Transport for London

Planning – Strategic Analysis

Sub-regional Highway Assignment Model

Guidance on Model Use

Picture / photograph

Version 0.4

September 2012

Transport for London

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Date:	Sep 2012	
File Location:	\\ONELONDON.TFL.LOCAL\SHARED\PRUC_MODELLING\07 Modelling\14 Sub Regional HAM\28 Guidance Notes\Working Draft\Combined\TfL Strategic Highway Assignment Modelling Guidance_V0 4.doc	

Previous Revisions

Previous Version:	***Date Issued:***	***Prepared by:***	***Changes:***
0.1	**Jan 2012**		
0.2	**Mar 2012**		
0.3	**Apr 2012**		
0.4	**Sep 2012**		

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1. Introduction

1.1 Modelling Guidance for Local Transport Studies

This guidance note provides advice for users of Transport for London (TfL)'s Sub-regional Highway Assignment Models (HAMs) undertaking modelling work for a local study.

TfL would expect HAM users to follow the guidance in this note unless exceptional local requirements apply, in which case the user should justify departures from the guidance,

This guidance is not intended to cover all aspects of good practice in modelling.

The guidance is issued by TfL's Planning Strategy Analysis Division. The Division welcomes comments, both directly and through the HAM Users' Forum meetings.

In a local study using a HAM, users should follow the following steps, each of which is considered in a later chapter of this guidance:

1. Review the models and model data provided by TfL.

   This includes review of Base Year models, Future Year/Reference Case models, traffic counts, journey time data, the zoning system, and any other data/information.

   Users should refine, update, and/or correct the models in the area of interest when necessary. They are responsible for ensuring that the models are fit for their purpose.

   Chapter 2 of this note focuses on the local network audit.

2. Undertake local Base Year model validation.

   Users should not heavily rely on the validation of the original HAM models provided to them, as these were developed as strategic models, whilst a local study will require further refinement in the local area. The requirements for a validated model and issues to be addressed in achieving a satisfactory 'local' re-validation are addressed in Chapter 3.

3. Develop Future Year models without developments or schemes.

   TfL will provide HAM Reference Case Models. These models are strategic in nature and the users should develop their own future year models (without the developments or schemes) for their local study. The development of the Future Year 'Base' models is described in Chapter 4.

4. Develop Future Year models with developments or schemes.

   There are two options for developing future year matrices with the developments that are being tested. The first option is by obtaining the future demand matrices from the LTS model. This involves running the LTS model, which will require additional time and cost. The second option is to create trip generations and develop a trip distribution for the additional trips due to the new developments.

   Chapter 5 discusses the preferred approach to the development of 'with development' models.

5. Adjust local signal timings

   Local Signal ‘Optimisation’ (capped to avoid excessive reduction in modelled delays) should be used, as described in Chapter 6.

6. Carry out sensitivity Tests

7. Extract statistics and thresholds for Model Results

Users may wish to consider cordoning a smaller model from the HAM, as discussed in Chapter 9, Development and Use of Cordon Models.

1.2 Supporting Notes

Appendix A outlines the summary of the development of HAMs standard Reference Case Models.

The Reference Case models require a level of signal optimisation. The detailed process is available on the Technical Guidance MG001 << File: MG001_Borough_Level_Signal_ Optimisation_Process_v1.1Draft.docx>>.

The process of WEZ Removal, in Central London HAM as an example, is outlined in Technical Guidance Note MG002 << File: MG002_Adjusting matrix for WEZ removal.docx>>.

2. Local Network Audit

2.1 Introduction

A local study such as an Opportunity Area Planning Framework (OAPF) requires an accurate network representation allied to a high level of validation in the localised area and also for key strategic movements through the area. The model also needs to be responsive enough to test development and other scenarios, including major scheme tests, without these effects being lost in ‘model noise’.

This section addresses the accuracy of the local network and the scale of network enhancements that are likely to be required before a locally based scheme is implemented and tested in one of the HAM models. Its starting point is the need to assess the local suitability of the strategic HAM model before undertaking such tests. This requirement recognises that not all areas of a necessarily strategic model will be coded or validated to sufficiently accurate degrees, hence the need for local area checks. This guidance focuses on features that fall within the remit of a network audit.

2.2 Network Audit Procedures

The assumption is that any significant proposal for site development or traffic related scheme will be subject to traffic impact assessment at a strategic level through testing on the HAM most appropriate to the location of the scheme. This will require the development of network modifications and scheme specific demands. The network audit forms the first step in this process.

The network audit will comprise two stages:

1. An assessment of base year adequacy
2. Sensitivity tests to assess forecast year adequacy and model robustness.

2.2.1 Base Year Adequacy

Assessments will be required to show that the modelled network in the vicinity of the site is represented at an appropriate level of detail. For the purposes of this note, the vicinity shall include all junctions within a radius of 2km of the defined development area.

Checks should be undertaken and documented for networks representing each of the AM and PM peak hours, and the average Inter-peak hour modelled by the appropriate HAM.

Additional consideration must be given to the suitability and integrity of the network represented in the HAMs in the vicinity of the development site. The user will need to check the network for structural, detailed coding and usage issues in the vicinity of the development. Whilst the majority of checks will relate to coding and are therefore possible using an unloaded network, we strongly recommend that loaded Base Year networks be used by default so that any operational issues, including poor validation against local area counts, are exposed.

2.2.2 Structural Issues

The proposer must check against the model for:

1. The inclusion of all significant roads and junctions in the vicinity of the site
2. The potential need to include additional minor roads and junctions which may significantly affect local routeing patterns; any such proposals should be communicated to the various parties involved e.g. the Model sponsors/ London Boroughs
3. The adequacy of the local (demand) zoning and its adequacy under changed levels of demand (future year projections), in the context of the 'maximum zone size/ trip end' requirements of the model; this will particularly relate to the development site itself
4. The location, type and number of zone loading points (centroid connectors) with regard to critical junctions, allowing for major local influences such as car park entry/ exit arrangements as appropriate.

Any modifications should be proposed and agreed with TfL and the Model Sponsor or clients, e.g. the appropriate London Borough, prior to model reruns.

2.2.3 Junction Detail Issues

The user must check coding for all modelled junctions within a 500m radius of the specified site.

Checks shall include but not be restricted to:

- Junction error reports:
  - all NFEs and Serious Warnings should be assessed and corrected as necessary
  - all warnings should be assessed for coding accuracy
- Junction specific parameters e.g. Cycle times, Stack, Gap and Tax values
- Lane descriptions for:
  - Link lengths
  - Correct number of Lanes
  - Use of speed-flow
  - Bus lanes coded
- Turn coding to include:
  - Banned turns
  - Lane allocations
  - Saturation flows
  - Priority markers
- Signal timings and movements

TfL recognises that the above checks, whilst identifying coding errors or inadequacies in the original model, may also highlight occasions where junction layouts or operations have changed between the modelled Base year (taken to be 2009) and the review year. Where local revalidation is required, it will generally be appropriate to recode junction detail (including elements such as signal timings) to the review year conditions. Signal timings should then be obtained from TfL sources.

2.2.4 Usage Issues

The proposer must check the operation of all junctions in the vicinity of the site with respect to:

- Local convergence issues – check list of '10 worst' nodes/turns to determine relevance.
- Realism checks for
    - Excessive delays
    - Queuing and blocking back
    - High V/Cs

Note that the importance of operational checks will fall primarily in the context of the local model validation check process described in later sections.

2.2.5 Forecast Year Adequacy and Model Robustness

The purpose of the forecast year adequacy test is to pick up at an early stage where network and zoning enhancements may be needed to maximise the compatibility between Base Year and forecast models. The test is most needed where the numbers of generated or attracted trips is expected to increase significantly over base levels or significant road infrastructure is planned. A robust model is required in the sense that no local discontinuities in costs should be generated from the introduction of additional trips.

The tests will require an initial assessment of additional trips generated by the development as a basis for determining:

- The adequacy of existing zone sizes and boundaries
- The adequacy of existing zone loading points and mechanisms.

The outcome of the tests should guide the development of disaggregated zones and network refinements in the immediate vicinity of the development site.

3. Local Base Year Model Validation

3.1 Introduction

A local study such as an OAPF requires an accurate network representation allied to a high level of validation in the localised area and also for key strategic movements through the area. The model also needs to be responsive enough to test development and other scenarios without these effects being lost in 'model noise'.

This section of the guidance addresses the accuracy of the HAM model in the local (or OAPF) area to determine what level of model enhancement is likely to be required before a locally based scheme is implemented and tested in one of the HAM models. Its starting point is the need to assess the validation of the strategic HAM model in the local area before undertaking such tests. This requirement recognises that not all areas of a necessarily strategic model will be coded or validated to sufficiently accurate degrees, hence the need for local area checks and, where necessary, model enhancements leading to local model recalibration and revalidation.

This section focuses on features that fall within the remit of local area model validation, and also addresses the accuracy of the (enhanced) HAM model in the local (or OAPF) area and the validation standards required.

3.2 Model Validation Procedure

Subject to agreement with TfL, the assumption is that any significant proposal for site development will be subject to traffic impact assessment at a strategic level through testing on the HAM most appropriate to the location of the scheme. The Base Year HAM models will be subject to validation checks in the vicinity of the model.

The validation checks will comprise:

1. An assessment of local validation against screenline count data in the area used in model development
2. A similar assessment against additional available count data for the area and counts commissioned for the purpose
3. Comparison of modelled and observed journey times on key routes in the vicinity of the area.

Checks should be undertaken and documented for networks representing each of the AM and PM peak hours, and the average Inter-peak hour, modelled by the appropriate HAM. Consideration should also be given to the development of a separate model for either a Saturday or Sunday periods of peak demand, should local circumstances or the type of development (e.g. large retail) indicate that particular issues of traffic congestion might arise.

The combined validation across both screenlines and individual local sites will guide the decision on the need for further local model recalibration and validation.

Should network enhancement and local (or OAPF) area matrix recalibration be required, any subsequent matrix estimation should be undertaken in line with TfL standard procedures, including the use of calibration and validation counts organised as mini-screenlines rather than being used as individual counts. This approach is important in ensuring that matrix estimation is not allowed to compensate unduly for deficiencies in aspects of the model other than those in the demand matrices. Issues of network structure, zoning detail and centroid connector locations, network coding and route choice coefficients should all be thoroughly checked prior to matrix estimation.

DMRB 12.2.1 advises that matrix estimation should not be used if differences between the count data and modelled flows are within survey accuracies and matrix estimation causes significant changes to the prior matrix. The implication is that matrix estimation should be used only where the confidence intervals of used counts are very small i.e. that the accuracy of individual counts is very high or else that they should be grouped as mini-screenlines. Car and total vehicle counts have 95% confidence intervals of typically 5% and 10% for ATC and MCC respectively. Confidence intervals for LGV ang HGV counts are much higher, typically 24% and 28%. This may have implication for the way mini-screenlines are formed for the different user-classes.

In general terms:

- Counts used as constraints in matrix estimation should be grouped to avoid making changes to the matrices which merely compensate for routeing inaccuracies;
- The length of a mini-screenline will depend on the length of the movements ‘intercepted’: longer distance movements will generally require longer screenlines;
- Where the majority of movements through a screenline are short (which will be many cases), screenlines will also be short.;
- The length of mini-screenlines should also take into account the vehicle class and related count accuracy, including count sources and ages.

A separate TfL technical note (Ref) describes the appropriate treatment of counts and their organisation into mini-screenlines in accordance with WebTAG Highway Assignment Modelling guidance.

Local Model Validation for both count and flow data should be presented in accordance with current WebTAG Highway Assignment Modelling guidance. TfL will provide the ‘dashboard’ spreadsheet together with relevant ‘key files’ and macros to assist in the presentation of model validation.

In addition, a comparison with TrafficMaster congestion plot should be provided by the consultant to highlight local congestion issues.

3.3 Local Validation across Screenlines

Assessments will be required to show that the model is adequately validated in the vicinity of the site is represented at an appropriate level of detail. For the purposes of this note, the vicinity shall generally comprise the network within a radius of 2 km of the defined development area, though in this case we require comparisons across all calibration and validation screenlines within 5km.

Calibration and validation screenlines should be separately identified with comparisons made for each site within the screenline and for the screenline as a whole. Comparisons for screenlines and mini-screenlines introduced for the development study (and indications of which are calibration and which validation, i.e. excluded from any matrix estimation) should be separately presented.

Model performance should also be reported against all screenlines used in the calibration and validation processes of the original model, so that model stability and wider accuracy can be assessed. For this purpose, TfL will provide the ‘dashboard’ spreadsheet together with ‘key files’ (for the extraction of flow and journey time data from SATURN files) and macros to automate comparisons against count and observed journey time data.

Local Model Validation should be presented in accordance with current WebTAG Highway Assignment Modelling guidance.

3.4 Additional Local Count Validation

Additional local model validation should be presented against non-screenline count data as used in HAM model calibration and development, and separately against specific count data (see below) collected as part of the development study.

Specific count data will be required where existing data for important roads and/or junctions in the vicinity of the development is unavailable. Manual Classified Counts for both link and turning movements should usually be supported by ATC data recorded for a period of two weeks over the survey period.

Local Count Validation should be presented in accordance with current WebTAG Highway Assignment Modelling guidance.

In specifying count data collection and making subsequent validation comparisons against modelled flows, allowance should be made for the different years represented by model and count data, including changes in circumstance in the intervening period e.g. the removal of the WEZ charging zone. Validation should be reviewed in this light. The general assumption will be that the local model Base Year will remain that of the original model, i.e. 2009, provided that only limited local data (e.g. counts, journey time, traffic signals, etc) for the review year e.g. 2012 is used in the re-validated model. Where significant local changes have occurred since 2009, the appropriate year for the revalidated model should be discussed and agreed with TfL prior to the work being undertaken.

3.5 Modelled and Observed Journey Times

Journey Time validations prepared as part of the HAM LMVR and whose routes pass within the vicinity of the development should be presented and reviewed for acceptability in accordance with current WebTAG Highway Assignment Modelling guidance.

In the absence of appropriate routes, additional journey times may be required for key routes passing close to or through the development area. It is expected that any new timed routes will be generated through analysis of TrafficMaster link time data, rather than through the use of moving car observations (taking care to make a “like for like” comparison: if TrafficMaster link times include delays to turning traffic, then the SATURN link times including turners should be used). This may also present a way of overcoming potential issues of condition changes since the base year validation.

3.6 Local Congestion Issues

For the AM and PM peak hours, we recommend that additional network plots be produced that, for Core Boroughs, show link delay in terms of minutes delay per km using the following scales:

- 0-0.25 minute/km
- 0.25-0.5 minutes/km
- 0.5-1.0 minutes/km
- 1.0-1.5 minutes/km
- >1.5 minutes/km

This can be used as a comparator for the TrafficMaster sourced TfL congestion maps for the relevant areas. Tabular presentations may also be required.

3.7 Model Validation Sign-off

A Model sign-off will relate to the original HAM provided that local validation conforms to WebTAG Highway Assignment Modelling guidance, **or more likely to an enhanced HAM with 'local area' improvements**.

Such improvements may encompass both network and demand (matrix) changes.

Sign off will require the following:

- Confirmation that matrix estimation has been undertaken from the original prior matrices to an enhanced set of counts for the local area, used where possible as mini-screenlines
- Model convergence consistent with or better than WebTAG standards (e.g. Minimum duality GAP<0.05 for four successive model iterations)
- Count validation to original HAM screenlines no worse than provided by the original supplied HAM
- Journey Time validation to original HAM routes no worse than provided by the original supplied HAM
- Local area screenline count calibration in line with WebTAG guidance
- Local area individual count calibration in line with WebTAG guidance, relaxed to the equivalent of a GEH of 7.5 for turning count data presented separately
- Local area Journey Time validation accurate to within 15 per cent of observed.

4. Future Year Models without Development

4.1 Introduction

TfL has developed and will keep updating the HAMs standard future year Reference Case models. The note on the development of HAM Reference Case is outlined in APPENDIX A.

Since the Western Extension Zone (WEZ) of the congestion charging was removed in 2010, we have adjusted our Reference Case models to reflect this. The process of WEZ Removal, in Central London HAM as an example, is outlined in Technical Guidance Note MG002 << File: MG002_Adjusting matrix for WEZ removal.docx>>.

These Reference Case models are strategic in nature and may not contain specific new developments to be tested. In order to understand the full impact of a new development, in particular a large scale one, it is important to be able to isolate the development specific impacts from the effects of wider background growth.

Therefore, a future year without development scenario must be developed. We will use the term "Base Minus" for this scenario. The Base Minus model should be based upon current future year reference case planning data for (at least) the standard maximum forecast year, currently 2031, and should preferably be generated using the LTS model. The growth from the base year to the future year Base Minus can be referred to as background growth, i.e. growth to the future year that is not attributable to the development.

4.2 The "Base Minus" Approach

The planning data input for the Base Minus for any given forecast year should be the same as the standard future year Reference Case except for the population and employment level in the area of interest. As such, the Base Minus should be developed from the current LTS reference case planning data[1] and should remain consistent with GLA population and employment projections at a Borough and LTS zone level outside the study area.

The LTS zone(s) that contain the development site should be isolated. No adjustments are required outside of this area(s). For each identified LTS zone, the proportion of the zone that is part of the development area should be established[2], through appropriate GIS software.

In common with all LTS zones, future year population and employment growth will be made up of both a 'structural' and a 'development' component[3]. For each affected zone, the development component of the growth should be removed in line with the proportion of the zone that is taken up by the development site (e.g. remove 100% of development growth if 100% of the zone is taken up by the development site, 20% if only 20% of the

[1] Smoothed forecast

[2] As of January 2012 this has already been done by TfL for each Opportunity Area but may need to be calculated for any new study area

[3] Structural growth refers to the general background or organic population and employment growth that is spread across all of London. Development growth relates specifically to growth generated by large scale developments such as those found in Opportunity Areas or Areas of Intensification.

zone is taken up by the development site, etc). This provides the new ‘Base Minus’ population and employment forecasts for all zones that cover the development site.

The new figures for population and employment in each of the affected zones should be combined with the data for all of the other zones to create the forecast ‘Base Minus’ planning data. This should form the basis of the ‘Base Minus’ LTS model run. It is accepted practice that prior to running the LTS model; several adjustments are made to the planning data. In generating a ‘Base Minus’, each of these adjustments should be carried out (to ensure consistency) with the exception of adjusting to the labour market balance sheet[4].

LTS should be run using the new ‘Base Minus’ planning data. Once checked, the outputs should then be input into Regional Railplan and the appropriate HAM. Assessments can then be made comparing the ‘Base Minus’ against the ‘Base Year’ and the development scenario (future year including development site proposals). To aid reporting, a GIS plot outlining the changes in trip origins and destinations between the ‘Base Year’, ‘Base Minus’ and ‘Development Scenario’.

Note that scenario projections will not be constrained to GLA estimates and therefore the GLA Borough population and employment totals for the ‘Base Minus’ will be reduced. In these projections, only LTS zones where development occurs are altered.

The ‘Base Minus’ should be the base for comparison of all future year scenario tests.

[4] The Labour Market Balance Sheet controls the number of jobs in the model to a set total in line with London-wide and UK forecasts. It is necessary to remove this adjustment for any ‘Base Minus’ (and / or future scenario test), as if the jobs were controlled to the Labour Market Balance Sheet, it would not be possible to assess the real impact of the development. This process affects all zones, not only those specific to a particular development area’s zones.

5. Future Year Trip Generation and Distribution

5.1 Introduction

Trip generation and distribution is key to identifying the impact of a development on the transport network. This note outlines how development trip generation and distribution should be produced and reviewed to ensure it is sensible. It is assumed that development trip generation and distribution is done through the LTS model and sense checked using other methods, notably the TRAVL and TRICS databases (and in some areas of East London, the LUTE database). It should be noted that in some circumstances it may be more appropriate to use TRAVL and TRICS as the core method and use LTS and/or other methods to validate the outputs.

5.2 Approach

Prior to running the LTS model, the future year planning data in the relevant model zones should be amended to reflect the proposed level of development. This should be added on top of the Base Minus' (See 4.2), but should also remove any existing land uses that would be replaced by development. All further adjustments to the planning data prior to running LTS should be consistent with the process used for the base minus[5].

The change in trips between the Base Minus and the scenario test represents the trips generated by the development. All figures should be reviewed to ensure that they look reasonable. In particular, the change in total trips and trips by mode should be compared against those for the Base Minus as well as the differences in trips into, out of and internal to the specific development zones (in total and by mode). It is recommended that GIS plots outlining the changes in trip origins and destinations between the 'Base Year' and 'Base Minus' and the 'Base Minus plus Development Scenario'.

The number of car trips generated should be reviewed against the proposed level of car parking to ensure that there is not a mismatch (i.e. more trips generated than there are parking spaces available). If such a mismatch is apparent, the excess car trips should be identified, based on a logical assessment of trips, and removed from the highway matrix prior to be being input into the HAM. These trips should then be added into the Public Transport matrix prior to being input into Regional Railplan (using the same distribution), so as to ensure a 'worst case' situation.

The LTS trip generation should also be reviewed against other sources to ensure a level of accuracy. The main comparator should be the TRAVL database (supplemented by TRICS if required). Within TRAVL, where possible a large number of similar development types (including car parking ratios) in similar parts of London should be assessed. As with the development of the LTS planning data, care must also be taken to take account for any current land uses that are to be removed as part of the proposed development.

The distribution of trips from LTS should also be assessed by mode to ensure that the results are reasonable (e.g. the majority of walk/cycle trips are short trips, trips into central London are predominantly on public transport etc). LTDS data should be reviewed to sense check the results and make sure they are broadly reflective of the study area.

When inputting the LTS outputs into Regional Railplan and the appropriate HAM, care must be taken to ensure that the distribution of trip ends in the development area accords

[5] All the standard adjustments with the exception of adjusting to the labour market balance sheet

to the proposed distribution of development. This should be done through assigning each portion of development to the relevant HAM/Railplan zone and establishing the proportion of LTS generated trips to be applied to that zone based on the TRAVL (& TRICS) assessment.

The HAM and Railplan assignments can then be generated and the development impact on the strategic transport network assessed.

6. Local Signal Optimisation

6.1 Introduction

The general use of signal optimisation in future year sub-regional models is addressed in Technical Guidance Note MG001 << File: MG001_Borough_Level_Signal_Optimisation_Process_v1.1Draft.docx>>. Whilst the process outlined in MG001 examines the scale of optimisation that is required in order to maintain a feasible level of signal operational efficiency under changed levels of future year demand, this section addresses the issue of local and specifically scheme related signal optimisation.

At issue is the coverage and extent of signal optimisation to be undertaken for a scheme to ensure that no bias is introduced into scheme assessments.

6.2 General Approach

The wider approach to signal optimisation described by MG001 is intended to ensure that any optimisation is limited to that which will result in a realistic level of speed elasticity with respect to demand. Its application is also restricted to the Borough level and the process is designed to prevent unrealistic levels of network wide optimisation. It is widely acknowledged that network wide unrestrained signal optimisation in SATURN is inappropriate, often delivering future year costs below those in the validated base year.

The aim of local signal optimisation is to achieve a realistic response to demand changes in future year scenarios in the vicinity of schemes whilst not creating unreasonable advantages over without-scheme scenarios. As a consequence, optimisation should be:

- Restricted to the vicinity of the scheme
- Applied equally to both with and without scheme scenarios

It is recommended that optimisation should therefore:

- Be for all junctions within a defined area of the scheme (within 1km radius)
- Involve a review of signal cycle times, offsets and green splits
- Allow for stage/ phase changes where necessary.

Whilst the process described above allows for a fuller level of optimisation than that specified in MG001, this can be justified because of its limited geographical application and the required application to both with and without scheme scenarios. Should local costs reduce significantly relative to the Base year however, some scaling back of signal changes may be required. In this case, a similar level of optimisation will still need to be implemented for both with and without scenarios. The impacts of any signal optimisation should be checked by comparing both flows and routeing patterns for strategic origin and destination pairs in base and with-optimisation assigned networks.

7. Sensitivity Tests

7.1 Introduction

Application of LTS growth to HAM based development studies in accord with Guidance must be supplemented by sensitivity checks using variations around the central demand levels of growth. This process is required to demonstrate that the model responds in a predictable and realistic way and is not critically tailored to a given level of demand.

7.2 Sensitivity Tests

Variations in both local development specific and global levels of demand may be required.

Initial sensitivity tests should be carried out, assuming base level demand but modified to include 'full development' trip demand for the development area only.

This scenario will be called "Magic Wand" (as if the development suddenly appeared by magic) and aims to provide an indication of the additional demand against a known benchmark.

Unless otherwise agreed, the following future year sensitivity tests will also be required:

- Local Development (above base minus levels) subject to growth by a factor of 110 percent.
- Global Demand subject to growth by a factor of 105 percent.

7.3 Reporting

Comparisons shall be required for each of AM, PM and IP periods for each forecast year, and for network wide and relevant core borough separately. Statistics recorded shall include for each sensitivity scenario and area, absolute values and percentage changes in:

- PCU hours
- PCU Kms
- Average speeds
- Elasticities of speed change and pcu hours against demand

Network plots of the core borough shall be produced with junction hotspots highlighted (bandwidth and plots of significant changes in vehicle hours delay) by both link and junction based on differences between Reference and sensitivity tests.

8. Statistics and Thresholds for Model Output

8.1 Introduction

This section sets out the transport analysis that will usually be required to report on the impacts of an OAPF Traffic Study or Highway Scheme Study using the Sub-regional Highway Assignment Models (HAMs).

8.2 Future year scenarios to be modelled

The following scenarios should be considered for the AM, PM and IP time periods:

- Base year (assumed 2009);
- Future year 2021 and 2031 without the OAPF development - the OA do-nothing (OA DN);
- Future year 2021 and 2031 with the OAPF development - the OAPF do-something land-use (OA DSL). There might be different scenarios – OA DSL A, OA DSL B etc;
- Future year 2021 and 2031 with the OAPF development and mitigation - the OAPF do-something land-use with mitigation (OA DSLM). There might be more than one mitigation package – OA DSL M1, OA DSL M2 etc.

Traffic growth should be drawn from LTS and applied to the HAM using the method set out in Technical Note 01.

For the OAPF DN, the process set out in Section 3 should be followed to remove the OAPF traffic generation to create the do-nothing land-use.

A sensitivity test should be carried out with the development traffic added to the base year network without any further traffic growth (DS – zero growth). An additional test should be carried out on the same basis with the mitigation package (DSM – zero growth).

The analysis should be presented with and without signal optimisation. The methodology for the signal optimisation for the OAPF DN is set out in the Signal Optimisation Process Guide Technical Note. For the DS scenarios individual junction optimisation should be applied in the study area – A similar level of optimisation should be done for both the do nothing and do something to avoid masking the traffic impact. Application of local signal optimisation should be in line with the processes described in Technical Note 1.

The analysis should be presented for the AM, PM peak hours and the inter-peak average hour.

8.3 Reporting and Model Statistics

8.3.1 Junction and link impacts

The following statistics should be reported and annotated plots produced showing the link impacts for:

- Demand Flows;
- Actual flows;

- Average Delay per vehicle;
- Average Queue length;
- Queue to Stacking Capacity ratios (proportional);
- Volume over capacity to tie in with wider TfL performance thresholds including red (>90%), amber (80 – 90%), and green (<80%);
- All hot spots link with V/C>90%;
- Blocking back factor;
- Total vehicle hours delay.

The following statistics should be reported for the junction impacts:

- Delay per vehicle;
- Volume over capacity ratios to tie in with wider TfL performance thresholds including red (>90%), amber (80 – 90%), and green (<80%);
- All hot spots (junction with V/C>90%);
- Total vehicle hours delay;
- Highlight junctions with any network coding changes between DN and Base, DS and DN (e.g. signal optimisation, widening etc.).

Beyond those in the immediate vicinity of the OA, a judgement will be required, based on the area of influence, as to which other junctions and links are assessed.

The absolute measures will be dependent on the quality of the validation in the model study area. In areas where the validation is less good, this should be taken into account in framing conclusions.

8.3.2 Corridors

The following information will be reported for major corridors adjacent to the OA:

- Journey times (observed and modelled) as elapsed time graphs;
- Total flows;
- Select link analyses for certain key links that serve significant routes through or adjacent to an OA (if appropriate);
- Approximate bus journey time changes on high frequency bus routes (taken as >10 buses per hour) using highway journey times.

In each study, a judgement will need to be taken as to the length of each corridor.

Analysis will be presented for:

- TLRN corridors;

- Sub-regional corridors ;
- Bus corridors.

8.3.3 Area based statistics

The following area wide statistics will be reported for the whole model and core study area broken down by borough and simulation/buffer area:

- Total demand (pcu/hr for cordon model)
- Average speeds
- Traffic flow (pcu kms or veh kms)
- Travel time (pcu-hrs or veh hours)
- Congestion (delay in pcu-hrs)

TfL will provide a spreadsheet to assist in the calculation of appropriate Borough Statistics.

8.3.4 Demand Changes

A GIS thermal map should be produced showing the changes in demand by Origin and Destination totals (by zone/sector) between:

- Future year OA do nothing (base minus) vs Base Year (Future vs Base)
- Future Year Scenario vs Future year OA do nothing (base minus) (With Development vs Background growth)
- Future Year Scenario vs Base Year (Full Impact vs Base)

8.3.5 Thresholds/Acceptable levels of service

Each study should be considered on its own merits and it is recognised that trade-offs and reconciliation with other studies and development areas may need to be made.

The default assumptions for acceptability are that:

- on average junction delay, journey times and average speeds with the OAPF development in place should be no worse than in the core future year OA do nothing; and
- V/C at individual junctions, based on TfL's junction classification system:
    - o should not increase so as to cross into 'amber' or into 'red' from 'amber'; and
    - o any junction classified as 'red' must be mitigated if possible to reduce V/C to acceptable levels.

8.4 Specific Impacts of Development Traffic

Proposed developments will generate and attract vehicle trips to the development zones, but the full traffic impacts are often masked by displaced traffic, which diverts to avoid the scheme specific generated traffic. These impacts are particularly important in locally congested areas where the network has difficulty in accommodating the additional traffic from developments.

In order to understand more fully the underlying traffic impacts, we would expect the following to be done:

8.4.1 Network

The following network based plots will be required:

- Plot showing the demand flow of trips derived from a Select link Analysis on **all** Origin and Destination zones within the development area (development scenario)
- Plot showing the demand flow of trips derived from a Select link Analysis on **all** Origin and Destination zones within the development area but without development (Base Minus)
- Plot of 1-2 to obtain the GROSS impact of development traffic
- Standard plot of demand flow of (With development – Without development) to show the NET impact of developments
- Plot showing the Displacement of traffic resulting from the presence of development traffic (4 – 3)

8.4.2 Matrix

In order to assess the direct local impact of development trips, the following cordoning and analysis processes should be undertaken:

- Cordon the study area (defined by a boundary approximately 2km from the development) for both DS and Base Minus;
- Sector the cordon matrices into three sectors (Development zones, Non development zones, and External zones);
- Compare the two sector matrices and report changes. The increase in trips to/from Development zones will be indicative of the demand for the developments, whilst any reductions in External-to-External trip numbers reflect the displacement traffic.

8.4.3 Displacement Traffic

The comparison of Actual Flows between the future year Scenario against Base Minus will give us the Net Traffic Impact of the development trips. However, the Gross Traffic Impact is masked by displacement trips where traffic avoids the area due to increase congestion and diverted around the study area. We need to understand the extent of the displacement traffic by reporting the following:

- Net Traffic Impact plot (Scenario – BM Actual flows)
- Gross traffic Impact (Scenario – BM select link analysis for Origin and Destination for all development zones)
- Displacement traffic (2 – 1)

The above plots are equivalent to the sector cordon matrices in the Matrix section above.

9. Development and Use of HAM Cordon Models

9.1 Overview

This section outlines a proposal for the development of cordon models for any of the HAM models as part of OAPF modelling work. It outlines the strengths and weaknesses of the approach and recommends procedures to be followed.

9.2 Background

A major local study such as an OAPF requires a high level of validation in the localised area and also for key strategic movements through the area. The model also needs to be sufficiently responsive to test a range of development and network related scenarios without these effects being lost in 'model noise'. Given the size of the HAM models, typically with in excess of 2000 zones and a simulation area covering wide areas of the GLA as far as the M25, the magnitudes of scheme impacts can often be of the same order as model noise, despite the extremely high degree of model convergence routinely achieved across the models.

Further to this, and because the models are so large, matrix estimation can sometimes struggle to meet all the counts even when obvious inconsistencies have been removed. The strategic nature of the HAMs means that It is often the case that a particular HAM will not validate sufficiently well in the local OAPF study area, despite a satisfactory level of validation overall.

9.3 Model Cordoning

Cordoning of the HAM model to achieve a better local area model may be considered to resolve the above issues. This would provide a smaller, more responsive model to which further counts could be added to improve validation in the local area through matrix estimation. It would also have the added advantage of significantly reducing run times.

There are significant risks that would need to be mitigated if this approach is to be implemented. The most immediate concerns are that:

- The process would result in a proliferation of models which are significantly different but of a similar quality to that of the donor HAM model;
- The Cordon model may not be large enough to capture all scheme effects

In order to mitigate these risks and to ensure the consistency and quality of such an approach, the following process and tests are proposed for the cordoning of a HAM model

9.4 Identification of Cordon Area

The following information should be used to identify the area of influence. All significant (in terms of scale and relevance to study) movements should be captured in the cordon area.

- Plot of destinations / origins from / to study area zones in terms of ODs and paths in the base year
- Assignment of base year demand + scheme uplift (maximum impact scenario) to base year network, then compare flows against base. Also, plot of ODs as defined for base (previous point)

9.4.1 Process

The cordoning process is as follows:

- Review of network / zoning detail and sense check
- Prior matrix + full network cordoned for the area identified above.
- Counts for matrix estimation added for the study area as requirements dictate (where possible organised as mini-screenlines)

This may be iterative depending on validation results

9.4.2 Validation

The cordoned model validation should comprise of:

- Dashboards presented for the cordon model for each time period. These correspond to the DMRB flow and journey time validation criteria
- Comparison of the Trip Length Distribution between the cordon model with matrix estimation and the model with the prior matrix assigned. Any difference should be justifiable in the context of the study.

Section 3 provides further guidance on the model validation processes and requirements.

9.5 Conclusions and Recommendations

It is recommended that where cordoning is required the above steps are followed, subject to review and refinement. This will ensure that a robust modelling process is followed and that changes can be readily imported back into the full HAM model where appropriate.

APPENDIX A: HAM Reference Case Matrix Building Process Summary

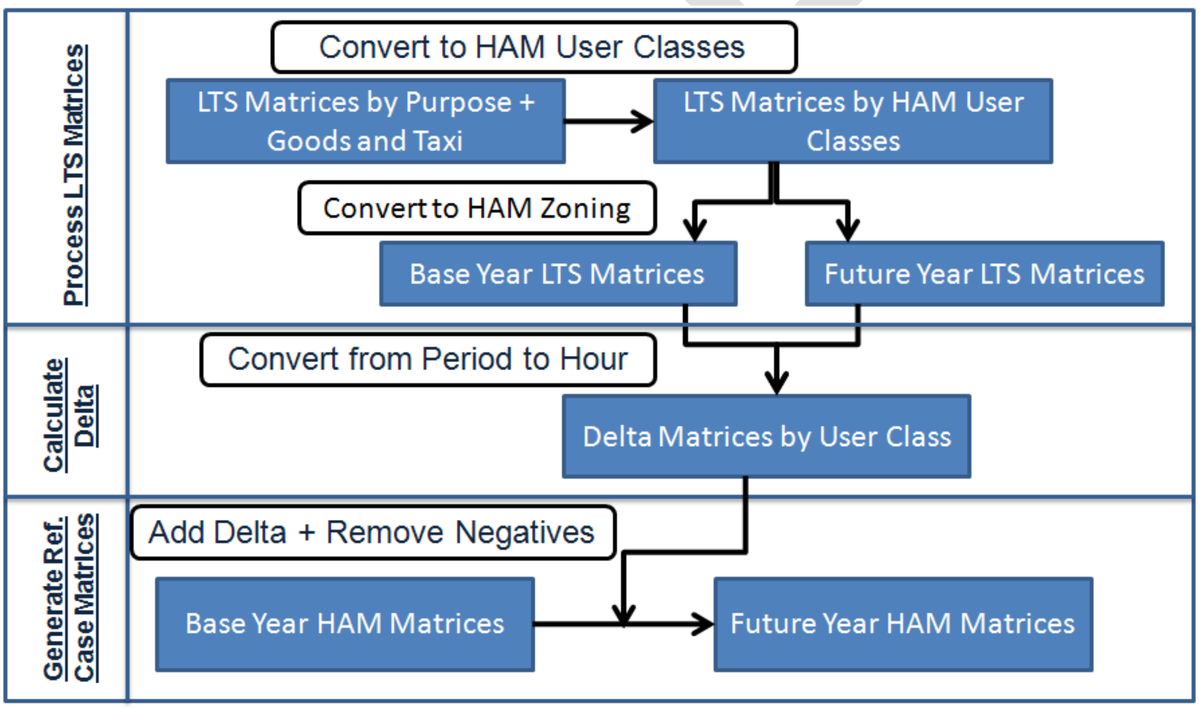
Overview

This document briefly outlines the steps involved in creating the HAM future year reference cases. It focuses on the matrix side as this is where much of the complication is. In summary, absolute differences between the LTS future and base year matrices are taken, converted to HAM zoning and from peak period to peak hour matrices. This is then added to the HAM base year matrix to give the future year reference case matrix. This matrix is assigned to the reference case network, signals are then optimised to allow for changes to timings which would be made in 'real life' to accommodate different traffic patterns. This results in the final reference case run.

Matrix Process

Figure 1 below summarises the future year matrix process used to generate HAM reference case matrices.

Figure 1: Overview of Matrix Process



The steps are described in more detail below:

1. Download LTS base year and future year assignment matrices. The Car matrices are downloaded by purpose. This download process is summarised by the note titled 'LTS Car Total Matrix Purpose Split Methodology'. LGV, OGV and taxi matrices are also downloaded.
2. These are read into CUBE. A CUBE process exists for each HAM. The car purpose wise matrices are then combined into the purposes (User Classes) required for each HAM.
3. The matrices are then disaggregated into HAM zoning. This process differs by HAM but is chosen to be as consistent as possible with the base year in order to

ensure that LTS demand is allocated in a similar way to that in development of HAM base year matrices.

4. The matrices are converted from peak period to peak hour. The factors are again chosen to be consistent with base year HAM matrix development. HAMs differ in their approach to calculation of these factors. ELHAM uses factors by sector, SoLHAM by purpose and sector, where as others use a flat factor of 1/3 i.e. same as average hour. The overall factor is given in ***table 1*** for each HAM

Table 1: Summary of HAM Peak Period to Hour Factors

HAM	Factor
CLoHAM	1/3
WeLHAM	1/3
NoLHAM	1/3
SoLHAM*	0.35
ELHAM*	0.41

*Calculated average from comparison of LTS demand to final HAM demand, as actual factors are by sector

5. LTS peak hour absolute difference matrices by user class (in HAM zoning) are calculated by subtracting the base year matrices from the future year matrices.
6. The difference matrices are then added to the base year HAM matrices, with any resultant cells that are negative made 0.

Network Process and signal optimisation

The network building process is again not uniform across the HAMs as some of the networks were in existence before this work started and were not revised. They were deemed to be acceptable. For the networks developed as part of this project (ELHAM and SoLHAM), boroughs and Surface were contacted to find details of all committed and funded schemes. These were then reviewed to see if they required any network coding. Schemes that made it through this process were coded.

The signal optimisation process is summarised by the guidance note outlined in Appendix.

Areas of Possible improvement

This section lists the areas where improvements should be considered:

1. **Revised methodology for dealing with negative cells:** Such cells, although mostly outside the area of interest in the HAMs, do cause a degree of inconsistency. This occurs where the cell does not have enough trips available to subtract trips from in areas where LTS predicts a decrease in trips. It should be noted that significant re-distribution takes place in LTS and so this is not a trivial issue.

2. **LTS intrazonals:** The allocation of LTS intrazonals in the future year HAM matrices depends largely on the zonal disaggregation factors. Assigning trips to one zone may result in the trips being intrazonal in the Ham, where as assigning those to the zone next door will generate short distance trips. It is therefore important to scrutinise these lookups and perhaps even carry out a detailed area by area review.

3. **Adjustment for Difference in Modelled Years in the base:** Currently we do not adjust LTS demand to account for differences in HAM (2008/2009) and LTS (2007) base year. This is because traffic levels fell between 2007 and 2008/2009 (HAM base year). This means that we are applying LTS growth to a lower level of base year demand and so by applying the full LTS absolute growth, we would reach somewhere close to the LTS absolute total in 2031. If the growth was factored down to account for the difference in modelled years, this may not be correct as we would not reach the LTS future year absolute total. This approach needs to be scrutinised.