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UPDATED AIR QUALITY RE-ANALYSIS

IMPACT OF NEW COPERT EMISSION FACTORS AND ASSOCIATED NEW POLLUTION CLIMATE MAPPING SENSITIVITY TESTING

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WSP | PARSONS BRINCKERHOFF

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Department for Transport

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1.1 BACKGROUND

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- Gatwick Second Runway (2R),
- Heathrow Northwest Runway (NWR), and
- Heathrow Extended Northern Runway (ENR).

1.1.2 The Sustainability Appraisal included a detailed assessment of the impacts of the options on air quality.

1.1.3 Under the EU Ambient Air Quality Directive, the UK Government has a legal obligation to achieve air quality limit values. A key aspect of the AC's air quality assessment was consideration of the likely impact of the options on the UK's compliance with the limit values.

1.1.4 In April 2015, the Supreme Court ruled that the UK Government should develop a new Air Quality Plan to meet limit values for nitrogen dioxide. At the time of the ruling, the plans in place indicated that some areas of the UK would not achieve compliance with limit values until 2030. The AC's assessment was based on these original plans.

1.1.5 The Government published its Plan (the 2015 Plan) and supporting technical evidence in December 2015. The evidence base included revised compliance projections using the Pollution Climate Mapping (PCM) model showing all areas of the UK meeting the limit values by 2025.

1.1.6 Subsequent to the publication of the 2015 Plan, WSP | Parsons Brinckerhoff was commissioned to undertake a re-analysis of the AC's air quality modelling to consider the impact of the 2015 Plan on EU limit value compliance with increased airport capacity. This study is a follow-up to the WSP | Parsons Brinckerhoff re-analysis of the AC's air quality modelling, which was published in October 2016 (the WSP | Parsons Brinckerhoff 2016 Re-analysis study), and should be read in conjunction with it.

1.1.7 Since the completion of the WSP | Parsons Brinckerhoff 2016 Re-analysis study in June 2016, the vehicle emissions factors (COPERT) on which the 2015 Plan and associated PCM modelling were based were updated in September 2016, with the updated factors being higher than the previous version. In November the High Court ordered the Government to produce a modified Air Quality Plan and to publish the final, modified Plan by 31 July 2017.

1.1.8 The Government has begun work on the modified plan, which is being overseen by the Inter Ministerial Group on Clean Growth. In accordance with the timetable set by the High Court, the Government will bring forward a revised package of measures likely to achieve compliance in the shortest possible time, having modelled the updated vehicle emissions factors. Proposals will be published for consultation by 24 April 2017. The 2015 Plan will remain in force until a modified plan is adopted.

1.1.9 This study considers the impact of the 2016 update to the COPERT emission factors on EU limit value compliance with increased airport capacity. The updated COPERT emission factors have been incorporated into sensitivity testing undertaken by Defra using a streamlined version of the

PCM model (SL-PCM). The basic methodology employed for this study is the same as that used in the previous Re-analysis study (WSP | Parsons Brinckerhoff 2016 Re-analysis study).

1.2 SUMMARY OF UPDATED RE-ANALYSIS

1.2.1 The outcome of the re-analysis of the impact of increased airport capacity on limit value compliance is summarised in Table 1-1. The table takes into account the 2016 update to COPERT emission factors.

1.2.2 In this study, the core scenario considers the addition of the impact of increased airport capacity to SL-PCM projections modelled using updated COPERT emission factors and taking into account the Government's 2015 Plan measures.

Table 1-1 Summary of conclusions on impact of increased airport capacity on limit value compliance

Option	Conclusion with 2016 update to COPERT factors	Commentary on Conclusions
Gatwick Second Runway	The option is ***unlikely*** to impact on compliance with limit values	The conclusion has *low vulnerability* to uncertainties, since only in the most pessimistic emissions scenario does the option risk triggering non-compliance within the South East Zone and the estimated airport impact is likely to be conservative. The risks can be mitigated by the implementation of an air quality management strategy for the airport, focussing on both air and landside sources.
Heathrow Northwest Runway	In 2030, the option ***does not impact*** on compliance with limit values in the core assessment scenario. There is, however, ***a risk that the option will delay compliance*** with limit values. In 2030, the 2015 Plan measures and the ***effective implementation*** of RDE[1] (phase 2) would ensure that the option would be ***unlikely*** to impact on the compliance with limit values.	The risk of an impact on compliance with limit values increases the earlier the assumed opening year for the option. In 2025, the risk is high and the option is likely to impact on zone compliance due to impacts in central London. The level of risk is primarily dependent on the timing of the introduction of, and effectiveness of, measures to reduce emissions from vehicles on the wider road network. It is largely independent of assumptions relating to the impact of the option itself or the direct mitigation of option-related emissions. Impacts near the airport do not, in general, affect zone compliance. Additional measures at the national, local and London level, including measures aimed at reducing emissions on the wider road network could potentially mitigate this risk further.

[1] Real Driving Emissions – EU legislation requiring vehicles to be subject to more stringent emissions testing procedures than at present, improving the real-world control of emissions - see paragraph 3.2.11.

Option	Conclusion with 2016 update to COPERT factors	Commentary on Conclusions
Heathrow Extended Northern Runway	In 2030, the option ***impacts*** on compliance with limit values in the core assessment scenario. ***With the updated surface access strategy***, the option ***does not impact*** on compliance with limit values in the core assessment scenario in 2030. However, there is ***a risk that the option will delay compliance*** with limit values. In 2030, the 2015 Plan Measures and the ***effective implementation*** of RDE (phase 2) would ensure that the option, ***with the updated surface access strategy***, would be ***unlikely*** to impact on compliance with limit values.	The risk of an impact on compliance with limit values increases the earlier the assumed opening year for the option. In 2025, the risk is high and the option is likely to impact on zone compliance due to impacts in central London and/or impacts in the vicinity of the airport. A risk exists, due to impacts in central London, whether or not the updated surface access strategy is implemented, but the updated strategy is required to reduce risks in the vicinity of the airport. With the updated surface access strategy, the level of risk is primarily dependent on the timing of the introduction of, and effectiveness of, measures to reduce emissions from vehicles on the wider road network. It is largely independent of assumptions relating to the impact of the option itself or the direct mitigation of airside emissions. Additional measures at the national, local and London level, including measures aimed at reducing emissions on the wider road network, could potentially mitigate this risk further.

1.3 DISCUSSION

1.3.1 The overall conclusion of the study is that, with the Government's 2015 Plan measures and taking into account the updated COPERT emission factors, increased airport capacity will not affect compliance with EU limit values in 2030. This applies whichever option is in operation, although for Heathrow ENR the updated surface access strategy Iteration 3[2] must be in place.

1.3.2 There is, however, a risk that the options will delay or worsen compliance with limit values. This risk is lowest for Gatwick 2R and highest for the Heathrow options, in particular Heathrow ENR without the updated surface access strategy in place. Furthermore, the risk increases the earlier the option is assumed to come into operation.

1.3.3 The study demonstrated that the risks to EU limit value compliance with increased airport capacity fall into two broad categories:

- → In the vicinity of the airports, a large increase in emissions due to the option is combined with the SL-PCM projections in which air pollution concentrations are projected to be relatively low. This is typical of the Gatwick 2R scenarios and the Heathrow ENR option without the updated surface access strategy.
- → Alongside roads remote from the airport, where a small increase in emissions due to the option is combined with SL-PCM projections in which air pollution concentrations are projected to exceed limit values. This is typical of the impacts of the Heathrow NWR and Heathrow ENR options in central London.

[2] Appraisal of Sustainability, Appendix D

1.3.4 This has significant implications for the potential mitigation of the risks since the option promoters have greater control over mitigation measures in the vicinity of the airport than actions required to reduce risks in central London.

1.3.5 The AC did not quantify specific air quality mitigation measures for Gatwick 2R. However, the airside measures proposed for Heathrow could be applied to Gatwick including provision of fixed electrical ground power, all electric auxiliary power units, reducing emissions from taxiing; and NO_X emission charging. In addition, landside emissions could be reduced by measures to encourage modal shift. Such measures would have the potential to reduce the low risk of an impact on limit value compliance to negligible levels.

1.3.6 The AC considered air quality mitigation measures for both Heathrow NWR and ENR (Table 5.16 and Table 6.16 in AC's Air Quality Assessment[3]). The proposed mitigation measures are expected to reduce the impact of airport expansion in the vicinity of the airport. However, the roads in the vicinity of the airport are not the only ones relevant when determining the impact of the option on compliance. Whilst the mitigation measures for aircraft emissions would not have an impact on central London, arguably, the impact of the measures on road transport and use of public transport may have an impact. This would, however, be substantially reduced from the effects close to Heathrow and unlikely to remove all risks of increased roadside pollutant concentrations in central London. As a result, the reduction in compliance risks associated with these schemes is primarily dependent on actions and measures implemented at national and local government level over which, the airport expansion scheme promoters have no direct control.

1.3.7 The adoption and effective implementation of measures including, but not limited to, measures set out in the 2015 Plan and the effective implementation of Real Driving Emissions (RDE) testing are required to remove the risk of impact on compliance with limit values with either Heathrow NWR or Heathrow ENR. Additional measures at the national, local and London level, including measures aimed at reducing emissions on the wider road network could potentially mitigate this risk further.

1.3.8 In November 2016 the High Court ordered the Government to produce a modified Air Quality Plan and to publish the final, modified Plan by 31 July 2017. The Government has commenced work on the amended plan. In accordance with the timetable set by the High Court, the Government will bring forward a revised package of measures likely to achieve compliance in the shortest possible time, having modelled the updated vehicle emissions factors. Proposals will be published for consultation by 24 April 2017. The impact of any measures which might be included within a modified Plan has not been assessed in this study, but would be expected to improve air quality in the Greater London zone.

1.3.9 For the Heathrow ENR, Iteration 3 of the surface access strategy is required to reduce risks of impacting on compliance with EU limit values in the vicinity of the airport. This iteration alone is not, however, sufficient to ensure compliance with limit value.

2 PROJECT BACKGROUND

2.1 OVERVIEW

2.1.1 The AC undertook a Sustainability Appraisal to support its independent examination of 3 shortlisted options to increase aviation capacity in the UK, namely:

- Gatwick Second Runway (2R),
- Heathrow Northwest Runway (NWR), and
- Heathrow Extended Northern Runway (ENR).

2.1.2 In relation to ambient air quality, the AC's Appraisal Framework required that the Air Quality Local Assessment[3] considered the impacts of the options on nitrogen oxides (NOx including NO_2) and particulate matter (as PM_{10} and $PM_{2.5}$).

2.1.3 The AC's local air quality assessments used a 'worst' case scenario. They were based on projections of future activity levels taken from demand forecasts that resulted in the greatest likely air quality impacts consistent with the Promoters' preferred business models, namely:

- Carbon Traded Low Cost is King for Gatwick 2R and
- Carbon Traded Global Growth for Heathrow NWR and ENR.

EU LIMIT VALUE COMPLIANCE

2.1.4 The European Union's Ambient Air Quality Directive 2008 (2008/50/EC) sets health-based limit values for the concentration of pollutants in ambient air, including nitrogen dioxide (NO_2) and particulate matter (PM_{10}). Under the Directive, the UK Government is responsible for ensuring that the air quality across the UK improves over time and meets the limit values set out in the Directive in the shortest possible time.

2.1.5 The UK uses a combined monitoring and modelling approach to assess current and future compliance with limit values and to make annual air quality compliance returns to the European Commission[4]. The collection of models used in the compliance assessment process is known as the Pollution Climate Mapping (PCM) model. The model provides pollution concentration output on a 1kmx1km grid of 'background' locations covering the whole of the UK, plus roadside concentrations from around 18,000 representative road links on 9000 roads. The PCM model baseline and future projections are updated on an annual basis. A streamlined version of the model (SL-PCM) is run at additional times, as required, to undertake sensitivity testing of policy options and specific local action plans.

2.1.6 The UK is divided into 43 zones and agglomerations (hereafter referred to only as zones) for limit value compliance reporting purposes. A zone is defined as being compliant when the maximum monitored or modelled concentration within that zone is less than or equal to the limit value.

2.1.7 In the latest compliance report[4], the UK reported that the limit value for annual mean NO_2 was exceeded in 37 out of the 43 zones. A key aspect of the AC's air quality assessment was

[3] Module 6: Air Quality Local Assessment, Detailed Emissions Inventory and Dispersion Modelling, prepared by Jacobs for the Airports Commission, May 2015

[4] Defra's most recent compliance report for the UK is available at: https://uk-air.defra.gov.uk/library/annualreport/

consideration of the likely impact of the options for increased airport capacity on the UK's compliance with the limit values for NO_X and NO_2.

2.1.8 The methodology used by the AC followed guidance set out in the Design Manual for Roads and Bridges[5]. It is a screening approach which treats the Government's PCM projections for roadside concentrations as the future baseline without airport expansion. The impacts of the options for airport expansion, as modelled by the AC, are then added to this future baseline to estimate total concentrations with increased capacity for comparison with the limit value.

2.1.9 The AC's compliance assessment was based on the PCM projections undertaken in 2013, taking into account measures in the Government's 2011 Air Quality Plan for improving air quality in the UK.

2.2 FURTHER WORK UNDERTAKEN SINCE AC REPORTING

2.2.1 The following sections summarise further work undertaken since the publication of the AC's air quality assessment in July 2015, either directly related to or potentially impacting on EU limit value compliance.

2015 AIR QUALITY PLAN

2.2.2 In December 2015, the Government published its 2015 Air Quality Plan (the 2015 Plan) for reducing nitrogen oxides emissions and improving air quality, together with supporting technical evidence. The evidence base included revised compliance projections using the PCM model showing all areas of the UK meeting the limit values by 2025.

2.2.3 The 2015 Plan identified that currently non-compliant zones across the UK had projected compliance dates between 2020 and 2030 with the air quality improvement measures set out in the previous 2011 Air Quality Plan, or between 2020 and 2025 with the additional measures set out in the 2015 Plan.

2.2.4 In November 2016, the High Court ordered the Government to produce a modified Air Quality Plan and to publish the final, modified plan by 31 July 2017.

2.2.5 The Government has begun work on the modified plan, which is being overseen by the Inter Ministerial Group on Clean Growth. In accordance with the timetable set by the High Court, the Government will bring forward a revised package of measures likely to achieve compliance in the shortest possible time, having modelled the updated vehicle emissions factors. Proposals will be published for consultation by 24 April 2017. The 2015 Plan will remain in force until a modified plan is adopted. The impact of any measures which might be included within a modified Plan has not been assessed in this study, but have the potential to improve air quality in the zones where the airports are located.

2.2.6 COPERT emission factors are the recommended method for calculating emissions inventories in the EMEP (European Monitoring and Evaluation Programme) guidebook, and they are regularly updated as new evidence on vehicle emissions emerges.

2.2.7 The PCM projections used in the AC's assessment were based on COPERT version v4.10 (issued in November 2012). The 2015 Plan was based on COPERT v4.11. COPERT v4.11.0 included updated emission factors for Euro 5/V and Euro 6/VI for cars, LGVs, HGVs and

[5] Interim Advice Note 175/13, updated advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07)

buses/coaches, as well as emission factors for the second stage of Euro 6 vehicles, referred to as Euro 6c (although Euro 6c emissions were not fully incorporated into the PCM modelling).

SURFACE ACCESS ITERATIONS

2.2.8 The AC's shortlisted scheme promoters continued to refine their schemes following the formal submission of scheme designs in May 2014 to the AC.

2.2.9 Variations to the scheme designs were discussed between Government and the scheme promoters and recorded in the form of a Statement of Principles (SoP) for each scheme option[6]. The principal changes to scheme design as described in the SoP's comprise:

- Gatwick 2R: Change in phasing of construction; the first phase of the new terminal would open at the same time as the new runway in 2025.
- Heathrow ENR: Two variations to the surface access plans included in the AC report were described in the SoP. They are described in more detail in Appendix D of the Assessment of Sustainability. The principal changes are: that the M4 would not require widening to cope with the increased demand resulting from expansion; surface access proposals comprising M25 works and tunnelling (J14 to the south and J15 to the north) (on a like for like replacement basis); local road diversions and improvements including the A4 and A3044.
- Heathrow NWR: The M4 would not require widening to cope with the increased demand resulting from expansion.

2.2.10 Of these variations, the alternative surface access schemes for Heathrow ENR, termed Iteration 3 and Iteration 4, are relevant to consideration of EU limit value compliance since they directly affect critical roads in the assessment.

WSP | PARSONS BRINCKERHOFF RE-ANALYSIS STUDY

2.2.11 WSP | Parsons Brinckerhoff were commissioned to assess the implications of the 2015 Plan and PCM modelling on the conclusions of the AC's air quality assessment in relation to EU limit value compliance. Specifically, the study considered:

- The change in projected roadside nitrogen dioxide concentrations with the 2015 Plan PCM modelling,
- Whether the new projections indicate that the shortlisted options will or will not cause or contribute to exceedances of EU limit values,
- The potential impacts of mitigation on compliance with EU limit values (from either the national Plan or scheme-specific measures identified by the AC),
- Whether the new projections will change the conclusions of the AC's compliance assessment, and
- Uncertainties in the future PCM projections and in the AC's modelling of impacts, including the opening date for the option, the rate of growth and operations at full capacity.

[6] The Secretary of State for Transport and Gatwick Airport Limited, 2016. *Statement of Principles;* The Secretary of State for Transport and Heathrow Hub Limited and Runway Innovations Limited, 2016. *Statement of Principles;* The Secretary of State for Transport and Heathrow Airport Limited, 2016. *Statement of Principles*

2.2.12 No new modelling was undertaken for the study, rather it was based on the re-analysis of the AC's modelling work and the Government's PCM modelling (undertaken in 2015).

2.2.13 This report (termed WSP|Parsons Brinckerhoff Re-analysis study) was published in October 2016[7].

2016 COPERT UPDATE

2.2.14 In September 2016, subsequent to the publication of the Government's 2015 Plan and the completion of the WSP | Parsons Brinckerhoff Re-analysis study, updated COPERT emission factors were released (v4.11.4). The update included new NO_X emission factors for Euro 6 passenger cars and light commercial vehicles and Euro 5 light commercial vehicles. The new factors were based on the latest emission information collected by ERMES (European Research on Mobile Emission Sources) parties and individual EU Member States[8]. The emission factors for the current generation of Euro 6 vehicles in the updated dataset were significantly higher than those incorporated into the 2015 Plan PCM modelling.

2.2.15 The updated COPERT factors were supplied as an interim set of emissions factors aimed at reflecting average measured emissions levels and a best estimate of future technology progress. With the introduction of Real Drive Emissions (RDE) regulations from 2017 onwards, diesel emissions improve over time in the factors but the likely rate of improvement is the subject of ongoing research. A more refined set of data is scheduled for release in 2017, but EMISIA[9] do not expect the data to differ substantially from the current release.

2.2.16 The potential impact of the 2016 update to COPERT emission factors was assessed qualitatively in a foreword to the final issue of the WSP | Parsons Brinckerhoff Re-analysis study.

2016 SL-PCM MODEL SENSITIVITY TESTS

2.2.17 In November 2016, Defra undertook sensitivity testing of the PCM model projections based on the updated COPERT emissions factors.

2.2.18 The testing was undertaken with the SL-PCM model. The SL-PCM model does not fully incorporate the complexities of atmospheric science included in the full PCM suite of models. It is specifically designed for use as a screening tool for the impacts of local mitigation measures on road transport sources and for undertaking sensitivity testing[10].

2.2.19 At the time of writing, these sensitivity tests represent the most up to date projections of future compliance with limit values.

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[7] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/562180/air-quality-re-analysis-impact-of-new-pollution-climate-mapping-projections-and-national-air-quality-plan.pdf

[8] Leonidas Ntziachristos, Giannis Papadimitriou, Norbert Ligterink, Stefan Hausberger, Implications of diesel emissions control failures to emission factors and road transport NOX evolution, Atmospheric Environment, Volume 141, September 2016, Pages 542-551

[9] EMISIA SA – http://emisia.com/about-emisia

[10] Details on the Streamlined PCM are available from: http://uk-air.defra.gov.uk/assets/documents/reports/cat09/1511260938_AQ0959_Streamlined_PCM_Technical_Report_(Nov_2015).pdf

2.3 SCOPE AND STRUCTURE OF UPDATED AIR QUALITY RE-ANALYSIS

2.3.1 This study is a follow-up to the WSP | Parsons Brinckerhoff Re-analysis study and should be read in conjunction with that study's report[7].

2.3.2 Specifically, the scope of the assessment is:

- A quantified assessment of the impact of the 2016 update to the COPERT emission factors as incorporated in the SL-PCM model sensitivity testing on EU limit value compliance with increased airport capacity.

2.3.3 As for the original study, no new modelling work has been undertaken for this assessment rather, it is based on:

- AC's local air quality assessment
- Defra's SL- PCM sensitivity testing projections for 2025 and 2030

2.3.4 In the following sections, we provide further details on the SL-PCM sensitivity testing, the methodology used for the re-analysis, and the results and conclusions of the re-analysis.

2.3.5 The scope of the study is limited to consideration of the implications of the 2016 update to the COPERT emission factors and SL-PCM modelling on EU limit value compliance with expanded airport capacity. The scope does not extend to consideration of impacts on local air quality during construction, or to impacts on compliance with the UK's air quality objectives[11].

[11] The UK's air quality objectives for nitrogen dioxide are numerically the same as the EU limit values. They are, however, policy targets rather than mandatory limits. Furthermore, compliance with air quality objectives is assessed at locations of relevant exposure to pollution, as set out in Defra's technical guidance TG(16), without recourse to Defra's PCM modelling. The AC undertook separate assessments of compliance with EU limit values and compliance with air quality objectives.

3 STREAMLINED PCM SENSITIVITY TESTING

3.1 INTRODUCTION

3.1.1 For this study, the following PCM model datasets for NO_2 were considered

- → **PCM *& SL-PCM Datasets*** issued in 2015 and considered in the WSP | Parsons Brinckerhoff Re-Analysis study
  - ***2015 Plan PCM Baseline*** – PCM data, generated from a 2013 base year, based on COPERT v4.11.0 emissions factors and the measures identified in the UK's 2011 Air Quality Plan
  - ***2015 Plan PCM With Measures*** –2015 Plan PCM data, based on COPERT v4.11.0 emissions factors and taking into account the additional measures identified in the UK's 2015 Plan
- → **SL-PCM *Datasets*** generated in November 2016
  - ***2016 Baseline Sensitivity Testing*** – SL-PCM data, generated from a 2013 base year, based on COPERT v4.11.4 emissions factors and the measures identified in the UK's 2011 Air Quality Plan
  - ***2016 With Measures Sensitivity Testing*** – SL-PCM data, based on COPERT v4.11.4 emissions factors and taking into account the additional measures identified in the UK's 2015 Plan
  - ***2016 With Measures + RDE Sensitivity Testing*** – SL-PCM data, based on COPERT v4.11.4 emissions factors and taking into account the additional measures identified in the UK's 2015 Plan and potential emissions reductions achievable with RDE legislation

3.1.2 The PCM and SL-PCM datasets used in the October 2016 re-analysis study are included in this section only, to illustrate the impact of the incorporation of the updated COPERT emission factors in the modelling. No further re-analysis of these datasets has been undertaken for this study.

3.1.3 The SL-PCM datasets generated in November 2016 were provided by Defra for all links within 3 zones (Greater London, South East and Eastern[12]) for 2025 and 2030.

3.2 COPERT EMISSION FACTORS

3.2.1 COPERT emission factors are the recommended method for calculating emissions inventories in the EMEP (European Monitoring and Evaluation Programme) guidebook, and they are regularly updated as new evidence on vehicle emissions emerges.

3.2.2 Vehicle performance and emissions in the real world do not, in general, correspond with those measured in European test cycles and NO_X emissions from diesel cars have been significantly higher than the European standards would suggest.

[12] A limited number of links in the Eastern zone are potentially affected by airport expansion. However, these links are not at any risk in relation to future limit value compliance.

3.2.3 The COPERT emissions factors include 'conformity factors' to account for this observation. These conformity factors are the ratios between actual vehicle emissions and the emissions standard for that vehicle and are, therefore, speed dependent. For ease of reference, Defra defines the conformity factor as the ratio at 33.6kph (this is the average speed of the current vehicle emissions test cycle) and this definition is used in the discussion below. It is of note that the conformity factors increase at lower speeds.

3.2.4 The 2016 update to the COPERT emissions factors (v4.11.4) was issued in response to the latest information on emissions from Euro 5 and 6 light duty diesel vehicles. Table 3-1 shows the impact of the update on emissions from Euro 6 cars and commercial vehicles through comparison of the conformity factors for the initial COPERT v4.11 release (as used in the 2015 Plan PCM modelling) and the 2016 update.

Table 3-1 Conformity factors for diesel vehicles as a function of COPERT version (at 33.6kph)

Vehicle Class	Euro Standard	COPERT v4.11.0[a] (As Used for 2015 Plan PCM Modelling)	COPERT v4.11.4 (2016 Update)
Passenger Cars	Euro 6 up to 2016	2.8	6.60
	Euro 6 2017 – 2019	2.8	5.05
	Euro 6 2020+	2.8	2.45
Light Commercial Vehicles	Euro 6 up to 2016	2.6	7.58– 9.02
	Euro 6 2017 – 2019	2.6	3.94 – 5.05
	Euro 6 2020+	2.6	1.97 – 2.45

a. As incorporated in 2015 PCM baseline modelling, which did not use COPERT emissions factors for Euro 6c/d vehicles.

3.2.5 The PCM baseline modelling undertaken for the 2015 Plan was based on emissions from light duty diesel vehicles with conformity factors of 2.6 – 2.8[13] (COPERT v4.11.0). These factors were constant over time and, therefore, reductions in average vehicle emissions over time were driven by the replacement of older vehicles (Euro 5 standard and earlier) in the fleet with Euro 6 standard vehicles, rather than improvements in Euro 6 vehicles over time.

3.2.6 In the 2016 update to COPERT, the conformity factors for Euro 6 vehicles (and the emissions on which they are based) decrease over time. For vehicles entering the fleet between 2016 and 2019, the updated factors are significantly higher than the previous factors; for vehicles released after 2020, the updated factors are lower than previous. As such, with the updated COPERT factors, average emissions per vehicle across the UK fleet are currently higher than previously estimated. However, this disparity will decrease over time and, as the turnover of the fleet progresses post 2020, average emissions will fall below previously estimated levels.

3.2.7 The updated COPERT factors were based on on-road/real world emissions monitoring data (from portable emissions measurement systems (PEMS) reported in the 2016 ERMES paper[8]. For urban drive cycles i.e. cycles with mean speeds <40kph, the monitoring data showed Euro 6 diesel passenger cars with a conformity factor of 6.25 and a standard deviation of 36%. This is consistent with the conformity factor (at 33.6kph) in the updated COPERT factors for 2016 release vehicles (6.60). For rural drive cycles (speeds 40-80kph), the conformity factor for in the ERMES data was 4.2; for highway drive cycles (speeds >80kph), the factor was 5.7.

[13] A lower conformity factor was used in some of the 2015 Plan SL-PCM modelling for the 2025 'With Measures' scenario to take account of the benefits of RDE.

3.2.8 DfT recently published the results of their on-road emissions testing[14] and a summary of other recent testing can be found in a report published by Air Quality Consultants (AQC, 2016)[15]. The DfT on-road testing showed Euro 6 vehicles emitting, on average, 6 times the Euro 6 standard. The average conformity factor for Euro 6 diesel cars in the datasets analysed by AQC (2016) was 3.9. Both DfT and the AQC data are consistent with the ERMES data and the updated COPERT factors. However, with tests undertaken under a variety of conditions, direct comparison between individual test results is not possible.

3.2.9 Importantly, it is a consistent theme across all datasets that Euro 6 vehicles emit significantly less NOx than Euro 5 vehicles and, as such, it is reasonable to conclude that there will be a decrease in roadside pollutant concentrations over time as Euro 6 vehicles make up an increasing proportion of the vehicle fleet.

3.2.10 However, data for Euro 6 vehicles is based on testing of a relatively low number of vehicles.

3.2.11 New legislation on vehicle emissions, incorporating Real Driving Emissions (RDE) testing, has been developed at European level. It takes effect from September 2017. Under the RDE legislation, NOx emissions from vehicles during all normal driving conditions must be controlled to be at or below 2.1 times the laboratory emissions test limit by 2017 and must meet the limit from 2020 (with a margin of 0.5 to account for measurement uncertainty i.e. emissions limited to 1.5 times the limit). Manufacturers will have to produce vehicles with emissions below 1.5 of the limit value in all normal driving conditions (as defined in the RDE test) in order to meet the standards. Furthermore, it has been decided that there will be an annual review of the measurement error allowance and if it is shown that it is lower than 0.5 it will be tightened.

3.2.12 This should mean that future Euro 6 vehicles will have lower emissions than the current Euro 6 vehicles. The updated COPERT factors do indeed show conformity factors for Euro 6 vehicles decreasing with time, as would be expected with RDE legislation, but the COPERT conformity factor (at 33.6kph) for diesel passenger cars post 2020 substantially exceeds the limits set out in RDE legislation i.e. 2.45 v 1.5.

3.2.13 The full and effective implementation of RDE should, therefore, result in emissions from vehicles being lower than those modelled with the updated COPERT factors. Indeed the RDE legislation includes an annual review of the final conformity factor to account for technological progress in PEMS equipment. However, the vehicles that will be required to meet this future legislation are not currently available for testing or, in some cases, developed, and information on the real world deterioration and failure rates of emission control technologies in existing and future vehicles is limited.

3.2.14 The estimation of future vehicle emissions is, therefore, subject to uncertainty.

3.2.15 Importantly, whilst existing tests and knowledge indicate that the technology is available to enable vehicles to meet the requirements of RDE, some development of new vehicle types will be required for the UK Euro 6 fleet to meet the future emission levels estimated by the updated COPERT factors, let alone the more stringent RDE requirements.

3.2.16 Since the publication of the 2015 Plan, there have also been updates to speed emission curves for Heavy Duty Vehicles (HGVs, coaches and buses). These leave overall emissions largely unchanged for these vehicle classes. However, they change the profile of emissions. They

[14] https://www.gov.uk/government/publications/vehicle-emissions-testing-programme-conclusions
[15] Air Quality Consultants, Emissions of Nitrogen Oxides from Modern Diesel Vehicles, January 2016

generally resulted in increases in emissions at low speeds and decreases in emissions at high speeds. This updated analysis updates the emission factors for HGVs to reflect these changes.

3.3 SL-PCM SENSITIVITY TESTING

3.3.1 In November 2016, Defra undertook sensitivity testing of the SL-PCM model projections based on the updated COPERT emissions factors. The scenarios modelled included, for 2025 and 2030

- Baseline projections, which incorporate existing measures set out in the 2011 Air Quality Plan;
- With Measures projections, which incorporate all the measures, such as clean air and low emission zones, set out in the 2015 Plan; and
- With Measures + RDE, which incorporate all 2015 Plan measures and reduce emissions from Euro 6 vehicles from the COPERT levels to account for the full implementation of RDE i.e. conformity factors reducing to 1.5 or less for vehicles entering the fleet after 2020.

3.3.2 In addition, acknowledging the uncertainty in future emission estimation, each of these scenarios was modelled using 'High', 'Central' and 'Low' emissions for Euro 6 vehicles. The 'Central' emissions modelling was based directly on the updated COPERT factors (or RDE compliance); the 'High' and 'Low' emissions estimations were based on the COPERT factors (or RDE limit) plus or minus 33% respectively for the vehicles that had updated emissions for Euro 5 and Euro 6 vans and Euro 6 cars. The 33% uncertainty range is consistent with the variation seen in the ERMES emissions monitoring data for Euro 6 cars.

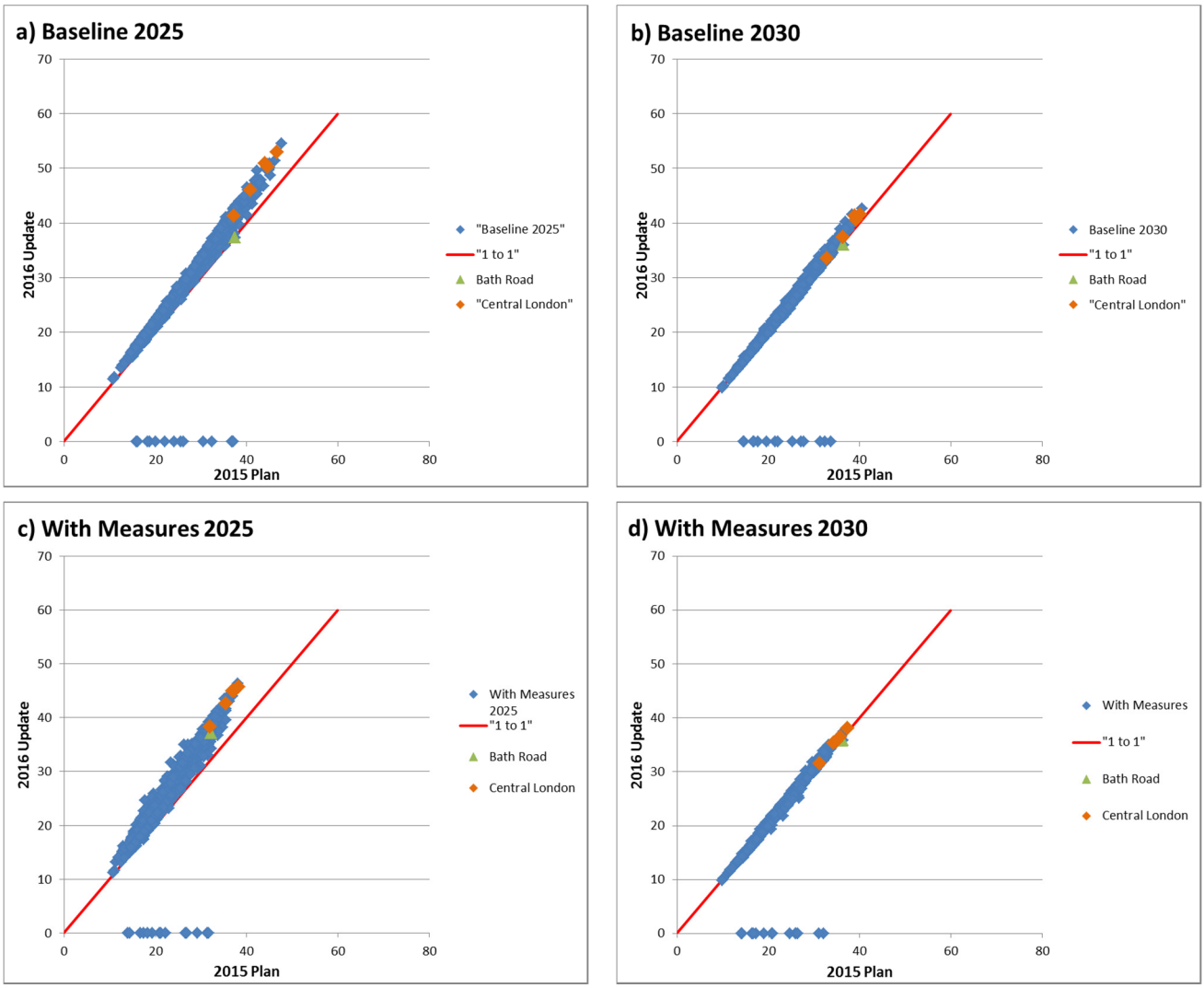
3.3.3 The SL-PCM sensitivity testing was undertaken for projections forward from a base year of 2013 (as used for the 2015 Plan PCM modelling). The key changes implemented since the modelling reported with the 2015 Plan are, therefore:

- Incorporation of the updated COPERT factors for cars and vans
- Revised speed emission curves for Heavy Duty Vehicles
- Recalibration of the base year model

3.3.4 To illustrate the impact of the changes on the projected future year concentrations, Figure 3-1 shows plots of the updated SL-PCM projections of NO_2 concentrations versus the 2015 Plan projections for 2025 and 2030. The data shown are taken from all road links in the Greater London zone; road links in the South East zone show similar trends.

3.3.5 The plots show that in 2025 (Figures 3.1a and 3.1c), the updated 2016 projections of NO_2 concentrations are generally higher than the 2015 Plan projections. In contrast, in 2030 (Figures 3.1b and 3.1d), the updated 2016 projections are generally equal to, or very slightly lower than the 2015 Plan projections. These observations are entirely consistent with the trends in the COPERT emissions factors for Euro 6 vehicles. That is to say, the conformity factors for existing Euro 6 vehicles are higher in the updated COPERT emissions than in the emissions used for the 2015 Plan, but that, over time, the new conformity factors reduce to levels at or below the 2015 Plan factors.

Figure 3-1 Comparison of annual mean nitrogen dioxide concentrations (µg/m^3) PCM model projections for the 2016 update (sensitivity testing) and the 2015 Plan for Greater London. 3.1a and 3.1b show the comparison of the baseline projections (without 2015 Plan measures) in 2025 and 2030 respectively; 3.1c and 3.1d show the comparison of the With Measures (with 2015 Plan measures but without RDE) projections for 2025 and 2030 respectively. The red line shows the 1 to 1 correspondence between datasets; points above the red line indicate that concentrations are higher in the 2016 update dataset than in the 2015 Plan. PCM data for links used in this study are shown in red diamonds (central London) and green triangles (in the vicinity of the Airport). Some links appeared in the 2015 dataset but not in the 2016 update, these data points lie along the horizontal axis but do not affect the re-analysis.



3.3.6 Appendix A shows the subsets of the 2015 Plan PCM and updated SL-PCM data for all links within the various option-specific study areas.

3.3.7 Table 3-2 shows impact of the 2016 update to the COPERT factors on the maximum concentration in the Greater London and South East zones respectively. As for the individual links, the maximum concentrations in the zones increase significantly between the 2015 PCM modelling and the 2016 update for 2025 projections. In contrast, there is relatively little impact on maximum concentrations in 2030.

Table 3-2 Maximum concentration in zones

Zone		2015 PCM Modelling		2016 Update SL-PCM Modelling		
		Baseline	With Measures	Baseline	With Measures	With Measures + RDE
Greater London	2025	47.7	38.2	54.5	46.3	44.5
	2030	40.5	37.3	42.6	38.1	35.5
South East	2025	29.6	29.6	33.1	32.4	30.6
	2030	27.1	27.1	27.1	27.0	24.9

3.3.8 There is some scatter in the various comparisons, but this is to be expected with the incorporation of updated COPERT factors coupled with different fleet mixes on the various road links, movement from the full PCM model to the streamlined PCM model and model recalibration.

4 METHODOLOGY

4.1 OVERVIEW

4.1.1 The scope of this updated air quality reanalysis study mirrored that of the WSP | Parsons Brinckerhoff Re-analysis study. That is to say, to re-analyse existing datasets to assess the implications of the updated COPERT emission factors, and associated updates to the SL-PCM projections, on the conclusions of the AC's work in relation to EU limit value compliance. Specifically, the scope stated that no new modelling was to be undertaken.

4.1.2 Therefore, the study has been based on:

- AC's air quality local assessment, and
- Defra's SL-PCM sensitivity testing.

4.1.3 The UK uses the PCM model, in combination with monitoring, to assess and report on compliance for submission to the EU. No other models are used for this purpose. Therefore, this assessment of the impact of airport expansion on compliance had to take account of PCM model projections. However, since the PCM model itself is not freely publicly available, it was not possible to directly include the options for airport expansion within the PCM projections.

4.1.4 As such, the methodology selected for the study followed the guidance set out in the Design Manual for Roads and Bridges[5]. The method is a screening approach to the assessment of future compliance with EU limit values, applicable to situations where the impacts of a scheme or development have only been modelled outside of the PCM model itself.

4.1.5 In summary, the method treats the Government's updated SL-PCM projections for roadside concentrations as the future baseline without airport expansion. The impacts of the options for airport expansion, as modelled by the AC, are then added to this future baseline to estimate total concentrations with increased capacity.

4.1.6 The study combines projections and modelling of future air quality from two different sources/models: the Government's projections are based on the PCM model; and the AC's modelling is based on the ADMS-Airports model[16]. This approach introduces uncertainty into the assessment but, as set out above, is the only practicable method for the study. It is the same method that was used by the AC in their Sustainability Assessment. This issue is to a large extent mitigated by the fact that the impact of airport capacity options on concentrations on the majority of links at risk of exceeding the limit value is small.

4.1.7 Further details on the assessment methodology are available in the WSP | Parsons Brinckerhoff Re-analysis study[7].

[16] www.cerc.co.uk

4.2 SCENARIOS

4.2.1 The risks of non-compliance with EU air quality limit values has been assessed under the same scenarios for which SL-PCM sensitivity testing has been undertaken for 2025 and 2030, namely

- Baseline projections, which incorporate existing measures set out in the 2011 Air Quality Plan;
- With Measures projections, which incorporate all the measures, such as clean air and low emission zones, set out in the 2015 Plan; and
- With Measures + RDE, which incorporate all 2015 Plan measures and reduces emissions from Euro 6 vehicles from the COPERT levels to account for the full implementation of RDE (first and second stages).

4.2.2 As noted earlier, under each scenario, Defra assumed 'high', 'central' and 'low' emissions uncertainty as a sensitivity test. Each scenario is considered to be represented by the 'central' estimate, with the 'high' and 'low' testing included to understand the vulnerability of the conclusions to uncertainties in the projection of future emissions.

4.2.3 The 'With Measures' scenario is considered to be the core scenario, since it takes account of actions to which the Government is committed and is consistent with the updated COPERT emissions factors. The Baseline scenario shows the situation if none of the 2015 Plan measures were implemented or effective. The With Measures + RDE scenario is a best case scenario as, in addition to effective 2015 Plan measures, it also assumes RDE legislation is fully effective. This will require implementation of European RDE legislation and action by manufacturers to develop RDE compliant diesel vehicles.

4.2.4 None of the scenarios considered take account of measures that may be implemented with the Government's 2017 modified Air Quality Plan.

4.3 ADJUSTMENT OF AC MODELLED IMPACTS

4.3.1 The adjustment of the AC modelled impacts to take account of the update to the COPERT factors is identical to that used in the WSP | Parsons Brinckerhoff Re-analysis study.

ADJUSTMENT FOR UPDATES TO PCM BACKGROUND CONCENTRATIONS

4.3.2 The AC's assessment of impacts from airport expansion uses outputs from the PCM model in two ways:

- Method 1: The roadside projections for NO_2 concentrations are used directly in the compliance assessment calculations
- Method 2: The background projections for NO_X concentrations are used in the calculation of the airport impacts on NO_2 through their inclusion in the method for calculating the proportion of NO_X in the form of NO_2

4.3.3 The update to the PCM modelling therefore has a potential direct impact on the PCM projections and an indirect impact on the AC's modelled impacts.

4.3.4 In relation to impacts via the PCM model, this assessment considers Method 1 only and therefore neglects any impacts associated with Method 2. This is due to a limitation of the available data such that the impact of the airport was made available to the study as a change in NO_2 concentrations only. To account for the impact of the new PCM projections on the modelled change in NO_2 concentration, the airport impact on NO_X would also have been required.

4.3.5 In general, as the concentration of total NO_X increases, the overall proportion of the NO_X that is present in the form of NO_2 decreases. With the 2016 SL-PCM projections giving generally lower pollutant concentrations than the original PCM projections used by the AC (not shown in this report), it is possible that the impact of the airport sources is underestimated slightly in this study[17]. However, within the overall uncertainties in the assessment, this second order effect is unlikely to be significant in the context of the conclusions of the assessment.

ADJUSTMENT FOR SCHEME OPENING PRIOR TO 2030

4.3.6 The AC air quality assessment considered impacts in the year 2030 only. This was determined by the availability of surface access data rather than a fixed airport opening date. The opening date for any expanded airport option is likely to be between 2025 and 2030. The theoretical scenario of accelerated development of the airport was included in the WSP | Parsons Brinckerhoff Re-analysis study and is also included in this updated re-analysis.

4.3.7 This considers the potential impact of the options if a similar level of airport activity to that modelled by AC for 2030 occurs in 2025 by multiplying roadside impacts by 1.25. This is the same adjustment as set out in the WSP| Parsons Brinckerhoff Re-analysis study.

4.3.8 The adjustment is applied to the road-related component of the airport impact since the AC's local air quality assessment did not make any allowance for improvements in aircraft emissions over time.

ADJUSTMENT FOR UPDATE TO COPERT FACTORS

4.3.9 In the WSP | Parsons Brinckerhoff Re-analysis study, a sensitivity test was undertaken in which the AC's modelling work was adjusted to an assumed conformity factor of 5 for Euro 6 diesel vehicles. This test was included because Defra had themselves included a sensitivity test in their modelling for the 2015 Plan in which the conformity factor for Euro 6 vehicles was increased to 5.

4.3.10 The adjustment is also relevant to the impact of the inclusion of the updated COPERT emissions factors (with conformity factors between 2.45 after 2020 and 6.6 in 2016 for diesel passenger cars) on the AC's modelled impacts in 2025. As such, the AC's impacts for 2025 (calculated as in the previous paragraphs by adjustment for early opening) were multiplied by an additional factor of 1.33 to take account of the new COPERT emissions data.

4.3.11 This adjustment was only applied to the assessment of 2025. The AC's impact for 2030 is unaffected by early opening. The updated COPERT factors have little adverse impact on emissions in 2030 (by which time, the conformity factor for the fleet approaches the 2.45 factor for post 2020 Euro 6 vehicles). Retaining the AC's modelled impacts for 2030 without adjustment is likely to represent a slightly conservative estimate of airport impacts under the updated COPERT factors.

4.3.12 The WSP | Parsons Brinckerhoff 2016 Re-analysis study demonstrated that the re-analysis is relatively insensitive to assumptions relating to the magnitude of the airport impact itself. The assessment outcome is primarily dependent on the changes to the PCM projections.

[17] Lower PCM projections would mean lower total NO_X concentrations with the airport contribution and, potentially, a higher proportion of the NO_X in the form of NO_2 with the new PCM projections i.e. for each 1µg/m^3 of NO_X added by airport sources, a greater proportion of the 1µg/m3 would be converted to NO_2 with the new, lower, PCM projections than with the original, higher, PCM projections. Based on the change in NO_2 concentrations between the various PCM projections, this impact is unlikely to exceed 10% of the modelled impact.

MITIGATION

4.3.13 The WSP | Parsons Brinckerhoff 2016 Re-analysis study demonstrated that, whilst the direct mitigation of the increase in emissions with increased airport capacity reduces the potential impacts of the options, the overall conclusions of the re-analysis were relatively insensitive to the direct mitigation of airport impacts (since these were effective in the vicinity of the airport, whereas risks also existed in central London). As such, the data presented in this report relate to the airport options prior to the application of mitigation measures by the scheme promoters, including any commitments made in relation to use of public transport.

4.3.14 The exception to this is consideration of the updated surface access strategy for Heathrow ENR. Impacts are considered without the strategy and, separately, with Iteration 3 of the updated strategy.

4.4 IMPACT ASSESSMENT

4.4.1 The impact is assessed against the following criteria:

- Criteria A: Does the option cause a compliant zone/agglomeration to become non-compliant
- Criteria B: Does the option cause a delay to compliance within a non-compliant zone/agglomeration, or a worsening of the zone compliance assessment
- Criteria C: Does the option cause a worsening of exceedances of the limit value alongside one or more PCM links without delaying compliance of the zone/agglomeration

4.4.2 It should be noted that where an option causes a delay to compliance within a non-compliant zone (Criteria B = Yes), it may also cause a worsening of compliance alongside other links that do not, on their own, delay the zone compliance. In this case, Criteria C is also answered yes. This allows a distinction to be made between a case where only a single link is affected and where multiple links are affected.

5 ASSESSMENT FINDINGS

5.1 OVERVIEW

5.1.1 This section provides an overview of the compliance assessment for the various options and scenarios on a link by link basis.

5.1.2 The assessment is provided by option, for both 2025 and 2030, rather than scenario.

5.1.3 The data are presented in tabular format in this chapter and in graphical format in Appendix B.

5.1.4 In the following sections, reference to the 'airport impact' refers to the AC modelled impact of airport expansion, taking into account any adjustments required for the assessment year and/or conformity factors. SL-PCM projection refers to the update to the SL-PCM projections undertaken in November 2016 and taking into account the 2016 update to the COPERT factors. All discussion is limited to impacts on nitrogen dioxide concentrations.

5.1.5 This study, and the WSP | Parsons Brickerhoff 2016 Re-analysis study, considered **all** PCM/SL-PCM links included in the AC's limit value compliance assessment. In this section, data are presented for the critical links only. These are selected, as appropriate, to represent those links which delay compliance for the zone or see a reintroduction of non-compliance, or worsened exceedance. In particular, for Heathrow options, the study considered links in the vicinity of the airport and links in central London, but for some scenarios the critical links are in central London.

5.1.6 All scenarios and options were assessed against criteria A to C outlined in Section 4.4. The following tables include colour gradings using the following classes:

- **No impact on limit value compliance**
  - ***Green Shading = Scenario does not cause or contribute to exceedances of EU limit values (Answer to all criteria = 'No')***
- **Impact on limit value compliance**
  - ***Yellow Shading = Scenario causes a new exceedance on a road or worsens an existing exceedance, but does not affect the maximum concentration within a zone (Answer to Criteria A and B = 'No'; Criteria C = 'Yes')***
  - ***Red Shading = Scenario impacts on compliance status of zone or introduces new non-compliances by increasing the maximum predicted concentration within a zone (Answer to Criteria A or B = 'Yes')***

5.1.7 In the tables:

- Criteria A is answered 'Yes' if the Total NO_2 concentration on the critical link is increased by the option **and** is **greater than** the limit value (40µg/m^3) **and** the Maximum NO_2 concentration in zone (without the option) is **less than** or equal to the limit value
- Criteria B is answered 'Yes' if the Total NO_2 concentration on the critical link is increased by the option **and** is **greater than** the limit value (40µg/m^3) **and** greater than the Maximum NO_2 concentration in zone (without the option), such that the option causes a delay to compliance
- Criteria C is answered 'Yes' if the Total NO_2 concentration on the critical link and/or any other link is increased by the option **and** is **greater than** the limit value (40µg/m^3) but **less than or**

equal to the Maximum NO_2 concentration in zone (without the option)[18]. (If this applies to links other than the critical link, then this Criteria may be triggered at the same time as Criteria B)

5.2 GATWICK 2R

5.2.1 Table 5-1 shows the compliance assessment for all scenarios for the Gatwick 2R option for increased airport capacity.

5.2.2 The critical link in both 2025 and 2030 is the A23 (London Road and Airport Way). This road currently runs alongside the airport boundary but will be re-aligned with the Gatwick 2R option. Details of the realignment are not available at this time.

5.2.3 In general, in the 'central' and 'low' emissions sensitivity tests, the SL-PCM sensitivity test projections are relatively low and well within the limit values and the addition of the airport impact, albeit a potentially large impact (up to 14µg/m^3), does not result in an exceedance of the limit value.

5.2.4 Concentrations are slightly higher in the 'high' emissions sensitivity test, but the primary driver for impacts on EU limit value compliance is the airport impact which, in 2025 and 2030, amounts to ~25 - 35% of the limit value.

5.2.5 In 2025, in the Baseline and With Measures 'high' emission scenarios the impact of the option is to move the South East Zone from compliance into non-compliance. In the With Measures + RDE 'high' emissions scenario, the maximum concentrations with the option are very close to the limit value (39.9µg/m3) but do not exceed the limit.

5.2.6 There are no projected exceedances of the limit values in any 2030 emissions scenario.

[18] It is possible that Criteria C may be triggered by links not shown in the table. This could happen, for example, where the critical link causes a delay to compliance but there are other links where exceedances of limit values are worsened. These cases are captured in the Tables in Section 5.

Table 5-1 Compliance assessment for the critical links for the Gatwick G2R option. (N=No = does not trigger criterion; Y = Yes = Triggers criterion). Conc = Concentration in µg/m³ The shading in the criteria column reflects the overall grading of the impact of the option in the sensitivity test.

Scenario	Critical PCM Link	Change in Conc due to Option (AC Modelled Impact)	PCM Projected Conc	Total NO_2 Conc	Max NO_2 conc in zone (without Option)	Criteria		
						A: Zone becomes noncompliant	B: Delay to zone compliance	C worsened exceedances on links
2025 Scenarios								
Baseline								
Low	78155 (A23)	14.0	22.7	36.6	28.1	N	N	N
Central	78155 (A23)	14.0	25.2	39.1	33.1	N	N	N
High	78155 (A23)	14.0	27.6	**41.6**	38.5	Y	N	N
With Measures								
Low	78155 (A23)	14.0	22.3	36.3	27.4	N	N	N
Central	78155 (A23)	14.0	24.8	38.8	32.4	N	N	N
High	78155 (A23)	14.0	27.2	**41.2**	37.2	Y	N	N
With Measures + RDE								
Low	78155 (A23)	14.0	21.7	35.6	26.3	N	N	N
Central	78155 (A23)	14.0	23.9	37.8	30.6	N	N	N
High	78155 (A23)	14.0	26.0	39.9	34.8	N	N	N
2030 Scenarios								
Baseline								
Low	18231 (A23)	10.2	22.6	32.8	24.0	N	N	N
Central	18231 (A23)	10.2	24.0	34.2	27.1	N	N	N
High	18231 (A23)	10.2	25.6	35.8	31.6	N	N	N
With Measures								
Low	18231 (A23)	10.2	22.6	32.8	23.9	N	N	N
Central	18231 (A23)	10.2	23.9	34.1	27.0	N	N	N
High	18231 (A23)	10.2	25.6	35.8	31.4	N	N	N
With Measures + RDE								
Low	18231 (A23)	10.2	22.3	32.5	22.6	N	N	N
Central	18231 (A23)	10.2	22.8	33.0	24.9	N	N	N
High	18231 (A23)	10.2	24.0	34.2	27.5	N	N	N

5.3 HEATHROW NWR

5.3.1 Table 5-2 shows the compliance assessment for the critical link(s) for all scenarios for the Heathrow NWR option for increased airport capacity. As set out in the methodology, all links in the PCM model at risk of exceeding the limit value and for which the option is predicted to result in an increase in concentrations are considered in the compliance risk assessment. For clarity in reporting, only the key links in the compliance assessment are reported in the table. For Heathrow NWR, this includes links in the vicinity of the airport and links towards the centre of London.

Table 5-2 Compliance assessment for the critical links for the Heathrow NWR option. (N=No = does not trigger criterion; Y = Yes = Triggers criterion). Conc = Concentration in µg/m^3 The shading in the criteria columns reflects the overall grading of the impact of the option in the sensitivity test

Scenario	Key PCM Links	Change in Conc due to Option (AC Modelled Impact)	PCM Projected Conc	Total NO_2 Conc	Max NO_2 conc in zone (without Option)	Criteria		
						A: Zone becomes noncompliant	B: Delay to zone Compliance	C worsened exceedances
2025 Scenarios								
Baseline								
Low	58173 (A40)	0.3	**45.6**	**45.9**	**47.1**	N	N	Y
	18727 (A312)	1.8	34.0	35.7				
Central	58173 (A40)	0.3	**52.9**	**53.3**	**54.5**	N	N	Y
	18727 (A312)	1.8	38.9	**40.7**				
High	58173 (A40)	0.3	**60.6**	**61.0**	**62.4**	N	N	Y
	18727 (A312)	1.8	**43.8**	**45.6**				
With Measures								
Low	70181 (A40)	0.3	**40.1**	**40.4**	**40.3**	N	Y	N
	18727 (A312)	1.8	32.7	34.4				
Central	70181 (A40)	0.3	**45.8**	**46.1**	**46.3**	N	N	Y
	18727 (A312)	1.8	37.3	39.0				
High	70181 (A40)	0.3	**51.6**	**52.0**	**52.5**	N	N	Y
	18727 (A312)	1.8	**41.9**	**43.6**				
With Measures + RDE								
Low	70181 (A40)	0.3	38.8	39.1	39.1	N	N	N
	18727 (A312)	1.8	31.5	33.2				
Central	70181 (A40)	0.3	**43.8**	**44.1**	**44.5**	N	N	Y
	18727 (A312)	1.8	35.6	37.3				
High	70181 (A40)	0.3	**48.9**	**49.2**	**50.0**	N	N	Y
	18727 (A312)	1.8	39.6	**41.3**				

Scenario	Critical PCM Link	Change in Conc due to Option (AC Modelled Impact)	PCM Projected Conc	Total NO_2 Conc	Max NO_2 conc in zone (without Option)	Criteria		
						A: Zone becomes noncompliant	B: Delay to zone Compliance	C worsened exceedances
2030 Scenarios								
Baseline								
Low	70181 (A40)	0.2	35.7	35.9	37.3	N	N	N
	16112 (A4)	1.3	35.5	36.8				
Central	70181 (A40)	0.2	**40.5**	**40.7**	**42.6**	N	N	Y
	16112 (A4)	1.3	36.0	37.3				
High	70181 (A40)	0.2	**45.4**	**45.6**	**48.0**	N	N	Y
	16112 (A4)	1.3	36.5	37.8				
With Measures								
Low	70181 (A40)	0.2	34.0	34.2	35.4	N	N	N
	16112 (A4)	1.3	35.2	36.5				
Central	70181 (A40)	0.2	38.1	38.3	38.1	N	N	N
	16112 (A4)	1.3	35.7	37.0				
High	70181 (A40)	0.2	**42.3**	**42.5**	**42.3**	N	Y	Y
	16112 (A4)	1.3	36.1	37.4				
With Measures + RDE								
Low	70181 (A40)	0.2	32.1	32.3	35.2	N	N	N
	16112 (A4)	1.3	35.1	36.4				
Central	70181 (A40)	0.2	35.4	35.6	35.5	N	N	N
	16112 (A4)	1.3	35.4	36.7				
High	70181 (A40)	0.2	38.6	38.8	38.6	N	N	N
	16112 (A4)	1.3	35.7	37.0				

5.3.2 In the core scenario ('With Measures', Central emissions estimate) in 2030, the Heathrow NWR option has no impact on compliance with limit values.

5.3.3 The critical link in both 2025 and 2030 is the A40 (Westway) in central London – over 15 km away from the airport boundary. The primary driver for risk of impact on compliance with limit values is the magnitude of the SL-PCM projection rather than the magnitude of the airport impact. On the critical link, the impact of the airport is small and related entirely to surface access. The impact of airside emissions on the link, and on the compliance risks for the option overall, is negligible.

5.3.4 In 2025, exceedances of EU limit values are widespread throughout Greater London in the SL-PCM data in all scenarios (although in the 'low' emission sensitivity tests, exceedances are markedly reduced, and removed completely in the With Measures + RDE scenario). As such, any impact from the airport expansion on these links results in an impact on limit value compliance.

5.3.5 The airport impacts on Bath Road (A4) are assessed but the link is not the critical link in that, for this option, it does not trigger non-compliance of the zone or experience a worsening of exceedance of the limit value in any scenario. In 2025, the airport impacts on the A312 result in worsened exceedances of the limit value. This road is approximately 1.5km away from the airport boundary. Whilst the impact of the option is larger than in central London (1.8µg/m^3 in comparison to 0.3µg/m^3), it remains small in comparison to PCM projected concentrations.

5.3.6 Modelled roadside pollutant concentrations in Greater London are elevated across a wide area. Typically, the highest concentrations are consistent across a number of SL-PCM links although, the maximum concentration in the zone can switch between links on the A40 (as seen in the PCM modelling used in the AC's assessment) and other roads such as the A4 in central London. The former were included in the AC's assessment but the latter were not since they did not experience a significant change in traffic with the option. As such, in some scenarios the links in central London that are affected by the airport option (albeit by a relatively small impact, <1µg/m^3) coincide with the maximum concentration in the zone or have concentrations very close to the maximum in the zone. Taking into account uncertainties in the SL-PCM modelling on a link-by-link basis, it should, therefore, be assumed that, where SL-PCM concentrations in central London exceed the limit value, the option is at risk of causing a delay to the compliance of the zone.

5.3.7 In 2030, the majority of scenarios have SL-PCM projected concentrations below the limit value and, in these scenarios the NWR option has no impact on compliance. The exceptions to this are the 'high' emissions sensitivity tests in both the Baseline and With Measures scenarios and the central emissions test in the Baseline, where the option results in either worsened exceedances or a delay to compliance with limit values.

5.3.8 With RDE, there are no projected exceedances of the limit values in any 2030 emissions scenario.

5.4 HEATHROW ENR

5.4.1 Table 5-3 shows the compliance assessment for all scenarios for the Heathrow ENR option for increased airport capacity for key links in the PCM model. Data are shown for links in the vicinity of the Airport (A4) and towards central London (A40). These links are less than 1km and over 15km from the airport boundary respectively.

5.4.2 In the core scenario ('With Measures', Central emissions estimate) in 2030, the Heathrow ENR option impacts on compliance with limit values on road links near the airport (but not in central London).

5.4.3 With the updated surface access strategy, the impact of Heathrow ENR follows that of Heathrow NWR, with risks to compliance largely dictated by the impacts of surface access on roads in central London, and the critical link in both 2025 and 2030 is the A40 (Westway) in central London, over 15 km away.

5.4.4 However, without the updated surface access strategy, the impact of the option on Bath Road near the airport is also significant, particularly in 2030 and in 'low' emissions scenarios in 2025 when total concentrations in central London are relatively lower. On Bath Road, the option impacts result from a combination of both airside and surface access emissions.

5.4.5 In the 2025 'baseline' scenarios, exceedances of limit values are worsened on links both in central London and near the airport. However, the highest concentrations occur in central London. This scenario is, therefore, unaffected by the surface access strategy which affects Bath Road only.

5.4.6 In the 'low' and 'central' emissions sensitivity tests in the With Measures and With Measures + RDE scenarios, the reduction in concentrations on roads in central London implies that the critical

link switches to the A4 (Bath Road) where it runs along the airport's northern boundary. The impact results in either a delay to compliance ('central' emissions) or non-compliance ('low' emissions) being reintroduced in the Greater London zone.

5.4.7 Under Iteration 3 of the surface access strategy for the option, Bath Road is diverted further to the north and, following the AC's work and assumptions in the Heathrow NWR assessment, it is assumed that the link is excluded from the compliance assessment. As such, in the With Measures 'low' emission scenario and the With Measures + RDE 'low' emission scenario, the risk of impact on compliance is removed with the updated surface access strategy.

5.4.8 However, this has limited impact on the overall assessment for the option for 2025 since in all 'central' emissions sensitivity tests, compliance is dictated by the impacts and SL-PCM concentrations in central London.

5.4.9 Risks of non-compliance or worsened compliance in 2030 are significantly reduced with the updated surface access strategy such that, with measures from the 2015 Plan, impacts on compliance with limit values are only seen in the 'high' emissions sensitivity tests.

5.4.10 With RDE and updated surface access strategy, there are no projected exceedances of the limit values in any 2030 emissions scenario. This is evidenced by the NO_2 concentrations on the A40 (link 70181) and the maximum concentration in the zone being less than 40µg/m^3 in all emissions tests for this scenario.

Table 5-3 Compliance assessment for the critical links for the Heathrow ENR option. (N=No = does not trigger criterion; Y = Yes = Triggers criterion). Conc = Concentration in µg/m³. The shading in the criteria columns reflects the overall grading of the impact of the option

Scenario	Critical PCM Link	Change in Conc due to Option (AC Modelled Impact)	PCM Projected Conc	Total NO_2 Conc	Max NO_2 conc in zone (without Option)	Criteria		
						A: Zone becomes noncompliant	B: Delay to zone Compliance	C worsened exceedances
2025 Scenarios								
Baseline								
Low	56114 (A4)	9.9	36.8	**46.7**	**47.1**	N	N	Y
	74534 (A40)	0.3	**43.5**	**43.8**				
Central	56114 (A4)	9.9	37.3	**47.2**	**54.5**	N	N	Y
	74534 (A40)	0.3	**50.9**	**51.2**				
High	56114 (A4)	9.9	37.8	**47.8**	**62.4**	N	N	Y
	74534 (A40)	0.3	**58.6**	**59.0**				
With Measures								
Low	56114 (A4)	9.9	36.6	**46.5**	**40.3**	N	Y	Y
	70181 (A40)	0.3	**40.1**	**40.4**				
Central	56114 (A4)	9.9	37.1	**47.0**	**46.3**	N	Y	Y
	70181 (A40)	0.3	**45.8**	**46.1**				
High	56114 (A4)	9.9	37.6	**47.6**	**52.5**	N	N	Y
	70181 (A40)	0.3	**51.6**	**52.0**				
With Measures + RDE								
Low	56114 (A4)	9.9	36.4	**46.3**	39.1	N	Y	Y
	70181 (A40)	0.3	38.8	39.1				
Central	56114 (A4)	9.9	36.9	**46.8**	**44.5**	N	Y	Y
	70181 (A40)	0.3	**43.8**	**44.1**				
High	56114 (A4)	9.9	37.4	**47.3**	**50.0**	N	N	Y
	70181 (A40)	0.3	**48.9**	**49.2**				

Scenario	Critical PCM Link	Change in Conc due to Option (AC Modelled Impact)	PCM Projected Conc	Total NO_2 Conc	Max NO_2 conc in zone (without Option)	Criteria		
						A: Zone becomes noncompliant	B: Delay to zone Compliance	C worsened exceedances
2030 Scenarios								
Baseline								
Low	56114 (A4)	8.3	35.5	**43.8**	37.3	Y	N	N
	58173 (A40)	0.1	36.4	36.5				
Central	56114 (A4)	8.3	36.0	**44.3**	**42.6**	N	Y	Y
	58173 (A40)	0.1	**41.6**	**41.7**				
High	56114 (A4)	8.3	36.5	**44.8**	**48.0**	N	N	Y
	58173 (A40)	0.1	**46.9**	**47.0**				
With Measures								
Low	56114 (A4)	8.3	35.4	**43.7**	35.4	Y	N	N
	70181 (A40)	0.2	34.0	34.2				
Central	56114 (A4)	8.3	35.8	**44.1**	36.1	Y	N	N
	70181 (A40)	0.2	38.1	38.3				
High	56114 (A4)	8.3	36.3	**44.6**	**42.3**	N	Y	Y
	70181 (A40)	0.2	**42.3**	**42.5**				
With Measures + RDE								
Low	56114 (A4)	8.3	35.2	**43.5**	35.2	Y	N	N
	70181 (A40)	0.2	32.1	32.3				
Central	56114 (A4)	8.3	35.5	**43.8**	35.5	Y	N	N
	70181 (A40)	0.2	35.4	35.6				
High	56114 (A4)	8.3	35.8	**44.1**	38.6	Y	N	N
	70181 (A40)	0.2	38.6	38.8				

6 CONCLUSIONS

6.1 OVERVIEW

6.1.1 All scenarios and options were assessed against the following criteria:

- Criteria A: Does the option cause a compliant zone/agglomeration to become non-compliant
- Criteria B: Does the option cause a delay to compliance within a non-compliant zone/agglomeration, or a worsening of the zone compliance assessment
- Criteria C: Does the option cause a worsening of exceedances of the limit value alongside one or more PCM links without delaying compliance of the zone/agglomeration

6.1.2 In the following sections, the tables show the summary of the Scenarios tested and a grading of the options against these criteria using the following classes:

- **No impact on zone or limit value compliance**
  - ***Green Shading = Scenario does not cause or contribute to exceedances of EU limit values (Answer to all criteria = 'No')***
- **Impact on limit value compliance**
  - ***Yellow Shading = Scenario causes a new exceedance on a road or worsens an existing exceedance, but does not affect the maximum concentration within a zone (Answer to Criteria A and B = 'No'; Criteria C = 'Yes')***
  - ***Red Shading = Scenario impacts on compliance status of zone or introduces new non-compliances by increasing the maximum predicted concentration within a zone (Answer to Criteria A or B = 'Yes')***

6.1.3 In the following discussion, it is assumed that the core scenario for all options is the combination of the 2030 With Measures PCM projection and the 2030 AC modelled impact.

6.2 GATWICK 2R

6.2.1 Table 6-1 shows a summary of the results of the assessment for Gatwick 2R. The overall conclusion on compliance for the option is as follows:

Option	Conclusion	Commentary
Gatwick Second Runway	The option is ***unlikely*** to impact on compliance with limit values.	The conclusion has *low vulnerability* to uncertainties, since only in the most pessimistic emissions scenario does the option risk triggering non-compliance within the South East Zone and the estimated airport impact is likely to be conservative

6.2.2 All scenarios considered for the development of Gatwick 2R in 2030 result in no impact on the compliance status of the South East zone. No new exceedances of the limit value or any worsening of exceedances of the limit value are predicted.

Table 6-1 Summary of assessment of Scenarios for Gatwick 2R

SCENARIO	SENSITIVITY	2025	2030
No of Links Assessed		**2**	**2**
Baseline	**Low**	Zone compliant	Zone compliant
	Central	Zone compliant	Zone compliant
	High	Non-compliance for zone re-introduced due to impacts on London Road & Airport Way; Worst case because impact is highly conservative	Zone compliant
With Measures	**Low**	Zone compliant	Zone compliant
	Central	Zone compliant	Zone compliant
	High	Non-compliance for zone re-introduced due to impacts on London Road & Airport Way; Worst case because impact is highly conservative	Zone compliant
With Measures + RDE	**Low**	Zone compliant	Zone compliant
	Central	Zone compliant	Zone compliant
	High	Zone compliant	Zone compliant

6.2.3 With the opening of G2R in 2025, a risk of an impact on the compliance status of the South East zone is identified.

6.2.4 The PCM projections for road links in the vicinity of Gatwick Airport show relatively low sensitivity to assumptions relating to vehicle emissions on the wider road network and the principal driver for the introduction of new exceedances on links is the estimated impact of the airport. As such, the risk of impact only occurs in the scenarios based on the 'high' emissions sensitivity tests, which incorporate relatively pessimistic assumptions relating to emissions from diesel vehicles (in relation to the COPERT factors).

6.2.5 For example, the maximum PCM projected concentration on any link in the vicinity of Gatwick Airport in 2025 is well within the limit value (less than 30µg/m^3). This applies in all emissions

sensitivity scenarios. The estimated contribution from the airport alongside these links exceeds 12µg/m^3.

6.2.6 As set out in the WSP | Parsons Brinckerhoff 2016 Re-analysis study (Section 4.3), the airport contribution to PCM link concentrations was not directly modelled by the AC but had to be estimated for the re-analysis using conservative assumptions including:

- Extrapolation of AC modelled concentrations from receptor locations up to 50m from the roadside to the PCM standard distance of 4m from the roadside using Defra's calculator
- Use of verified AC modelled impacts where the verification factor tends to overestimate impacts
- Assuming the same high level of growth in airport activity for 2025 as 2030

6.2.7 As such, the estimated impact of the airport is potentially overly pessimistic and should not, therefore, be given significant weight.

6.2.8 No mitigation measures were proposed for Gatwick in the AC's assessment. However, it is reasonable to assume that an air quality management strategy could be developed for Gatwick, focussing on both landside and airside emission sources. This strategy could result in a similar magnitude of reductions to those expected at Heathrow and has the potential to reduce concentrations to within the limit value in all scenarios.

6.2.9 In addition, the Government has commenced work to produce a modified Air Quality Plan, with a final, modified Plan to be published by 31 July 2017. In accordance with the timetable set by the High Court, the Government will bring forward a revised package of measures likely to achieve compliance in the shortest possible time, having modelled the updated vehicle emissions factors. Proposals will be published for consultation by 24 April 2017. The impact of any measures which might be included within a modified Plan has not been assessed in this study, but the measures will have the potential to improve air quality in the zone where the airport is located.

6.2.10 Overall, therefore, it is concluded that the Gatwick 2R option is at low risk of impacting on compliance with EU limit values.

6.3 HEATHROW NWR

6.3.1 Table 6-2 shows a summary of the results of the assessment for Heathrow NWR. The overall conclusion on compliance for the option is as follows:

Option	Conclusion	Commentary
Heathrow Northwest Runway	In 2030, the option ***does not impact*** on compliance with limit values in the core assessment scenario. There is, however, ***a risk that the option will delay compliance*** with limit values. In 2030, the 2015 Plan Measures and the ***effective implementation*** of RDE (phase 2) would ensure that the option would be ***unlikely*** to impact on the compliance with limit values.	The risk of an impact on compliance with limit values increases the earlier the assumed opening year for the option. In 2025, the risk is high and the option is likely to impact on compliance with limit values due to impacts in central London. The level of risk is primarily dependent on the timing of the introduction of, and effectiveness of, measures to reduce emissions from vehicles on the wider road network. It is largely independent of assumptions relating to the impact of the option itself or the direct mitigation of option-related emissions. Impacts near the airport do not, in general, affect zone compliance. Additional measures at the national, local and London level, including measures aimed at reducing emissions on the wider road network could potentially mitigate this risk further.

6.3.2 For Heathrow NWR, with the 2015 Plan measures and opening in 2030, the option does not affect the compliance status of the Greater London zone. However, the uncertainty in this conclusion should be noted, since some scenarios in which emissions from vehicles on the wider road network do not decrease as much as expected – for example, the 2030 With Measures 'high' emissions sensitivity test – show the option worsening exceedances of limit values and impacting on the compliance of Greater London.

6.3.3 With the opening of NWR in 2025, a high risk of an impact on the compliance status of the Greater London zone is identified.

6.3.4 The risks of an impact are largely unrelated to the magnitude of the impact of the airport option, although clearly the duration of any delay to compliance of the Greater London zone would be proportional to the magnitude of the impact. In fact, the impact on links in central London is relatively small, <1µg/m^3.

6.3.5 The impacts of the option on roads closer to the airport were considered in this re-analysis and are, in places, higher than in central London. However, for Heathrow NWR, the total NO_2 concentrations with the option (*i.e.* SL-PCM projection + Airport Impact) is highest on links in central London. As such, the key links for the compliance assessment are generally those in central London.

6.3.6 It should be noted that the assessment of the impact of the option on compliance against criteria A, B and C depends on both the concentrations on individual links and the maximum concentration in the zone. As overall concentrations across scenarios reduce e.g. moving from Baseline through to With Measures + RDE scenarios, or from 2025 to 2030 opening years, projected concentrations decrease overall, as does the overall impact of an option on limit value compliance (if any). However, this does not necessarily imply that the impact of the option decreases on individual links or that impacts on zone compliance are reduced/removed.

6.3.7 With the option, some traffic growth is expected on roads between central London and the airport. Measures to increase the use of public transport for airport-related travel may reduce the level of growth. The airport has pledged a public transport mode share target for passengers of at least 55% by 2040 (at least 50% by 2030) and that, with expansion, there will be no more airport-related traffic on the roads than today. However, the impact of this commitment on specific routes to the airport has not been evaluated. Similarly, the introduction of clean air zones and/or the implementation of RDE have the potential to reduce emissions per vehicle, but will not wholly remove the increase in emissions from any airport-related traffic growth.

6.3.8 The roads likely to be affected by airport-related traffic e.g. A40, include some of the PCM model links that have the highest projected future year concentrations in central London. Therefore, any impact on these road links could potentially result in a delay to the date of compliance for the zone.

6.3.9 Impacts on roads near the airport with this option have relatively little impact on compliance with limit values. This is due, in part, to changes to the alignment of sections of the Bath Road further to the north and away from the airport, which reduces the potential for combined impacts from airside and landside (surface access) emissions.

6.3.10 As such, there is relatively little direct action that can be taken by the airport to reduce the risk of an impact on zone or individual link compliance with limit values in central London. Rather, the reduction in compliance risks is primarily dependent on the measures taken by national and local government to reduce emissions on the wider road network.

6.3.11 The Government has commenced work to produce a modified Air Quality Plan, with a final, modified Plan to be published by 31 July 2017. In accordance with the timetable set by the High Court, the Government will bring forward a revised package of measures likely to achieve compliance in the shortest possible time, having modelled the updated vehicle emissions factors. Proposals will be published for consultation by 24 April 2017. The impact of any measures which might be included within a modified Plan has not been assessed in this study, but the measures will have the potential to improve air quality in the Greater London zone.

6.3.12 In 2030, the 2015 Plan Measures and the effective implementation of RDE would ensure that the Heathrow NWR option would be unlikely to impact on the compliance of the Greater London zone.

Table 6-2 Summary of assessment of Scenarios for Heathrow NWR

SCENARIO	SENSITIVITY	2025	2030
No of Links Assessed		**18**	**18**
Baseline	**Low**	Worsened exceedance on 6 links - Central London	Zone compliant
	Central	Worsened exceedance on 15 links - Central London and near airport	Worsened exceedance on 4 links - Central London
	High	Worsened exceedance on 17 links - Central London and near airport	Worsened exceedance on 7 links - Central London
With Measures	**Low**	Delay to compliance with non-compliance reintroduced (A40, Westway, City of Westminster)	Zone compliant
	Central	Worsened exceedance on 8 links - Central London	Zone compliant
	High	Worsened exceedance on 15 links - Central London and near airport	Delay to compliance (A40, Westway, City of Westminster); Worsened exceedance on 4 links - Central London
With Measures + RDE	**Low**	Zone compliant	Zone compliant
	Central	Worsened exceedance on 6 links - Central London	Zone compliant
	High	Worsened exceedance on 14 links - Central London and near airport	Zone compliant

6.4 HEATHROW ENR

Table 6-3 shows a summary of the results of the assessment for ENR. The overall conclusion on compliance for the option is as follows:

Scheme	Conclusion	Commentary
Heathrow Extended Northern Runway	In 2030, the option ***impacts*** on compliance with limit values in the core assessment scenario. ***With the updated surface access strategy***, the option ***does not impact*** on compliance with limit values in the core assessment scenario in 2030. However, there is ***a risk that the option will delay compliance*** with limit values. In 2030, the 2015 Plan Measures and the ***effective implementation*** of RDE (phase 2) would ensure that the option, with the updated surface access strategy, would be ***unlikely*** to impact on compliance with limit values	The risk of an impact on compliance with limit values increases the earlier the assumed opening year for the option. In 2025, the risk is high and the option is likely to impact on zone compliance due to impacts in central London and/or impacts in the vicinity of the airport. A risk exists, due to impacts in central London whether or not the updated surface access strategy is implemented, but the updated strategy is required to reduce risks on roads in the vicinity of the airport. With the updated surface access strategy, the level of risk is primarily dependent on the timing of the introduction, and effectiveness of, measures to reduce emissions from vehicles on the wider road network. It is largely independent of assumptions relating to the impact of the option itself or the direct mitigation of airside emissions. Additional measures at the national, local and London level, including measures aimed at reducing emissions on the wider road network, could potentially mitigate this risk further.

Table 6-3 Summary of assessment of Scenarios for Heathrow ENR

SCENARIO	SENSITIVITY	2025		2030	
No of Links Assessed		**18**	**With Surface Access Iteration 3**	**18**	**With Surface Access Iteration 3**
Baseline	**Low**	Worsened exceedance on 8 links - Central London and near airport	No Change; but worsening on Bath Road removed	Non-compliance for zone reintroduced (A4 Bath Road, Hillingdon)	Zone compliant
	Central	Worsened exceedance on 14 links - Central London and near airport	No Change; but worsening on Bath Road removed (1 of 2)	Delay to compliance with non-compliance reintroduced (A4, Bath Road, Hillingdon); Worsened exceedance on 4 links - Central London	Worsened exceedance on 4 links - Central London
	High	Worsened exceedance on 17 links - Central London and near airport	No Change; but worsening on Bath Road removed (1 of 2)	Worsened exceedance on 8 links - Central London and Near Airport	No Change but worsening on Bath Road removed
With Measures	**Low**	Delay to compliance with non-compliance reintroduced (A4, Bath Road, Hillingdon); Plus worsened exceedance on 1 link - central London	No Change except Delay on Bath Road Removed; Max Conc reduced	Non-compliance in zone reintroduced (A4 Bath Road, Hillingdon)	Zone compliant
	Central	Delay to compliance (Bath Road); Plus worsened exceedance on 8 links - Central London & Airport	Worsened exceedance on 8 links - Central London & Airport	Non-compliance in zone reintroduced (A4 Bath Road, Hillingdon)	Zone compliant
	High	Worsened exceedance on 14 links - Central London and near airport	No Change except 1 of 2 worsening on Bath Road removed	Delay to compliance with non-compliance reintroduced (A4, Bath Road, Hillingdon); Plus worsened exceedance on 5 links - Central London inc delay	No Change except non-compliance on Bath Road removed
With Measures + RDE	**Low**	Non-compliance for zone reintroduced (A4, Bath Road, Hillingdon)	Zone compliant	Non-compliance in zone reintroduced (A4 Bath Road, Hillingdon)	Zone compliant
	Central	Delay to compliance (Bath Road); Plus worsened exceedance on 8 links - Central London & Airport	Worsened exceedance on 8 links - Central London & Airport	Non-compliance in zone reintroduced (A4 Bath Road, Hillingdon)	Zone compliant
	High	Worsened exceedance on 13 links - Central London and near airport	No Change except 1 of 2 worsening on Bath Road removed	Non-compliance in zone reintroduced (A4 Bath Road, Hillingdon)	Zone compliant

6.4.1 Iteration 3 of the surface access strategy for Heathrow ENR does not reduce overall emissions from traffic. Rather it diverts traffic from the existing A4 Bath Road, which runs along the northern boundary of the airport, close to airside emission sources, onto a more northerly route. This reduces the potential for a significant combined effect from airside emission and emissions from road traffic. This iteration effectively mimics the impacts for Heathrow NWR and, with NWR, it was assumed by the AC that the diversion of the A4 would remove the road link from consideration in the PCM model and the compliance assessment (Footnote 3, Section 5.4.4).

6.4.2 It is possible that, in future PCM models, the diversion route itself would be included as a compliance assessment link. However, it is reasonable to conclude that the impacts would be lower than those modelled by the AC for the Bath Road without the surface access variation since, as stated above, the contribution from airside emissions would be lower alongside the diversion route.

6.4.3 Notwithstanding this, even with the surface access variation in place, the risks of impact on limit value compliance with ENR are not removed, since risks remain in relation to the increase in traffic on roads in central London. In this regard, the discussion set out at paragraphs 6.3.10 and 6.3.11 for NWR applies equally to this option.

6.4.4 Scenarios in which emissions from vehicles on the wider road network do not decrease as much as expected – for example, high emissions scenarios – show the ENR option worsening exceedances of limit values and impacting on the compliance of Greater London whether or not the updated surface access strategy is used.

6.4.5 With the opening of ENR in 2025, a high risk of an impact on the compliance status of the Greater London zone is identified.

6.4.6 In 2030, the effective implementation of RDE and the 2015 Plan Measures, together with Iteration 3 of the updated surface access strategy, would ensure that the Heathrow ENR option would be unlikely to impact on the compliance of the Greater London zone.

Appendix A

SL-PCM PROJECTIONS FOR OPTION STUDY AREAS

APPENDIX A-1

GATWICK 2R

Figure A-1.1 PCM Projections for 2025. Main bars show the 'Central' emissions projections; error bars show the range of the 'high' and 'low' emissions tests (µg/m^3 NO_2)

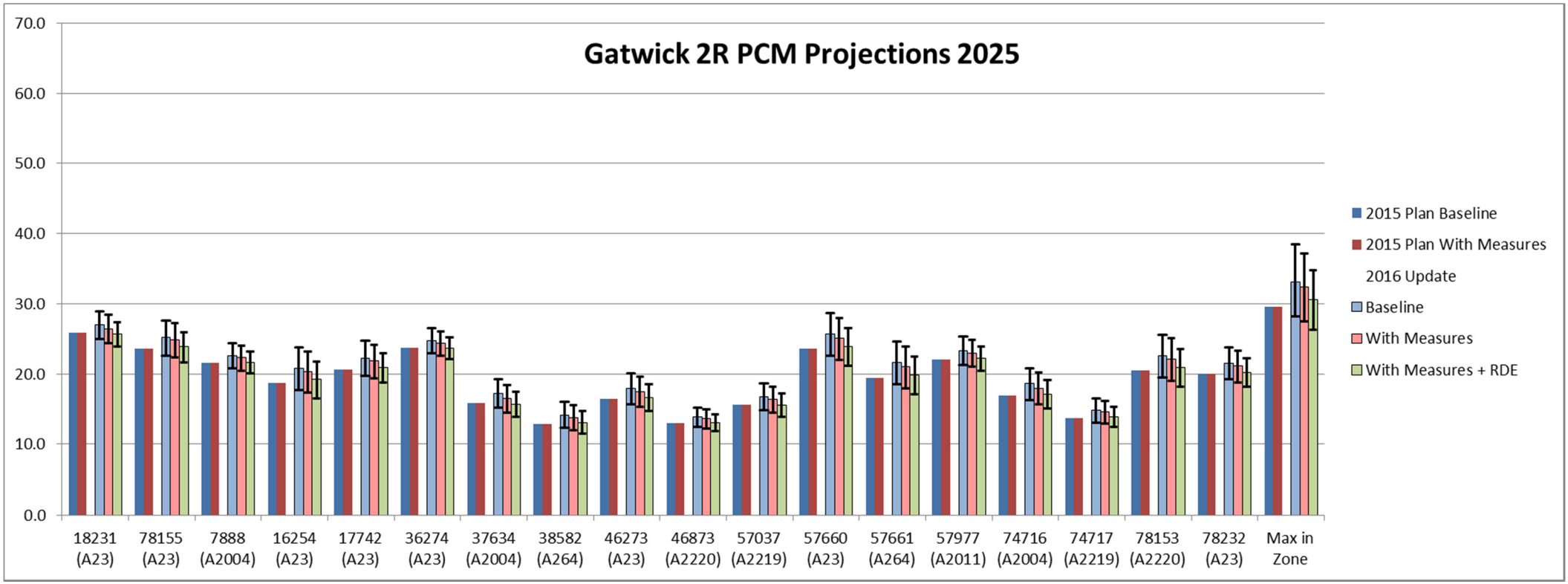
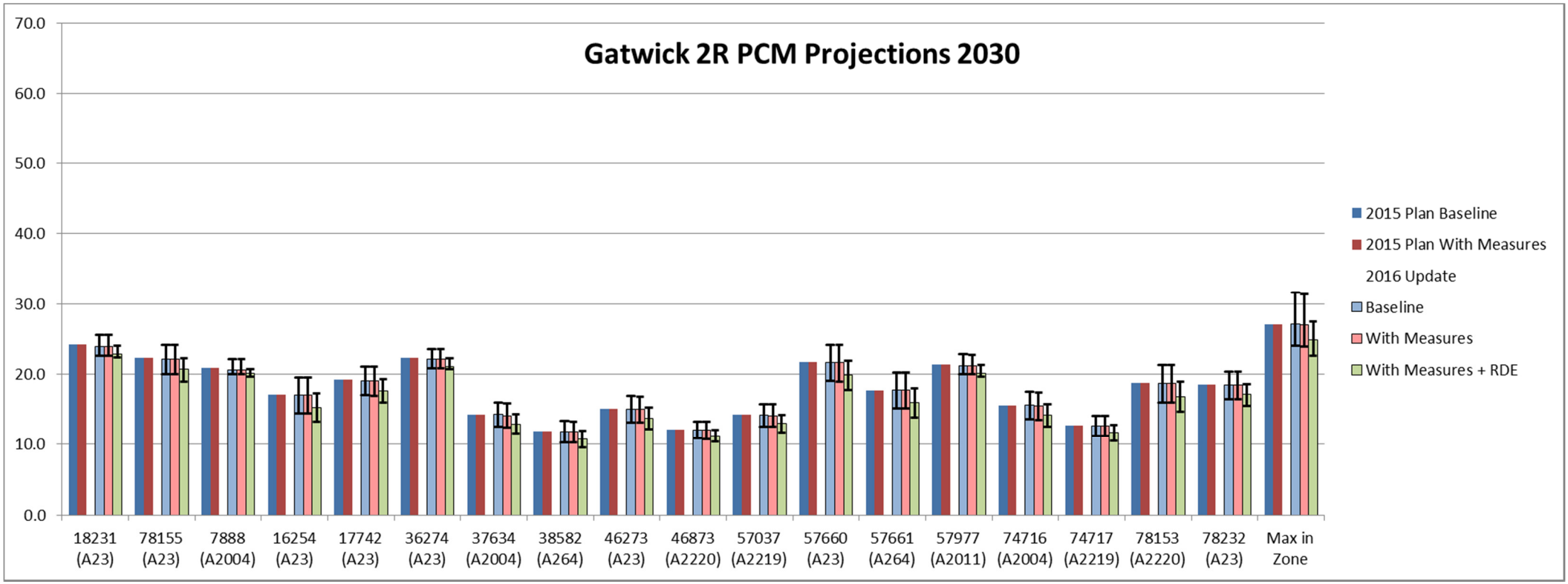


Figure A-1.2 PCM Projections for 2030. Main bars show the 'Central' emissions projections; error bars show the range of the 'high' and 'low' emissions tests (µg/m^3 NO_2)



APPENDIX A-2

HEATHROW - NWR

Figure A-2.1 PCM Projections for 2025. Main bars show the 'Central' emissions projections; error bars show the range of the 'high' and 'low' emissions tests (µg/m^3 NO_2). Links in central London except where indicated.

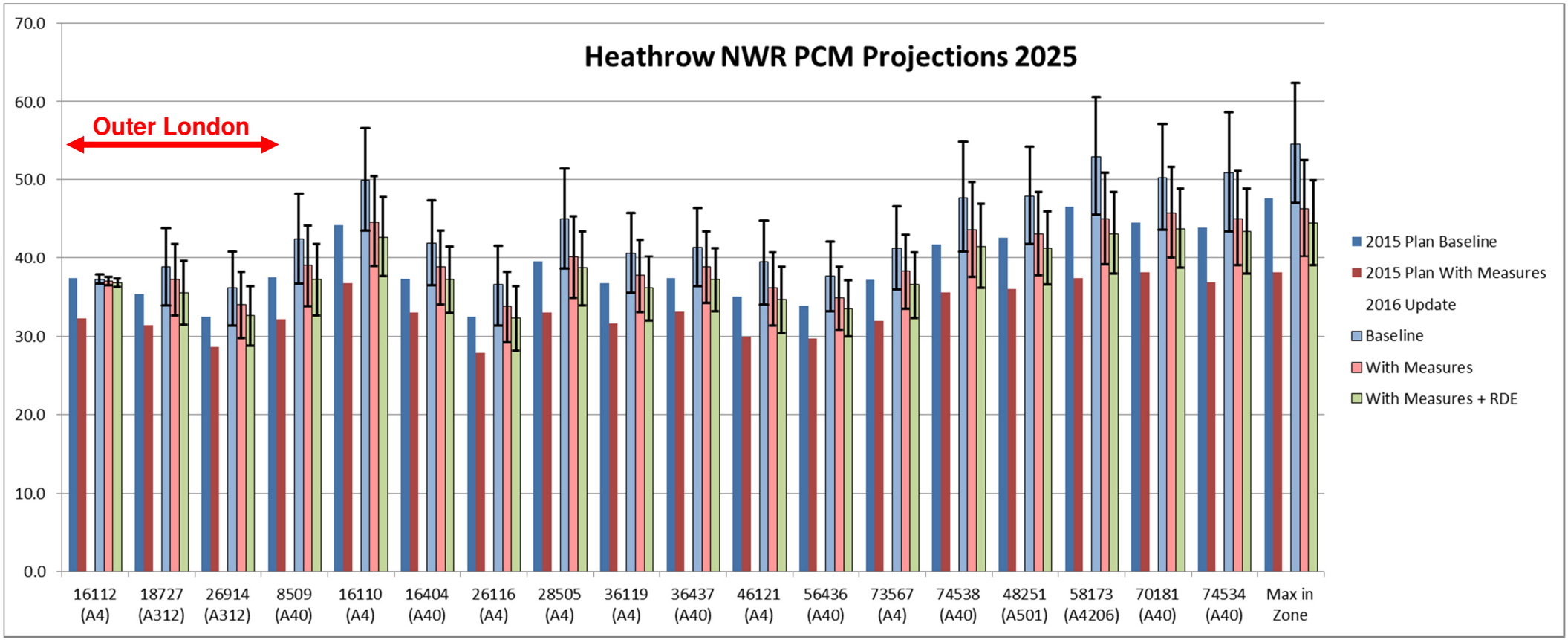
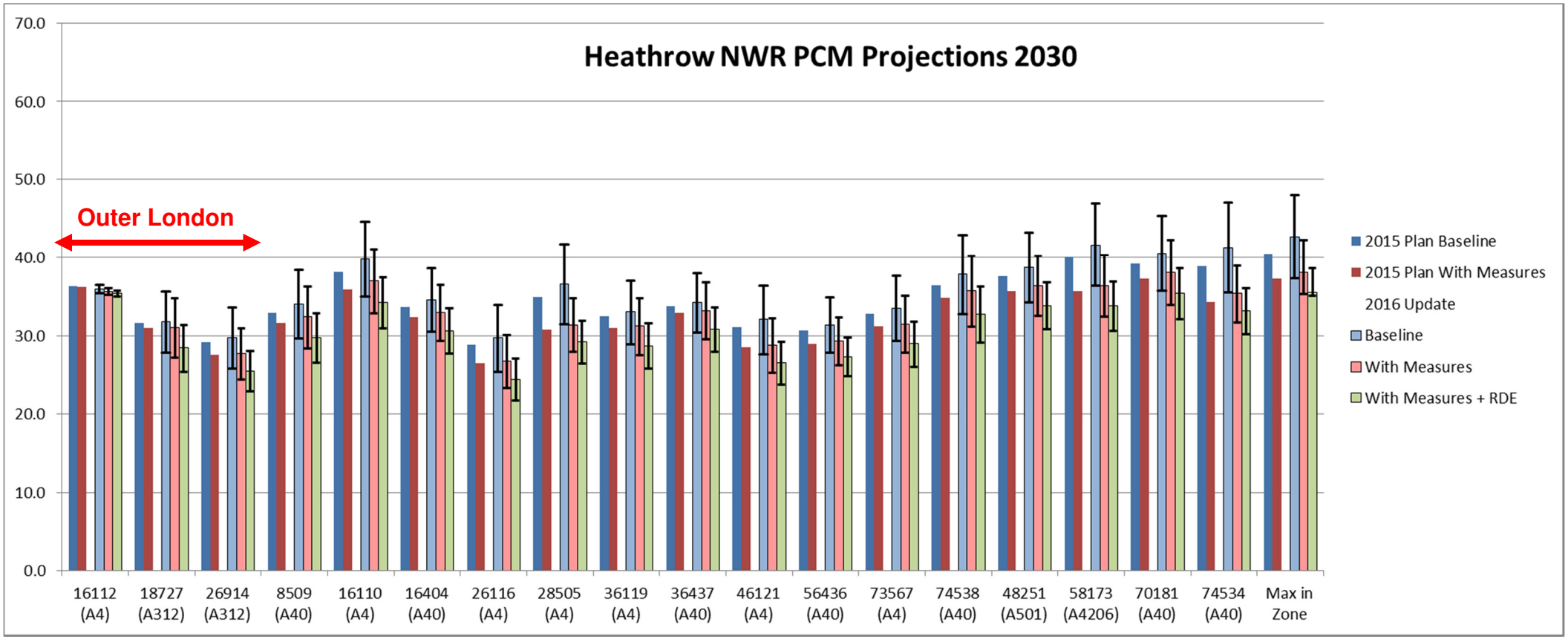


Figure A-2.2 PCM Projections for 2030. Main bars show the 'Central' emissions projections; error bars show the range of the 'high' and 'low' emissions tests (µg/m^3 NO_2). Links in central London except where indicated



APPENDIX A-3

HEATHROW - ENR

Figure A-3.1 PCM Projections for 2025. Main bars show the 'Central' emissions projections; error bars show the range of the 'high' and 'low' emissions tests (µg/m^3 NO_2). Links in central London except where indicated.

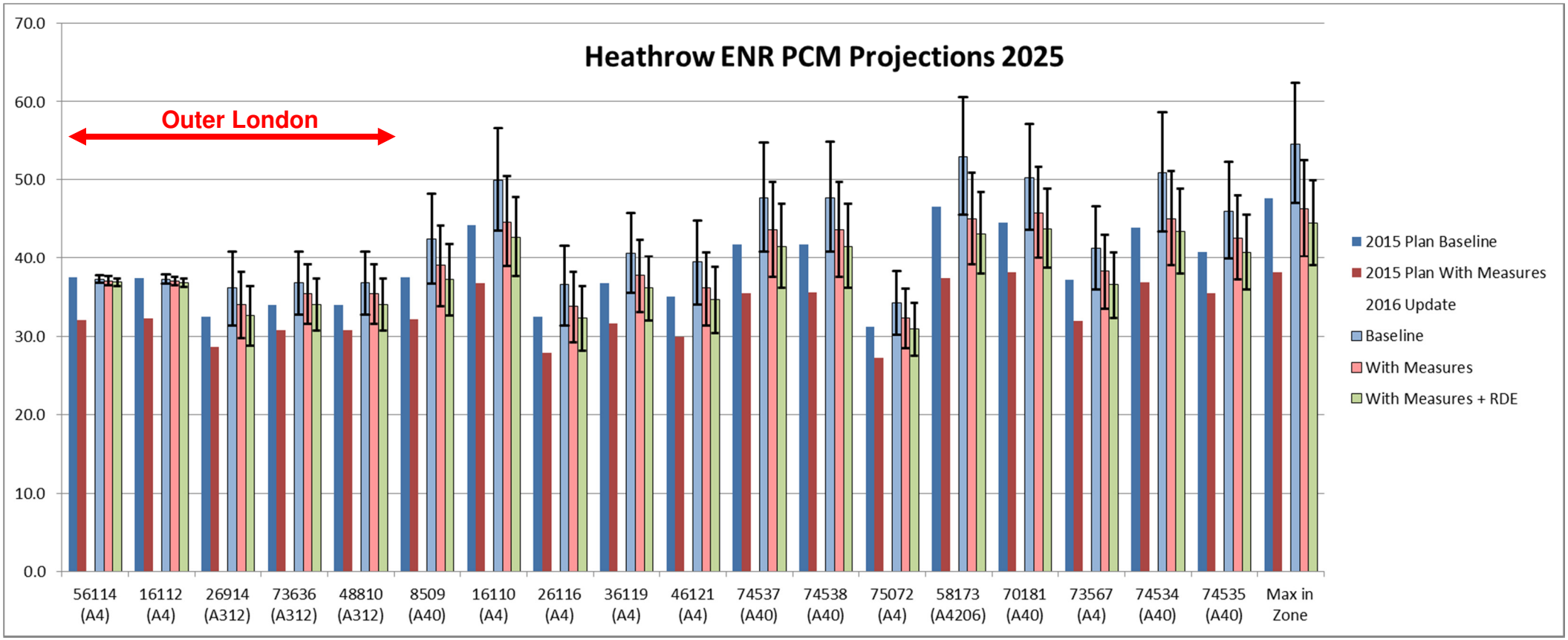
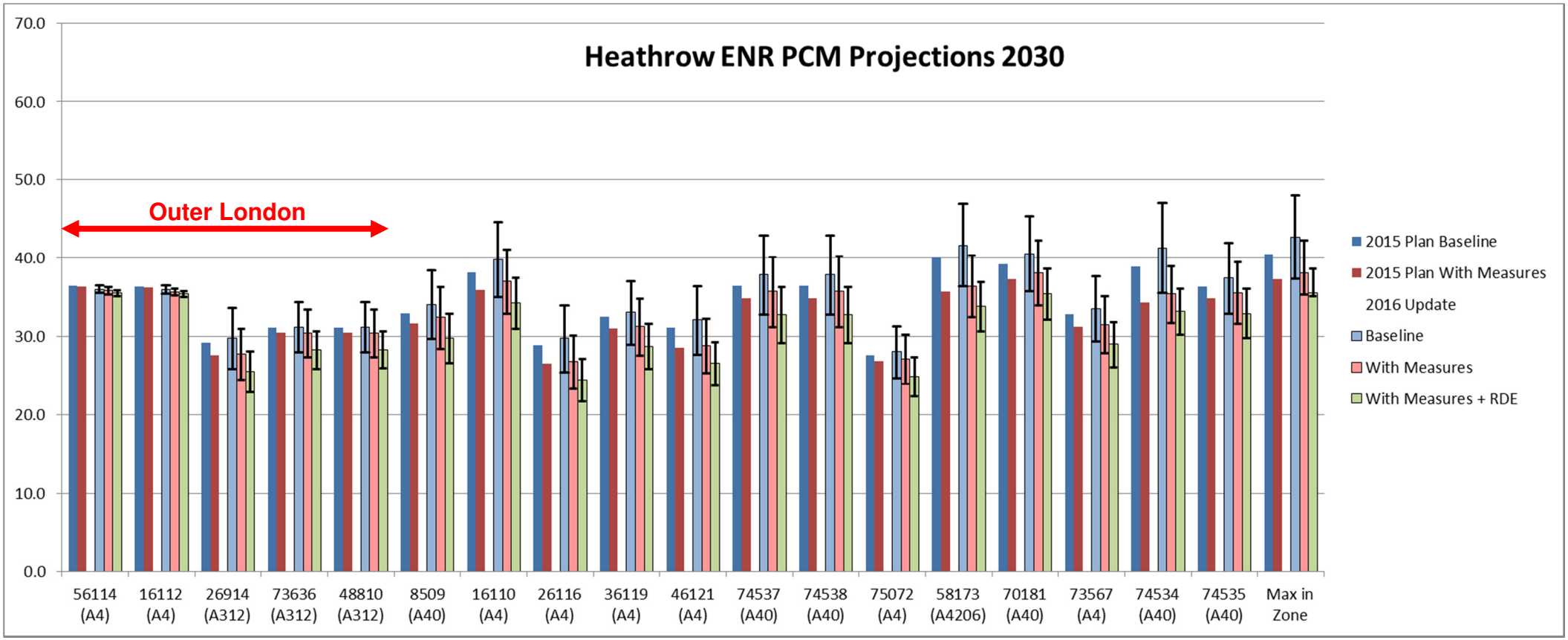


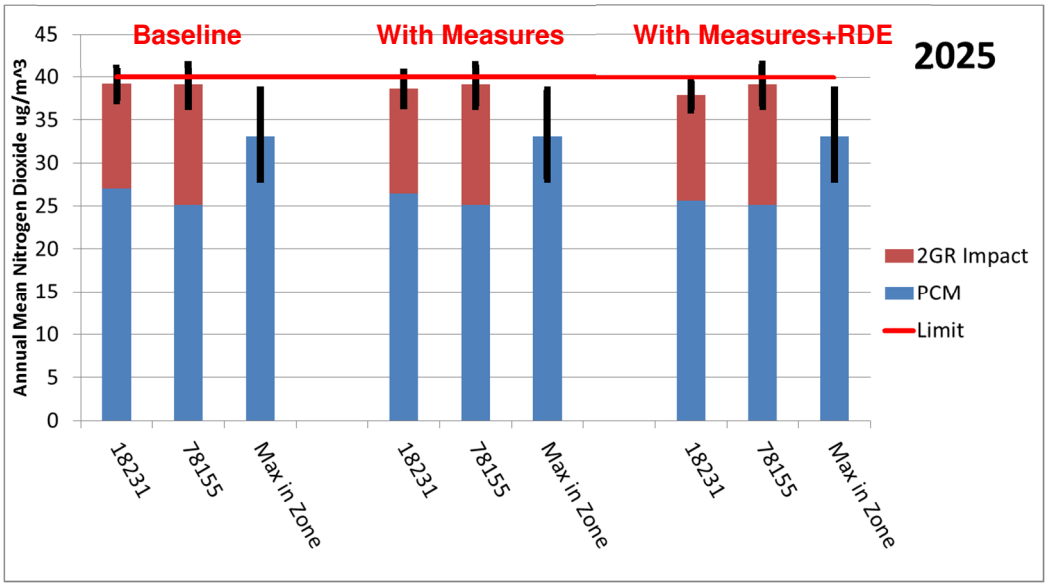
Figure A-3.2 PCM Projections for 2030. Main bars show the 'Central' emissions projections; error bars show the range of the 'high' and 'low' emissions tests (µg/m^3 NO_2). Links in central London except where indicated.



Appendix B

CRITICAL LINKS ANALYSIS

Figure B.1 Gatwick 2R Compliance Summary Graph. (18231, 78155 = A23)



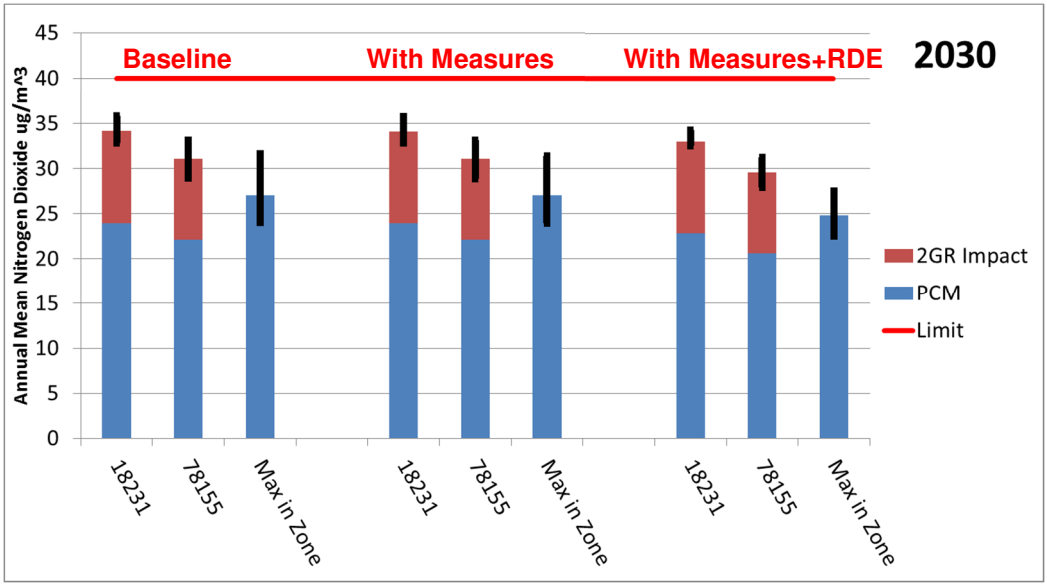
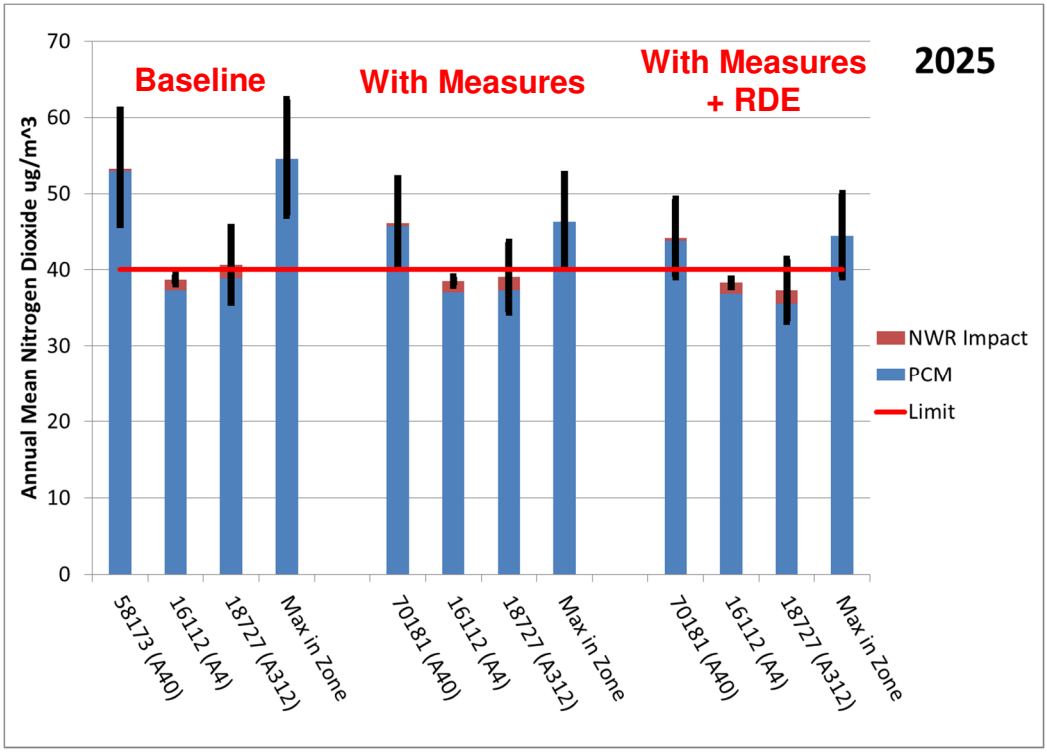


Figure B.2 Heathrow NWR Compliance Summary Graph



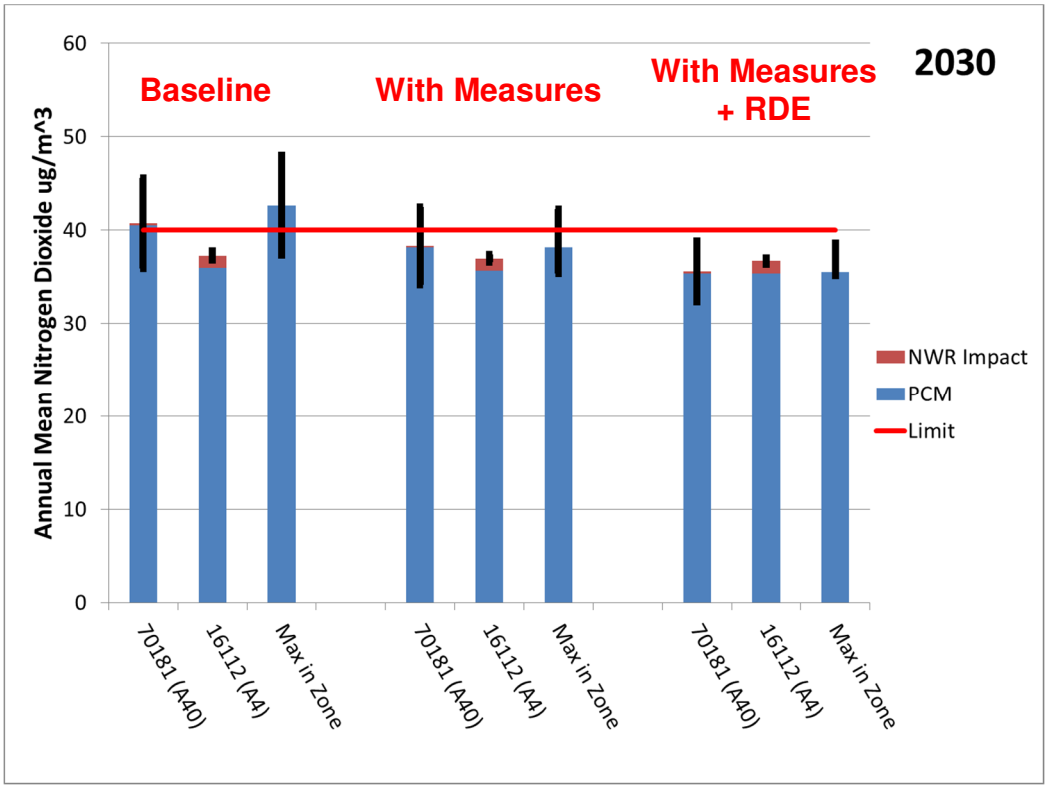


Figure B.3 Heathrow ENR Compliance Summary Graph