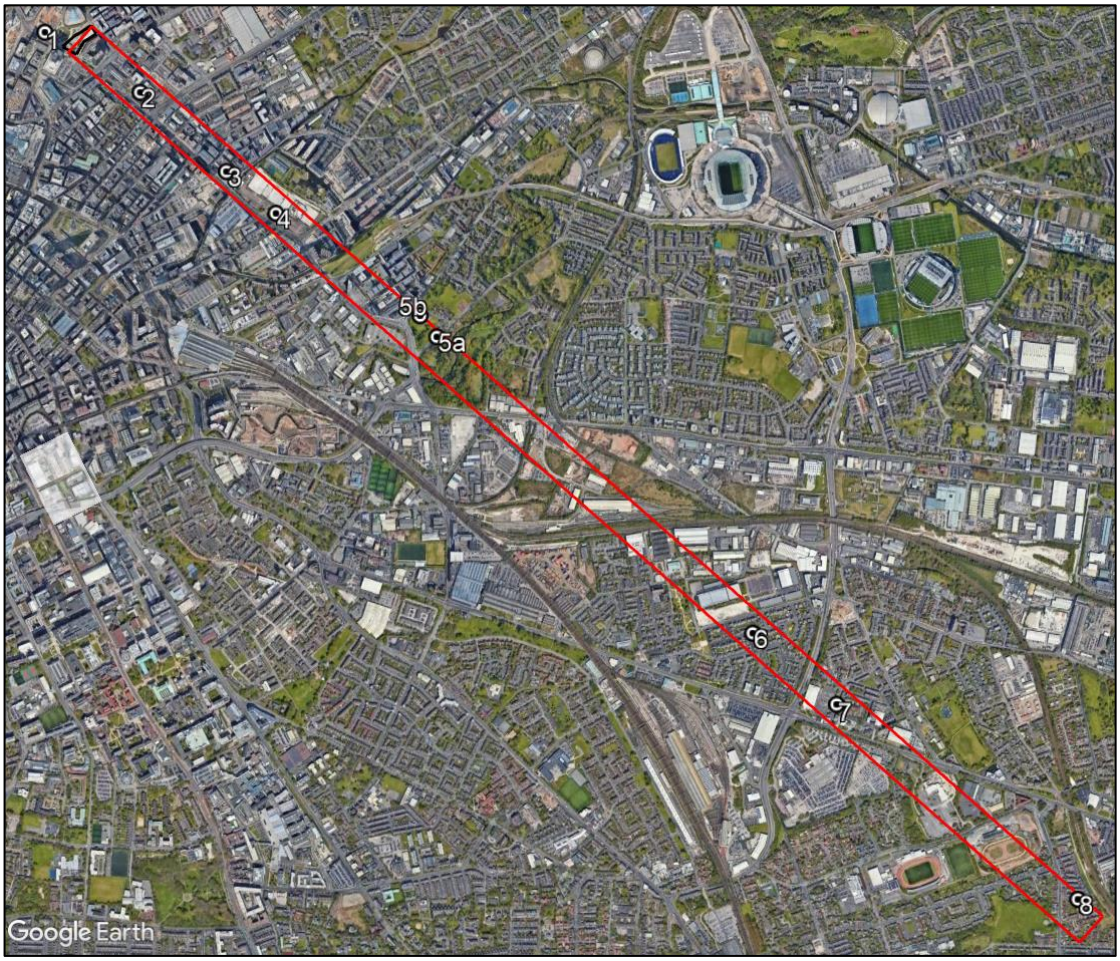


Figure 7 *Survey locations*

5.3 Survey Results

A summary of the television survey results is presented in Table 4 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: 43.6 (Moderate) Main TV MUX: 47.2 (Good) Local TV MUX: 36.4 (Moderate)	No UHF[9] aerials or satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.4dB. One local multiplex displayed fine picture and audio quality. Two local multiplexes did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.2dB.	Surveyed location in an area known as the 'back scatter[10]' region. This location is approximately 90 metres from (and in front of) the proposed development. A tall building development under construction in front of the proposed development is located adjacent to this location. Significant obstructions already exist in the city centre between the aerial and the transmitter which is likely to contribute to the observed signal strength. The proposed development would not be expected to add to any interference in this location.

[9] Ultra-High Frequency
[10] Backscatter region is the area in front of the proposed development in the direction Winter Hill transmitter.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
2	Average: 42.8 (Moderate) Main TV MUX: 46.7 (Good) Local TV MUX: 35.0 (Moderate)	No UHF aerials or satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.3dB. One local multiplex displayed fine picture and audio quality. Two local multiplexes did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 275 metres from the proposed development. Multi-storey flats and/or commercial property are located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. Significant effects are not predicted due to the height or presence of any aerials in the area.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
3	Average: 40.6 (Moderate) Main TV MUX: 44.3 (Moderate) Local TV MUX: 33.2 (Low)	Two HP[11] UHF aerials directed towards the Winter Hill transmitter were observed. No satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.3dB. One local multiplex displayed fine picture and audio quality. Two local multiplexes did not decode. An average of low signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 707 metres from the proposed development. Multi-storey flats and/or commercial property are located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. Significant effects are not predicted due to the height or presence of any aerials in the area.
4	No access was available at or near to this location.	N/A.	N/A.

[11] Horizontally Polarised

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
5a	No services were available at this location.	Three HP UHF aerials directed towards the Winter Hill transmitter were observed. Multiple satellite dishes were observed.	This location is approximately 1.695km metres from the proposed development. Predominately two-storey dwellings are located adjacent to this location. These dwellings are located at a terrain height of approximately 3m lower than those located at survey location 5b (discussed on the following page). Dwellings located immediately north may already be affected by existing obstructions in the form of trees and existing tall buildings. Based on the current signal quality and height of identified aerial relative to the proposed development, further interference is possible.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
5b	Average: 41.8 (Moderate) Main TV MUX: 43.9 (Moderate) Local TV MUX: 37.7 (Moderate)	Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.5dB. One local multiplex displayed fine picture and audio quality. Two local multiplexes did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.1dB.	This location is approximately 1.6km metres from the proposed development. Predominately two-storey dwellings are located adjacent to this location. A reduction in signal strength is possible based on the proximity to the proposed development. Based on the current signal quality and height of identified aerial relative to the proposed development, interference is possible.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
6	Average: 55.3 (Very good) Main TV MUX: 63.2 (Very good) Local TV MUX: 39.5 (Moderate)	One HP UHF aerials directed towards the Winter Hill transmitter were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of very good signal strength and signal fluctuations of less than or equal to 0.4dB. Two local multiplexes displayed fine picture and audio quality. One local multiplex did not decode. An average of moderate signal strength and signal fluctuations of less than or equal to 0.7dB.	This location is approximately 3.305km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable. Interference is unlikely.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
7	Average: 54.8 (Good) Main TV MUX: 61.8 (Very good) Local TV MUX: 40.9 (Moderate)	Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of very good signal strength and signal fluctuations of less than or equal to 0.3dB. All local multiplexes displayed fine picture and audio quality. An average of moderate signal strength and signal fluctuations of less than or equal to 0.3dB.	This location is approximately 3.715km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable. Interference is unlikely.

Location	Average Measured Signal Strength (dB)	Remarks	High Level Conclusion
8	Average: 64.6 (Very good) Main TV MUX: 70.3 (Very good) Local TV MUX: 53.2 (Good)	Multiple HP UHF aerials directed towards the Winter Hill transmitter were observed. Multiple satellite dishes were observed. All main multiplexes displayed fine picture and audio quality. An average of very good signal strength and signal fluctuations of less than or equal to 0.2dB. All local multiplexes displayed fine picture and audio quality. An average of good signal strength and signal fluctuations of less than or equal to 0.2dB.	This location is approximately 4.860km from the proposed development. Effects at this range are likely to be relatively small based on previous experience. Based on the current signal quality, effects are unlikely to be noticeable. Interference is unlikely.

Table 4 *Television baseline survey results*

6 MITIGATION

6.1 Mitigation Requirement

If an adverse effect on television services occurs and is attributable to the proposed development, mitigation may be required. The most effective form of mitigation is dependent on the specific impact. Common options are shown below.

Mitigation options for television include:

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

6.2 Recommended Options

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.

6.3 Recommended Process

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

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

There is no reason to install pre-emptive mitigation.

APPENDIX A – DETAILED SURVEY RESULTS

Location 1

Coordinates: Lon: -2.23898, Lat: 53.48763					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	37.2 +/- 0.2	1.2x10^-7	Fine	Fine
27	Glmax	34.2 +/- 0.2	DND	-	-
29	SDN	47.0 +/- 0.2	3.9x10^-7	Fine	Fine
31	Arqiva A	48.1 +/- 0.4	1.6x10^-7	Fine	Fine
32	BBC A	46.5 +/- 0.2	4.9x10^-9	Fine	Fine
34	D3+4	45.9 +/- 0.3	1.7x10^-8	Fine	Fine
35-	BBC B	48.0 +/- 0.2	1x10^-8	Fine	Fine
37	Arqiva B	47.4 +/- 0.2	3x10^-5	Fine	Fine
55	Arqiva C	37.9 +/- 0.1	DND	-	-

Notes: No UHF aerial or satellite dishes were observed.

Location 2

Coordinates: Lon: -2.23347, Lat: 53.48567					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	33.7 +/- 0.1	3x10^-5	Fine	Fine
27	Glmax	32.7 +/- 0.2	DND	-	-
29	SDN	45.3 +/- 0.3	2x10^-5	Fine	Fine
31	Arqiva A	47.8 +/- 0.2	4.2x10^-7	Fine	Fine
32	BBC A	48.0 +/- 0.3	4.5x10^-9	Fine	Fine
34	D3+4	46.5 +/- 0.2	3.3x10^-7	Fine	Fine
35-	BBC B	47.6 +/- 0.2	1x10^-8	Fine	Fine
37	Arqiva B	45.2 +/- 0.2	4x10^-5	Fine	Fine
55	Arqiva C	38.7 +/- 0.1	DND	-	-

Notes: No UHF aerial or satellite dishes were observed.

Location 3

Coordinates: Lon: -2.22855, Lat: 53.48310					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	32.9 +/- 0.2	4.4x10^-3	Fine	Fine
27	Glmax	32.5 +/- 0.1	DND	-	-
29	SDN	44.7 +/- 0.2	4x10^-6	Fine	Fine
31	Arqiva A	45.1 +/- 0.3	6x10^-6	Fine	Fine
32	BBC A	44.1 +/- 0.2	1.7x10^-7	Fine	Fine
34	D3+4	45.2 +/- 0.2	5.2x10^-8	Fine	Fine
35-	BBC B	43.0 +/- 0.1	1x10^-8	Fine	Fine
37	Arqiva B	43.4 +/- 0.3	2.2x10^-5	Fine	Fine
55	Arqiva C	34.3 +/- 0.1	DND	-	-

Notes: Two HP UHF aerial directed towards the Winter Hill transmitter was observed. No satellite dishes were observed.

Location 4

No access was available at or near to this location.

Location 5a

Coordinates: Lon: -2.21661, Lat: 53.47775					
Channel	**Service**	**Signal Strength (dBμV)**	**BER**	**Picture**	**Audio**
24	LTVmux	-	DND	-	-
27	Glmax	-	DND	-	-
29	SDN	-	DND	-	-
31	Arqiva A	-	DND	-	-
32	BBC A	-	DND	-	-
34	D3+4	-	DND	-	-
35-	BBC B	-	DND	-	-
37	Arqiva B	-	DND	-	-
55	Arqiva C	-	DND	-	-

Notes: Three HP UHF aerial directed towards the Winter Hill transmitter was observed. Multiple satellite dishes were observed. Dwellings located immediately north may already be affected by existing obstructions in the form of trees and existing tall buildings. Intermittent rain occurred during the baseline survey and may have contributed to the lack of service.

Location 5b

Coordinates: Lon: -2.21755, Lat: 53.47844					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	37.7 +/- 0.1	1x10^-8	Fine	Fine
27	Glmax	37.3 +/- 0.1	DND	-	-
29	SDN	43.3 +/- 0.1	8x10^-5	Fine	Fine
31	Arqiva A	45.2 +/- 0.1	5x10^-9	Fine	Fine
32	BBC A	44.5 +/- 0.5	2x10^-7	Fine	Fine
34	D3+4	43.2 +/- 0.2	1.5x10^-6	Fine	Fine
35-	BBC B	43.7 +/- 0.2	1x10^-8	Fine	Fine
37	Arqiva B	43.3 +/- 0.2	1.3x10^-6	Fine	Fine
55	Arqiva C	38.2 +/- 0.1	DND	-	-

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

Location 6

Coordinates: Lon: -2.19853, Lat: 53.46810					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	38.4 +/- 0.2	1x10^-8	Fine	Fine
27	Glmax	34.5 +/- 0.1	DND	-	-
29	SDN	65.0 +/- 0.2	1x10^-8	Fine	Fine
31	Arqiva A	64.9 +/- 0.2	1x10^-8	Fine	Fine
32	BBC A	63.8 +/- 0.2	1x10^-8	Fine	Fine
34	D3+4	61.8 +/- 0.2	1x10^-8	Fine	Fine
35-	BBC B	61.4 +/- 0.4	1x10^-8	Fine	Fine
37	Arqiva B	62.2 +/- 0.3	1x10^-8	Fine	Fine
55	Arqiva C	45.5 +/- 0.7	1x10^-8	Fine	Fine

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

Location 7

Coordinates: Lon: -2.19374, Lat: 53.46579					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	42.3 +/- 0.2	1x10^-8	Fine	Fine
27	Glmax	39.0 +/- 0.3	1x10^-8	Fine	Fine
29	SDN	62.0 +/- 0.2	1x10^-8	Fine	Fine
31	Arqiva A	61.9 +/- 0.3	1x10^-8	Fine	Fine
32	BBC A	63.5 +/- 0.2	1x10^-8	Fine	Fine
34	D3+4	62.9 +/- 0.2	1x10^-8	Fine	Fine
35-	BBC B	60.7 +/- 0.3	1x10^-8	Fine	Fine
37	Arqiva B	59.6 +/- 0.2	1x10^-8	Fine	Fine
55	Arqiva C	41.4 +/- 0.3	1x10^-8	Fine	Fine

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

Location 8

Coordinates: Lon: -2.18004, Lat: 53.45949					
Channel	Service	Signal Strength (dBμV)	BER	Picture	Audio
24	LTVmux	53.4 +/- 0.1	1x10^-8	Fine	Fine
27	Glmax	47.5 +/- 0.1	1x10^-8	Fine	Fine
29	SDN	69.9 +/- 0.2	1x10^-8	Fine	Fine
31	Arqiva A	71.0 +/- 0.1	1x10^-8	Fine	Fine
32	BBC A	71.5 +/- 0.1	1x10^-8	Fine	Fine
34	D3+4	70.2 +/- 0.1	1x10^-8	Fine	Fine
35-	BBC B	69.6 +/- 0.1	1x10^-8	Fine	Fine
37	Arqiva B	69.3 +/- 0.1	1x10^-8	Fine	Fine
55	Arqiva C	58.8 +/- 0.2	1x10^-8	Fine	Fine

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

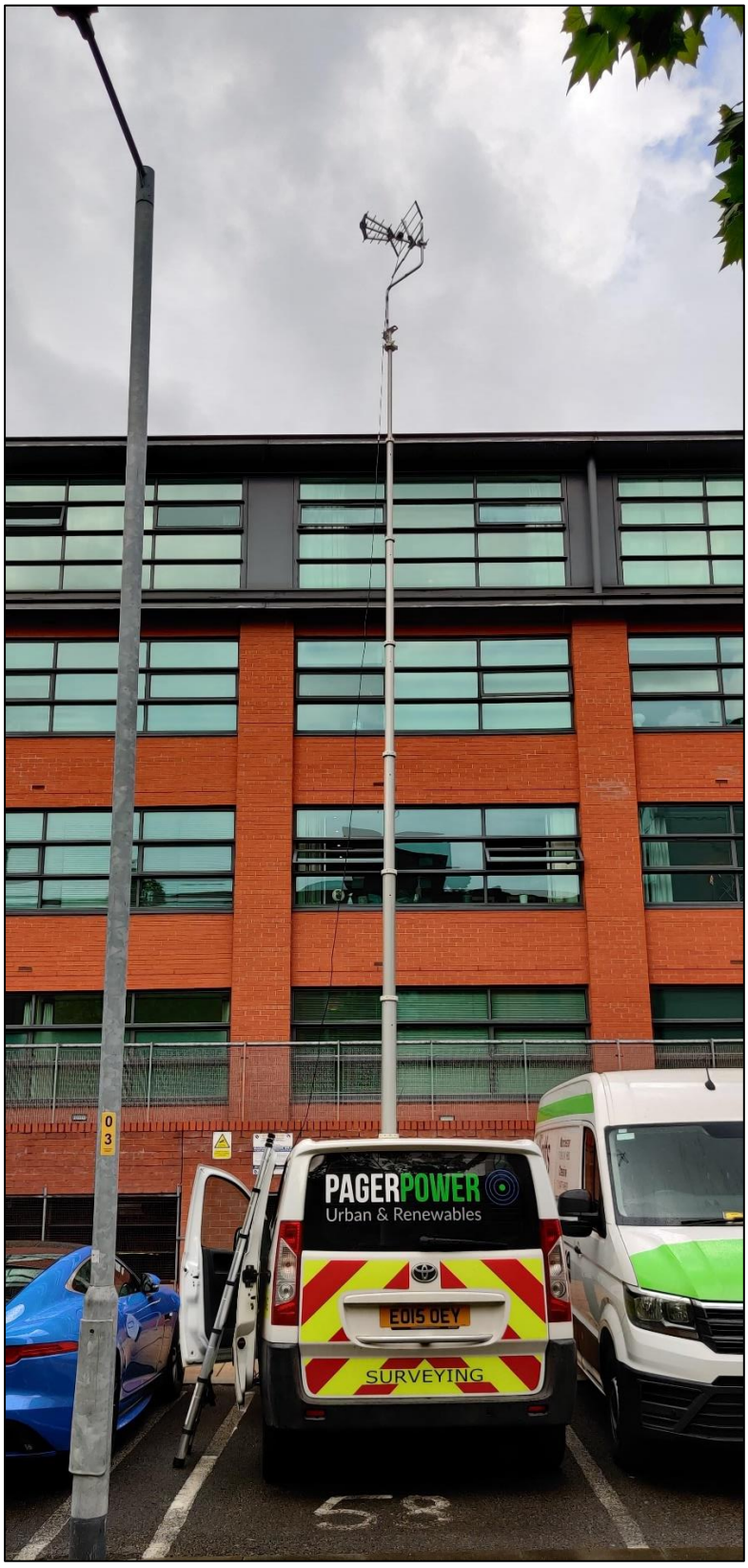
APPENDIX B – SURVEY PHOTOGRAPHS

Location 1

Location 2

PAGERPOWER
Urban & Renewables
SURVEYING
T+44 (0)1787 319001
www.pagerpower.com
E015 OEY

Location 3



Location 4

No access available.

Location 5a

Street view image adjacent to survey location 5a.

Location 5b

Location 6

PAGERPOWER
Urban & Renewables
T+44 (0)1787 319001
SURVEYING
www.pagerpower.com

Location 7

PAGERPOWER
Urban & Renewables
SURVEYING
EO15 OEY
SURVEYING
PAGERPOWER
Urban & Renewables
SURVEYING
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Location 8

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