
Transport
for London

Sub-Regional Highway Modelling in London using SATURN

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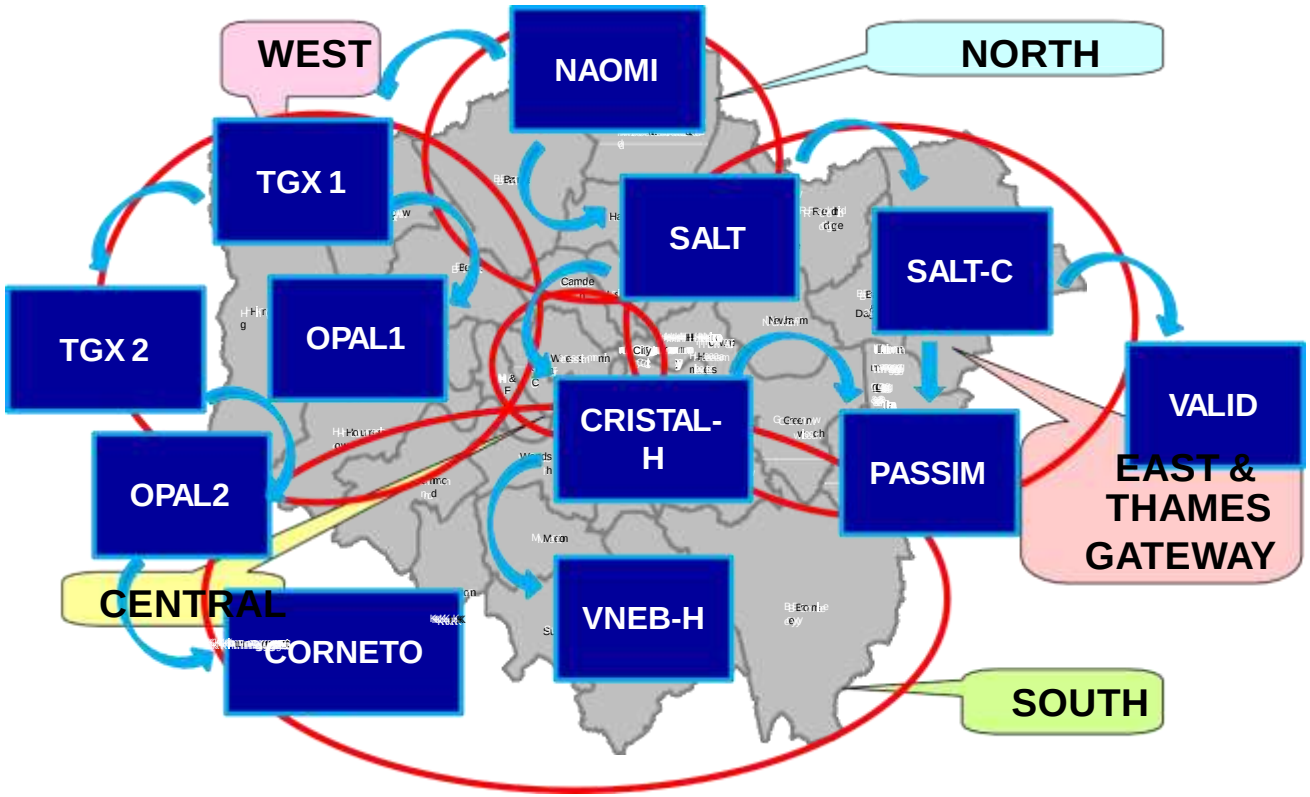
SATURN User Group Meeting – Epsom

22 November 2012

Structure of the Presentation

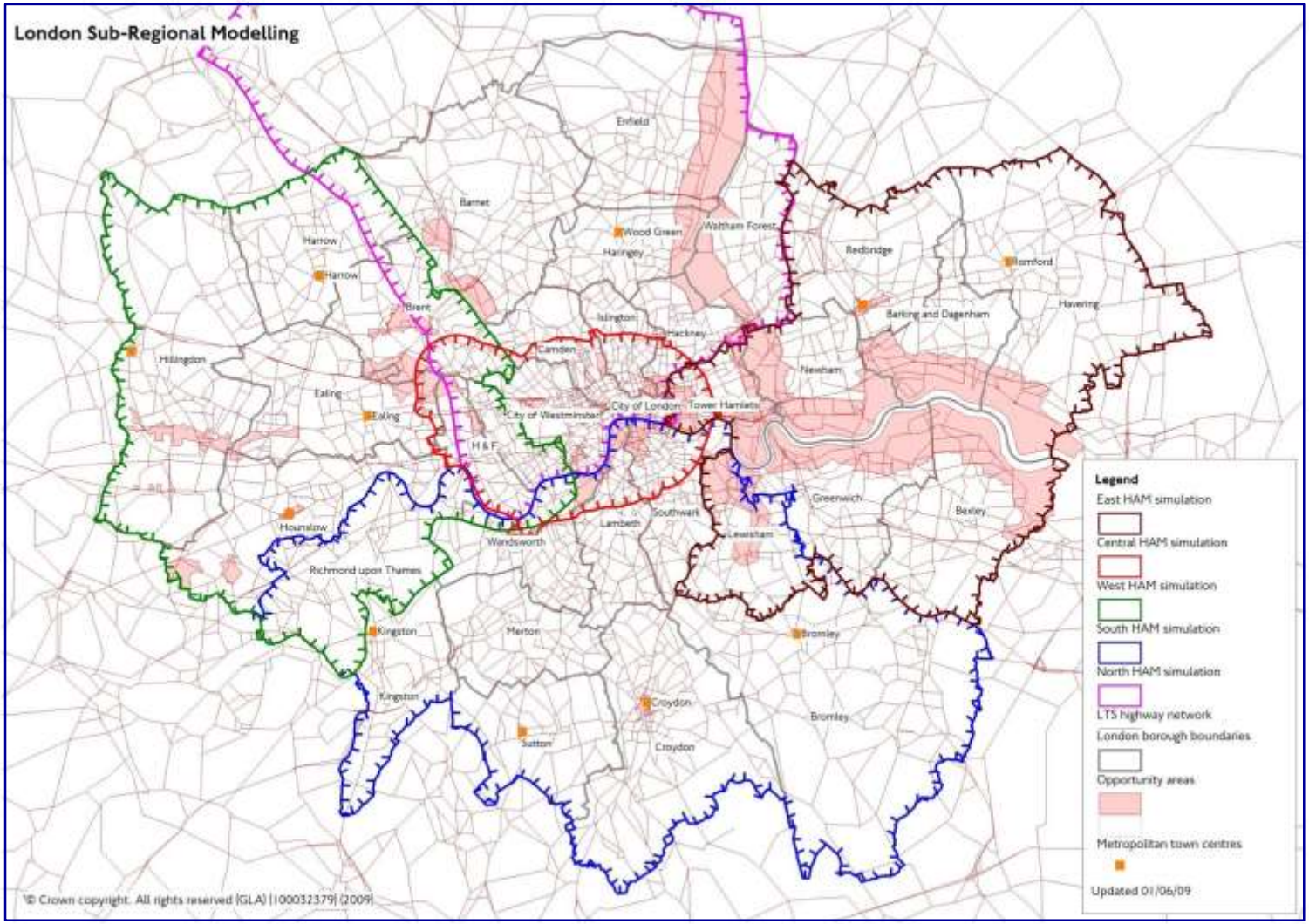
- Introduction
- HAM Applications
- HAM Development Phase 1
- HAM Development Phase 2
- In-house Developments – Tools
- Guidance Note
- Example: White City OAPF

Why have we built them?

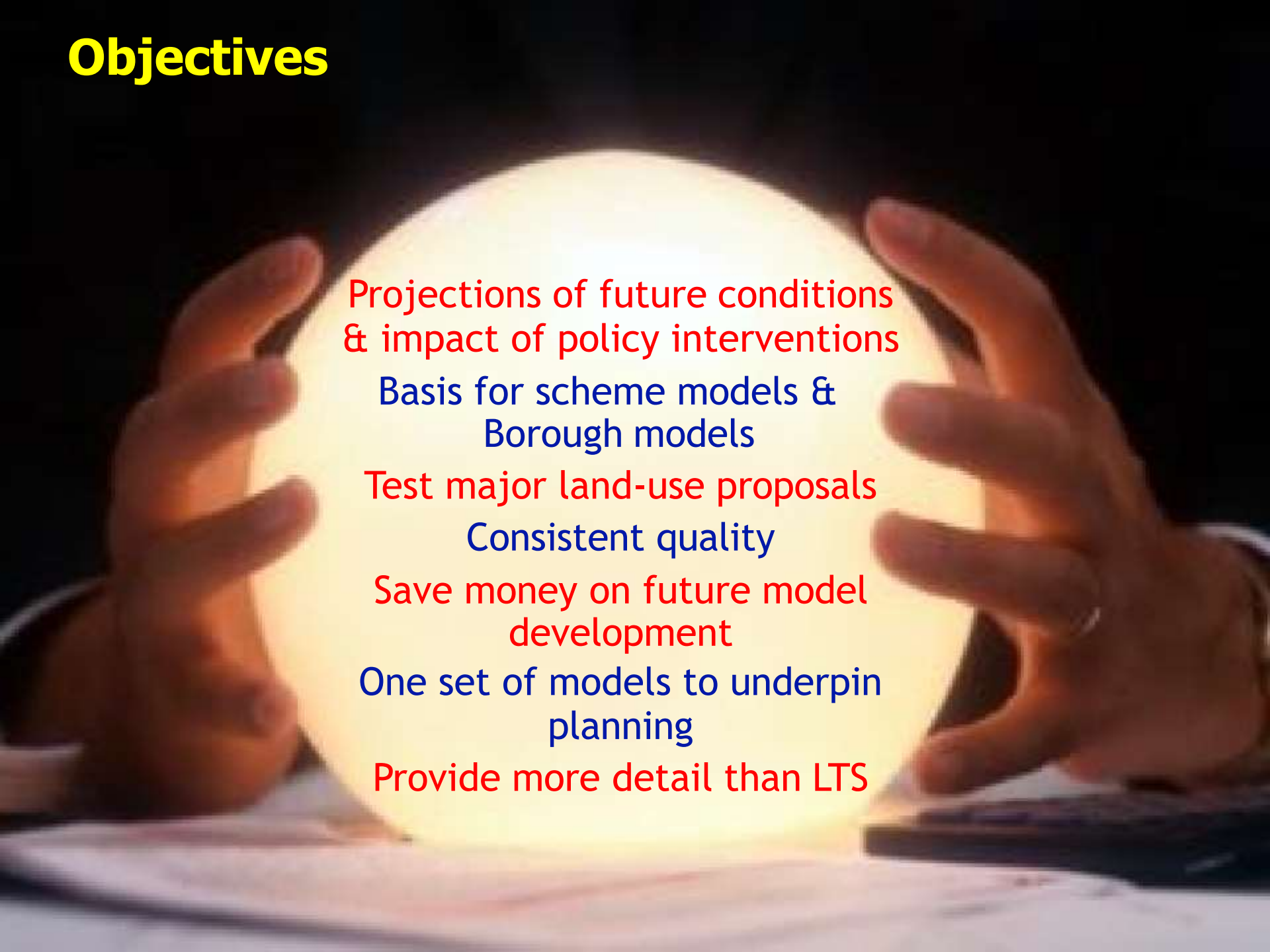


Why not have one model per region?

HAM Core Boroughs



Objectives



Projections of future conditions & impact of policy interventions

Basis for scheme models & Borough models

Test major land-use proposals

Consistent quality

Save money on future model development

One set of models to underpin planning

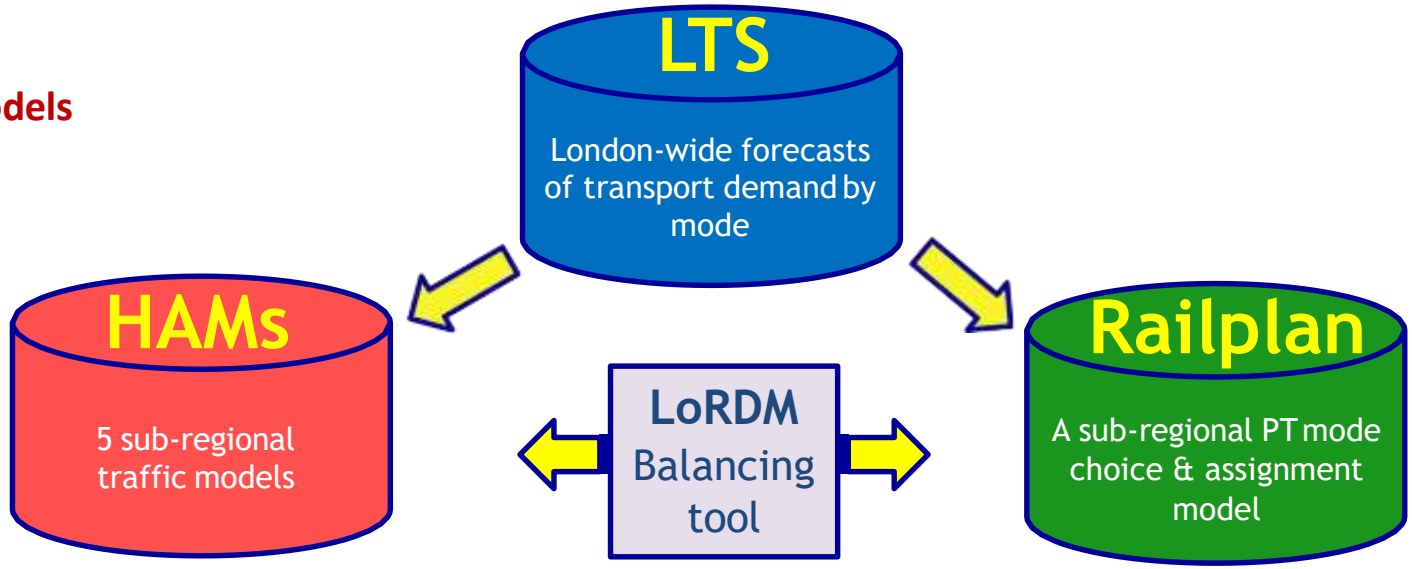
Provide more detail than LTS

Objectives

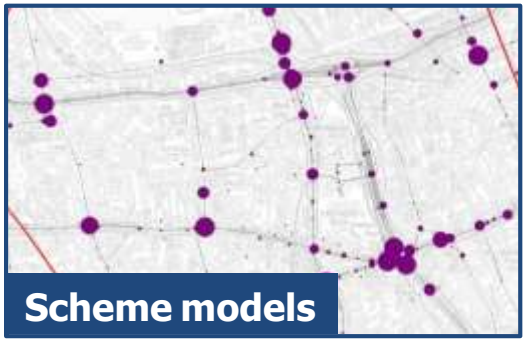

Available to all
to improve the
quality of
planning across
London

How the models work together?

Sub-regional models



Not Sub-regional models



What have we done?

- Programme started in 2008
  - North and Central London Highway Assignment Models
  - Continuous Road Side Interview Programme (CRISP)
  - Enhancements to Railplan
  - LoRDM (developed from CRISTAL-D model)
- First major deliverables were in 2009 - Central and North London models
- Peer review in January 2010 - and our own lessons learnt exercise
- Re-wrote LoRDM to incorporate LTS
- Completed West, South and East models October 2010
- In-house recalibration of West, South and East (Production ver 1) Spring 2011
- Introducing Network spreadsheet, Dashboard, Journey Time, Count DB
- Currently recalibrating all 5 HAMs with revised matrices
- Major count programs

Who has delivered the work?

mva consultancy

JE JACOBS

ARUP

AECOM

Scott Wilson

steer davies gleave

COLIN BUCHANAN

Mott MacDonald

SINCLAIR KNIGHT MERZ SKM

ATKINS

Hyder

Halcrow

Denvil Coombe Practice

Past Application of HAM models

1. Upper Lee Valley OAPF
2. Earl's Court and West Kensington OAPF (Halcrow)
3. White City OAPF (TfL / MVA/ Motts)
4. Vauxhall Nine-Elms Battersea (VNEB) (SKM)
5. Olympic Stadium Legacy (SDG)
6. Hayes Town Centre major bid (SDG)
7. Bow roundabout early start (TfL)
8. Harrow AAP (SKM)
9. Cycle Superhighways - Swiss Cottage R11 (SKM)
10. Cycle Superhighways - Stratford extension to R2 (TfL)
11. Croydon OAPF (MVA/Motts)

Application of HAM models (1)

1. Northern Line Extension to Battersea (TfL/SDG)
2. River Crossings – regeneration (TfL/Motts/SDG)
3. HS2 Euston termini assessment (TfL)
4. HS2 Environmental Statement (Halcrow/Arup/Motts)
5. Thames Tideway Tunnel (PBA)
6. Croydon Whitgift Centre - Westfield (WSP)
7. Croydon Tramlink (AECOM)
8. Redesign of Hanger Lane Gyratory (AECOM)
9. A13 Management Company (Motts)
10. South of River Study (Pell)

Application of HAM models (2)

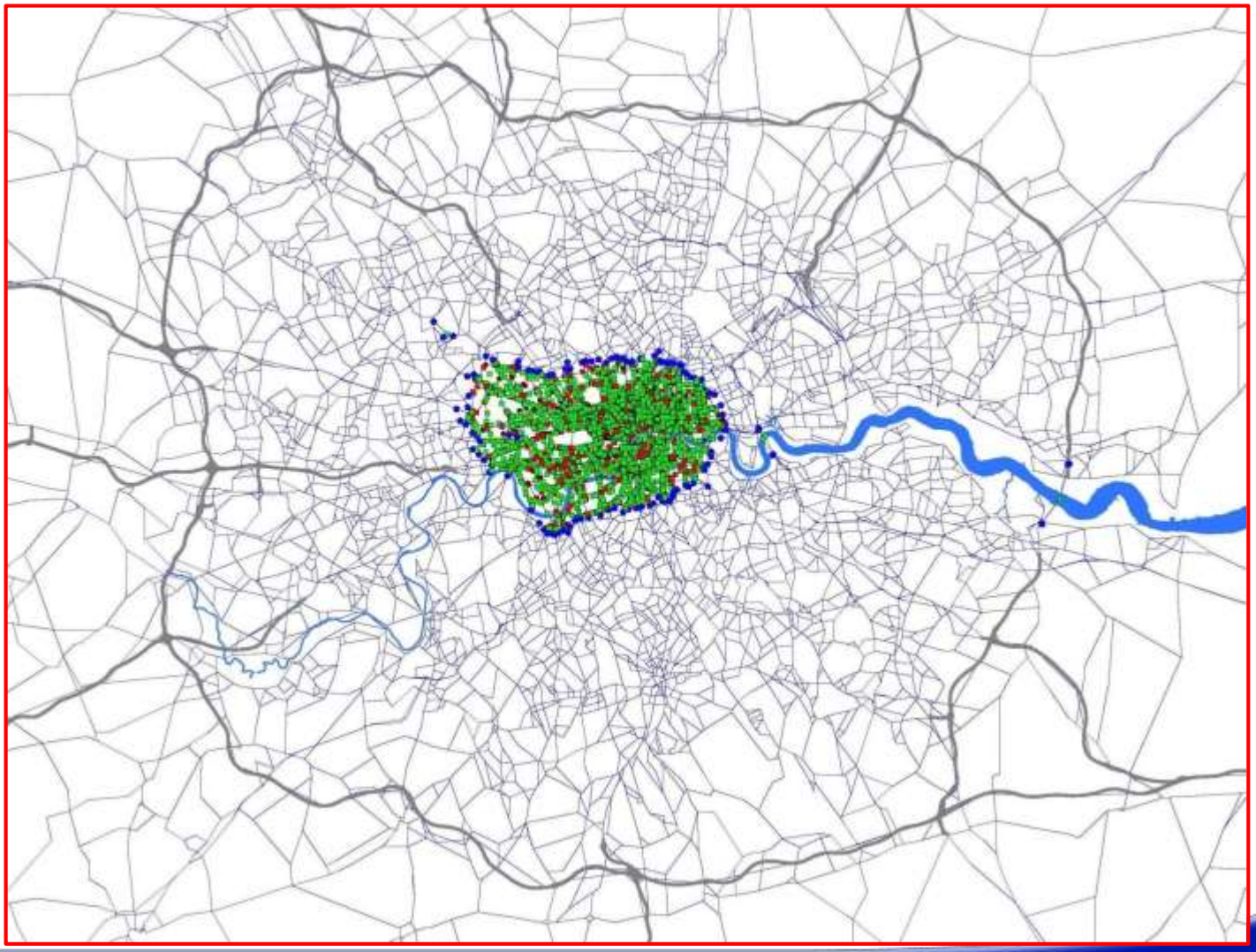
11. Olympic Legacy (Arup)
12. Hounslow LDF (WSP)
13. Southall OAPF (AECOM)
14. South Westminster Traffic Management Study (JMP)
15. Aldgate HW changes & Public Realm Improvements (SKM)
16. DfT Lower Thames River Crossings (AECOM)
17. Olympic Park Legacy Transformation (Capita)
18. Three Rivers and Watford LDF Model (AECOM for HA)
19. Euston AAP (SKM)
20. Park Royal City (Old Oak Common) OAPF (URS)

Proposed Application of HAM models

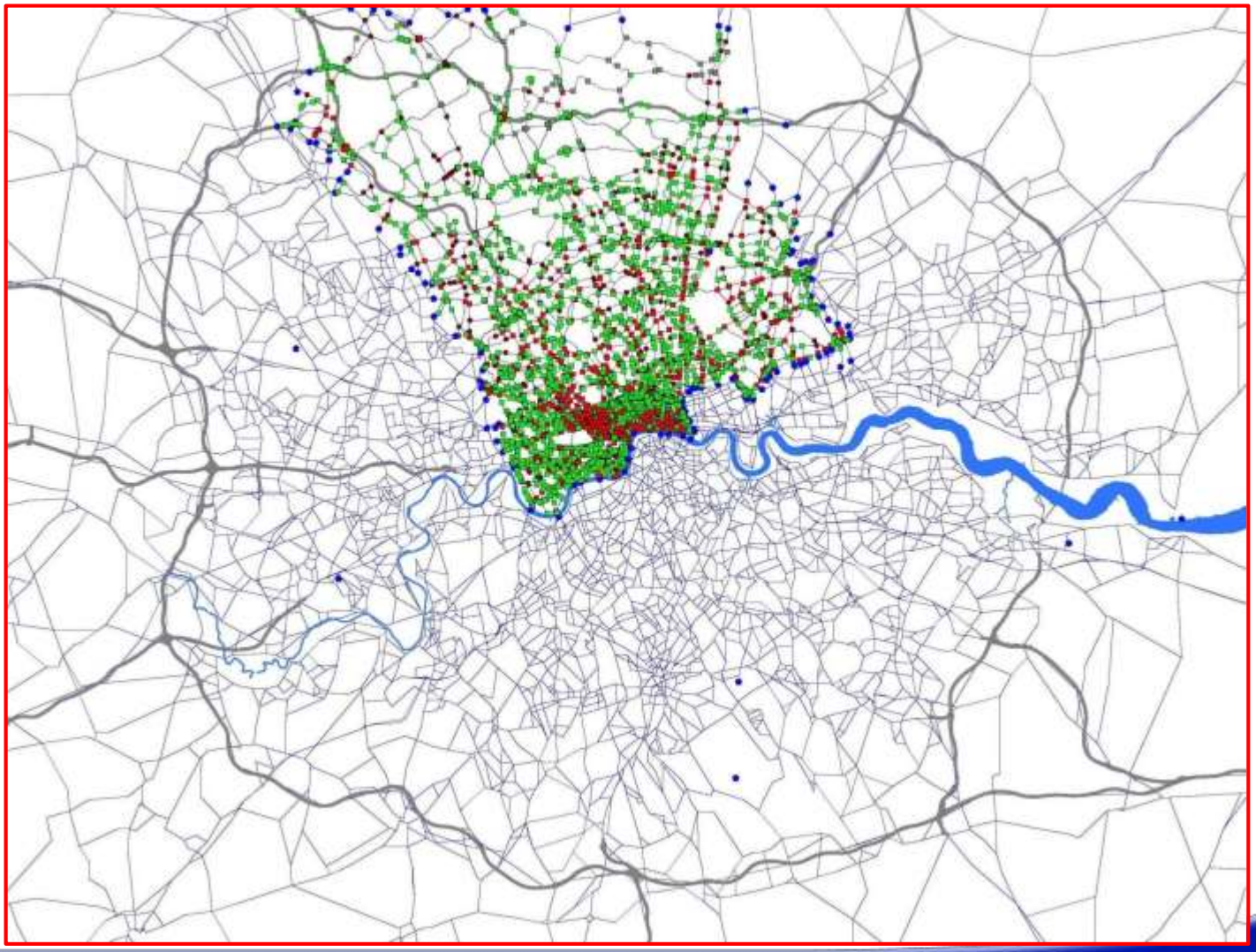
1. West End Project - Traffic Modelling (TCR 2-way Scheme)
2. Wembley AAP
3. R9 Cycle Superhighway (Hounslow to Hyde Park along the A315)
4. LB of Enfield
   - Meridian Water
   - Northern Gateway Access Road
5. Herts CC / Broxbourne – Local Development Plan

HAM Developments Phase 1

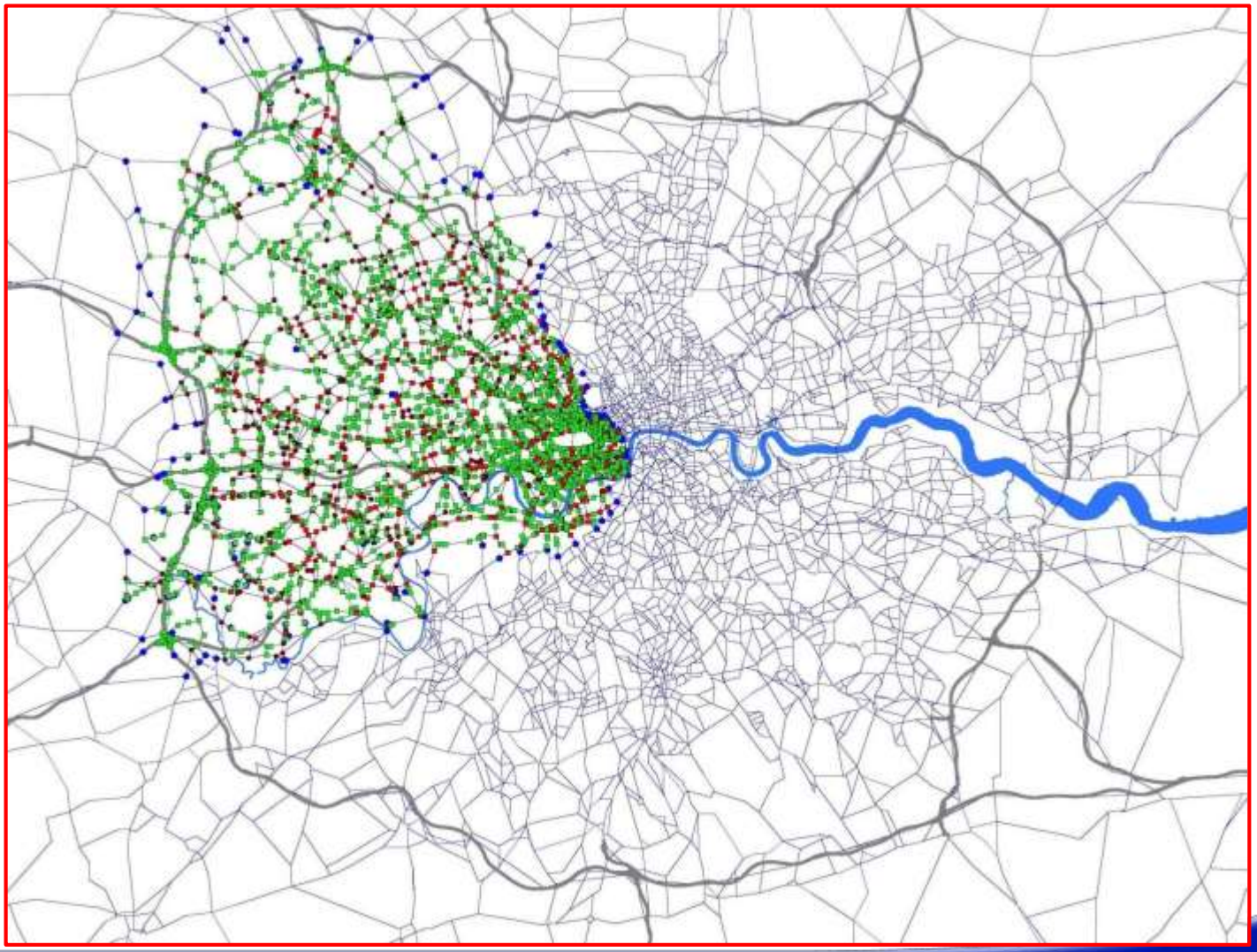
CLoHAM



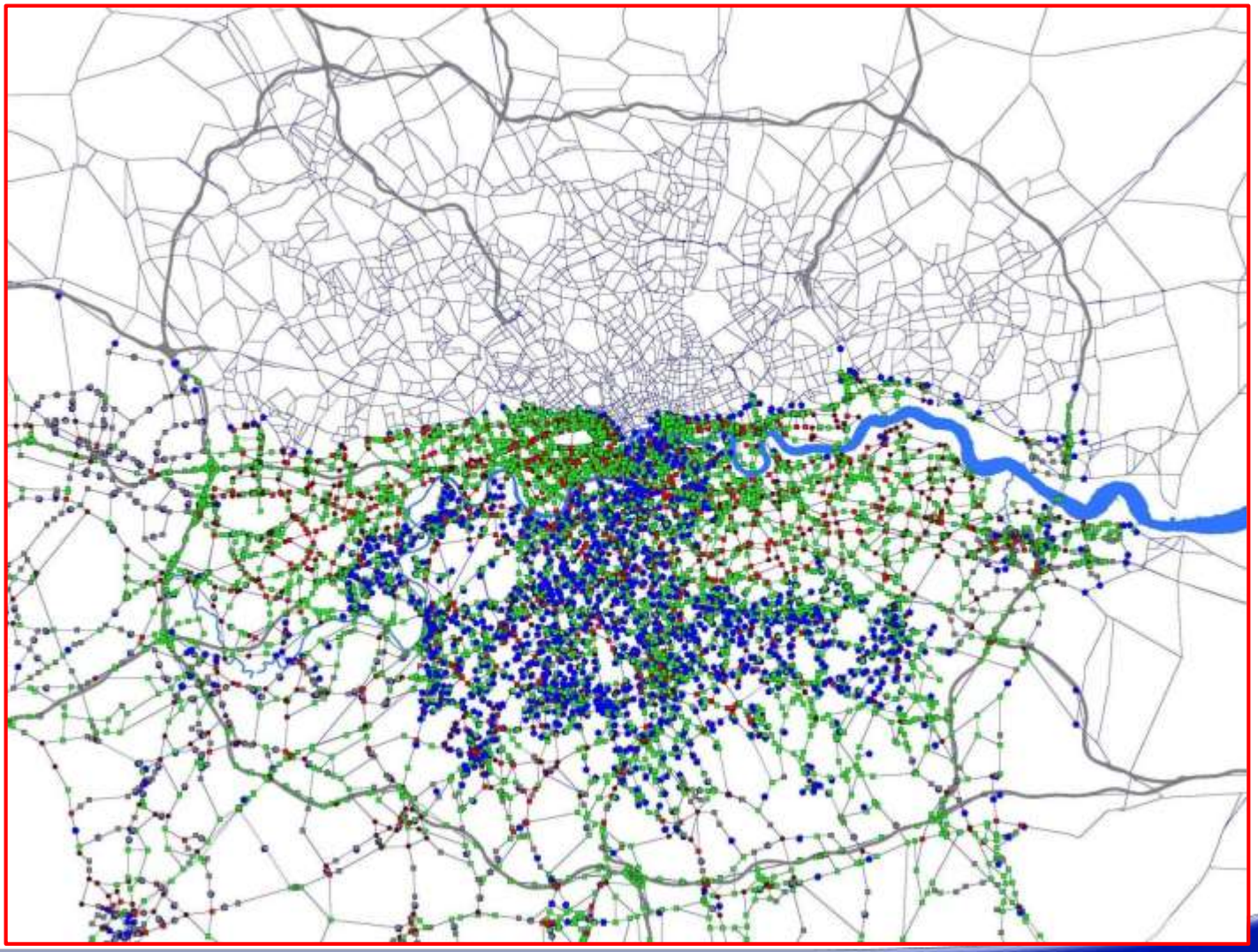
NoLHAM



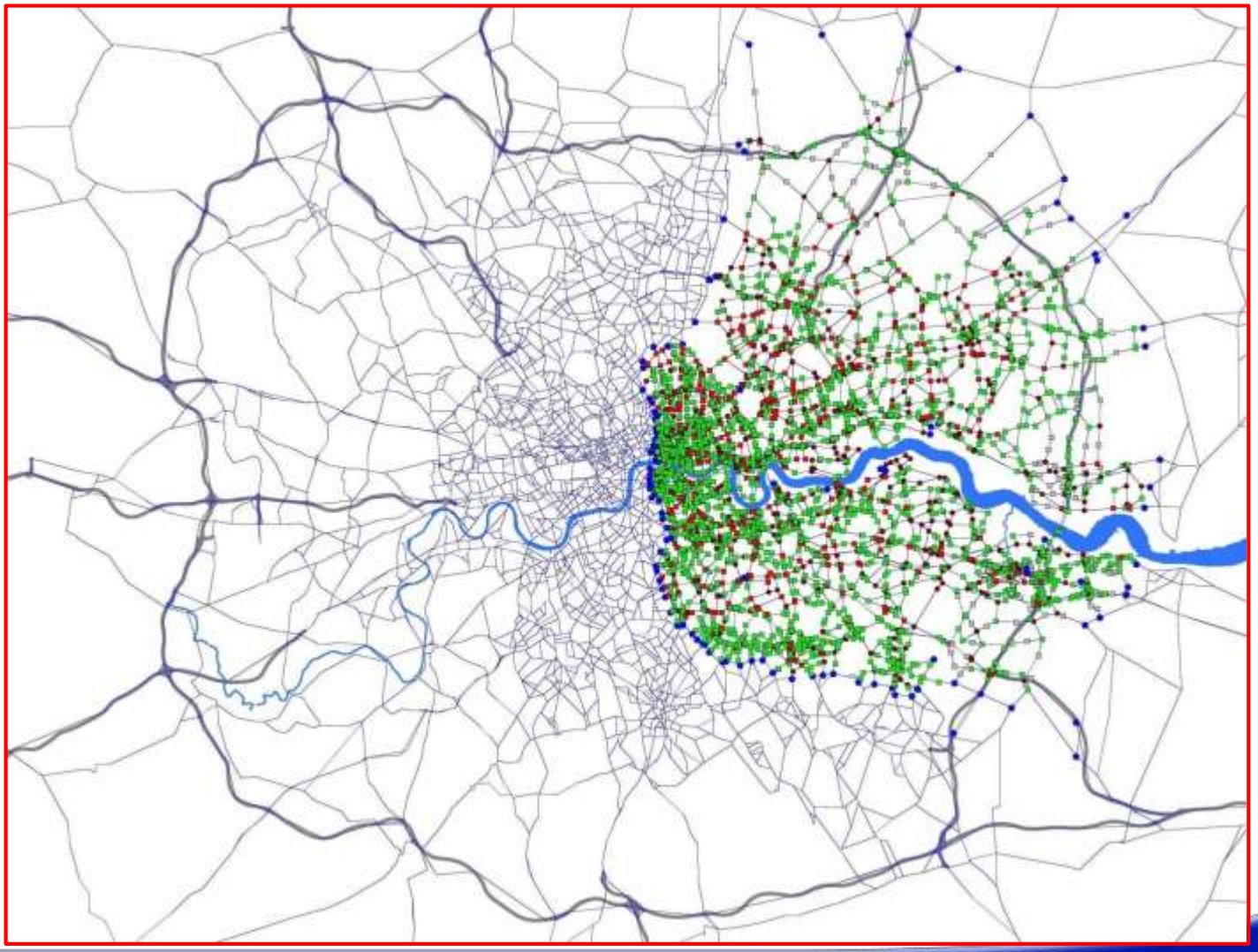
WeLHAM



SoLHAM



ELHAM



HAM Developments Phase 2

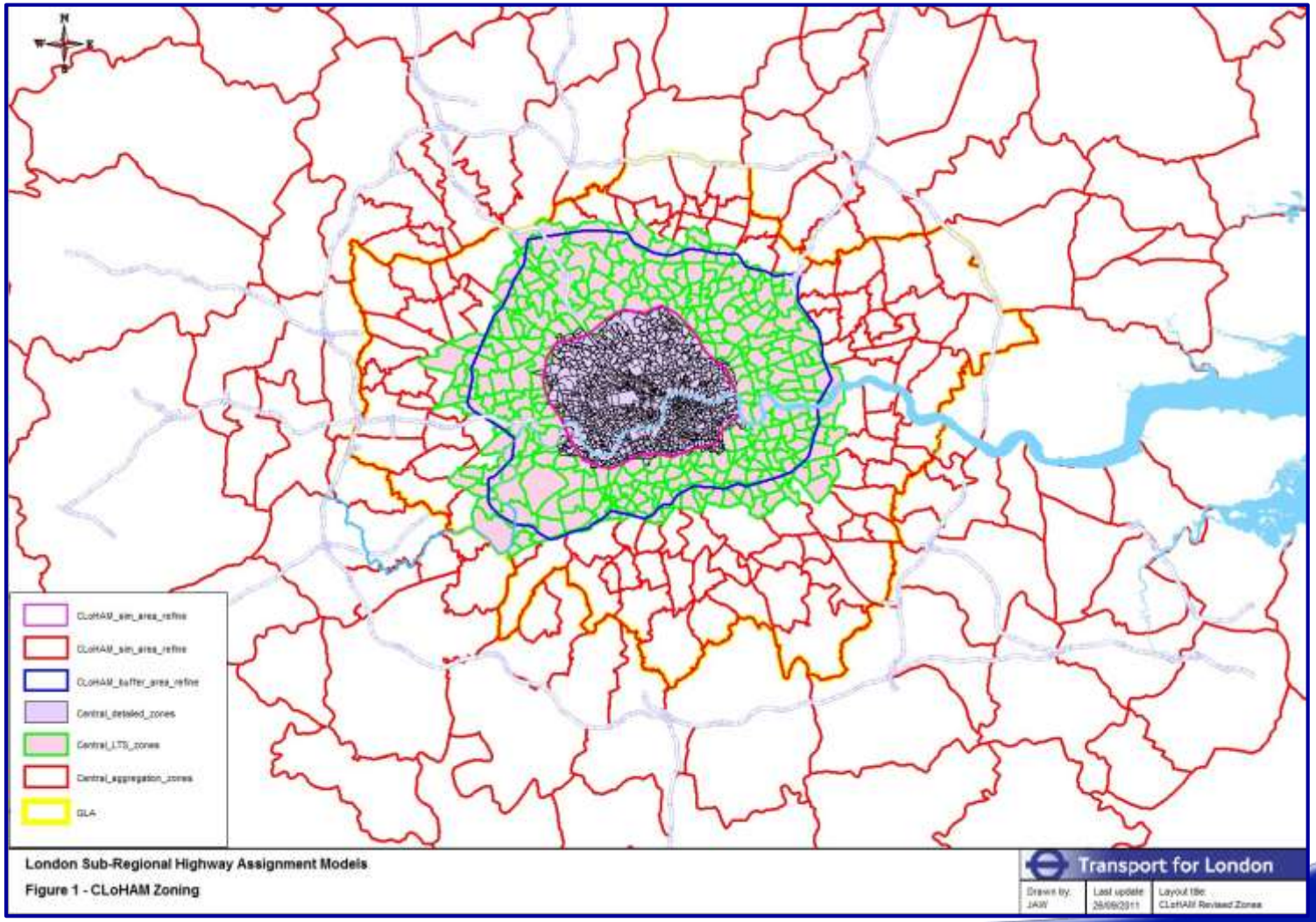
HAM Production Version 2

- **Aim:**
  - **Consistent in model structure to increase commonality between HAMs**
  - **Each zone should have no more than 350 trips**
  - **Each HAM consists of the following annuli that covering:**
    - **Simulation area (junction details beyond the core boroughs)**
    - **Speed-flow buffer area (link with congestion effects)**
    - **Fixed-speed buffer area (link with fixed speed for external area)**

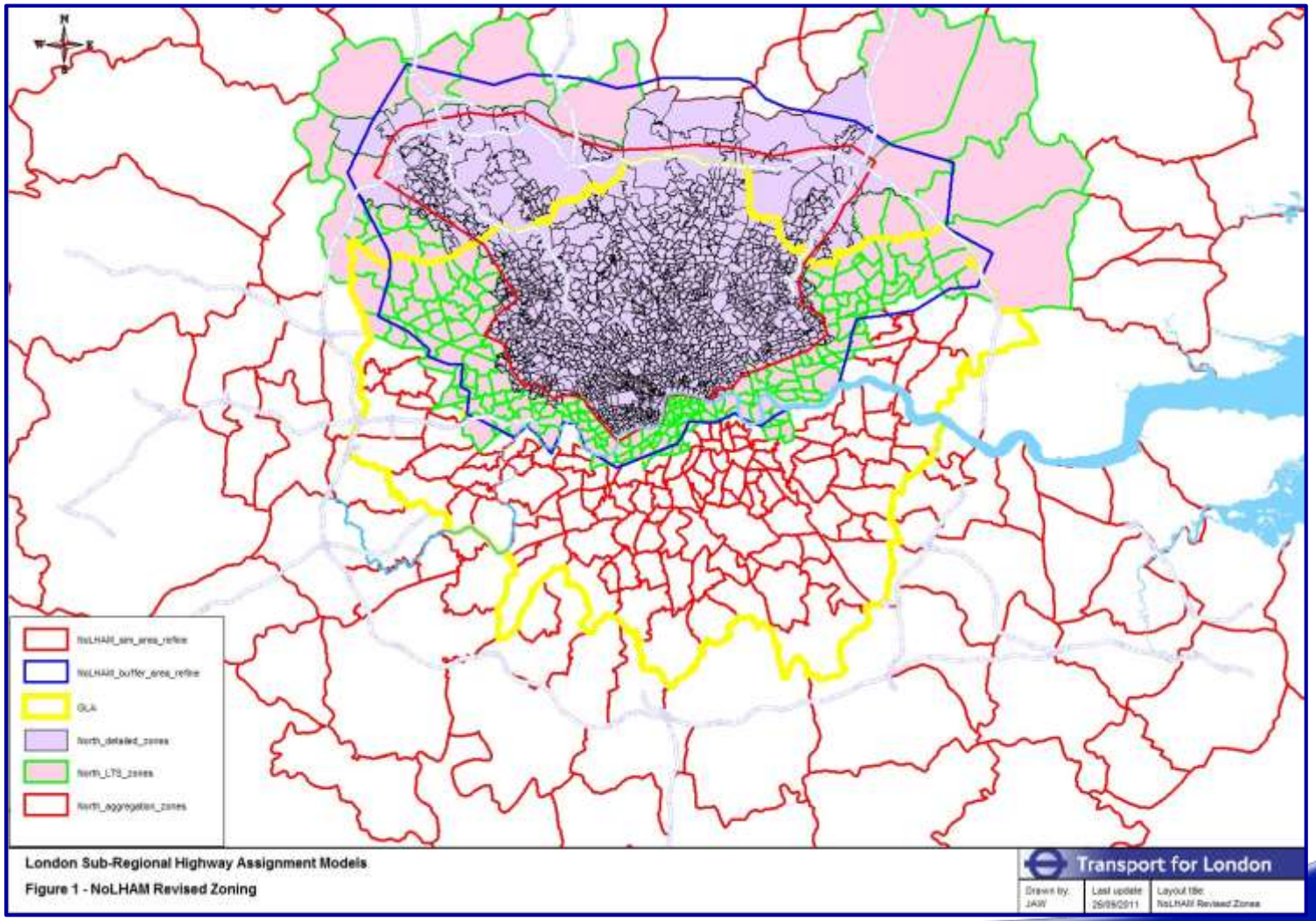
Zoning System

- **3 level of zoning corresponding to the different levels of the network details:**
  - **Detailed zoning (simulation)**
  - **LTS zoning (speed flow buffer)**
  - **Aggregated LTS zoning (fixed speed external area).**

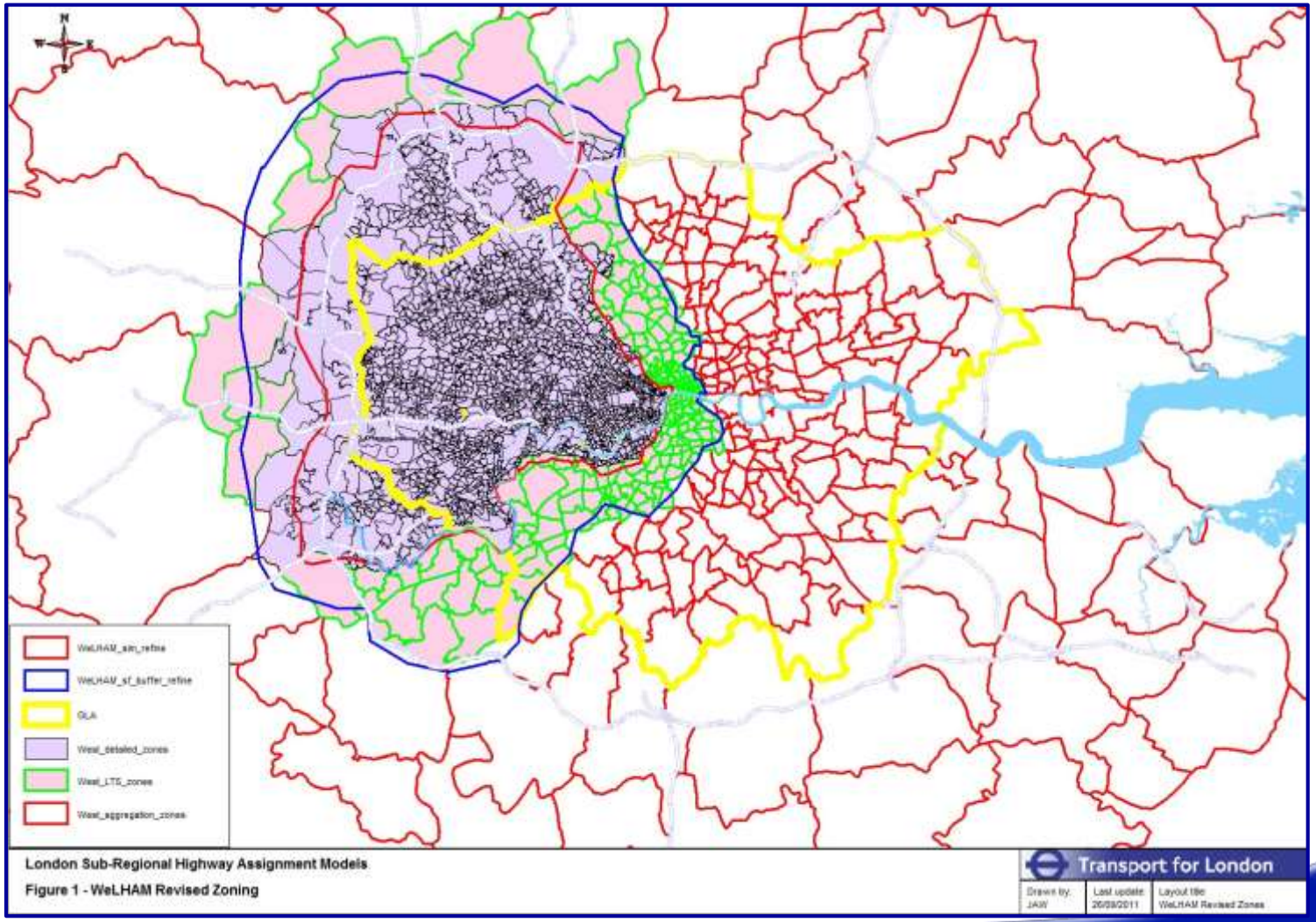
CLoHAM Zoning



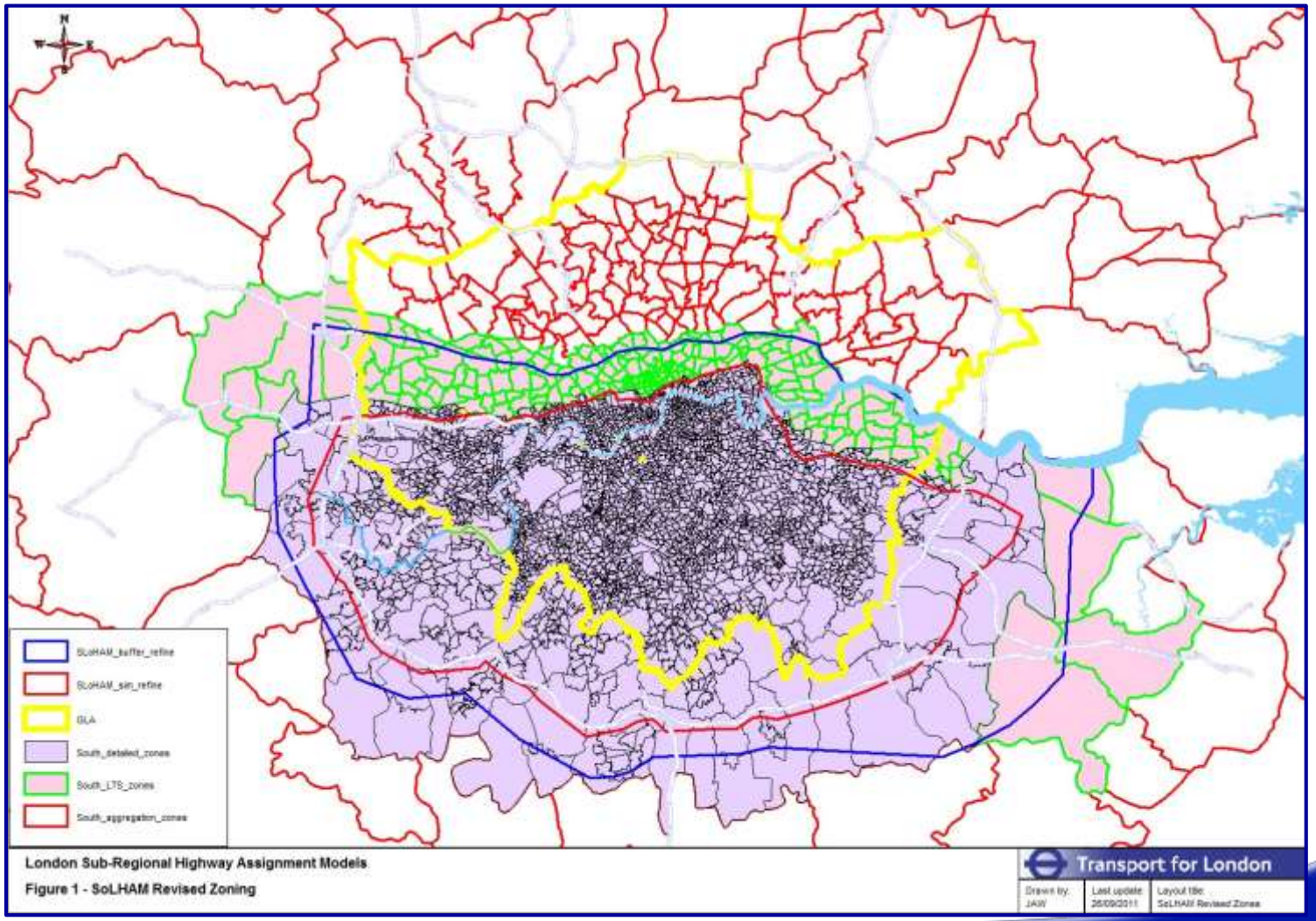
NoLHAM Zoning



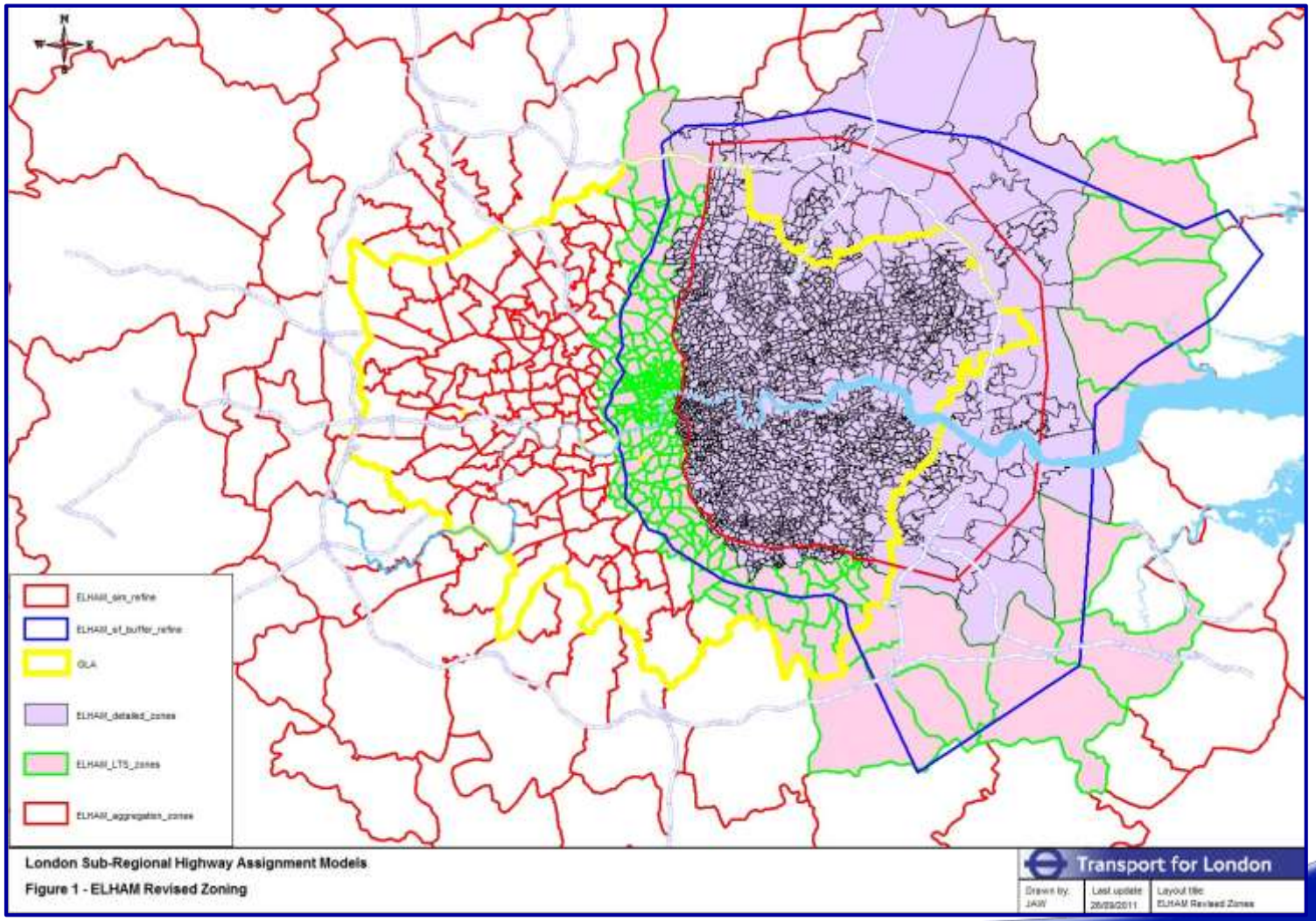
WeLHAM Zoning



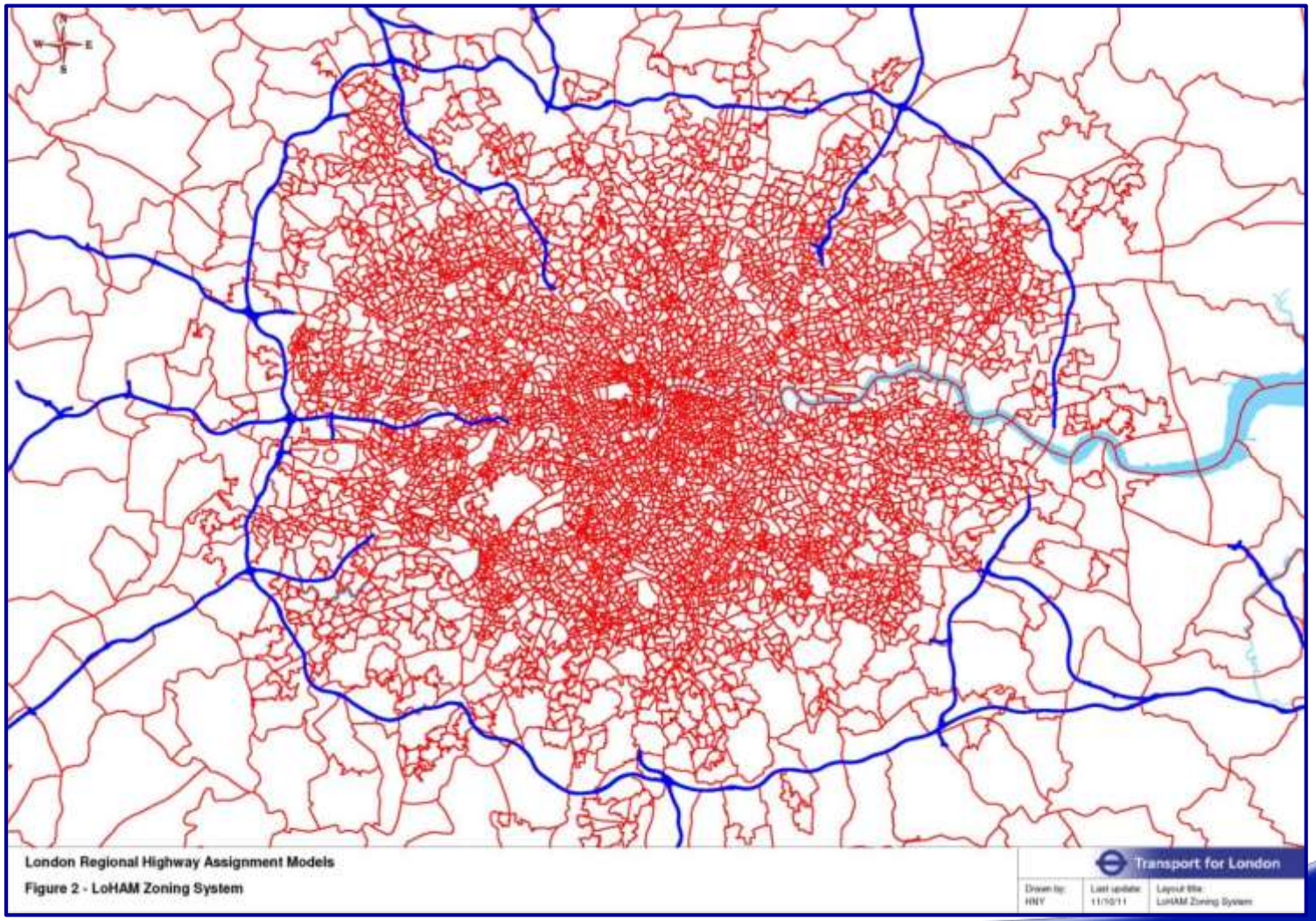
SoLHAM Zoning



ELHAM Zoning



LoHAM Zoning



Statistics of HAM zoning

HAM Area	Detailed zones	LTS zones	Aggregation zones	Total
CLoHAM	910	304	238	1452
ELHAM	1882	256	223	2361
NoLHAM	1498	207	237	1942
SoLHAM	2838	220	201	3259
WeLHAM	1728	227	277	2232
LoHAM	5109	256	84	5449

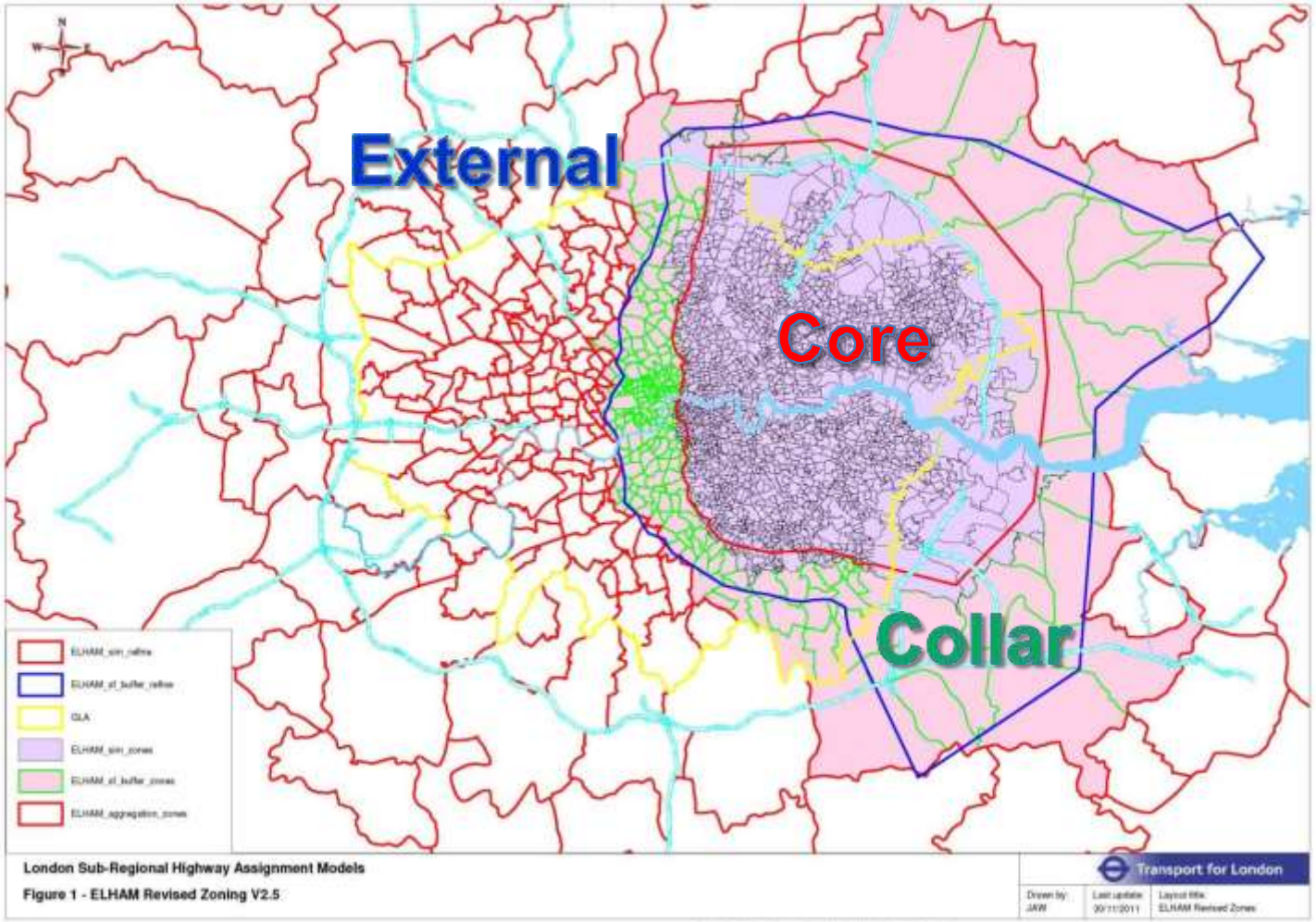
Networks

- Simulation network derived from the existing 5 HAMs
- Buffer Networks derived from LTS and LoHAM
  - Speed Flow Curve area
  - Fixed speed area
- Master Network database for all HAMs
- Updating bus routes with BusNet data
- Master database for counts and Rebased to Nov 2009
- Refined zonal system

New set of HAMs

Area	Network	Zonal system
Core	Simulation	LoHAM
Collar	Buffer with speed flow curve	LTS
External	Buffer with fixed speed	Aggregated of LTS

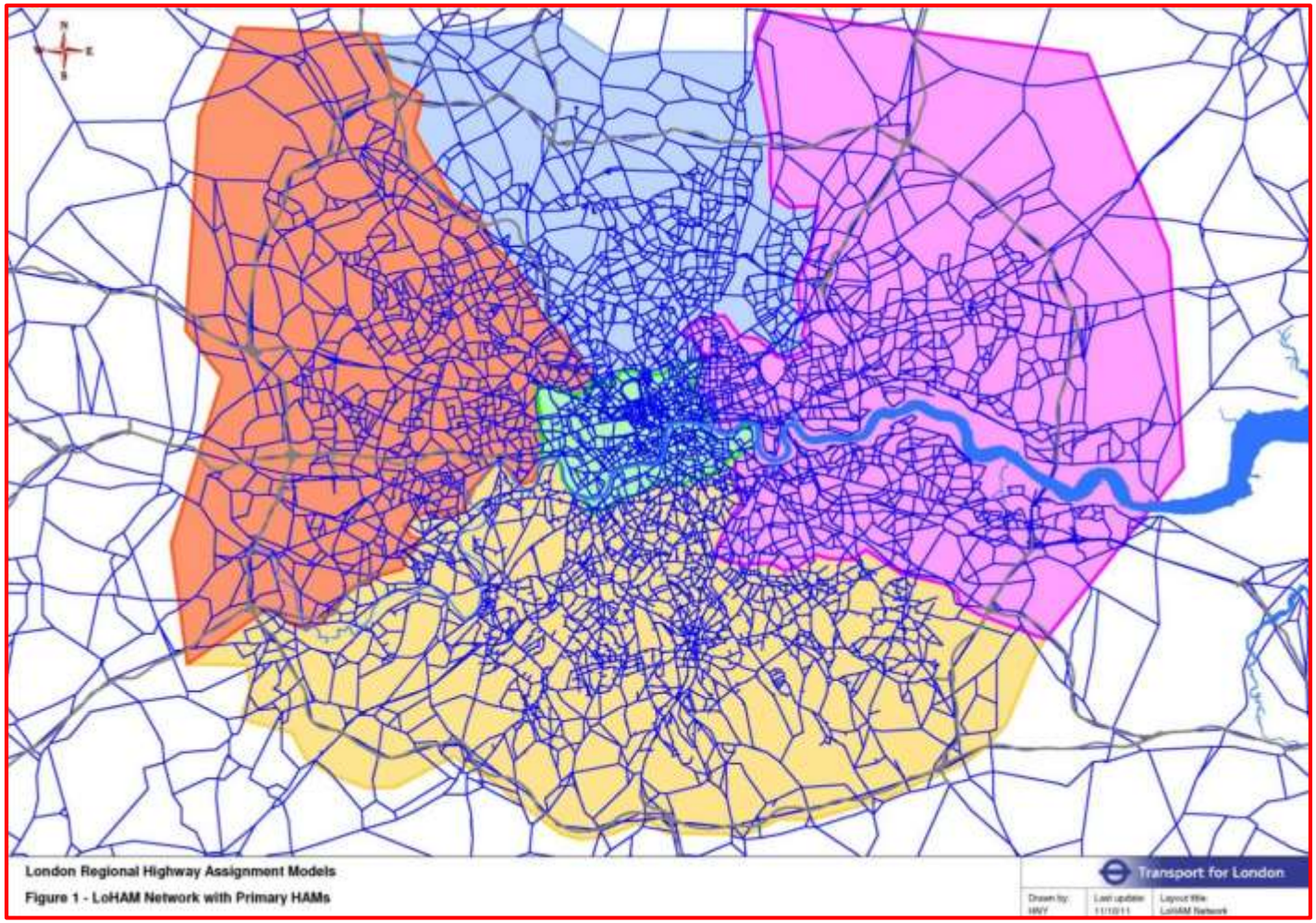
Example - ELHAM Model



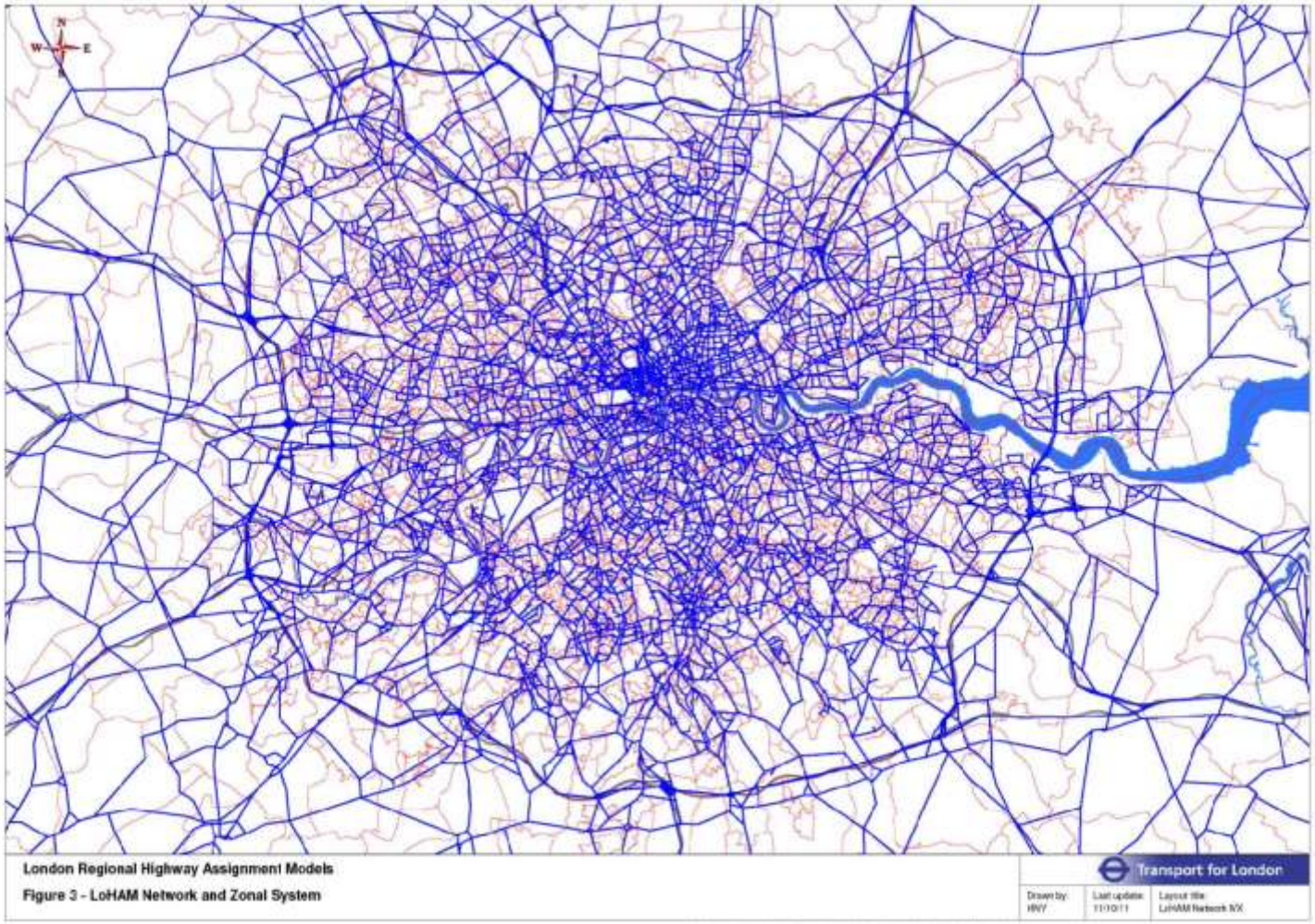
3-level Network

- Harmonize HAM models by combining all 5 models
- Network
  - Fully simulated within and including the M25
  - LTS network for the rest of the country
- Matrix
  - LoHAM level
    - Consist of 5449 zones, 5109 zones are in the simulation area
  - LTS level
    - Consist of 1285 zones, 1029 zones are in the simulation area
  - Aggregated level (buffer area only)
    - Consist of 518 zones, 101 buffer zones are coded in the model

LoHAM – Primary HAMs



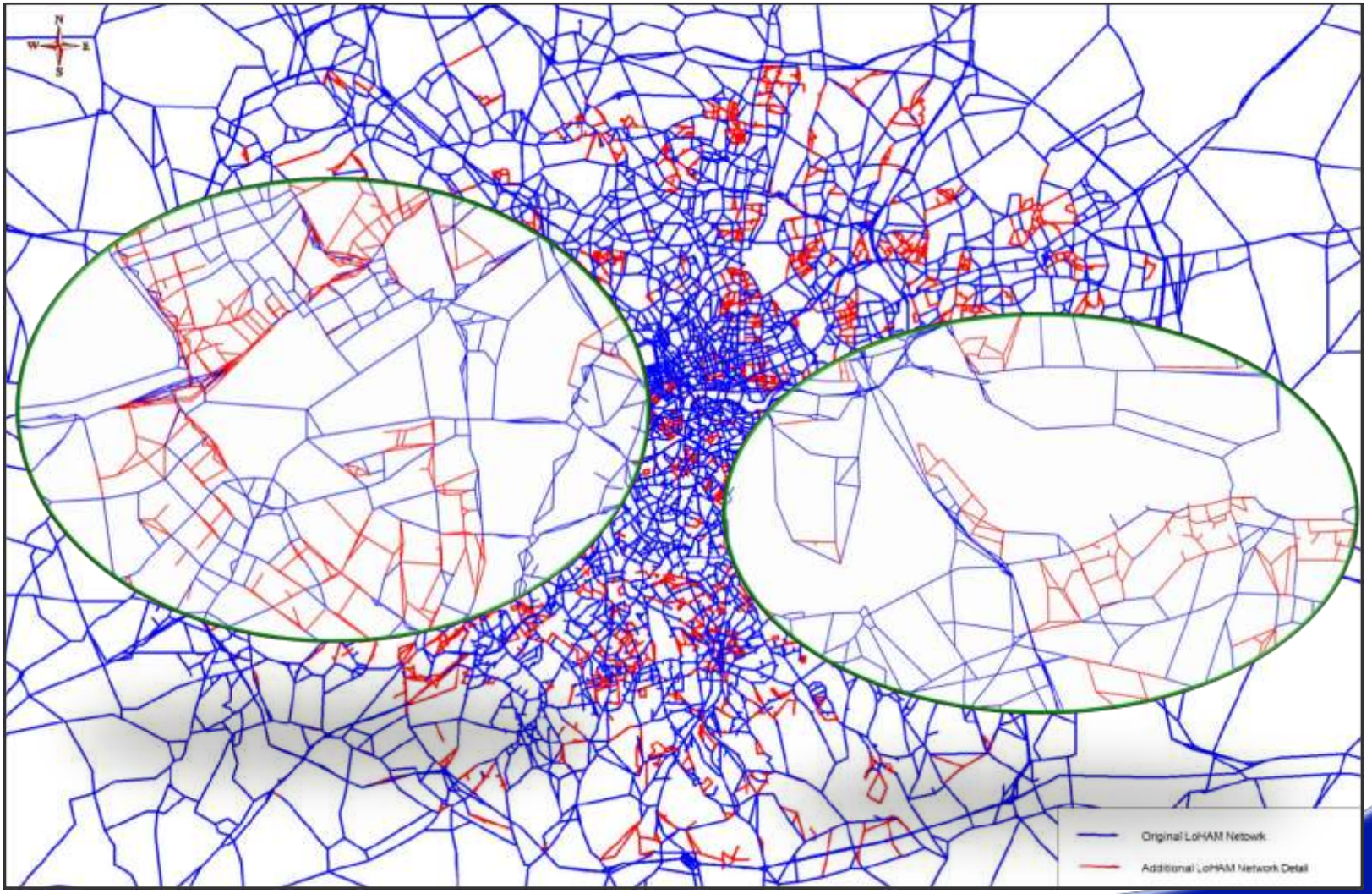
LoHAM Model


London Regional Highway Assignment Models
Figure 3 - LoHAM Network and Zonal System
Transport for London

HAM Prod v2 - Network Improvements

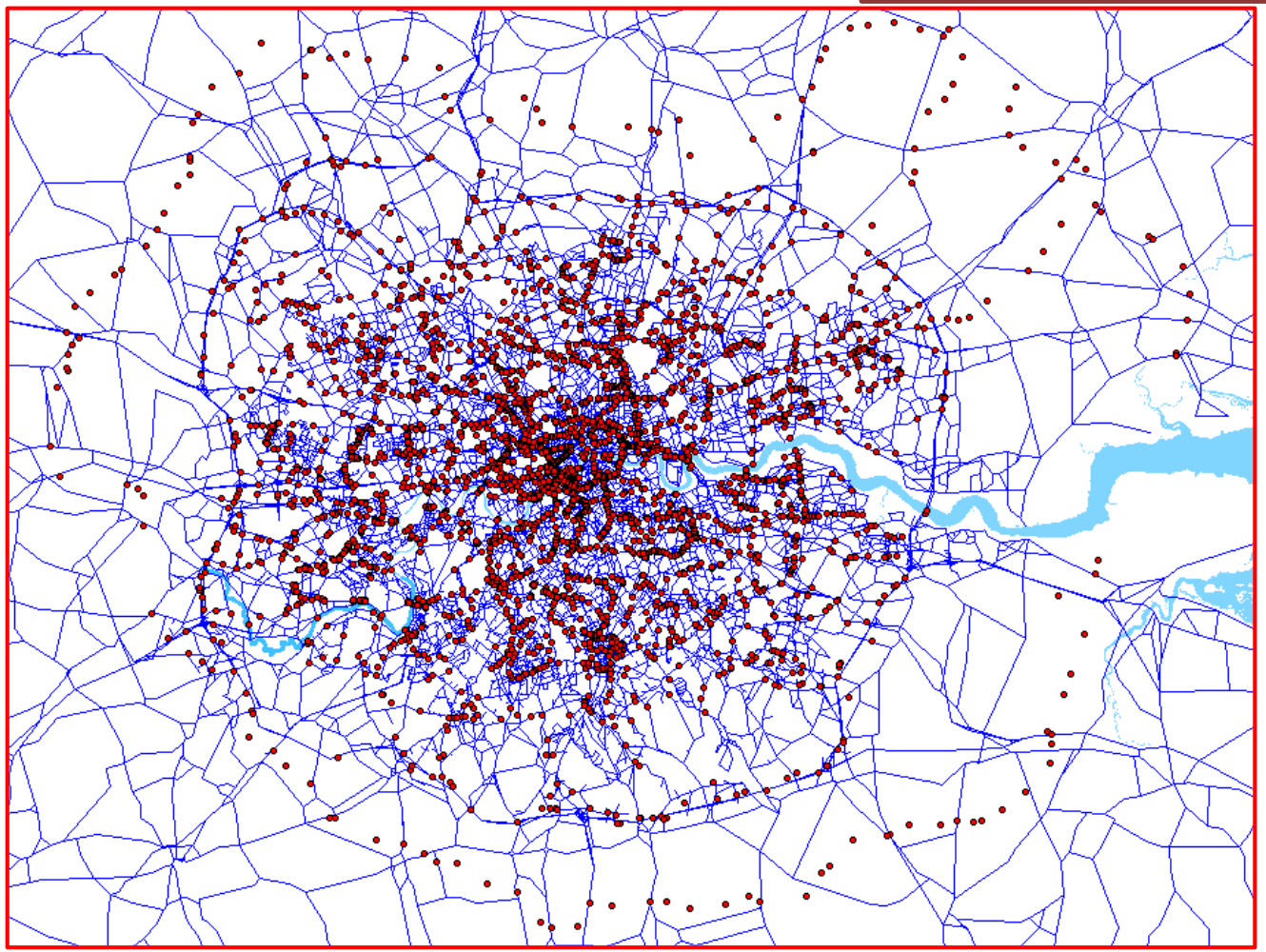
- **Harmonized 5 HAM networks**
- **Finer zoning system, Centroid Connectors review**
- **Build Bus Route using TfL BusNet database**
- **Introducing Bus Lane setbacks**
- **Updating count database**
- **Additional Network Details**
  - **Bus links**
  - **Water tight cordon for enclosures and screenlines**
  - **Central and North area – URS**
  - **West and South area – Pell Frischman**
  - ***Additional network details for the areas in between***

Additional Network Details

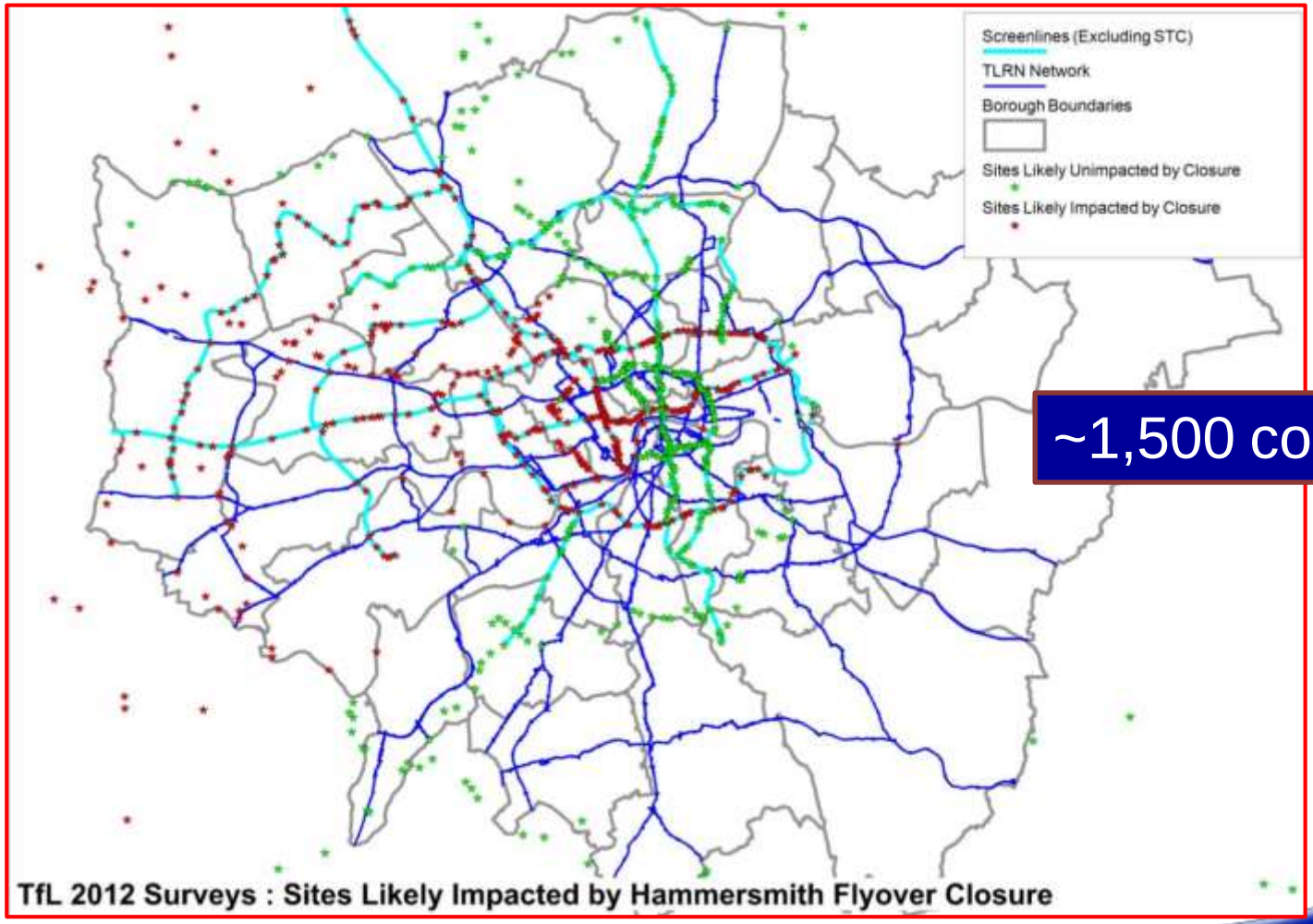


Existing Counts

~10,000 link counts



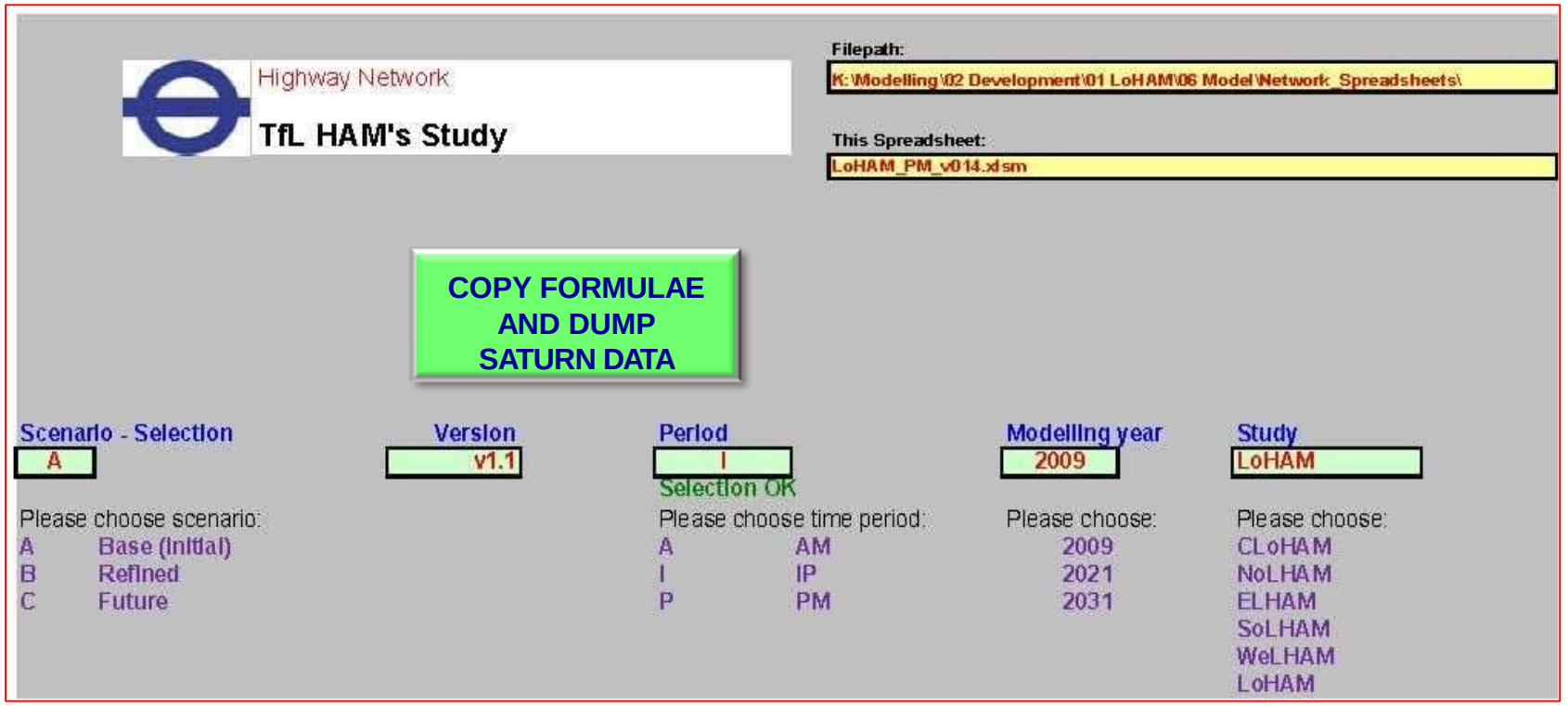
Count Survey Program - 2012



Useful In-house Developments - Tools

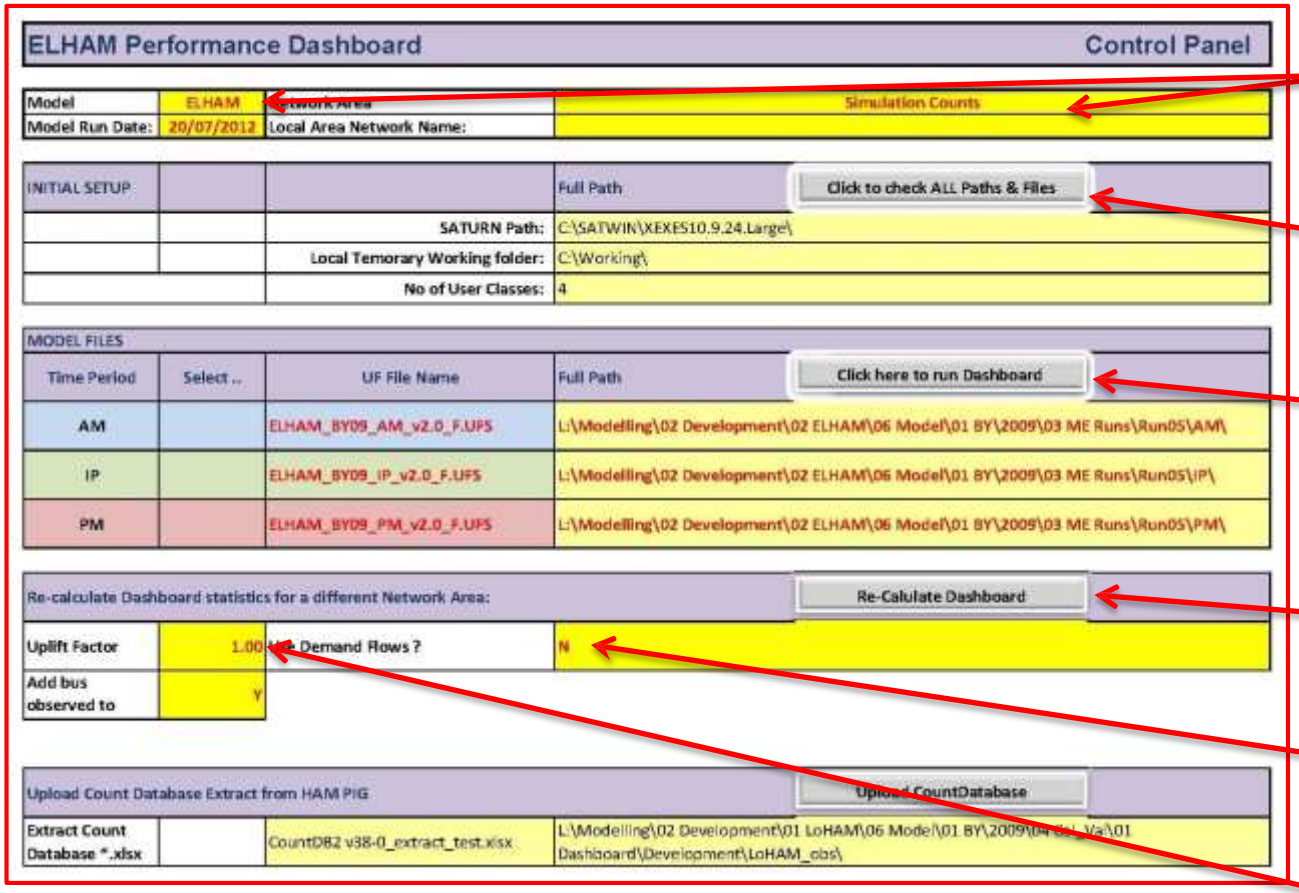
- Network Spreadsheet
- Dashboard
- TrafficMaster
- Reporting
- Guidance Note
- HAM – ITN matching
- LoHAM Count database
- Combined 5 HAMs into LoHAM

Network Spreadsheet



- Pull down menu
- Deal with scenario, year, time period, area
- Generate SATURN network data file

Dashboard - Control Panel



ELHAM Performance Dashboard — Control Panel

Model	ELHAM	[illegible]	Simulation Counts
Model Run Date:	20/07/2012	Local Area Network Name:	

INITIAL SETUP			Full Path	Click to check ALL Paths & Files
		SATURN Path:	C:\SATWIN\XEXES10.9.24.Large\	
		Local Temorary Working folder:	C:\Working\	
		No of User Classes:	4	

MODEL FILES

Time Period	Select ..	UF File Name	Full Path	Click here to run Dashboard
AM		ELHAM_BY09_AM_v2.0_F.UFS	L:\Modelling\02 Development\02 ELHAM\06 Model\01 BY\2009\03 ME Runs\Run05\AM\	
IP		ELHAM_BY09_IP_v2.0_F.UFS	L:\Modelling\02 Development\02 ELHAM\06 Model\01 BY\2009\03 ME Runs\Run05\IP\	
PM		ELHAM_BY09_PM_v2.0_F.UFS	L:\Modelling\02 Development\02 ELHAM\06 Model\01 BY\2009\03 ME Runs\Run05\PM\	

Re-calculate Dashboard statistics for a different Network Area:			Re-Calulate Dashboard
Uplift Factor	1.00	Demand Flows ?	N
Add bus observed to	Y		

Upload Count Database Extract from HAM PiG			Upload CountDatabase
Extract Count Database *.xlsx		CountDB2 v38-0_extract_test.xlsx	L:\Modelling\02 Development\01 LoHAM\06 Model\01 BY\2009\04 [illegible] Va\01 Dashboard\Development\LoHAM_obs\

Drop down lists to select HAM model and Study Area

Button to check Paths and Files

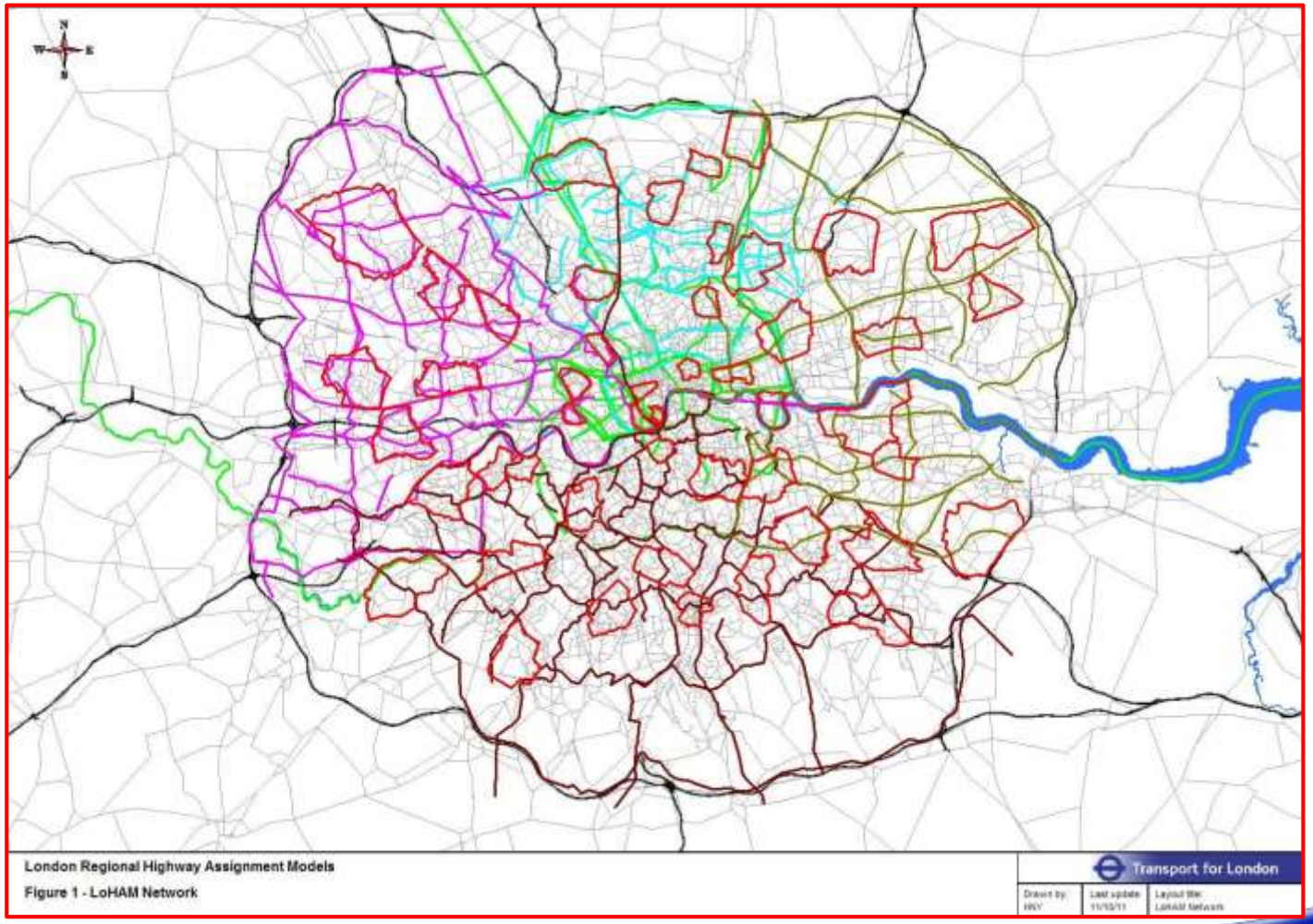
Button to run Dashboard and extract results from SATURN

Button to run Dashboard with out extracting results from SATURN (allows quicker calculation)

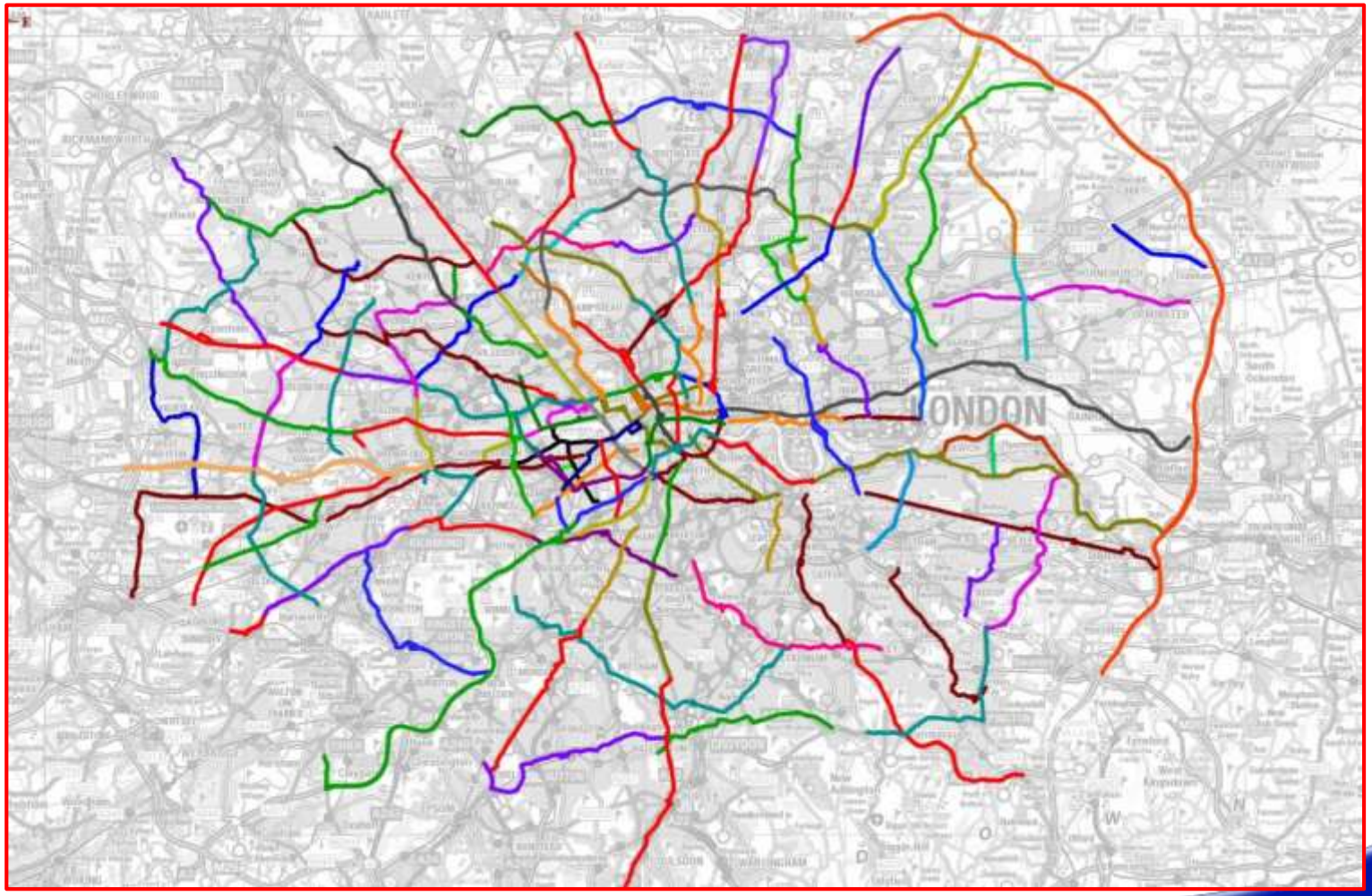
Demand or Actual Flows?

Uplift factor on modelled flows. To allow quick test on global increases in demand

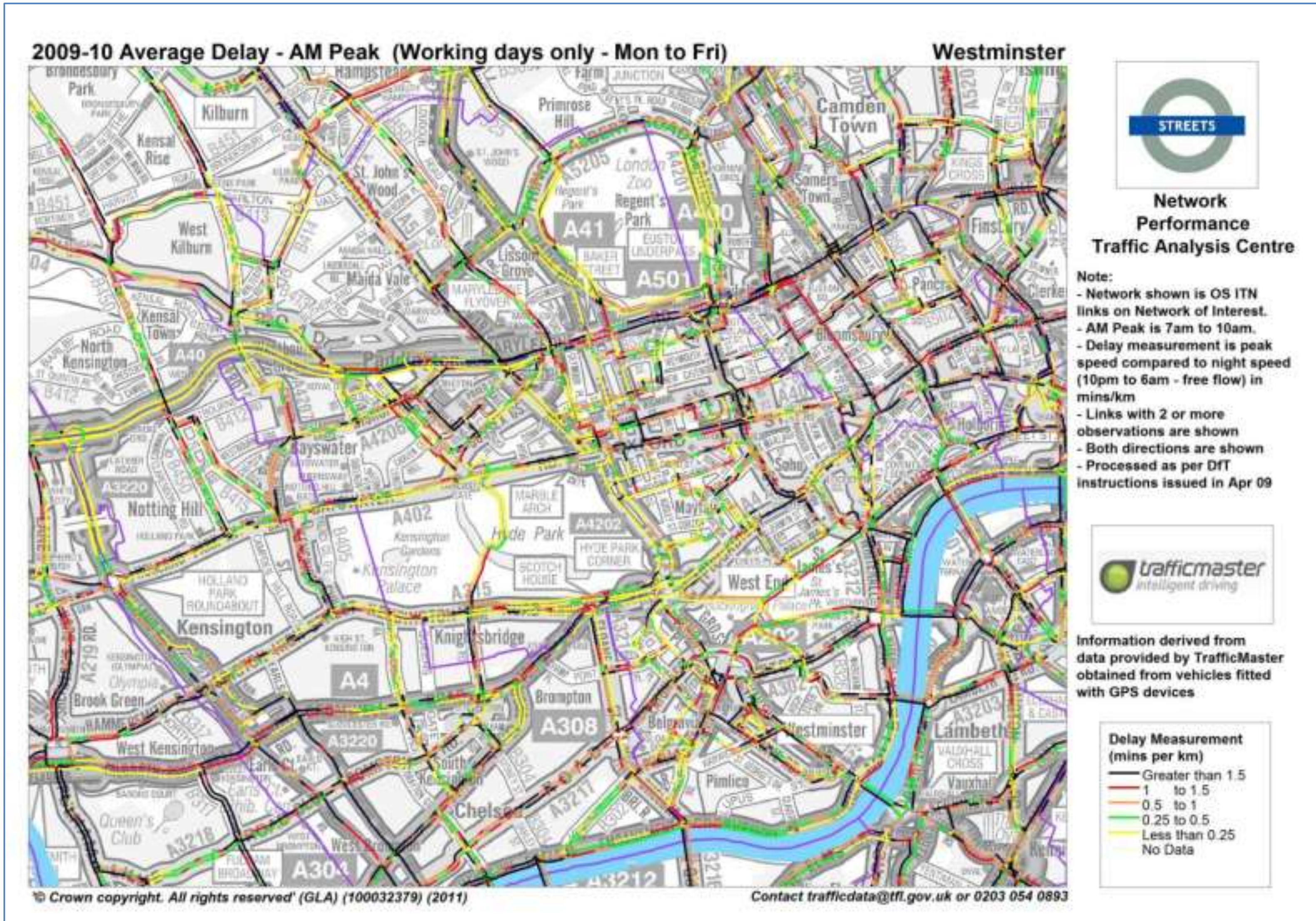
Enclosures and Screenlines



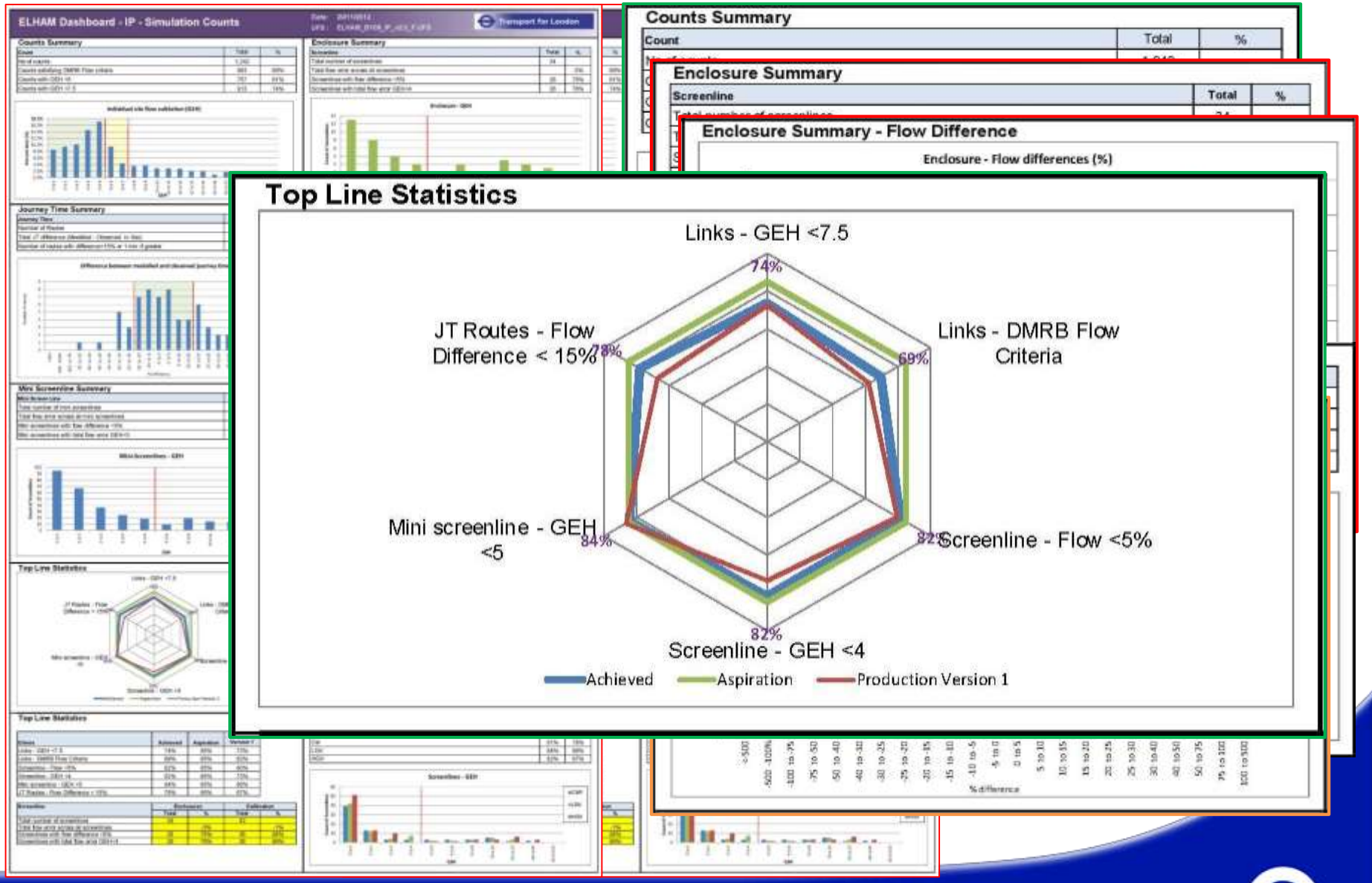
Journey Time Routes



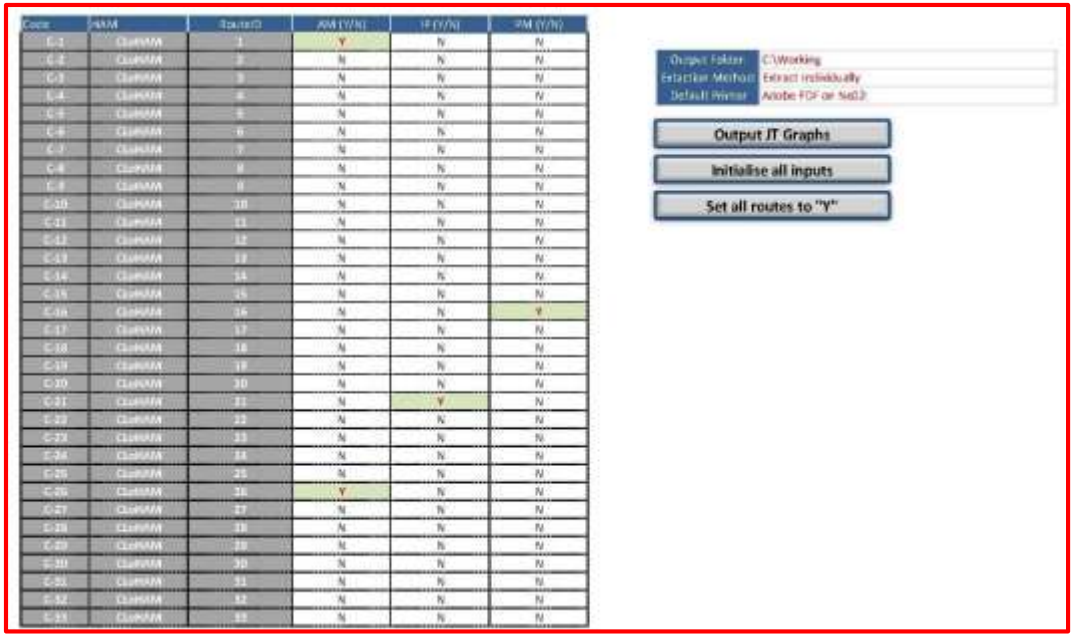
TrafficMaster Congestion Plot



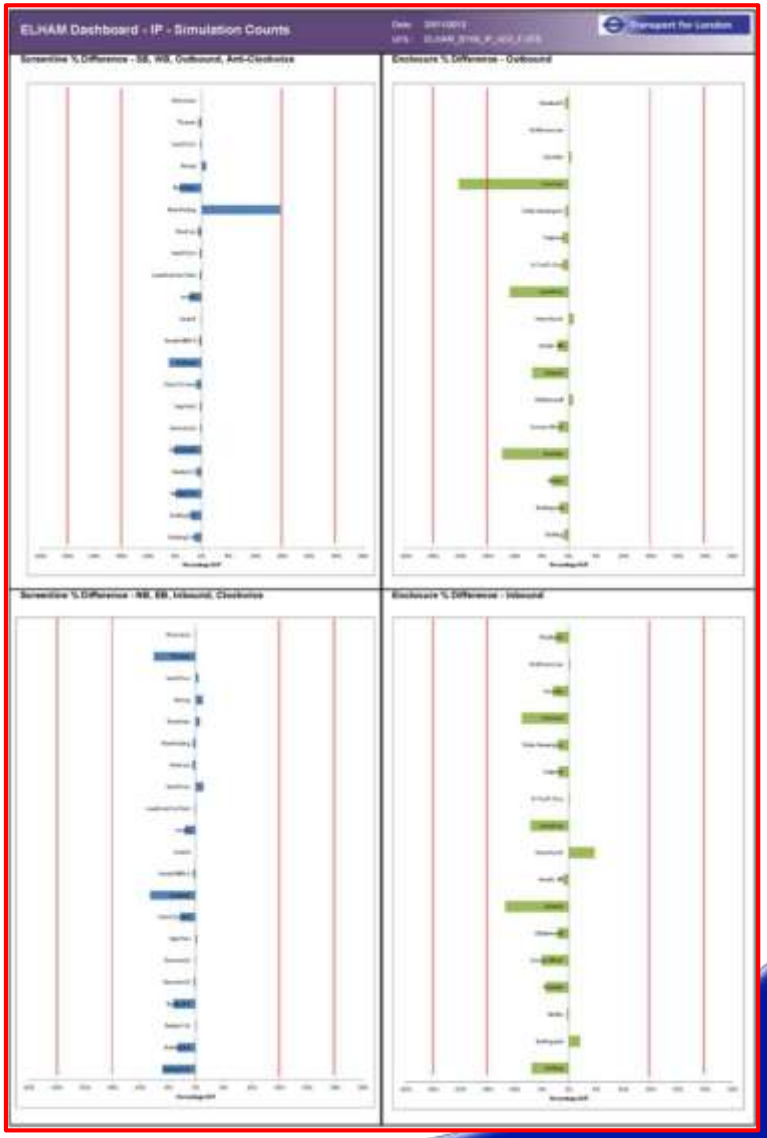
Dashboard

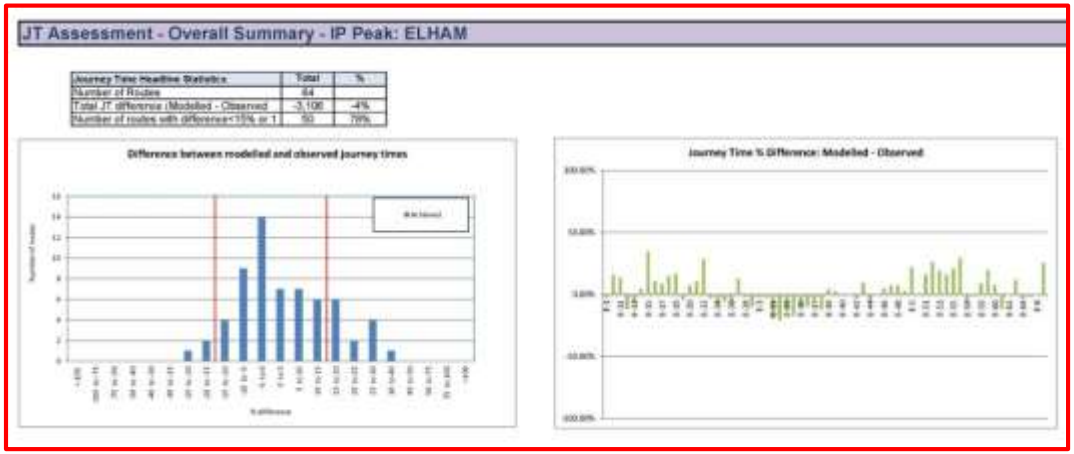

ELHAM Dashboard - IP - Simulation Counts
Counts Summary
Count
Total
%
Enclosure Summary
Screenline
Total
%
Enclosure Summary - Flow Difference
Enclosure - Flow differences (%)
Top Line Statistics
Links - GEH <7.5
74%
JT Routes - Flow Difference < 15%
78%
Links - DMRB Flow Criteria
69%
Mini screenline - GEH <5
84%
Screenline - Flow <5%
82%
Screenline - GEH <4
82%
Achieved
Aspiration
Production Version 1
% difference

Journey Time Validation - Summary

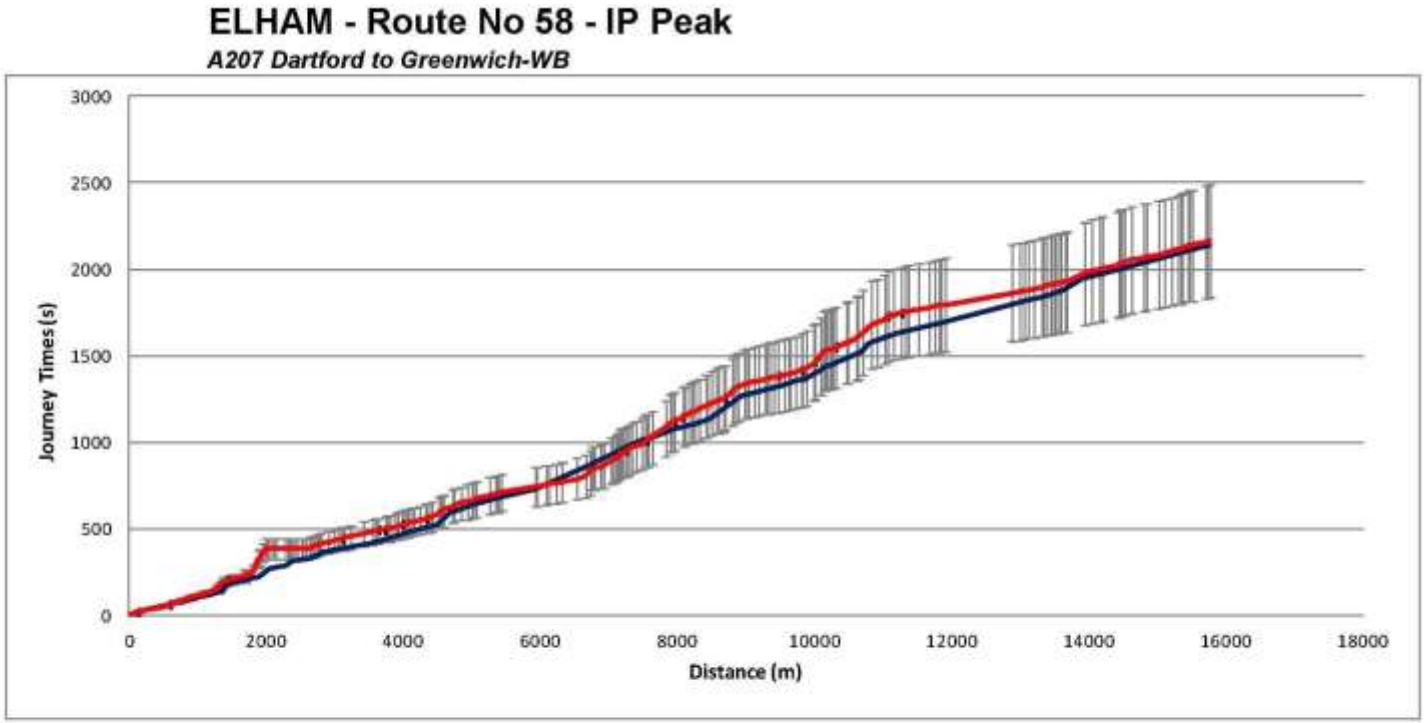


Code	AM/M	Route ID	AM (Y/N)	IP (Y/N)	PM (Y/N)
C-1	ClaAMM	1	Y	N	N
C-2	ClaAMM	2	N	N	N
C-3	ClaAMM	3	N	N	N
C-4	ClaAMM	4	N	N	N
C-5	ClaAMM	5	N	N	N
C-6	ClaAMM	6	N	N	N
C-7	ClaAMM	7	N	N	N
C-8	ClaAMM	8	N	N	N
C-9	ClaAMM	9	N	N	N
C-10	ClaAMM	10	N	N	N
C-11	ClaAMM	11	N	N	N
C-12	ClaAMM	12	N	N	N
C-13	ClaAMM	13	N	N	N
C-14	ClaAMM	14	N	N	N
C-15	ClaAMM	15	N	N	N
C-16	ClaAMM	16	N	N	Y
C-17	ClaAMM	17	N	N	N
C-18	ClaAMM	18	N	N	N
C-19	ClaAMM	19	N	N	N
C-20	ClaAMM	20	N	N	N
C-21	ClaAMM	21	N	Y	N
C-22	ClaAMM	22	N	N	N
C-23	ClaAMM	23	N	N	N
C-24	ClaAMM	24	N	N	N
C-25	ClaAMM	25	N	N	N
C-26	ClaAMM	26	Y	N	N
C-27	ClaAMM	27	N	N	N
C-28	ClaAMM	28	N	N	N
C-29	ClaAMM	29	N	N	N
C-30	ClaAMM	30	N	N	N
C-31	ClaAMM	31	N	N	N
C-32	ClaAMM	32	N	N	N
C-33	ClaAMM	33	N	N	N



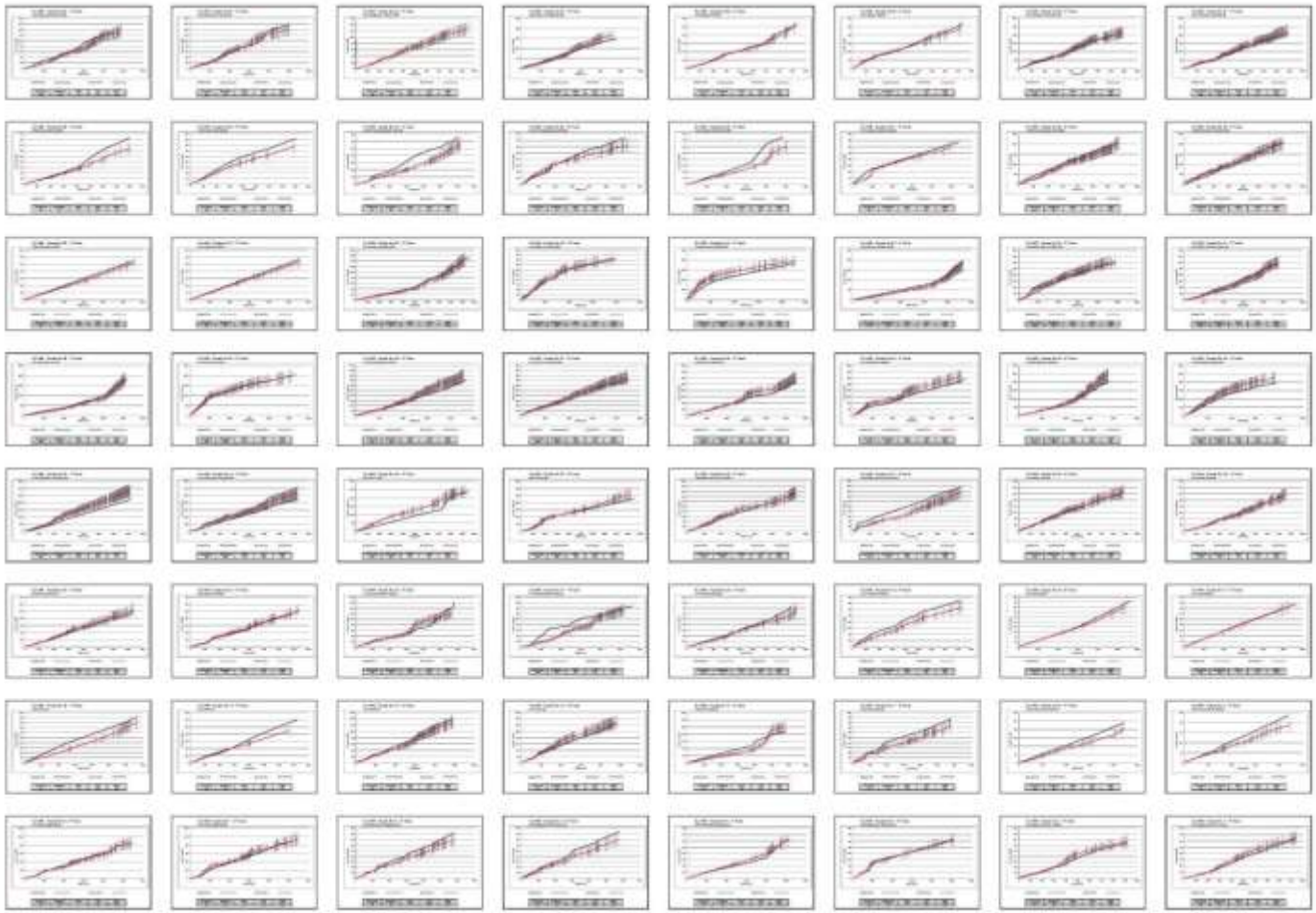


Journey Time Validation – Individual Route



Observed (s)	Modelled (s)	Diff (s)	% Diff	DMRB
2163	2138	-25	-1%	Pass

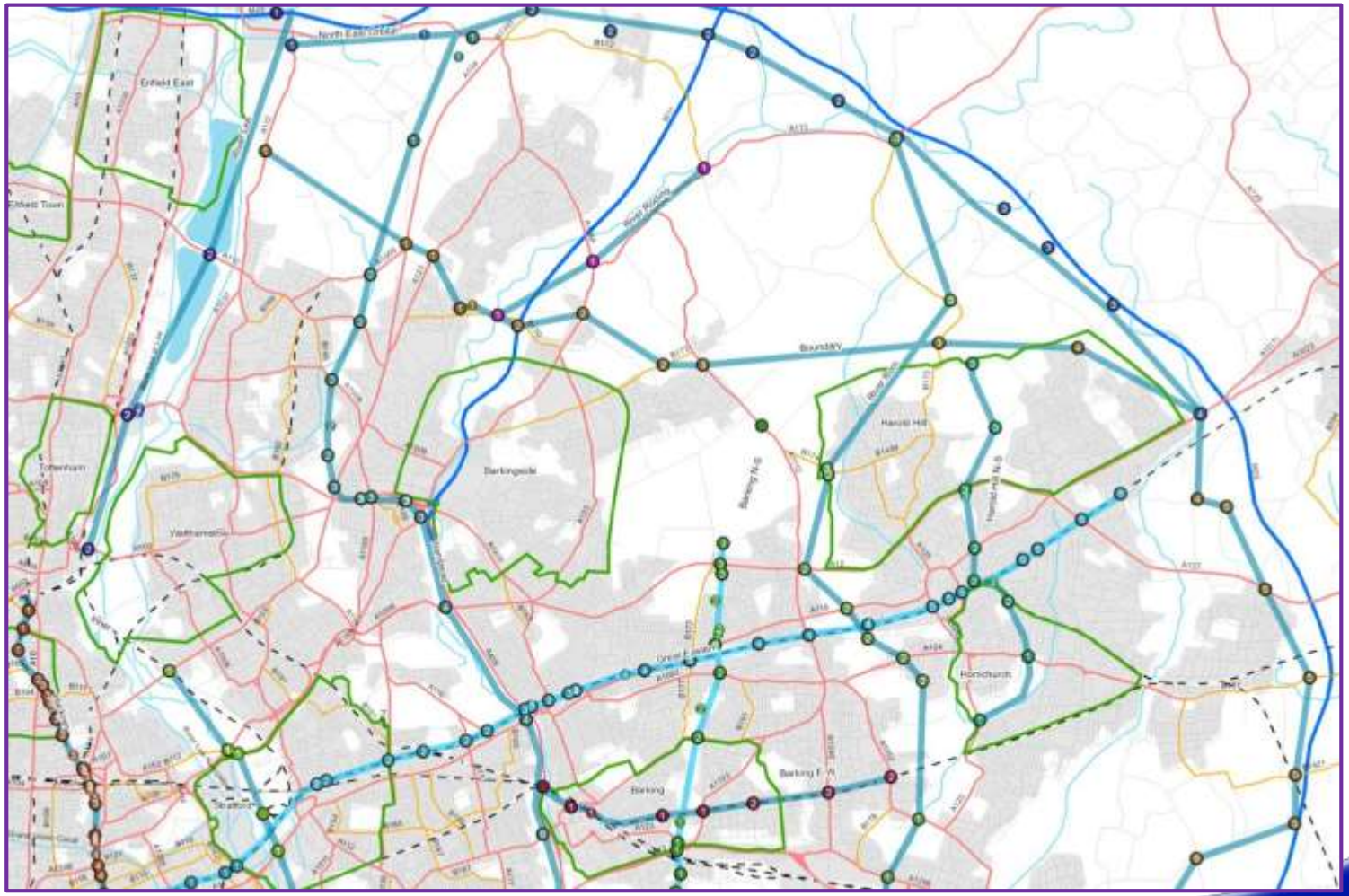
Journey Time Validation – Overview



Mini Screenlines - What are we trying to achieve?

- **What?**
  - **Improve the way we approach matrix estimation**
  - **Make the best and most appropriate use of the tools we have**
- **Why?**
  - **Better understanding; more control; improved result**
- **How?**
  - **Matrix estimation in SATURN (SATME2) gives us flexibility to use groups of counts as well as for individual links**
  - **We want to make small adjustments to the matrix to better reflect traffic volumes observed**

ELHAM Mini-Screenlines



Guidance Note - Use of models for local studies

1. Local Network Audit
2. Local Base Year Model Validation Check
3. Local Model Validation Standards and Sign-off
4. Future year background growth: Development of Base Minus
5. Development Trip Generation and Distribution
6. Local Signal Optimisation
7. Development and Use of HAM Cordon Models
8. Sensitivity tests
9. Transport studies – highways statistics and thresholds

Example: White City OAPF

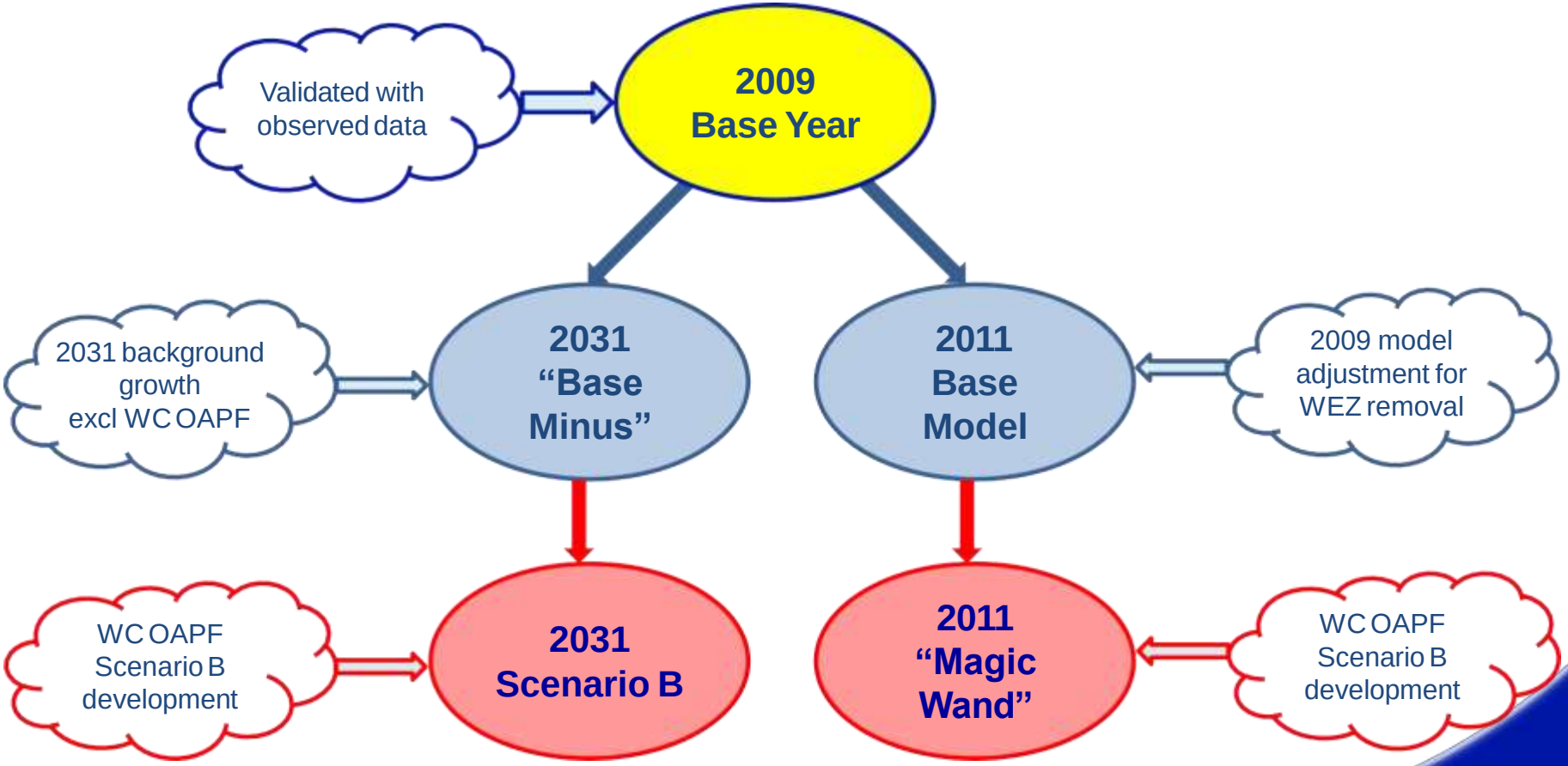
Headline Summary

- **Study Assumptions**
  - Scenario B: 6300 new homes, 8400 new jobs.
  - 2031 Committed Transport network includes Crossrail, Mayor's investments on walking and cycling, and promotion of smarter travel choices.

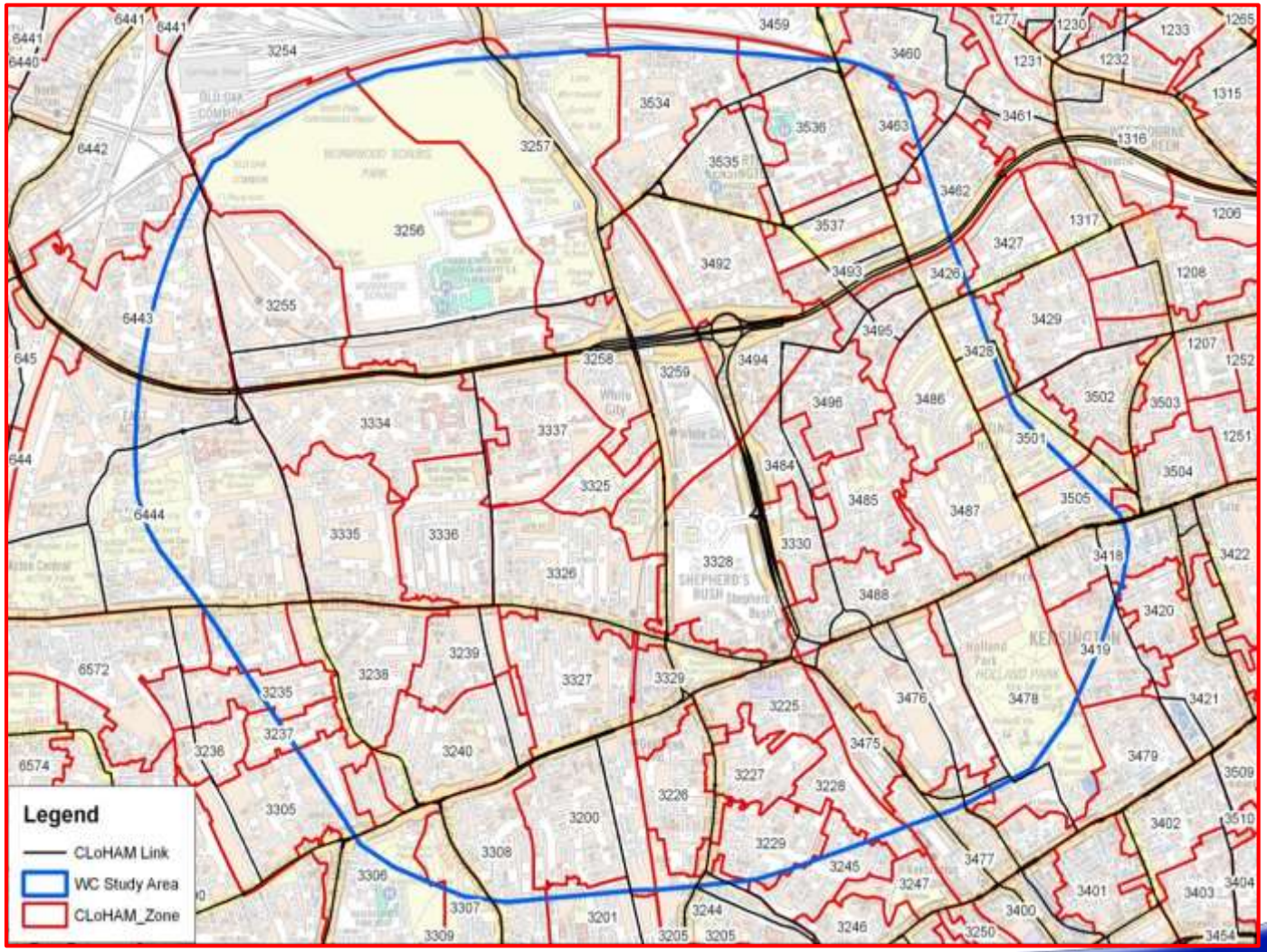
- **Development Impact only:**
  - Scenario B would generate about 13000 trips per day. Of this, about 1000 development trips are made in the PM peak hour.

White City Development Area

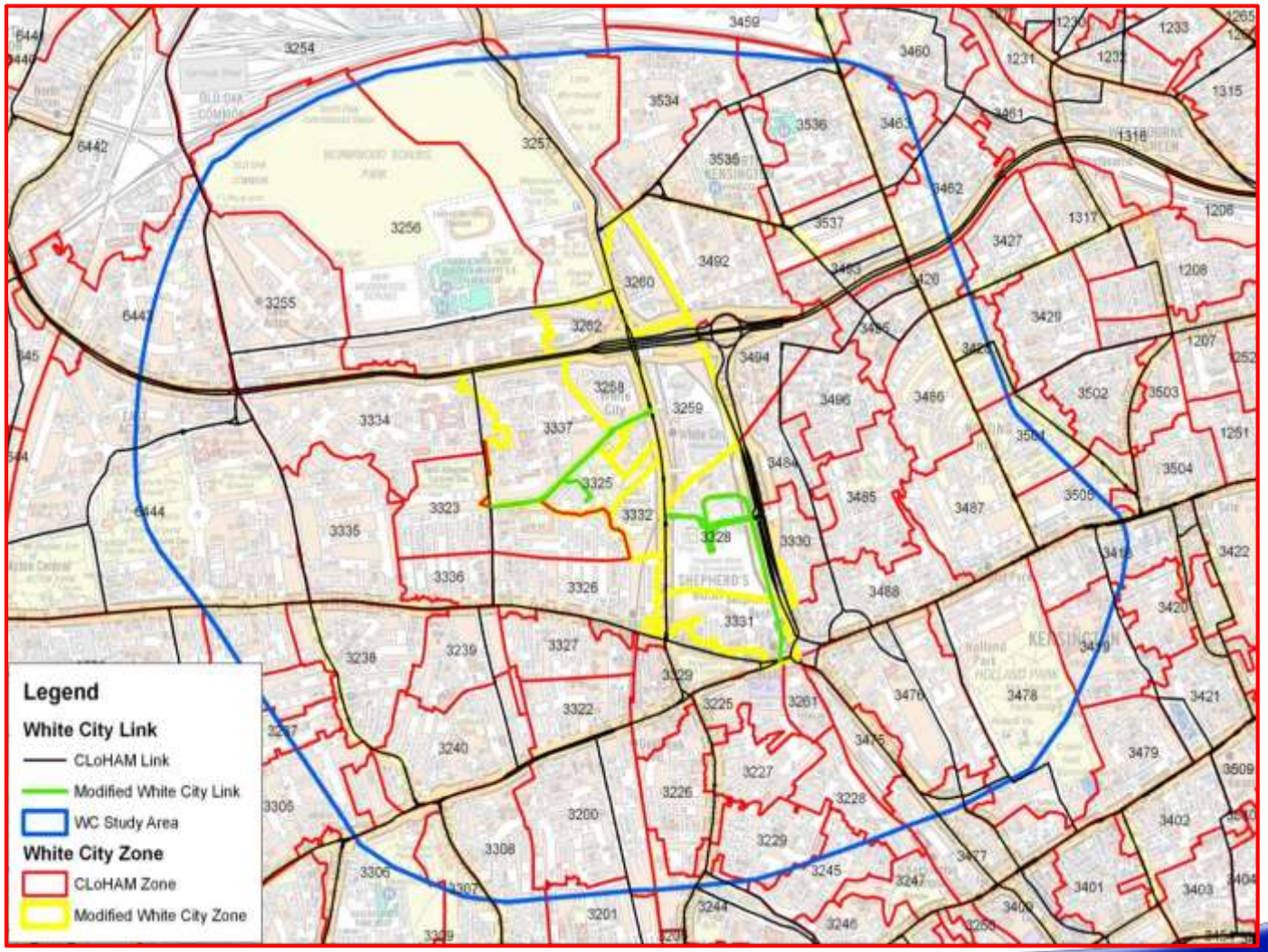
Highway SATURN Modelling



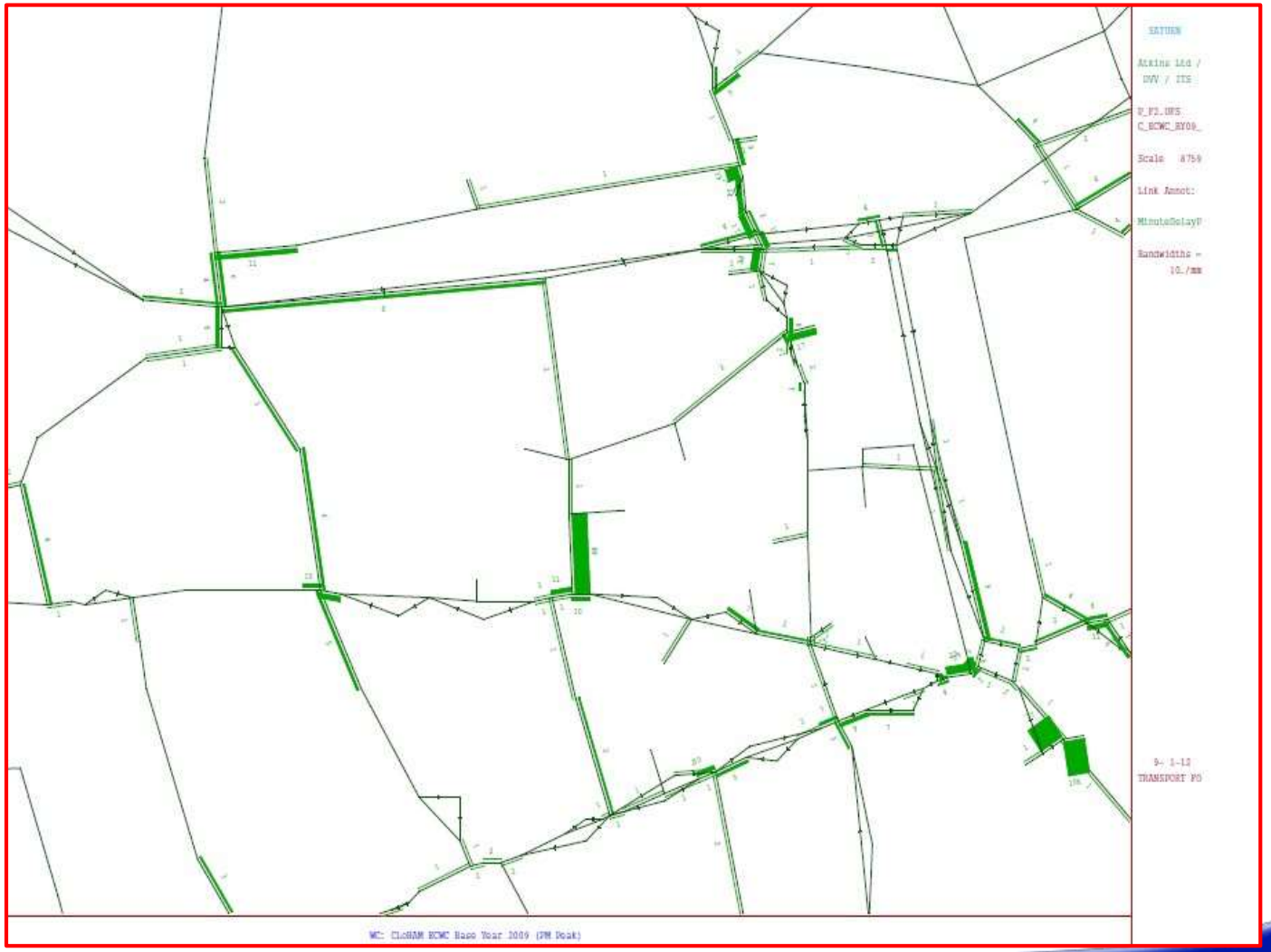
CLoHAM Network and Zonal System



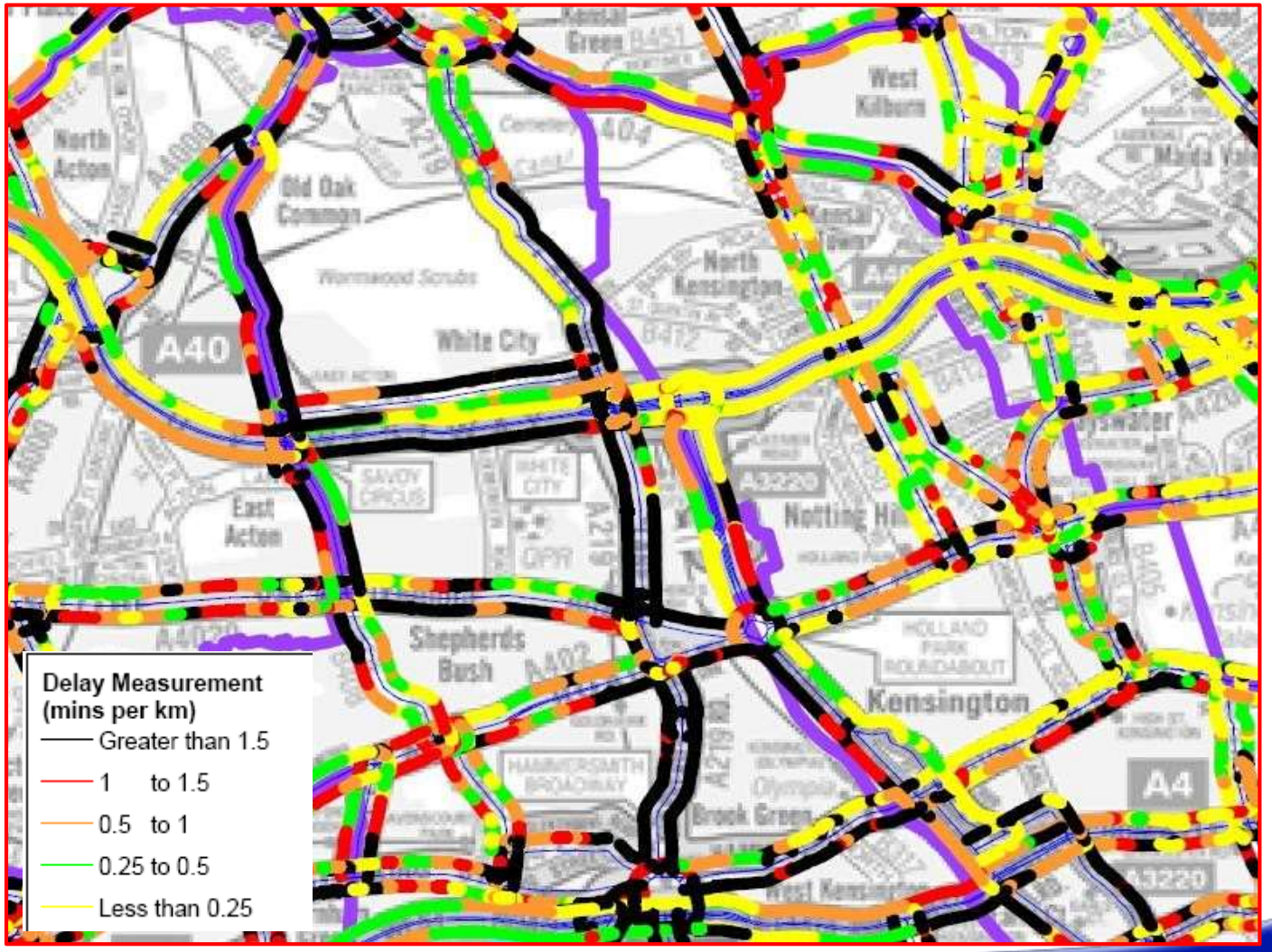
Network and Zone modification for White City



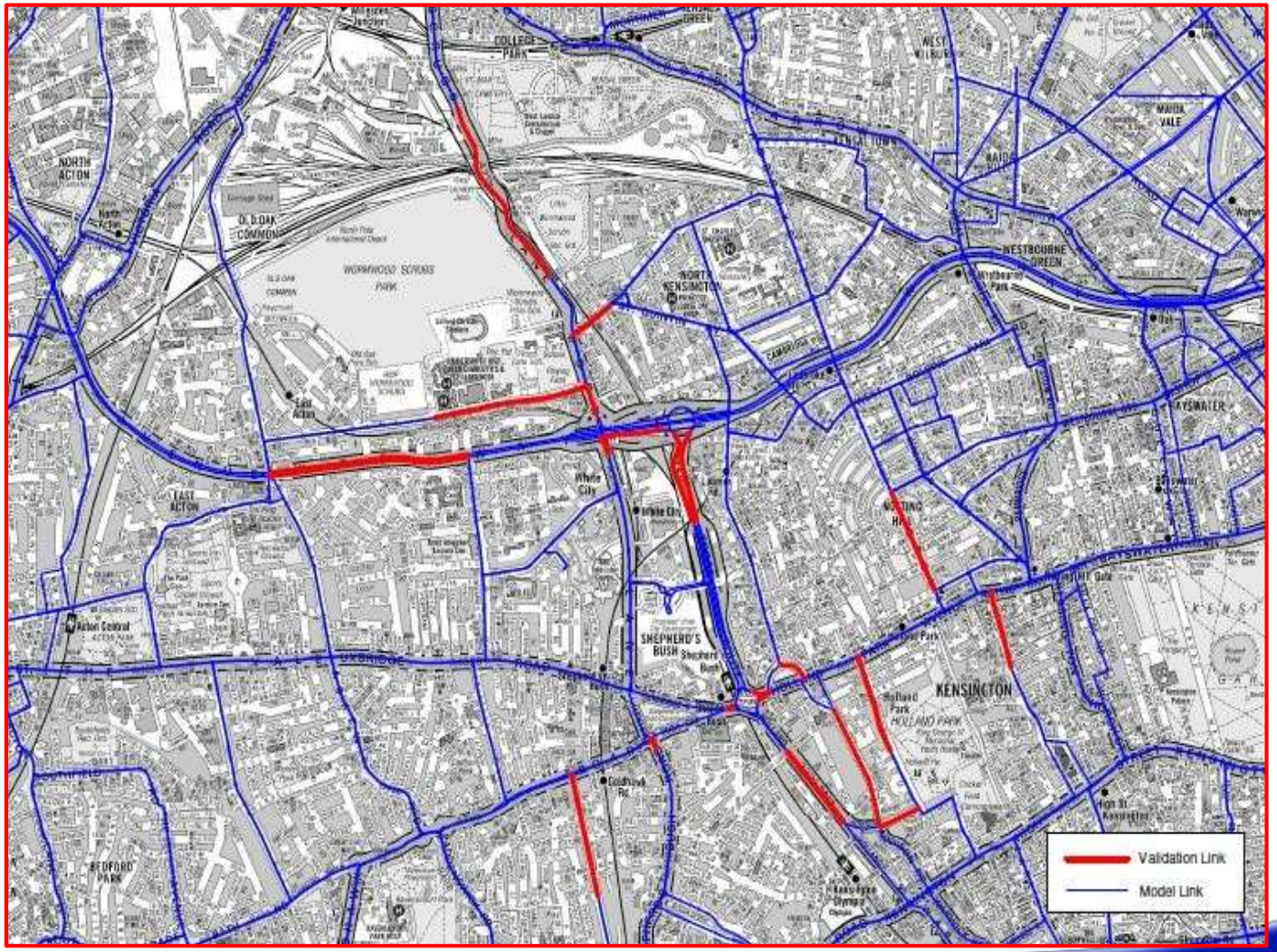
Calibration - Delay



Delay as shown in TrafficMaster



Calibration – Count Locations



Calibration – Count Results (2009)

White City Local Area Validation (2009 PM Peak)
Direction 1

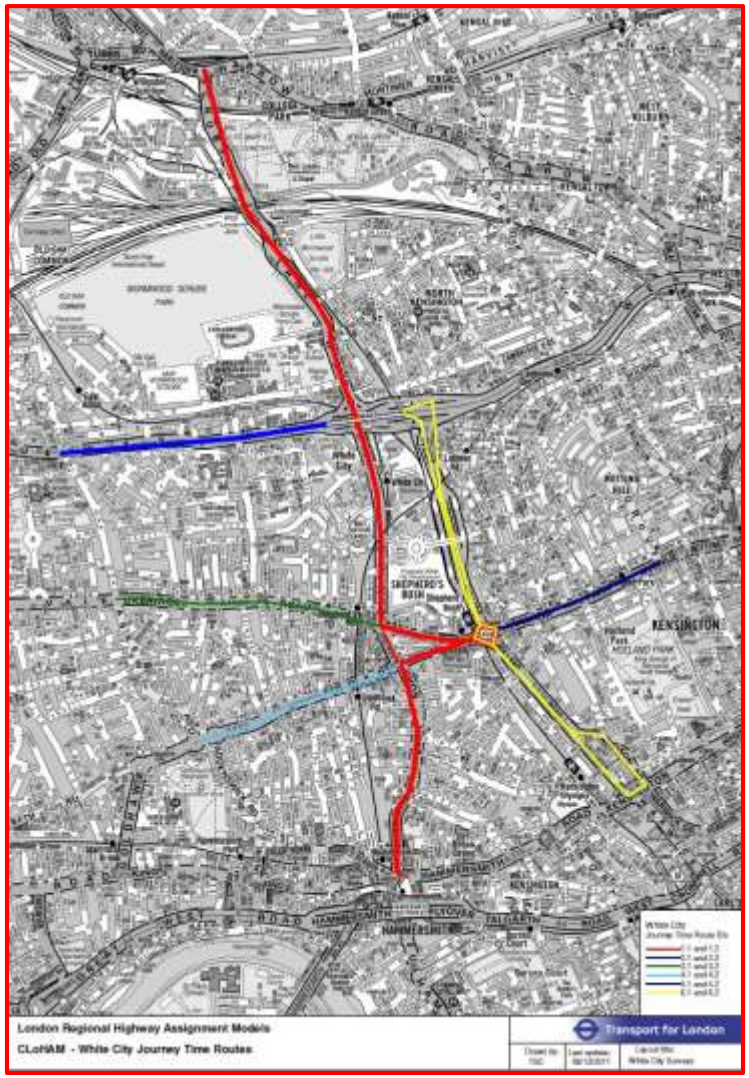
SCREENLINE	DESCRIPTION	DIRECTION	ANODE	BNODE	Observed	Modelled	Diff	GEH	GEH < 5	DMRB
Just Inside Extension Zone	Addison Road	Inbound	34348	34217	201	206	5	0	1	1
Just Inside Extension Zone	Holland Park Avenue	Inbound	34304	34208	747	961	213	7	0	0
Just Inside Extension Zone	North Pole Road	Inbound	34158	34171	348	281	-67	4	1	1
Just Outside Extension Zone	Uxbridge Rd	Inbound	32350	32173	1514	1405	-108	3	1	1
Just Outside Extension Zone	A40 Westway east of Bloemfontain Road	Inbound	32092	32218	2431	2480	49	1	1	1
Just Outside Extension Zone	Du Cane Rd	Inbound	32166	34010	406	436	30	1	1	1
Western Extension Boundary	Holland Road (Addison Gardens- Holland Park Roundabout)	Clockwise	34385	34212	1003	1042	39	1	1	1
Western Extension Boundary	West Cross Route	Clockwise	34311	34164	2083	1960	-123	3	1	1
Western Extension Boundary	Wood Lane (just S of Westway)	Clockwise	34321	34170	551	688	137	5	0	0
Western Extension Boundary	Wood Lane (just N of Westway)	Clockwise	34314	34010	1257	1100	-157	5	1	1
Western Extension Boundary	Scrubs Lane	Clockwise	32213	32167	1126	1003	-122	4	1	1
Orbital Screenline West	Campden Hill Road	Northbound	34301	34200	472	463	-9	0	1	1
Orbital Screenline West	Holland Park Gardens	Northbound	34383	34284	430	388	-42	2	1	1
Orbital Screenline West	Shepherd's Bush Road, south of A402 Roman Road	Northbound	32200	32099	741	769	28	1	1	1
Orbital Screenline West	Hammersmith Grove	Northbound	32222	32100	274	274	0	0	1	1
Enclosure_Notting Hill	Ladbrooke Grove	Inbound	34349	34192	451	523	72	3	1	1
Enclosure_Notting Hill	West Cross Route	Inbound	34166	34312	1960	1728	-232	5	0	1
Enclosure_Notting Hill	North Pole Road	Inbound	34171	34178	294	281	-12	1	1	1
Enclosure_Hammersmith	Shepherd's Bush Road north of Hammersmith Road	Inbound	32099	32200	614	585	-30	1	1	1
	No of valiadtion links								19	19
	No of links passing the validation criteria								16	17
	% Pass								84%	89%

Direction 2

SCREENLINE	DESCRIPTION	DIRECTION	ANODE	BNODE	Observed	Modelled		GEH	GEH < 5	DMRB
Just Inside Extension Zone	Oakwood Court	Outbound	34350	34217	113	114	1	0	1	1
Just Inside Extension Zone	Holland Park Avenue	Outbound	34208	34304	825	819	-6	0	1	1
Just Inside Extension Zone	North Pole Road	Outbound	34171	34158	403	488	85	4	1	1
Just Outside Extension Zone	Uxbridge Rd	Outbound	32173	32350	1674	1722	48	1	1	1
Just Outside Extension Zone	A40 Westway east of Bloemfontain Road	Outbound	32061	32092	3052	2881	-171	3	1	1
Just Outside Extension Zone	Du Cane Rd	Outbound	34010	32166	411	444	33	2	1	1
Western Extension Boundary	Holland Road (Addison Gardens- Holland Park Roundabout)	Anticlockwise	34212	34385	1334	1419	86	2	1	1
Western Extension Boundary	West Cross Route	Anticlockwise	34166	34312	1960	1728	-232	5	0	1
Western Extension Boundary	A40 Slip Road (westbound offslip)	Anticlockwise	34167	34170	764	713	-51	2	1	1
Western Extension Boundary	Wood Lane (just S of Westway)	Anticlockwise	34170	34321	729	648	-81	3	1	1
Western Extension Boundary	Wood Lane (just N of Westway)	Anticlockwise	34314	34313	826	968	142	5	1	0
Western Extension Boundary	Scrubs Lane	Anticlockwise	32094	32167	624	647	23	1	1	1
Orbital Screenline West	Campden Hill Road	Southbound	34200	34301	299	287	-12	1	1	1
Orbital Screenline West	Holland Park Gardens	Southbound	34284	34383	167	173	6	0	1	1
Orbital Screenline West	Shepherd's Bush Road, south of A402 Roman Road	Southbound	32099	32200	614	585	-30	1	1	1
Orbital Screenline West	Hammersmith Grove	Southbound	32100	32222	380	290	-90	5	1	1
Enclosure_Notting Hill	Ladbrooke Grove	Outbound	34192	34349	381	333	-48	3	1	1
Enclosure_Notting Hill	Royal Crescent	Outbound	34378	34207	554	561	7	0	1	1
Enclosure_Notting Hill	West Cross Route	Outbound	34311	34164	2083	1960	-123	3	1	1
Enclosure_Notting Hill	North Pole Road	Outbound	34178	34171	345	488	143	7	0	0
Enclosure_Hammersmith	Shepherd's Bush Road north of Hammersmith Road	Outbound	32200	32099	741	769	28	1	1	1
	No of valiadtion links								21	21
	No of links passing the validation criteria								19	19
	% Pass								90%	90%

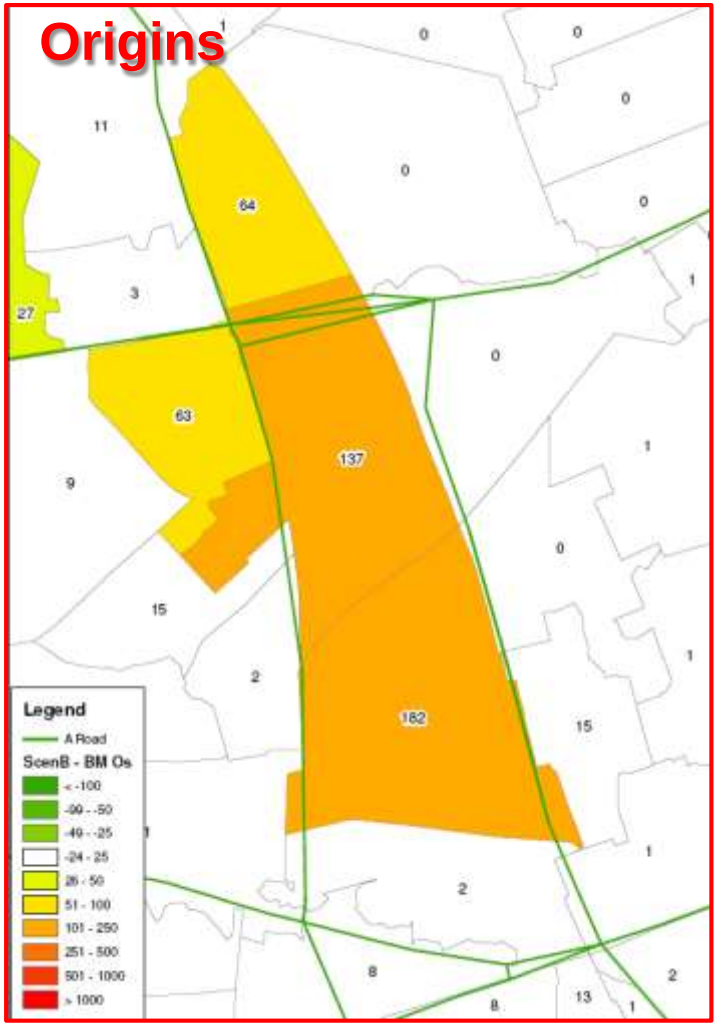
~90%

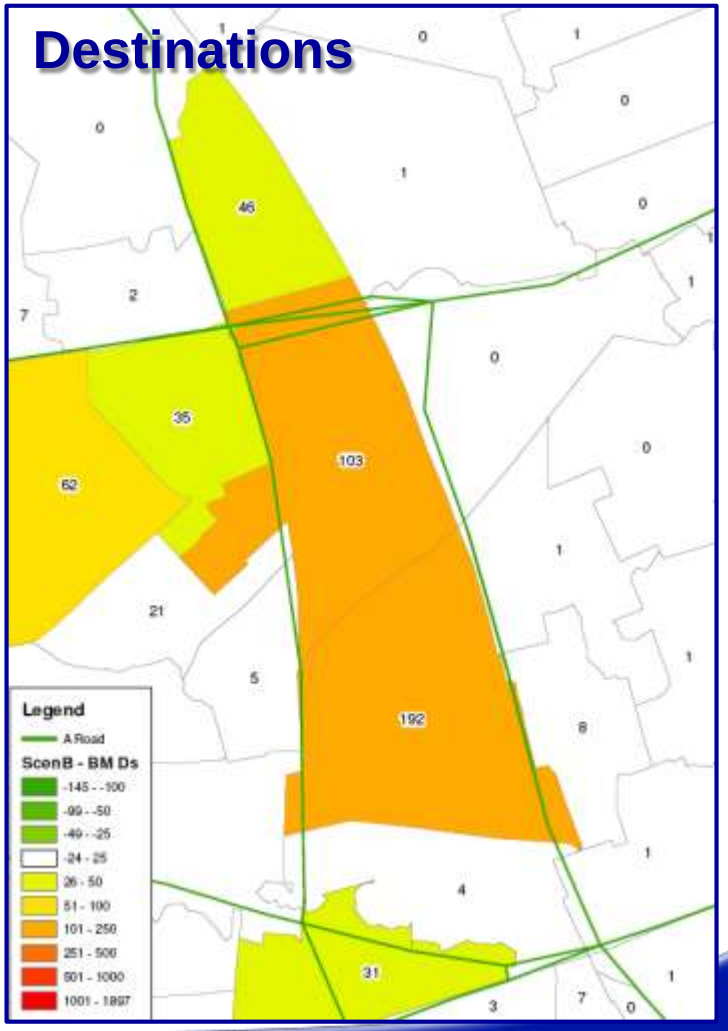
Calibration – Journey Time Routes



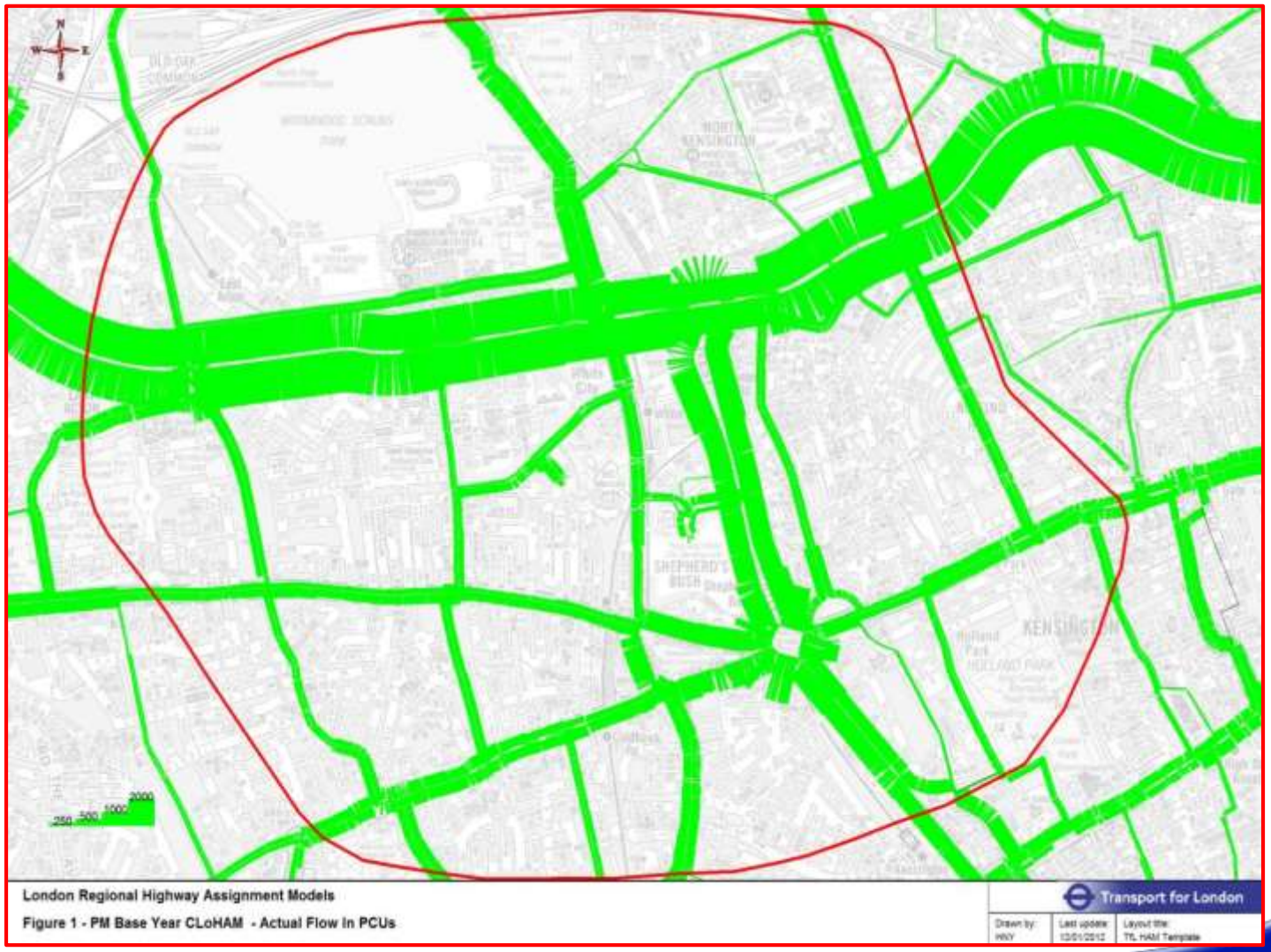
Routes	Direction	Total Length	Total Obs Time	Total Mod Time	Pass/Fail
1.1	SB	6474	1456	1268	PASS
1.2	NB	4695	1708	1001	FAIL
2.1	EB	1829	124	146	PASS
2.2	WB	1885	522	490	PASS
3.1	EB	1496	298	239	PASS
3.2	WB	1491	314	260	PASS
4.1	EB	1138	170	192	PASS
4.2	WB	1128	249	213	PASS
5.1	WB	1008	208	213	PASS
5.2	EB	1001	176	236	PASS
6.1	SB	3318	432	534	FAIL
6.2	NB	3277	448	354	FAIL

Development Trips by Zone

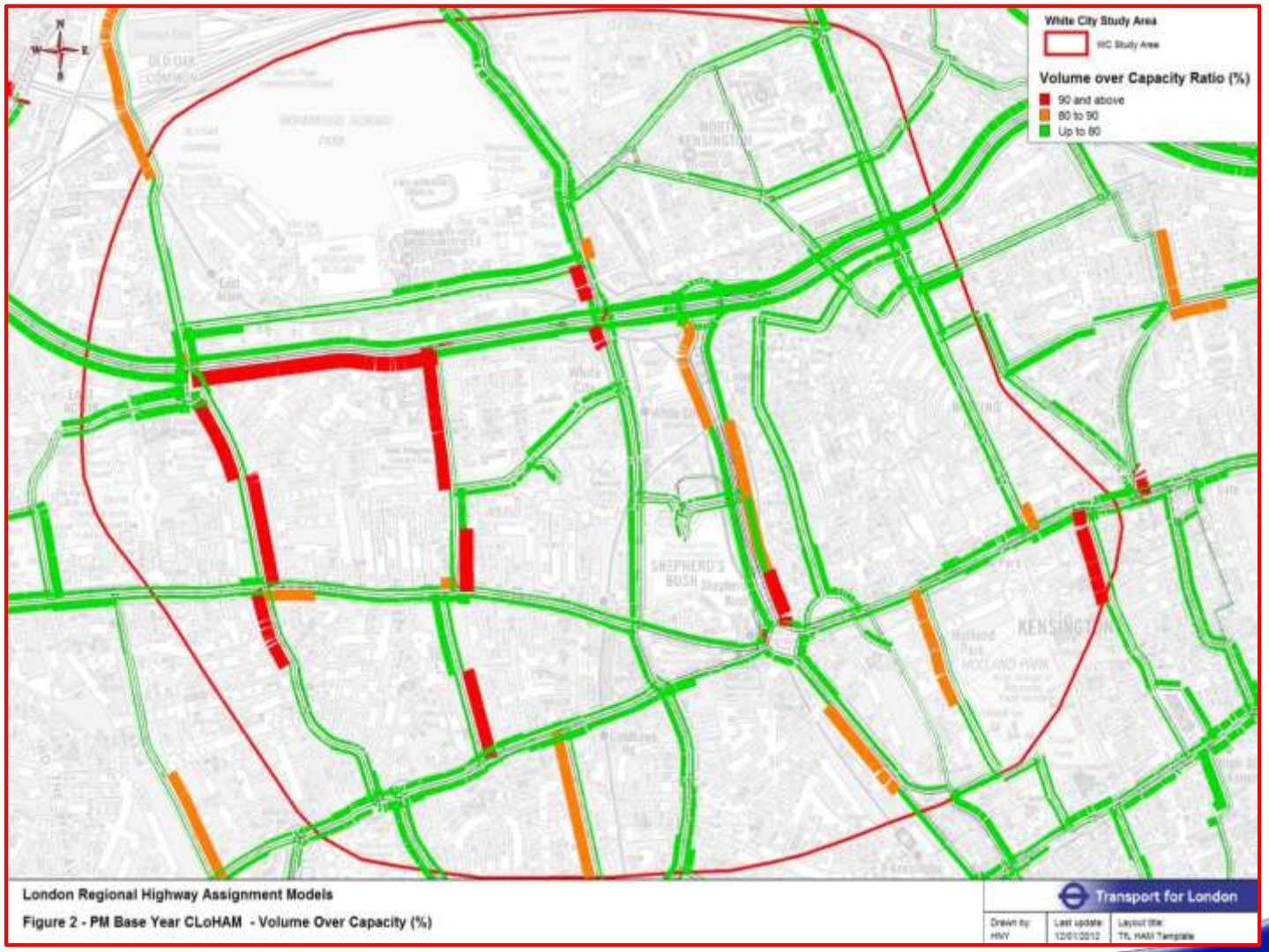




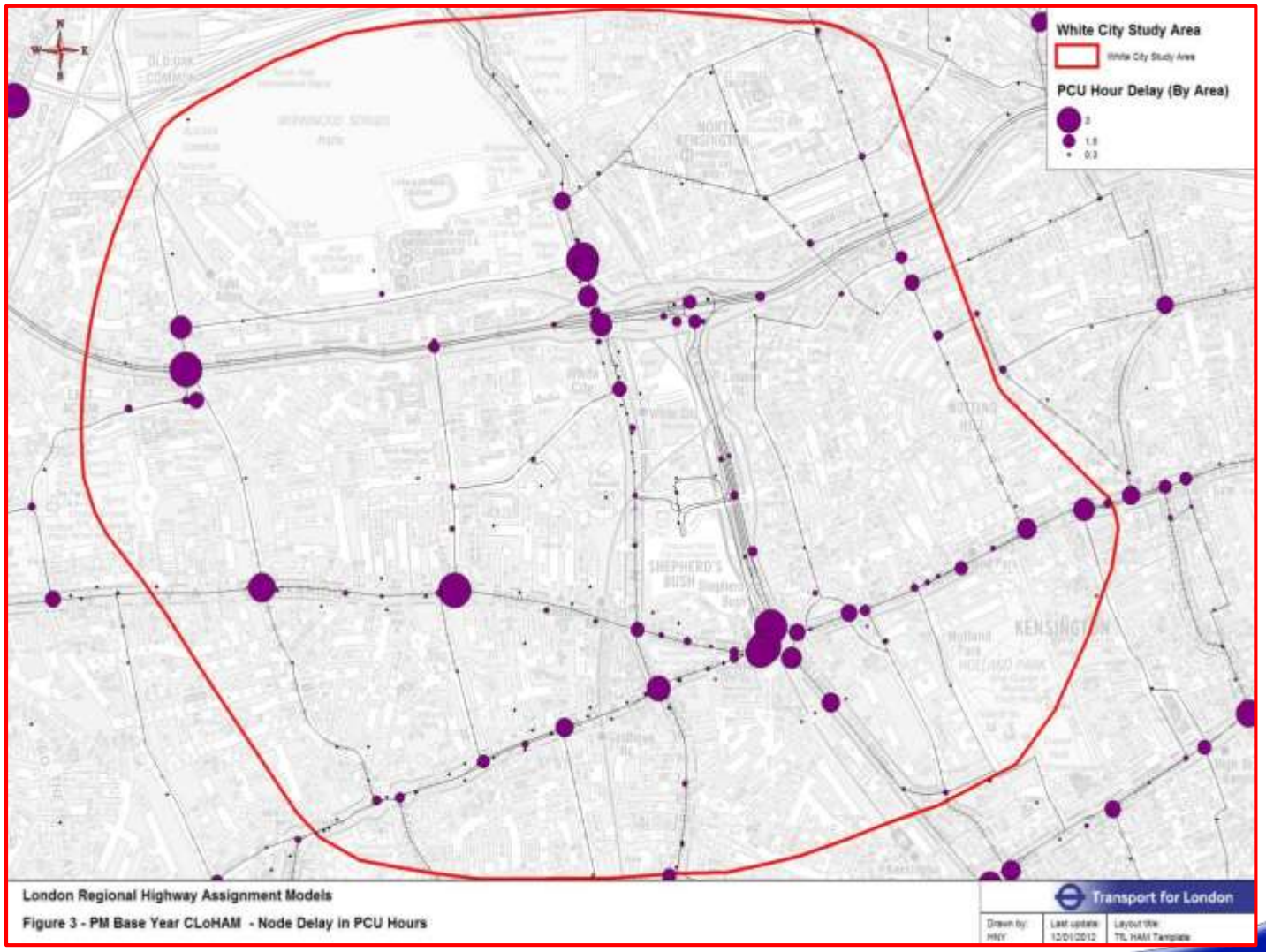
Base Year 2009 Output: Actual Flow



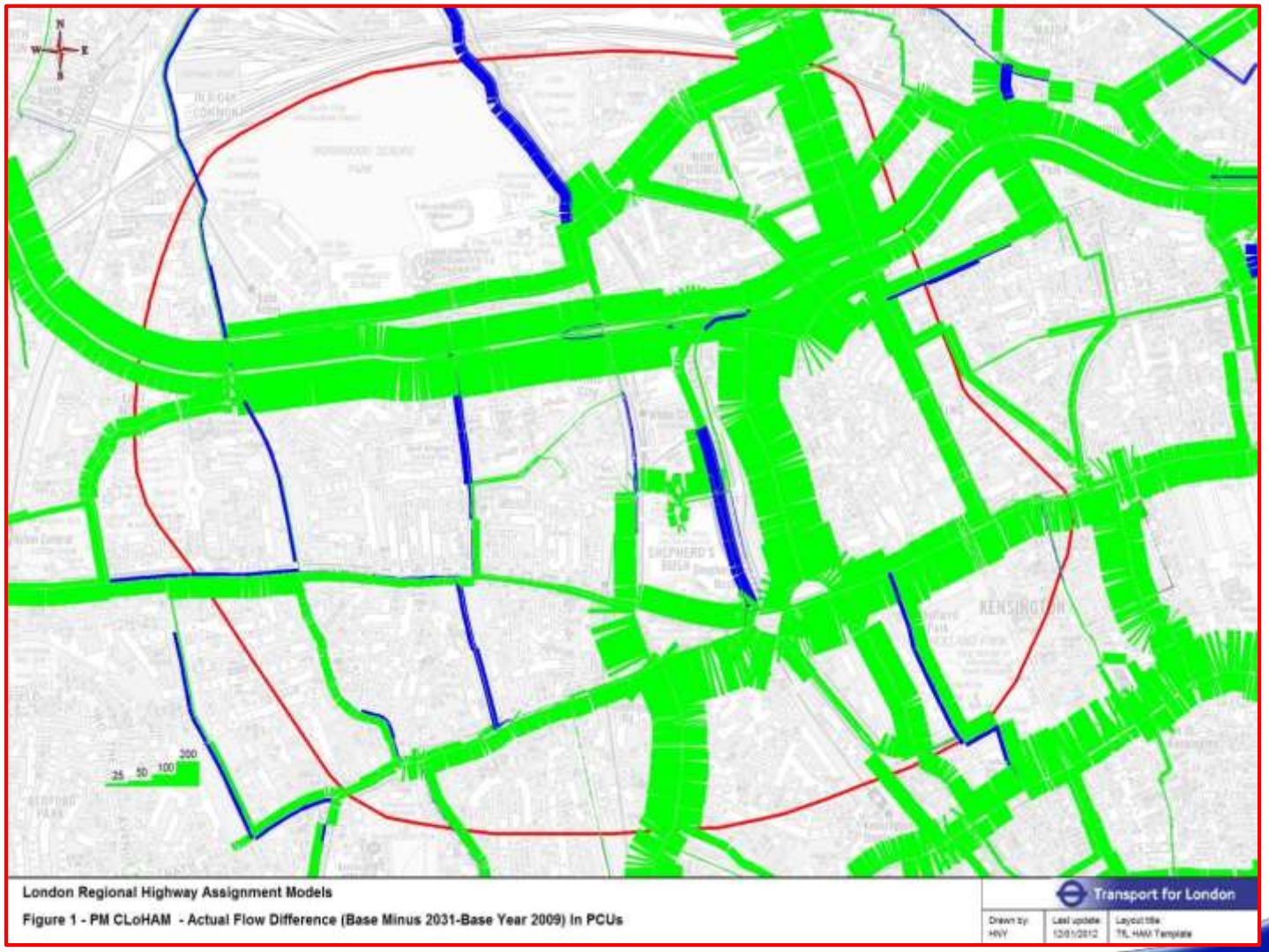
Base Year 2009 Output: V/C



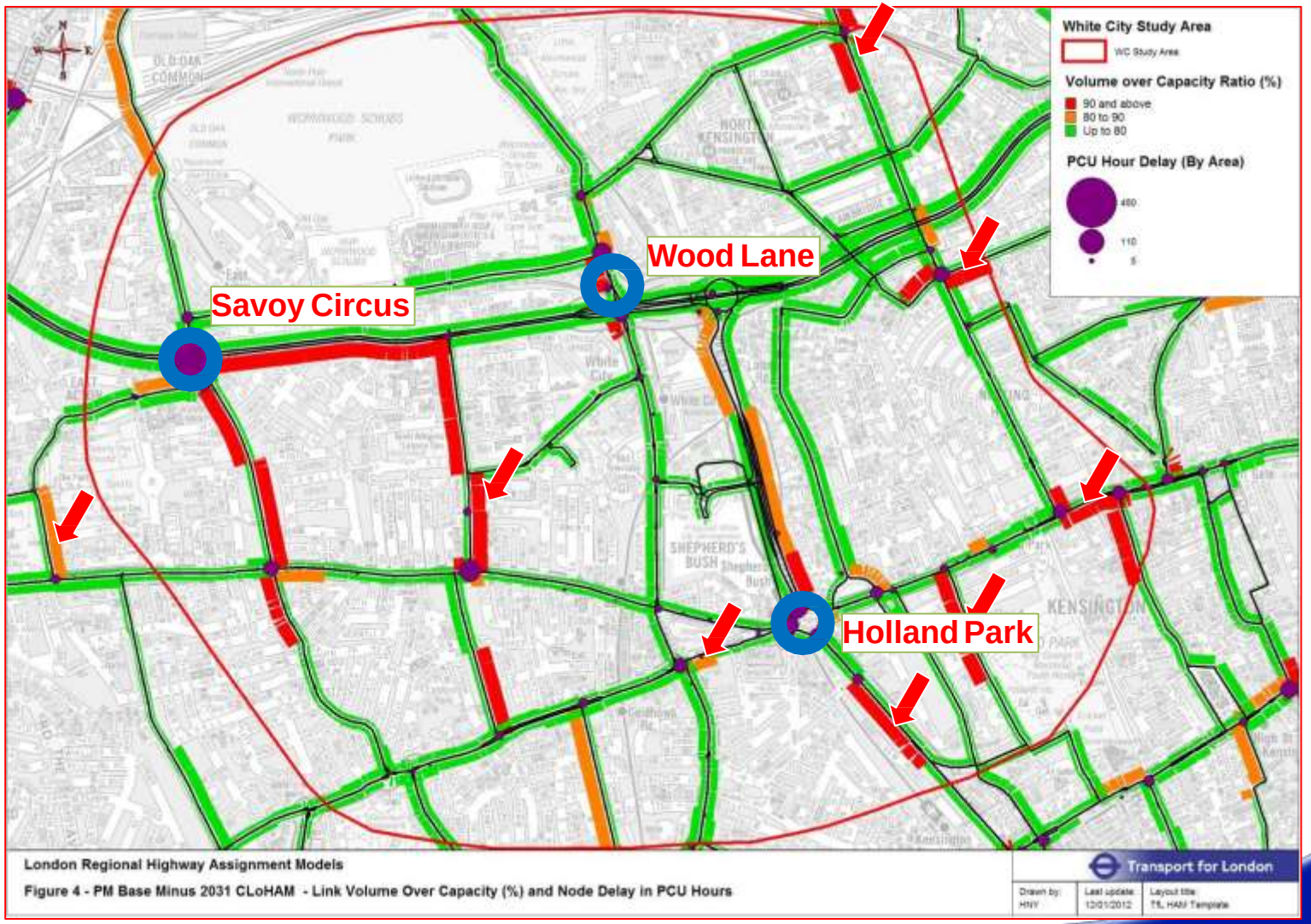
Base Year 2009 Output: Delay



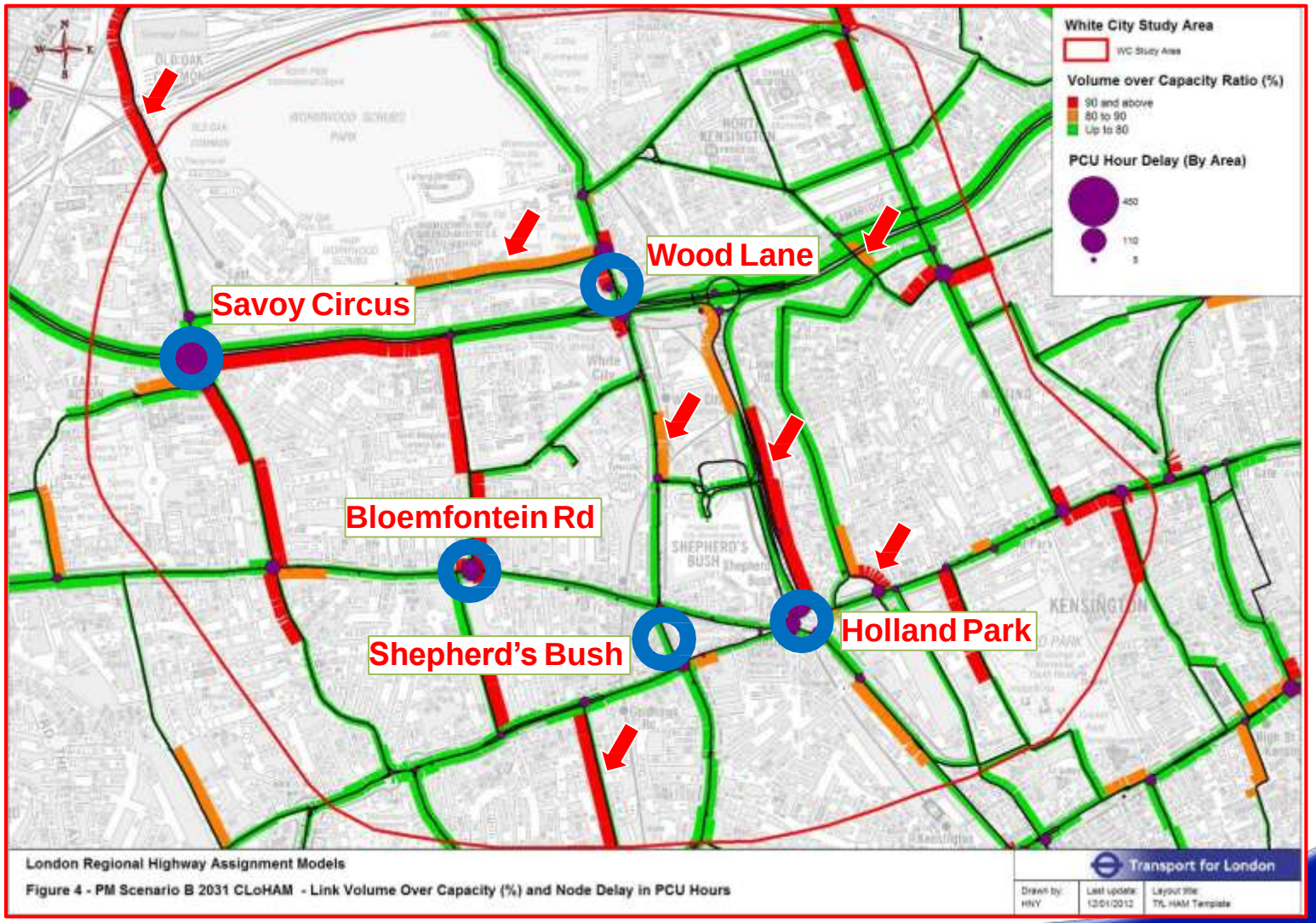
BM31-BY09 Output: Actual Flow



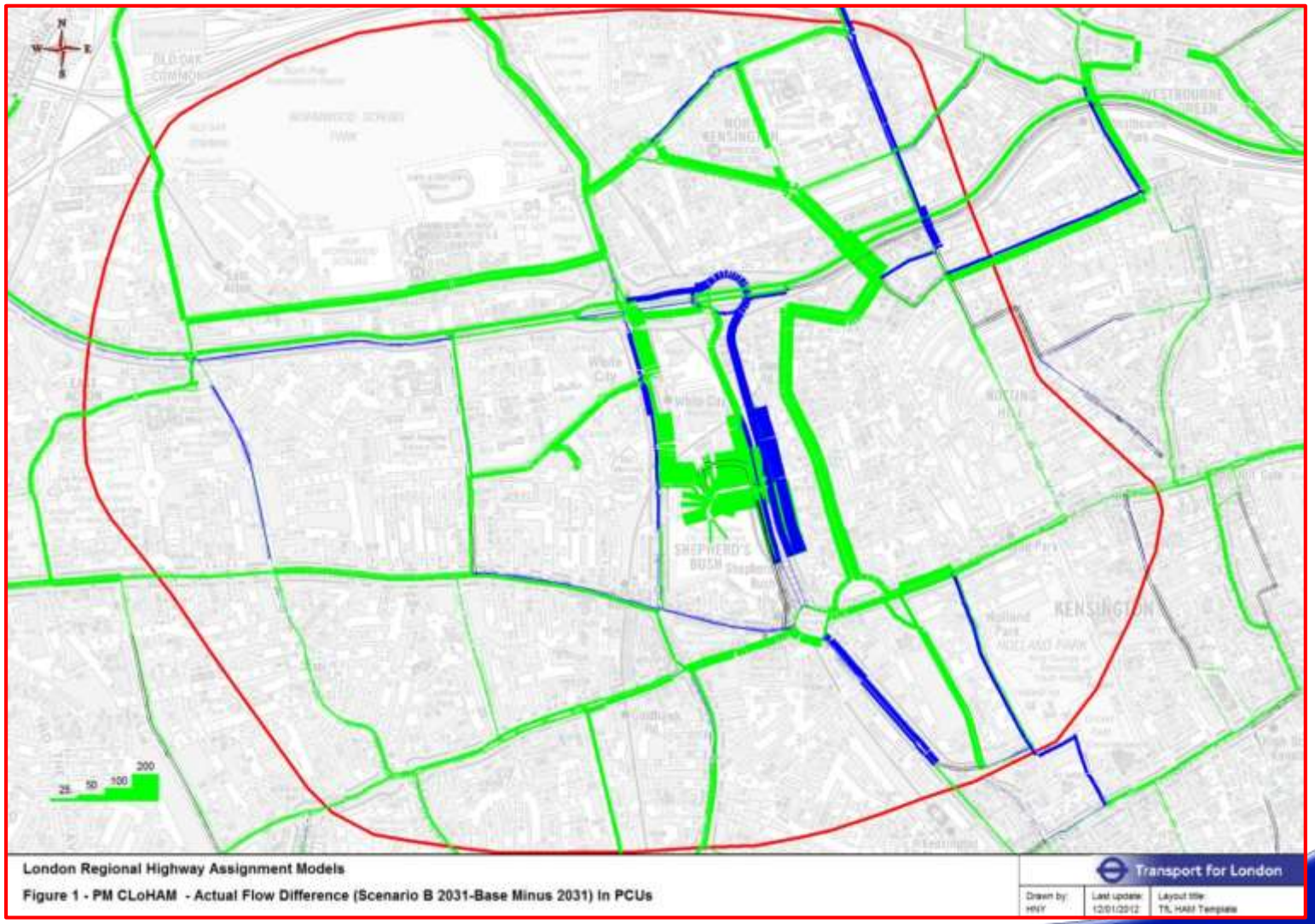
Base Minus 2031: Delay and V/C



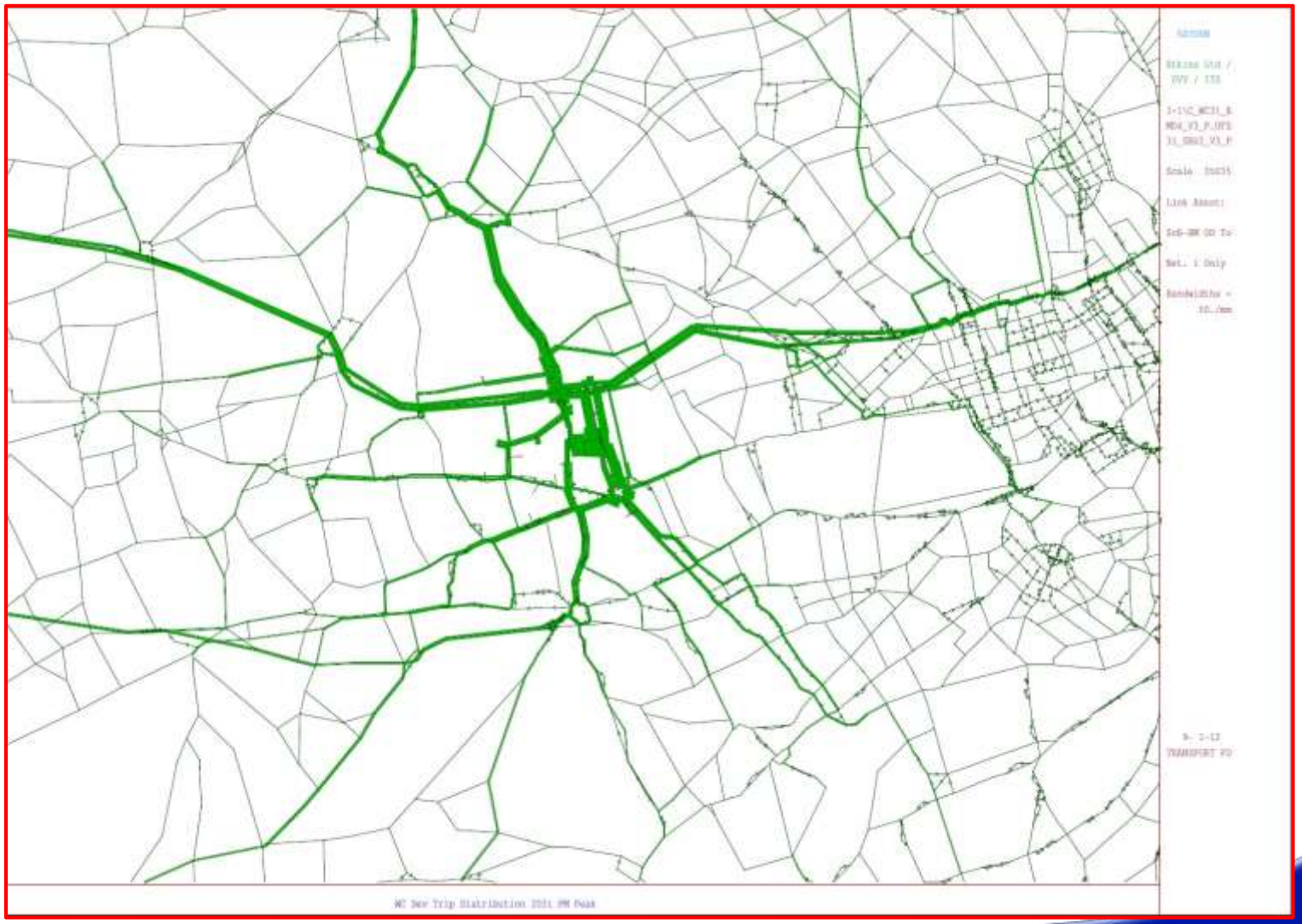
Scenario B 2031: Delay and V/C



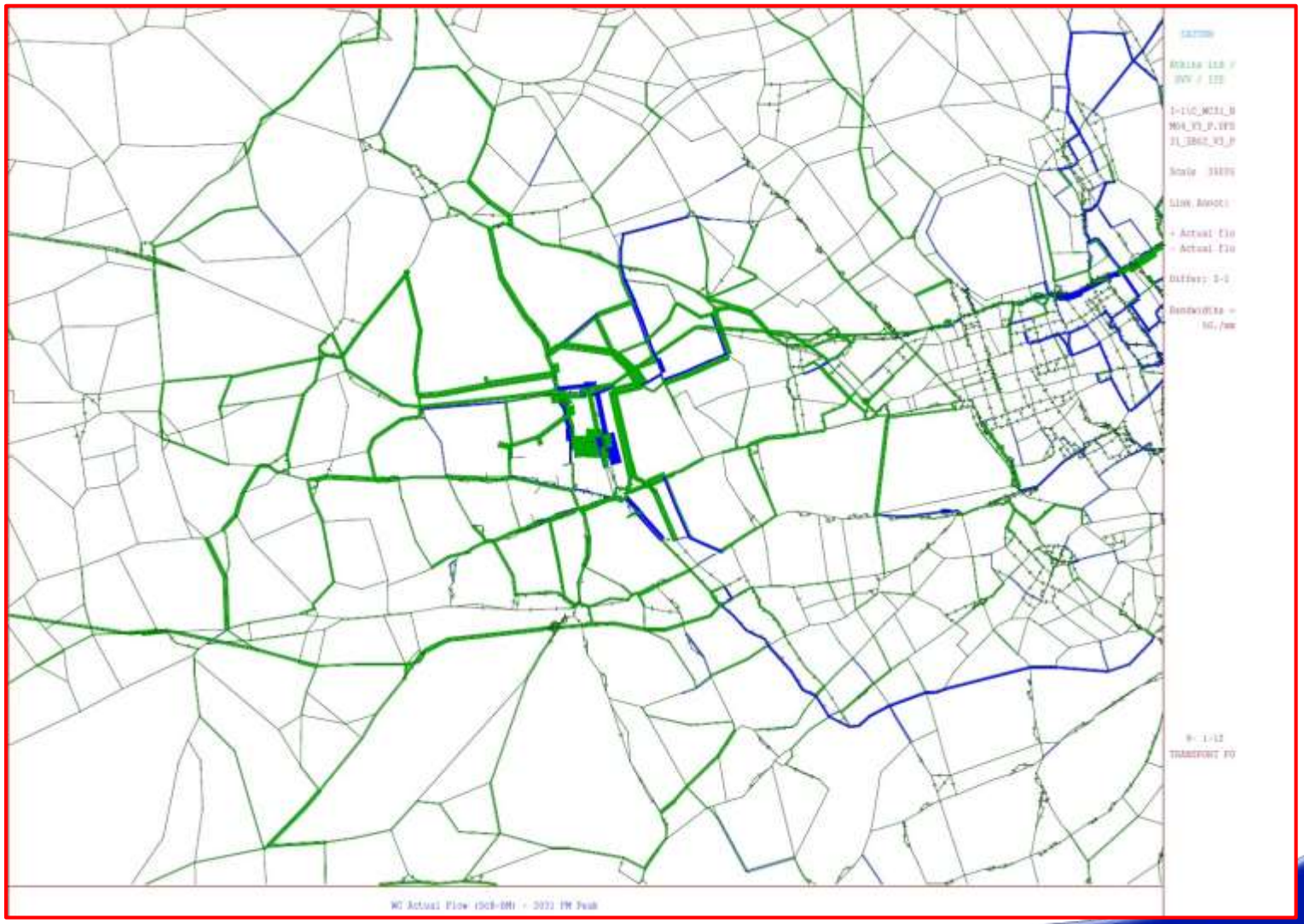
ScB31-BM31: Actual Flow



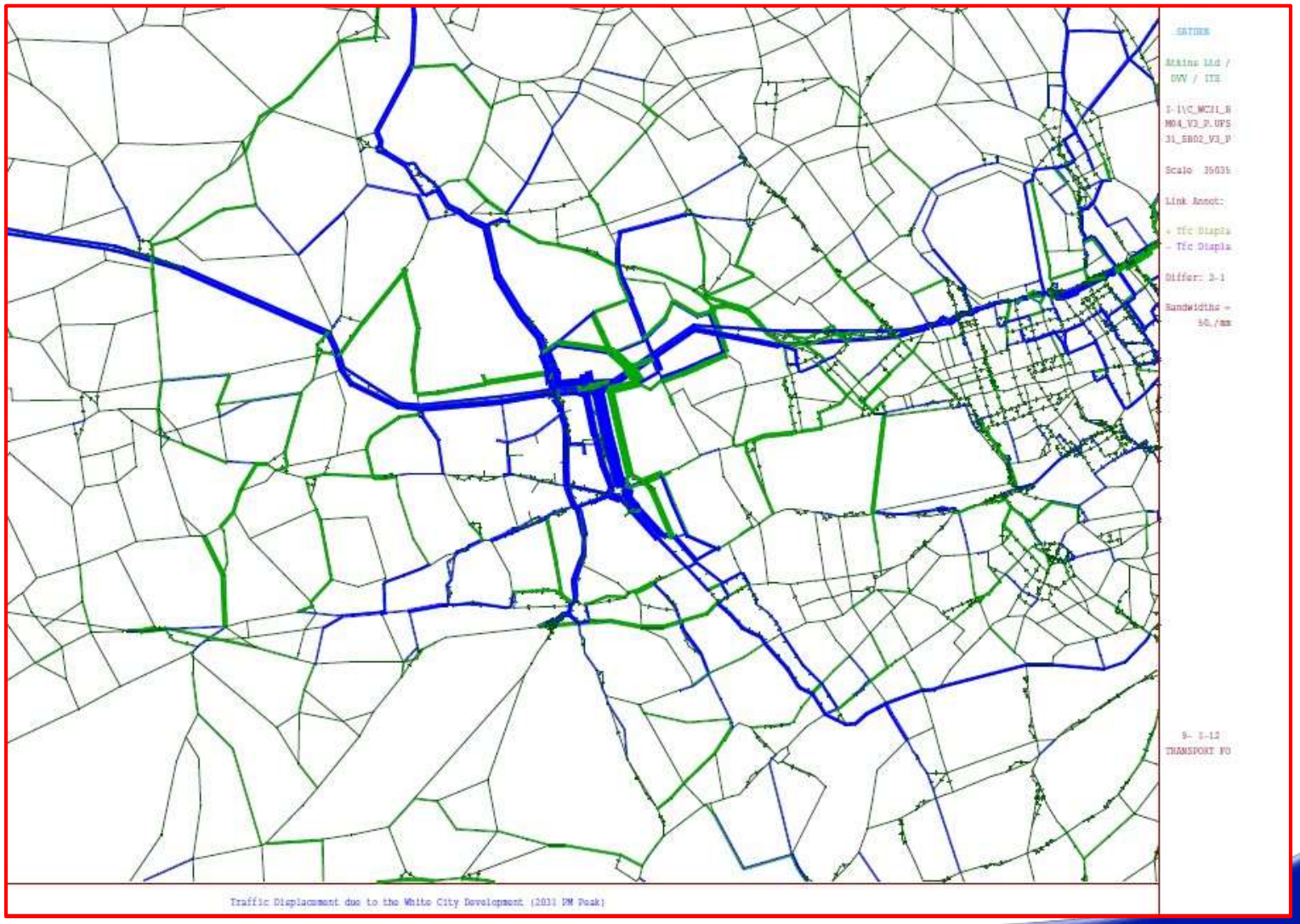
Gross Impact - WC Development



Net Impact - WC Development



Traffic Displacement 2031



Core Study Area Statistics

Scenario	PCU-kms	PCU-Hrs	Average speed
BM vs Base 09	12.1%	21.6%	-7.8%
Scn B vs BM	1.6%	5.7%	-3.9%
MW11 vs Base 11	1.7%	5.9%	-4.0%

Conclusion

- Background growth between 2009 and 2031 (14%) resulted in additional pressure on already congested network
- Development demand increase by ~950 highway trips (2-ways) adding to congestion at key junctions
- Comparison between With and Without development scenarios indicates relatively small changes in flows but substantial displacement of through traffic (~1/3 of dev trips)
- Local mitigations will be required to reduce traffic impact

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