Heathrow Hub

Independent Innovation

Heathrow Hub Limited/Runway Innovations Ltd – Response to Airports Commission Consultation on Air Quality Assessment

May 2015

Introduction

Heathrow Hub Limited/Runway Innovations Ltd welcome the opportunity to respond to the Airport Commission's consultation on air quality assessment.

We are pleased that the Commission's assessment shows that there are no predicted exceedances of the air quality objective at any receptor location in the LHR-ENR scheme. We also note that of the three shortlisted schemes, only LHR-ENR provides any improvement in air quality, with a total of 6,600 properties predicted to experience improvements as a result of the scheme.

On Bath Road (A4), the consultation shows two links (Defra Census ID 16112 and 16114) where there are predicted delays to achieving compliance with the EU Limit Value for NO_2 as a result of the LHR-ENR scheme.

However, based on the traffic information provided in the consultation we believe that there is a traffic modelling error. The data predicts there to be a transfer of traffic onto the A4 from other local roads, when there are no relevant network changes in the area which would cause such an impact. The impacts of modal shift and redistributed access have also been under estimated. In reality both factors would result in decreased traffic along the A4/M4 corridor in the LHR-ENR scheme compared to the modelling in the consultation.

The above suspected traffic modelling error coupled with the omission of modal shift and traffic redistribution associated with the LHR-ENR scheme, has resulted in over predicted increases in traffic on the A4 which in turn has resulted in the over prediction of the contributions to total NO_2 concentrations along the A4. It is also considered that the potential to mitigate contributions of NO_2 from aviation sources are under-estimated in this location.

Additionally, although it is recognised that our proposed Heathrow Hub interchange surface access option has not been assessed as part of the LHR-ENR scheme, and this consultation response largely considers the LHR-ENR scheme assumed by the Commission, it remains important to consider the impact of the proposed Hub scheme on the modal share of passengers and employees accessing the airport; the impact the Hub would therefore have on local road traffic; and the resulting impact on local air quality.

Further consideration of the Hub surface access option is provided within this response. However, it can be summarised that, whilst the LHR-ENR scheme would not impact significantly on local air quality or compliance with the air quality objectives (as outlined within this response document), the Hub option would likely result in a far greater benefit to local air quality than either LHR-NWR or LGW-2R, with no more airport related traffic on the network around the airport than currently.

The Commission has previously referred to our proposals for the Hub interchange *"as deserving further exploration."*[1] As they have specifically not been assessed in terms of air quality, we urge the Commission to carry out this *"further exploration"* of our proposal, and in particular a comparative analysis with the alternative *"on-site"* surface access scheme assumed by the Commission. Without this, we believe there is the risk of a fundamental gap in assessment.

[1] Para 3.58, Consultation Document, Airports Commission November 2014

We hope it may be possible for this further analysis to be carried out as part of the Commission's decision-making process and would of course be pleased to assist in this process. However if time doesn't allow at this stage, we urge the Commission in its final recommendation to leave open the issue of the alternative Heathrow surface access proposals pending further assessment by the scheme promoters, Network Rail, DfT and Highways England.

Structure of this response

This report is structured as follows:

- Question 5 Response
    - Comments on the Airport Commissions Appraisal
    - Proposed Mitigation
    - Summary of Proposed Mitigation
    - Other Measures
    - Comparison of proposed schemes
- Question 6 Response
- Question 7 Response
- Conclusions

Response to the Commission's consultation

We respond with comments under the following questions from the Airports Commission's previous Consultation Document, which the Commission consider are most relevant to this new analysis.

Question 5 – Do you have any comments on how the Commission has carried out its appraisal of specific topics (as defined by the Commission's 16 appraisal modules), including methodology and results?

Comments on how the Commission has carried out its appraisal of air quality are provided first in relation to consideration of Surface Access and secondly Aircraft Movements:

Surface Access

The following are the key points relating to surface access which form the basis for our review of the air quality assessment:

- The Commission's predicted changes to traffic levels on the A4 in the LHR-ENR scheme do not appear to have any logical explanation.
- The Commission's traffic analysis is considered to be incorrect, as:
    - No allowance has been made for modal shift for employees with LHR-ENR but the Commission has assumed 15% mode shift from car for LGW-2R. However public transport interventions for LHR-ENR (and LHR-NWR) are much greater than those for Gatwick.

- It has assumed the wrong public transport mode share in mitigation (50%). The Commission has previously forecast 55%, some 5% higher than assumed in the air quality analysis.

- The Commission's analysis misrepresents the LHR-ENR air quality position by presenting traffic levels without any mode shift to public transport and states in relation to the mode shift *"…but it is not clear whether this is deliverable."*
- The Southern road tunnel changes the focus of access to the T2 (Eastern) airport campus, resulting in fewer vehicles accessing from the north compared with today. This further undermines the proposition that there will be air quality compliance issues on the A4.
- The Commission accept that an airport congestion charge, which is compatible with our surface access strategy, could reduce airport traffic to 2013 levels.
- Our alternative Heathrow Hub surface access proposals would have a further and dramatic beneficial impact on local road traffic around the airport due to the combination of mode shift to rail and traffic dispersion. However this has not been considered by the Commission. Further details are given under other measures at the end of this section.

Aircraft Movements

Regarding the air quality modelling of aircraft movements, we agree with the assumption of hold-times utilised within the main air quality modelling exercise.

However, for the sensitivity test we believe that the assumption of 10.42 minutes delay is an overestimate. Further details are provided later in this response document.

Through the use of single engine taxiing there is the potential to reduce the associated emissions by up to 20% more than has been considered possible by the Commission's air quality assessment. In addition to this it is thought that the taxi times assumed are currently overestimated in the assessment which will result in an overestimate of the associated emissions. Further details are provided later in our response.

Dispersion modelling methods

The Commission's air quality assessment does not assess which impacts to air quality are caused by airport related road traffic and which are due to other traffic and general growth, as outlined by the Commission in their response to queries raised during the consultations period:

> *"Apportionment of surface access emissions into airport and non-airport related categories was not possible as outputs of the traffic model for airport related traffic were in a format incompatible with those of the outputs for total traffic on the network. As such, it has not been possible to attribute the proportion of impacts caused by changes in traffic emissions to airport-related surface access".*

This makes it effectively impossible for the Commission or consultees to assess whether the impacts from surface access are a result of general traffic growth or due to emissions associated with road traffic accessing the airport. In important areas, this is considered to be critical in the overall evaluation of the scheme in air quality terms - for example it is not possible to determine whether road contributions to NO_2 along the A4, where a delay to compliance with the air quality objective for NO_2 is predicted, are a result of airport expansion or of more general growth.

Proposed Mitigation

A number of mitigation measures are reviewed by the Commission and our responses are set out below.

It must be recognised that there are a significant number of mitigation options and in order to ensure that the air quality around the airport does not deteriorate a combination of measures will be necessary. It is however clear from the Commissions consultation documents and our responses that air quality can be maintained at current levels with the LHR-ENR scheme.

Measure 1 – Modal shift of 38-50% of passengers from cars to public transport to the airport

The predicted changes to traffic levels on the A4 in the ENR scenario appear to have no logical explanation

The analysis identifies that the combined traffic on the A4 and the Northern Perimeter Road – taking a screen line to the west of the M4 spur – is the same for the Base, DM (Do Minimum) and LHR-ENR models. However the distribution changes between the two roads between the scenarios such that with the LHR-ENR scheme, traffic on the A4 is assumed to increase by some 7,000 vehicles per day and decrease by some 7,000 vehicles per day on the Northern Perimeter Road compared with the base. Given there are no significant changes to road layouts we can see no reason why the traffic distribution should change in this way in the LHR-ENR scheme.

This calls into question the contribution from road traffic to the Commission's predicted delay to compliance with the air quality objective for NO_2 along the A4.

Employee mode shift from cars ignored for LHR-ENR but 15.3% assumed for LGW-2R

Based on Jacobs analysis the number of surface access trips for passengers and employees in 2012 and 2030 is shown in the table below. This indicates a significant increase in the total number of surface access (passengers and employees) trips with the LHR-ENR scheme.

Surface Access trips							
	Pax			Employees			
	Daily trips	car mode share	car trips	Daily trips	car mode share	car trips	Total daily trips
2012	136000	59%	80240	88000	47%	41360	**121600**
2030	202000	45%	90900	104000	47%	48880	**139780**
					Difference		**18180**

Source: Appraisal Framework Module 4. Surface Access: Heathrow Extended Northern Runway Appendices Table 1.

However this analysis appears to assume that the car mode share for employees in 2030 is the same as for 2012. This is inconsistent with the approach taken in the Commission's assessment of LGW-2R and is a major overestimate for the following reasons:

- Gatwick employee car mode share is assessed to reduce by 15.3% due to investment in public transport,[2] yet the improvements in terms of Gatwick's public transport accessibility are far less than those proposed for either Heathrow option.
- Heathrow's passenger public transport mode share increases significantly (rail increase by 14%) as a result of the new rail links: Crossrail, Southern Rail Access, HS2 and WRAtH. It is therefore not clear why this does not have at least the same (or more likely much greater) impact on employee mode shift.
- Some 54% of Heathrow employees live in Hounslow, Hillingdon, Slough, Spelthorne and Ealing and the next five largest locations are Windsor & Maidenhead, Richmond, Runnymede, Harrow and Bracknell Forest (based on HAL employee's survey 2013).[3] The vast majority of these locations benefit from new/improved public transport.
- Jacobs have tested a 60% public transport mode share for employees[4] which is said to make little difference in terms of road traffic impacts. This appears inconsistent, given that a 30% car mode share for employees (60%PT + 10% cycle) is shown as effectively resulting in no net increase in cars for passengers + employees in the 3 runway 2030 scenario. This is illustrated in the table below.

Surface Access trips								
	Pax			Employees				
	Daily trips	car mode share	car trips	Daily trips	car mode share	car trips	Total daily trips	Comments
2012	136000	59%	80240	88000	47%	41360	**121600**	
2030	202000	45%	90900	104000	30%	31200	**122100**	Employees PT mode share increased to 60% (ref lhr-nwr appendix) plus 10% cycle
					Difference		**500**	

Source: deduced from Table above by applying 30% car mode share to employees in 2030

Incorrect public transport mode share assumption

We believe that modal shift to public transport should be greater than assumed in the consultation as the Commission has previously confirmed a 55% public transport mode share for passengers for LHR-ENR.[5], The mitigation benefit should therefore be greater than the -2µm/m^3 calculated by the Commissions assessment.

Misrepresentation of Modal Shift

The air quality analysis has been undertaken assuming that there is no modal shift from car to public transport, and modal shift has then been applied as a mitigation. The Commission states:

> *"The Stage 2 Submission from the Promoter sets out a vision for high public transport access, but it is not clear whether this is deliverable"*[6] and under its mitigation measures states *"Modal shift of 38-50% of passengers from cars to public transport access to the airport"*[7]

[2] Appraisal Framework Module 4: Surface Access Gatwick Second Runway Executive Summary Objective 1

[3] Ipsos MORI Heathrow Employment Survey 2013: Taking Britain Further Volume 2 Appendix 6

[4] Appraisal Framework Module 4. Surface Access: Heathrow Airport North West Runway Appendices

[5] Appraisal Framework Module 4: Surface Access Heathrow Extended Northern Runway Executive Summary Objective 1, Jacobs Access

[6] Para 4.6.3, Detailed Emissions Inventory and Dispersion Modelling, Jacobs May 2015

This is inconsistent with the Commission's previous calculation and confirmation that LHR-ENR public transport mode share will increase to 55% as part of its surface access appraisal.[8] This should therefore be included in the Do minimum analysis - the consultation's assumption of 50% public transport mode share is a significant underestimate.

The LHR-NWR scheme redistributes traffic such that inter-terminal traffic uses the Southern road tunnel to the T2 campus and a significant proportion of Greater London and South East passengers and employees will access the airport from the south, reducing pressure on roads to the north of the airport (including on the A4).

The assumption as to the use of the southern perimeter road and the south tunnel for distribution is equally valid for the ENR proposal as for the HAL proposal, yet do not appear to be reflected in the analysis. This raises into question the validity of the predicted impacts of the air quality assessment.

Measure 2 – Maximising the distance between the new road sections, car parks and other key emissions sources from future sensitive receptors

The Southern Road Tunnel

We have derived the 2 way AADT flows from the time period traffic volumes provided by the Commission as part of the consultation. This evaluation established that the number of trips that terminate in the T2 campus is approximately 55,000 vehicles per day in the Do-Minimum and 70,000 vehicles per day with LHR-ENR and that approximately 1/3rd of trips in the LHR-ENR scenario are through the Southern road tunnel. This means that with LHR-ENR approximately 45,000 trips/day will access the airport from the North which is a significant reduction on the Do-minimum. This evaluation demonstrates the benefit of the Southern road tunnel in:

- Taking the focus of access away from the north.
- Reinforcing the view that there will be less traffic on the north side of the airport and thus making it highly unlikely that there will be more vehicles on the A4 compared with the Do-Minimum and the base case.
- Any impacts of growth on air quality will therefore be distributed away from the key locations on the A4.

Heathrow Hub

Our Heathrow Hub proposal, which provides a new gateway to the airport, together with the Southern road tunnel, maximises the distance between emission generators and receptors and would therefore have a beneficial effect on air quality around the airport, as described later in this response.

Measure 3 – Incorporating ventilation systems within the M25 tunnel to reduce build-up of emissions at tunnel portals

The consultation confirms that there are no receptors within 200m of the tunnel portals and that there is therefore no need for mitigation measures to be considered.

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[7] Para 6.6.3, *ibid*

[8] Appraisal Framework Module 4: Surface Heathrow Extended Northern Runway Executive Summary Objective 1, Jacobs Access

Measure 4 – Use of the extended runway to allow a proportion of the take-off emissions on the LHR-ENR to be well away from the airport boundary

The consultation assumes *"a two thirds departure with LHR-ENR during all westerly operations."* It is agreed that this is representative of the proposed scheme.

Measure 5 – NOx emission charging to encourage airline to use the cleanest aircraft and encouragement to use optimised thrust take-off techniques

Whilst we support the principle of charging and best practice, we believe that this is an example of how planning conditions could be imposed to ensure measures such as use of the cleanest aircraft and operational procedures to limit air quality and other environmental impacts, (including noise). Bearing in mind the timescales for delivery of new runway capacity, airlines would have ample time to plan fleets and introduce new procedures as required.

It is therefore considered that the benefit attributed to this measure within the Commission's air quality report would be fully realised.

Measure 6 – The provision of Fixed Electrical Ground Power (FEGP) and Pre-Conditioned Air (PCA) to reduce the need for APU usage

We believe that this is another example of measures that could be controlled by planning conditions, enforced by strict monitoring and stringent financial penalties for non-compliance. Heathrow is in the almost unique position where its commercial attractiveness to airlines would permit such rigorous measures, which at other airports may act to discourage airlines from operating.

It is not clear why the consultation assumes that aircraft using remote stands would not have access to FEGP and PCA. We envisage this being provided at all stands in the LHR-ENR scheme and believe that the Commission's assessment of a 90% reduction in NOx emissions as a result of imposing the strict rules regarding the use of APU for commercial aircraft on both arrival and departure would be achieved.

Measure 7 – Improve infrastructure for Ultra Low Emission Vehicles (ULEVs) such as electrical charge points and hydrogen fuel stations, both airside and landside

This is again a measure that could be implemented and controlled through appropriate planning conditions and we believe the Commission's assessment should be amended accordingly. We again note that the timescales for delivery of new runway and stand capacity are such that airlines, the airport operator and other vehicle owners have ample time to plan their fleet management accordingly. The benefit attributed to this measure within the Commission's assessment of -0.2 $\mu g/m^3$ would therefore be achieved as a minimum.

Measure 8 – Minimising aircraft emissions through the development of take-off/landing and taxiing schedules to reduce hold times on the apron and taxiway

We agree with the assumption of hold-times utilised within the main air quality modelling exercise.

However, for the sensitivity test it is understood that the assumption of 10.42 minutes is based on Leigh Fisher's analysis (2012)[9] on the typical delay times for Heathrow. We assume these are historical delay times based on a two runway airport and therefore would not reflect a three runway scenario. In fact,

[9] Average Day Forecasting Methodology, Leigh Fisher March 2015

our analysis confirms that capacity should easily outstrip demand in 2030, with the new runway in operation but additional capacity not fully utilised.

We also believe the 2008 Safety, Health and Environment (SH&E) report used in the Commissions assessment is out of date. Since the publication of this report, Heathrow Airports Ltd has implemented measures to reduce the departure delay, meaning that this report should not be used as evidence for significantly longer delay times as assumed in the sensitivity tests.

The NOx emissions associated with the departure delay times as presented within the Commission's Air Quality Reports sensitivity test are therefore considered to be overestimated.

The Commission have assessed LHR-NWR on the basis of a mitigation measure assuming an airport layout *"designed to minimise the distances that aircraft taxi between stands and runways"*[10] However no similar measure has been included in the assessment of LHR-ENR, even though this is likely to reduce taxiing distances, eg: compared to the distance between T4 and the North West runway in the LHR-NWR scheme, taking into account the additional distance incurred by the use of End-Around taxiways to avoid the need for runway crossings.

The NOx emissions associated with the taxi times within the Commission's Air Quality Reports are therefore considered to be overestimated.

Measure 9 – Ensuring additional emissions from heat and power generation plant are mitigated

We again suggest this is a measure best implemented and controlled through planning conditions. We also note, as set out in our previous submission,[11] the opportunity for an integrated energy and waste strategy by use of the nearby Lakeside Energy from Waste plant.

Measure 10 - Encouraging airlines to shut down an engine during taxiing

The Commission suggest that an approximate reduction of 25% in taxi-out emissions is achievable for the LHR-ENR scheme through shutting down an engine during taxiing.

This assumption was based on a study funded by NASA Ames (Kumar et al, 2014), which concluded that single engine taxi-out procedures have the potential to reduce taxi-out NOx emissions by 27% at Orlando (MCO) Airport and by 45% at New York La Guardia (LGA).

LGA appears to be a much smaller airport than MCO or Heathrow Hub. However, MCO has more runway crossings than either airport. On this basis, the reduction in NOx emissions achievable with the LHR-ENR scheme should be closer to LGA.

We therefore suggest that a 45% reduction in NOx emissions from taxi-out should be assumed as part of the assessment, which would further mitigate the airport emissions contribution to local pollutant concentrations in locations surrounding the airport, such as on the A4.

Measure 11 - Alternative fuels for aircraft

[10] Para 5.6.3, Detailed Emissions Inventory and Dispersion Modelling, Jacobs May 2015

[11] Appendix C-4, HHL/RIL response to Airports Commission consultation, February 2015

We believe that the aviation industry is making faster progress than assumed in the consultation. For example, by 2017 BA's joint venture with Solena is intended to supply the airline with 50,000 tonnes/year of synthetic jet fuel, without requiring any modifications or changes to aircraft engines or supply infrastructure.[12] However, it is understood that there is no method currently available of quantifying the impact, if any, of alternative fuels on NO_X emissions.

12 - Operate LHR-ENR with a steeper glide slope

We agree that this measure, which would be adopted to reduce noise impacts, would contribute little to reducing ground level concentrations of NO_2.

13 - Introduce an airport congestion charge

As stated in our previous submissions, a terminal forecourt access (cordon) charge is entirely compatible with our surface access strategy. A charge of this nature is an additional element in the armoury to ensure that private car traffic levels do not increase above the current levels[13], as referred to in the Jacobs report. In addition we would suggest the use of planning conditions to ensure that any such charge was ring fenced for public transport and surface access improvements. Assuming that c17m cars currently access the airport[14] a £10 charge would generate c£170m/year, which when capitalised could fund significant infrastructure investment.

The consultation states in relation to congestion charging that *"An evaluation of Measure 1 (see above) assumes no increase in traffic levels above Do-Minimum, and no further analysis was considered necessary.",* This seems incompatible with Jacobs statement that traffic levels could be maintained at current levels which are different from those assumed in the Do-Minimum.

Whilst a cordon charge would be likely to be effective in delivering greater modal shift to public transport under the LHR-ENR scenario (with the *"on-site"* rail scheme assumed by the Commission), we believe it would be even more effective with our alternative Heathrow Hub Interchange and additional Southern Rail Access proposals. These provide much greater direct public transport accessibility and connectivity – *"the carrot"* for passengers and employees to balance the congestion charge -*"the stick"*..

As part of the further development of the third runway proposals, we would propose that the level of charge and the markets it relates to (passengers or employees or both) would be determined to best meet the air quality and mode share objectives.

14 - Implementation of an Ultra-Low Emissions Zone (ULEZ)

The Commission has considered the impacts of a ULEZ to evaluate the potential reduction in NO_2 concentrations along the A4 Bath road with the LHR- ENR scheme.

As outlined within the Commission's air quality assessment, TfL have consulted on proposals for a ULEZ which could reduce outer London emissions by c10% for NO_2 and NO_X. [15]It is considered that given the

[12] http://www.alternativefuelsworldwide.com/presentations/Solena%20Fuels%20-%20British%20Airways%20Presentation.pdf

[13] Module 6 Airports Commission Air Quality Assessment page 103

[14] Appraisal Framework Module 4: Surface Access Heathrow Extended Northern Runway, Jacobs: 2012 Surface Access passengers = 43.3m, car mode share 59%, car occupancy 1.5 passengers per car

[15] Table 12, Para 16.3 Supplementary Information, Ultra Low Emission Zone consultation, TfL October 2014 https://consultations.tfl.gov.uk/environment/ultra-low-emission-zone/user_uploads/ulez-supplementary-information---final-291014.pdf-1

recent Supreme Court ruling on air quality and the Mayor's confirmation of the introduction of a ULEZ from 2020,[16] the maximum benefit outlined in the commission's report is considered achievable.

Summary of Proposed Mitigation

We comment below on the Commission's summary of mitigation measures for LHR-ENR (Table 6.16)

Measure	Consultation assessment of impact on PCM exceedance (µg/m^3)	HHL/RIL assessment of impact on PCM exceedance (µg/m^3)	Comments
1 – Modal shift of 38-50% of passengers from cars to public transport to the airport	Modal shift considered through use of Do Minimum road traffic as proxy. Benefit of -2. µg/m^{3}attrributed to measure.	Potential for significant reduction in impacts from road traffic on local air quality. Greater than -2 µg/m^3.	The potential reductions in local road traffic (including along the A4 Bath Road) due to the surface access strategy have not been properly represented within the traffic modelling. No allowance has been made for the modal shift of employees and the Modal shift should be 55%, which is 5% higher than assumed in the analysis.
2 - Maximising the distance between the new road sections, car parks and other key emissions sources from future sensitive receptors	The layout of the LHR-ENR scheme has been incorporated into the assessment – no benefit assigned.	Potential for significant reduction in impacts from road traffic on local air quality.	No consideration has been given to the potential benefits of the Heathrow Hub surface access proposals.
3 - Incorporating ventilation systems within the M25 tunnel to reduce build-up of emissions at tunnel portals	Outlines no receptors within 200m therefore no mitigation would be required and so no benefit to air quality assigned.	Agreed that as no receptors within 200m no mitigation is required due to lack of exposure.	No benefit.
4 - Use of the extended runway to allow a proportion of the take-off emissions on the LHR-ENR to be well away from the airport boundary	Assessment has assumed a two-thirds departure with Heathrow ENR during all westerly operations, and maximises the benefits of take-off emissions away from the airport boundary. No benefit to air quality assigned.	Agreed.	No Benefit.

[16] http://www.tfl.gov.uk/modes/driving/ultra-low-emission-zone?cid=ultra-low-emission-zone

Measure	Consultation assessment of impact on PCM exceedance (µg/m^3)	HHL/RIL assessment of impact on PCM exceedance (µg/m^3)	Comments
5 - NOx emission charging to encourage airline to use the cleanest aircraft and encouragement to use optimised thrust take-off techniques	-1.2 µg/m^3	-1.2 µg/m^3	We suggest this measure is made mandatory via planning conditions.
6 - The provision of Fixed Electrical Ground Power (FEGP) and Pre-Conditioned Air (PCA) to reduce the need for APU usage	Results indicate a 90% reduction in annual NOx emissions resulting in -0.4 µg/m^3 benefit attributed to measure.	-0.4 µg/m^3	We suggest this measure is made mandatory via planning conditions for all aircraft.
7 - Improve infrastructure for Ultra Low Emission Vehicles (ULEVs) such as electrical charge points and hydrogen fuel stations, both airside and landside	Sensitivity test for the introduction of a higher proportion of non-road GSE for the Heathrow ENR Scheme has been based on an assumption that 80% of the diesel NRMM is replaced with electric variants by 2030. The results suggest that the use of 80% electric NRMM within the GSE fleet could lead to reductions in total annual NOx emissions of around 106 tr/yr, equivalent to a 60% . - 0.2 µg/m^3 benefit attributed to measure.	- 0.2 µg/m^3	We suggest this measure is made mandatory via planning conditions.
8 - Minimising aircraft emissions through the development of take-off/landing and taxiing schedules to reduce hold times on the apron and taxiway	Commission report that hold times used in modelling likely to be under predicted therefore no benefit assigned.	Potential benefit from shorter taxiing times to and from the runway.	We believe hold times are overestimated in sensitivity test. We also believe that the taxiing times have not been properly represented within the modelling and therefore the associated emissions overestimated.
9 - Ensuring additional emissions from	Mitigation included in assessment based on ultra-low NOx emissions.	Agreed that assumed emission represents likely outcome.	No Benefit.

Measure	Consultation assessment of impact on PCM exceedance (µg/m^3)	HHL/RIL assessment of impact on PCM exceedance (µg/m^3)	Comments
heat and power generation plant are mitigated			
10 - Encouraging airlines to shut down an engine during taxiing	Potential for 25% reduction in NOx assumed based on US studies. -0.25 µg/m^3 benefit attributed to measure.	Potential for 45% reduction in NOx, rather than 25% currently assumed. Greater than -0.25 µg/m^3	Having reviewed studies, this suggests the potential for benefit is more likely to be in the region of 45% as Heathrow airport is more similar to La Guardia.
11 - Alternative fuels for aircraft	Not possible to quantify what, if any effect, the future uptake of biofuels would have on reducing NOx emissions from aircraft associated with the ENR scheme.	No benefit attributed to measure.	We suggest further analysis is required.
12 - Operate LHR-ENR with a steeper glide slope	A steeper glide slope of 3.2 degrees has been assumed for the LHR-ENR scheme. However emissions during approach make very little contribution to ground-level concentrations (as the emissions are principally at altitude).	No benefit attributed to measure.	Agreed.
13 - Introduce an airport congestion charge	An evaluation of measure 1 (see above) assumes no increase in traffic levels above do minimum and no further analysis was considered necessary.	Potential for further reduction above that outlined in Measure 1 in the contribution from local road traffic.	As outlined in response to measure 1 the potential reductions in local road traffic (including along the A4 Bath Road) due to the surface access strategy have not been represented within the traffic modelling. Should airport congestion charging be put in place this would further discourage users of the airport from arriving by car. It is considered that the Commissions air quality assessment overestimates the

Measure	Consultation assessment of impact on PCM exceedance (µg/m^3)	HHL/RIL assessment of impact on PCM exceedance (µg/m^3)	Comments
			impact from road traffic.
14 -Implementation of an Ultra-Low Emissions Zone	It is unclear what form a ULEZ would take. However, an indicative sensitivity test has been carried out assuming A) only euro VI and Euro 6 vehicles are on Bath Road and B) in addition to (A) 30% of the light duty vehicles are zero emission. Potential benefit of A) 0.4 µg/m^3 and A+B) -1.6 µg/m^3	-1.6 µg/m^3	The maximum benefit outlined in the commission's report is considered achievable.
Total	-4.45 to -5.65	Greater than -5.65	Given potential benefits from measures 1, 2, 8 and 13, the Commission's assessment of airport contributions to local pollutant concentrations are likely to be over-estimated and so the total concentrations predicted with mitigation are likely to be too high.

Other measures

We suggest the Commission also considers the following in its air quality assessment:

Heathrow Hub surface access proposal

We believe that the consultation confuses our *"Stage 2 submission"* with the surface access scheme that has actually been assessed by the Commission.

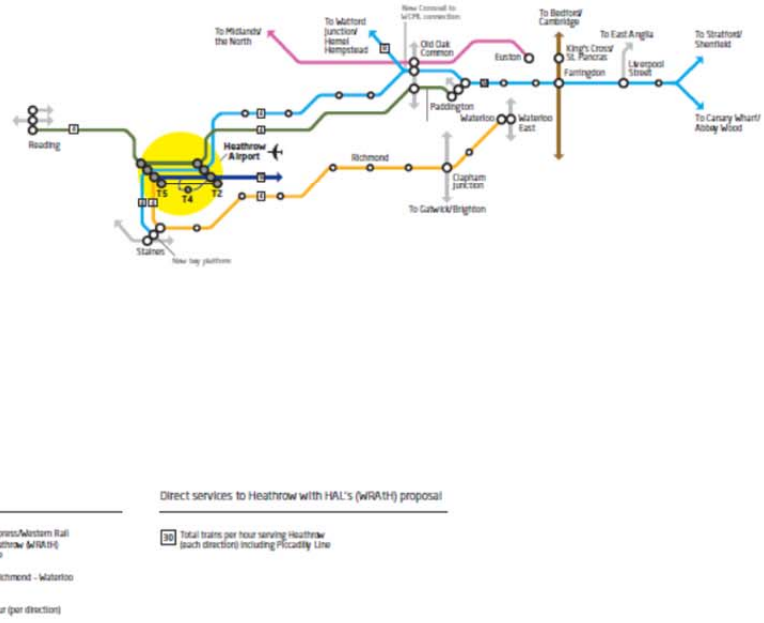
To clarify, the Commission decided at an early stage of the appraisal process to assess both LHR-NWR and LHR-ENR *"as containing an "on-site" surface access strategy"*[17] – effectively Heathrow Airport Ltd's (HAL) scheme based on Western Rail Access to Heathrow, rather than our alternative Heathrow Hub proposal.[18]

[17] Para 3.58, Consultation Document, Airports Commission November 2014

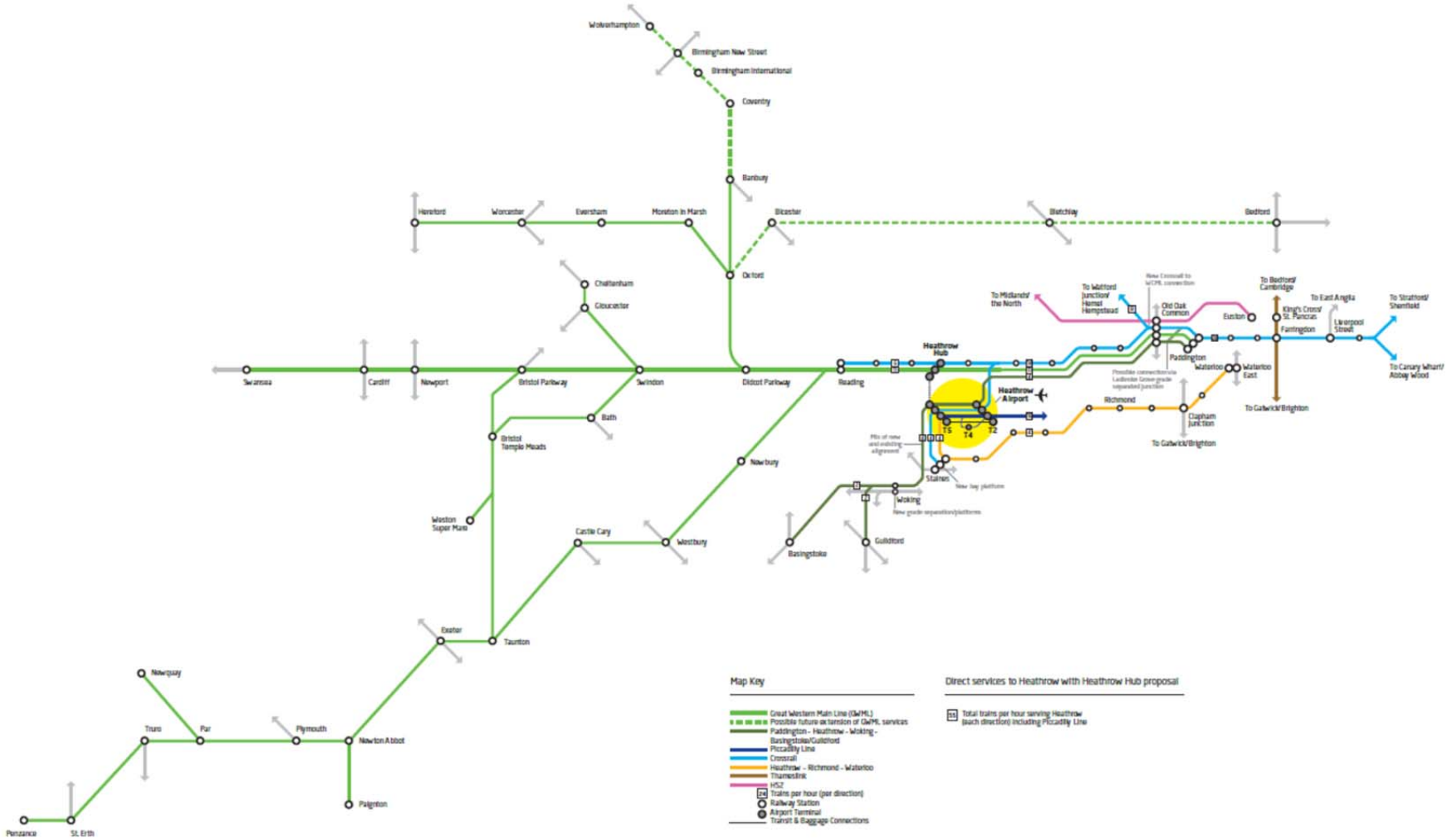
[18] *"The assessments throughout these consultation documents are based on the use of an on-site surface access solution for both Heathrow options"* – Para 3.58, Consultation Document, Airports Commission November 2014

The diagrams below illustrate the significant differences between these proposals;

Airports Commission "On-site" scheme



Heathrow Hub proposal



The Heathrow Hub proposal has two distinct benefits:

- It significantly increases the airport rail population catchment and public transport mode share.
- It provides a new gateway to the airport ensuring that the airport related traffic on the road network around the airport would remain at or below the 2013 levels with the addition of the 3rd runway.

Public Transport

The Heathrow Hub proposals provide a "one seat ride" from a much larger catchment, with 110 trains per hour direct to the airport, serving all compass points at very high frequencies with a population of more than 36m within 2 hours by rail and 48m within 3 hours. The significant impact of this on public transport mode share is accepted by the Commission's consultants who confirm that, considering the Great Western Main Line corridor alone, *"our mode choice model predicted that the rail mode share of passengers from the Greater Western sector would be 17% with WRAtH, compared to 30% with the Hub surface access proposal (while HH indicate an increase to 38%)."*[19]

Our previous submissions confirmed a conservative estimate of an overall market share for travel to and from Heathrow of 46% for rail and 10% for bus and coach resulting in a total public transport mode share much greater than that assumed in the consultation.

The consultation assumes *"Heathrow Hub would promote a modal shift of approximately 38-50% of passengers moving from cars to public transport access to the airport."*[20] It also states *"the Stage 2 submission from the Promoter sets out a vision for high public transport access, but it is not clear that this is deliverable."*

This appears to be inconsistent with the Commission's previous forecasts of a public transport mode share (assuming the core baseline) of 55% for LHR-ENR[21] (the same as LHR-NWR[22] as both assume the same *"on-site"* surface access scheme), of which 43% would be rail (compared to 28% in 2012).

It also ignores the fact that a surface access scheme including Heathrow Hub will deliver an even higher public transport mode share.

In addition, the work carried out by Network Rail and ourselves as part of the Southern Rail Access Steering Group confirms that the A3/M3 corridors offer a dense and attractive target markets for rail access to Heathrow, as demonstrated by the Railplan modelling we have carried out since our previous submission (report attached at Appendix 2). The Southern Rail Access study has so far concluded that the two routes for which there was a prime facie case for further development are those which are included in our previous submissions to the Commission - Heathrow to Waterloo via Staines and Heathrow to Woking/Guildford/Basingstoke.[23]

Whilst the former appears to be included in the consultation's assumptions, the latter is not. The modelling therefore under-estimates the modal shift likely to be achievable with our surface access

[19] Paras 4.3.3 and 4.4.12, Appraisal Framework Module 4 - Surface Access: Heathrow Airport Hub Station Option, Final for Consultation Jacobs 28th October 2014

[20] Para 6.6.1, Module 6: Air Quality Local Assessment – Detailed Emissions Inventory and Dispersion modeling, Jacobs May 2015

[21] Figure 7, Para 3.4.1 Module 4, Surface Access: Heathrow Airport Northern Runway Extension, Jacobs October 2014

[22] Figure 7, Para 3.4.1 Module 4, Surface Access: Heathrow Airport North West Runway, Jacobs October 2014

[23] Appendix D-6, Appendices to HHL/RIL response to Airports Commission consultation, February 2015

proposals. Network Rail intends to complete the Southern Rail Access Study by the end of July 2015 and we suggest that air quality assumptions and modelling are then revised accordingly.

Maximising the airport catchment accessible by direct rail services is key to reducing airport access road journeys generally and the disproportionate impact of *"kiss and ride"/*minicab trips in particular.[24]

We also note that the consultation does not appear to assess the implications of the apparent loss of the Colnbrook freight branch and its extensive rail freight facilities in the LHR-NWR scheme. In the absence of any proposals for their replacement elsewhere, we suggest that air quality modelling should consider the possible implications of some or all of this traffic switching from rail to road, including the need to maintain aviation fuel supplies that are currently brought by rail to Heathrow

Highway Access

Heathrow Hub changes the airport's road accessibility by providing a new gateway from the M25 and M4, connected directly to the airport campus via fast high capacity transit and baggage systems. This allows greater dispersal of traffic, dramatically reducing the amount of airport traffic that needs to use the road network in and around the existing airport, and therefore having a significant effect on air quality.

The Commissions consultants have previously recognised these benefits;

"It is acknowledged that the location of the remote parking is likely to remove some airport related traffic from the final links of their journey in the vicinity of the airport, particularly from trips approaching from the north and west"[25] and *"the role of the Hub as the northern gateway to Heathrow … adjacent to the M25 …. allows drivers to avoid the more congested M25/M4 links closer to the airport and the approach roads to the CTA."*[26]

In addition to the benefits for car access, Heathrow Hub brings significant benefits for bus & coach operators as accepted by the Commissions consultants; *"for routes serving destinations to the south west, and west of London, this could be an operational benefit to express coaches as it offers the possibility of keeping services closer to the M25 / M4 / M40 corridors and avoiding the more severely congested access roads approaching the CTA."* [27]

Our previous submission noted the potential for the Hub interchange to *"significantly reduce emissions, for example by relocating coaches and other diesel vehicles from the congested Central Terminal Area, where the prevailing south west winds lead to a combination of road and aircraft emissions affecting sensitive receptors to the north east of the airport."*[28]

In responding to the current consultation, we have discussed our proposals for the Hub interchange with senior management at Oxford Bus Company and National Express. Both companies confirm that

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[24] *"61% of passenger travel emissions are generated by kiss & fly, taxi and minicab journeys which all generate four trips per return flight"*—Heathrow Carbon Footprint & Surface Access Strategy, BAA 2009

[25] Para 4.6.2, Appraisal Framework Module 4 - Surface Access: Heathrow Airport Hub Station Option, Final for Consultation Jacobs 28th October 2014

[26] Para 3.3.4, Appraisal Framework Module 4 - Surface Access: Heathrow Airport Hub Station Option, Final for Consultation Jacobs 28th October 2014

[27] Para 3.2.5, Appraisal Framework Module 4 - Surface Access: Heathrow Airport Hub Station Option, Final for Consultation Jacobs 28th October 2014

[28] Para 4.23-5, C-5 Response to Commission identified Delivery Risks to LHR-ENR, Appendices to HHL/RIL response to Airports Commission consultation, February 2015

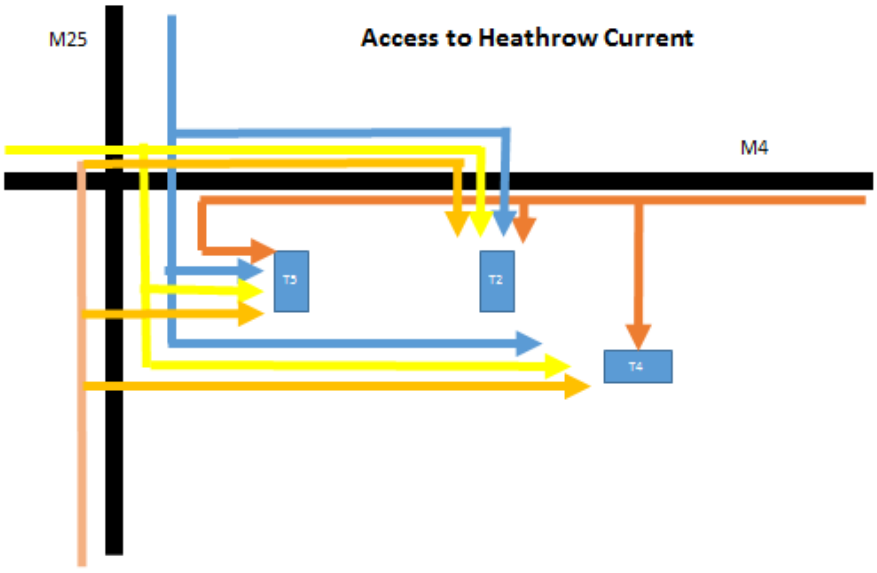
they would envisage significant benefits in being able to serve Heathrow without the time and mileage penalty that results from a diversion off the motorway corridors to access the Central Terminal Area. Whilst their coaches comply with Euro 6 standards, Heathrow is the busiest bus and coach interchange in the UK and there is therefore significant potential to reduce emissions.

Our previous submission[29] also noted that the large size (c200 acres) of the Hub interchange site could provide a consolidated car rental facility to remove the large number of shuttle buses that are currently required to serve the airport's existing widely dispersed sites. This adopts the approach of other airports to reduce road traffic and improve air quality.

Miami's similar scheme released 50 acres of previous individual car rental facilities for redevelopment, whilst also reducing the airport's shuttle bus fleet by 50%, and removing 15% of terminal area traffic.[30]

The reality is that Heathrow Hub dramatically changes the dynamics of road access to Heathrow and within the airport campus, thus reducing the contribution to pollutant concentrations near to the road network accessing the airport.

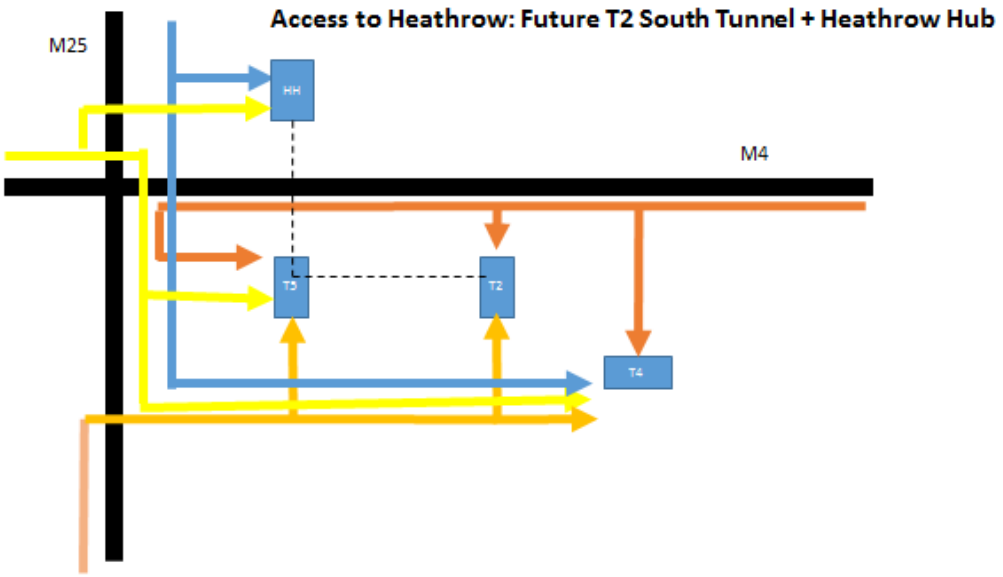
The diagram below indicates the assumed current access routes by passengers to each of the terminals from Greater London, the West, the South and the North. The assumptions are conservative in that they assume all traffic will use either the A4, M4 or M25 or some combination thereof whereas in practice a reasonable amount of Greater London traffic, in particular, will use other roads to access the airport.



[29] Appendix C-5, Para 4.26-7, Appendices to HHL/RIL submission to Airports Commission consultation, February 2015
[30] http://www.airportimprovement.com/content/story.php?article=00207

The picture is dramatically different with the Heathrow Hub strategy as:

- Passengers from the West (M4) for the T2 complex would access the airport via the Hub, T5 passengers would likely still access T5 directly.
- Passengers from the North (M25) for both T5 & T2 complexes would use the Hub.
- Coach operators could access the airport via the Hub.
- Passengers from the South would access the T2 campus via a new Southern road tunnel.
- Inter-airport movements to/from the T2 complex would similarly use the Southern tunnel.
- 40% of employees live on the south side of the airport and would use the Southern tunnel for access as opposed to using the A4/M4 corridor.



The impact of this redistribution is to dramatically reduce the traffic levels in and around the airport.

Although there might be different views as to the airport catchments from the various directions, using the Jacobs assessment as the baseline,[31] the numbers of airport passenger traffic on the critical section of the M25 and M4 corridors more than halve, as shown in the table below.

Car Per Annum			
Critical Road Section	2012 mpa	2030 HH + T2 South Tunnel (mpa)	Difference (mpa)
M4 East of M25	7.14	3.71	-3.43
M25 South of M4/M25 junction	8.15	4.65	-3.5

In addition to the compelling transport benefits detailed in our previous submissions, this reinforces the point that Heathrow Hub would result in reduced contributions to pollutant concentrations near to the airport.

We suggest that the current consultation therefore significantly understates the impact of mitigation on local air quality provided by our surface access proposals.

[31] Deduced from Appraisal Framework Module 4 Surface Access: Heathrow Hub Station Option Table 4-3, Table 4-7

Comparison of schemes

The below table provides a comparison of the air quality outcomes for all three options. The comparison suggests that the LHR-ENR option has similar overall effects to the other options and that with mitigation the air quality effects of the LHR-ENR option should not be significant.

Assessment Element considered	**Airport Option**			**HHL/RIL comment**
	LGW-2R	LHR-NWR	LHR-ENR	
Compliance with NECD and Gothenburg Protocol	No Effect on Compliance.	No Effect on Compliance.	No Effect on Compliance.	Agreed.
Defra Compliance/PCM modelling	No Compliance delay.	Marginally higher concentration in 2030 on A4 Bath Road than max in Agglomeration with change of +0.1µg/m^3 therefore delay to compliance. One of the compliance links considered for the LHR-ENR scheme is not considered within the LHR-ENR option as the A4 is being severed. It is not clear, but it is assumed that the traffic on this link will have been redistributed elsewhere on the network.	Higher concentrations in 2030 on A4 Bath Road than max in Agglomeration with change of 7.2 µg/m^3 therefore delay to compliance.	As outlined in the above review of mitigation measures, we believe the Commissions local air quality assessment over predicts the impacts from the LHR-ENR scheme due to the suspected traffic modelling error, the omission of modal shift and traffic redistribution associated with the LHR-ENR scheme and the reduction in emission to air achievable through shutting down one engine during taxiing etc.
Critical Loads	No new exceedences, but some increases to existing exceedences. Defra interpretation is that critical levels do not apply in these locations.	New exceedences at South West waterbodies RAMSAR/SPA and Wraysbury Reservoir SSSI. Defra interpretation is that critical levels do not apply in these locations.	New exceedences at South West waterbodies RAMSAR/SPA and Wraysbury Reservoir SSSI. Defra interpretation is that critical levels do not apply in these locations.	As these critical levels are considered not to apply at any location where any of the schemes are predicted to have impacts, they should not form part of the overall

Assessment Element considered	Airport Option			HHL/RIL comment
	LGW-2R	LHR-NWR	LHR-ENR	
				decision making process.
Local Air Quality Assessment and Summary of impacts.	Worsening of air quality at 21,000 properties.	Worsening of air quality at 47,000 properties.	Improvement of air quality at 6,600 properties Worsening of air quality at 39,000 properties.	LHR-ENR is the only scheme for which improvements in air quality are predicted.
Damage Costs	NOx: £73.6m PM_{10}: £246.9m Total: £320.5m	NOx: £94.2m PM_{10}: £863.5m Total: £957.7m	NOx: £69.6m PM_{10}: £618.7m Total: £688.3m	The overall Damage costs associated with the LHR-ENR scheme are lower than those associated with the LHR-NWR scheme for both NO_X and PM_{10} emissions. The LHR-ENR scheme is also predicted to have lower damage costs for NO_X than the LGW-2R scheme.

Question 6 – Do you have any comments on the Commission's sustainability assessments, including methodology and results?

Following the Commission's air quality assessment as presented in the consultation, it is necessary to consider whether the new information presented would influence the overall assessment of the scheme's air quality impacts as determined by the previous consultation documents.

Having reviewed the new information and documentation, it is considered that the overall conclusions of the sustainability assessment should identify the air quality effects of the LHR-ENR scheme as being not significant in comparison to the 'Do Minimum' case with mitigation.

Question 7 – Do you have any comments on the Commission's business cases, including methodology and results

We note that the current consultation does not change the Commission's previous conclusion, that LHR-ENR provides the best overall business case of the three shortlisted options.

However, as noted in our previous submissions, the LHR-ENR business case would be further improved by adopting our surface access proposals including the Heathrow Hub interchange and Southern Rail Access to Woking and beyond. Additionally including air quality in the overall assessment is likely to further enhance the LHR-ENR business case with the Hub Interchange.

Conclusion

We consider that the Commission's Air Quality assessment has not considered all aspects accurately or in sufficient detail and as a result has over-estimated the potential impacts on air quality from road traffic and airport emissions associated with the LHR-ENR scheme, which in turn has resulted in the prediction of a delay to compliance with the air quality objective for annual mean NO_2 concentrations along the A4 Bath Road, to the North of the airport boundary.

Specifically, those elements which have not been considered adequately or for which inaccurate assumptions of LHR-ENR impacts have been made, include:

- Based on the traffic information provided in the consultation we believe that there is a traffic modelling error. The data predicts there to be a transfer of traffic onto the A4 from other local roads, when there are no relevant network changes in the area which would cause such an impact. If this is the case, the data underpinning the assessment should be revisited.
- Additionally, the traffic data input to the local air quality assessment has not incorporated the full modal shift from cars to public transport achievable with the ENR scheme in operation. As a result of the assumptions made during the production of traffic data, the assessment has failed to properly consider the impact of this modal shift on local air quality.
- The potential benefit to emissions from aircraft using only one engine during taxiing has been underestimated in both the detailed modelling completed and in the sensitivity test scenario considered as part of the mitigation measures.
- The potential benefit to emissions from aircraft from shorter taxiing times has been underestimated in the detailed modelling completed.

These key elements which have not been incorporated into the data used for completing the air quality assessment have resulted in the overestimation of impacts on local air quality from the proposed scheme.

Additionally, we believe that there are a number of ways in which the predicted delays to compliance with the air quality objective value for NO_2 along the A4 would be avoided by the LHR-ENR scheme. These include a combination of airport and surface access considerations as summarised below:

Airport Operations:

1. Mandatory NOx emission charging to encourage airline to use the cleanest aircraft and encouragement to use optimised thrust take-off techniques.
2. FEGP and PCA for all future pier served and remote stands to achieve 90% reduction in associated NO_X emissions.
3. Infrastructure for ULEVs.
4. Mandatory single engine taxiing for all aircraft to achieve 45% reduction in associated NO_X emissions.

Surface Access

1. The combination of the increase in public transport mode share for air passengers to 55% and a reduction in the employees car mode share of a similar magnitude to LGW-2R would result in no more airport related traffic on the road network in the vicinity of the airport in 2030 with a third runway than in 2013.
2. The provision of the T2 campus Southern road tunnel has a significant impact on access routes and on the traffic levels on the A4/M4 east of the M25.
3. A terminal forecourt access (cordon) charge is fully compatible with the Heathrow Hub surface access strategy and would give further guarantees that traffic levels would not exceed current levels.
4. Implementation of a ULEZ for central London.

Heathrow Hub

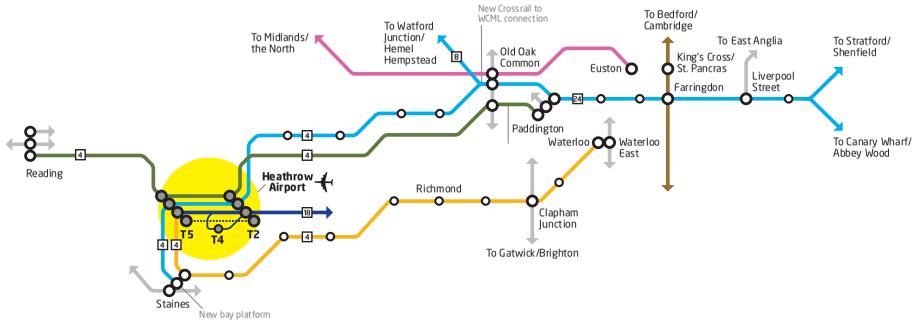
1. The Heathrow Hub Interchange will reduce the traffic levels on the A4/M4 east of the M25 and on the M25 south of the M4/M25 junction to significantly below current levels, which will in turn reduce the road contribution to local pollutant concentrations.

In combination, the above measures would mean that compliance with the EU Limit values for NO_2 along the A4 would not be delayed as a result of the proposed ENR scheme. However, we would request that the Commission revisit the assumptions underpinning the road traffic and airports modelling as at present the assumptions made result in overestimated impacts on air quality for the LHR-ENR scheme.

Following consideration of the additional air quality information provided by the Commission, it is our view that the overall air quality effect of the LHR-ENR scheme should be not significant overall in comparison to the 'Do Minimum' case with mitigation.

Appendices

1. **Rail Access Diagrams**
2. **Railplan Modelling Report**

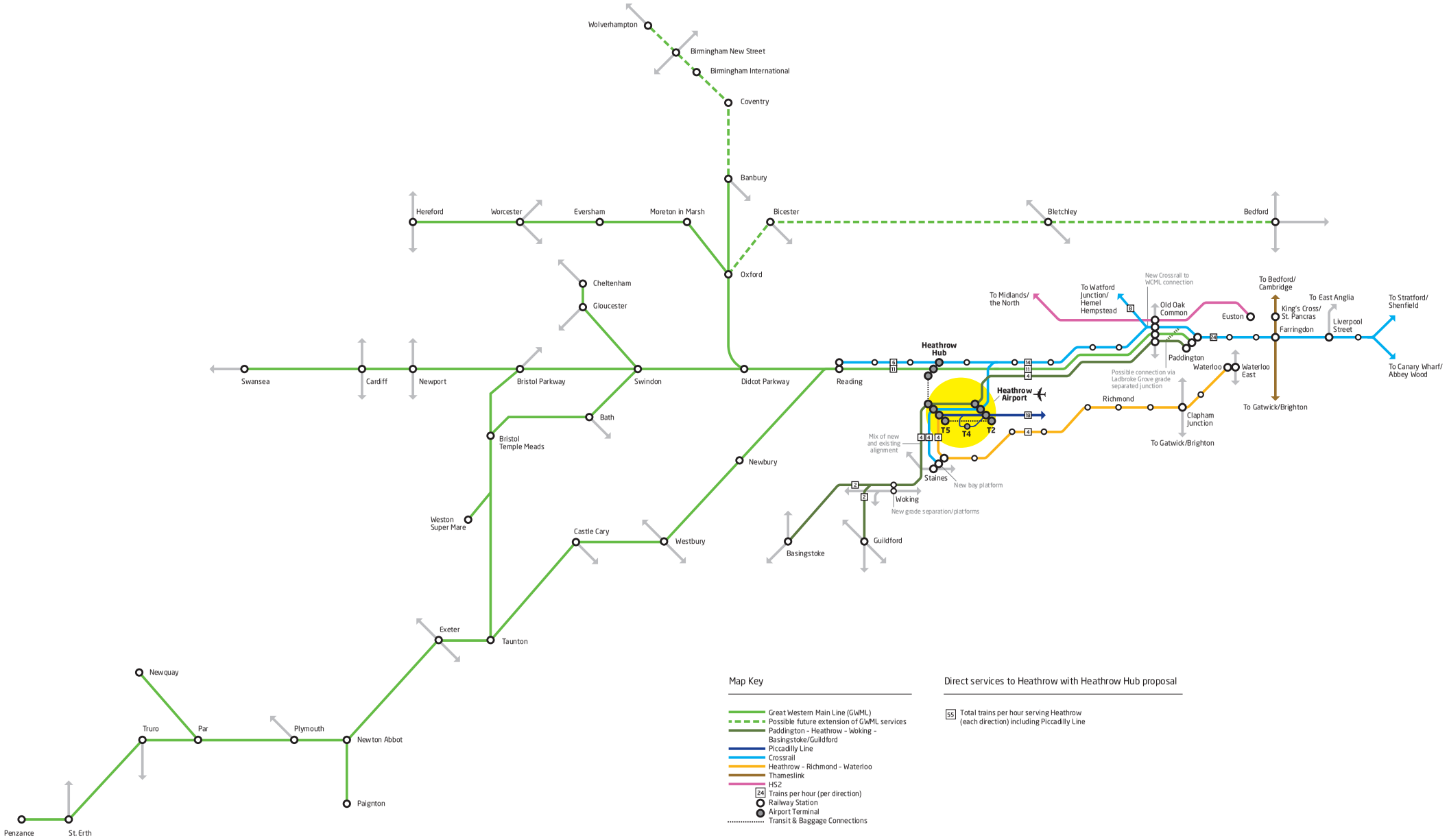


Map Key

- Heathrow Express/Western Rail Access to Heathrow (WRAtH)
- Piccadilly Line
- Crossrail
- Heathrow – Richmond – Waterloo
- Thameslink
- HS2
- 24 Trains per hour (per direction)

Direct services to Heathrow with HAL's (WRAtH) proposal

- 30 Total trains per hour serving Heathrow (each direction) including Piccadilly Line


Wolverhampton
Birmingham New Street
Birmingham International
Coventry
Banbury
Hereford
Worcester
Evesham
Moreton in Marsh
Bicester
Bletchley
Bedford
Oxford
Cheltenham
Gloucester
Swansea
Cardiff
Newport
Bristol Parkway
Swindon
Didcot Parkway
Reading
Bath
Bristol Temple Meads
Newbury
Weston Super Mare
Castle Cary
Westbury
Exeter
Taunton
Basingstoke
Guildford
Woking
New grade separation/platforms
Staines
New bay platform
Mix of new and existing alignment
Heathrow Hub
Heathrow Airport
T5
T4
T2
To Midlands/ the North
To Watford Junction/ Hemel Hempstead
New Crossrail to WCML connection
Old Oak Common
Euston
Paddington
Possible connection via Ladbroke Grove grade separated junction
Waterloo
Waterloo East
Richmond
Clapham Junction
To Gatwick/Brighton
To Bedford/ Cambridge
King's Cross/ St. Pancras
Farringdon
To East Anglia
Liverpool Street
To Stratford/ Shenfield
To Canary Wharf/ Abbey Wood
Newquay
Truro
Par
Plymouth
Newton Abbot
Paignton
Penzance
St. Erth
Map Key
Great Western Main Line (GWML)
Possible future extension of GWML services
Paddington – Heathrow – Woking – Basingstoke/Guildford
Piccadilly Line
Crossrail
Heathrow – Richmond – Waterloo
Thameslink
HS2
24 Trains per hour (per direction)
Railway Station
Airport Terminal
Transit & Baggage Connections
Direct services to Heathrow with Heathrow Hub proposal
55 Total trains per hour serving Heathrow (each direction) including Piccadilly Line

AECOM

Capability

Submitted to
Heathrow Hub

Submitted by
URS

Woking to Heathrow rail link – Railplan modelling

High-level study

[redacted]

[redacted]

Rev No	Comments	Checked by	Approved by	Date
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1 Introduction

1.1 Aim of Work

This report presents the findings of a high-level study into a potential Woking-Heathrow rail link. The new link would connect Woking station with Heathrow Terminal 5 and beyond to London Paddington, taking over the paths of the existing Heathrow Express service.

The aim of this report is to assess the likely demand for such a service. It is anticipated that the service would be of use to both airport passengers and to through-passengers (e.g. Woking to Paddington). An indirect benefit of crowding relief may also apply to the existing Woking-Waterloo services.

To estimate these effects, AECOM has modelled the service using Transport for London's public transport assignment model, Railplan. The revised demand was supplied by Heathrow Airport Ltd using their bespoke demand model, LASAM. The service specification for the service was provided by the client.

Due to the high-level nature of this study, the results contained in this report should be considered indicative only.

2 Inputs and Methodology

2.1 Service specifications

2.1.1 Do Minimum

Transport for London (TfL) supplied the standard Railplan v7 model for the year 2031. This model represents all committed transport schemes and represents the best estimate of the demographic growth scenario at this date. TfL also supplied an adjusted model incorporating the proposed HS2 service, including the consequent additional connections at Old Oak Common and the recasting of timetables on the West Coast, Midland and East Coast Mainlines. In this model Heathrow is served by a four trains per hour (tph) Heathrow Express service (including a stop at Old Oak Common), and a four tph Crossrail service (replacing the current Heathrow Connect).

Minor revisions to this model were undertaken to adjust the timings of the Heathrow Express service. This was necessary to ensure consistency with the proposed service specification for the Woking-Heathrow-Paddington service.

A new service from Waterloo to Heathrow Terminal 5 via Richmond and Staines was also added. The service is modelled with a frequency of four tph and uses identical timings for the up and down direction. We note that the provision of this service – as modelled – in the AM peak would be contingent on there being sufficient track capacity for the service. The rolling stock modelled is identical to that used for other Windsor line services (10-car class 458). This service is modelled to have the following stopping pattern:

Station	(minutes)
Heathrow Terminal 5	0
Staines	6
Ashford	9
Feltham	13
Whitton	17
Twickenham	21
Richmond	26
Putney	32.5
Clapham Junction	37
Vauxhall	41
London Waterloo	47

Table 1 – Specification for Heathrow-Waterloo service

This scenario will be referred to throughout this note as the Do-Minimum[1].

2.1.2 Do Something

The Do-Something network was constructed by applying modifications to the Do-Minimum network. The principal modification is the extension of the Heathrow Express services to Basingstoke and Guildford. The

[1] note that this is a slight misnomer since the Do-'Minimum' contains two non-committed schemes.

service to each of these branches is two tph. The full service pattern is given in Table 2. These trains are modelled to take the existing Heathrow Express paths on the Great Western Main Line. It is assumed that sufficient track capacity exists west/south of Woking to accommodate these extra services without affecting existing services.

A pre-requisite of the introduction of the through service is the removal of the premium fare charged on the Heathrow Express service. This is necessary to avoid the possibility of fare anomalies, for example the current single fare on Heathrow Express is £21.50 versus £10.90 for a Woking to London Terminals anytime single. The change to the fare structure was modelled within Railplan by a modification to the station links and zone connectors in the airport area (uniquely within Railplan, service split is enforced at Heathrow Airport using restrictive connections – see the following section for more details.

Early in the modelling process it was found that this treatment for the removal of the premium fare had the consequence of making the Heathrow Express service particularly attractive. A significant proportion of the demand was transferring from Crossrail to the Express service. On inspection, it was found that the Crossrail service was modelled several minutes slower on the Hayes & Harlington to Paddington section than other Crossrail service. The timings of this service were then harmonised with other Crossrail services. The revised service pattern and timings for this service is shown in Table 2, together with the revised Express services for comparison.

Table 2 shows the journey time in minutes for each service. These have been zeroed at Heathrow to allow a comparison between the Express and Crossrail services. So for example, the journey time from Basingstoke to Old Oak Common is 44 + 14 = 58 minutes.

Station	Basingstoke – Paddington	Guildford – Paddington	Crossrail
Basingstoke	-44		
Farnborough	-31		
Guildford		-10	
Woking	-20	-20	
Heathrow Terminal 5	-4	-4	
Heathrow Terminal 4			-5.5
Heathrow CTA	0	0	0
Hayes & Harlington			5.5
Southall			9.5
West Ealing			13
Ealing Broadway			16.5
Acton Mainline			20
Old Oak Common	14*	14*	26
London Paddington	19	19	32

Table 2 – Specification for Heathrow-Paddington services in Do-Something scenario

*pick-up/set-down only (as appropriate)

The aim of this work is to estimate the demand for the through-Heathrow service since, to some extent the service's capacity could be matched to the expected demand. To investigate this, the capacity constraint was removed from the extended Heathrow Express services (modelled in Railplan by setting the vehicle capacity to be an extreme value) essentially turning off crowding on the service. Consequently, unless otherwise stated, outputs pertaining to the new service in this note should be interpreted as 'demand' rather than 'flow'.

2.2 Demand

The Heathrow-related demand in Railplan is drawn from the South East and East of England Regional Air Services Study (SERAS). This demand represents both passenger and employee trips. The demand is split by mode (Piccadilly line, premium rail, standard rail, and non-rail) and the network coding in the airport is intended to maintain these splits. This artificial splitting is unusual within Railplan and is necessary because fares are not explicitly modelled.

To represent the change in demand due to the new service, Heathrow Airport Limited (HAL) provided outputs from the London Airports Surface Access Model (LASAM). This model provides annualised demand outputs for a given year and time period, segregated by mode and purpose. LASAM annual 'AM Peak' outputs were converted to daily AM Peak outputs using an annualisation figure of 250 (the approximate number of working days per year).

As LASAM only models airport-passenger trips it was concluded that it was not feasible to simply replace the existing Railplan demand with the LASAM demand since employee trips would be lost. Instead an incremental approach of calculating the difference between LASAM's Do-Something vs Do-Minimum outputs, and adding this 'delta' to the Railplan demand was used.

LASAM has 250 zones based on local authority districts (or aggregations thereof). This zoning system is considerably coarser than Railplan's 4,094 zones (excluding Heathrow). Using GIS software, a correspondence was developed between the two zoning systems (using a simplifying assumption that the systems nested perfectly i.e. each Railplan zone lies in precisely one LASAM zone). The disaggregation factors were calculated using the Railplan Heathrow-related demand.

All demand used in the modelling represents a two-runway scenario. Sensitivity tests for three-runway scenarios may be modelled by applying global uplift factors supplied by HAL (20.5% in 2030).

The Railplan demand is nominally for 2031 versus LASAM's year of 2030. Given the closeness of these two model years, it was not considered significant enough to warrant any uplift to the demand.

The following two tables compare the aggregated Heathrow-related Do-Minimum (DM) demand from the two models. Note that 'CTA' refers to the Central Terminals Area. These are total trips (arrivals plus departures) in the three-hour AM Peak.

2031 Railplan DM Demand	CTA	Terminal 4	Terminal 5	Total
Piccadilly line	2,840	1,237	1,923	**6,001**
Rail	4,264	1,589	3,896	**9,750**
Total	**7,105**	**2,826**	**5,819**	**15,751**

Table 3 – Aggregated default Heathrow-related Railplan demand (*note: totals may not sum exactly due to intermediate rounding effects*).

2030 LASAM DM Demand	CTA	Terminal 4	Terminal 5	Total
Piccadilly line	965	633	1,893	**3,492**
Rail	2,069	1,125	4,415	**7,609**
Total	**3,034**	**1,759**	**6,308**	**11,101**

Table 4 – Aggregated Heathrow-related LASAM DM demand (*note: totals may not sum exactly due to intermediate rounding effects*).

It has been assumed that the difference between the different modelled totals is principally due to the lack of airport-employee trips in the LASAM output. This may also explain the slightly higher proportion of Piccadilly line usage in Railplan (i.e. employees are more likely than passengers to live locally on that line of route). The principal difference in patterns between the two demand outputs is the distribution between Terminal 5 and

the CTA; however for the purposes of the modelling in this note this is not relevant because we only consider demand to Heathrow as a single entity (rather than disaggregating between termini) and Terminal 5 and the CTA are both on the line of route of the through service.

The following table shows the corresponding LASAM outputs for the Do-Something (DS) scenario.

2030 LASAM DS Demand	CTA	Terminal 4	Terminal 5	Total
Piccadilly line	952	627	1,877	**3,456**
Rail	2,122	1,142	4,519	**7,783**
Total	**3,074**	**1,769**	**6,396**	**11,238**

Table 5 – Aggregated Heathrow-related LASAM DS demand (*note: totals may not sum exactly due to intermediate rounding effects*).

Comparing Table 4 with Table 5, there is a minor increase in rail trips to/from Heathrow and a slight decrease in Piccadilly line trips. The table below shows the modelled Do-Something Railplan demand (calculated as the Table 3+ (Table 5 – Table 4)).

2031 Railplan DS Demand	CTA	Terminal 4	Terminal 5	Total
Piccadilly line	2,827	1,231	1,907	**5,965**
Rail	4,317	1,605	4,001	**9,923**
Total	**7,144**	**2,836**	**5,907**	**15,888**

Table 6 – Calculated Heathrow-related Railplan DS demand (*note: totals may not sum exactly due to intermediate rounding effects*).

Comparing Table 6 with Table 3, we see that the changes are signed intuitively (i.e. rail share increases); however, the relative change in rail mode share is small. To sense-check this, we analysed the LASAM outputs for the two counties of Surrey and Hampshire which we consider to be the principal target market for the new rail link. LASAM output indicates that these two counties account for 7.8% of the total surface access trips at Heathrow[2].

The tables below present the LASAM-derived mode shares for the two counties. These data are presented for the two modelled scenarios and the increment is given in both relative and absolute terms.

Surrey	Rail / Piccadilly	Coach / Bus	Taxi / Kiss & Ride	Park & Ride
Do-Minimum	10%	13%	68%	10%
Do-Something	16%	11%	64%	9%
Increment (absolute)	*+6%*	*-2%*	*-4%*	*-1%*
Increment (relative)	*+65%*	*-16%*	*-5%*	*-7%*

Table 7 – LASAM mode shares for Surrey (*note: row totals may not sum exactly to 100% due to intermediate rounding effects*).

Hampshire	Rail / Piccadilly	Coach / Bus	Taxi / Kiss & Ride	Park & Ride
Do-Minimum	9%	26%	49%	15%
Do-Something	14%	24%	47%	15%
Increment (absolute)	*+5%*	*-2%*	*-2%*	*-1%*
Increment (relative)	*+50%*	*-8%*	*-4%*	*-4%*

Table 8 – LASAM mode shares for Hampshire (*note: row totals may not sum exactly to 100% due to intermediate rounding effects*).

[2] Note that LASAM is only a mode-choice model (i.e. it is has no redistribution or trip induction/suppression effects) so this figure is the same for both the Do-Minimum and Do-Something scenarios

The relative changes for both counties are logical; the introduction of the Woking-Heathrow rail link increases the rail demand share by 65% in Surrey and 50% in Hampshire. In both counties, the majority of the abstraction is from car trips.

However, the Surrey coach/bus mode share in the Do-Something scenario appears to be counter-intuitively high. The new rail service will provide an alternative to the dedicated Woking-Heathrow coach link and it will compete on journey time, frequency and difficulty of interchange. Indeed it would be a reasonable assumption that the Woking-Heathrow coach link would cease to operate (at least in its current form), and therefore the bus/coach share would be almost entirely transferred to the rail link. For destinations further afield – such as Basingstoke, Southampton and Bournemouth – Heathrow is served by infrequent direct coach services. Whilst these services would likely continue to operate by providing competition on price, we would expect the rail link to abstract significant volumes from these markets by providing faster services which would be direct (or involve a same-platform interchange at Basingstoke).

Given these factors, it might be expected that the rail share for destinations to the south west of Heathrow would be significantly more than the coach/bus share. We therefore consider that the modelled demand increment is conservative and that further detailed demand modelling may suggest an increase in the rail trips accessing Heathrow from the south-west.

3 Results

Railplan outputs are at the three-hour AM Peak period; all figures in this section have been factored down to a nominal peak hour by using the factor of 0.52 (this is a standard figure used for Railplan analysis).

3.1 Analysis of Demand on extended Heathrow Express services

We first analyse the flows on the extended Heathrow Express services in the Up direction. The graph below shows the composition of the trip volumes on each of the three links between Woking and London Paddington. These figures are aggregated across both the ex-Basingstoke and ex-Guildford services. As a sensitivity test, the additional demand expected due to the addition of a third runway is also indicated.

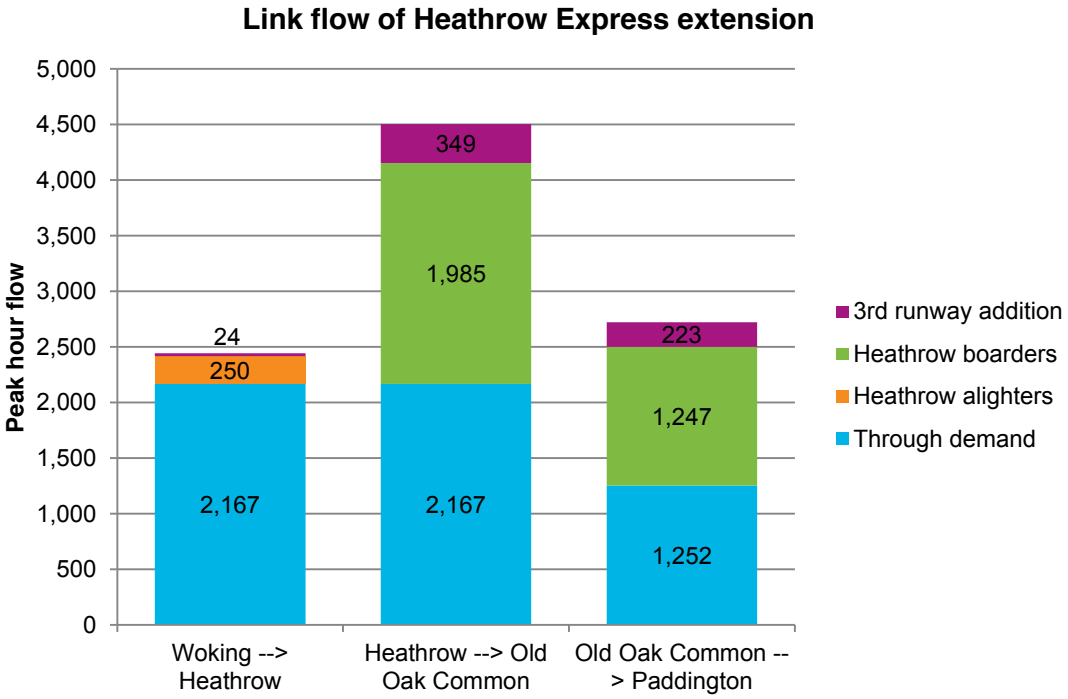

Figure 1 – Peak hour link flow of Heathrow Express (Up services)

The graph shows that the total flow volume on the new Woking-Heathrow link is 2,417. Of these passengers, 2,167 (90%) are through-passengers i.e. those who remain on the service in order to reach destinations beyond Heathrow. The demand on the Woking-Heathrow link is split unequally between the ex-Basingstoke and ex-Guildford services; the former are modelled to carry 59%, the latter 41%. At Heathrow, each alighter is replaced by approximately eight boarders; with only four services in the peak hour, this demand would require rolling stock to have in excess of 1,000 seats to ensure every Heathrow boarder is able to find a seat. Approximately 42% of the through-passengers alight at Old Oak Common; the corresponding figure for Heathrow boarders is 37%.

Of the 250 passengers alighting at Heathrow, only 41% are passengers for the airport itself. Forty percent of the demand alighting at Heathrow transfers to the Piccadilly line for access to West London and eight per cent transfers to the Staines service. The remainder transfer to Crossrail services or access the local walk/bus network for destinations close to Heathrow.

3.2 Analysis of Through-Demand

As shown in Figure 1, the peak hour through-demand is 2,167. The distribution of this demand is shown in the following two figures (note that links with little or no demand are omitted for clarity).

Figure 2 – Distribution of through-demand across network (small scale)

Figure 2 shows that the through-demand is drawn from the principal routes feeding into Woking such as the South West and West of England Mainlines, the Portsmouth Direct line, the Alton branch and the North Downs line. There is also some demand in the South West Main line in the Down direction. Principal feeder stations are Southampton, Basingstoke, Farnborough, Guildford and Woking. The new service also provides improved cross-London connectivity for some movements, for example to destinations served by the Great Western, West Coast, Midland and East Coast Mainlines. Access to HS1/Eurostar at St Pancras and HS2[3] via Old Oak Common are both improved.

As shown in Figure 1, 42% of the through-demand alights at Old Oak Common. The full distribution of the through-demand is shown in the following figure.

[3] note that HS2 is modelled within Railplan using a bespoke methodology and its link flows do not show on the standard plots

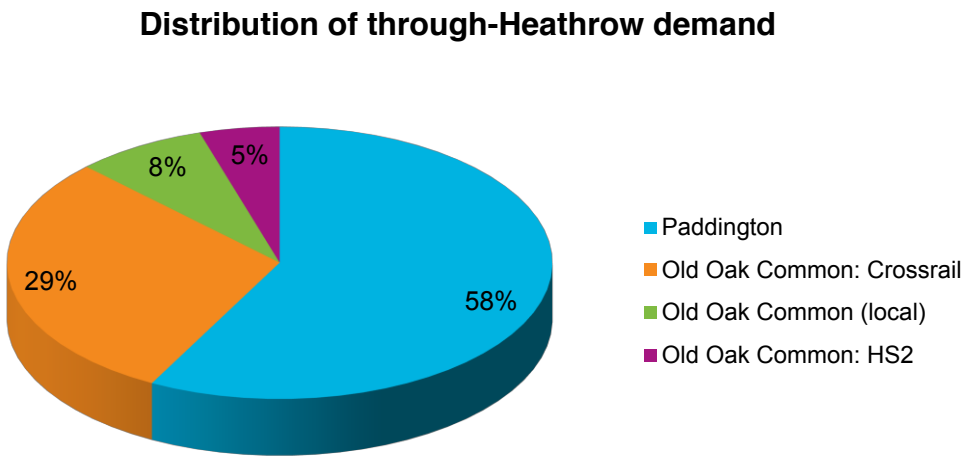

Figure 3 – Distribution of through-Heathrow Demand

The majority of the through-demand alighting at Old Oak Common transfers to eastbound Crossrail services for access to the central London Crossrail corridor (Bond Street, Farringdon, Canary Wharf etc.). The remaining demand transfers to other rail services (e.g. westbound intercity, northbound HS2, local metro) or accesses the area local to Old Oak Common itself.

Of the through-demand continuing to (or beyond) central London, only one third transfers to Crossrail at Old Oak Common. The remaining two thirds continue to Paddington and interchange there for other non-Crossrail services (note that the interchange between mainline and Crossrail services is modelled to be more convenient at Old Oak Common than at Paddington so no such interchange is assumed to take place at the latter). The distribution of this demand is shown in the following two figures.

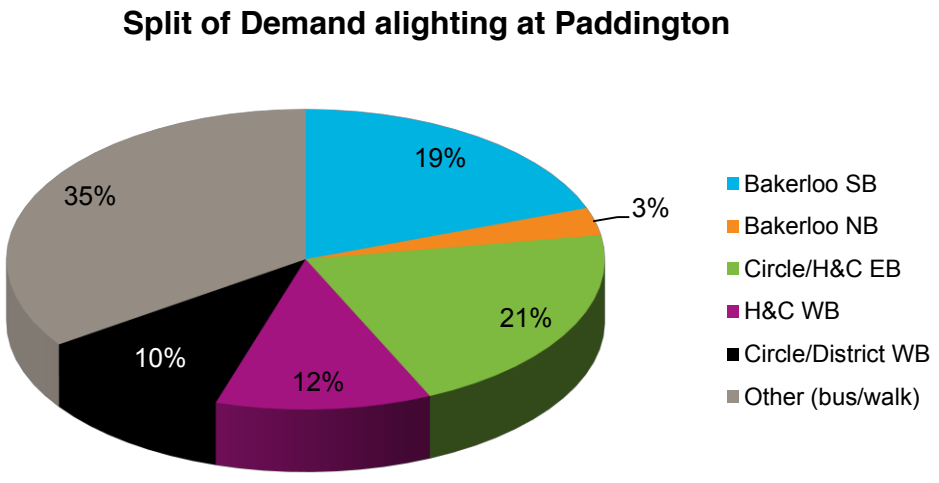

Figure 4 – Distribution of through demand alighting at Paddington

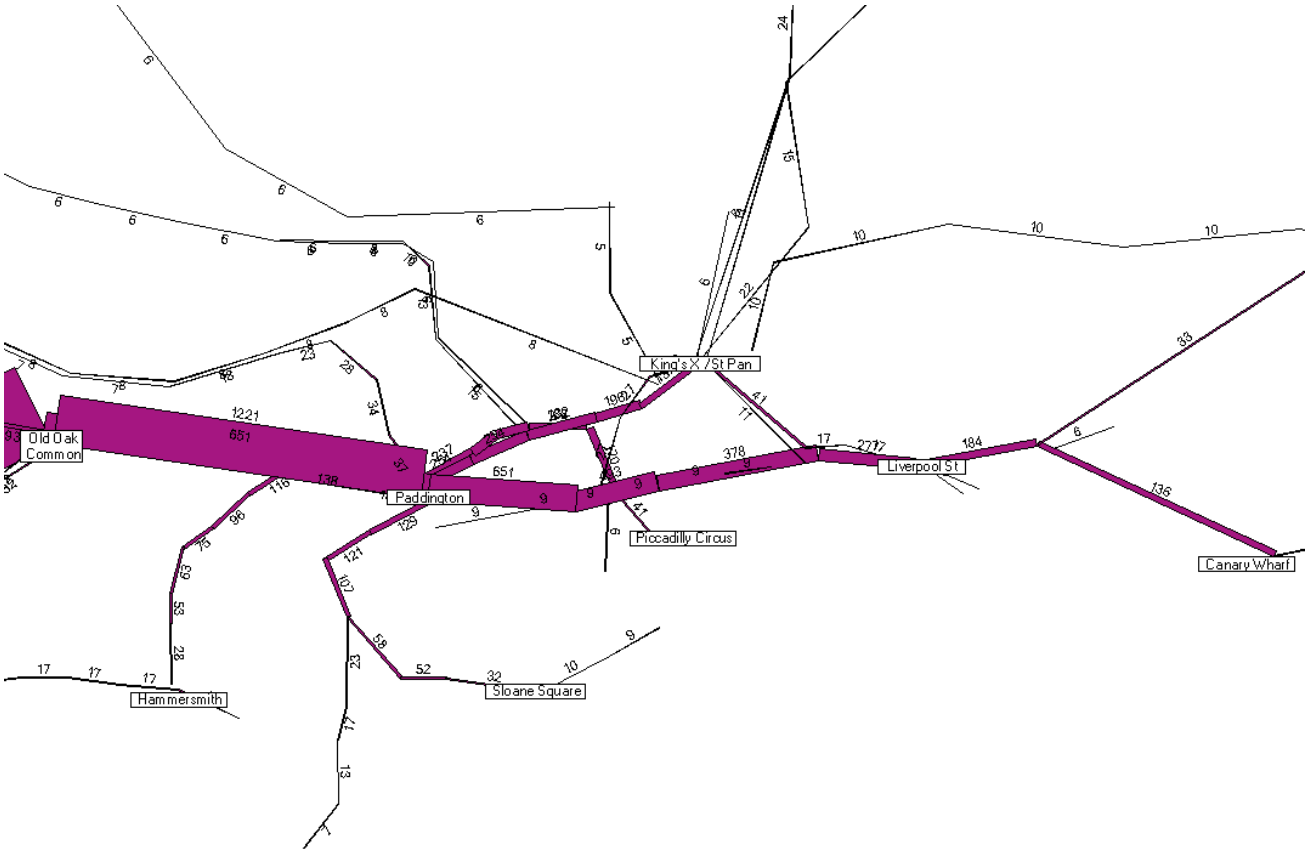

Figure 5 – Distribution of through-demand across network (large scale)

3.3 Crowding sensitivity

As discussed earlier, the modelling in this note assumes a non-capacity-constrained extended Heathrow Express service. Tests restoring the capacity constraint (specifically the service modelled as a 10-car class 444) show that approximately 8% of the through demand is crowded off the service. In the three-runway scenario, this figure is 11%.

3.4 Relief of existing services

The new service provides some crowding relief on the South West Mainline. This can be seen by comparing Figure 6 with Figure 7. Compared to the Do-Minimum scenario, the Do-Something has a reduction in peak hour flow of 1,357 (6.7%) on the Woking-West Byfleet link, and 1,659 (3.7%) on the Wimbedon-Earlsfield link. The discrepancy between these figures and the through-Heathrow demand of 2,167 is due to at least two factors: firstly, some of the demand from Basingstoke and beyond will be re-routing from the via-Reading route rather than from the South West Mainline. Secondly, some of the released capacity will be re-utilised by demand re-routing from parallel routes.

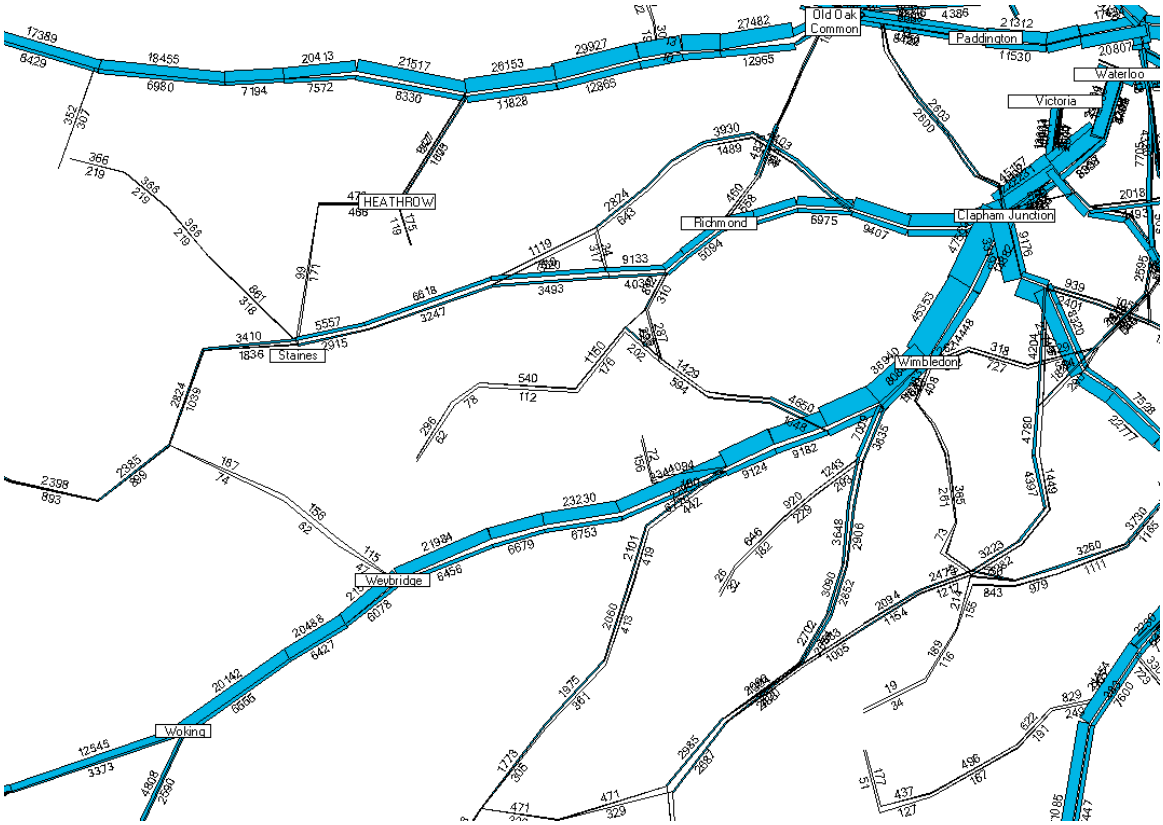

Figure 6 – South-west corridor link flow plot (Do-Minimum)

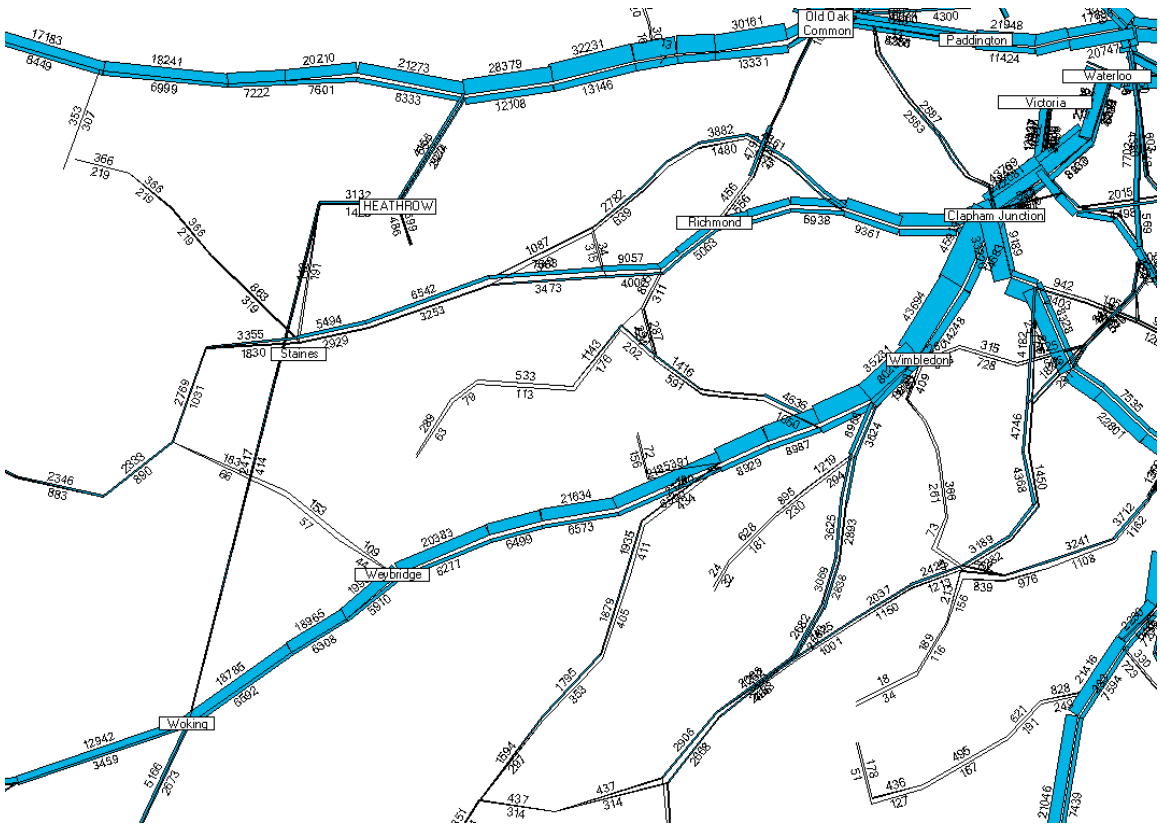

Figure 7 – South-west corridor link flow plot (Do-Something)

3.5 Summary

The extension of the Heathrow service to Woking and beyond provides an attractive alternative route to London for demand from the South West corridor to certain destinations in, and beyond, London. Destinations within London for which the via-Heathrow route is more attractive include Old Oak Common and those along, or to the north of the Crossrail corridor. Furthermore, the interchange with the subsurface Underground lines at Paddington represents improved connectivity to many destinations in the London boroughs of Kensington & Chelsea and Hammersmith & Fulham. Demand to destinations to the north of London will also find the new service attractive.

For destinations further south of these areas, the faster (albeit crowded) route to Clapham Junction/Waterloo will continue to be the preferred route. Figure 7 shows that, of the demand heading east/north from Woking, 89% will continue to use the existing direct route in order to access south London, the Jubilee line corridor, central London south of Crossrail and the central City area (via the Waterloo and City line).

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