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LONDON CITY AIRPORT

MASTER PLAN

NOISE ASSESSMENT REPORT

Report to

York Aviation LLP
Primary House
Spring Gardens
Macclesfield
Cheshire
SK10 2DX

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1.0 INTRODUCTION

Since its inception in the 1980's, London City Airport (LCY) have operated in a manner that seeks to minimise the impact of noise emissions on the local community. Under their current City Airport Development Programme (CADP) planning permission (ref: 13/01228/FUL) granted in July 2016, London City Airport (LCY) are permitted to operate up to 111,000 aircraft movements each year. Air noise emissions to the local community are controlled by a variety of methods including a noise envelope limit that is checked annually. This envelope is described by the area of the 57 dB $L_{Aeq,16h}$ noise contour and has an area limit of 9.1 km^2.

The airport are updating their existing 2006 master plan, which covered a period up to 2030, and is setting out a plan for the longer-term development at the airport and looking forward a further 5 years through to 2035.

The airport are considering the infrastructure and operational requirements that would facilitate an increase in aircraft movements up to around 150,000 per year by 2035. This may include additional aircraft stands or some changes to the existing stands, which would require the relocation of the existing fuel farm and some other support facilities to the eastern end of the airport, and upgrades to the western apron to include new aircraft hold points. An overriding aim of the airport in developing the master plan is to ensure air noise emissions remain within the noise envelope limit area of 9.1 km^2 and where possible, reduce going forward. Operational changes being considered include increasing the peak hour movements from 45 movements per hour up to 52 movements per hour and adjustments to the operational hours, to allow more flexibility on the number of flights during the first half hour of the operational day and during the last half hour of permitted operations and at the weekends. There will be no changes to the runway or the 8 hour night time closure.

This report considers these future proposals for LCY and describes the expected noise impacts resulting from changes in the number and mix of aircraft movements per year, along with measures that are proposed to protect the community.

This report commences by describing the noise control measures in place at LCY currently. Air noise is then discussed and noise contours presented for 2017, representing the current situation, and for four future years 2020, 2025, 2030 and 2035 to provide an indication of the expected noise impacts arising from the proposals. Predicted aircraft ground noise levels are also presented for the current (2017) situation and the four future years up to 2035.

A glossary of acoustic and aviation terms is provided in Appendix 1.

2.0 NOISE CONTROL AT THE AIRPORT

The airport operate in a manner that seeks to minimise the impact of noise emissions on the local community. This is achieved through a combination of physical noise control measures, such as the use of noise barriers and also soundproofing to dwellings and community buildings; operational controls such as steep approaches and noise abatement procedures and also management including noise limits and incentives, noise monitoring and flight track monitoring. These measures are described in Sections 2.1 to 2.3 below.

2.1 Physical Noise Control Measures

The airport terminal building and pier are designed specifically to protect those dwellings that are located to the south of the airport against noise. They form a continuous barrier against the ground noise of aircraft taxiing and manoeuvring on the apron, as well as partially protecting against the noise of aircraft departure rolls on the runway.

The airport have operated since 1987, and continue to operate a Sound Insulation Scheme (SIS) which takes account of the close proximity of dwellings to this City airport. The scheme was further enhanced as part of the CADP and now has three tiers offering differing levels of sound insulation. Eligibility for the Tier 1 scheme starts at 57 dB $L_{Aeq,16h}$ of airborne aircraft noise. The intermediate tier offers a contribution towards high performance double glazing to dwellings within the 63 dB contour and Tier 2 provides the full cost of high performance double glazing to those within the 66 dB contour. Schools, churches, health care centres and other noise sensitive public buildings that are within the contours also receive sound insulation treatment. The airport also operate a property purchase scheme for dwellings within the 69 dB contour.

The airport have recently introduced a Construction Sound Insulation Scheme (CSIS) as part of CADP, which provides enhanced sound insulation to protect those dwellings expected to be most exposed to construction noise. The airport have sought to ensure those likely to be affected by construction noise are suitably protected and have encouraged those eligible to take advantage of the scheme. The take up rate is anticipated to exceed 85%.

2.2 Operational Noise Control Measures

A significant factor controlling noise emissions at the airport is the requirement for all landing aircraft to approach at a glide slope of 5.5 degrees. The normal approach angle adopted at most UK and International Airports is 3 degrees. This ensures aircraft are kept higher for longer, reducing the noise impact on local communities under the arrival flight paths.

Ground noise control procedures are also in place and to minimise the use of auxiliary power units Fixed Electrical Group Power is also being installed on all new and reconfigured stands as part of the CADP delivery.

2.2.1 Airspace Strategy

The airport recently underwent an airspace change to introduce modern navigation technology (RNAV1) along the airport's flightpaths. This upgrade was mandated by the Civil Aviation Authority (CAA) and was implemented to improve the operational efficiency and safety of the airspace, minimise future delays and improve environmental performance. This resulted in 1.2 million people no longer being regularly overflown below 7,000ft, arrivals staying over the sea for longer and in a narrower area over land, and departures climbing higher quicker.[1]

NATS are now developing airspace change proposals to modernise the airspace structure and route network above 7,000 ft. All airports in the South East are key consultees in this process and are therefore planning to review their arrival and departure routes to determine how best to connect with these high-altitude network changes. LCY also share London's airspace with several other airports, and, at times, this restricts aircraft departing the airport from climbing above a certain altitude or requires aircraft approaching the airport to be at a lower altitude than would otherwise be necessary.

The airport are committed to working with all London airports to facilitate an integrated approach to the modernisation of the London airspace in order to maximise the benefits. The airport will be engaging with stakeholders on the airspace change proposals later this year in line with the CAA's guidance (CAP1616).

[1] Report of the CAA's Post Implementation Review of the London Airspace Management Programme (LAMP) Phase 1A Module C Airspace Change Proposal – London City Network Changes, Civil Aviation Authority

2.3 Noise Control by Management

2.3.1 Movement Limits

The airport have strict limits on the number of flights it can operate. There is a limit of 111,000 total annual flights, as well as individual limits on the numbers of flights at weekends and on bank holidays. Compared to other UK airports LCY have relatively limited operating hours, with limits on the number of flights between 6:30 and 7:00 and between 22:00 and 22:30 and no flights between 22:30 and 6:30.

2.3.2 Noise Monitoring and Flight Track Keeping System

For many years the airport have operated a noise monitoring and flight track keeping system that records the levels of noise generated by departing and arriving aircraft as well as their departure and arrival tracks. This system is used to produce statistics on the way aircraft types and airlines are operating at LCY. This system was recently enhanced and now includes seven permanent noise monitors and two mobile noise monitors.

2.3.3 Incentives and Penalties Scheme

The airport have recently introduced the Incentives and Penalties Scheme. The scheme encourages airlines to operate aircraft more quietly, by awarding credits to aircraft that are operated quietly. The most improved airline each year co-partners with the airport delivering a Community Projects Fund. Under the penalties part of the scheme a fixed penalty for exceeding upper noise limits is charged at a rate of £600 per dB of exceedance. The money from any penalties accrued is added to the Community Projects Fund. The Community Projects Fund is used to deliver specific projects in the local community and is subject to an annual minimum of £75,000.

2.3.4 Aircraft Noise Categorisation Scheme

The airport operate an Aircraft Noise Categorisation Scheme (ANCS) which categorises each aircraft by its noise characteristics. Until recently, and for many years, this scheme has been based on a noise factored scheme. Under this, the airport operated within a ‘noise factored movement’ (NFM) limit of 120,000 movements each year. Following completion of a recent ANCS review, this has now been updated to ensure aircraft are categorised based on their noise certification which is a Government requirement. The ANCS now follows the principles of the Night Noise Quota Count System in place at the designated airports such as Heathrow, Gatwick and Stansted. A key difference however is that at LCY, the ANCS controls noise during the daytime rather than the night-time.

Under the new ANCS each aircraft type is assigned a separate quota count (QC) for arrivals and for departures, based on their certification noise levels.

Certification noise levels are measured in EPNdB and are assessed according to a standardised procedure set out by the International Civil Aviation Organisation (ICAO). The certification noise levels are measured at three points known as approach, sideline and flyover, which are shown in the figure below. As the certification noise levels are assessed with an approach angle of 3°, an adjustment is made to the arrival certification noise levels to allow for the 5.5° approach used at LCY.

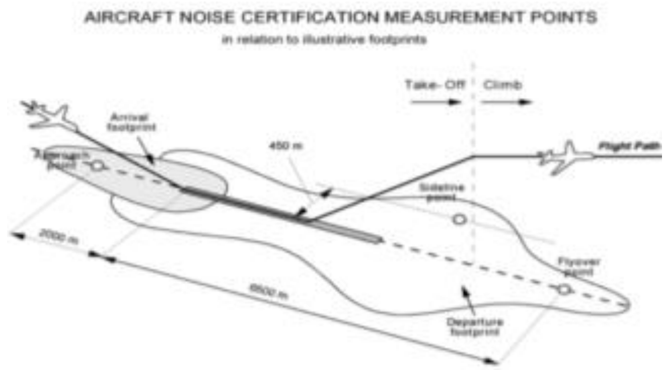

Figure 1: Noise Certification Points[2]

The ANCS QC system has an annual limit of 22,000 per calendar year, with a maximum of 742.5 in any single week. Under the ANCS all aircraft that operate at LCY must comply with the noise requirements of ICAO Chapter 4[3].

In addition the following noise level limits will be applied:

- Flyover: 88.0 EPNdB;
- Sideline: 93.5 EPNdB;
- Approach 98.0 EPNdB[4]

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[2] Reproduced from ERCD Report 0205 Quota Count Validation Study: Noise Measurements and Analysis, Civil Aviation Authority

[3] Chapter 4 of Annex 16 to the Convention on International Civil Aviation, Environmental Protection, Volume 1,

[4] This relates to the specific noise certification level on approach given in the aircraft's noise certificate (which relates to an approach at 3 degrees) rather than the Arrival Level used for determining QC scores as described above (which relates to an approach at 5.5 degrees.)

The sum of the certification noise levels at each of the three positions must also be less than 271 EPNdB.

2.3.5 Noise Contouring

London City Airport produce air noise contours on an annual basis, which are reported in the airport's Annual Performance Report. These contours are validated regularly by comparing the predicted levels with the noise levels measured at the airport's noise monitors to ensure that noise contours reflect the noise climate.

In addition to illustrating noise levels around the airport, these contours are used as the basis for determining eligibility for the sound insulation scheme, to assist in monitoring the change in the noise environment from year to year and to check compliance with the airport's 57 dB $L_{Aeq,16h}$ noise contour area limit of 9.1 km^2.

3.0 AIR NOISE

The term air noise refers to noise from aircraft that are airborne or on an airport runway during take-off or landing. The total air noise to which local communities are exposed over a given period depends on the noise emitted by individual aircraft and the total number of aircraft movements (arrivals and departures) in that period. An overall measure of air noise exposure can be depicted by noise contours.

The impact of air noise from aircraft operations is assessed in the UK in absolute terms against various criteria. This is in contrast to the assessment of some other sources of noise, such as industrial noise, where a comparison is made between the source noise level and the prevailing background noise in the vicinity. The impact of airborne aircraft noise is conventionally assessed in the UK using noise contours indicating the dB $L_{Aeq,T}$ values. The use of these values results from detailed work relating community annoyance to noise levels for aircraft noise. The $L_{Aeq,T}$ unit is also used for other types of environmental noise such as railway noise, road noise, construction noise and industrial noise.

The criteria used in the analysis takes into account the latest Government Guidance on what level of noise constitutes the onset of significant community annoyance for a population. Further information on this topic is given in Section 3.1 and 3.2.

3.1 UK Noise Policy

The current planning policy documents of relevance to London City Airport which contain advice relating to noise are set out below:

- Noise Policy Statement for England (NPSE) (2010)[5]
- National Planning Policy Framework (NPPF) (2019)[6]
- Aviation Policy Framework (2013)[7]
- National Planning Practice Guidance (NPPG) (2014)[8]

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[5] Noise Policy Statement for England https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf

[6] National Planning Policy Framework https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

[7] Aviation Policy Framework https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/153776/aviation-policy-framework.pdf

[8] National Planning Practice Guidance https://www.gov.uk/guidance/noise--2

Aviation policy in the UK is currently under review and new guidance has recently emerged through the publication of documents by the Government as part of a consultation process into changes to UK air space and proposals for an Aviation Strategy within the UK. Relevant documents include:

- Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace (2017)[9]
- Survey of Noise Attitudes 2014, CAP 1506 (2017)[10]
- Airspace Design Guidance (CAP 1616) (2017)[11]
- Air Navigation Guidance (2017)[12]
- Airports National Policy Statement (2018)[13]
- Aviation 2050 (2018)[14]

The key documents relevant to this assessment for LCY are discussed in Section 3.2 below and have been used to derive the air noise criteria used in this document.

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[9] Department for Transport: Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace: October 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/653801/consultation-response-on-uk-airspace-policy-web-version.pdf

[10] Civil Aviation Authority: Survey of noise attitudes 2014: Aircraft CAP 1506: February 2017 http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7744

[11] Airspace Design: Guidance on the regulatory process for changing airspace design including community engagement requirements https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8127

[12] Department for Transport: Air Navigation Guidance 2017: October 2017 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/653978/air-navigation-guidance-2017.pdf

[13] Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England, June 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714106/airports-nps-new-runway-capacity-and-infrastructure-at-airports-in-the-south-east-of-england-web-version.pdf

[14] Aviation 2050, The future of UK aviation. A consultation, December 2018 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/769696/aviation-2050-print.pdf

3.2 Air Noise Assessment Criteria

3.2.1 Absolute Criteria

The noise index commonly used to rate the acceptability of air noise in the UK is the $L_{Aeq,T}$ index. $L_{Aeq,T}$ is the equivalent continuous sound level. This is a notional steady sound level which would cause the same A-weighted sound energy to be received as that due to the actual and possibly fluctuating sound from 07:00 to 23:00 (day-time, 16h) and 23:00 to 07:00 (night time, 8h). At LCY due to the airport's operating hours, 16h daytime noise contours are produced covering 06:30-22:30.

In summary, this assessment rates daytime air noise on the following basis:

Noise Level, dB $L_{Aeq,16h}$	Significance
54	Onset of significant community annoyance
57	
60	
63	Moderate level of significant community annoyance
66	
69	High level of significant community annoyance

Table 1: Importance of absolute noise levels

This advice results from recent work undertaken for the Government to supplement the primary research that has underpinned aircraft noise assessment in the UK since 1982. This primary research was published in 1985 as the ANIS study which related community annoyance to aircraft noise levels. This work formed the basis of Government policy up until late 2017 at which time the Government published further advice and produced a number of reports for airspace consultation purposes.

The Social Noise Attitudes Survey 2014 (SoNA)[10] study compared reported mean annoyance scores against average summer-day noise exposure defined using $L_{Aeq,16h}$ and a variety of other noise indices, including L_{den}, N70 and N65. Mean annoyance scores correlated well with average summer day noise exposure, $L_{Aeq,16h}$. No evidence was found to suggest any of the other indicators correlated better with annoyance than $L_{Aeq,16h}$.

SoNA also found that for a given noise exposure (at levels below 63 dB) a higher proportion of respondents was found to be highly annoyed than compared with ANIS. The same percentage of respondents said by ANIS to be highly annoyed at 57 dB $L_{Aeq,16h}$ now occurs at 54 dB. In contrast, the evidence was that 63 dB and 69 dB $L_{Aeq,16h}$ still represent medium and high levels of annoyance as found in the ANIS study.

Government policy concerning sound insulation is currently that airports should offer protection to residential buildings, schools and hospitals exposed to air noise exposure levels of 63 dB $L_{Aeq,16h}$ and above. The Government is currently consulting[13] on whether to extend the noise insulation policy threshold to the 60 dB $L_{Aeq,16h}$ contour. In addition, the Government is consulting on a new minimum threshold of an increase of 3 dB L_{Aeq}, which leaves a household in the 54 dB $L_{Aeq,16h}$ contour or above as a new eligibility criterion for assistance with noise insulation for airspace changes which lead to significantly increased overflight.

3.2.2 Relative Criteria

The magnitude of a change in a noise level is relevant to the impacts likely to be experienced. The guidance used in this report relates to that adopted at various public inquiries including CADP and is also broadly in line with the IEMA Environmental Assessment Guidelines. Table 2 below sets out the subjective importance of a change in noise level.

While a significance rating is given in Table 2 below, the absolute significance of a change will also depend on the absolute level associated with it and the noise conditions prior to the change.

Change in Level (dB)	Subjective Impression	Impact	Significance
≤ 2	Imperceptible change	Negligible	None
2 to 3	Barely perceptible change	Minor	Minor
3 to 6	Perceptible change	Moderate	Significant – Moderate
6 to 9	Up to a halving or a doubling of loudness	Substantial	Significant – Substantial
> 9	Equal to or more than a halving or doubling of loudness	Very Substantial	Significant – Very Substantial

Table 2: Subjective importance of changes in noise level

3.3 Air Noise Contours

Daytime $L_{Aeq,16h}$ (06:30-22:30) noise contours have been prepared for 2017, 2020, 2025, 2030 and 2035. The contours have been produced using the FAA's Integrated Noise Model (INM) version 7.0d, which has been used to produce air noise contours at the airport for many years. The model is regularly validated using measured noise data from the airport's noise monitoring terminals. Estimates of the number of dwellings and people within the noise contours have also been produced, based on 2018 postcode level data provided by CACI Ltd.

3.3.1 New Generation Aircraft

A new generation of passenger turbofan aircraft are being introduced. They are significantly quieter than the current generation aircraft they replace, particularly on departure. The Airbus A220-100 already operates at the airport and operations by it are forecast to increase in the future. This is forecast to be joined by further new generation aircraft types in the future, such as the Embraer E190-E2. Allowances have been made in the production of the noise contours for the expected lower noise levels of these aircraft types.

3.3.2 Current Conditions (2017)

Table 3 below summarises the number of aircraft movements that occurred in 2017. Figure 01 shows the summer daytime noise contours for 2017 and Table 4 presents the contour areas and dwelling and population counts. Dwelling counts are rounded to the nearest 50 and population counts are rounded to the nearest 100. 2017 has been used to represent the current conditions as at the time of the assessment 2018 data was not available. There were 80,668 total movements in 2018 which is similar to 2017.

Aircraft Category	2017
Passenger Turboprop	19,910
Current Generation Passenger Turbofan	55,583
New Generation Passenger Turbofan	456
Corporate	4,350
Total	**80,299**

Table 3: 2017 annual aircraft movements

Noise Contour, dB $L_{Aeq,16h}$	Contour Area, km^2	Dwellings	Population
54	13.0	34,550	82,400
57	7.3	14,600	33,000
60	3.7	5,850	12,800
63	1.9	1,050	2,900
66	1.0	200	700
69	0.6	0	0

Table 4: 2017 contour areas and dwelling and population counts

Last year the airport received just 5 noise complaints per 1,000 aircraft movements. Table 5 below compares the 2018 complaints with those at the other major London airports for 2017[15], and shows LCY received significantly fewer complaints per 1,000 flights. For the other airports, aircraft movement data has been obtained from the CAA and complaint statistics from noise action plans and other airport reports.

Airport	Annual Aircraft Movements	Number of Complaints	Complaints per 1,000 Aircraft Movements
Gatwick (2017)	285,912	24,672	86.3
Heathrow (2017)	475,783	78,794	165.6
Luton (2017)	133,743	15,384	115.0
Stansted (2017)	189,919	8,395	44.2
London City Airport (2018)	80,299	405	5.0

Table 5: Comparison of annual noise complaints received by major London airports

[15] Data for 2018 not available for all airports at time of publication therefore fullest dataset (2017) used

3.3.3 Future Noise Contours

Table 6 summarises the number of aircraft movements forecast to occur in the future.

Aircraft Category	Forecast Annual Aircraft Movements				
	2020	2025	2030	2035 forecast 75% refleeting	2035 potential increased refleeting (up to 80%)
Passenger Turboprop	16,700	22,100	15,000	15,000	15,000
Current Generation Passenger Turbofan	68,000	49,900	40,500	32,000	26,200
New generation Passenger Turbofan	6,200	47,500	76,500	99,000	104,800
Corporate	5,000	5,000	5,000	5,000	5,000
Total	**95,900**	**124,500**	**137,000**	**151,000**	**151,000**

Table 6: Summary of forecast annual aircraft movements

Movements by the quieter new generation passenger turbofan aircraft are forecast to increase significantly up to 2035. These aircraft will gradually replace movements by the current generation passenger turbofan aircraft such as the Embraer E190, which are the loudest aircraft that currently or are planned to operate at the airport. Movements by corporate aircraft are forecast to remain broadly constant between 2020 and 2035. By 2035 around 75% of all movements by passenger jet aircraft are forecast to be by the quieter new generation aircraft types. LCY will work with the airlines to potentially achieve 80% new generation aircraft types. Contours have therefore been prepared based on 2035 with an increased proportion of new generation passenger aircraft to demonstrate the effect if they are able to achieve this. The proportion of new generation aircraft is expected to continue to increase beyond 2035.

Compared to the 2006 master plan, which forecast 171,000 movements by 2030 to accommodate 8 million passengers per annum (mppa), the forecast to 2035 is 151,000 movements to accommodate 11mppa. This reduction in forecast flights with more passengers is due to some of the new generation aircraft having additional seats and the reduced proportion of small turboprop and corporate aircraft operating at the airport.

The forecast summer daytime noise contours are shown in Figures 02-06 for 2020, 2025, 2030, 2035 and 2035 with increased refleeting respectively. Figure 07 presents a comparison of the 57 dB noise contours for each of these scenarios. Table 7 presents the corresponding contour areas.

Noise Contour, dB $L_{Aeq,16h}$	**Contour Area, km²**				
	2020	**2025**	**2030**	**2035 forecast 75% increase**	**2035 potential increased refleeting (up to 80%)**
54	16.0	16.1	15.8	15.8	15.0
57	9.0	9.1	9.1	9.1	8.7
60	4.8	4.9	4.9	5.0	4.7
63	2.4	2.5	2.5	2.5	2.4
66	1.3	1.3	1.3	1.4	1.3
69	0.7	0.7	0.8	0.8	0.8

Table 7: 2020, 2025, 2030 and 2035 summer daytime noise contour areas

The airport are forecast to remain within their 57 dB $L_{Aeq,16h}$ noise contour area limit of 9.1 km² for each year assessed. The area of the 54 dB noise contours reduce slightly from 2020 to 2035. The areas of the 60 dB and higher noise level contours increase slightly. Achieving 80% refleeting by 2035 will reduce the area of the 57 dB $L_{Aeq,16h}$ noise contour. Beyond 2035 the proportion of new generation aircraft is expected to further increase, which would result in additional consequential decreases in the area of the noise contours.

Estimates of the number of dwellings and people[16] within the noise contours are presented in Table 8 and Table 9 respectively. Dwelling counts are rounded to the nearest 50 and population counts are rounded to the nearest 100.

[16] The populations have been determined estimates using data supplied by CACI Ltd. are based on a 2018 postcode level database and do not include allowances for future population growth. This data is based on census information factored up to 2018 and consists of population by postcode.

Noise Contour, dB $L_{Aeq,16h}$	Dwellings				
	2020	2025	2030	2035 forecast 75% refleeting	2035 potential increased refleeting (up to 80%)
54	43,750	42,800	42,100	41,600	39,200
57	20,050	20,150	19,950	20,150	18,750
60	7,500	8,050	8,200	8,450	8,050
63	1,800	1,850	1,900	1,750	1,550
66	350	400	400	500	450
69[17]	0	0	0	0	0

Table 8: Estimate of dwellings exposed to noise in 2020, 2025, 2030 and 2035

Noise Contour, dB $L_{Aeq,16h}$	Population				
	2020	2025	2030	2035 forecast 75% refleeting	2035 potential increased refleeting (up to 80%)
54	107,100	104,600	102,400	101,000	94,400
57	45,700	45,900	45,400	45,900	42,700
60	16,500	18,100	18,600	19,100	18,000
63	4,500	4,700	4,900	4,700	4,200
66	1,200	1,300	1,300	1,600	1,400
69[17]	0	0	0	0	0

Table 9: Estimate of population exposed to noise in 2020, 2025, 2030 and 2035

[17] A detailed modelling exercise has been undertaken allowing for local screening from the airport's noise barriers and terminal buildings. The resulting predicted levels were confirmed using measured noise levels from aircraft noise surveys. With local screening taken into account no dwellings or population are forecast to be exposed to a noise level of 69 dB $L_{Aeq,16h}$ or greater.

The number of dwellings and people within the contours (those exposed to 54 dB and above) is forecast to reduce from 2020 to 2035. While the number of people exposed to 57 dB and above are forecast to increase slightly over time, any increase in noise will generally be of a small magnitude, as shown in Table 10. Achieving 80% refleeting by 2035 reduces the number of people within the 57 dB $L_{Aeq,16h}$ noise contours.

Table 10 shows the changes in noise level from 2020 to 2035 for those people within the 54 dB and above 2035 75% refleeting contours.

Change in noise level 2020 to 2035, dB $L_{Aeq,16h}$	Population
> 3 dB decrease	0
2 – 3 dB decrease	0
0 – 2 dB decrease	65,800
0 – 2 dB increase	33,400
2 – 3 dB increase	1,800
> 3 dB increase	0

Table 10: Change in noise level 2020 to 2035

Table 10 shows that between 2020 and 2035 most people within the noise contours will experience a negligible change in aircraft noise and more people will experience a decrease in aircraft noise than an increase. A small number of people located to the north and south of the airport are forecast to experience a minor increase in noise of less than 3 dB. Achieving 80% refleeting would result in more people experiencing a decrease in noise.

3.4 Operating Hours

The airport are committed to maintaining the 8 hour night time closure 7 days per week. It is recognised that any potential changes to the airport's existing operational hours or aircraft movement restrictions would change how local residents experience noise. Should any changes be proposed to the existing operations, these would be fully assessed and appropriate mitigation provided. This could include further enhancements to the Sound Insulation Scheme, which already has the current joint lowest daytime threshold in the UK at 57 dB.

4.0 GROUND NOISE

Aircraft related noise generated other than by aircraft in flight or taking off or landing is termed ground noise. The main sources of aircraft related ground noise are:

- Taxiing and manoeuvring aircraft
- Aircraft Auxiliary Power Units (APUs)
- Testing (ground running) of aircraft engines
- Mobile ground equipment such as Ground Power Units (GPUs)

Aircraft related ground noise is heard in the context of off-airport noise sources, often termed background noise. The most dominant contributor to the noise climate in the residential areas surrounding London City Airport is road traffic and, to a lesser extent industrial activity and along the southern perimeter of the airport the Docklands Light Railway will also contribute to the ambient noise environment. Ground noise will be audible for some locations close to the airport boundary although many properties to the south of the airport are currently well shielded by the barrier formed by the airport terminal and pier structure. The closest properties have also been treated/offered to be treated with enhanced sound insulation under the airport's air noise SIS and/or CADP CSIS.

The use of APU's and aircraft taxiing produce the most significant airport ground noise source, although the rare occurrence of engine testing at high power settings after an aircraft has had significant maintenance can generate higher noise levels than taxiing, but it is of comparatively limited duration.

The airport have developed and implemented measures to ensure that ground operations are carried out as quietly as practicable to minimise impact and these include:

- Encouraging the minimum use of reverse thrust on landing consistent with safety constraints.
- Except in emergencies engine testing shall be restricted to areas designated for that purpose.
- Limiting engine test and maintenance activities to those associated with engine rectification, rather than routine testing.
- Limiting the use of APU's to no more than 10 minutes prior to departure from the stand and 10 minutes after arrival, except under exceptional circumstances.

Only 3 complaints related to ground noise were received in 2018. This demonstrates the effectiveness of the airport's controls in mitigating the impact of current ground noise on the local community.

The growth of activity at the airport is expected to slightly increase ground noise. The degree of increase will be a function of the future aircraft mix and numbers of future aircraft and the degree to which buildings and barriers situated between the apron/taxiways/runway and local housing provide noise shielding. Any future proposals will be subject to a detailed noise assessment to ensure that satisfactory mitigation is in place prior to them coming into operation.

4.1 Ground Noise Assessment Criteria

There is no definitive agreement on the method of assessment of aircraft ground noise. Various methods have been adopted in the past, and these have led to the assessment of ground noise in terms of the equivalent continuous sound level, $L_{Aeq,T}$. Various time periods have been used, and in this report consideration has been given to the $L_{Aeq,16h}$ metric for the period 06:30-22:30.

The ground noise level assessed at various receptors can be compared to the existing ambient environmental noise which has been shown in recent ground noise studies at the airport[18] to lie in the range 50 to 55 dB L_{Aeq} during the daytime in locations to the south of the airport where aircraft ground noise does not dominate the noise environment.

To put this into context, over half of the UK population is exposed to levels which exceed 55 dB $L_{Aeq.}$ This was confirmed by the results of the DEFRA funded 2000/2001 National Noise Incidence Study[19], as shown in Table 11.

[18] London City Airport Ground Noise Study 2016, Bickerdike Allen Partners, August 2016

[19] The National Noise Incidence Study 2000/2001 (United Kingdom): Volume 1 –Noise Levels, BRE, Feb 2002.

Daytime Environmental Noise Levels in UK, dB $L_{Aeq,16h}$	Population of UK so Exposed (%)
40	99.9
50	89.3
55	56.0
60	26.0
70	1.8

Table 11: Results of National Noise Survey - daytime

Based on the above, the following guidelines in Table 12 have been used to classify the impact of absolute ground noise levels at representative residential receptors in the surrounding communities.

Absolute Ground Noise Criteria, dB $L_{Aeq,16h}$	Impact classification
<50	Negligible
50 – 55	Minor
55 – 60	Significant - Moderate
60 – 65	Significant - Substantial
>65	Significant - Severe

Table 12: Ground noise impact classification – absolute criteria

The subjective importance of changes in noise level on people relates to the magnitude of the change. An indication of the importance is given in Table 13. This semantic scale used to assess changes in ground noise is based on the guidance available for airborne aircraft noise.

Change in Level, dB $L_{Aeq,16h}$	Subjective Impression	Impact
≤ 2	Imperceptible change	Negligible
2 to 3	Barely perceptible change	Minor
3 to 6	Perceptible change	Significant – Moderate
6 to 9	Up to a halving or a doubling of loudness	Significant – Substantial
> 9	Equal to or more than a halving or doubling of loudness	Significant – Very Substantial

Table 13: Subjective importance of changes in noise level

The impact will depend on a number of variables, including the level of ambient noise from other sources (road traffic/airborne aircraft/DLR/industry). There will also be a variation in individual response to ground noise.

4.2 Ground Noise Predictions

Current (2017) and expected future ground noise levels around the airport have been predicted. Consideration has been given to noise expected from each segment of the aircraft taxi-route, taking account of the changes in aircraft mix and number expected in the future.

In the event of any new stands being built in the future appropriate noise barriers will be constructed to ensure that satisfactory mitigation is in place prior to them becoming operational. This commitment by the airport has been taken into account in this assessment.

2017 has been used to represent the current conditions as at the time of the assessment 2018 data was not available. In 2018 the total number of movements was similar to 2017. As for the air noise assessment, 2020 is used as a baseline as it complies with what the airport are currently permitted to do and is compared with the 2025, 2030 and 2035 proposals.

Table 14 and Table 15 show the current and future predicted ground noise levels respectively. The noise levels are presented for twelve representative positions around the airport and are rounded to 1 dB. The locations of the receiver positions are shown in Figure 08.

Receiver Position	Location relative to airport terminal	2017 Ground Noise Level, dB $L_{Aeq,16h}$
A – Drew Road	South	52
B – North Side of Royal Albert Dock	North	60
C – Camel Road Flats	South	52
D – Parker Street	South	51
E – Newland Street	South east	54
F – Storey Road School	South east	49
G – Norton Pharmaceutical	East	53
H – University of East London	North east	57
I – Royal Docks Business Park	North east	60
J – Brixham Street	South east	48
K – No 2 Camel Road	South	55
L – 10 Camel Road	South	55

Table 14: Current ground noise levels at receiver positions around LCY, dB $L_{Aeq,16h}$

Receiver Position	Location relative to airport terminal	Ground Noise Level, dB $L_{Aeq,16h}$				Change in Noise Level 2020 – 2035, dB $L_{Aeq,16h}$
		2020	2025	2030	2035	
A – Drew Road	South	52	52	52	53	+1
B – North Side of Royal Albert Dock	North	60	61	61	62	+2
C – Camel Road Flats	South	53	52	53	53	0
D – Parker Street	South	52	52	52	53	+1
E – Newland Street	South east	48	49	49	50	+2
F – Storey Road School	South east	52	51	51	52	0
G – Norton Pharmaceutical	East	55	54	55	56	+1
H – University of East London	North east	59	59	59	60	+1
I – Royal Docks Business Park	North east	62	61	61	62	+1
J – Brixham Street	South east	52	52	53	53	+2
K – No 2 Camel Road	South	55	52	52	53	-3
L – 10 Camel Road	South	56	51	52	52	-3

Table 15: Future ground noise levels at receiver positions around LCY, dB $L_{Aeq,16h}$

The above ground noise levels are generally low in absolute terms. In 2035 eight of the twelve positions will be exposed to noise levels of 50-55 dB, which is considered a minor impact. There are no residential dwellings near to the North Side of Royal Albert Dock nor the Royal Docks business park, the nearest dwellings to these locations are significantly further from the airport and therefore will receive much lower noise levels. The Great Eastern Quays housing development and the University of East London student accommodation blocks, near positions G and H respectively, have been specifically designed to protect the occupants from noise from the airport.

The ground noise levels at most positions will increase by less than 2 dB between 2020 and 2035, representing a negligible impact. Two positions in the Camel Road area will experience a minor to moderate decrease in noise. Overall the proposed changes are forecast to result in a negligible impact on the local community compared to 2020.

5.0 SUMMARY

The airport are updating their master plan, setting out a plan for the longer-term development at the airport up to 2035. The airport are considering the infrastructure and operational requirements that would facilitate an increase in aircraft movements up to around 150,000 per year by 2035. The expected air and ground noise impacts resulting from changes in the number and mix of aircraft movements per year has been considered.

Overall the increase in the number of movements up to 2035 will not have a significant impact on the local community due to the increase in the proportion of movements by quieter new generation aircraft.

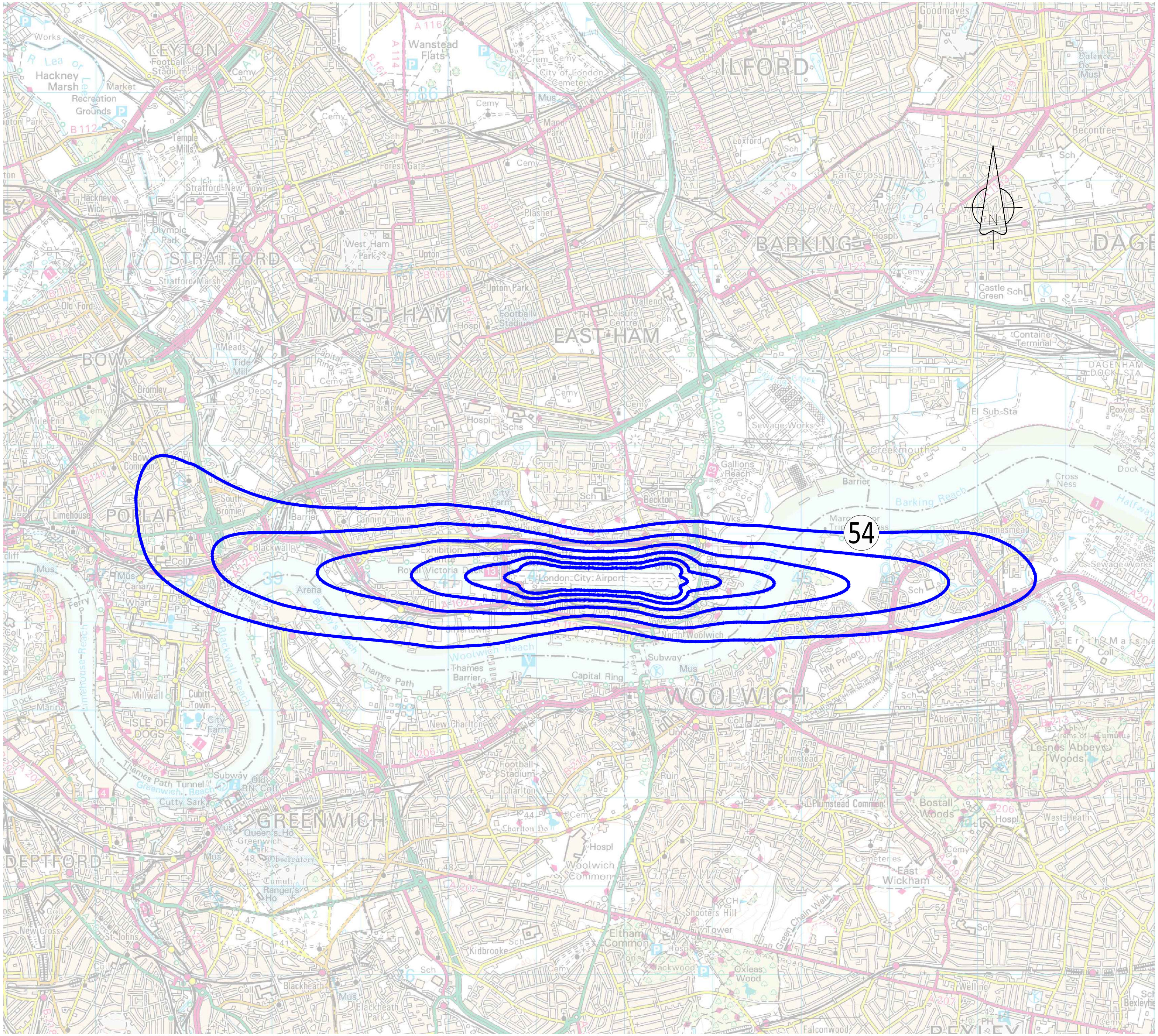
The 57 dB $L_{Aeq,16h}$ daytime air noise contour area will remain within the current limit of 9.1 km^2. The number of people within the 54 dB noise contour is forecast to reduce from 2020 to 2035. While the number of those people within the 57 dB and above noise contours are forecast to increase slightly over time, any increase in noise will generally be of a small magnitude. Most of the people within the airport's air noise contours will experience a slight decrease in average daytime noise levels from 2020 to 2035 and no one will experience a significant increase in noise.

Achieving 80% refleeting by 2035 would reduce the area of the 57 dB noise contour below the current permitted limit of 9.1 km^2 and the number of people who would otherwise fall within it. The proportion of new generation aircraft is expected to continue to increase beyond 2035, which would result in further reductions in the areas of the noise contours.

The airport are also considering adjustments to the hours they operate, to allow more flexibility on the number of flights during the first half hour of the operational day and during the last half hour of permitted operations. Changes to their operational hours at the weekend are also being considered. Any changes to weekend operating hours would result in a loss of respite for the local community, however the 8 hour night time closure period, 7 days per week, will be maintained. Should any changes be proposed they would be fully assessed and appropriate mitigation provided.

Ground noise levels at most positions around the airport are currently relatively low, representing a minor impact, and are forecast to remain so in the future. The proposed changes will result in a negligible increase in noise in most areas compared to 2020. Overall the proposed changes are forecast to result in a negligible impact on the local community compared to 2020.

Duncan Rogers	**Peter Henson**	**David Charles**
for Bickerdike Allen Partners LLP	**Practice Consultant**	**Partner**



LEGEND:

Noise Contours,
54 to 69 dB $L_{Aeq,16h}$ in 3 dB steps

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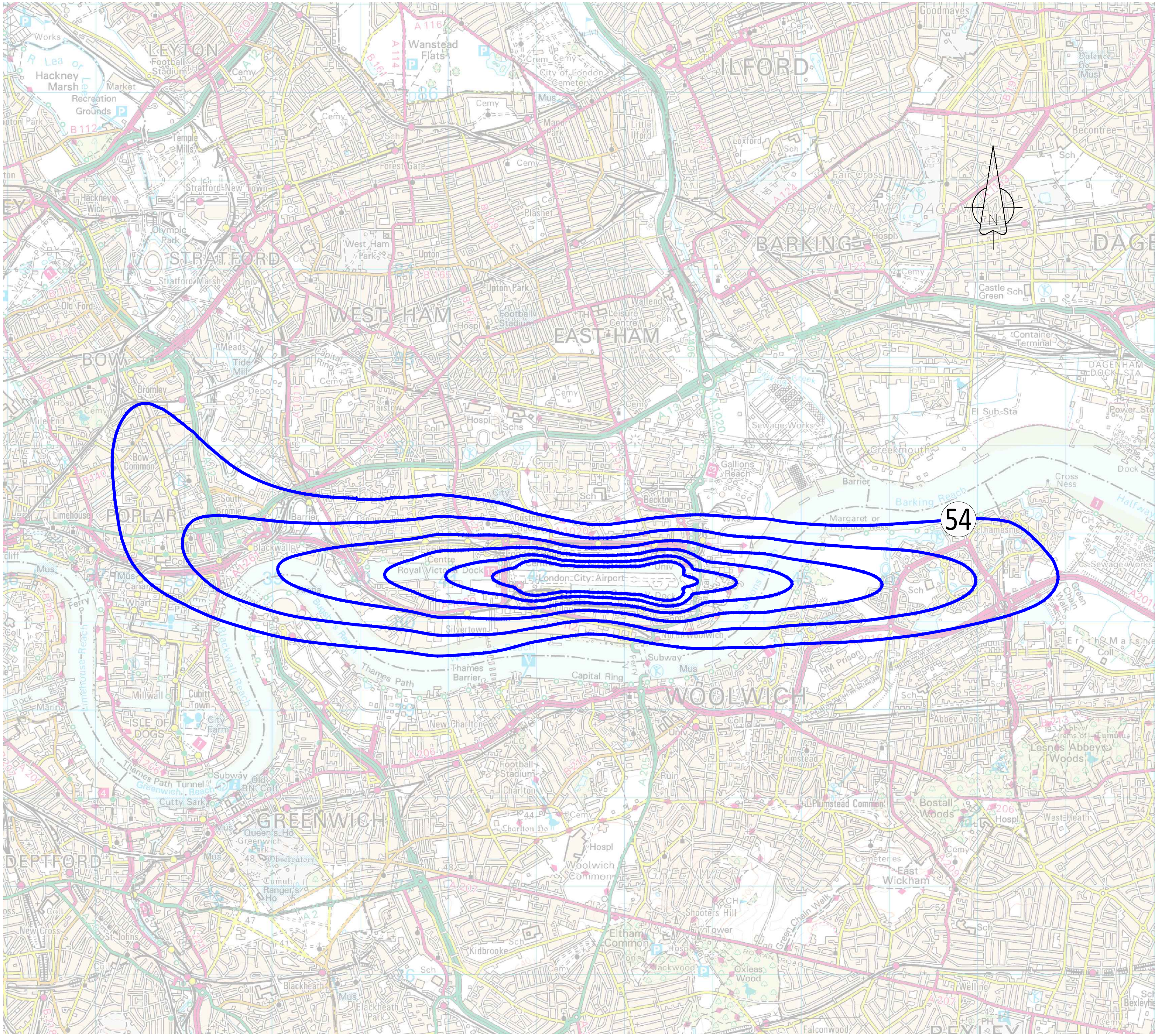
Figure 01
Summer Daytime Noise Contours
2017

DRAWN: DCH CHECKED: DR

DATE: April 2019 SCALE: 1:60000@A4

FIGURE No:

A11205-01-FG013-2.0



LEGEND:

Noise Contours,
54 to 69 dB $L_{Aeq,16h}$ in 3 dB steps

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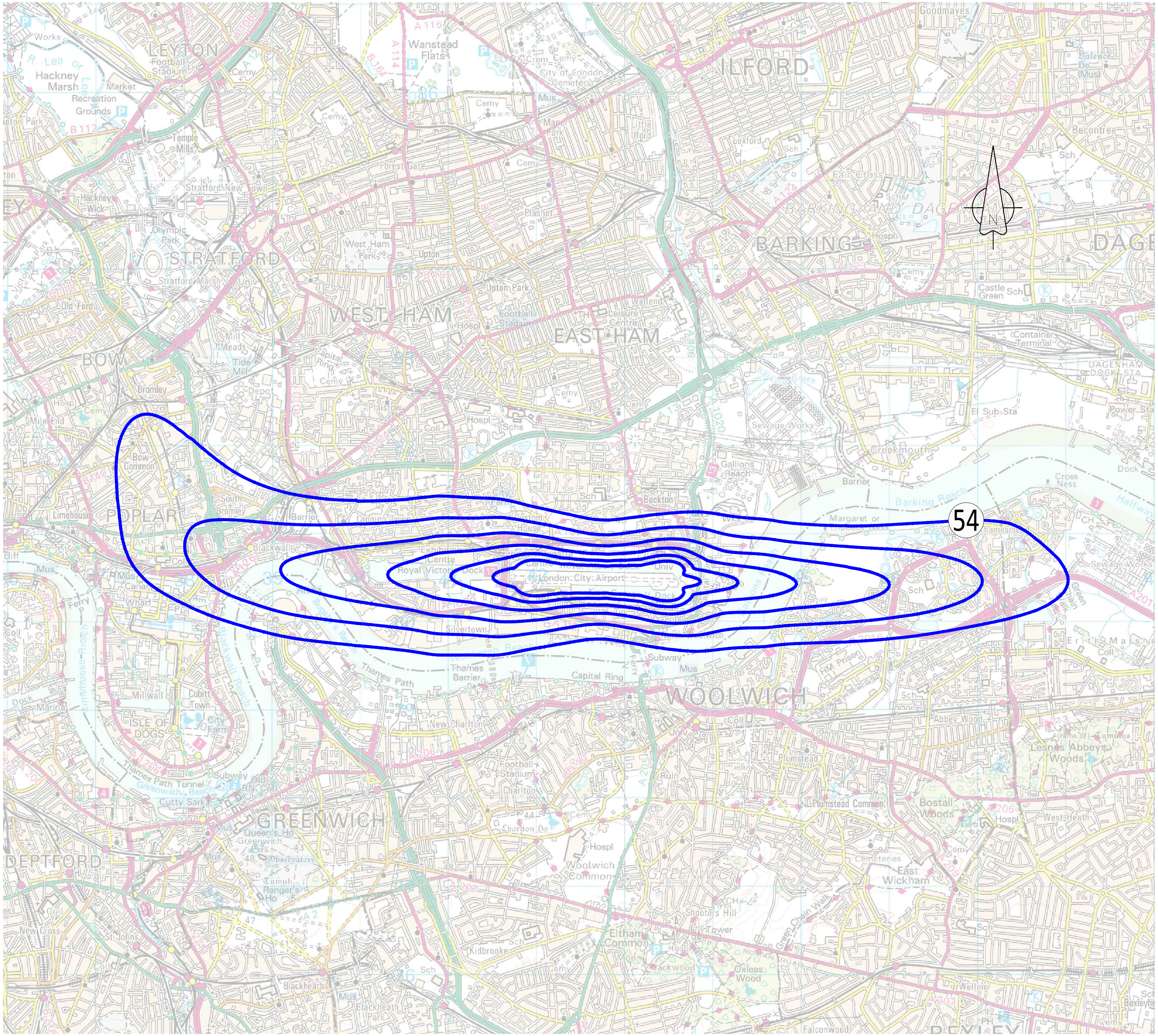
Figure 02
Summer Daytime Noise Contours
2020

DRAWN: DCH
CHECKED: DR

DATE: April 2019
SCALE: 1:60000@A4

FIGURE No:

A11205-01-FG014-1.0



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LEGEND:

Noise Contours,
54 to 69 dB $L_{Aeq,16h}$ in 3 dB steps

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Figure 03
Summer Daytime Noise Contours
2025

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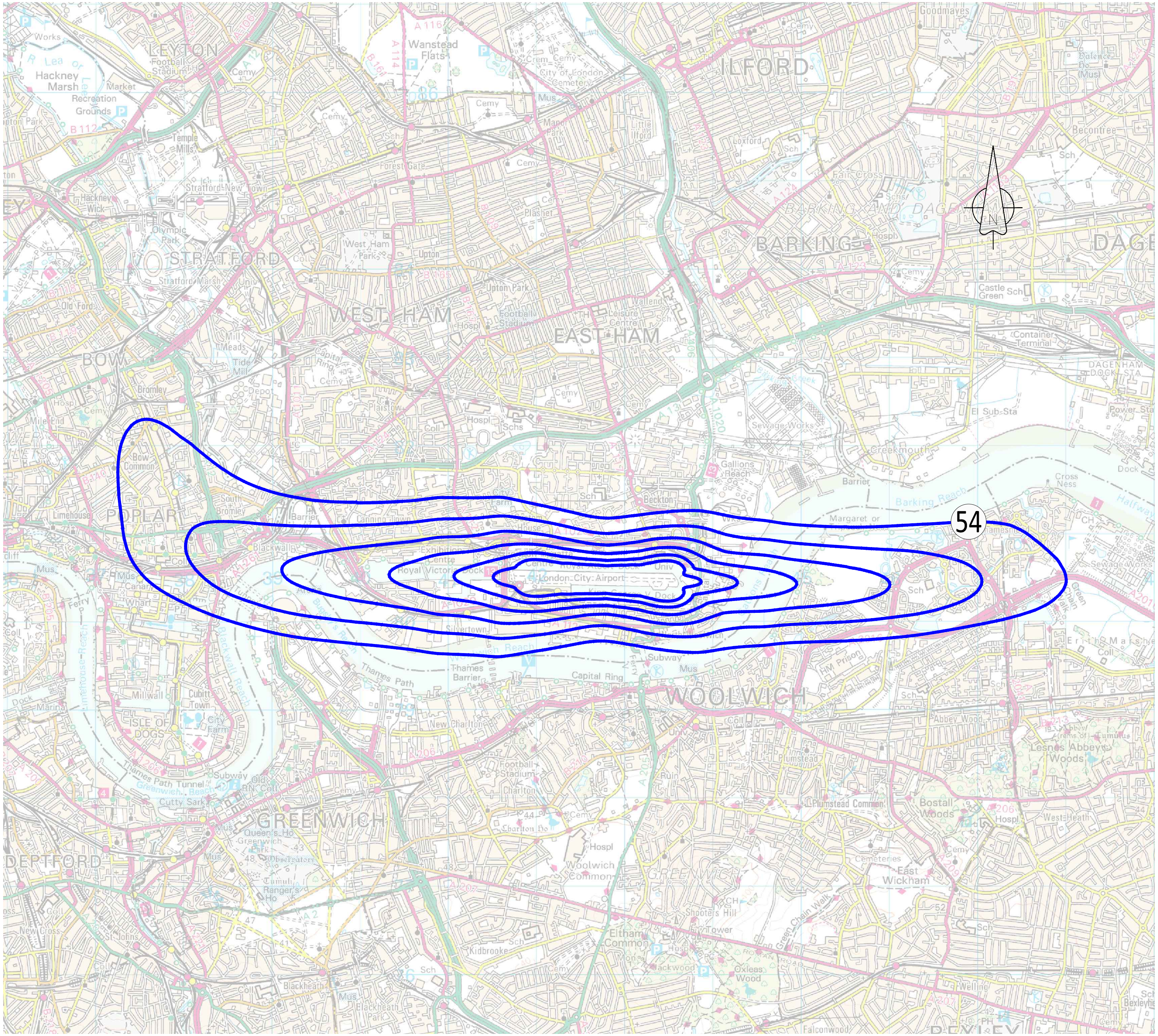
DATE: April 2019 SCALE: 1:60000@A4

FIGURE No:

A11205-01-FG015-1.0



LEGEND:

Noise Contours,
54 to 69 dB $L_{Aeq,16h}$ in 3 dB steps

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Figure 04
Summer Daytime Noise Contours
2030

DRAWN: DCH

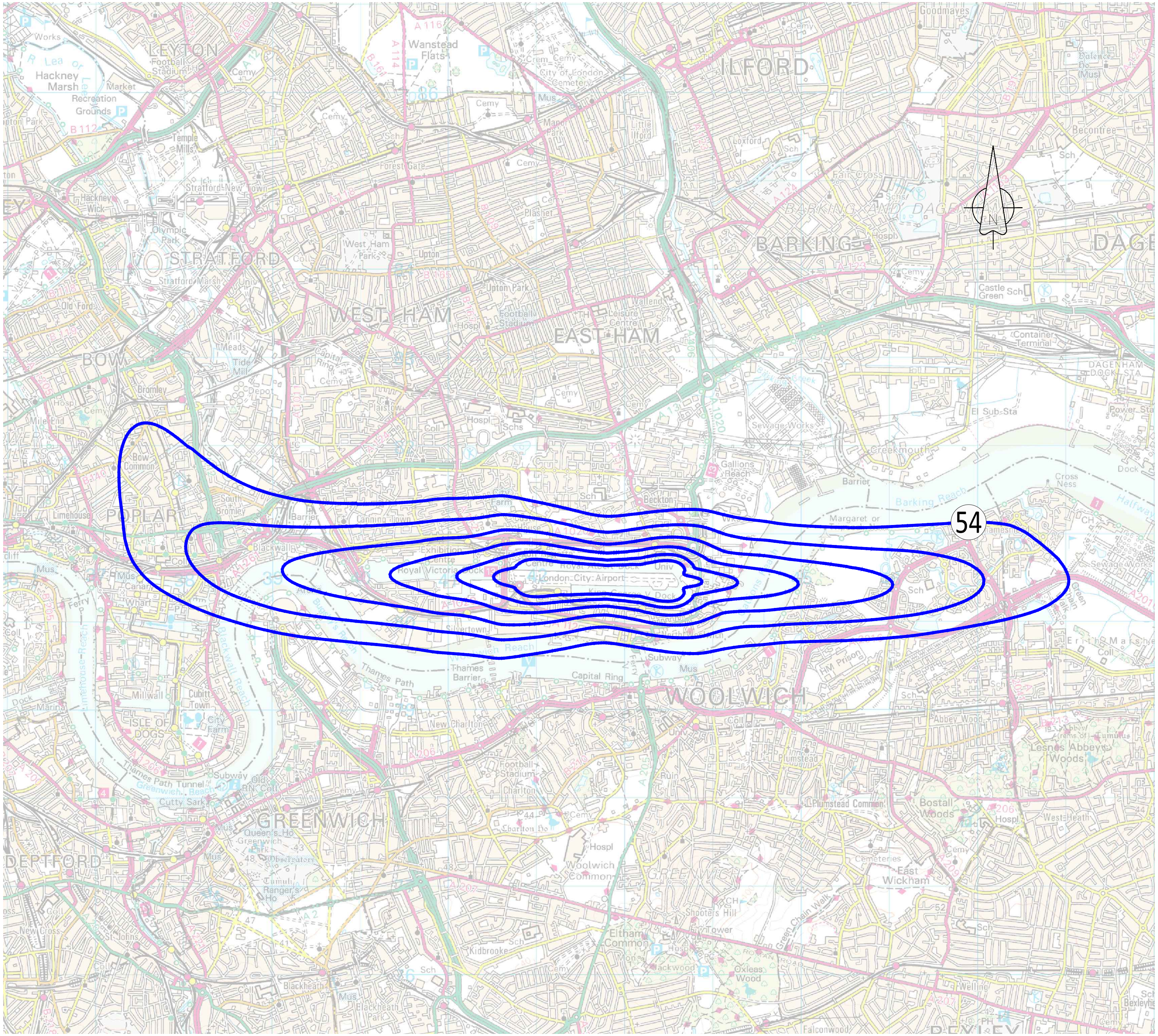
CHECKED: DR

DATE: April 2019

SCALE: 1:60000@A4

FIGURE No:

A11205-01-FG016-1.0



LEGEND:

Noise Contours,
54 to 69 dB $L_{Aeq,16h}$ in 3 dB steps

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Figure 05
Summer Daytime Noise Contours
2035 - Forecast 75% Refleeting

DRAWN: DCH

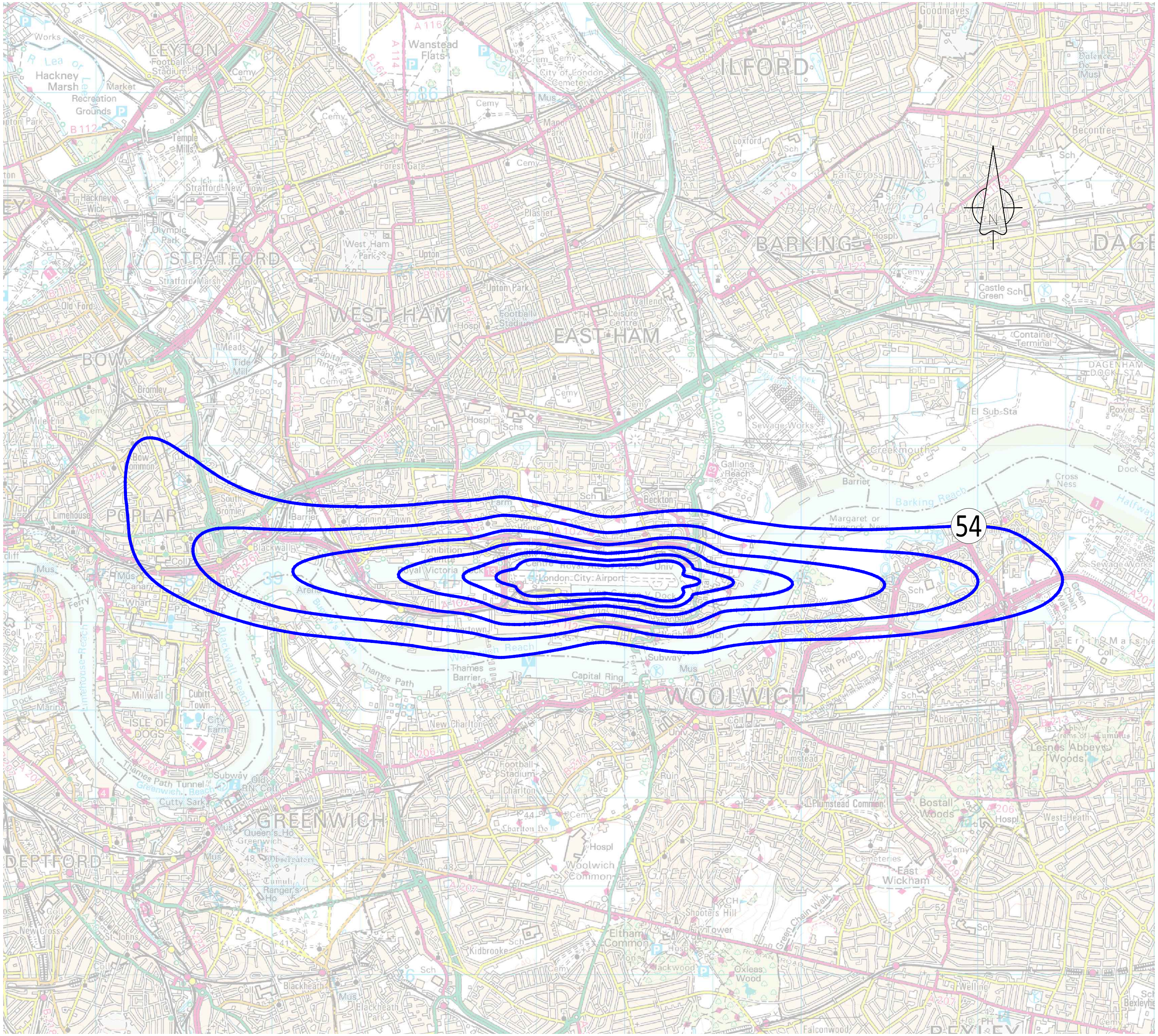
CHECKED: DR

DATE: April 2019

SCALE: 1:60000@A4

FIGURE No:

A11205-01-FG017-1.0



LEGEND:

Noise Contours,
54 to 69 dB $L_{Aeq,16h}$ in 3 dB steps

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Figure 06
Summer Daytime Noise Contours
2035 - Potential Increased Refleeting (80%)

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CHECKED: DR

DATE: April 2019
SCALE: 1:60000@A4

FIGURE No:
A11205-01-FG018-1.0

LEGEND:

- 2020
- 2025
- 2030
- 2035 - Forecast 75% Refleeting
- 2035 - Potential Increased Refleeting (80%)

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Figure 07
Comparison of 57 dB $L_{Aeq,16h}$ Noise Contours 2020 - 2035

DRAWN: DCH

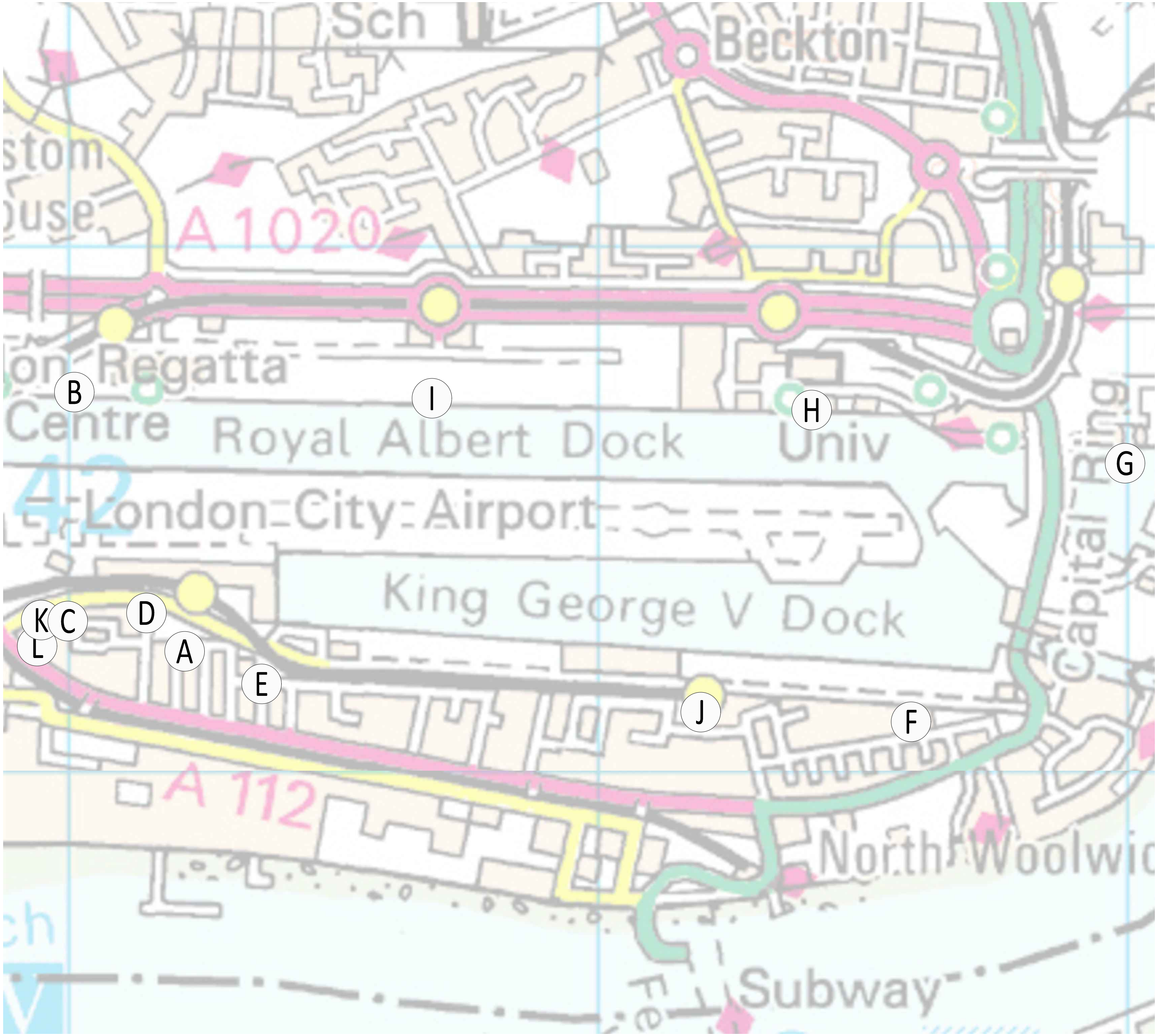
CHECKED: DR

DATE: April 2019

SCALE: 1:50000@A4

FIGURE No:

A11205-01-FG019-1.0



LEGEND:

(X) Assessment Location

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Figure 08
Ground Noise Assessment Locations

DRAWN: DCH	CHECKED: DR
DATE: April 2019	SCALE: 1:10000@A4

FIGURE No:

A11205-01-FG020-1.0

APPENDIX 1

GLOSSARY OF ACOUSTIC AND AVIATION TERMINOLOGY

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10^{-5} Pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

Statistical Term	Description
$L_{Aeq, T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level (LAeq, T). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.