GTech Surveys Limited

Telecommunication Impact Assessment

Paddington Green Police Station

CHANGE HISTORY

Issue	Date	Details of Changes
0.1	01/02/2023	Working Draft
A	10/02/2023	First Draft Issue
B	10/02/2023	First Draft Review
C	15/02/2023	Second Draft Issue
D	15/02/2023	Second Draft Review
E/F	16/02/2023	Third Draft Issue
1	16/02/2023	Issue for Client Review
2	17/02/2023	Updates incorporating Client Comments
3	21/02/2023	Issue for Planning
Author: G Phillips		**Reviewer: O Lloyd**

Issue: 2

Issue: 2

Contents

GTech Surveys Limited

GTech Surveys Limited is a Midlands based broadcast and telecommunications consultancy conducting projects throughout the entire UK. We undertake mobile phone network, television and radio reception surveys (pre- and post-construction signal surveys), conduct broadcast interference and reception investigations, and support telecommunications planning work for wind energy developers, construction companies, architects, broadcasters and Local Planning Authorities.

In addition to radio interference modelling services and television reception surveys, we produce Telecommunications Chapters for Environmental Statements (ES); satisfying the requirements of Part 5, Regulation 18 (Parts 5a and 5b) of The Town and Country Planning Environmental Impact Assessment (EIA) Regulations 2017. We peer review ES and EIA work, liaising with telecommunications providers (Arqiva, BT etc.) and advise developers with respect to associated Section 106 (Town and Country Planning Act 1990) and Section 75 (Town and Country Planning (Scotland) Act 1997) agreements.

GTech Surveys Limited is a consultant member of the Trade Association for Content Delivery - (Confederation of Aerial Industries Ltd - CAI) and the RDI - the digital sector's professional body and trade organisation. We are listed on Constructionline and verified as a Safety Schemes in Procurement (SSIP) member by Safety Management Advisory Services (SMAS), making us compliant with the industry standard PAS 91:2013 + A1:2017.

Professional broadcast trained project engineers deliver, and supply QBE insured technical products to support planning applications, discharge planning conditions (including S106 Agreements) and for due diligence. For more information about GTech Surveys Limited please visit our website - www.gtechsurveys.com

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Executive Summary

Ramboll UK Limited, on behalf of Berkeley Homes (Central London) Limited, has commissioned GTech Surveys Limited to undertake a telecommunication impact assessment of the proposed Padding Green Police Station development (centered at National Grid Reference: TQ 26952 81743).

A full planning application was submitted by the Applicant on 1 April 2021 for the residential-led redevelopment of the Padding Green Police Station site at 2-4 Harrow Road, Paddington, W2 1XJ under application reference 21/02193/FULL. The application was accompanied by an Environmental Statement which reported on the outcomes of an environmental impact assessment of the proposed development. During the environmental impact assessment scoping process, telecommunication effects were scoped out as a technical assessment chapter of the environmental statement .

The application was considered at Westminster City Council's planning committee on 9 September 2021. Officers made a recommendation for approval; however, the planning committee resolved to refuse the application contrary to the officers' recommendation.

The application was subsequently called in by the Greater London Authority. Amendments and refinements were made to the proposed development in 2022.

The telecommunication impact assessment has been undertaken to inform the planning application for the 2022 amended proposed development as requested by the Greater London Authority.

The 2022 amended proposed development would comprise the demolition of the Paddington Green Police Station, excavation of a two-level basement connecting to the neighbouring West End Gate development, and the delivery of residential, flexible commercial and community floorspace, parking, access arrangements, and associated landscaping.

The assessment focused on point-to-point microwave links functionality and the reception of VHF (FM) radio and the two television broadcast platforms (digital terrestrial television and digital satellite television services) that could potentially be impacted by the 2022 amended proposed development;.

Desktop-based studies and a baseline television and radio reception survey were undertaken to define the baseline and identify sensitive receptors.

Microwave link and reception impact modelling techniques guided the identification of the relevant survey area; the locations and areas where sensitive residential receptors (existing point-to-point microwave links, local television viewers and radio listers) are located; and to what extent operational functionality and reception strength could be degraded. The modelling is based on publicly available data.

The assessment drew on the fundamentals of signal propagation and signal interference mechanisms, broadcast transmission information, relevant

regional transmitter and satellite locations, plans of the 2022 amended proposed development and detailed mapping of the study area.

Telecommunication impact assessments undertaken in respect of the historical West End Gate and 14-17 Paddington Green developments to the immediate north of the site highlighted the existence of 16 microwave links across the study area in 2014-2016. Since then microwave links have been decommissioned in favour of fibre to account for new technology and to overcome the complex evolving nature of urban environments and new tall building development.

Review of the publicly available Ofcom Spectrum Information Portal mapping in January 2023 confirmed only a single remaining microwave link (Licence Number 1126361/1) across the site.

As the portal is not regularly maintained and the portal no longer provides link operator data due to data protection requirements, the potential link operator information was identified as New Line Network, through review of the assessor's historical data base.

New Line Network was subsequently consulted to confirm the presence and status of the microwave link, the technical operating specifications and to characterise the baseline conditions. This is because microwave links are often commissioned, decommissioned and traded (link owners change, link IDs change etc.).

However, at the time of writing, consultation responses remained outstanding. Accordingly, a worst-case assessment was undertaken assuming the link is fully operational.

A visit to the study area was conducted on 5 February 2023 to establish the baseline television and radio reception conditions. During the survey, it was noted that existing reception television and radio conditions were optimal around the site and no existing interference was observed.

Based on the desktop studies; site visit; survey data (and visual observations), broadcast transmission information; plans of the 2022 amended proposed development and maps of the study area, the potential impacts on sensitive receptors were quantitatively assessed by means of modelling, with emphasis on microwave link, digital terrestrial television and digital satellite television reception. Outcomes were analysed, and together with various mitigation options, conclusions have been drawn on the overall effects of the 2022 amended proposed development on microwave link functionality, and the reception of broadcast services for local residents.

In respect of the identified microwave link, the potential for interference has been identified as a result of the link's close proximity to Block K of the 2022 amended proposed development. The assessment has been based on a worst-case assumption that the link is currently operational as this could not be verified through consultation.

As is standard practice, the identification of the appropriate mitigation measures would be determined in consultation with the link operator, in the event that the link operator confirms the link is operational and may be impacted. This would

include a detailed review of the existing radio communications infrastructure at each termination point; a review of the operational status of the link (with particular attention paid to possible link decommissioning or already pre-planned link reengineering); confirmation of the data for the services operated by the link's owner from the identified radio sites; a review of the dates and timescales for the demolition and construction phases of the 2022 amended proposed development and review of the theoretical analysis of the 2022 amended proposed development layout on the existing radio communication systems, to identify the exclusion zone for any affected radio infrastructure.

The following standard mitigation measures can be readily implemented to ensure the continuing operation of the link:

- Use of a radio relay facility (for example, a dedicated microwave link transmitter and receiver located away from any obstruction i.e. on the rooftop of Block I or the adjacent Westmark Tower, which is under the ownership of the Applicant); or
- Construction of a new base station facility on the rooftop of Block I or the adjacent Westmark Tower.

The following alternative mitigation measures could also be considered, if required:

- Use of other radio infrastructure sites; or
- Redefining of the exclusion zones by the use of aerial engineering to enable greater link reliability.

These measures are robust long-term mitigation solutions. Once undertaken, the 2022 amended proposed development would not have an opportunity to cause the same or any new impacts to the link and would enable the continued operation of the link.

The implementation of appropriate mitigation would be secured by means of a suitably worded planning condition, in the event that the link operator confirms the link is operational and may be impacted and that this confirmation is received within a reasonable timeframe (21 days).

It is noted that adverse impacts were historically also identified for the Westmark Tower. However none of the link operators consulted with at the time, subsequently confirmed the need for mitigation.

In respect of television services, due to the existing good coverage and the lack of antennas in any theoretical signal shadow zone, the 2022 amended proposed development is not expected to impact the reception of Freeview television services.

The 2022 amended proposed development may cause disruption to the reception of digital satellite television services (such as Freesat and Sky) in areas to the immediate north-west of the site, in particular to north-west of the tallest proposed building (Block K), within 162 metres north-west of Block I and within 114 metres north-west of Block J. In the identified areas, the 2022 amended proposed development could obscure satellite dishes' views of the southern skies (where the serving satellites are located), resulting in interference. Similar impacts and effects could occur in the same areas during

the demolition and construction stages. If interference does occur, the repositioning of the satellite dish to a new location without an obscured line of sight view to the serving satellites would restore all services. If this were not possible (which is an unlikely outcome) the use of digital terrestrial television (DTT, commercially known as *Freeview*) receiving equipment would offer any affected viewer an alternative source of digital television broadcasts. Whilst a risk to the reception of digital satellite television services exists, it is considered that any satellite dishes are installed on top of the buildings in that area, reducing the overall risk. In addition, as a result of likely signal interference caused in similar areas which would have occurred during the construction of Westmark Tower, mitigation solutions may have already been provided (dish moving, relocating etc.), further reducing any risk.

In respect of radio services, the 2022 amended proposed development is unlikely to adversely impact the reception of VHF(FM) radio broadcasts due to the existing good coverage in the survey area and the technology used to encode and decode radio signals.

Overall, as with any large-scale development, the 2022 amended proposed development may cause minor interference to the reception of digital satellite television services (such as Sky and Freesat) in localised areas around the site (only if satellite dishes are located in theoretical signal shadow areas); however, with the implementation of mitigation solutions that would restore the reception of affected television services, if required, the effects for any viewer would be short-term.

No significant effects are considered likely to arise.

With respect to a cumulative impact assessment which would normally consider the combined effects of the 2022 amended proposed development and cumulative schemes on a sensitive receptor (microwave links, television and radio broadcast users in this case), no assessment has been undertaken. This is because it is not possible to quantify or model all the possible signal interactions and changes in local reception. Based on professional experience and judgement, each of the cumulative schemes that have been identified, would consider their impacts on the existing telecommunication networks to ensure that no significant effects arise. Furthermore, the robust existing coverage observed during the baseline survey work and experience with broadcast coverage in densely built area and other major developments, it is considered that cumulative effects would be negligible on broadcast service reception for identified sensitive receptors.

1 - Introduction

Background

Ramboll UK Limited (Ramboll), on behalf of Berkeley Homes (Central London) Limited (hereinafter referred to as the 'Applicant'), has commissioned GTech Surveys Limited to undertake a telecommunication impact assessment of the proposed development of Paddington Green Police Station (centered at National Grid Reference: TQ 26952 81743).

A full planning application (the 'application') was submitted by the Applicant on 1 April 2021 for the residential-led redevelopment (the '2021 proposed development') of the Padding Green Police Station site at 2-4 Harrow Road, Paddington, W2 1XJ (the 'site') within the administrative boundary of the Westminster City Council (WCC) under application reference 21/02193/FULL.

The application was accompanied by an Environmental Statement (the '2021 ES') prepared by Ramboll and a team of technical specialists.

The 2021 ES reported on the conclusions of an environmental impact assessment (EIA) that was undertaken of the 2021 proposed development in accordance with the statutory procedures set out in The Town and Country Planning (Environmental Impact Assessment) (England) Regulations 2017 (hereafter referred to as the 'EIA Regulations'). During the EIA scoping process, telecommunication effects were scoped out as technical assessment chapter of the ES.

The application was considered at WCC's planning committee on 9 September 2021. WCC officers made a recommendation for approval. The planning committee resolved to refuse the application contrary to the officers' recommendation.

The application was subsequently referred to the Greater London Authority (GLA) for 'Stage 2' review. Following a review of the application and the proposed decision of WCC, the GLA considered that the 2021 proposed development was of strategic importance and had the potential to make an important contribution to housing and affordable housing supply. On 22 November 2021 the GLA directed that the GLA would act as the local planning authority for the purpose of determining the application.

Reason for Submission

The GLA's Stage 2 report (reference 2021/0711/S2) identified various areas where further work was anticipated in the event that the Mayor of London took over determination of the application. In particular, urban design, building height, residential quality, climate change and transport were identified.

The Applicant has made amendments and refinements to the 2021 proposed development in order to address the areas of further work. These amendments comprise the following:

- Removal of Block I bullnose and movement of block footprint 8 m east;
- Reduction of Block J footprint width by 10 m;

- Increase in distance between Block I and Block J from 9 m to 10 m;
- Removal of Block K shoulder element;
- Removal of podium element (now three standalone blocks linked at basement level);
- Increase in the height of Block I from 62.020 m above ground floor finished floor level (FFL) (94.355 m AOD) (18 storeys) to 83.019 m above ground Floor FFL (115.219 m AOD) (24 storeys);
- Increase in the height of Block J from 54.145 m above ground floor FFL (86.480 m AOD) (15 storeys) to 60.389 m above ground floor FFL (92.724 m AOD) (17 storeys);
- Increase in the height of Block K from 110.720 m above ground floor FFL (143.055 m AOD) (32 storeys) to 133.969 m above ground floor FFL (166.304 m AOD) (39 storeys);
- Removal of roof level communal, residential amenity space at Block J;
- Removal of office floorspace and amenity space;
- Relocation of internal residential amenity space at Block K from level 25 to level 1;
- Amendment of residential unit / floorplate design to increase percentage of social rented units;
- Removal of all north facing single aspect residential units and increase in dual aspect residential units up to approximately 55%;
- Amendments to core arrangement (all cores now have a dual staircase, with one staircase terminating at basement level and one terminating at ground floor level);
- Amendments to B2 footprint (overall minor increase), previously B2 accessed via Block J core terminating at B2 level, now accessed via Block I core terminating at B2 level and redesign of waste management services;
- Amendments to B1 footprint (reduction of the western extent and north-eastern extent), on account of the following layout changes:
  - Omission of office bin store, office lifts and office facilities;
  - Relocation of residential bin store in Block K further south, to suit the new location of the refuse chute;
  - Relocation of plant to the north;
- Complete stopping-up and partial pedestrianisation of Newcastle Place to vehicle traffic with the exception of fire / emergency access;
- Increase in ground level public realm provision from 3,553 m^2 to 4,755 m^2;
- Reduction in external communal amenity space provision from 835 m^2 to 0 m^2;
- Increase in play space provision from 1,138 m^2 to 1,150 m^2;
- Fully updated landscape design proposals; and
- Amendments to glazing ratio and the addition of spandrel panels to the façade to improve energy performance.

The 2021 proposed development as amended by the proposed amendments is hereafter referred to as the '2022 amended proposed development'.

A full update of the EIA was undertaken to consider and assess the likely significant effects of the 2022 amended proposed development on the environment.

A telecommunication impact assessment was scoped out of the ES as a technical assessment chapter; however, has been undertaken to inform the planning application for the 2022 amended proposed development upon request of the GLA.

Objectives of Report

This study outlines the findings of a telecommunication impact assessment and pre-construction signal reception survey, which has identified the existing baseline telecommunication conditions within the study area, and the potential impacts and likely effects of the 2022 amended proposed development.

The assessment focused on point-to-point microwave links functionality and the reception of VHF (FM) radio and the two television broadcast platforms (digital terrestrial television and digital satellite television services) that could potentially be impacted by the 2022 amended proposed development.

Other receptors within the study area are likely to utilise commercial signal receiving and signal distribution systems and networks which are more resilient to external interference effects. Such systems may include; fibre based signal distribution networks; broadband, cabled television networks and fibre to the premises (FTTP); hybrid networks (which utilise difference technologies to provide redundancy); and larger satellite dishes for signal reception (which offer better immunity to the effects of interference). Consequently, any impacts from the 2022 amended proposed development would be negligible and these other receptors have not been considered further.

The content of this report is based on the findings of:

- Desktop studies; and
- A survey undertaken on 5 February 2023.

The specific objectives of this report are as follows:

- Identify the presence of any microwave links passing close to or over the site;
- Identify the existing television and radio receptors and signal levels within the study area;
- Assess the potential for microwave links, television and radio signal disturbance arising as a result of the 2022 amended proposed development;
- Determine the potential impacts and likely effects to identified receptors; and
- Identify mitigation, as appropriate.

This report is supported by the following appendices:

- Appendix I - Television Transmission Frequencies;

- Appendix II - VHF (FM) Radio Transmission Frequencies;
- Appendix III - Signal Survey Measurements;
- Appendix IV - An Overview of Signal Measurements;
- Appendix V - Survey Equipment;
- Appendix VI - Calculation of Received Field Strength;
- Appendix VII – References; and
- Appendix VIII - Map and Data Sources.

Proposed Development Description

Site Arrangement

The 2022 amended proposed development is described as follows in the application form:

Demolition of the existing building and redevelopment of the site to provide three buildings of 39, 24 and 17 storeys in height, providing residential units (including affordable units)(Class C3), commercial uses (Class E), a community use (Class F.2), landscaping, tree and other planting, public realm improvements throughout the site including new pedestrian and cycle links, provision of public art and play space, basement level excavation to provide associated plant, servicing, disabled car parking and cycle parking and connection through to the basement of the neighbouring West End Gate (WEG) development.

The site arrangement of the 2022 amended proposed is shown in Figure 1.

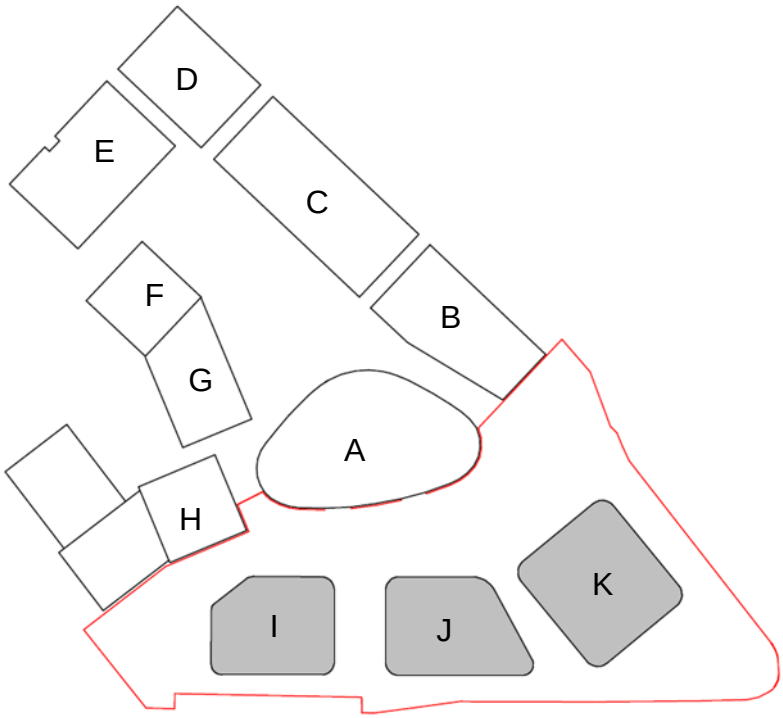

Figure 1 - 2022 Amended Proposed Development Site Arrangement

In summary, the 2022 amended proposed development would comprise the following:

- Demolition of the Paddington Green Police Station;
- Excavation of a basement with connection to the WEG development basement;
- Erection of three buildings (Blocks I, J, K) along, set back from, Harrow Road and Edgware Road;
- Delivery of ground floor commercial and community uses and residential at upper floors; and
- Stopping up of Newcastle Place with associated landscaping and cycle parking.

As illustrated in Figure 1, Blocks I, J and K would be constructed across the site, west to east respectively, to provide flexible commercial, community and residential floorspace. The blocks would be arranged along the southern frontage of the site enabling the delivery of a landscaped area to the north between the WEG (Blocks A-F) / 14-17 PG (Blocks G and H) developments and the new buildings. The main entrance to the site would be from Edgware Road onto Newcastle Place. This entrance would allow delivery and drop off vehicle and pedestrian access to the site. Vehicles associated with servicing would access the basement levels via Church Street and the WEG basement.

The 2022 amended proposed development would be 'car free', excluding disabled, service, delivery and drop off vehicles, and therefore car movement to and from the site would be minimal. Landscaping and public amenity space would be delivered across the 2022 amended proposed development. Newcastle Place would be redesigned to create an expanse of landscaped public realm that would link Paddington Green to Edgware Road.

Built Form, Height and Massing

The architectural design of the blocks has been informed by the surrounding context including the Paddington Green Conservation Area, the character of other surrounding neighbourhoods such as Maida Vale and Little Venice, the wider WEG masterplan and the prominent gateway location of the site.

Three main building typologies would be delivered across the 2022 amended proposed development, each having a distinct built form and performing a specific role within the townscape narrative.

The built form and typology of each building would be as follows:

- Block I: The bullnose form of the building, located adjacent to Paddington Green would be cut back and a new, more slender building form would be created to minimise the buildings impact on daylight and sunlight levels to the blocks immediately to the north.
- Block J: The overall building height would be increased in order to main the overall composition of the cluster of tall buildings but would remain lower in height than Block I and K to balance the overall composition of the cluster

of tall buildings. The overall building footprint would be reduced to increase the gaps between buildings and improve daylight and sunlight performance.

- Block K: The shoulder element of Block K would be removed to significantly reduce the building footprint and result in a slender tower form.

The 2022 amended proposed development's building heights are summarised in Table 1.

Table 1: 2022 Amended Proposed Development Building Heights

Block	Height (m AOD)	Storeys (above ground)
I	115.219	24
J	92.724	17
K	166.304	39

Legislation and Policy Framework

The following national, regional and local planning policies have informed this telecommunication impact assessment.

National Planning Policy Framework

The Government issued the National Planning Policy Framework (NPPF)[1] in March 2012 (DCLG 2012) and supporting Planning Practice Guidance in 2014 (DCLG 2014). The 2012 NPPF was revised and a new NPPF published in July 2018, with minor further revisions in February and June 2019 (MHCLG 2019), and additional revisions in July 2021 (MHCLG 2021).

At paragraph 114, emphasis is given for the need for robust and modern telecommunications networks and systems;

…… *Advanced, high quality and reliable communications infrastructure is essential for economic growth and social well-being. Planning policies and decisions should support the expansion of electronic communications networks, including next generation mobile technology (such as 5G) and full fibre broadband connections. Policies should set out how high quality digital infrastructure, providing access to services from a range of providers, is expected to be delivered and upgraded over time; and should prioritise full fibre connections to existing and new developments (as these connections will, in almost all cases, provide the optimum solution).*

At paragraph 116, it is stated that local planning authorities should;

…… *not impose a ban on new electronic communications development in certain areas, impose blanket Article 4 directions over a wide area or a wide range of electronic communications development, or insist on minimum distances between new electronic communications development and existing development. They should ensure that:*

a) they have evidence to demonstrate that electronic communications infrastructure is not expected to cause significant and irremediable interference with other electrical equipment, air traffic services or instrumentation operated in the national interest; and

b) they have considered the possibility of the construction of new buildings or other structures interfering with broadcast and electronic communications services.

Regional Policy

The London Plan 2021 (March 2021) - Spatial Development Strategy for Greater London[2], discusses at length the need for robust digital connectivity and that new development must not cause interference to telecommunications networks and local connectivity.

1 - Ministry of Housing, Communities and Local Government, 2021. National Planning Policy Framework. London.
2 - Greater London Authority, 2021. The London Plan The Spatial Development Strategy for London 2021. London

Two policies and associated text relating to telecommunications, broadcast reception and digital connectivity are presented below;

Policy SI 6 Digital connectivity infrastructure

a) To ensure London's global competitiveness now and in the future, development proposals should:

3) take appropriate measures to avoid reducing mobile connectivity in surrounding areas; where that is not possible, any potential reduction would require mitigation

4) support the effective use of rooftops and the public realm (such as street furniture and bins) to accommodate well-designed and suitably located mobile digital infrastructure

9.6.5 Development proposals should also demonstrate that mobile connectivity will be available throughout the development and should not have detrimental impacts on the digital connectivity of neighbouring buildings. Early consultation with network operators will help to identify any adverse impact on mobile or wireless connectivity and appropriate measures to avoid/mitigate them.

Policy D9 Tall buildings[3]

Impacts

c) Development proposals should address the following impacts:

f) buildings, including their construction, should not interfere with aviation, navigation or telecommunication, and should avoid a significant detrimental effect on solar energy generation on adjoining buildings

Local Policy

The City Plan 2019-2040 (City of Westminster, April 2021)[4], discusses at length the need for robust digital connectivity and that new development must not cause interference to telecommunications networks and local connectivity. In particular, tall buildings must avoid unacceptable impacts on telecommunications.

41. Building height

Tall buildings are defined as buildings of twice the prevailing context height or higher or those which will result in a significant change to the skyline. In all

3 - Tall buildings as defined in section 3.9.3. Tall buildings are generally those that are substantially taller than their surroundings and cause a significant change to the skyline. Boroughs should define what is a 'tall building' for specific localities, however this definition should not be less than 6 storeys or 18 metres measured from ground to the floor level of the uppermost storey. This does not mean that all buildings up to this height are automatically acceptable, such proposals will still need to be assessed in the context of other planning policies, by the boroughs in the usual way, to ensure that they are appropriate for their location and do not lead to unacceptable impacts on the local area. In large areas of extensive change, such as Opportunity Areas, the threshold for what constitutes a tall building should relate to the evolving (not just the existing) context. This policy applies to tall buildings as defined by the borough. Where there is no local definition, the policy applies to buildings over 6 storeys or 18 metres measured from ground to the floor level of the uppermost storey.

4 - City of Westminster, 2021. The City Plan 2019-2040. City of Westminster

locations proposals for tall buildings will need to satisfy both the general principles in clause B and relevant locational principles in clauses C and D (and for Housing Renewal Areas, Policy 42).

Clause B 6) avoid unacceptable impacts on aviation and telecommunications

Supplementary Planning Documents

Section 3.15 of The City of Westminster - Code of Construction Practice (CoCP), February 2022[5] is of relevance:

3.15 Electromagnetic Interference
The developer's nominated representative will consider the impacts of any electromagnetic interference on wireless telecommunication systems during the design and construction of the project. Technology should be used to prevent Radio Frequency Inference (RFI) where appropriate. Developers must also have regard for any potential adverse health impacts related to RFI. In the case of adverse impacts, the nominated representative will investigate, and if it is found to be linked to site activities, it must be resolved or, where this is not possible, mitigated.

5 - City of Westminster. 2022. City of Westminster - Code of Construction Practice (CoCP), 2022.

2 - Assessment Methodology

Approach

This assessment was undertaken to investigate whether the 2022 amended proposed development could cause interference to microwave links and local television and radio broadcast reception and to identify mitigation measures to reduce or offset any effects.

For the completed development stage, the assessment has been based on the 2022 amended proposed development as presented in the detailed planning drawings, as well as the 3D height and massing model.

For the demolition and construction stage, information on the demolition and construction works has been obtained from ES Volume 1(R): Introduction and Chapter 5(R): Demolition and Construction Description. However, due to the duration of the demolition phase and the phased nature and timescales involved with the construction phase, it is not feasible or possible to undertake accurate impact assessments for every element of the 2022 amended proposed development. During the demolition and construction works, large temporary structures such as cranes may cause highly localised disruption to the microwave links, radio and television reception services in the study area. As the phased construction of the 2022 amended proposed development progresses (Block I followed by Block J and then Block K), potential impacts would increasingly resemble that of the completed development stage.

Study Area

A study area of 500 m from the site boundary has been considered because beyond this distance, interference impacts and effects from other existing structures and buildings are likely to dominate local microwave functionality and television and radio reception conditions. With respect to the 2022 amended proposed development, this area is considered proportionate from a professional judgement viewpoint when assessing interference impacts and effects from similar sized new development in urban environments.

Potential Impacts

The following paragraphs outline the potential impacts to each technology considered as part of this assessment.

- The impacts to fixed point-to-point **Microwave links** near to or across the site. A fixed point-to-point microwave link is a wireless / radio link (a radio communication system which normally forms part of a more extensive telecommunication network), which can be explained as follows:
  - Microwave is a line-of-sight wireless communication technology that uses high frequency beams of radio waves to provide high speed wireless connections that can send and receive voice, video, and data information. Microwave links are widely used for point-to-point communications because their small wavelength allows conveniently-sized antennas to direct them in narrow beams, which can be pointed directly at the receiving antenna. This allows nearby microwave equipment to use the same frequencies without interfering with each

other, as lower frequency radio waves do. Another advantage is that the high frequency of microwaves gives the microwave band a very large information-carrying capacity; the microwave band has a bandwidth 30 times that of all the rest of the radio spectrum below it. Microwave links carry vital data for all modern communications systems including military and national infrastructure needs for communications, emergency services and government.

Microwave links can be adversely affected by physical obstructions on and near to their transmission path such as construction cranes, wind turbines, tall buildings and trees. In general, the directional nature of microwave links means that interference can be avoided by defining clearance zones beyond which any degradation will be insignificant, or by moving the link to avoid the obstruction. Disruption or interference caused to a microwave link's operation will cause degradation to the voice, video or data carried over the link. This would result in the overall functionality (efficiency and reliability) of the microwave link to be reduced and could impact the operations of the wider telecommunications network the microwave link is part of. As microwave links form parts of national infrastructure sectors, microwave link owners will be required to ensure link performance remains optimal.

- The impacts to **VHF (FM) radio, digital terrestrial television (DTT - Freeview) and digital satellite television (Freesat and Sky) reception** have been assessed. Impacts on the reception of analogue terrestrial television services have not been considered in this study because analogue terrestrial television services were switched off in London during 2012.
- With respect to impacts on private **Wi-Fi network** functionality, impacts from both the demolition and construction stage and the completed development stage are considered highly unlikely. Wi-Fi is a family of wireless network protocols based on a set of defined standards, which are commonly used for local area networking of devices and Internet access, allowing nearby digital devices to exchange data by radio waves. Private (domestic use) Wi-Fi networks are designed to offer wireless coverage within a limited range of a Wi-Fi enabled broadband router (normally placed somewhere inside a domestic dwelling) and the service area of the router falls away as distance is increased between the router and the wirelessly connected device. In addition to the limited operational area provided by Wi-Fi routers and associated devices, the frequencies most commonly used, 2.4 gigahertz and 5 gigahertz, are channelized, enabling robust coverage when other wireless networks (Wi-Fi systems) are also in operation in close proximity. This is due to the dynamic nature of the radio technology to adjust the operational Wi-Fi channel in use to assist unwanted interference effects. Furthermore, Wi-Fi operational radio bands (2.4 gigahertz and 5 gigahertz) have relatively high material absorption (their inability to propagate well through substances) and work best for line-of-sight use. Many common obstructions such as walls, pillars, home appliances, thermally efficient double glazing etc., will greatly reduce operational range, but this also assists minimise interference between different Wi-Fi networks in crowded

environments such as residential flats and residential housing estates. There is nothing that is commonly and lawfully used during any construction activity that could cause unwanted interference on regulated and licensed Wi-Fi operational bands. With respect to the completed development, internal Wi-Fi systems may be installed and used and these too would be limited in range due to the mechanism of signal propagation, as discussed. Consequently, interference to Wi-Fi networks has not been considered in the assessment.

- With respect to impacts on **radio broadcast services such as DAB (Digital Audio Broadcasting)**, structures and buildings rarely cause reception disruption. This is due to the lower frequencies used for the transmission of radio services (with respect to television) and the digital technologies and methods used for encoding, reception and signal decoding. Based on professional judgement and experience, DAB radio reception is considered robust in urban environments and the 2022 amended proposed development is unlikely to alter coverage significantly. Consequently, DAB radio reception has not be considered in the assessment.
- With respect to impacts on **mobile phone networks**, there are currently four mobile phone generations in use; 2G, 3G, 4G and the recently introduced 5G platform. All mobile platforms rely on numerous base stations (mobile phone transmitters) spread over an area to provide reliable coverage. This ensures that as the phone user moves from one location to another, a base station is available to continue seamless connectivity. In a busy urban and densely populated area, the density of base stations will be high enough to provide good coverage, especially if one particular base station is at capacity or offline. The telecoms and broadcast study area (500 m radius from the site boundary; the area considered for interference investigations) surrounding the site is well served by multiple mobile phone networks and, due to handsets' ability to continually utilise the best serving mobile network base station, the 2022 amended proposed development would not have any effect upon the operation of a mobile phone network. Therefore, an assessment on the effects to mobile phone networks has not been included in the assessment.
- With respect to **telecommunication service providers** and due to the evolving nature of telecommunications networks and systems (mobile phone networks in particular), significant changes will be occurring to all mobile phone networks as a result of the planned closure of third generation services (3G), the continued enhancement of fourth generation services (4G) and the rollout of new high data capacity fifth generation technologies (5G). The overall effect of these changes will ensure that coverage within urban areas is enhanced, optimised and robust. In addition, mobile network operators (MNOs) will wish to offer coverage to locations around new development, to attract new customers and retain existing users. Consequently, possible impacts to telecommunication services providers have not been considered.
- Cabled services such as **broadband television, broadband internet and telephone landline services** are transmitted and delivered via

underground copper and fibre optic cables. By not using air-borne electromagnetic waves (radio / wireless networks etc.), such services cannot be adversely affected by the layout and massing of the completed 2022 amended proposed development. Whilst the demolition and construction works for the 2022 amended proposed development would include utility diversion works, as set out in ES Chapter 5(R): Demolition and Construction Description, these works would be co-ordinated to ensure services to the site and surrounding facilities are maintained during the works and may require a phased approach for the removal of items in line with the agreements with the relevant statutory authorities. Works would be undertaken by a network operator who would operate under environmental controls to be coordinated with the Applicant. Therefore, an assessment on the effects to cabled communication systems has not been included in the assessment.

- Because of the need for reliable and robust **emergency services communication network operations**, consideration has been given to the effects that the 2022 amended proposed development may have on Airwave Solutions UK's radio network. Airwave Solutions is a British mobile communication company that operates the Airwave / Terrestrial Trunked Radio (TETRA) network; the mobile communications network used by Great Britain's emergency services. This infrastructure is targeted primarily at the mobile radio needs of public safety groups (such as police and fire departments), utility companies, and other enterprises that provide voice and data communications services. Impairments to the network's operation are caused by the same interference mechanisms that can affect television reception; obstructions on the line-of-sight from the transmitter to the receiver and the signal attenuating properties of common building materials such as steel, concrete, foil-backed insulation and thermally efficient glass. If the interference (or signal blocking) is severe enough, the reliability of the network can be adversely impacted resulting in communication problems. It is expected that the existing TETRA network will be phased out during 2024 and replaced with a new 4G-based network. Consequently, as superstructure construction work will only commence in 2025, an assessment on the effects to TETRA radio systems is not considered necessary.

Microwave link and reception impact modelling techniques guided the identification of the relevant survey area; the locations and areas where sensitive residential receptors (existing point-to-point microwave links, local television viewers and radio listers) are located; and to what extent operational functionality and reception strength could be degraded.

The assessment drew on the fundamentals of signal propagation and signal interference mechanisms, broadcast transmission information, relevant regional transmitter locations and satellite positions, massing and plans of the 2022 amended proposed development and detailed mapping of the study area.

With respect to a cumulative impact assessment which would normally consider the combined effects of the 2022 amended proposed development and cumulative schemes on a sensitive receptor, no assessment has been

undertaken, which is the norm. This is because it is not possible to quantify or accurately model all the possible signal interactions and changes in local reception over all possible times frames for all schemes. It is likely that each of the cumulative schemes that have been identified, would consider their impacts on existing local telecommunications networks to ensure that no significant effects arise.

Baseline and Receptors

Desktop studies of potential microwave links and existing television and radio services across the site and study area was undertaken.

In respect of microwave links, the publicly available Ofcom Spectrum Information Portal mapping was reviewed. However, it is noted that this portal is not regularly maintained and the portal no longer provides link operator data due to data protection requirements, so the potential link operator information was gained from the assessor's historical data base.

In respect of television and radio services, the publicly available Ofcom broadcast transmission information was reviewed.

A visit to the study area was conducted on 5 February 2023 to establish the baseline television and radio reception conditions. During the survey, the validity of the impact assessment was also determined by verifying the locations and quantity of sensitive receptors.

Consultations

As microwave links are often commissioned, decommissioned and traded (link owners change, link IDs change etc) and the Ofcom mapping platform is known not to be regularly maintained, consultation was initiated with the identified potential link operator.

Consultation assists in confirming the presence and status of any microwave links, the technical operating specifications and characterising the baseline conditions.

An assessment of the impacts that the 2022 amended proposed development could have on microwave link operations can only be undertaken by microwave link owners. This is standard practice, due to the complex nature of the technology, as well as the need for precise information regarding each link such as the;

- start and end locations of the microwave link;
- heights of antennas at the start and end points;
- frequency in use for the microwave link;
- length of the microwave link;
- transmit power of the microwave link; and
- modulation scheme of the microwave link and the traffic type the microwave link carries.

However, it is noted that based on experience, link operators are very slow to respond or do not respond at all.

Mitigation

From the output of the desktop studies, consultations, observations from the site visit and baseline survey data, the impacts on microwave links and local television and radio reception were assessed and quantified based on professional judgement, degradation of radio link performance research and guidance provided by Office of Communications (Ofcom)[6], and the standards identified by the Confederation of Aerial Industries (CAI)[7], for the rapidly growing TV signal reception industry.

Once the magnitude of potential impacts and scale of effects were understood, various mitigation solutions were identified to reduce or offset effects on reception, and conclusions were drawn on the overall effects of the 2022 amended proposed development on microwave links and television and radio broadcast service reception for the local residents.

The principles of radio signal transmission from the transmitting to receiving antenna were initially used to assess the effects of the 2022 amended proposed development on broadcast reception in the study area and are described in more detail in the following paragraphs. In addition, the principles of microwave link propagation from both termination points of a microwave link and obstruction modelling, were used to assess the effects of the 2022 amended proposed development on any identified microwave links.

Microwave Links

If any part of a microwave link encroaches into a physical structure or obstruction, disruption to the microwave link can occur. The magnitude of disruption is determined by how much of the microwave link's 1st Fresnel zone[8] has been obscured by the obstruction. The radius of the microwave link's Fresnel Zone is a product of the microwave link's operational frequency and the distance along the microwave link (the Fresnel zones of any microwave link are always widest at the middle point of the link's path and the most narrow at the termination points).

When a microwave link is modelled in a three-dimensional format, the path clearance to the ground and any other structure can be determined. By understanding the clearance zone required for the microwave link with respect to the structure to ensure optimal link operation, an assessment can be made on the potential impacts.

The modelling is based on publicly available data provided on the Ofcom Spectrum Information Portal.

Terrestrial Television Services

Any structure will produce two zones of potential disruption to television reception. One zone is where the development creates a 'shadow' (affecting all

6 - https://www.ofcom.org.uk/__data/assets/pdf_file/0026/63494/tall_structures.pdf
7 - https://www.cai.org.uk/index.php/contact/downloads/codes-of-practice-and-regulations/45-cop-02-aerials-antennas-and-receiving-equipment-in-the-single-dwelling-unit/file
8 - A Fresnel zone, is one of a series of confocal prolate ellipsoidal regions of space between and around a transmitter and a receiver. The primary wave will travel in a relative straight line from the transmitter to the receiver.

television broadcast platforms) and the other where it gives rise to a ‘reflection’. At the frequencies used for broadcasting, the processes of creating a ‘shadow’ or a ‘reflection’ are more complicated than with visible light, but an analogy between the creation of light shadows and radio signal shadows is considered appropriate to demonstrate the potential interference effects and how these can arise.

Signal ‘Shadowing’ Effects

In the area behind the structure, the television transmitter is effectively screened from the viewer and the strength of the signal is reduced - Figures 2 and 3.

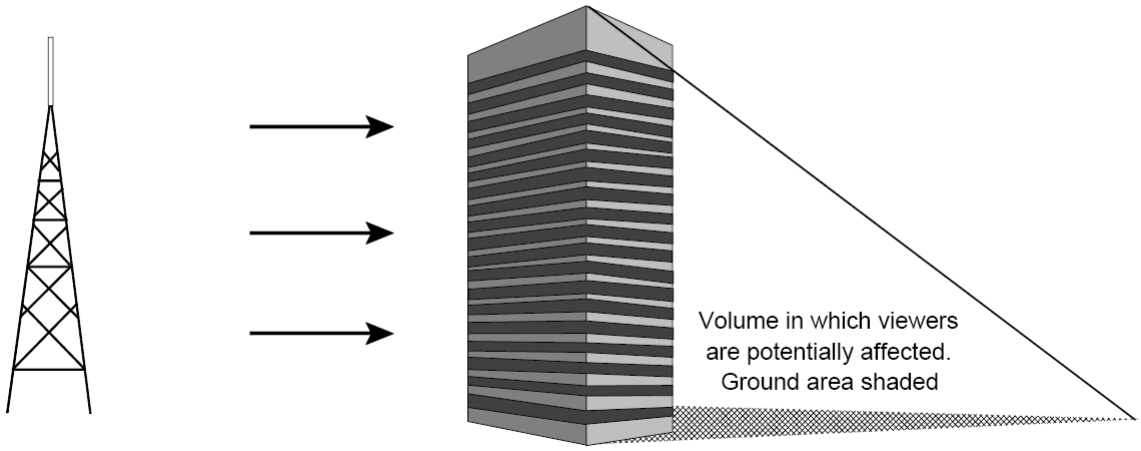

Figure 2 - Affected area in the ‘shadow’ zone behind the structure

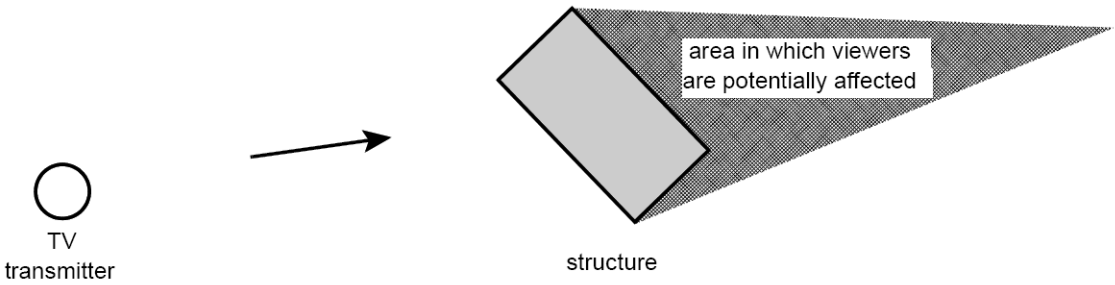

Figure 3 - Plan view of the ‘shadow’ zone

Television signals do not create such a ‘hard’ shadow as visible light, and for the purposes of explanation, a ‘shadow’ zone must be considered which is divided into three sub-zones, which are based on experience of television reception in densely built-up environments and Ofcom guidance[9] on the subject:

9 - https://www.ofcom.org.uk/__data/assets/pdf_file/0026/63494/tall_structures.pdf

- i. Within a few tens of metres from a solid structure, over the region where optical view of the transmitter is lost, the reduction in signal strength is critically dependent on the specific design and composition of the structure. For most brick and concrete buildings, the reduction can be severe and, in some cases, almost total if existing reception conditions are poor;
- ii. Further away from the structure (e.g. between 25 to 50 m, but this varies depending on its size) the limit of the ‘shadow’ zone and signal reduction are determined by diffraction at the edges of the structure and reflection off surrounding structures. The simple condition of whether or not a location has an optical view of the transmitter is not enough to classify the potential interference zone adequately. In general, the effect is that the signal appears to bend around the sides of the structure; the shadow zone reduces in size and the signal strength is reduced by much less than simple ray optics would suggest; and
- iii. Even further away from the structure (e.g. approximately 250 m) complex multiple reflections and diffraction, caused by structures in the locality, may result in the ‘shadow’ zone becoming almost non-existent, against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal as presented to the television receiver.

Signal ‘Reflection’ Effects

The second zone of potential interference is produced by ‘reflection’ or ‘scattering’ of the incident signal, see Figure 4.

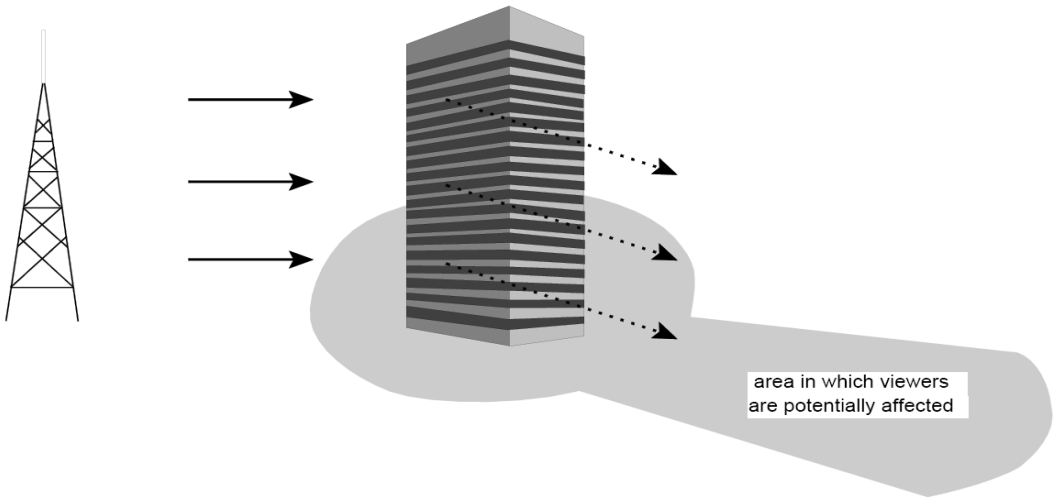

Figure 4 - Affected areas in the ‘reflected’ zone of the structure

In respect of Figure 5, the direct signal travels a distance P1 to the viewer, whilst the signal reflected from the structure travels slightly further, distance (P2 + P3). Although travelling at the speed of light, the different path lengths can mean that one signal arrives with a significant delay relative to the other. This results in a degradation in signal quality.

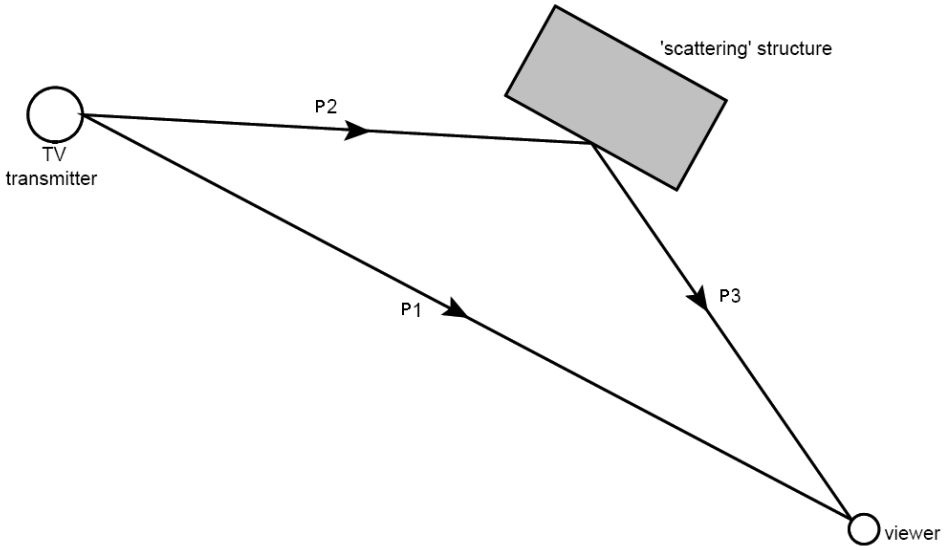

Figure 5 - Direct and Indirect Signal Paths

To avoid interference, it is necessary to ensure that the ratio of wanted signal along the direct path (P1) to the unwanted signal along indirect paths (P2+P3) is sufficiently high. Domestic TV receiving antennas generally have a significant directional response to incoming signals, which means that the antenna may discriminate against interfering signals that arrive on significantly different bearings. This can result in an increase in the ratio of wanted to unwanted signal, as presented to the television receiver.

Digital Terrestrial Television - Freeview

The digital terrestrial television (DTT) broadcast platform offers many advantages over obsolete analogue broadcast technologies. Due to the way picture signals are encoded and broadcast, DTT offers a much more resilient platform against interference. The construction of digital signals ensures that they are much more impervious to the effects of interference from indirect secondary reflections, which consequently ensures good quality and coherent data stream integrity at the receiver, resulting in an interference free picture. Disruption to DTT services is normally caused by a poor-quality receiving antenna system or locally generated wideband electrical noise. Signal blocking caused by buildings can also degrade received signal quality.

Digital Satellite Television Services - Freesat & Sky

Digital satellite television services are provided by geo-stationary earth orbiting satellites positioned above the equator. To ensure good reception of digital satellite television services, satellite receive antennas (satellite dishes) are normally positioned away from trees and other clutter and are orientated to face the southern (south-southeast) skies.

Disruption to digital satellite television services is normally caused by an obstruction on the line of sight from the satellite to the receive antenna e.g. a

tall building or tall trees. Adverse weather can also influence reception. In the United Kingdom, Freesat and Sky services come from the 28.2 degrees east ASTRA satellite cluster.

Figure 6 shows typical clearance distances and obstruction heights for interference free satellite television reception.

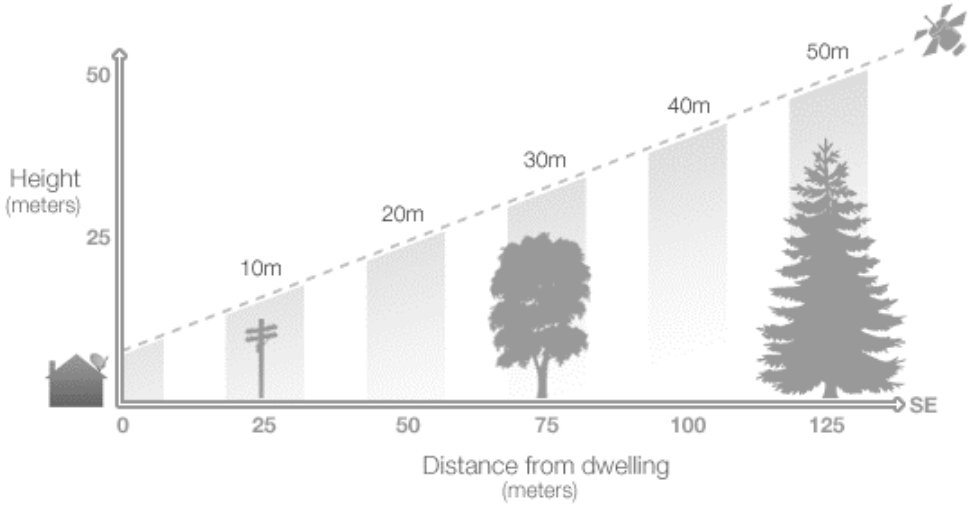

Figure 6 - Typical Clearance Distances and Obstruction Heights for Interference Free Satellite Television Reception

VHF (FM) Radio

VHF (FM) radio services are broadcast from similar structures as terrestrial television services. Many things can cause radio interference; however, simple mitigation measures exist that can quickly reduce the effects. Most reception problems on FM radio are caused either by a weak signal or by a form of interference.

Radio transmission signals will reflect into ‘shadow’ areas and also reflect from structures to cause ‘multi-path’ effects. The effect of multiple signals is to create zones of signal cancellation and signal enhancement. This is often demonstrated by the need to carefully position portable radio receivers for good reception or the fluctuation in signal quality whilst listening to VHF (FM) broadcasts in a vehicle. Due to the wavelength of the VHF (FM) signal (at 100 MHz, the wavelength is 3 m), zones of interference can quickly and easily physically move around, as the interference is generated from the sum interaction of all incoming signals. Consequently, prediction of VHF (FM) interference is not practically possible due to the complex interaction of reflected signals with wanted signals, the design of radio receivers and radio signal propagation characteristics.

Buildings rarely cause radio interference; however, should this be the case, there is little that can be done during the design stage to reduce any adverse effects. Due to the lower frequencies in use for radio transmission (with respect to television services) and the methods by which the radio signals are encoded, it is highly unlikely that a new structure in an already cluttered urban environment would disrupt the reception of radio services.

3 - Baseline Conditions

Desk Study

Microwave Links

Telecommunication impact assessments undertaken in respect of the historical West End Gate and 14-17 Paddington Green developments to the immediate north of the site, highlighted the existence of 16 microwave links across the study area in 2014-2016. Since then microwave links have been decommissioned in favour of fibre to on account for new technology and for the complex evolving nature of urban environments and new tall building development.

Review of the publicly available Ofcom Spectrum Information Portal mapping in January 2023 confirmed only a single remaining microwave link (Licence Number 1126361/1) across the site, as shown in Figure 7.

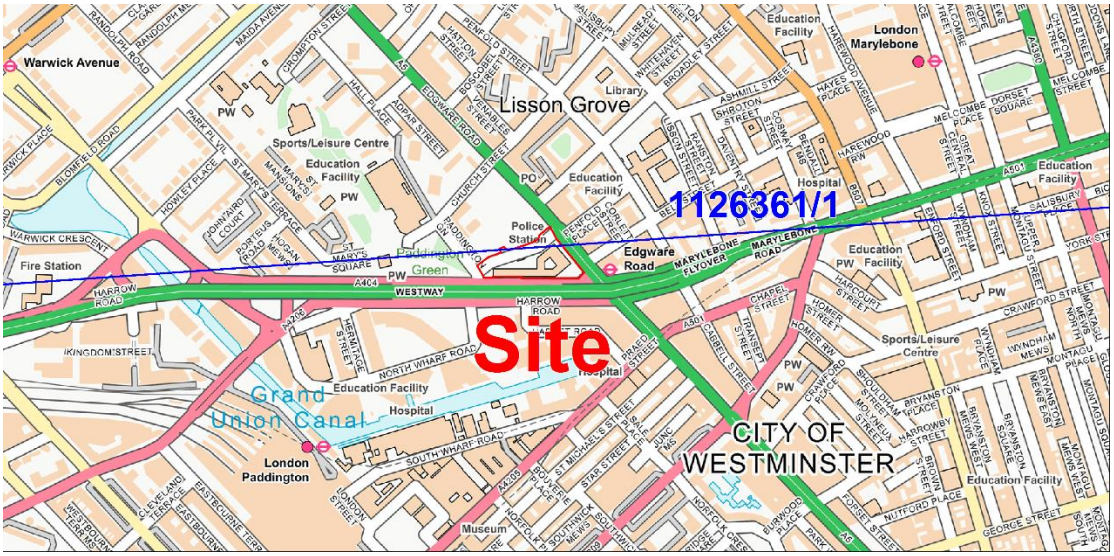

Figure 7 - Link 1126361/1 (shown in blue) and the Site

The Ofcom mapping platform indicates that the link passes between:

- Slough Main Telephone Exchange, located at British Telecom, Telephone Exchange, 100 Wellington Street, Slough, SL1 1YW; and
- The BT Communication Tower (Fitzrovia), located at 60 Cleveland St, London W1T 4JZ.

The two end points of the microwave link are shown in Figures 8 and 9.

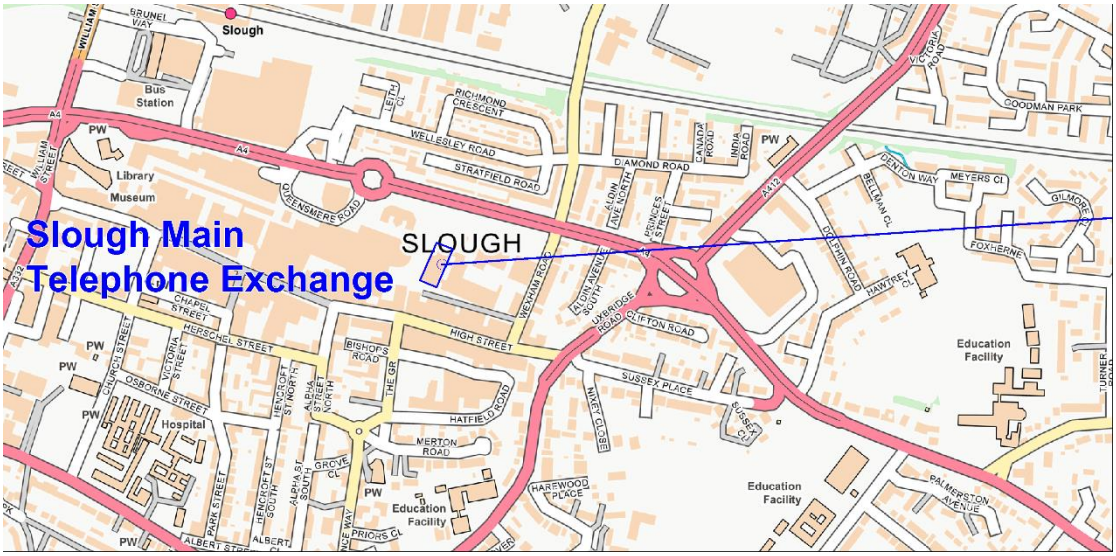

Figure 8 - Link 1126361/1 (shown in blue) Terminating at the Slough Main Telephone Exchange

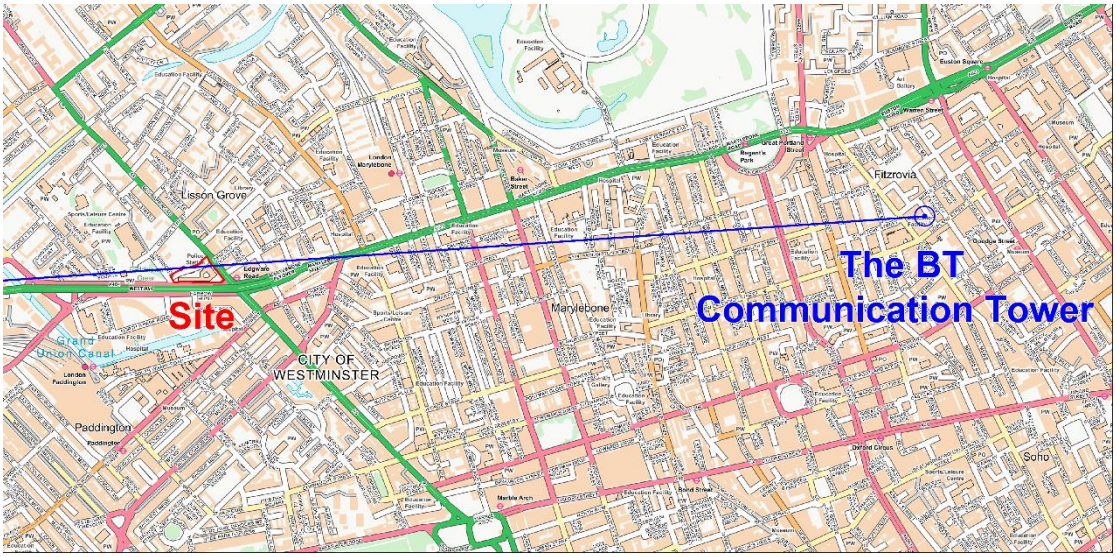

Figure 9 - Link 1126361/1 (shown in blue) Terminating at the BT Communication Tower End and crossing over the Site

Based on the assessor's historical data, New Line Network was identified as the potential link operator.

As the Ofcom mapping platform is not regularly maintained, consultation was initiated with New Line Network to assist in confirming the presence and status of the microwave links and characterising the baseline conditions.

However, at the time of writing, consultation responses remained outstanding. This is not unusual in the experience of the assessor.

Accordingly, a worst-case assumption has been made that the link is fully operational and therefore a sensitive receptor to potential impacts from the 2022 amended proposed development.

Available Television and Radio Broadcast Services

Digital Terrestrial Television - Freeview

The study area is served by DTT services (London TV region) from the Crystal Palace transmitter (NGR TQ 33940 71220), on a bearing of 146° (with respect to true north) and approximately 13 km away.

The site and transmitter locations, as well as the direction of the incoming DTT signals at the site (blue arrow)**,** are shown in Figure 10. Technical transmission information for each service at the Crystal Palace transmitter site is detailed in Table A, Appendix I - *Television Transmission Frequencies*.

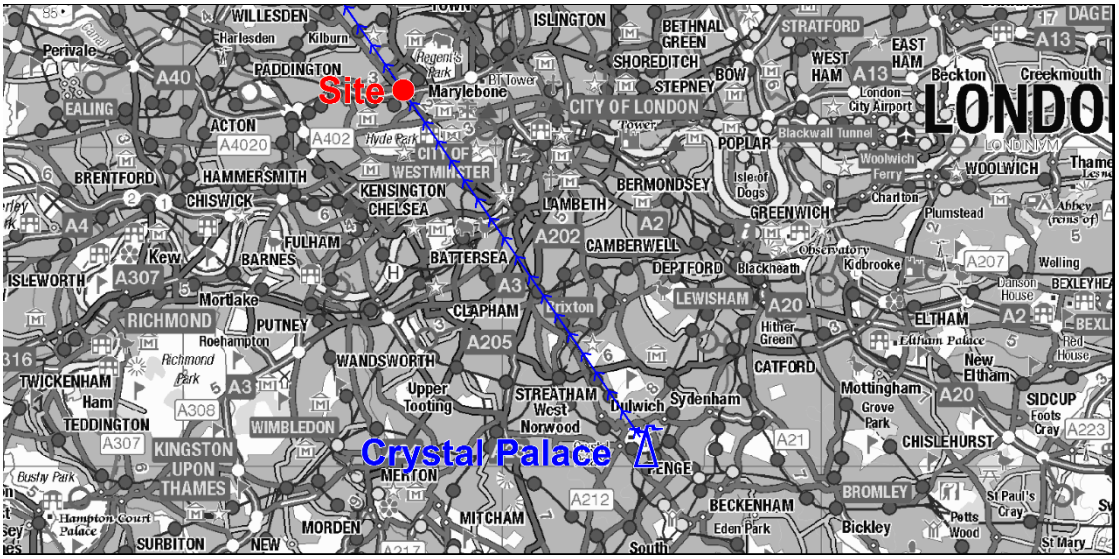

Figure 10 - Location of the Crystal Palace DTT Transmitter and the Site

Non-Terrestrial Television Services (Digital Satellite Television)

For the reception of the 28.2 degrees east ASTRA satellite cluster (Freesat and Sky services), dish elevations of 25.3 degrees are required at this latitude. Optimal satellite dish azimuths are 145.4 degrees with respect to true north.

VHF (FM) Radio

The study area is served by VHF (FM) radio services of BBC Radio 1, 2, 3, and 4 from the Crystal Palace transmitter (NGR TQ 33940 71220). Technical transmission information for each radio service at the aforementioned transmitter site is detailed in Table B, Appendix II - *VHF (FM) Radio Transmission Frequencies.*

Survey

Survey Method and Description of Baseline (pre-construction) Television and Radio Reception Conditions

Due to the high variability of television coverage in densely built urban environments caused by signal reflections and refraction, signal surveys and reception investigations are normally undertaken in the study area, and in all areas where potential interference has been considered possible. This is to ensure all-natural variations in coverage are considered.

For this assessment, signal measurements were undertaken up to 2 kilometres (km) from the site boundary and mainly focused around areas to the immediate north-west where interference has been considered (due to the direction of the incoming transmitter signals and consequently the only location where signal disruption could occur). The locations of the surveyed positions are presented in Figure 11 and the signal measurements are detailed in Tables C and D, in Appendix III – *Signal Survey Measurements*. In particular, the following data was recorded:

- Signal strength and technical signal measurements of DTT transmissions from the Crystal Palace transmitter;
- Viewing preference (choice of television transmitter) of residents in all areas visited; and
- Signal strengths of VHF (FM) radio transmissions from the Crystal Palace radio transmitter.

All television measurements were carried out using a UHF log-periodic receiver antenna, mounted on GTech Surveys's broadcast survey vehicle, at a receiver height of 10 m AGL (above ground level), which represents industry standard height for such work.

VHF (FM) radio field strength measurements were taken with a resonant half wavelength folded dipole antenna at 2 m AGL, which represents industry standard height for such work.

Equipment details are detailed in Appendix V - *Survey Equipment*.

The blue arrow in Figure 11 indicates the direction of the incoming DTT signals from the Crystal Palace DTT transmitter. The site is delineated in red.

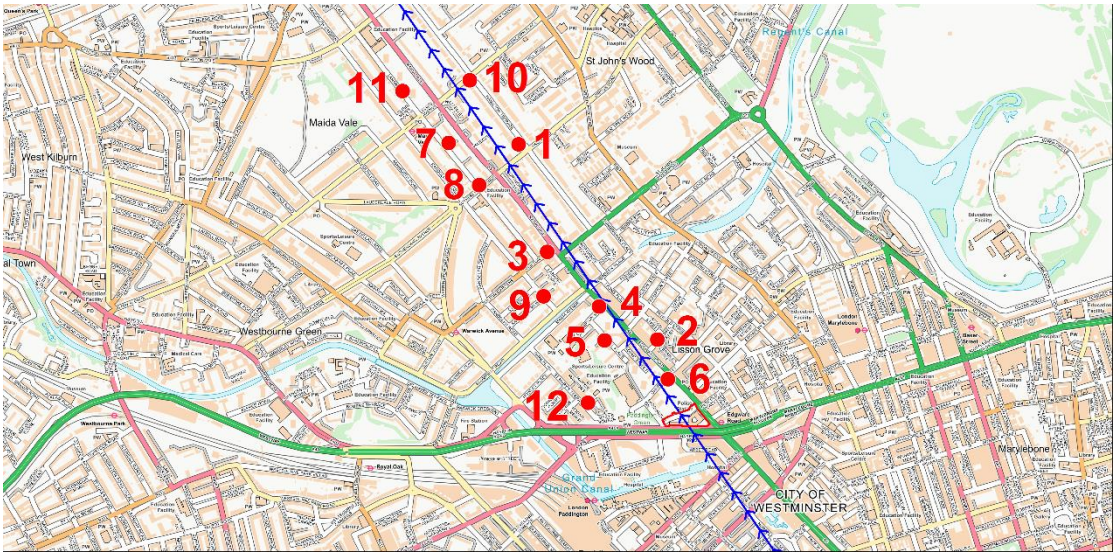

Figure 11 - Surveyed Locations

Survey Results and Observations

Buildings within the study area were noted to be predominantly in mixed-use, comprising residential, commercial, education and light industrial uses. A number of major roads and significantly tall buildings surround the site. Signal receiving antenna systems, when visible during the survey, appeared mounted on rooftops, ensuring optimal reception conditions; however, few television antennas were visible due to their required optimal orientation and mounting position (directed towards the south-east and attached to elevated positions on rooftops). With respect to existing and recently constructed tall buildings, , antenna systems are normally located on rooftops and subsequently not visible from street level When terrestrial television antennas were visible on buildings, all antennas were directed towards the Crystal Palace transmitter site, which is expected because the Crystal Palace television transmitter is the main regional high-powered television transmitter for London and the surrounding regions.

Sensitive residential receptors were identified at and along the following locations:

- Edgware Road (A5);
- Paddington Green;
- Church Street;
- Adpar Street;
- Church Street;
- Further from the site on roads adjacent to the A5 Maida Vale, including (but not limited to) Hamilton Terrance, Lanark Road, Clifton Gardens, Randolph Avenue, Elgin Avenue, Sutherland Avenue, Hall Road and St. Johns Wood Road; and
- Recently introduced receptors include those within the wider WEG masterplan.

Digital Terrestrial Television - Freeview

DTT services were available at all surveyed locations from the Crystal Palace transmitter. At all locations, received signal levels were in excess of recommended minimum criteria/thresholds (as specified in Code of Practice Confederation of Aerial Industries (CAI) COP 2)[10] and the technical quality of received signals was found to be good, indicating robust reception. At the time of the survey, DTT services provided good coverage and service throughout the survey area.

Digital Satellite Television - Freesat & Sky

During the survey, satellite dishes were observed to be mounted on existing residential properties. A number of dishes were observed on properties immediately adjacent to the site, especially along the Edgware Road. Additional satellite dishes may be mounted on rooftops; however, these would not be visible from street level. No existing interference was identified for any satellite television platform.

VHF (FM) Radio

VHF (FM) radio reception conditions were good throughout the survey area[11]. In-car reception was good at all surveyed locations, due to the proximity of the high-power radio transmission site at Crystal Palace, located approximately 13 km from the site.

10 - Signal levels as specified by the CAI - Association for Audio Visual Professionals Code of Practice (COP) For the Installation of Aerials/Antennas & Receiving Equipment in the Single Dwelling Unit CAI COP 2: September 2022 Further technical information regarding the Freeview signal can be found in Appendix IV - An Overview of Signal Measurements

11 - Minimum Recommended Field Strengths for Acceptable Levels of VHF (FM) Radio Service
Monophonic audio - 40 dBµV/m
Stereophonic audio (excellent quality) - 54 dBµV/m
Source - https://www.ofcom.org.uk/__data/assets/pdf_file/0013/54310/annex-f.pdf

4 - Impact Assessment

To assess the likely effects of the 2022 amended proposed development upon existing microwave links and television and radio broadcast service reception, consideration was given to the potential for the 2022 amended proposed development to create interference to microwave links and television and radio services in the study area around the site, in both signal reflection areas and in the signal shadow zones. Consideration was given to the differences in massing, form and height with respect to the existing structures on the site compared with the 2022 amended proposed development, as well as broadcast radio and television signal propagation theory, fixed point-to-point radio communication theory, the mechanisms of television and radio signal interference and those mechanisms affecting fixed point-to-point radio links. Building height data for the 2022 amended proposed development was derived from plans of the 2022 amended proposed development.

Microwave Links

Consultation responses were not received from the potential microwave link operator (New Line Network) and therefore a worst-case assumption has been made that there would be potential for impacts to result from the 2022 amended proposed development.

A methodology to model (calculate) clearance zones for wind turbines is defined in a paper published by Ofcom (Bacon, 2002) [12]. This methodology is applicable for any other physically tall structure. Based on experience, microwave link owners are likely to use a similar impact methodology when determining potential impacts to microwave link operations, and have therefore been adopted in this assessment.

The worst-case assessment of potential impacts and likely effects has been undertaken based upon experience and professional judgement.

The modelling was based on the following technical information provided by the Ofcom Spectrum Information Portal, as shown in Table 2. As Block K of the 2022 amended proposed development is the tallest block and the nearest to the microwave link's path, this block was given particular attention.

Table 2: Technical Specifications for Link 1126361/1

Transmitter (NGR)	Receiver (NGR)	Frequency (GHz)	Bandwidth (MHz)	Transmitter Antenna Height (m)	Receiver Antenna Height (m)
SU 98196 79772	TQ 29223 81928	13.059	28	28	172
TQ 29223 81928	SU 98196 79772	12.793	28	172	28

12 - Fixed-link wind-turbine exclusion zone method. D F Bacon. October 2002
https://www.ofcom.org.uk/__data/assets/pdf_file/0031/68827/windfarmdavidbacon.pdf

Predicted Effects Considering Modelling

Figure 12 shows the result of the path profile modelling along the microwave link's path. The red marker indicates the location along the path of Block K and the maximum height of Block K. Detail is shown in Figure 13.

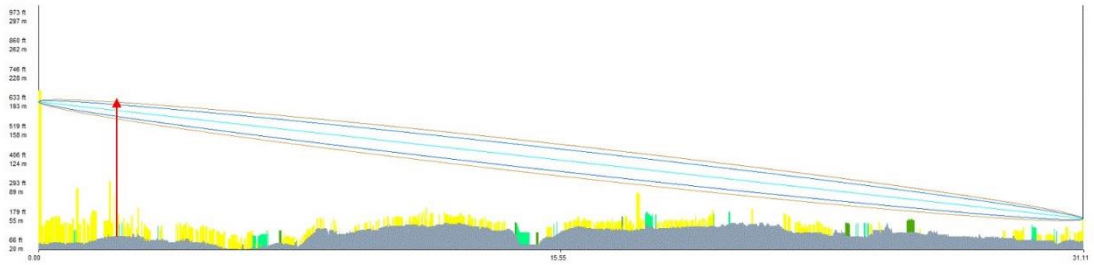

Figure 12 - Microwave Link and First and Second Fresnel Zones between both Termination Points

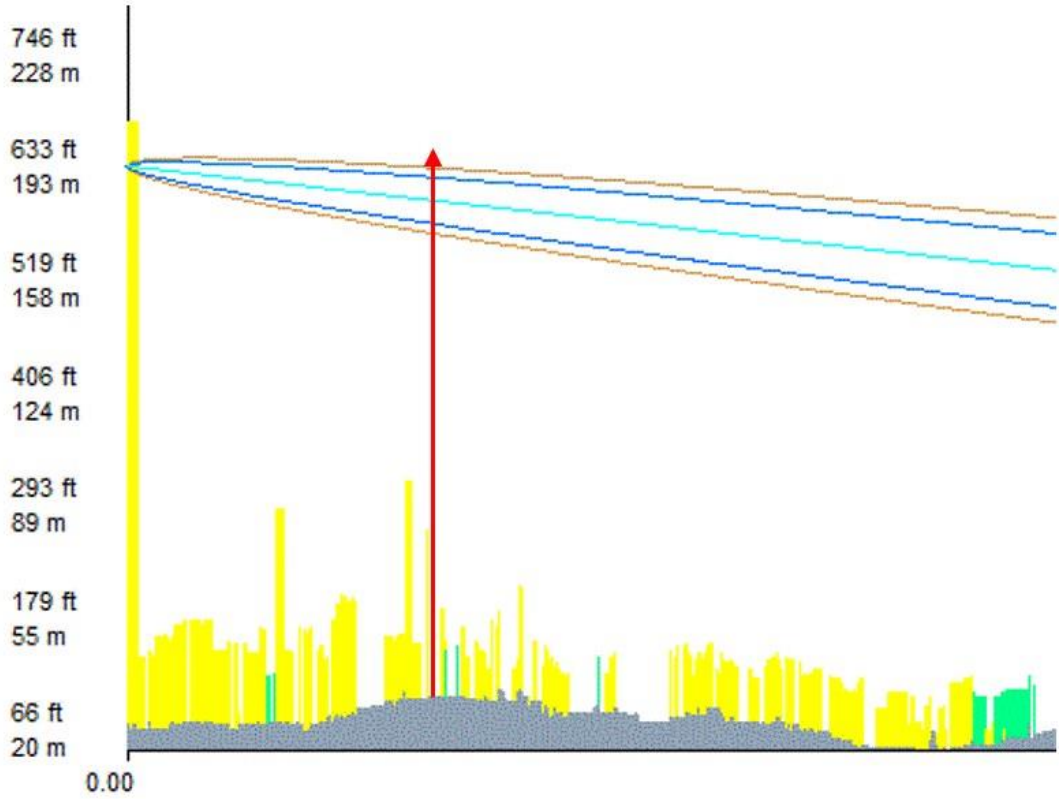

Figure 13 - Microwave Link and First and Second Fresnel Zones passing adjacent to Block K

When considered in a plan view (in limited resolution), the microwave link's Fresnel Zone just clears the northern facing edge of Block K, but clearance distances cannot be defined because the separation distance is too slight. The situation is shown in Figure 14, with the Fresnel Zone indicated in light blue.

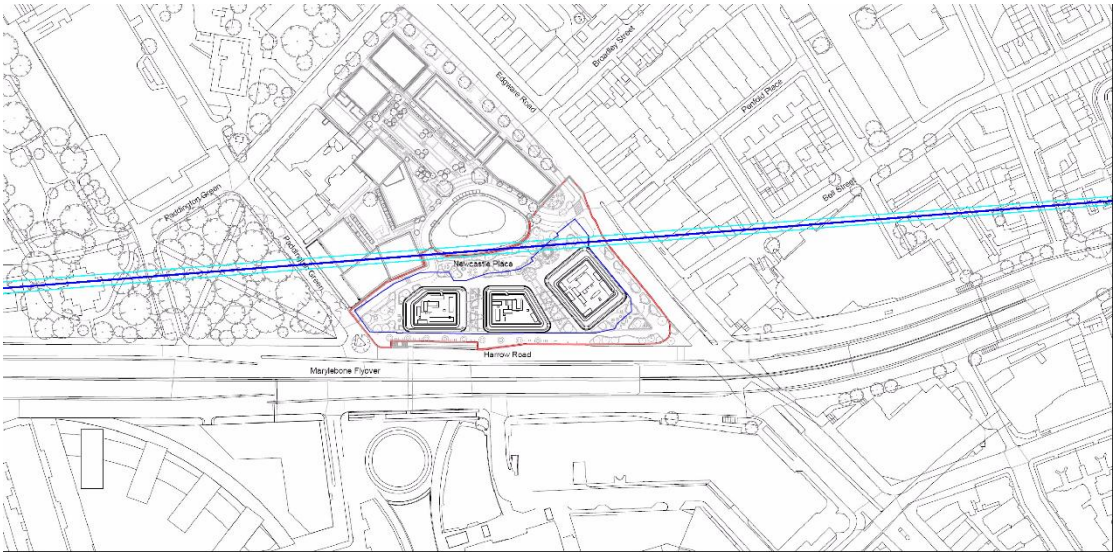

Figure 14 - Microwave Link across 2022 Amended Proposed Development

As can be seen, the completed 2022 amended proposed development would have the potential to result in adverse impacts upon the operation of the identified microwave link, as the taller elements, particularly Block K (39 storeys), could cause obstructions on the microwave link path, ultimately causing data disruption and a reduction in the link's overall operational reliability.

During the demolition and construction stage, the use of tower cranes would have the potential to cause interference to the microwave link as the metal frames and structures could encroach into the microwave link path, causing data disruption and a reduction in the microwave link's overall operational reliability.

The following mitigation options have been agreed with the Applicant to re-route the link in advance of completion of construction works and thereby ensure the continuing operation of the link:

- Use of a radio relay facility (for example, a dedicated microwave link transmitter and receiver located away from any obstruction i.e. on the rooftop of Block I or the adjacent Westmark Tower, which is under the ownership of the Applicant); or
- Construction of a new base station facility on the rooftop of Block I or the adjacent Westmark Tower.

The following alternative mitigation measures could also be considered, if required:

- Use of other radio infrastructure sites; or
- Redefining of the exclusion zones by the use of aerial engineering to enable greater link reliability.

As is standard practice, the identification of the mitigation measures would be determined in consultation with the link operator, should the link operator confirm that the link is operational and may be impacted. This would include:

- a detailed review of the existing radio communications infrastructure at each termination point;
- a review of the operational status of the link (with particular attention paid to possible link decommissioning or already pre-planned link re-engineering);
- confirmation of the data for the services operated by the link's owner from the identified radio sites;
- a review of the dates and timescales for the demolition and construction phases of the 2022 amended proposed development and review of the theoretical analysis of the 2022 amended proposed development layout on the existing radio communication systems, to identify the exclusion zone for any affected radio infrastructure.

These measures are robust long term mitigation solutions. Once undertaken, the 2022 amended proposed development would not have an opportunity to cause the same or any new impacts to the link and would enable the continued operation of the link.

The implementation of mitigation would be secured by means of a suitably worded planning condition, in the event that the link operator confirms the link is operational and may be impacted and that this confirmation is received within a reasonable timeframe (21 days).

It is noted that adverse impacts were historically also identified for the Westmark Tower. However none of the link operators consulted with at the time, subsequently confirmed the need for mitigation.

Television and Radio Broadcast Services

Based on the site visit (and visual observations), survey data, broadcast transmission information, plans of the 2022 amended proposed development and maps of the study area, the potential impacts on television reception was determined, with emphasis on DTT and digital satellite television services. Outcomes were analysed, and together with various mitigation options, conclusions were drawn on the overall effects of the 2022 amended proposed development on the reception of broadcast services for local residents.

Importantly, with respect to DTT services, all DTT transissions emminating from the main regional transmitter at Crystal Palace are encoded in a format which ensures that the impacts and effects of multiple additional signal interactions from reflections and refractions from buildings are nullified. Technically, this is referred to as the 'guard interval', which ensures that DTT transmissions can be received well within densly cluttered and built up urban areas. In addition to the inherent ability of the DTT signal to overcome the effects of unwanted mulitpath signal interference, the existing robust coverage observed during the baseline survey work (well above minimum levels as specified in the Code of Practice Confederation of Aerial Industries (CAI) COP 2)) ensures that with the use of professionally installed antenna systems (normally positioned on the tops of proposed buildings) optimal reception conditions will be maintained.

From experience and understanding of modern transmission formats and signal propagation with respect to television broadcast coverage in densely built areas

and other large proposed developments, it is considered that cumulative effects of all schemes considered would be negligible on broadcast service reception for local receptors. Where potential impacts have been identified for other cumulative schemes, it is anticipated that any required pre-construction or post-construction signal strength surveys and reception impact assessments would be undertaken as a result of appropriately worded planning conditions.

Digital Terrestrial Television - Freeview

Reception to DTT services is much less affected by signal reflections[13]; however, can still be impacted by signal blocking. Whilst widespread interference is not expected as a result of the 2022 amended proposed development, the 2022 amended proposed development could degrade the quality of received signals in areas within 50 m to the immediate north-west of the site.

Digital Satellite Television - Freesat and Sky

As discussed in Section 2 of this report, tall structures, trees and buildings can disrupt digital satellite television reception by causing unwanted obstructions on the line of sight to the signal receiving antenna (satellite dish) from the serving satellite.

Using the mathematical tangent function and based on the maximum above ordnance datum (AOD) height of each proposed block, the angle and orientation of the incoming satellite signals, theoretical signal shadow zones for the 28.2E ASTRA satellite cluster are as summarised in Table 3:

Table 3: 2022 Amended Proposed Development Theoretical Signal Shadow Zones

Block	Maximum Signal Shadow Length (m)
I	162
J	114
K	271

The areas where possible signal shadow zones fall are shown (delineated in black) in Figure 15. It is important to note that the signal shadow zones always fall in a north-westerly direction from the base of the structure, because the serving satellites are all located to the south-east.

13 - Whilst less prone to signal reflection-generated interference, modelling parameters assume that all installed antenna systems are mounted at least 10m above ground level (AGL) and are installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and substandard installations will be more prone to the effects of interference from external sources.

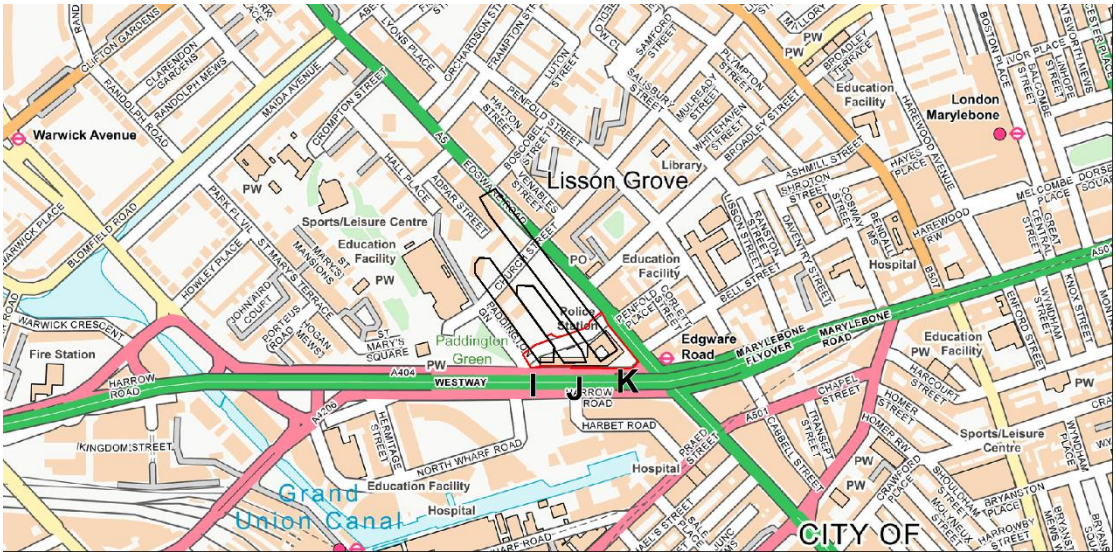

Figure 15 - Theoretical Digital Satellite Television Signal Shadow Zones

VHF (FM) Radio

As discussed in Section 2, the accurate modelling of VHF (FM) radio interference in a cluttered urban environment is not possible due to the number of constantly changing variables. New construction, moving vehicles and weather conditions can all greatly change reception conditions. VHF(FM) broadcast radio reception is robust throughout this part of the country, as shown by the survey results and signal availability with a typical car radio. Whilst any physical structure would change the immediate local signal propagation characteristics, due to the technical methods involved with encoding and receiving VHF (FM) radio transmissions, good reception conditions would remain following the introduction of the 2022 amended proposed development. Accordingly, the 2022 amended proposed development is not expected to adversely affect the reception of VHF (FM) radio broadcasts.

Predicted Effects Considering Survey Findings

The predicted effects on reception are discussed below.

Digital Terrestrial Television - Freeview

The 2022 amended proposed development may impact the reception of DTT services within 50 m to the immediate north-west of the site's northern-facing boundary. However, based on observations during the site visit, there are no low-level[14] antennas located in this area (all newly installed antenna systems are expected to be located on rooftops (normally adjacent to lift-overruns or roof plant) to ensure optimal reception conditions) and as existing coverage is robust, no interference would occur. Antenna systems on new development in this area would be mounted on the tops of buildings to ensure the most optimal

14 - *low-level* antennas are generally considered to be below 10 metres above ground level (AGL), where reception conditions may be less optimal

reception conditions. Installed antenna systems on existing old development are likely to be located in positions to enable optimal reception conditions. These locations would include; chimney stacks; eaves of buildings; areas of the roof; and on building gable ends.

Digital Satellite Television - Freesat and Sky

As shown in Figure 15 and Table 3, the largest theoretical signal shadow zones for the 28.2E ASTRA satellite cluster would fall up to 271 m in a north-westerly direction from the base of the tallest element, covering receptors located off Paddington Green, Church Street and parts of the Edgware Road. Whilst widespread interference is not expected due to the nature of building and land use in the affected areas, the 2022 amended proposed development buildings could cause signal disruption to users of satellite television services in this area only if satellite dishes are located in theoretical signal shadow zones. With respect to new development, this is considered unlikely because any satellite dishes will only be positioned on rooftops; the optimal location to ensure best reception and required to reduce the unwanted unsightly visual impact of satellite and terrestrial antenna systems. With respect to existing old development, satellite dishes would have been installed at the best possible location(s) where a clear line-of-sight view to the serving satellites could be best achieved. If interference to existing satellite dish installations on existing old development has already occurred from other development; obstructions; or as a result of tower crane use, satellite dish installations may be relocated to different positions where unwanted interference effects ceased. If satellite dish relocation was not possible or desired, alternative sources of television broadcasts (such as cable television, broadband, DTT or fibre) may have been adopted, thus providing suitable mitigation. Such content delivery systems cannot be adversely affected by construction work or new development. In addition, recently built developments which form part of the wider WEG masterplan (especially the Westmark Tower), will also have caused similar disruption in similar areas and consequently, any required mitigation may have already been applied.

However, if interference is reported in the identified areas, repositioning satellite dishes to new locations where views of the south-eastern skies are no longer obscured would restore services for any affected service. If satellite dishes cannot be relocated out of any signal shadow zone, the use of DTT receiving equipment could also offer viewers alternative sources of broadcasts. If any antenna work is required, it is advised that a registered antenna installer conducts all required work, as further detailed in Section 5.

VHF (FM) Radio

Combined with an ability to make constructive use of reflected signals, radio receivers are able to operate successfully in most urban environments, including following the introduction of new development. Hence the ability to receive radio transmissions with aerials attached to the radio unit itself, located inside buildings as opposed to TV aerials, which generally require a clear line-of-sight and elevated positioning. Therefore, as existing coverage is optimal

and given that radio broadcasts are able to be received successfully in most environments, there would be no significant effects to radio reception as a result of the 2022 amended proposed development.

Assessment Summary

Table 4 provides a summary of the assessments undertaken and the required mitigation.

Table 4: Summary of Television and Radio Interference

Technology	Area(s) of predicted interference	Risk of interference and reasoning	Mitigation Required
Microwave Links	Within an area to the immediate northern corner of Block K which encroaches the link's Fresnel zone	Required link clearance distances are likely to be at an absolute minimum and consequently the potential of interference does exist	If confirmed to be operational and further assessment indicates microwave link degradation, suitable mitigation to reroute the microwave link or the use of alternative communications channels. The following mitigation that can be readily implemented to re-route the link: • Use of a radio relay facility (for example, a dedicated microwave link transmitter and receiver located on the rooftop of Block I or the adjacent Westmark Tower, which is under the ownership of the Applicant); or • Construction of a new base station facility on the rooftop of Block I or the adjacent Westmark Tower.
DTT (Freeview)	Within 50 m to the immediate north-west of the site	No interference because coverage is robust and there are no viewers in this area	No
Digital Satelite TV (Freesat and Sky)	Up to 271 m to the north-west of the tallest proposed building in areas including; Paddington Green, Church Street and parts of Edgware Road	Possible, only if there are satellite dishes located in the shadow areas which have not already been moved as a result of recently completed buildings in the wider WEG masterplan	Satellite dish relocation or use of DTT receiving equipment

Table 4: Summary of Television and Radio Interference			
Technology	**Area(s) of predicted interference**	**Risk of interference and reasoning**	**Mitigation Required**
VHF(FM) Radio	None	No interference because the VHF (FM) broadcast technology is robust to interference effects and existing coverage is optimal	No

5 - Mitigation Measures

Microwave Links

The worst-case assessment undertaken in this report, has identified a potential impact to the microwave link operations of New Line Network (Licence Number 1126361/1) link in proximity to the tallest element of the 2022 amended proposed development.

In the event that the link is confirmed to be operational and an impact may occur, mitigation would be delivered to enable the ongoing optimal functioning of the communication channel. Due to the complex nature of microwave links and the technology associated with microwave links, mitigation would be confirmed by the link owner.

The following standard mitigation measures can be readily implemented to re-route the link in advance of completion of construction works and thereby ensure the continuing operation of the link:

- Use of a radio relay facility (for example, a dedicated microwave link transmitter and receiver located away from any obstruction i.e. on the rooftop of Block I or the adjacent Westmark Tower, which is under the ownership of the Applicant); or
- Construction of a new base station facility on the rooftop of Block I or the adjacent Westmark Tower.

The following alternative mitigation measures could also be considered, if required:

- Use of other radio infrastructure sites; or
- Redefining of the exclusion zones by the use of aerial engineering to enable greater link reliability.

Radio and Television Broadcast Services

For any affected digital satellite television user located to the north-west of the Site (up to 271m from the base of the tallest proposed building, K), relocating satellite dishes to different locations where views to the south and south-east horizon are no longer obscured should restore the reception of services. Affected digital satellite television viewers could also use DTT reception equipment to restore services. Additionally, some satellite television broadcasts may now be available via broadband or cable.

These are common and simple mitigation solutions for similar situations where local television reception conditions have been affected by adjacent construction work. A registered installer should be able to advise on the most effective mitigation measures once the existing installed antenna system has been inspected and construction-generated interference has been identified.

It is recommended that all antenna work (antenna betterment, dish moving, relocating etc.) is undertaken by a registered installer (CAI accredited) and any system components used must be CAI benchmarked. More information

regarding the Confederation of Aerial Industries can be found on the CAI's website[15].

The CAI's benchmarking scheme ensures that the cables and antennas have passed minimum requirements for the use of DTT and digital satellite television reception. The use on non-benchmarked products in an antenna system would degrade overall performance and effectiveness of the system, increasing the risk from interference. More information on CAI benchmarked products can be found on the CAI's website[16].

It should be noted that because tower cranes are normally taller than the structure being built and tower cranes operate over a wide area, moving dishes to different locations may not resolve all reception issues. To reduce tower crane interference, it is advised that the crane jibs / arms are positioned in a north-westerly to south-easterly facing orientation at the end of crane lifting operations, hence reducing the overall cross-sectional area presented to the incoming satellite signals. This action reduces disruption because the signals come in at a bearing of 145 degrees with respect to true north (for Freesat and Sky digital satellite television services), and so encounter less of the crane's structure if parallel to the direction of the incoming satellite signals.

15 - http://www.cai.org.uk/index.php
16 - https://www.cai.org.uk/index.php/services/product-certification-scheme

6 - Conclusions

Impact assessments and baseline television and radio signal survey have been undertaken to determine the potential and likely effects of the 2022 amended proposed development on the existing reception of microwave links and television and radio broadcast services. The assessment has focused on the reception of point-to-point microwave links, VHF (FM) radio and of the two television broadcast platforms that could potentially be impacted by the 2022 amended proposed development - digital terrestrial television and digital satellite television services.

Microwave Links

The potential for interference to an existing microwave link (owned by New Line Network (Licence Number 1126361/1)), has been identified as a result of the link's close proximity to Block K of the 2022 amended proposed development. This is based on a worst-case assessment that the link is operational.

As is standard practice, the identification of the appropriate measures would be determined in consultation with the link operator, should the link operator respond to consultation enquiries within a reasonable timeframe. This would include a detailed review of the existing radio communications infrastructure at each termination point; a review of the operational status of the link (with particular attention paid to possible link decommissioning or already pre-planned link reengineering); confirmation of the data for the services operated by the link's owner from the identified radio sites; a review of the dates and timescales for the demolition and construction phases of the 2022 amended proposed development and review of the theoretical analysis of the 2022 amended proposed development layout on the existing radio communication systems, to identify the exclusion zone for any affected radio infrastructure.

The following standard mitigation measures can be readily implemented to ensure the continuing operation of the link:

- Use of a radio relay facility (for example, a dedicated microwave link transmitter and receiver located away from any obstruction i.e. on the rooftop of Block I or the adjacent Westmark Tower, which is under the ownership of the Applicant); or
- Construction of a new base station facility on the rooftop of Block I or the adjacent Westmark Tower.

The following alternative mitigation measures could also be considered, if required:

- Use of other radio infrastructure sites; or
- Redefining of the exclusion zones by the use of aerial engineering to enable greater link reliability.

These measures are robust long-term mitigation solutions. Once undertaken, the 2022 amended proposed development would not have an opportunity to cause the same or any new impacts to the link and would enable the continued operation of the link.

The implementation of appropriate mitigation would be secured by means of a suitably worded planning condition, in the event that the link operator confirms the link is operational and may be impacted and that this confirmation is received within a reasonable timeframe (21 days).

Digital Terrestrial Television - Freeview

Due to existing good coverage and lack of viewers in any theoretical signal shadow area, the 2022 amended proposed development is not expected to have any adverse effect upon the reception of Freeview television services.

Digital Satellite Television - Freesat & Sky

Taller elements of the 2022 amended proposed development may cause disruption to the reception of digital satellite television services in well-defined areas to the immediate north-west of the site, within 271m from the base of the tallest proposed building and areas including; Paddington Green, Church Street and parts of the Edgware Road. In these areas, the 2022 amended proposed development could obscure clear views of the south-eastern skies, resulting in interference.

If interference does occur, the repositioning of satellite dishes to locations without an obscured line of sight view to the serving satellites would restore all services. If this was not possible (which is an unlikely outcome) the use of DTT receiving equipment would also offer any affected viewer an alternative source of digital television broadcasts. Whilst a risk to the reception of digital satellite television services exists, it is considered that any satellite dishes are be installed on top of the buildings in that area, reducing the overall risk. In addition, as a result of likely signal interference in similar areas which could have occurred during the construction of Westmark Tower, mitigation solutions may have already been provided (dish moving, relocating etc.), further reducing any risk.

VHF(FM) Radio

Due to the existing good coverage within the study area and robust technical nature of the broadcast radio network with respect to building-generated signal interference, the 2022 amended proposed development is not expected to affect the reception of VHF(FM) radio services.

The 2022 amended proposed development may cause some highly localised disruption to the reception of digital satellite television services to the immediate north-west of the site.

Should interference occur, moving satellite dishes to new locations out of any signal shadow areas should restore optimal reception conditions.

Concluding Statement

Telecommunication interference mitigation measures have been presented in this report and would be secured by planning condition (as confirmed and

agreed during the EIA Scoping process and presented in ES Chapter 5R), if required.

Accordingly, no significant telecommunication effects are predicted.

This report provides the existing level and quality of radio and television signal reception in the study area (pre-construction survey).

APPENDICIES

Appendix I - Television Transmission Frequencies
Appendix II - VHF (FM) Radio Transmission Frequencies
Appendix III - Signal Survey Measurements
Appendix IV - An Overview of Signal Measurements
Appendix V - Survey Equipment
Appendix VI - Calculation of Received Field Strength
Appendix VII - References
Appendix VIII - Map and Data Sources

Appendix I - Television Transmission Frequencies

Digital TV Multiplex	Multiplex Operator	UHF Channel Number[17]	Channel Frequency Fc (MHz)[18]	Transmitter Power (kW)
BBC A	BBC	23	490.000	200.00
D3&4	Digital 3 & 4	26	514.000	200.00
BBC B (HD)	BBC	30-	545.833	200.00
SDN	SDN	25	506.000	200.00
Arqiva A	Arqiva	22	482.000	200.00
Arqiva B	Arqiva	28-	529.833	200.00

Table A – Crystal Palace Digital Terrestrial Television Services

Public Service Broadcaster (PSB) Digital Multiplexes
Commercial (COM) Digital Multiplexes

Appendix II - VHF (FM) Radio Transmission Frequencies

Service	Frequency (MHz)	Transmitter Power (kW)
BBC Radio 1	98.5	4.0
BBC Radio 2	88.8	4.0
BBC Radio 3	91.0	4.0
BBC Radio 4	93.2	4.0

Table B – Crystal Palace VHF (FM) Radio Services

Information correct at time of writing. Information provided by DigitalUK and Arqiva

17 - Digital multiplexes with a "+" or "-" sign operate with a frequency offset making the channel frequency + or - 167 kHz
18 - The nominal channel frequency, Fc (in Megahertz) of the multiplex can be calculated using Fc = 8n+306, where 'n' is the UHF channel number

Appendix III - Signal Measurements

Measurement Point Number	Channel	23	26	30	25	22	28
	Frequency	490.00	514.00	545.83	506.00	482.00	529.83
	Service	BBC A	D3&4	BBC B -	SDN	Arqiva A	Arqiva B -
1	FS	93.3	91.9	91.9	88.7	89.9	96.9
	CSI	23.6	19.8	-	18.9	19.2	22.7
	MER	31.8	30.6	-	32.1	30.4	31.3
2	FS	91.9	88.4	89.2	93.3	93.9	92.1
	CSI	22.1	20.5	-	26.5	23.8	20.9
	MER	31.6	29.6	-	29.3	30.1	28.8
3	FS	89.7	96.0	91.6	96.0	96.2	93.8
	CSI	17.9	20.6	-	16.8	23.9	19.4
	MER	31.8	30.8	-	30.2	32.0	31.0
4	FS	97.4	90.0	95.4	90.1	91.5	90.7
	CSI	18.8	22.9	-	25.2	23.6	22.9
	MER	32.9	32.0	-	31.4	29.2	30.1
5	FS	90.9	94.1	86.6	94.6	96.3	99.8
	CSI	18.4	21.0	-	21.1	23.4	19.9
	MER	32.6	31.4	-	31.0	32.5	32.5
6	FS	86.5	91.1	97.4	97.8	95.4	95.1
	CSI	23.7	20.9	-	26.9	21.7	19.8
	MER	29.8	30.0	-	30.0	31.0	30.9
7	FS	92.7	86.5	86.6	97.8	96.3	93.1
	CSI	25.6	25.4	-	17.9	20.5	20.1
	MER	31.7	31.2	-	30.6	31.5	29.8
8	FS	92.3	97.8	89.5	86.9	93.0	88.9
	CSI	19.4	21.6	-	26.5	27.4	18.9
	MER	31.4	29.4	-	31.8	29.4	32.6
9	FS	92.4	85.6	83.8	94.7	95.9	94.6
	CSI	21.9	29.6	-	24.4	23.6	29.3
	MER	31.3	28.7	-	30.8	30.7	29.4
10	FS	89.2	86.9	90.5	88.9	96.7	92.4
	CSI	23.8	27.3	-	20.2	20.8	27.1
	MER	31.6	29.6	-	30.2	30.8	28.9
11	FS	96.3	95.6	94.2	95.5	90.3	93.2
	CSI	17.9	26.4	-	25.1	22.8	29.9
	MER	28.0	30.4	-	30.3	30.5	28.9
12	FS	83.9	91.3	91.8	92.7	94.0	89.1
	CSI	20.6	23.7	-	21.6	24.8	22.1
	MER	0.3	0.8	-	0.3	0.1	0.4

Table C - Measurements of Crystal Palace Digital Terrestrial Television Services

Frequencies listed are in MHz
Field strength (FS) values are indicated in dBμV/m
CSI Channel Status Information (%)
MER Modulation Error Ratio (dB)

Location	Service	Radio 1	Radio 2	Radio 3	Radio 4
1		65.0	66.6	69.0	66.1
2		67.6	64.5	70.8	68.4
3		63.0	63.0	62.1	63.2
4		65.9	68.7	70.1	66.0
5		66.2	65.0	67.2	65.1
6		62.8	64.5	65.8	60.9
7		67.9	64.4	63.0	70.1
8		67.2	62.1	66.8	71.6
9		68.1	72.0	64.8	70.9
10		66.5	67.2	65.5	67.5
11		67.8	71.7	64.8	66.0
12		65.7	67.9	69.0	67.8

Table D - Field Strength Measurements of VHF(FM) Radio Services

Field strength (FS) values are indicated in dBμV/m

Appendix IV - An Overview of Signal Measurements

The first and easiest parameter to check is signal level (also referred to as amplitude or terminated signal strength). In many cases this gives a good indication of the available decoding margin, or the extent of any shortfall.

At the receiver input, the terminated level of a DTT signal is measured in the usual units of dBμV (a maximum signal level of 70 dBμV and a minimum signal level of 50 dBμV). It is helpful to understand that the level of a DTT signal represents the total power of all the carriers in the Coded Orthogonal Frequency Division Multiplexing (COFDM) signal and not the level of each individual COFDM carrier. For satisfactory reception of digital signals, it is important the signals applied to the receiver are within these ranges. These maximum and minimum levels define a so-called window of operation for the receiver.

Common practice dictates that in order to measure the quality of a received DTT signal we have to look at one or more of the following parameters: Bit-Error Rate (BER), Channel BER (CBER), Carrier-to-Noise Ratio (CNR) and Modulation Error Ratio (MER). The Channel State Information (CSI) feature available in DTT measurement equipment is a very valuable tool providing additional insight into the quality of reception in a typical domestic or professional DTT installation.

Using the BER alone is an ill-advised “hit-or-miss” strategy because of the 'cliff-edge effect' characteristic of any digital TV system. A BER reading below the reference quasi error free (QEF) value of 2×10-4 might wrongly lead us to conclude that the receiving conditions are satisfactory.

However, the BER provides a very narrow signal measurement range. Even for vanishingly small BER readings, a small drop in the level of received DTT signal can push the DTT receiver over the digital cliff edge beyond the point of system failure. The CBER is closely related to the BER providing a wider signal measurement range. Depending on the type(s) of unknown disturbance(s) affecting our DTT installation (noise, co-channel or adjacent PAL, co-channel DTT, etc.), the CBER corresponding to the reference QEF BER of 2×10-4 varies between 4 and 7 in 100 [1]. Unfortunately, the CBER is not a reliable indicator of how far the digital cliff edge is.

DTT engineers need a tool with a wide measurement range that solves the shortcomings of the BER and CBER. This measurement tool should provide some estimate of the noise margin of the DTT installation. A first candidate comes to mind: CNR or, alternatively, its sibling the MER.

The CNR is defined as the ratio of the average RF power of the DTT signal to the power of the noise present in the UHF channel. Similarly, the MER is defined as the ratio of the average power of the DTT signal to the average power of the constellation errors. It can therefore be used to give a more direct indication of decoding margin when, as is often the case, there is co-channel interference as well as noise in the channel. The higher the MER value, the **better** the reception conditions. Our measurement equipment provides a maximum MER measurement value of up to 35 dB.

In situations where there is no multipath propagation so that the channel frequency response remains reasonably flat, CNR and MER are in principle the same thing. In practice, the accuracy of the measured CNR is limited by the noise floor of the measurement equipment and by the presence of other disturbances on adjacent UHF channels. Likewise, both the receiver's noise floor and other issues resulting from its practical implementation degrade the MER estimate.

Channel State Information (CSI)

Some flavour of CSI is used internally by all commercial DTT receivers to achieve the recommended target system performance[19]. The CSI counts the effect of both the noise present in the channel and the shape of the transmission channel itself. In other words, the CSI gives a measure of the reliability of the received DTT signal. We measure the average of the CSI across the UHF channel occupied by the DTT signal. The higher the percentage value of CSI, the **less** reliable DTT reception is.

As explained, the CSI can be used as a means to measure the noise margin in a DTT installation. Let us call CSI_{QEF} the percentage CSI measured at the point where the measurement equipment displays the reference QEF BER. The noise margin in dB is then approximately given by –

$$NM\ (dB) = \frac{CSI_{QEF} - CSI}{2.6}$$

This empirical approximation represents a good estimate for NM below 8dB. The CSI alone, on the other hand, has a wider measurement range, providing meaningful results for NM of up to 15dB.

19 - J. Lago-Fernández, "Using Channel State Information (CSI) to Characterize DVB-T Reception", IBC, Amsterdam, 12-17 September 2002

Appendix V - Survey Equipment

1 x Promax Prolink 4C Premium – Serial Number PK4COPAB11B / 060419030005 Running firmware version 2.47

1 x Sony Wide screen CRT Reference Receiver KV–16TIU – Serial Number 4014480

1 x Professional Broadcast Wideband Log Periodic 8 element antenna – Amphenol Jaybeam (details below)

Amphenol JAYBEAM

468-860 MHz

A Log Periodic antenna designed for UHF Broadcast, TETRA and Cellular communications applications. This antenna is often used in a stacked array to form a rugged, high power, extended range antenna. Produced to the highest quality standards, these robust antenna designs will insure reliable operation in harsh environmental conditions.

LPU/Rx

V-Pol or H-Pol | Log Periodic | 70° | 7.9 dBd

Replace "x" with desired model number option.

Electrical Characteristics		
Frequency band	468-860 MHz	
Model number options (x)	Model Number LPU/R-N LPU/R-7/16	Connector type N-Female 7/16-DIN Female
Polarization	Vertical or Horizontal	
Horizontal beamwidth	70°	
Gain	7.9 dBd	
Impedance	50Ω	
VSWR	<1.3:1	
Maximum power	250 W	
Connector type	see model number options above	
Lightning protection	DC grounded	
Mechanical Characteristics		
Materials	Aluminium Alloy	
Dimensions (Length x Width)	1210 x 320 mm	47.6 x 12.6 in
Weight without bracket	3.5 kg	7.7 lbs
Mounting Options		
Mounting	Mounting bracket included to fit 38-50 mm dia. pipe.	

Technical Specification for an Amphenol Jaybeam Professional Broadcast Wideband Log Periodic 8-Element Antenna

All RF cables, interconnects and systems of professional quality and calibrated to determine feeder losses and antenna gains. These are factored into the results, providing accurate descriptions of actual field strength values at 10m AGL for each surveyed location – see *Calculation of Received Field Strength*

Appendix VI - Calculation of Received Field Strength

The Field Strength (dBµV/m) is derived from the Terminated Level (dBµV) as measured at the input of the Promax measurement receiver in the survey vehicle.

Field Strength (dBµV/m) = Terminated Level (dBµV) – Aerial Gain (a) + Dipole Factor (b) + Feeder Loss (c)

where -

Dipole Factor (to matched load)	(b)	$20Log(\frac{2\pi}{\lambda})$ *Where λ = Transmission Wavelength (m)*
Feeder Loss	(c)	3 dB
Aerial Gain (dB_{dipole})	(a)	10 dB

Appendix VII - References

The building information found in Section 2 was sourced from the following Ofcom document -

http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

Appendix VIII - Map and Data Sources

Mapping data used in this report is provided by Ordnance Survey (OS), under the terms of the Open Government Licence, OS data Crown copyright and database copyright (2022).

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The UK's terrestrial television and radio networks are highly complex engineering systems and are constantly being modified, re-designed, upgraded and maintained. The reception conditions detailed in this report were those prevailing at the time of the survey in the study area. Engineering work at transmitter sites, weather conditions and the time of the year will influence the quality and coverage of terrestrial services and their susceptibility to interference. Whilst every effort was made to accurately measure and assess the available television and radio transmissions and services at the time of the survey, GTech Surveys Limited cannot assume that any part of the television or radio broadcast network or transmission from any transmitter was operating in required specification or correctly to any design criteria. The signal measurements undertaken during the survey work were used to define the possible impacts to television and radio reception for this project. Although best practice has been applied in understanding the potential impacts, due to the complex nature of the subject, GTech Surveys Limited is not accountable in anyway whatsoever if unpredicted impacts occur at any location anywhere in the study area.

Modelling parameters assume that all installed UHF antenna systems are mounted at least 10m AGL and installed to a modern standard, with all components meeting CAI quality standards. Antennas mounted at lower heights and poor-quality installations will be more prone to the effects of interference from external sources and as such, reception conditions to installations with the aforementioned characteristics have not been accounted for in any impact modelling. Consequently, properties with such installations may be prone to interference effects that have not been identified. Such installations are commonly found in camping and caravan parks, on bungalows and properties where it is not possible to attach an antenna to the exterior roof. Antennas mounted in lofts are also more prone to interference effects arising from the signal attenuation caused by roofing materials. Again, reception conditions to properties with the aforementioned antenna installation characteristics have not been accounted for in any impact modelling and as such, properties with these

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