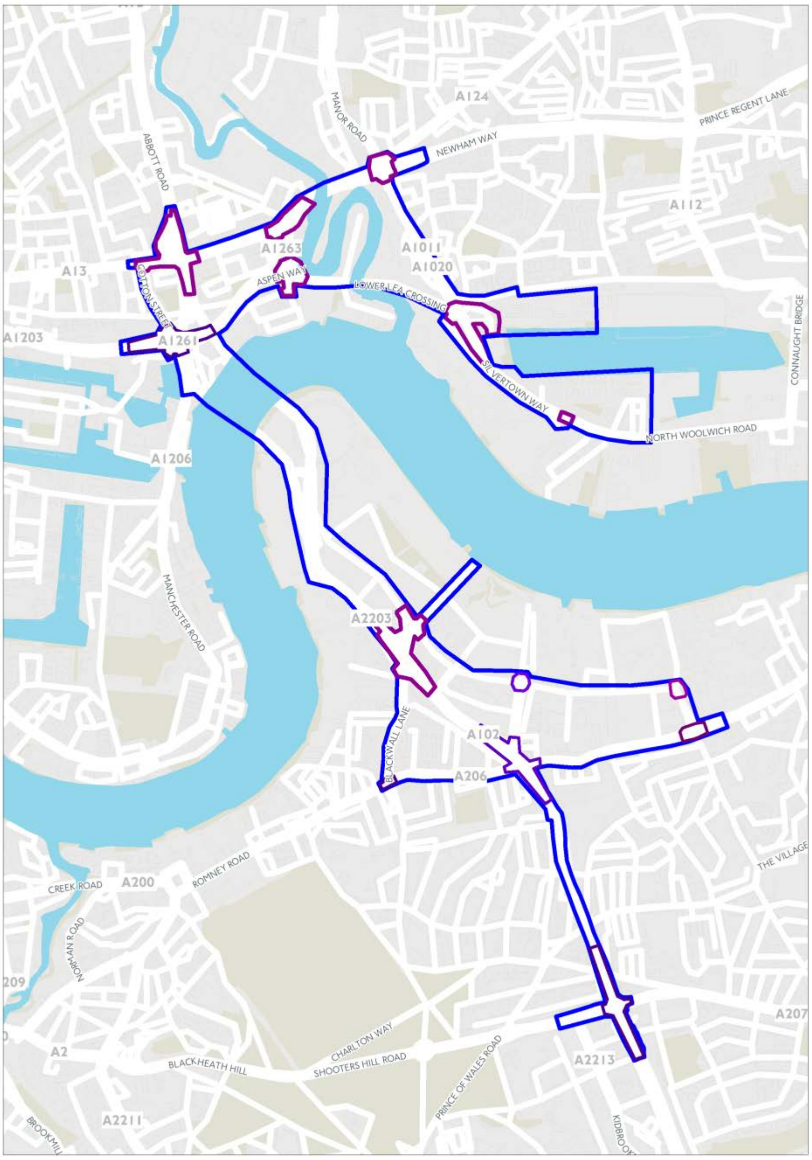
APPENDIX A – COLLISION REVIEW

A.1 Study area

A.1.1 The study area identified for the Silvertown collision review predominantly comprised the main road network along both approaches to the proposed new Silvertown Tunnel, as well as the existing Blackwall Tunnel and approaches, parts of the A13 East India Dock Road and Lower Lea Crossing, the A102 Brunswick Road, Blackwall Tunnel and Blackwall Tunnel Approaches, part of the A2 Shooters Hill Road, A206 Woolwich Road and A1020 Silvertown Way. The minor roads were also included in the study area, which is shown below.

Figure A-1: Silvertown Tunnel collision review study area



A.2 Purpose

A.2.1 The purpose of this study was to provide base line reference data only, for use in future ‘before and after’ comparison studies as required, and comprised:

- An overview of collision, road user and casualty profiles for the study area as a whole
- A summary of collision numbers and a breakdown of the main collision types at fourteen previously identified key intersections
- Identification and listing of all collision clusters at which two or more collisions per year occurred within a 25m radius (50m diameter circle) across the study area as a whole, with more detailed summaries provided for all those within which three or more injury collisions were recovered per year

A.2.2 The data used to create graphs has been provided as appropriate, along with details of the extent and coverage of each of the key intersections to enable this analysis to be easily replicated in future ‘before and after’ comparisons, if required.

A.3 Overview of collisions

A.3.1 Collision data for the London Boroughs of Greenwich, Newham and Tower Hamlets for the three year period between 1 January 2012 and 31 December 2014 was obtained from Transport for London, for all roads (Transport for London Road Network and Borough roads), with the dates selected to match those used in the 8km wider study carried out using COBA-LT by the strategic modelling team.

A.3.2 In the 36 months between 1 January 2012 and 31 December 2014 there were 477 recorded injury collisions, of which six resulted in a fatality, and 35 resulted in serious injury. The remaining 436 collisions resulted in slight injury. These collisions resulted in 607 casualties of all severities during the period.

A.3.3 A breakdown of the collisions and casualties by severity and year across the study area as a whole is provided below, along with the percentage of most serious collisions (Killed or Seriously Injured: KSI).

Table A-1: Collisions by severity and year: Whole area

Year	Fatal	Serious	Slight	TOTAL	% KSI
Year 1: 01/01/2012 – 31/12/2012	3	12	147	162	9.3%
Year 2: 01/01/2013 – 31/12/2013	1	10	133	144	7.6%
Year 3: 01/01/2014 – 31/12/2014	2	13	156	171	8.8%
TOTAL	6	35	436	477	8.6%
Annual Average	2.0	11.7	145.3	159.0	

A.3.4 From the collisions table, there were no obvious trends over the three year period studied: the total number of collisions in Year 1 was higher than the average for the three year period, but fell to its lowest point in Year 2, before increasing again in Year 3. Generally, both the number and severity of collisions fluctuated around the average of 159 collisions of all severities per annum, with the percentage of collisions resulting in the most serious of injuries remaining relatively stable, at around 8.6%.

Table A-2: Casualties by severity and year: Whole area

Year	Fatal	Serious	Slight	TOTAL	% KSI
Year 1: 01/01/2012 – 31/12/2012	3	12	218	233	6.4%
Year 2: 01/01/2013 – 31/12/2013	1	10	152	163	6.7%
Year 3: 01/01/2014 – 31/12/2014	2	13	196	211	7.1%
TOTAL	6	35	566	607	6.8%
Annual Average	2.0	11.7	188.7	202.3	

A.3.5 The casualty breakdown followed a similar trend to the collision trend, with a dip in overall numbers in Year 2. The annual average percentage of casualties resulting in the most serious injuries within the study area was 6.8%: lower than both the London average of 7.6% and the national average 14.5% reported for 2014[49].

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[49] Source: ‘Reported Road Casualties in Great Britain 2014: Main Results’, Department for Transport, June 2015, ‘Casualties in Greater London during 2014’, Transport for London Factsheet, June 2015

A.3.6 A summary of the main collision types occurring within the study area as a whole is provided below, with comparisons made between the percentages of each that might be expected to occur in Greater London as a whole.

A.3.7 Control data for Greater London as a whole was used for comparison because two of the three boroughs (Greenwich and Tower Hamlets) are defined as 'Inner London' boroughs whilst Newham is defined as an 'Outer London' borough within Transport for London's 'Levels *of Collision Risk'* document. Comparisons were made with 2012 data, as more recent reports issued by Transport for London provide casualty comparisons only for road user groups, and collision data for hours of darkness and non-dry road conditions only.

A.3.8 Collision types with higher than average percentages than might typically be expected (in comparison to the 2012 Greater London Borough averages) are shown in red and collision types with lower than average percentages are shown in green. Collision types with percentages which are relatively similar to the Greater London average are not colour coded.

Table A-3: Collisions by type and severity with compared with Greater London averages[50]

Collision Type	Killed or Seriously Injured (KSI)	Slight	TOTAL	% of all Collisions	% Greater London Boroughs
Pedestrian	8	34	42	8.8%	21.8%
Pedal cyclist	1	37	38	8.0%	15.4%
Powered two-wheeler	23	93	116	24.3%	20.1%
Goods vehicle	11	89	100	21.0%	11.8%
Bus/coach	4	21	25	5.2%	8.7%
Right turn	3	33	36	7.5%	22.0%
Left turn	3	26	29	6.1%	8.4%
U-turn	0	7	7	1.5%	2.3%
Hours of darkness	14	127	141	29.6%	28.8%
Non-dry road	10	83	93	19.5%	19.4%

A.3.9 From the table, collisions involving goods vehicles were notably higher than the Greater London average, with 21% of collisions in the study area

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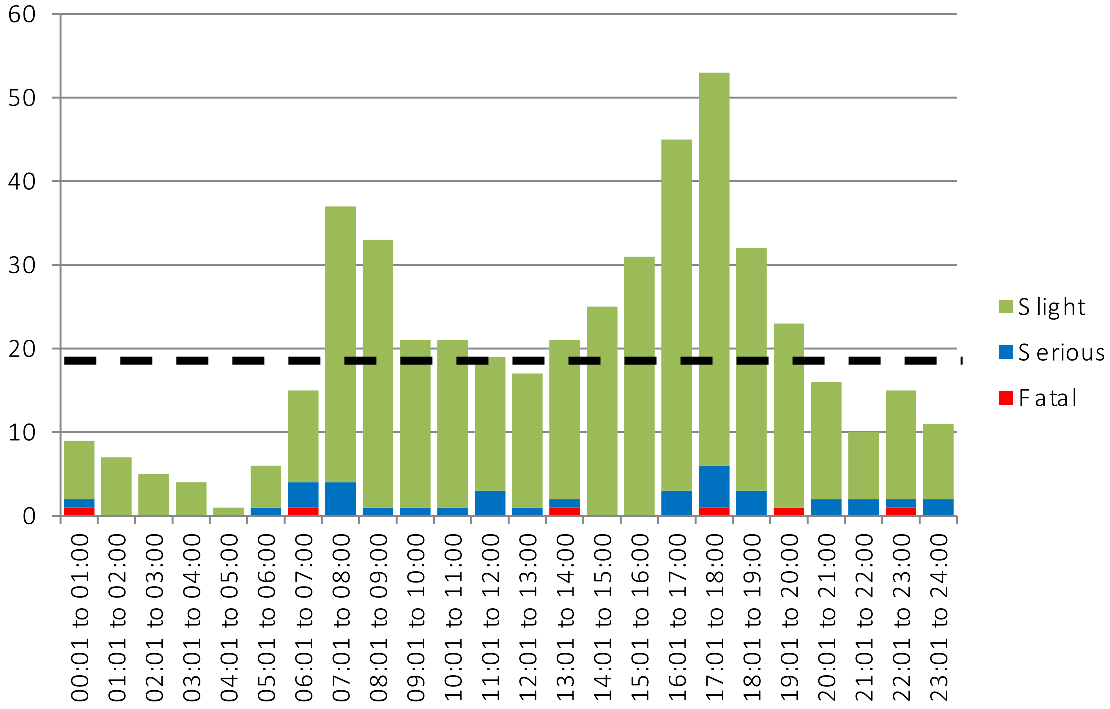
[50] Source: Table 2.1.36 – Greater London Boroughs from Levels of Collision Risk in Greater London, Issue 13 (April 2012) for All Sites

involving goods vehicles compared to 11.8% in Greater London. The percentage of collisions which involved powered two wheeler users was also higher than might be expected across Greater London as a whole, at 24.3%. Collision which involved pedestrians, pedal cyclists and right turn manoeuvres were lower than might be expected. This could be a reflection of the strategic nature of many of the routes within the study area, which also includes the Blackwall Tunnel river crossing, and of the use of this network for commercial travel.

A.4 When collisions occurred

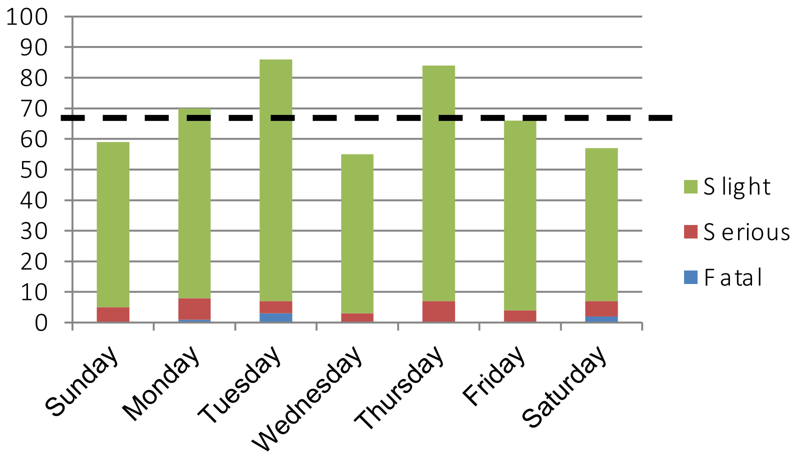
A.4.1 A profile of collisions by time of day, day of the week, and month of the year is summarised in the graphs below. Hourly, daily and weekly averages are shown as a black dashed line, for reference purposes.

Figure A-2: Collisions by time of day



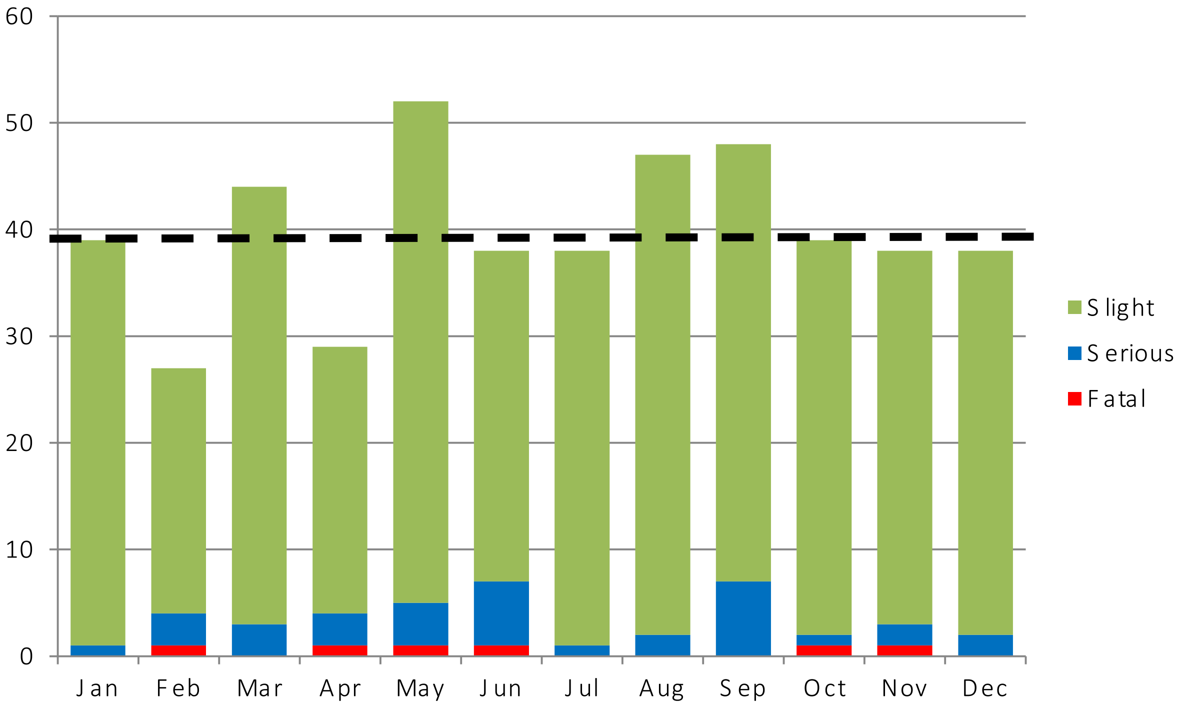
A.4.2 From the above, the number of collisions varied throughout the day following a fairly typical pattern of sharp increases in collisions during the peak periods (and the PM peak in particular) with reduced collision numbers during the daytime off peak period and during the early hours of the morning, and the highest peaks occurring between the hours of 16:00 and 18:00, and between 07:00 and 09:00. In all, 35.2% of all collisions (168 of 477) and 34.1% of those collisions resulting in the most serious injuries (14 of 41) occurred during these four hours. This broadly reflects the expected normal variation in traffic levels throughout the day.

Figure A-3: Collisions by day of week



A.4.3 It was unknown why numbers were lower on Wednesdays, but lower collision numbers at the weekend may be related to traffic levels, traffic composition, and the nature of journeys (more commercial journeys), but there was insufficient information to draw any firm conclusions.

Figure A-4: Collisions by month of the year

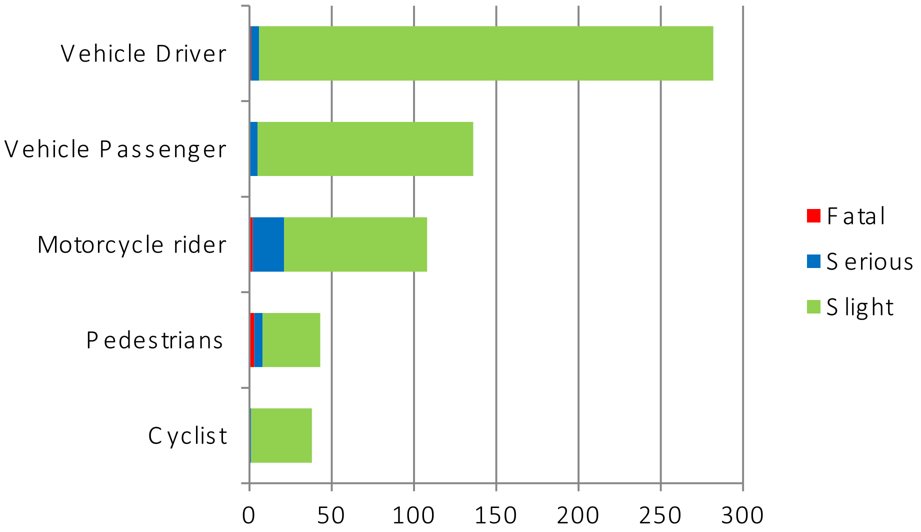


A.4.4 In the graph above it can be seen that the number of collisions resulting in the most serious of injuries increased through the spring months, to a peak during June, with a second marked increase in the number of most serious injuries occurring in September. Collision numbers were lowest during February and April (possibly related to the shorter months, and holiday periods) and collision levels within the study area were highest during the month of May. The number of collisions during mid-winter (November, December and January) and mid-summer (June and July), was around 38 collisions per month. By comparison, across Greater London as a whole during 2014 (source: 'Casualties in Greater London during 2014', Transport for London Factsheet, June 2015), more injury collisions were recorded in October and November than in any other month.

A.5 Who was injured

A.5.1 The 477 collisions in the 36 month period to 31 December 2014 gave rise to a total of 607 casualties, of which six resulted in a fatality, 35 casualties were seriously injured, and 566 casualties received slight injuries. A breakdown of these casualties by road user type and severity of injury is provided below.

Figure A-5: Casualties by road user group and severity

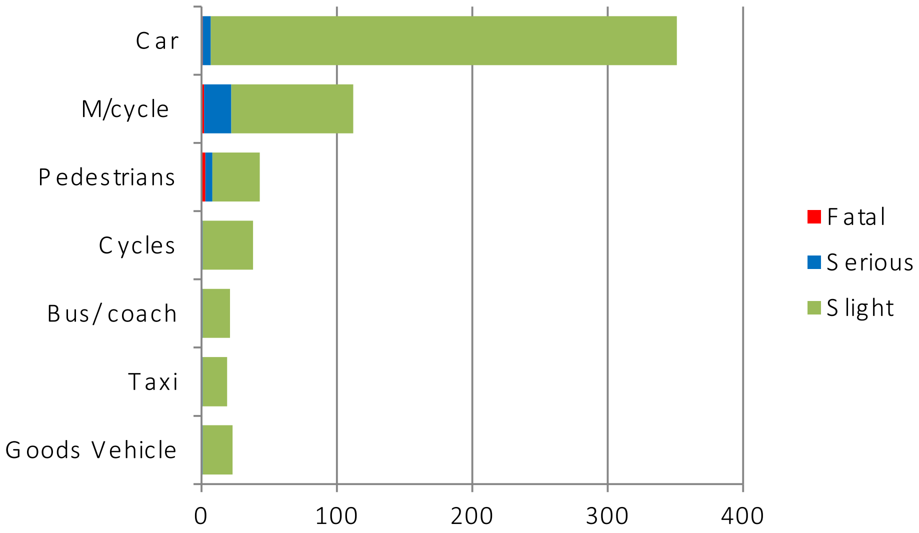


A.5.2 Vehicle drivers accounted for the highest percentage of casualties within the Silvertown study area, with 46.5% of all casualties in this category. Across Greater London as a whole during 2014, just over 31% of casualties were vehicle drivers. The percentages of casualties within the Silvertown area who were pedestrians (7.1%) or pedal cyclists (6.3%) were both lower than across greater London as a whole in 2014 (accounting for 18.2% and 16.7% of casualties respectively).

A.5.3 This again is likely to be a reflection on the strategic nature and purpose of this part of the road network, which will result in higher numbers of vehicle trips, and fewer trips on foot or by cycle than in other parts of London.

A.5.4 A more detailed breakdown of casualties who were involved in collisions by mode of travel is provided below.

Figure A-6: Casualties by mode of travel: Whole study area[51]



A.5.5 Of the six fatalities, three were pedestrians, two were motorcyclists, and one was a vehicle driver who collided with the tunnel entrance whilst possibly involved in a race with another driver. In all, 20 of the 35 casualties who were seriously injured were motorcyclists (one of whom was a passenger on a motorcycle), accounting for over half of all serious injuries in the area.

A.5.6 By far the majority of those injured were car users, with powered two wheeler users having the second highest number of casualties (and the highest number of the most severe injuries). Although the involvement of goods vehicles in collisions has been shown to be higher than the average for Greater London, the resulting number of casualties amongst this user group was very low, at 3.8% of all casualties. This total is still slightly higher than the figure of 2.1% for Greater London as a whole in 2014.

A.5.7 Car users accounted for 57.8% of all casualties in the Silvertown area in the three years to December 2014, which is considerably higher than the 38.3% of all casualties who were car users in Greater London during 2014. This again reflects the different mix of travel modes in this area, with very many fewer pedestrian and pedal cyclist casualties included within the casualty profile for the Silvertown area.

A.5.8 The age and gender profile of those injured during the study period is shown below.

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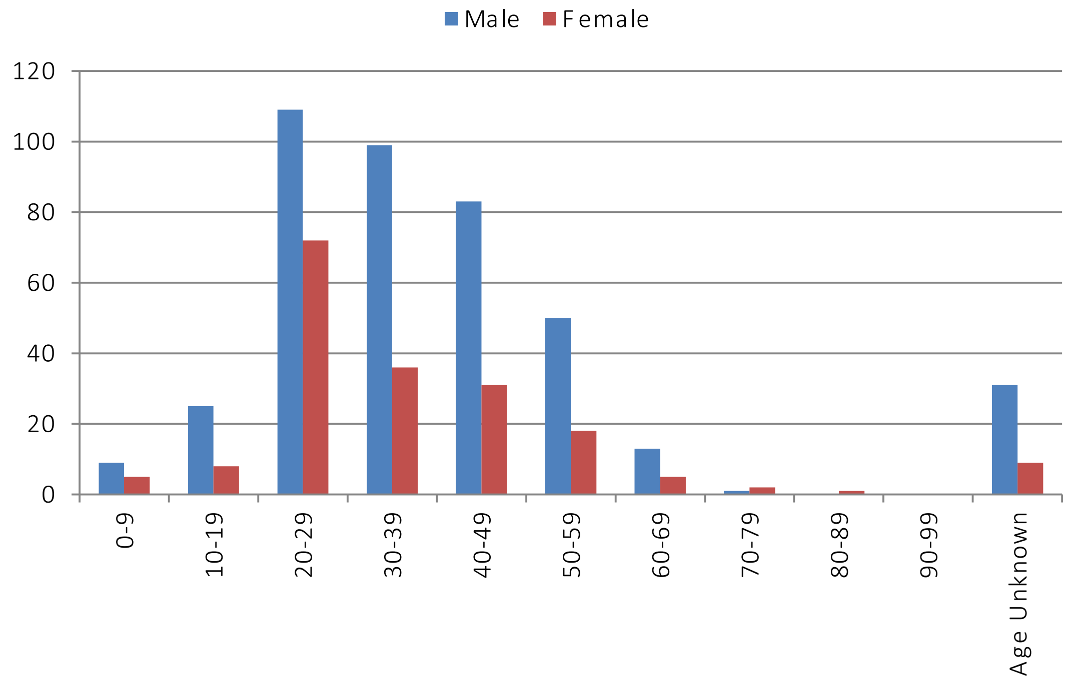
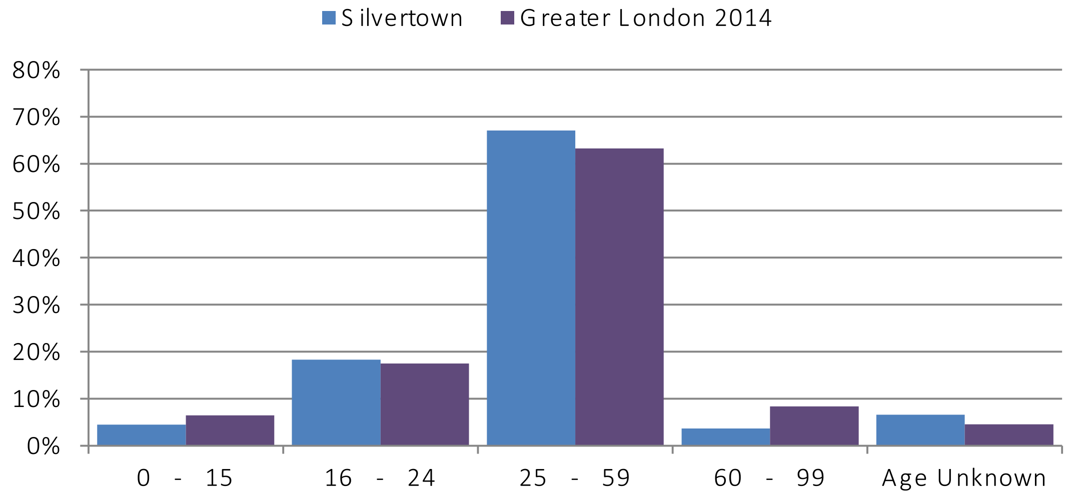
[51] There were no casualties during the three year period in road user groups which are not specifically listed above

Figure A-7: Casualty breakdown by age and gender



A.5.9 From the graph, 82% of all casualties (498 of 607) were between the ages of 20-59 (working age), and 69% of all casualties (420 of 607) were males of all ages. A comparison between the casualty profiles within the study area and across Greater London as a whole showed broadly similar profiles when the percentage of casualties within each age band was plotted for each (shown overleaf).

Figure A-8: Casualty profile comparison: Silvertown and Greater London



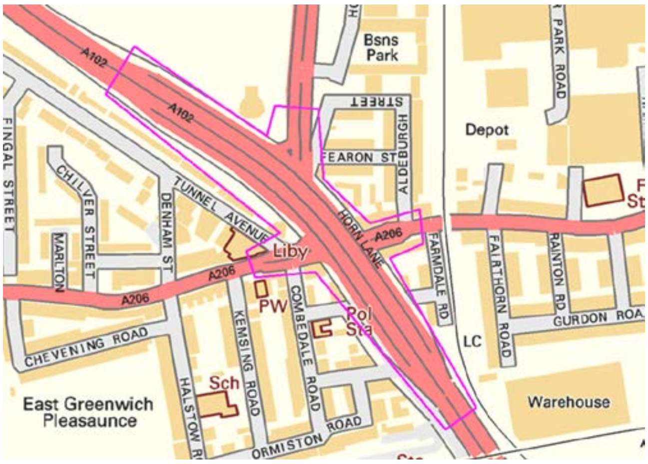
A.5.10 The overall age profile of casualties varied slightly with that of Greater London in 2014, with slightly higher percentages of working age casualties, and lower percentages of the oldest and youngest road users being recorded in the Silvertown area than across Greater London as a whole.

A.6 Key junctions

A.6.1 A total of fourteen key interchanges which required specific reporting for monitoring purposes within the study area were identified by the Project Manager. The boundaries and extent of each of these has been provided below, for reference purposes, and to ensure that future revisions of this study can be easily compared.

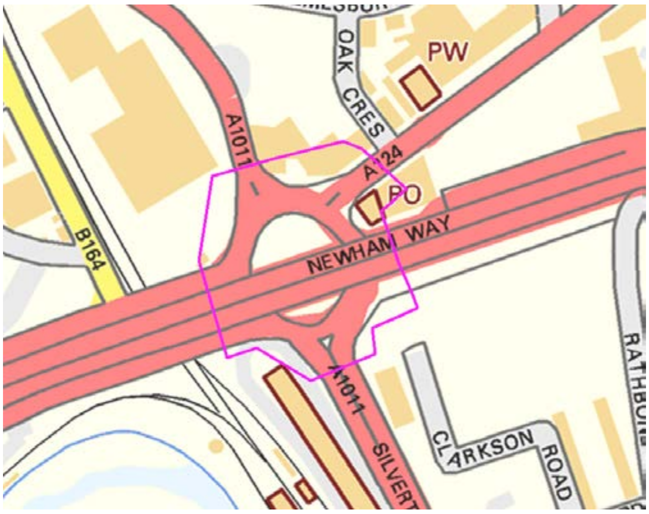
A.6.2 Link or node numbers are assigned to collisions by Transport for London which relate to the location on the network at which they occurred. Reference was made to these numbers where appropriate, to assist with determining where a collision took place.

A102/A206 Woolwich Road/Peartree Way Junction



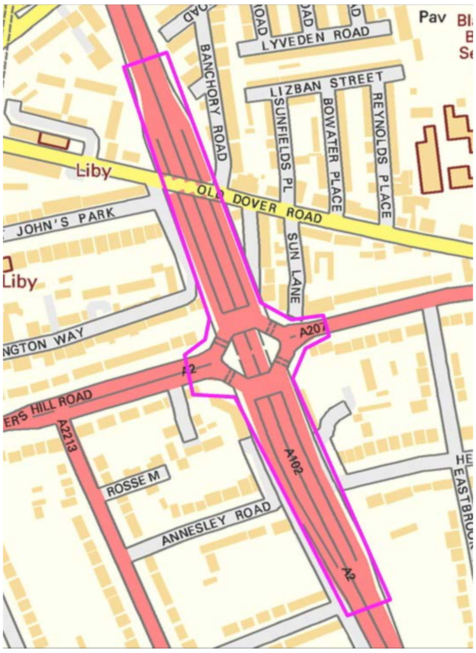
The boundary of this key intersection included collisions which occurred at the signal-controlled junction with Peartree Way and Woolwich Road, and both the north-westbound, and south-eastbound slip roads, merges and diverges, but collisions which occurred on the mainline flyover between the merges and diverges were excluded.

A13 Newham Way/A124 Barking Road/A1011 Silvertown Way Roundabout



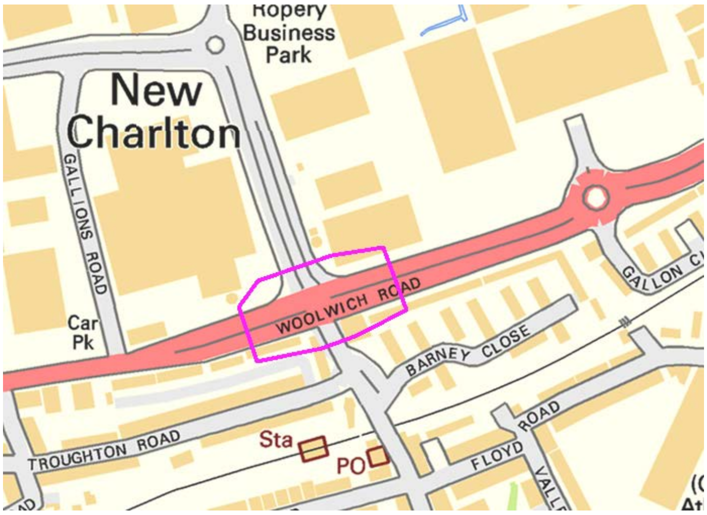
This key interchange comprised the roundabout junction beneath the A13 Newham Way, and its immediate approaches, but excluded the collisions which occurred on Newham Way itself, as the merges and diverges were located a considerable distance from the main junction. Of the 25 collisions which were included in this key interchange, all were assigned to Node 0029.

A2/A102/A207 Sun in the Sands Roundabout and approaches



The A2 Shooters Hill Road foms part of a grade separated roundabout located above the A102/A2 which passes beneath the intersection. Segregated pedestrian and cycle facilities are provided which avoid the roundabout circulatory area. The intersection included collisions on the roundabout and immediate approaches, as well as the northbound and southbound A102/A2 slip roads merges and diverges, but excluded northwest-southeast collisions on the through carriageway of the A102/A2.

A206 Woolwich Road/Anchor and Hope Lane Crossroads



The study area included the junction and all immediate approaches to this four arm signal-controlled at-grade crossroads junction.

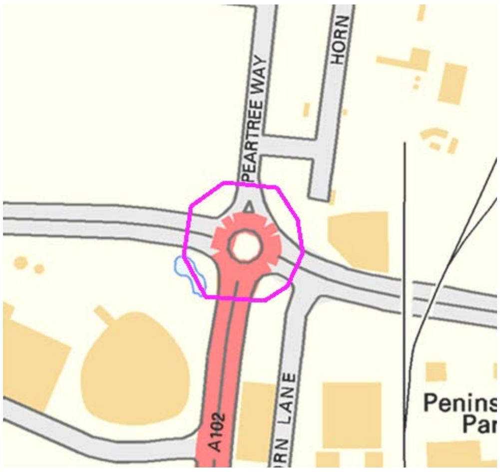
A206 Woolwich Road/Blackwall Lane Junction

The study area included the A206 Woolwich Road, as well as the junctions with Rodmere Street (one way south-east bound), Blackwall Lane, and Vanburgh Hill, as the whole area forms a single, signal controlled junction. Both arms of the staggered crossing on Woolwich Road close to the junction with Vanburgh Hill were also included.

Anchor and Hope Lane/Bugsby’s Way Roundabout

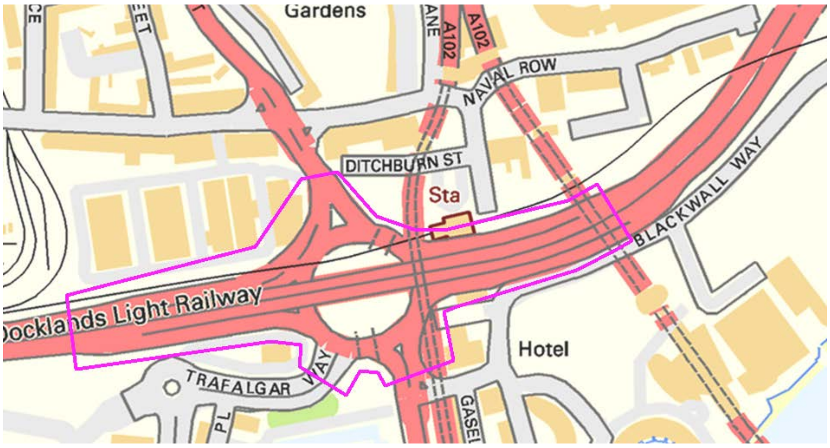
The study included the entire three arm roundabout junction and immediate approaches.

Bugsby’s Way/Peartree Way Roundabout



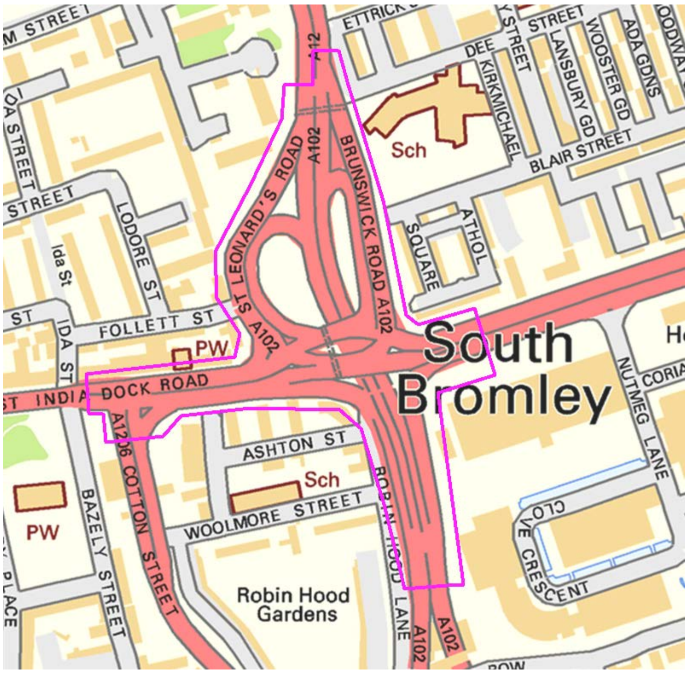
The study included the entire four arm multi-lane entry arm roundabout junction and immediate approaches.

A1261 Aspen Way/A1206 Preston's Road/Cotton Street Roundabout



The study area included all approaches and the circulatory area of this grade-separated signal-controlled roundabout junction, as well as the slip roads and merges and diverges with the A1262 Aspen Way, but excluded the mainline east-west flyover section through the junction.

A13 East India Dock Rd/A102/Cotton St intersections



This major intersection at the entry to the Blackwall Tunnel comprises a number of junctions and slip roads, at various elevations. The study area included all junctions, slip roads, merges and diverges and extended westwards to include the junction with Cotton Street.

A102/ A2203 Blackwall Lane Junction & Blackwall Lane/ Millennium Way junctions

This interchange included all collisions which occurred at and within 20m of the Blackwall Lane/ Millennium Way roundabout junction; along Blackwall Lane and the link roads between this junction and the A102, at the signal controlled junctions under the A102 flyover, and at the junction with Tunnel Avenue. However, collisions which took place on the mainline flyover of the A102 between the merges and diverges, and along Tunnel Avenue other than at its junction with Blackwall Lane, were excluded.

A13 East India Dock Road/Abbott Road/Leamouth Rd Junction

This intersection included all collisions which occurred on the A13 at its junctions with Leamouth Road and Abbott Road, and on the slip roads and merges and diverges with the Blackwall Tunnel to the east of the junctions. Collisions which occurred between the merges and diverges and the tunnel entrance were excluded.

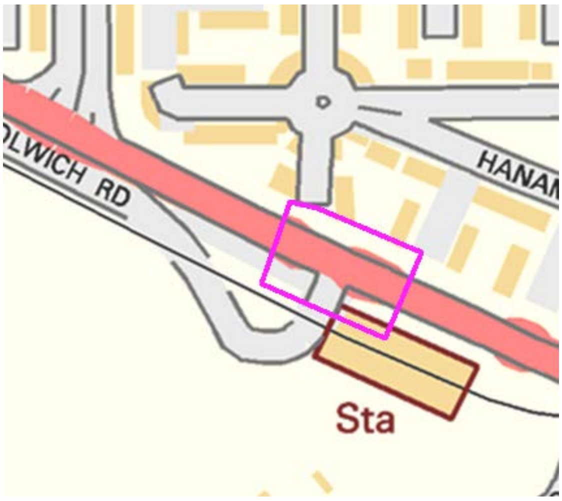
A1020 Lower Lea Crossing/ A1011 Silvertown Way Roundabout & Tidal Basin Road/Western Gateway T-junction

This complex network includes a number of junctions which although are at different elevations, are all interconnected. Therefore, all collisions which occurred within the area were included in reporting.

A1261 Aspen Way/A1020 Lower Lea Crossing & Leamouth Road/Blackwall Way roundabouts

The study reported on all collisions which occurred at both the large signal-controlled roundabout junction with Lower lea crossing, the landscaped roundabout layout at Blackwall Way, and on the approaches to each and the short stretches of link road between the two.

A1020 Silvertown Way/North Woolwich Road T-junction by West Silvertown DLR Station



All collisions which occurred at this three arm signal-controlled junction and immediate approaches were included.

A.7 Key interchanges: Collision summary

A.7.1 A breakdown of collisions by severity in the three year period to December 2014 which occurred within the boundaries of each of is provided below.

Table A-4: Collisions by severity: Key Interchanges

Key interchange	Fatal	Serious	Slight	TOTAL	% KSI
A102/A206 Woolwich Road/Peartree Way Junction	0	2	20	22	9.1%
A13 Newham Way/A124 Barking Road/A1011 Silvertown Way Roundabout	0	2	23	25	8%
A2/A102/A207 Sun In The Sands Roundabout	0	1	12	13	7.7%
A206 Woolwich Road/Anchor and Hope Lane Crossroads	0	0	15	15	0%
A206 Woolwich Road/Blackwall Lane Junction	0	0	8	8	0%
Anchor and Hope Lane/Bugsby's Way Roundabout	0	0	1	1	0%
Bugsby's Way/Peartree Way Roundabout	0	1	6	7	14.3%
A1261 Aspen Way/A1206 Preston's Road/Cotton Street Roundabout	0	1	20	21	4.8%

Key interchange	**Fatal**	**Serious**	**Slight**	**TOTAL**	**% KSI**
A13 East India Dock Rd/A102/Cotton St Junction	0	7	35	42	16.7%
A102/A2203 Blackwall Lane Junction & Blackwall Lane/Millenium Way/Bugsby’s Way Roundabout	0	2	21	23	8.7%
A13 East India Dock Road/Abbott Road/Leamouth Rd Junction	1	2	28	31	9.7%
A1020 Lower Lea Crossing/A1011 Silvertown Way Roundabout & Tidal Basin Road/Western Gateway T-junction	0	1	1	2	50%
A1261 Aspen Way/A1020 Lower Lea Crossing & Leamouth Road/Blackwall Way roundabouts	0	0	10	10	0%
A1020 Silvertown Way/North Woolwich Road T-junction	0	0	1	1	0%
TOTAL at key interchanges	1	19	201	221	9.0%
Remaining area	Fatal	Serious	Slight	TOTAL	%KSI
Remainder of area	5	16	235	256	8.2%
TOTAL FOR STUDY AREA	6	35	436	477	8.6%
% of collisions which occurred at the key interchanges	16.7%	54.3%	46.1%	46.3%	

A.7.2 The figures for the remainder of the area were calculated by subtracting the total number of collision types at the key interchanges from the total for each which occurred within the study area as a whole.

A.7.3 From the table it can be seen that two of the smaller interchanges had fewer than 3 collisions in the three years to 31 December 2014, and Silvertown Way had very few collisions despite comprising a large grade-separated roundabout, and flyover. A review of satellite imagery appeared to show very low traffic levels on this route, which passes to the north of the river and to the south of Excel.

A.7.4 The interchanges vary in size, type and complexity and are likely to cater for different volumes and modal breakdowns of traffic and so no direct comparisons between individual interchanges have been attempted. The purpose of this section is to report on the number and type of collisions within each, to provide a baseline for comparison in potential future 'before and after' studies.

A.7.5 Almost half of the collisions recorded within the study area (46.3%) occurred at these fourteen key interchanges, with the remainder occurring elsewhere within the study area which comprises links between the key interchanges, over- or under-passes, the Blackwall Tunnel itself, and a number of side roads and minor junctions. A higher percentage (20 of 221: 9%) of collisions occurring at the key interchanges resulted in the most serious injuries, compared to the remainder of the study area (21 of 256: 8.2%).

A.7.6 A summary of the main collision types occurring at each of the key interchanges is provided in the table below.

Table A-5: Summary of main collision types: Key Interchanges[52]

Key interchange	Ped	Cyclist	P2W	Bus	Goods	Non-dry	Dark
A102/A206 Woolwich Road/Peartree Way Junction	0	2	3	4	5	2	6
A13 Newham Way/A124 Barking Road/A1011 Silvertown Way Roundabout	0	2	4	2	7	3	8
A2/A102/A207 Sun In The Sands Roundabout	0	0	2	0	3	3	4
A206 Woolwich Road/Anchor and Hope Lane Crossroads	6	2	3	0	3	2	6
A206 Woolwich Road/Blackwall Lane Junction	1	1	2	1	2	0	3
Anchor and Hope Lane/Bugsby's Way Roundabout	0	0	0	0	0	1	0
Bugsby's Way/Peartree Way Roundabout	0	1	0	3	1	1	2
A1261 Aspen Way/A1206 Preston's	0	3	5	1	6	7	11

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[52] Note: The collision characteristics above are not mutually exclusive. Stats 20 (2005 edition) Vehicle types : P2W= 2,3,4,5, 97; Bus = 11, Goods vehicle= 19,20, 21, 98

Key interchange	Ped	Cyclist	P2W	Bus	Goods	Non-dry	Dark
Road/Cotton Street Roundabout							
A13 East India Dock Rd/A102/Cotton St Junction	3	0	14	1	10	4	13
A102/A2203 Blackwall Lane Junction & Blackwall Lane/Millenium Way/Bugsby's Way Roundabout	1	0	5	0	6	6	8
A13 East India Dock Road/Abbott Road/Leamouth Rd Junction	3	1	9	0	5	6	6
A1020 Lower Lea Crossing/A1011 Silvertown Way Roundabout & Tidal Basin Road/Western Gateway T-junction	0	0	1	0	0	1	0
A1261 Aspen Way/A1020 Lower Lea Crossing & Leamouth Road/Blackwall Way roundabouts	0	5	2	0	1	0	0
A1020 Silvertown Way/North Woolwich Road T-junction	0	0	1	0	0	0	1
TOTAL at interchanges	14	17	51	12	49	36	68
Remainder of area	28	21	65	13	51	57	73
TOTAL IN STUDY AREA	42	38	116	25	100	93	141
% of all collisions which occurred at the key interchanges	33.3 %	44.7%	44.0 %	48.0 %	49.0%	38.7 %	48.2 %

A.8 Collision clusters within the Silvertown area

Methodology

A.8.1 All collision records within the study area for the 36 month period between 1 January 2012 and 31 December 2014 were subjected to cluster analysis, using a map-based collision analysis system.

A.8.2 A cluster was defined initially as any location where six or more collisions resulting in injury had been recorded in the three year period (i.e. an average of at least two collisions per year of any severity) within a 25m radius (50m diameter circle) anywhere within the study area, rather than being restricted to specific junctions so that clusters which occurred away from junctions would also be identified. Where junctions extend across areas greater than 50m, clusters may not have included all collisions which occurred at a particular junction, which is why clusters may be described below as 'vicinity of' rather than 'at its junction with'.

A.8.3 The methodology employed in identifying clusters is undertaken in two stages: the first stage involves a count of the number of collisions located within a 25m radius of each and every collision, and initially gives rise to a very large number of overlapping clusters. The second stage of cluster selection involves a comparison of every overlapping cluster, with the one recording the highest number of collisions being retained, and the rest discarded. This avoids duplication of data, and prevents individual collisions being included in more than one cluster site.

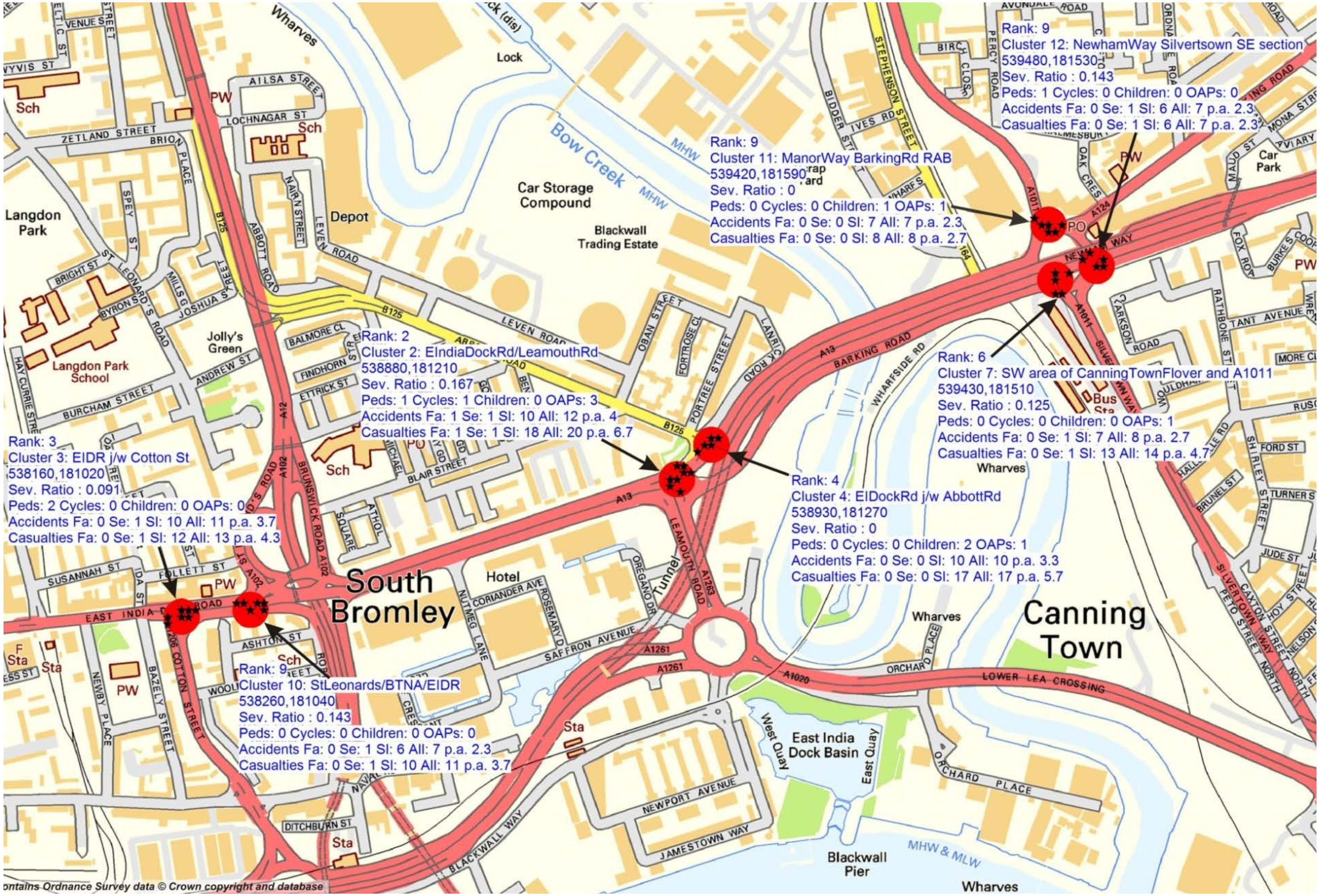
Overview of results of cluster analysis

A.8.4 The analysis identified 17 separate cluster sites within which six or more collisions had occurred within the 36 month period, as follows:

- Seven clusters were located along the A13 East India Dock Road and Barking Road;
- Five clusters were located along the A102 Blackwall Tunnel Approach, to the south of the river;
- Four clusters were located along the A206 Woolwich Road;
- One cluster on Shooters Hill Road, close to its junction with Kidbrooke Park Road.

A.8.5 The cluster sites, along with a summary of their ranking and key characteristics, are shown on the map extracts on the pages which follow.

Figure A-9: Canning Town and Blackwall Tunnel Northern Approach area collision clusters



Rank: 9
Cluster 12: NewhamWay Silvertsown SE section
539480,181530
Sev. Ratio : 0.143
Peds: 1 Cycles: 0 Children: 0 OAPs: 0
Accidents Fa: 0 Se: 1 Sl: 6 All: 7 p.a. 2.3
Casualties Fa: 0 Se: 1 Sl: 6 All: 7 p.a. 2.3

Rank: 9
Cluster 11: ManorWay BarkingRd RAB
539420,181590
Sev. Ratio : 0
Peds: 0 Cycles: 0 Children: 1 OAPs: 1
Accidents Fa: 0 Se: 0 Sl: 7 All: 7 p.a. 2.3
Casualties Fa: 0 Se: 0 Sl: 8 All: 8 p.a. 2.7

Rank: 2
Cluster 2: EIndiaDockRd/LeamouthRd
538880,181210
Sev. Ratio : 0.167
Peds: 1 Cycles: 1 Children: 0 OAPs: 3
Accidents Fa: 1 Se: 1 Sl: 10 All: 12 p.a. 4
Casualties Fa: 1 Se: 1 Sl: 18 All: 20 p.a. 6.7

Rank: 6
Cluster 7: SW area of CanningTownFlover and A1011
539430,181510
Sev. Ratio : 0.125
Peds: 0 Cycles: 0 Children: 0 OAPs: 1
Accidents Fa: 0 Se: 1 Sl: 7 All: 8 p.a. 2.7
Casualties Fa: 0 Se: 1 Sl: 13 All: 14 p.a. 4.7

Rank: 3
Cluster 3: EIDR j/w Cotton St
538160,181020
Sev. Ratio : 0.091
Peds: 2 Cycles: 0 Children: 0 OAPs: 0
Accidents Fa: 0 Se: 1 Sl: 10 All: 11 p.a. 3.7
Casualties Fa: 0 Se: 1 Sl: 12 All: 13 p.a. 4.3

Rank: 4
Cluster 4: ElDockRd j/w AbbottRd
538930,181270
Sev. Ratio : 0
Peds: 0 Cycles: 0 Children: 2 OAPs: 1
Accidents Fa: 0 Se: 0 Sl: 10 All: 10 p.a. 3.3
Casualties Fa: 0 Se: 0 Sl: 17 All: 17 p.a. 5.7

Rank: 9
Cluster 10: StLeonards/BTNA/EIDR
538260,181040
Sev. Ratio : 0.143
Peds: 0 Cycles: 0 Children: 0 OAPs: 0
Accidents Fa: 0 Se: 1 Sl: 6 All: 7 p.a. 2.3
Casualties Fa: 0 Se: 1 Sl: 10 All: 11 p.a. 3.7

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Figure A-10: North Greenwich and Blackwall Tunnel Southern Approach area collision clusters

Rank: 9
Cluster 9: A102 BTA j/w OrdnanceCres
539050,179520
Sev. Ratio : 0
Peds: 0 Cycles: 0 Children: 0 OAPs: 0
Accidents Fa: 0 Se: 0 SI: 7 All: 7 p.a. 2.3
Casualties Fa: 0 Se: 0 SI: 8 All: 8 p.a. 2.7

Rank: 13
Cluster 17: BTA vicinity of Tunnel Ave by Primrose Wharf
539210,179270
Sev. Ratio : 0.167
Peds: 0 Cycles: 0 Children: 0 OAPs: 0
Accidents Fa: 0 Se: 1 SI: 5 All: 6 p.a. 2
Casualties Fa: 0 Se: 1 SI: 5 All: 6 p.a. 2

Rank: 6
Cluster 6: BTA vicinity TunnelAve
539070,179410
Sev. Ratio : 0
Peds: 0 Cycles: 0 Children: 0 OAPs: 1
Accidents Fa: 0 Se: 0 SI: 8 All: 8 p.a. 2.7
Casualties Fa: 0 Se: 0 SI: 12 All: 12 p.a. 4

Rank: 13
Cluster 13: Bugsbys / Blackwall Ln
539610,179040
Sev. Ratio : 0.333
Peds: 0 Cycles: 0 Children: 1 OAPs: 0
Accidents Fa: 0 Se: 2 SI: 4 All: 6 p.a. 2
Casualties Fa: 0 Se: 2 SI: 5 All: 7 p.a. 2.3

Rank: 13
Cluster 16: BTA area north of BlackwallLn
539460,179000
Sev. Ratio : 0
Peds: 0 Cycles: 0 Children: 0 OAPs: 2
Accidents Fa: 0 Se: 0 SI: 6 All: 6 p.a. 2
Casualties Fa: 0 Se: 0 SI: 9 All: 9 p.a. 3

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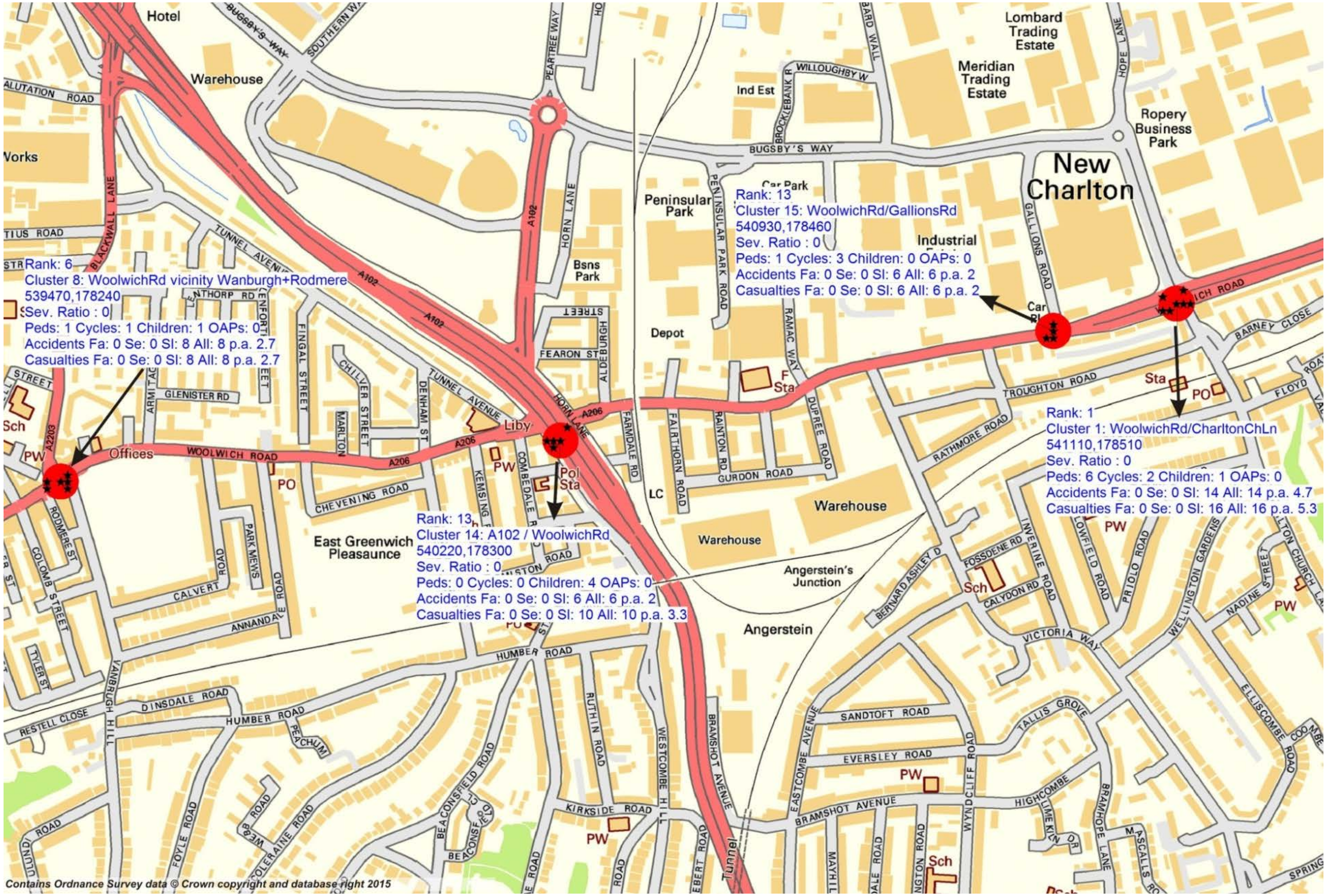
Figure A-11: Shooters Hill area collision cluster

Rank: 5
Cluster 5: ShootersHillRd/ KidbrookePkRd
540500,176970
Sev. Ratio : 0.111
Peds: 1 Cycles: 0 Children: 1 OAPs: 0
Accidents Fa: 0 Se: 1 Sl: 8 All: 9 p.a. 3
Casualties Fa: 0 Se: 1 Sl: 12 All: 13 p.a. 4.3

Figure A-12: Woolwich Road collision clusters



Rank: 6
Cluster 8: WoolwichRd vicinity Wanburgh+Rodmere
539470,178240
Sev. Ratio : 0
Peds: 1 Cycles: 1 Children: 1 OAPs: 0
Accidents Fa: 0 Se: 0 SI: 8 All: 8 p.a. 2.7
Casualties Fa: 0 Se: 0 SI: 8 All: 8 p.a. 2.7

Rank: 13
Cluster 14: A102 / WoolwichRd
540220,178300
Sev. Ratio : 0
Peds: 0 Cycles: 0 Children: 4 OAPs: 0
Accidents Fa: 0 Se: 0 SI: 6 All: 6 p.a. 2
Casualties Fa: 0 Se: 0 SI: 10 All: 10 p.a. 3.3

Rank: 13
Cluster 15: WoolwichRd/GallionsRd
540930,178460
Sev. Ratio : 0
Peds: 1 Cycles: 3 Children: 0 OAPs: 0
Accidents Fa: 0 Se: 0 SI: 6 All: 6 p.a. 2
Casualties Fa: 0 Se: 0 SI: 6 All: 6 p.a. 2

Rank: 1
Cluster 1: WoolwichRd/CharltonChLn
541110,178510
Sev. Ratio : 0
Peds: 6 Cycles: 2 Children: 1 OAPs: 0
Accidents Fa: 0 Se: 0 SI: 14 All: 14 p.a. 4.7
Casualties Fa: 0 Se: 0 SI: 16 All: 16 p.a. 5.3

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A.8.6 A summary of the collisions which occurred within each cluster is provided in the table below.

Table A-6: Summary of collisions by severity at the highest ranking cluster sites

Cluster Rank	Location Description	KSI	Slight	Total Collisions
1	**Woolwich Rd, vicinity of Charlton Church Lane**	**0**	**14**	**14**
2	**East India Dock Rd, vicinity of Leamouth Rd**	**2**	**10**	**12**
3	**East India Dock Rd, vicinity of its junction with Cotton St**	**1**	**10**	**11**
4	**East India Dock Rd close to its junction with Abbot Rd**	**0**	**10**	**10**
5	**Shooters Hill Rd, vicinity of its junction with Kidbrooke Park Rd**	**1**	**8**	**9**
6=	Blackwall Tunnel Approach, vicinity of Tunnel Avenue	0	8	8
6=	South-western section of the Canning Town Flyover junction with the A1011 Silvertown Way	1	7	8
6=	Woolwich Rd, vicinity of the junctions with Vanburgh and Rodmere	0	8	8
9=	A102 Blackwall Tunnel Approach, vicinity of Ordnance Crescent	0	7	7
9=	St Leonards / Blackwall Tunnel Approach/ East India Dock Road	1	6	7
9=	Manor Road/ Barking Road./ East India Dock Road	0	7	7
9=	Newham Way Silvertown Way (SE section)	1	6	7
13=	Bugsbys Way, vicinity of Blackwall Lane	2	4	6
13=	A102 immediately to the south of the junction with Woolwich Rd	0	6	6
13=	Woolwich Rd, vicinity of the junction with Gallions Rd	0	6	6
13=	Blackwall Tunnel Approach: area to the north of Blackwall Lane	0	6	6
13=	Blackwall Tunnel Approach, vicinity of Tunnel Avenue adjacent to Primrose Wharf	1	5	6
TOTAL CLUSTER COLLISIONS		10	128	138
All collisions in study area		41	436	477
Percentage of all collisions which are included in the 17 cluster sites		24.4%	29.4%	28.9%

A.8.7 From the table, almost one third of all the collisions which took place within the Silvertown area occurred at these locations, with three of the highest ranking cluster sites located along the East India Dock Road. A summary of the key collision and casualty data recorded within each cluster during the three year period between 11 January 2012 and 31 December 2014 is summarised overleaf.

Summary of cluster rsults

TRAFFMAP **Run on: 23/07/2015**
AccsMap - Accident Analysis System **ACCIDENT CLUSTERS REPORT**
Accidents between date **01/01/2012** **and** **31/12/2014** (36) months
Selection: **Notes:**

4 accidents within a radius of 25 metres Ranked by Total Accidents Selected using Build Query : ; Refined using Accidents within selected Polygons -Silvertown tunnel study ("silvertown key areas")

Cluster ID	Rank	Location	Node No.	Grid Reference		Severity Ratio	Collisions						Casualties						Collisions involving			
				Easting	Northing		Fa	Se	Sl	Tot.	p.a.	KSI	Fa	Se	Sl	Tot.	p.a.	KSI	Peds	Cycs	Child	OAPs
1	1	WoolwichRd/CharltonChLn	0158	541110	178510	0.00	0	0	14	14	4.67	0	0	0	16	16	5	0	6	2	1	0
2	2	EIndiaDockRd/LeamouthRd	0511	538880	181210	0.17	1	1	10	12	4.00	2	1	1	18	20	7	2	1	1	0	3
3	3	EIDR j/w Cotton St	0078	538160	181020	0.09	0	1	10	11	3.67	1	0	1	12	13	4	1	2	0	0	0
4	4	EIDockRd j/w AbbottRd	0103	538930	181270	0.00	0	0	10	10	3.33	0	0	0	17	17	6	0	0	0	2	1
5	5	ShootersHillRd/ KidbrookePkRd	0091	540500	176970	0.11	0	1	8	9	3.00	1	0	1	12	13	4	1	1	0	1	0
6	6	BTA vicinity TunnelAve		539070	179410	0.00	0	0	8	8	2.67	0	0	0	12	12	4	0	0	0	0	1
7	6	SW area of CanningTownFlover and A1011		539430	181510	0.13	0	1	7	8	2.67	1	0	1	13	14	5	1	0	0	0	1
8	6	WoolwichRd vicinity Wanburgh+Rodmere		539470	178240	0.00	0	0	8	8	2.67	0	0	0	8	8	3	0	1	1	1	0
9	9	A102 BTA j/w OrdnanceCres	0146-	539050	179520	0.00	0	0	7	7	2.33	0	0	0	8	8	3	0	0	0	0	0
10	9	StLeonards/BTNA/EIDR		538260	181040	0.14	0	1	6	7	2.33	1	0	1	10	11	4	1	0	0	0	0
11	9	ManorWay BarkingRd RAB	0029	539420	181590	0.00	0	0	7	7	2.33	0	0	0	8	8	3	0	0	0	1	1
12	9	NewhamWay Silvertsown SE section		539480	181530	0.14	0	1	6	7	2.33	1	0	1	6	7	2	1	1	0	0	0
13	13	Bugsbys / Blackwall Ln	0165-	539610	179040	0.33	0	2	4	6	2.00	2	0	2	5	7	2	2	0	0	1	0
14	13	A102 / WoolwichRd		540220	178300	0.00	0	0	6	6	2.00	0	0	0	10	10	3	0	0	0	4	0
15	13	WoolwichRd/GallionsRd	0236	540930	178460	0.00	0	0	6	6	2.00	0	0	0	6	6	2	0	1	3	0	0
16	13	BTA area north of BlackwallLn		539460	179000	0.00	0	0	6	6	2.00	0	0	0	9	9	3	0	0	0	0	2
17	13	BTA vicinity of Tunnel Ave by Primrose Wharf		539210	179270	0.17	0	1	5	6	2.00	1	0	1	5	6	2	1	0	0	0	0

Further details of collisions at the highest ranking cluster sites

A.8.8 Three or more collisions per year resulting in injury were recorded at five of the cluster sites, and these have been reviewed in more detail below.

A.8.9 Where relevant, the node or link number, as attributed by Transport for London for use in assigning collisions to particular parts of the network, have been included for reference.

Woolwich Road in the vicinity of Charlton Church Lane

In the three years to 31 December 2014, there were 14 collisons (all resulting in slight injury) within this cluster, of which six occurred during the hours of darkness. This site is a large, at-grade signal-controlled junction with multiple lane entries, and therefore the cluster did not include all of the junction. In the three years to 31 December 2014, 15 collisions occurred at this jucntion and were assigned to node 0158.

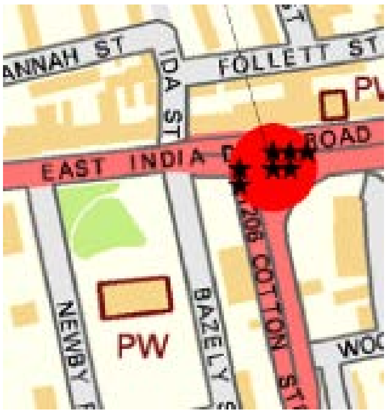
A.8.10 Six of the fourteen cluster collisions involved pedestrians, of which four occurred during the hours of darkness. Three of the collisions were attributed to “wrong use of pedestrian crossing facility”. In all, ten of the 14 collisions involved either a pedestrian, a pedal cyclist (2) or a rider of a powered two wheeler vehicle (2), and so vulnerable road user safety is a major issue at this location. In addition, ten of the collisions involved vehicles approaching the junction from the east/ north east. Three shunt incidents and one incidence of disobeying a red signal were recorded on this approach during the study period.

East India Dock Road in the vicinity of Leamouth Road

In the three years to 31 December 2014, there were 12 collisions within this cluster, of which one resulted in a pedestrian fatality and one resulted in serious injury to a motorcyclist. The remaining ten collisions resulted in slight injury. The cluster was centred in the north eastern section of this large at-grade signal controlled junction. The junction extents were greater than the cluster size, and a total of 16 collisions were assigned to this junction (Node 0511) during the three years to 31 December 2014 which extended beyond the limits of the 50m diameter cluster.

A.8.11 Of the 12 cluster collisions, two were single vehicle collisions involving motorcyclists only although there were no other common factors in these, other than a loss of control. Eight of the 12 collisions resulted in nose to tail shunts: six involving vehicles held up whilst travelling east or south east. Three of these shunt collisions involved three or more vehicles. Seven of the twelve incidents –including the pedestrian fatality- occurred during the daytime off peak period (after 10am and before 4pm), with all but one of these occurring during dry road conditions. The pedestrian was fatally injured whilst crossing through queuing traffic, and the overall indication may be that this junction experiences capacity issues even during off peak times.

East India Dock Road in the vicinity of its junction with Cotton Street



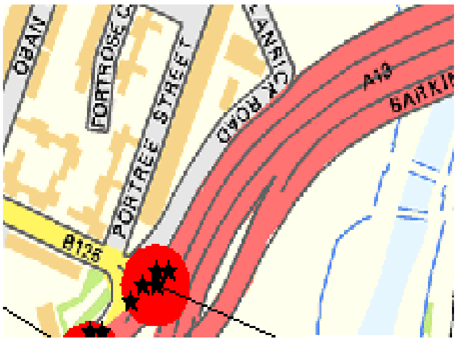
In the three years to 31 December 2014, eleven collisions occurred within the 50m diameter of this cluster. Of these, four involved eastbound vehicles who collided on East India Dock Road having cleared the junction (two were nose to tail shunts and two involved goods vehicles changing lane into the path of cars in adjacent lanes). Overall, four collisions resulted in lane changes within this cluster, which may be indicative of the proximity of junctions, and the lack of time over which drivers can process the guidance information provided.

A.8.13 A short distance to the east of the junction with Cotton Street, vehicles wishing to use the A12 must position themselves in the nearside lane, tunnel traffic must be in Lane 2, and A13 traffic should be in Lanes 3 and 4. A brief review of satellite imagery appeared to show that direction signs provided to the east of Cotton Street were small, and listed multiple destinations, which could make them difficult for motorists to read and therefore increase the potential for last minute lane changes, as evidenced in the collision data.

A.8.14 Five collisions occurred during the hours of darkness (two eastbound lane changes, one eastbound nose to tail shunt, one westbound nose to tail shunt and one pedestrian collision). Both pedestrian injuries resulted from pedestrians being struck by vehicles travelling westbound, but with no other obvious common factors. There were no recorded pedal cyclist injuries in this location.

A.8.15 In this instance, the cluster dimensions were greater than the junction extents, with 9 collisions assigned to Node 0078 during the study period.

East India Dock Rd in the vicinity of its junction with Abbott Road



Five of the ten collisions which were recorded within this cluster involved three or more vehicles, with all but one of these occurring in dry road conditions during daylight hours. All ten collisions resulted in slight injuries. As with the junction above, the cluster in this instance extended beyond the extents of the junction, with only seven collisions assigned to Node 0103 during the period.

A.8.16 The remaining three collisions within the cluster all occurred approximately 23m to the north east of the junction on East India Dock Road: all three resulted in north east to south westbound two or three vehicle nose to tail shunts.

A.8.17 In all, eight of the ten collisions were nose to tail shunts involving vehicles travelling ahead: six on the south westbound carriageway, and two on the north-east bound carriageway of East India Dock Road.

Shooters Hill Road in the vicinity of Kidbrooke Park Road

There were 9 collisions (8 slight, one serious) within the 50m diameter cluster at this three arm, large signal controlled junction. Although two collisions involving motorcyclists took place during the hours of darkness in wet road conditions, the main factor in collisions within this cluster was that five of the nine resulted in nose to tail shunts (two south-westbound, two northbound, and one southbound). In this instance, the cluster collisions, and all of the collisions assigned to Node 0091 were the same.

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APPENDIX B – INDUCED TRAFFIC

B.1 Introduction

B.1.1 Responses to previous Silvertown public consultations have revealed a concern over ‘induced demand’ or ‘induced traffic’ as a result of the introduction of the Silvertown Tunnel scheme (the Scheme).

B.1.2 The purpose of this note is to outline the definition of induced traffic and the different ways in which additional traffic can be ‘generated’. This note also relates this to the possible impacts of the scheme and how these dynamics are reflected in the modelling.

B.2 Induced traffic

B.2.1 The implementation of an improvement to the road network has the potential to generate additional traffic on the improved section if new users respond by, for example, diverting from other routes, changing their origin or destination (trip locations), or switching from other transport modes. This additional traffic is often referred to as ‘induced’ traffic.

B.2.2 A similar generation effect can occur with public transport passenger demand following the introduction of a new rail or bus service. Such an improvement can attract new passengers from other public transport routes, trip locations, as well as from other transport modes – including car.

B.3 Silvertown context

B.3.1 Various highway schemes proposed over the past 30 years have raised concerns regarding their potential to generate induced traffic, due mainly to the resulting environmental impacts. However, the Silvertown Tunnel scheme should be seen in a different context since the highway network improvement is accompanied by (1) a powerful demand management tool in the form of a user charge; (2) a public transport improvement in the form of dedicated bus lanes which will accommodate improved cross-river bus connections in the local area; and (3) the Scheme is being built in a congested urban environment where capacity is constrained on the surrounding network. Furthermore, the user charge will not be confined to the new crossing as the Blackwall Tunnel will also be charged as part of the Scheme package. On this basis, the ‘induced traffic’ effects outlined earlier could operate both ways – it is plausible that the scheme will result in no net additional traffic, possibly even an overall reduction.

B.4 Definition and effects

B.4.1 The precise definition of induced traffic is somewhat uncertain. Some guidance can be found by referring to UK industry-recognised research and good practice. For example, the 1994 SACTRA report on induced traffic outlined a number of possible sources of additional traffic – this formed a basis for the definition of induced traffic outlined in DfT WebTAG[53] guidance. This definition states that 'induced traffic' refers to the *additional traffic, beyond the level of traffic that would use the network without the intervention*. An alternative way to look at this is in the reverse: this is actually suppressed traffic that is released through a scheme improvement.

B.4.2 Induced traffic is often said to arise from a number of sources though, as outlined below, not all of these are necessarily deemed as induced traffic when referring to the WebTAG definition:

- **Route Choice** covers users who ***change route*** in response to the Scheme e.g. by switching to a route via the Silvertown Tunnel instead of the Rotherhithe Tunnel or vice versa. The WebTAG definition suggests the effects of route choice do not lead to induced traffic as the rerouted traffic is not additional to the wider network. The potential for such changes in route choice is reflected in the 'highway assignment' component of the model;

- Some models that cover a small study area could exclude this effect if the scheme attracts traffic from outside of the model's study area. This is not the case with the Silvertown traffic forecasts as the modelled area is sufficiently large to cover all possible trip locations where users could plausibly use the Silvertown or Blackwall Tunnels.

- **Trip redistribution** covers users who ***change their trip origin or destination*** in response to the Scheme. Trip redistribution involves the relocation of an *existing* trip and so does not result in any additional traffic. The potential for trip redistribution is reflected in the Silvertown traffic forecasts and informed by recognised guidance in the form of WebTAG elasticities for demand model responses. The modelling suggests that this effect is not significant due to the estimated impact of charging and provision of an enhanced bus network.

- **Modal shift** covers users who ***switch between modes*** (e.g. public transport) following implementation of the Scheme. Users may switch to car from public transport, and vice versa, due to the combination of the

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[53] https://www.gov.uk/transport-analysis-guidance-webtag

new Tunnel, the user charge, and improved cross river bus connections. The potential for such shifting in behaviour is reflected in the traffic forecasts, in accordance with WebTAG guidance (Unit M2) though this is unlikely to happen to any significant effect as supported by the modelling.

- **Trip generation** concerns whether the Scheme will change ***the overall number of trips*** that a user will make over the whole day, regardless of their mode of transport, location, and route taken. There is some evidence suggesting that this is dependent on the personal characteristics and situation of the individual making the journey rather than on external factors – including transport supply. For example, 'Travel in London 6'[54] suggests that trip rates have been noticeably stable between 1993 and 2012, at around 2.8 trips per person per day (despite various changes in capacity and connectivity of both highway and public transport networks).

- The total number of trips produced by the Silvertown models over a 24-hour period (across modes) is therefore assumed to be fixed for a given level of population and employment. Trip rates are based on LTDS[55] planning data and do not change with the introduction of the Silvertown Tunnel. The transport models assume that people make the same number of trips per day, however those trips can be made by car, public transport, walking or cycling so the number of trips by car per day can and does fall in response to increased congestion.

- **Time of day effects** concern the potential for trips to ***change their time of travel*** following the implementation of the Scheme since the Scheme can have a greater impact on journey times during peak periods than off peak, which could reduce the duration of the peak periods. Any time of day effects would likely concern the profile of demand over time with no overall increase in traffic across the day as a whole. Hence, any time of day effects are not considered to be induced traffic.

- There is limited evidence on this effect and therefore this mechanism is not modelled in the Assessed Case. However, a sensitivity test is planned which will draw on any available evidence to look at the likely impact of time shifting. It is unlikely to lead to large changes in the time of day people make most trips as certain types of trips often have time constraints e.g. start time of work, medical appointments etc.

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[54] https://tfl.gov.uk/corporate/publications-and-reports/travel-in-london-reports

[55] https://tfl.gov.uk/corporate/about-tfl/how-we-work/planning-for-the-future/consultations-and-surveys/london-travel-demand-survey

B.4.3 Conclusion

B.4.4 This Appendix has considered the potential for induced traffic to arise from the introduction of the Silvertown Tunnel scheme, by setting out the definition and discussing each specific effect in turn, and how each effect is reflected in the models. This exercise has been undertaken as concerns regarding induced traffic have been typically raised whenever a major highway scheme has been proposed in the UK, particularly over the past 30 years or so.

B.4.5 The Silvertown Tunnel scheme differs from most conventional highway improvement schemes previously undertaken in the UK since the enhancement to the road network is to be countered by an accompanying user charge on both existing and the new infrastructure as well as complimentary improvements to public transport so any induced traffic effects have the potential to work in both directions. At this stage it is uncertain which of these effects will be the greater, but it is expected that the overall level of change will be modest.

B.4.6 In the meantime, it is important to note that the modelling assumptions, including the model structure, when taken with other evidence and sensitivity testing, appropriately reflect the effects that are most likely to occur when the Silvertown scheme is implemented, where the modelling approach is in accordance industry-wide guidance and good practice.

APPENDIX C – WIDER JUNCTION IMPACTS

C.1 Introduction

C.1.1 Overall, as set out in the body of the Transport Assessment, the principal effect of the Silvertown Tunnel is expected to be a significant improvement in the efficiency of traffic movement on the strategic A102/A2 and A12 corridor within the AM and PM peak hours, with little change in levels of demand during the wider three-hour peak periods. This largely reflects the fact that the Scheme entails embedded mitigation for potential traffic impacts in the form of the user charge, which acts to manage demand stimulated by the newly improved conditions.

C.1.2 Aside from the benefits at the A102, the implementation of the Scheme is expected to have only modest impacts on junction delays in the 2021 modelled year, and none of the increases in 2021 appear to warrant the implementation of specific mitigation measures prior to Scheme opening, particularly as none of the changes are currently anticipated to have a material impact on journey times.

C.1.3 As the road network is going to change and evolve between now and the Scheme opening year, TfL acknowledges that a need for junction mitigations could emerge closer to (or after) the time of Scheme opening. At present although committed changes to the road (and transport) networks have been taken account of in the assessment, the actual changes to the road network that are likely to occur between now and Scheme opening are less certain and TfL is not proposing specific junction mitigation works in the DCO application as this would be premature.

C.1.4 TfL proposes to commit to future monitoring and implementation of mitigation under existing powers where appropriate by assessing the traffic impacts closer to Scheme opening, and monitoring actual impacts thereafter to accurately identify the scale and location of adverse impacts to enable implementation of effective mitigation where required. This approach is explained in more detail below and is referenced in the Preliminary Monitoring and Mitigation Strategy which is presented in Appendix C of the Preliminary Case for the Scheme.

C.2 Considerations in detailed junction mitigation planning

C.2.1 The road network and the pressures on it are going to evolve between the time of application and Scheme implementation. TfL and the boroughs are working on a wide-ranging programme of local network and junction improvements across east and south-east London, some of which could potentially interact with the Silvertown Tunnel's area of influence. Many of the projects and programmes will have relatively short gestation periods as they can be delivered under existing highway and traffic authority powers.

C.2.2 Only planned interventions and developments which are formally committed have been accounted for in the traffic forecasting models for the Silvertown Tunnel Scheme. This is in line with WebTAG (Unit M4) guidance, which states that schemes that are reasonably foreseeable but not committed should be excluded from core scenario model tests.

C.2.3 Typically the schemes under consideration here would be comparatively small and would not have a material impact on the forecasting outcomes at a strategic level; however they may have a more significant impact at a local level on junctions where potential mitigations are being considered. This means that in the context of assessing the need for local road and junction mitigations, the local road network is likely to look materially different in six to eight years' time. Therefore committing to junction specific mitigations is not appropriate at this premature stage and may in fact conflict with the objectives of later projects and programmes.

C.2.4 A further significant factor is the role of the user charging element of the scheme in helping to balance and secure its overarching objectives. As set out in the Preliminary Case for the Scheme and the Preliminary Charging Report, the opening charge would not be confirmed until closer to implementation – recognising the importance of specific circumstances (e.g. around levels and spatial distribution of growth, rates of car ownership). Given that the need for junction mitigations would be highly sensitive to potentially small changes in charging, there would be a risk that mitigations identified at the current time in relation to the Assessed Case charges could in time prove to be redundant (or indeed ineffective).

C.3 Monitoring and mitigation requirements

C.3.1 TfL has a statutory duty under the Traffic Management Act 2004 to ensure the effective management of the road network, and in accordance with this duty will provide the above commitments to monitor and mitigate any potential unforeseen Silvertown Scheme impacts in the DCO application itself. Details of these are set out in the Preliminary Monitoring and Mitigation Strategy and are summarised below.

C.3.3 TfL would start the pre-Scheme monitoring process, refresh the strategic modelling and carry out local junction modelling around two to three years in advance of Scheme opening. TfL would identify the locations for monitoring in liaison with the relevant boroughs in advance of the commencement of the monitoring programme, prior to Scheme opening. This ensures that pre-Scheme data would be collected for comparison purposes and that the boroughs would be able to provide their input on the locations they are concerned about and would like to see included in the monitoring programme.

C.3.4 At that stage there would be much greater certainty on the charging parameters appropriate to balance the objectives of the Scheme, and more clarity on other schemes being implemented which could affect the road network and levels of traffic. Based on this modelling, any additional mitigation that is considered necessary would be designed, consulted on and implemented prior to opening, in close liaison with the relevant borough(s).

C.3.5 Following the opening of the Silvertown Tunnel, detailed traffic data would be collected on an annual basis for a period of five years to identify actual Scheme impacts on the local road network and then develop appropriate mitigation measures in consultation with the relevant borough(s). At the end of the five year period, the monitoring programme would be replaced by TfL’s general network performance monitoring programme and form part of TfL’s overall network management duty under the Traffic Management Act 2004.

C.3.6 This process would be set out in the DCO as a requirement in order to assure the boroughs and other stakeholders of TfL’s commitment to deliver necessary and appropriate mitigation. More definition on the proposed approach to monitoring and mitigation is available in the *Monitoring and Mitigation Strategy*.

C.4 Assessment example

C.4.1 Notwithstanding the proposed approach set out above, TfL has carried out an ‘example’ assessment based on the Assessed Case defined for the consultation and DCO application. This provides evidence that none of the flow changes in 2021 appear to justify the implementation of specific mitigation measures prior to Scheme opening to be designed at this stage in the process. It also provides readers with an understanding of the assessment process methodology and illustrates the potential type and scale of mitigations that may be required if flow patterns change.

C.4.2 The remainder of this note will present this assessment example of the impacts on local road network, focussing on the road network surrounding the tunnel portals.

C.4.3 A list of junctions to be assessed was identified through two different channels:

- junctions shown in the strategic traffic forecasting model (RXHAM) as experiencing greater than ten passenger car unit (PCU) hours delay in future 2021 Assessed Case; and
- junctions highlighted by stakeholders (including local boroughs) through the Silvertown Tunnel public consultation in autumn 2014.

C.4.4 Table C-1 presents an overview of the analysis that has been carried out. It should be read as follows:

- **Location description:** the location of the junction identified
- **Issue source (e.g. RXHAM, public consultation):** RXHAM is TfL's river crossings traffic assignment model which was developed using industry-standard SATURN strategic traffic modelling software to assess the impact of new river crossings on highway network performance in the wider East/South-East London area. The model was based on TfL's existing sub-regional East London Highway Assignment Model (ELHAM), with amendments made to enhance the model in the vicinity of river crossings with detailed input from relevant boroughs
- **Time period identified by RXHAM:** refers to one or more of the three one-hour periods assessed through the model, namely AM peak, Inter peak, PM peak
- **RXHAM summary:** gives a summary of delay statistics obtained from the Assessed Case modelled in RXHAM
- **SCOOT operation:** SCOOT stands for Split Cycle Offset Optimisation Technique, which is a tool used for managing and coordinating traffic signals in London (and other urban areas) to improve network performance. It is an adaptive system that responds automatically to real-time fluctuations in traffic flow through the use of on-street detectors to optimise performance within a set of pre-defined parameters

- **Active Traffic Management (ATM) site:** Active Traffic Management (ATM) points on the strategic network, making use of traffic signals to balance flows across London
- **Mitigation likely to be required:** provides detail on the justification for implementing or not implementing mitigation measures at this stage in the process.

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Table C-1: Junction assessment based on Assessed Case

Location description	Issue source (e.g. RXHAM, public consultation)	Time period identified by RXHAM	RXHAM summary	SCOOT operation	Active Traffic Management (ATM) site	Mitigation likely to be required
North of the River Thames						
A100 Tower Bridge / A1203 E Smithfield / A1210 Mansell St	High-level RXHAM analysis suggests there may be some delay increase	AM Peak	70 seconds delay increase per user in the A100 northbound approach (north of Tower Bridge); no changes in other entry approaches	SCOOT operational at this junction	Yes	Expect to address the delay increase through SCOOT or by 'manual' signal retiming
B112 Marsh Hill - Daubeney Rd (Hackney)	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Additional 60 seconds delay for users emerging from Daubeney Road. Users on Marsh Hill experience no additional delay	SCOOT operational at this junction	No	Mitigation not justified at this stage. Flow from Daubeney Road is low (residential road) and delay increase is modest, expected to be addressed through SCOOT
A1261 Aspen Way / A1261 W India Dock Rd / A1203 Limehouse Link	High-level RXHAM analysis suggests there may be some delay increase	AM Peak	18 seconds delay increase per user in A1261 Aspen Way westbound	SCOOT operational at this junction	Yes	The relatively small delay increase of 18 seconds combined with the fact that this site operates as an ATM site does not justify implementing mitigation measures at this stage
Aspen Way / Upper Bank Street (near Billingsgate Market)	Raised in response to Public Consultation (2014)	None - delay shows little change in AM and falls in PM	No additional delay for any users	SCOOT operational at this junction	No	Lack of additional delay suggests mitigation measures will not be necessary at this stage
Preston's Roundabout	High-level RXHAM analysis suggests there may be some delay increase & junction raised in response to Public Consultation (2014)	AM Peak	40 seconds delay increase per user entering roundabout from A1261 Aspen Way westbound. All other movements entering the junction show no additional delay	SCOOT operational at this junction (Part time signals)	No	Expect to address the delay increase of 40 seconds through SCOOT or by 'manual' signal retiming
A13 E India Dock Rd / A102 Brunswick Rd	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Additional 5 min delay A13 for traffic exiting southbound A12 due to increased demand of approximately 300pcu	SCOOT operational at this junction	No	No physical mitigation justified as signal timings can be reconfigured. The 5 minute delay increase occurs on the arm where green time is 8 seconds, whilst all other movements have 60 seconds of green time whilst operating below 50% capacity
A12 Blackwall Tunnel Northern Approach / Devas Street	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	20 seconds delay increase per user in the A12 northbound approach - merge with traffic coming from Devas Street	SCOOT operational at this junction	No	The relatively small delay increase of 20 seconds combined with the fact that this site operates SCOOT site does not justify implementing mitigation measures at this stage

Location description	Issue source (e.g. RXHAM, public consultation)	Time period identified by RXHAM	RXHAM summary	SCOOT operation	Active Traffic Management (ATM) site	Mitigation likely to be required
Merge of A12 northbound movement and entry slip road coming from Devas St	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	20 seconds delay increase per user in the A12 northbound approach	Not applicable (no signals)	Not applicable (no signals)	The relatively small delay increase of 20 seconds does not justify implementing mitigation measures at this stage
Junction between A12 Eastern Ave and Whalebone Lane	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Northbound users on Whalebone Lane may experience an additional 3 minute delay, this represents a small minority of users of this junction	SCOOT operational at this junction	No	Expect to address the delay increase through SCOOT or by 'manual' signal retiming
Junction between A112 Prince Regent Lane and A124 Barking Road	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Southbound users on Prince Regent Lane may experience an additional 90 second delay, this represents a small minority of users of this junction	SCOOT operational at this junction	No	Delay only impacts one arm of the junction and expect to address the delay increase through SCOOT or by 'manual' signal retiming
Victoria Dock Road / Prince Regent Lane A112	Raised in response to Public Consultation (2014)	None - delay shows little change in AM and PM	No additional delay for any users	SCOOT operational at this junction	No	Lack of additional delay suggests mitigation measures will not be necessary at this stage
Silvertown Way / Tidal Basin Road	Raised in response to Public Consultation (2014)	None - delay shows little change in AM and PM	No additional delay for any users	SCOOT operational at this junction	No	Lack of additional delay suggests mitigation measures will not be necessary at this stage
Dock Road / North Woolwich Road / A1020 Connaught Bridge	Raised in response to Public Consultation (2014)	None - delay shows little change in AM and PM	No additional delay for any users	Not applicable (no signals)	Not applicable (no signals)	Lack of additional delay suggests mitigation measures will not be necessary at this stage
A13 Eastbound diverge at A117 junction	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Additional 60 seconds delay for A13 eastbound traffic approaching the junction	SCOOT operational at this junction	No	Expect to address the delay increase through SCOOT or by 'manual' signal retiming
North Circular Road / Newham Way	High-level RXHAM analysis suggests there may be some delay increase	AM Peak and Inter Peak	85 seconds (AM Peak) and 100 seconds (Inter Peak) delay increase per user in the A406 SB to A13 eastbound left turn lane. All other movements entering the junction show no additional delay	SCOOT operational at this junction	Yes	Due to the combination of SCOOT being operational and the junction functioning as an ATM site, mitigation not justified at this stage. Should mitigation beyond signal timing changes become necessary, this could be achieved by implementing minor changes to the traffic island adjacent to the roundabout

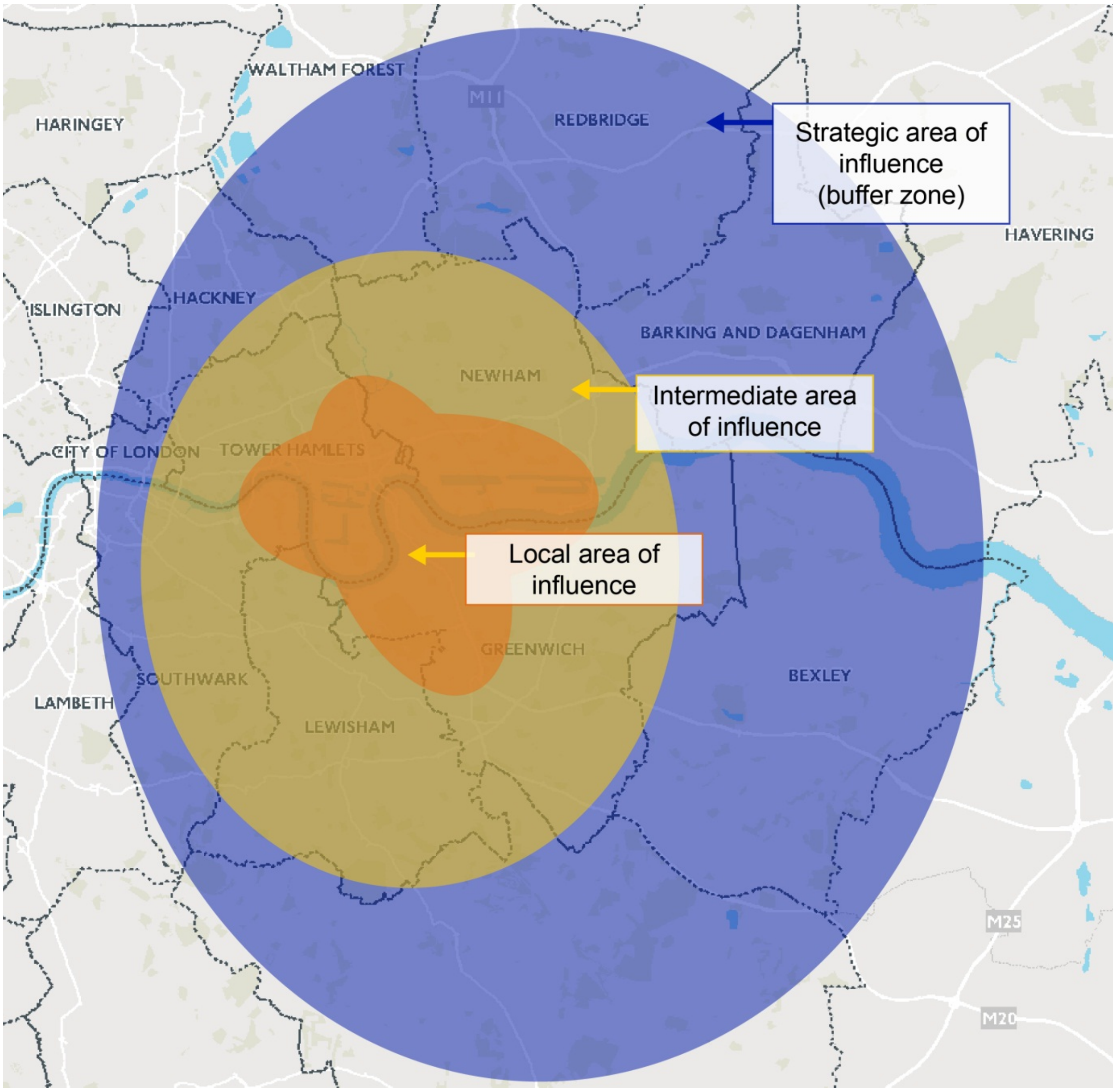
Location description	Issue source (e.g. RXHAM, public consultation)	Time period identified by RXHAM	RXHAM summary	SCOOT operation	Active Traffic Management (ATM) site	Mitigation likely to be required
A13 / Renwick Road	Raised in response to Public Consultation (2014)	None - delay falls in AM and little change in PM	No additional delay for any users	SCOOT operational at this junction	Yes	Lack of additional delay suggests mitigation measures will not be necessary at this stage
A124 Rush Green Road / Dagenham Rd	High-level RXHAM analysis suggests there may be some delay increase	AM Peak	103 seconds delay increase per user in the A124 Rush Green Rd westbound and 32 seconds delay increase per user in Dagenham Rd southbound approach. No additional delay in the other entry approaches	SCOOT operational at this junction	No	Expect to address the delay increase by 'manual' signal retiming as
South of the River Thames						
A100 Tower Bridge Rd / Grange Rd / Bermondsey St	High-level RXHAM analysis suggests there may be some delay increase	AM Peak	100 seconds delay increase per user in the A100 Tower Bridge Rd northbound approach - all other movements show no additional delay	SCOOT operational at this junction	No	Expect to address the delay increase by 'manual' signal retiming as overall the junction operates under capacity
Junction between A2218 Southend Lane and Dunfield Road/Brookehowse Road	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Westbound users may experience an additional 2 minutes of delay, all other junction movements are unaffected	SCOOT operational at this junction	No	Physical mitigation not justified at this stage as delay only affects one arm of the junction. As all other arms operate significantly below capacity, the delay can be resolved by signal retiming
Junction between A21 Bromley Rd and Bellingham Rd/Randlesdown Rd	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Northbound users on A21 may experience an additional 3 minutes of delay, all other junction movements are unaffected	SCOOT operational at this junction	No	Expect to address the delay increase through SCOOT or by 'manual' signal retiming
Greenwich Town Centre	Raised in response to Public Consultation (2014)	None - delay shows little change in AM and PM	No additional delay for any users	SCOOT operational at this junction	No	Lack of additional delay suggests mitigation measures will not be necessary at this stage
Blackwall Lane / Trafalgar Road / Vanbrugh Hill	Raised in response to Public Consultation (2014)	None - delay falls in AM and little change in PM	No additional delay for any users	SCOOT operational at this junction	No	Lack of additional delay suggests mitigation measures will not be necessary at this stage
A102 / A206 Woolwich Road	Raised in response to Public Consultation (2014)	None - delay shows little change in AM and PM	No additional delay for any users	SCOOT operational at this junction	No	Lack of additional delay suggests mitigation measures will not be necessary at this stage

Location description	Issue source (e.g. RXHAM, public consultation)	Time period identified by RXHAM	RXHAM summary	SCOOT operation	Active Traffic Management (ATM) site	Mitigation likely to be required
Sun in the Sands	Raised in response to Public Consultation (2014)	PM Peak	15 seconds delay increase per user at roundabout for traffic exiting the southbound A102	Not applicable (no signals)	Not applicable (no signals)	The relatively small delay increase of 15 seconds, impacting one arm of the junction does not justify implementing mitigation measures at this stage
A206 Plumstead Rd / Burrage Rd	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Additional delay of below 30 seconds for users approaching the junction along the eastbound A206. No additional delay for users approaching from westbound A206 or Burrage Road	No	No	The relatively small delay increase of 30 seconds, impacting one arm of the junction does not justify implementing mitigation measures at this stage
Shooters Hill Road / Academy Road / Well Hall Road	Raised in response to Public Consultation (2014)	None - delay shows little change in AM and PM	No additional delay for any users	SCOOT operational at this junction	No	Lack of additional delay suggests mitigation measures will not be necessary at this stage
Kidbrooke Interchange	High-level RXHAM analysis suggests there may be some delay increase & raised in response to Public Consultation (2014)	PM Peak	20 seconds delay increase per user in the A12 northbound approach - merge with traffic coming from A2213 Kidbrooke Park Road	SCOOT operational at this junction	Yes	The relatively small delay increase of 20 seconds combined with the fact that this site operates as an ATM site does not justify implementing mitigation measures at this stage
A2 - close to Riefield Rd	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Additional 45 seconds of delay per user along eastbound A2	Not applicable (no signals)	Not applicable (no signals)	No mitigation necessary. Delay increase of 45 seconds is modest
Junction between A20 Sidcup Rd and B263 Green Lane / Southwood Road	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Small increases in delay per user on most approaches up to a maximum of 30 seconds	SCOOT operational at this junction	No	The relatively small delay increase of 30 seconds does not justify implementing mitigation measures at this stage and expected to be addressed through SCOOT
Junction between A224 Orpington bypass, and Orpington high street	High-level RXHAM analysis suggests there may be some delay increase	PM Peak	Additional 30-60 second delay for southbound users along A224. No change for other users	Non UTC Signals in operation (require manual on-site signal timing changes)	No	Delay only impacts one arm of the junction and expect to address the delay increase by 'manual' signal retiming

C.5 Monitoring and mitigation

C.5.1 Based on the results presented in Table C-1, measures to mitigate the impacts of the Silvertown Tunnel Scheme cannot reasonably be justified at this preliminary stage. Where mitigations cannot be justified at present, junctions will be monitored (see Preliminary Monitoring and Mitigation Strategy) and mitigations implemented should they become required. Notwithstanding this overall conclusion, for the purposes of illustrating potential types and extents of mitigation the map below shows three areas radiating out from the Scheme that could be subject to a hierarchy of mitigation measures suitable to manage changes in traffic flows and these are described below.

Figure C-1: Areas of influence



C.5.2 The strategic area of influence or buffer zone refers to the furthest extends where changes in flow as a result of the Scheme are comparatively small and would be dealt with by the existing operation of SCOOT.

C.5.3 Should mitigations become necessary within the intermediate area of influence in future, these are likely to involve both SCOOT and 'manual' signal re-timings at junctions to manage changes in flow.

C.5.4 The local area of influence refers to the road network closest to the Scheme. Where future mitigations are required in this area, these are likely to involve SCOOT, manual signal re-timing and small physical changes to junctions such as the introduction of new signals or changes to flares, which are confined to the existing highway boundaries.

C.6 Summary

C.6.1 London's road network and the pressures on it are going to evolve between the time of application and Scheme implementation. This means that in the context of assessing the need for local road and junction mitigations, the local road network is likely to look materially different in six to eight years' time. Therefore committing to junction specific mitigations is not appropriate at this premature stage and may in fact conflict with the objectives of later projects and programmes.

C.6.2 Therefore, instead of committing to mitigation proposals at this stage, TfL proposes to commit to future monitoring and implementation of mitigation under existing powers where appropriate by assessing the traffic impacts closer to Scheme opening, and monitoring actual impacts thereafter to accurately identify the scale and location of adverse impacts to enable implementation of effective mitigation where required. This approach is explained in more detail in the Preliminary Monitoring and Mitigation Strategy which is presented in Appendix C of the Preliminary Case for the Scheme.

C.6.3 A finalised draft of the monitoring and mitigation strategy will be submitted with the DCO application. The implementation of the strategy will be secured by a requirement in the draft DCO which will require the strategy to be submitted to the relevant local authorities for approval prior to the opening of the Silvertown Tunnel and for the measures contained within it to be implemented.

C.6.4 Notwithstanding this proposed approach, TfL has carried out an 'example' assessment based on the Assessed Case defined for the consultation and DCO application. Based on this, the implementation of the Scheme is expected to have only modest impacts on junction delays in the 2021 modelled year, and none of the increases in 2021 appear to warrant the implementation of specific mitigation measures prior to Scheme opening, particularly as none of the changes are currently anticipated to have a material impact on journey times.

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APPENDIX D – RELIABILITY AND RESILIENCE

D.1 Overview

D.1.1 One of the primary objectives of the Silvertown Tunnel scheme is to improve the reliability and resilience of river crossings as an integral part of the highway network in east and southeast London. The improvement the Silvertown Tunnel would make to reliability and resilience represents a key part of the case for the scheme.

D.1.2 In a transport context, the term ‘reliability’ relates to the variability in a user’s journey that they are unable to predict; the more variable or unpredictable the journey time for a particular journey is, the less reliable it is deemed to be. The term ‘resilience’ here describes the ability of transport networks to provide and maintain an acceptable level of service in the face of incidents and planned closures, and a lack of resilience can lead to and exacerbate a lack of reliability.

D.1.3 Reliability affects all users of a transport network but is a particular issue for businesses, not least because a lack of predictability increases operational costs and uncertainty. Recent research on behalf of TfL found that 65% of firms located in and around the study area consider that poor reliability of cross-river acts as a constraint on or disrupts their businesses[56]. The freight community suffers from highly variable journey times; just-in-time deliveries become harder to achieve within their allotted windows, and the impacts on the receiving businesses and households can be economically significant.

D.1.4 Impacts on bus and coach services are also severe. Bus passengers on the route 108, the only bus service to run through the Blackwall Tunnel, are subject to regular delays and when incidents do occur curtailments of the service are sometimes necessary. Coach services are often unable to run to their advertised timings, with operators unable to plan effectively for the variable levels of delay.

D.1.5 Resilience also has a significant impact on all users of the transport network, particularly where incidents result in the diversion of traffic to other, alternative routes.

D.2 Factors affecting reliability and resilience of the current network

D.2.1 In east London it is known that the overall reliability and resilience of the strategic road network is sub-optimal due, in part, to the small number of

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[56] TfL survey of business views on new river crossings, 2013

river crossings and the significant distances between them. The relative scarcity of crossings means that cross-river traffic from across the entire east London sub-region converges at only three crossings, of which Blackwall Tunnel has the highest capacity and is of most strategic importance. This limits resilience and compounds traffic congestion and safety issues when incidents occur due to poor reliability of existing crossings.

D.2.2 The factors which negatively impact on the reliability and resilience of the existing cross-river highway network in east London can be summarised as follows:

- lack of alternative crossings and the distance between them – this primarily affects resilience
- the capacity of existing crossings to meet demand – this affects both resilience and reliability
- the susceptibility of existing crossings to closure – this primarily affects reliability

D.2.3 Each of these factors is considered in further detail below.

Lack of alternative river crossings and the distance between them

D.2.4 In the event of an incident or planned closure at the Blackwall Tunnel or on its approaches there are limited alternative crossings nearby. The closest alternative crossings are Tower Bridge, the Rotherhithe Tunnel and the Woolwich Ferry, all of which have little spare capacity to accommodate diverted traffic. The Dartford Crossing is a substantial distance away and has limited spare capacity during peak hours meaning that any diversion from Blackwall Tunnel has a direct adverse impact on an already very congested section of the motorway network.

D.2.5 The four principal diversion routes from the Blackwall Tunnel to alternative crossings are shown in the figure below, followed by a table showing the approximate length of diversion by road to each alternative crossing.

Figure D-1: Principal diversion routes from Blackwall Tunnel

	Tower Bridge	Rotherhithe Tunnel	Woolwich Ferry	Dartford Crossing
Northbound	6km	3.5km	7km	26km
Southbound	10km	8km	6km	25km

D.2.6 The diversion routes themselves, and in particular the shorter routes to Tower Bridge, the Rotherhithe Tunnel and the Woolwich Ferry, are not well suited to accommodating substantial additional volumes of traffic. This means that existing road users are therefore impacted by congestion and slower journeys at times when vehicles divert from the Blackwall Tunnel, including local traffic and buses. In the majority of cases where an unplanned tunnel closure is required as a result of an incident, it is not possible or practical to implement signed diversion routes to other crossings. In these cases tunnel users simply have to wait until the tunnel is reopened, during which time queuing traffic on the approach to the tunnel often builds up considerably, or re-route to an alternative crossing using local knowledge/satellite navigation.

D.2.7 Where a closure of the tunnel is planned, diversion routes are clearly signed in advance to assist those wishing to travel to alternative river crossings. In some instances, HGV traffic is directed to use an alternative diversion route in order to spread the impact and to discourage HGVs from attempting to use unsuitable routes (for example Rotherhithe Tunnel, which has a width restriction of 2.0m).

Diversion routes during planned closures

When planned closures of the tunnel are implemented, advance warning is provided to motorists and signed diversion routes to adjacent crossings are put in place. The closures are scheduled to take place overnight and at weekends where possible, in order to minimise impacts on the highway network and delay to users. The last major refurbishment requiring a planned closure of the tunnel was completed on the northbound bore in 2011, when six weekend closures were implemented.

A number of diversion routes are usually put in place; smaller vehicles are typically directed to use the Rotherhithe Tunnel or Tower Bridge, and HGVs are directed to use Dartford Crossing. Based on average diversion length and an assumed speed of 30 mph, it is estimated that the user delay incurred when the Blackwall Tunnel is closed accounts to approximately £810,000 per 24 hour period for northbound bore closures and £680,000 per 24 hour period for southbound bore closures[57]. This does not take into account delay that may be caused to non-tunnel users who may experience disruption as a result of the diversion.

The capacity of existing crossings to meet demand

D.2.8 The relative scarcity of road crossings in east London has a number of consequences for network performance and is a key factor in all of the existing crossings operating at, or close to, their practical capacity at peak times. The table below shows the approximate capacity and morning peak demand at the Blackwall Tunnel and its adjacent river crossings. The actual capacity varies both within and between days due to fluctuations in vehicle flow volumes, speeds and vehicle mix, so this is a guideline only.

Table D-1: Demand v capacity at east London river crossings

Crossing	Capacity (PCUs/hr)	Existing Flow in PCUs (0800-0900)	% capacity used (0800-0900)
Rotherhithe Tunnel NB	1,210	877	73%
Rotherhithe Tunnel SB	1,210	885	73%
Blackwall Tunnel NB	3,236	3,190	99%
Blackwall Tunnel SB	3,842	2,934	76%
Woolwich Ferry NB	164	161	98%
Woolwich Ferry SB	164	158	96%

D.2.9 Whilst the table shows that the Blackwall Tunnel has the greatest capacity of the two adjacent crossings, it also shows that the tunnel's maximum capacity in the northbound (peak) direction in the AM peak hour has been reached. A similar situation is found in the southbound tunnel in the PM peak hour, when demand is highest in this direction. The Woolwich Ferry is at capacity

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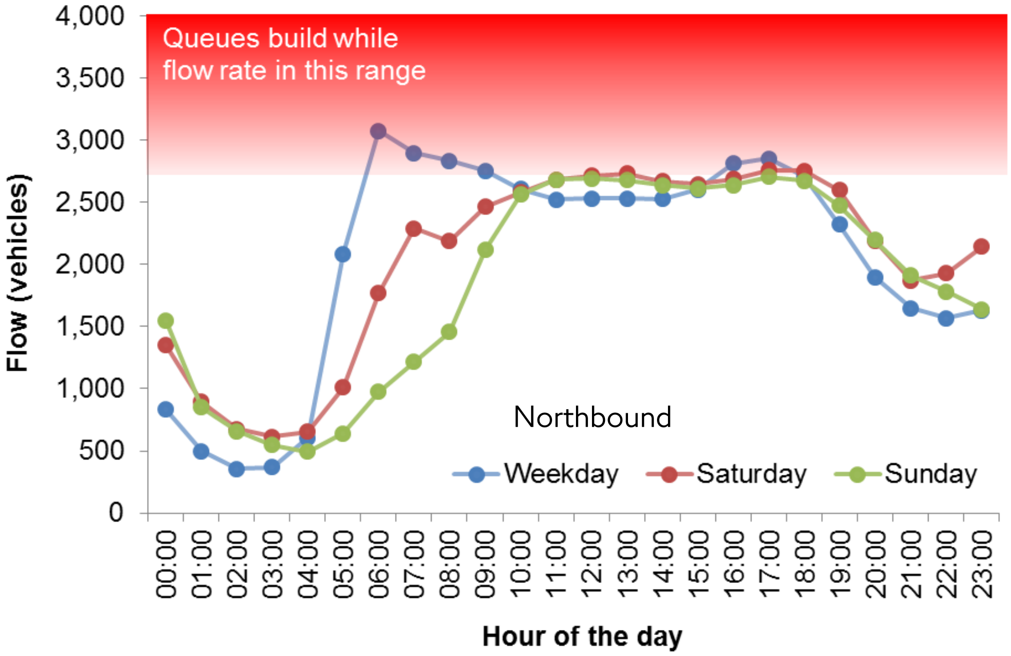
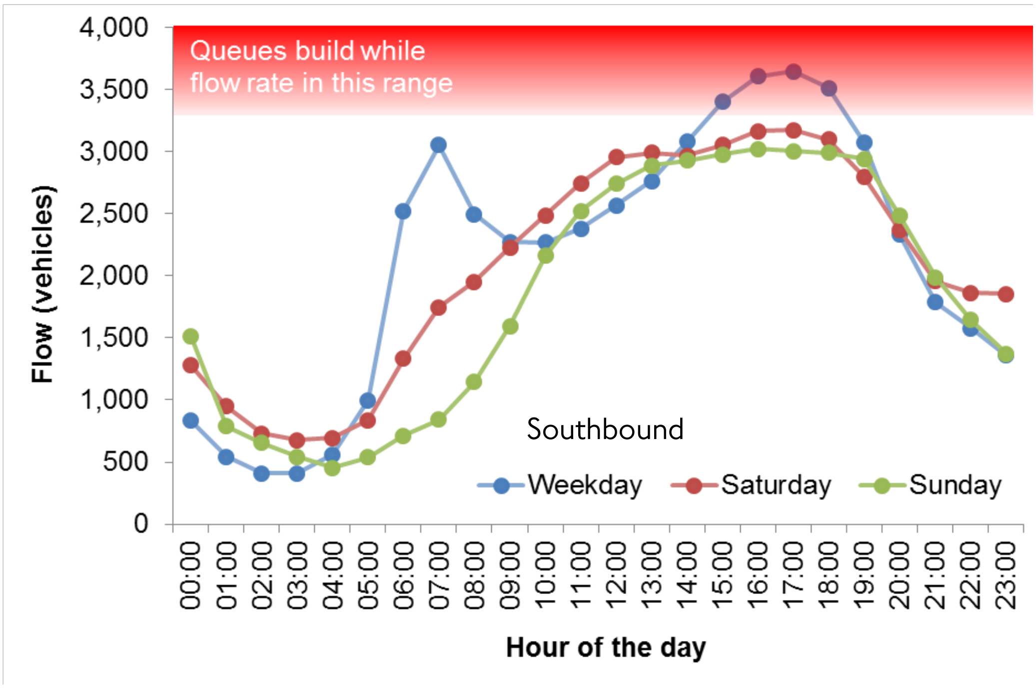
[57] Figures based on TfL tunnel criticality estimates of additional cost incurred by users when diverting to alternative crossings

throughout the morning peak, and in practice delays are a regular occurrence on the approaches to all three crossings at peak times.

D.2.10 The high level of demand relative to capacity at these crossings means that users are often faced with congestion which adds to journey time and generates additional unreliability. It also means that relatively minor incidents which temporarily reduce capacity can have significant impacts. This is a particular issue at the Blackwall Tunnel which is heavily used at most times of the day and week. The following graphs show the average hourly flows at the Blackwall Tunnel for a typical week, based on two years of data (December 2011 to November 2013).

Figure D-2: Demand profile at Blackwall Tunnel





D.2.11 The graphs show that vehicle flows through the Blackwall Tunnel are close to capacity for most of the day in the case of the northbound bore, and for much of the afternoon in the case of the southbound bore. The constraints encountered in the northbound bore result in a situation where queues build and vehicle flow through the tunnel actually falls in the period leading up to the morning peak as a result of the congested conditions. The southbound bore does not face the same operational difficulties and the evening peak throughput is significantly higher reaching around 3,600 vehicles.

Case study: An example of day-to-day variability at the Blackwall Tunnel

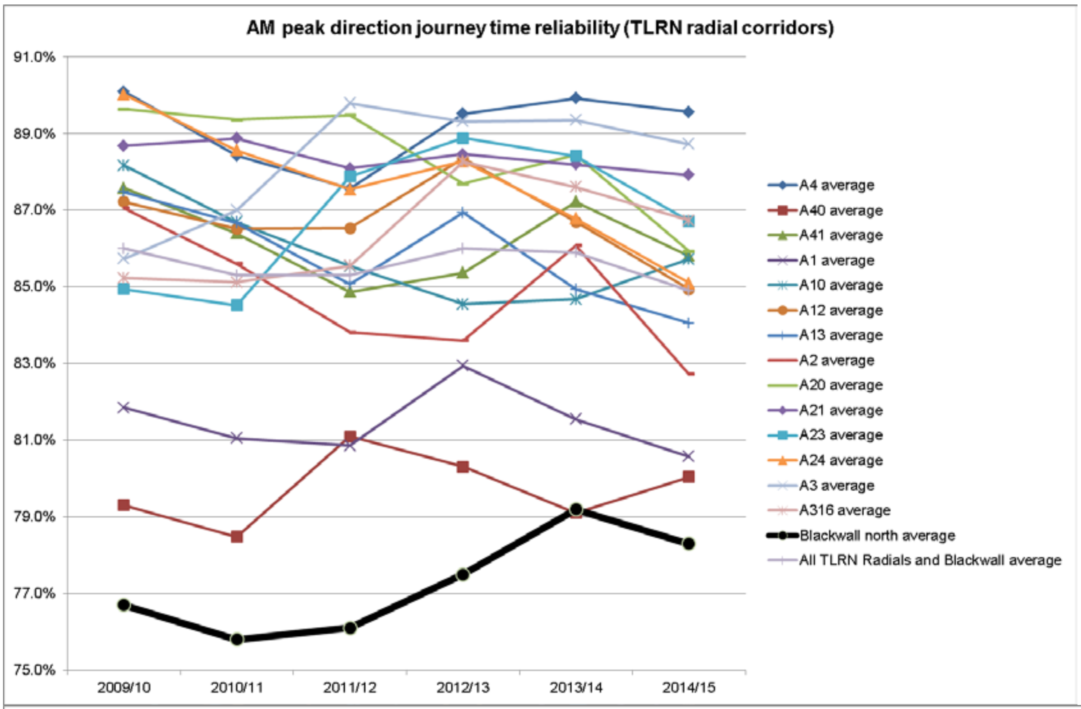
High levels of peak congestion at the Blackwall Tunnel results in considerable variability in journey times, therefore making journey times unpredictable even on ‘normal’ days when there are no recorded incidents. This is illustrated by the recorded journey times for AM peak trips between the A2 and A11 for three consecutive Wednesdays in January 2013:

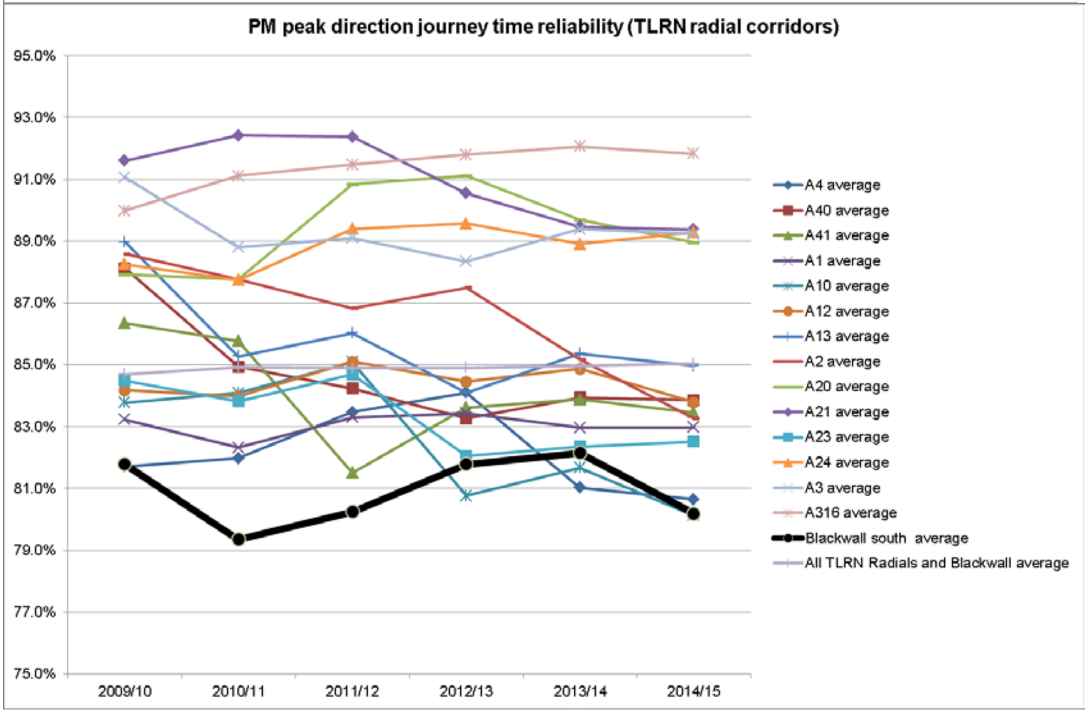
Day 1 – 16 January 2013 – journey time of 51 minutes

Day 2 – 23 January 2013 – journey time of 18 minutes

Day 3 – 30 January 2013 – journey time of 28 minutes

D.2.12 Poor journey time reliability is a particular problem at the Blackwall Tunnel. The graphs below show that journey time reliability – that is the percentage of nominal 30 minute journeys completed within five minutes of that time (i.e. 35 minutes) – is lower at the Blackwall Tunnel than any other radial corridor on the TLRN.





D.2.13 The consequence of this relative lack of spare capacity over long periods of the day mean that when incidents do occur (as discussed in the following section), the resultant reduction in capacity can have a major impact on the local network.

Figure D-3: Congestion on the approach to the northbound tunnel – AM peak 04/06/15

Susceptibility to incidents and closure

D.2.14 Incidents which cause obstruction and delay at the Blackwall Tunnel are a common occurrence, and are a result of a number of factors. In many cases these incidents necessitate the activation of an unplanned closure of the tunnel so that the incident can be dealt with safely and effectively.

D.2.15 In 2013 the most common frequency of all incidents recorded at Blackwall Tunnel affecting the northbound and southbound Tunnel bores are shown in the table below:

Table D-2: Incidents at the Blackwall Tunnel in 2013

Type of incident	Number			% of total
	N/b	S/b	Total	
Congestion[58]	396	274	670	31%
Over height vehicle	652	4	656	30%
Broken down vehicle	237	189	426	20%
Road traffic incident	67	46	113	5%
Other (pedestrians, debris, etc.)	140	166	306	14%
Total	**1492**	**679**	**2171**	**100%**

D.2.16 As can be seen from the table, incidents associated with over height vehicles attempting to use the northbound bore of the tunnel are frequent and represent close to one half of all incidents occurring in the northbound tunnel bore.

D.2.17 Further to the actual number of incidents, the duration of an incident is also critical to reliability. The figure below summarises the average duration of each main category of northbound incident, excluding congestion incidents. The graph indicates that over-height vehicle incidents were logged as occurring for 13 minutes on average. Broken down vehicle incidents had an average duration of 32, RTIs 17 minutes and other incidents 43 minutes.

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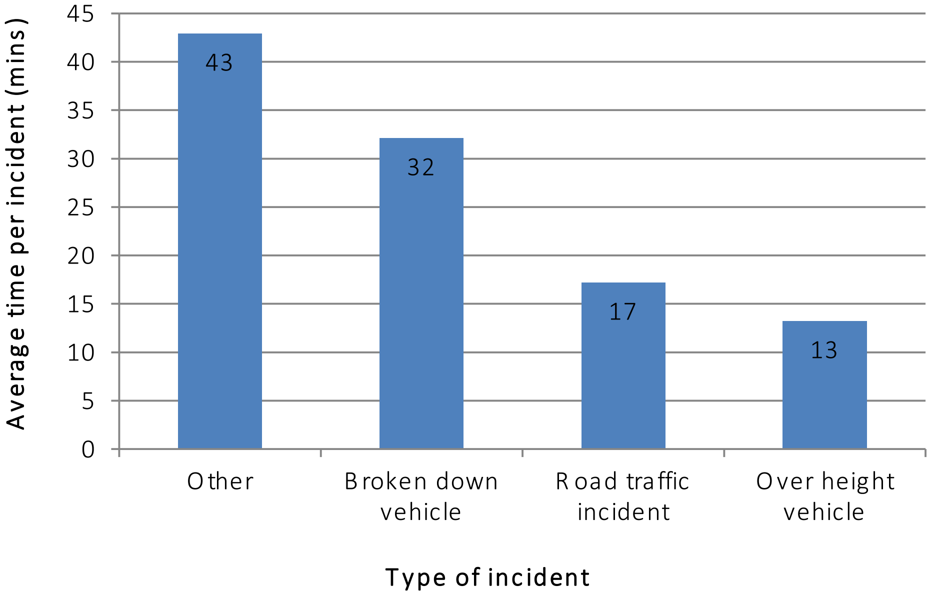
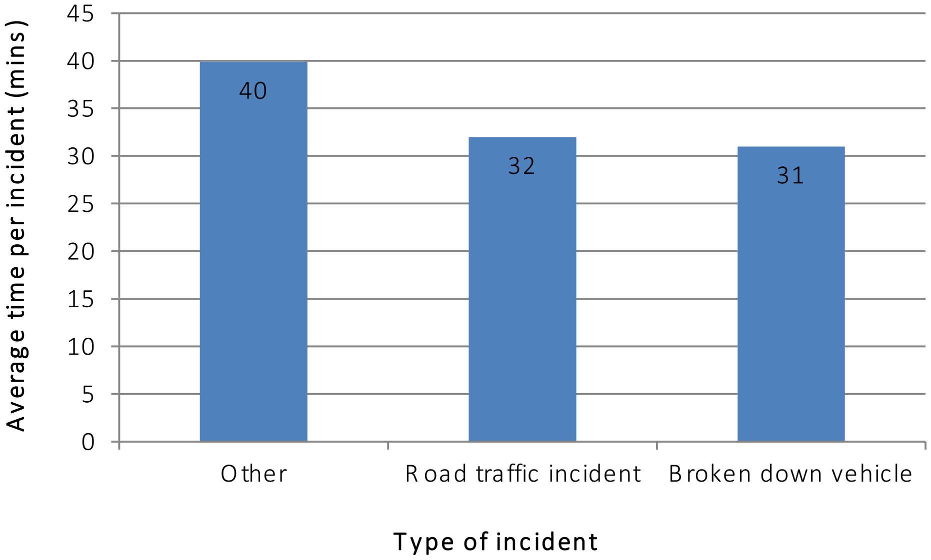
[58] Congestion incidents are recorded when levels of congestion on the approach to the tunnel are particularly high; they do not include congestion which is caused as a result of other incidents on the Blackwall Tunnel corridor, but may be related to other incidents elsewhere on the network.

Figure D-4: Northbound incidents by average duration in 2013



D.2.18 The figure below summarises the average duration of each main category of southbound incident, excluding congestion incidents. The graph indicates that RTI incidents had an average duration of 32, broken down vehicles 31 minutes and other incidents 40 minutes.

Figure D-5: Southbound incidents by average duration in 2013



D.2.19 In both north and southbound tunnels, congestion incidents were recorded over a significant period with an average incident durations of 226 and 205 minutes northbound and southbound, respectively.

D.2.20 Not all of the incidents described above result in a closure of the Blackwall Tunnel. For example, over-height incidents may be logged as such even if the vehicle in question is diverted on to Tunnel Avenue at the last exit before the actual northbound portal. The main problem with incidents is those which require a tunnel closure to deal with them. Given the high levels of congestion and lack of alternative routes noted above, such closures have a significant impact. Of the 2,171 incidents recorded at the Blackwall Tunnel in 2013, around 1,234 resulted in an unplanned closure of the tunnel. This equates to 57% of all reported incidents.

D.2.21 The number of incidents which resulted in a closure at Blackwall Tunnel in 2013 are shown in the table below:

Table D-3: Blackwall Tunnel closures in 2013

Type of incident resulting in closure	Number		% of total	
	N/b	S/b	N/b	S/b
Over height vehicle	618	0	50%	0%
Broken down vehicle	225	143	18%	12%
Road traffic collision	30	21	2%	2%
Other (pedestrians, debris, fire/flood, spillage)	85	112	7%	9%
Total	**958**	**276**	**100%**	

D.2.22 Over height vehicle incidents account for about half of all unplanned closures, which are implemented where it is necessary to extract an over height vehicle from the A102 Blackwall Tunnel Approach, which may require the vehicle to reverse, or in the worst case to deal with a vehicle striking an overhead structure. Broken down vehicles either within the tunnel or on its approach accounted for around a quarter of closures, with the closures often implemented to facilitate timely recovery of the broken down vehicle by the on-call recovery service. Road traffic collisions and other incidents accounted for the remaining closures.

D.2.23 Despite the 4.0m height restriction of the northbound bore being clearly signed on the approach to the Blackwall Tunnel, significant numbers of over height vehicles each year attempt to use this route. This is a relatively unique situation for so important a road link, and is not an issue on most other sections of the strategic road network. Likely explanations include drivers of over height vehicles being unfamiliar with the restriction or failing to acknowledge the signage, being unaware of the height of their vehicle (which may be different on different days) or simply taking a ‘chance’ given the long diversion to other suitable crossings. In all instances driver error is the sole cause. Other types of incident resulting in unplanned closures are experienced elsewhere on the strategic road network, and are not unique to the Blackwall Tunnel, albeit they do not generally have the same level of impact.

Case study: An example of an over height vehicle incident at the Blackwall Tunnel

On Wednesday 27 November 2013 there were three recorded over height vehicle incidents at the Blackwall Tunnel, all of which occurred within a 40 minute period between 09:56 and 10:36. The following day, on Thursday 28 November, there were a total of five over height vehicle incidents recorded within a 13 hour period. All of the incidents required a closure of the northbound bore to enable the vehicle to be safely diverted, ranging from between 1 and 5 minutes in length.

Figure D-6: Vehicles passing through the over height vehicle detection system

D.2.24 The table below indicates the current restrictions on large vehicles in place at road crossings in London east of Tower Bridge, highlighting that in addition to the Blackwall Tunnel, height and width restrictions are also in place at the Rotherhithe Tunnel and the Woolwich Ferry.

Table D-4: Usage restrictions for commercial vehicles on crossings east of Tower Bridge

River crossing	Max height	Max width	Max length	Load restriction[59]
Rotherhithe	4.4m	1.98m	10.0 m	Cat E
Blackwall NB	4.0m[60]	2.00m	n/a	Cat E
Blackwall SB	4.72m	2.00m	n/a	Cat E
Woolwich Ferry	4.7m	3.50m	n/a	IMDG[61]

D.2.25 The London Lorry Control Scheme represents a further constraint for some road traffic in restricting HGVs to a network of main roads for the majority of their trip during the night time to limit noise impacts. During scheme operating hours, the Blackwall Tunnel is the only permitted river crossing route between Richmond and the Dartford Crossing (a crow-fly distance of 22km).

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[59] Load restriction categories denote the type and quantities of dangerous goods that are allowed to enter the UK's larger road tunnels. Each regulated tunnel is assigned a particular category, A to E, with A being the least restrictive and E being the most restrictive. New restrictions were put in place in January 2010. For more information: http://www.roadsafeeurope.com/useful_info/Tunnel_Restrictions

[60] Left lane only, the right lane has a height restriction of 2.8m

[61] Any vehicle or trailer transporting any dangerous or harmful substances listed in the Dangerous Goods List within the International Maritime Dangerous Goods Code (IMDG) is prohibited from travelling on the Woolwich Ferry. For more information: http://www.imo.org/en/Publications/IMDGCode/Pages/Default.aspx

Incidents at other tunnel crossings

In order to compare the rate of unplanned closures which occur at the Blackwall Tunnel, reference has been made to data collected for a number of other strategic highway tunnels located within London and the UK during 2014/15 (herein referred to as the 'reference tunnels'). Data regarding the length and traffic flows of each tunnel, as well as the recorded number of unplanned closures and type, has been obtained[62]. The below table shows that, in absolute terms, the Blackwall Tunnel has a significantly higher number of unplanned closures when compared to the five reference tunnels – some nine times greater than the next highest.

Blackwall Tunnel & comparison tunnels

Tunnel name		Approx tunnel length (m)	Approx annual traffic (two-way)	Kms travelled per year (km/year)	Total unplanned closures (2014-15)
Blackwall Tunnel		1,350 - N/B 1,174 - S/B	36,500,000 vehicles	46.1 million	1,165
Limehouse Link Tunnel		1,553	23,725,000 vehicles	36.8 million	8
Mersey Tunnels	Kingsway Tunnel	2,414	15,000,000 vehicles	36.2 million	4
	Queensway Tunnel	3,235	10,000,000 vehicles	32.4 million	4
Rotherhithe Tunnel		1,483	12,045,000 vehicles	17.9 million	83
Tyne Tunnels		1,650 - N/B 1,500 - S/B	12,000,000 vehicles	19.1 million	125

Whilst in absolute terms the Blackwall Tunnel has a significantly higher number of incidents than the reference tunnels, there are other contributing factors that should be taken into account in comparing the rate of unplanned closures. In order to 'normalise' these factors, the total number of kilometres travelled per year[63] (*tunnel length* x *annual traffic*) has been calculated for each tunnel.

When the number of unplanned closures is considered on this basis, a more equalised comparison of actual closure rates can be undertaken. The figure below shows the number of unplanned closures per million kilometres travelled for each tunnel. It shows that unplanned closures in the Blackwall Tunnel occur at a rate nearly four times that of any of the other five reference tunnels, with some 25.3 unplanned closures occurring for every million kilometres travelled.

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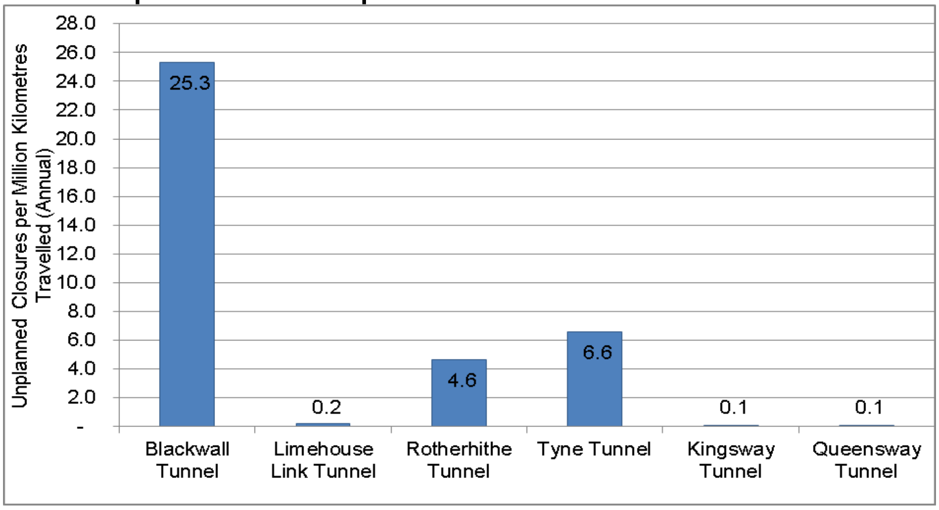
[62] Note that data on unplanned closures is collected and recorded by tunnel operators in different ways, there being no standard system in place for recording this data

[63] Based on distance travelled through the tunnels, excluding approach roads. For tunnels with two separate bores, the average length of the two bores has been used.

Rate of unplanned closures per million kilometres travelled

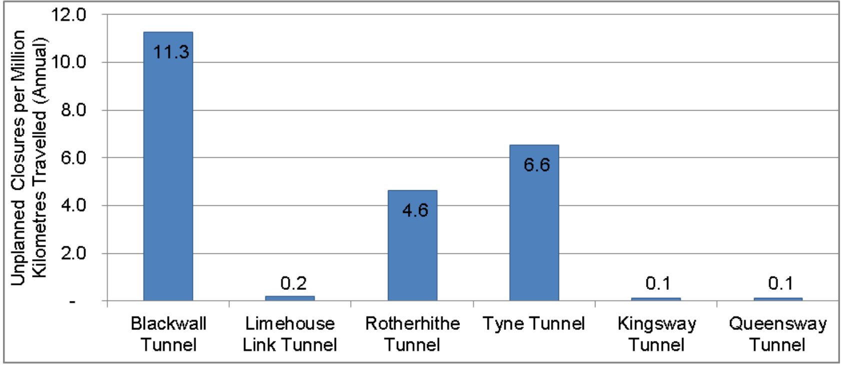


As noted above, over-height vehicle incidents account for the highest proportion of unplanned closures at the Blackwall Tunnel (resulting in 411 closures in 2014/15). This is a direct result of the height restriction on the northbound bore which does not exist at other tunnels. No such incidents were recorded at any of the other five reference tunnels.

Furthermore, a designated vehicle recovery service is based in an area between the north bore exit and the south bore entrance in order that broken-down vehicles can be recovered promptly, and this service can also attend incidents at other nearby tunnels (including Rotherhithe, Limehouse Link and East India Dock). When recovery vehicles are dispatched from this area one or other of the Blackwall Tunnel bores are closed for a short time to allow recovery vehicles to egress safely.

To reflect the fact that over-height vehicles and the despatching of recovery vehicles are specific to the Blackwall Tunnel, and to remove any skewing of data due to these types of incident, the figure below shows the rate of unplanned closures per million kilometres excluding incidents caused by over-height vehicles and recovery vehicles being dispatched to incidents elsewhere. The graph shows that even when such incidents are removed from the comparison, the rate of unplanned closures occurring at Blackwall Tunnel is still significantly higher than that of the five reference tunnels.

Rate of unplanned closures per million kilometres travelled (excluding over-height incidents and recovery in other areas)

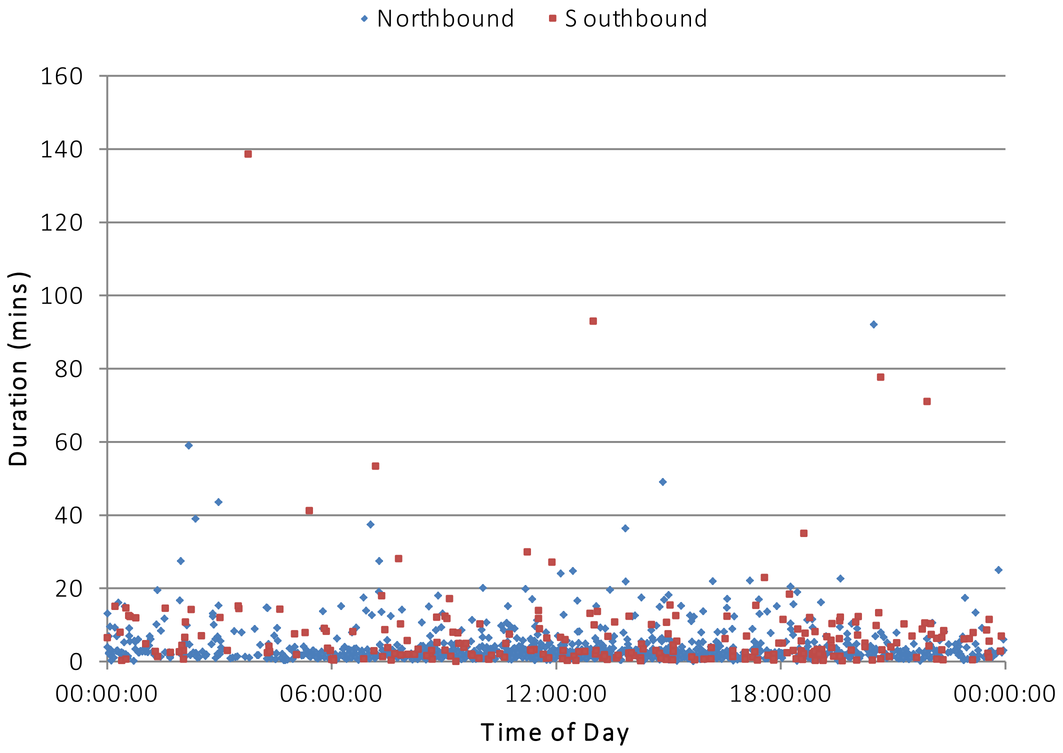


On the basis of the above, it is evident that the Blackwall Tunnel is subject to a disproportionate number of closures when compared to other strategic highway tunnels. This is the case even when the most common reason for closure at the Blackwall Tunnel (over-height vehicles) is removed from the equation, as well as closures of the Blackwall Tunnel that are associated with despatching recovery vehicles to other locations.

The principal reason for this is that the northbound bore of the Blackwall Tunnel, for which the majority of closures are implemented, is also the oldest (opening in 1897). As well as the Rotherhithe Tunnel, which is also subject to comparatively high number of closures, this tunnel was designed for horse-drawn traffic and has a much more constrained geometry than more recent tunnels. The constrained geometry means that most incidents within the tunnel require a closure so that the incident can be dealt with safely, unlike for other tunnels like the Limehouse Link which is of a much larger geometry and includes refuge space in which incidents can often be dealt with without the need to implement a closure.

D.2.26 Incidents requiring a closure of the Blackwall Tunnel are dealt with as promptly as possible and the tunnel is reopened as soon as it is safe to do so. The graph below shows the duration of all closures recorded in 2013, by time of day and direction.

Figure D-7: Blackwall Tunnel 2013 closures by duration



D.2.27 The data indicates that the average duration of a northbound tunnel closure in 2013 was 4.1 minutes, whilst for the southbound tunnel the figure was 7.4 minutes. The total amount of time the northbound tunnel was closed amounted to 67.8 hours across the year, whilst for the southbound tunnel the figure was 30.3 hours. A breakdown by the time period when each closure started is summarised in the tables below.

Table D-5: Blackwall Tunnel 2013 northbound closures by time period

Start time	% of closures	Average closure length (mins)	Total closure time (hours)
0000-0700 (early morning)	21%	4.8	16.5
0700-1000 (AM peak period)	14%	3.7	8.3
1000-1600 (inter-peak)	37%	3.9	23.9
1600-1900 (PM peak)	12%	4.4	8.5
1900-2400 (Evening)	16%	3.9	10.5
Total/average	**100%**	**4.1**	**67.8**

Table D-6: Blackwall Tunnel 2013 southbound closures by time period

Start time	Total closures	Average closure length (mins)	Total closure time (hours)
0000-0700 (early morning)	18%	10.4	7.6
0700-1000 (AM peak period)	14%	7.2	4.3
1000-1600 (inter-peak)	28%	6.1	7.1
1600-1900 (PM peak)	16%	5.6	3.8
1900-2400 (Evening)	23%	7.7	7.4
Total/average	**100%**	**7.4**	**30.3**

D.2.28 TfL has significantly improved its management of the tunnels over the last few years (see below) and as a result, the graph indicates that the majority of closures last for less than 15 minutes. Most closures relating to over height vehicle incidents are for a short period. In the northbound direction, 95 per cent of over height vehicle incidents resulted in a closure. The average duration of these closures was 2.3 minutes. No over height incidents in the southbound direction resulted in a closure.

D.2.29 The previous graph also shows a slightly higher instance of incidents in the northbound direction in the AM and the southbound direction in the PM, which corresponds with peak traffic flows. Clearly the impact that each closure has varies according to the length of closure, time of day and day of the week, but the fact that the tunnel operates at or close to capacity for most of the day means that most closures have a noticeable effect on many users’ journey times, congestion and the local highway network.

D.2.30 A total of 64 incidents required a closure in excess of 15 minutes, and in a few cases the closure was significantly in excess of 15 minutes. The longer the closure, the greater the impact tends to be on the wider highway network as potential users seek to divert to alternative river crossings. Generally speaking ‘other’ incidents accounted for the longest closures, with the longest closure of 139 minutes resulting from a road traffic collision.

Changing patterns of incidents at Blackwall Tunnel

Analysis of incident data recorded at the Blackwall Tunnel indicates there has been a general reduction of over 30% in the total number of incidents since 2010, particularly those incidents involving over height vehicles and breakdowns. Both of these reductions can be directly attributed to initiatives that have been implemented in recent years to reduce as far as possible the incidents which disrupt the smooth operation of the tunnel and their impacts, including:

- Introduction of a dedicated police response team, based at Blackwall, to respond to and clear incidents as quickly as possible;
- Installation of a new automated overweight vehicle detection system;
- Introduction of a dedicated vehicle recovery service to enable a timely removal of all types of broken-down vehicle;
- A publicised initiative to fine users who breakdown in the tunnel due to a lack of fuel; and
- Refurbishment of the northbound bore to reduce the number of instances it is necessary to close the tunnel for emergency or routine maintenance.

These initiatives represent all of the most viable options for minimising incidents at the Blackwall Tunnel, and further opportunities for reducing incidents are considered to be very limited.

Over the same period the number of ‘congestion’ incidents has however increased, from less than 1 per day in January 2010 to over 2 per day in April 2015. This is in conjunction with an increasing duration of congestion incidents, from 3 hours in 200 to just over 4 hours in April 2015. This appears to be associated with increased demand to use the tunnel throughout the day, with demand for the tunnel now at an all time high.

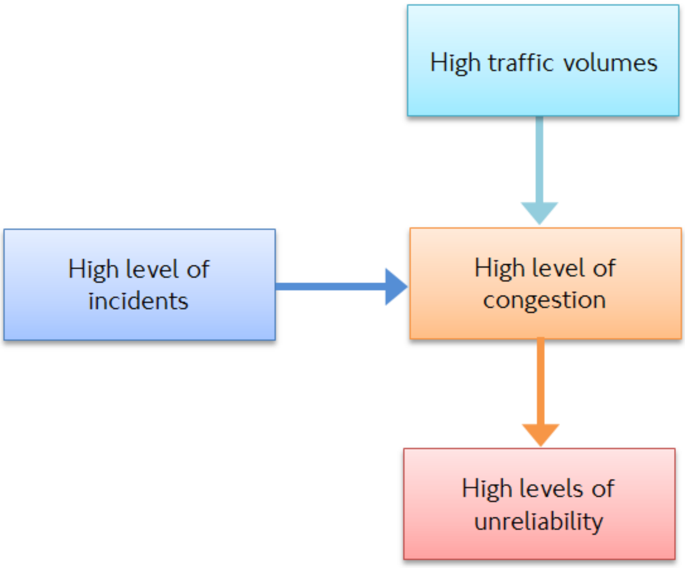
D.2.31 The strategic nature of the Blackwall Tunnel and the sub-standard nature of the northbound bore mean it has a high proportion of incidents relative to many other river crossings. Fewer incidents are recorded at the adjacent river crossings, albeit both the Rotherhithe Tunnel and Woolwich Ferry crossings have particular issues and are more susceptible to closure than most other crossings in London. In the case of the Rotherhithe Tunnel, usage restrictions prevent use of the tunnel by HGVs but the restricted geometry is typically a factor in a number of incidents recorded each year. In the case of the Woolwich Ferry, the service is subject to periodic delays or suspension during periods of extreme weather or high tides, or other issues inherent with a maritime operation.

D.3 The link between congestion, incidents and reliability

D.3.1 Current issues with the reliability of the Blackwall Tunnel are, to a significant degree, linked to congestion and incidents. As described above, it is known that congestion is a particular issue at the Blackwall Tunnel and that congestion is getting worse. It is also known that the tunnel is susceptible to a disproportionate number of incidents and closures.

D.3.2 Essentially, high levels of peak congestion cause a large variation in day-to-day journey times and therefore impact negatively on reliability[64]. The nature of the approach roads to the Blackwall Tunnel and the high level of demand mean that small changes in the volume of vehicles trying to use the tunnel can have a big impact on journey times, exacerbated by the fact that there are few alternatives routes for crossing the river. The approach roads effectively have characteristics of both urban and inter-urban roads; urban in the sense that there is significant traffic interaction as vehicles negotiate traffic signals and merges, and inter-urban in the sense that they carry high volumes of traffic and alternative routeing to other crossings is impractical. When incidents occur these often result in a reduction in capacity which can lead to further congestion, particularly at peak times, thereby further impacting on reliability.

D.3.3 The basic link between high traffic volumes, incidents and reliability is illustrated in the figure below:



D.3.4 Put simply, both high traffic volumes and incidents result in a reduction in network capacity, which in turn leads in increased journey times and greater journey time variability. The effects that congestion and incidents have on journey times are summarised in the graphs below. The graphs show typical

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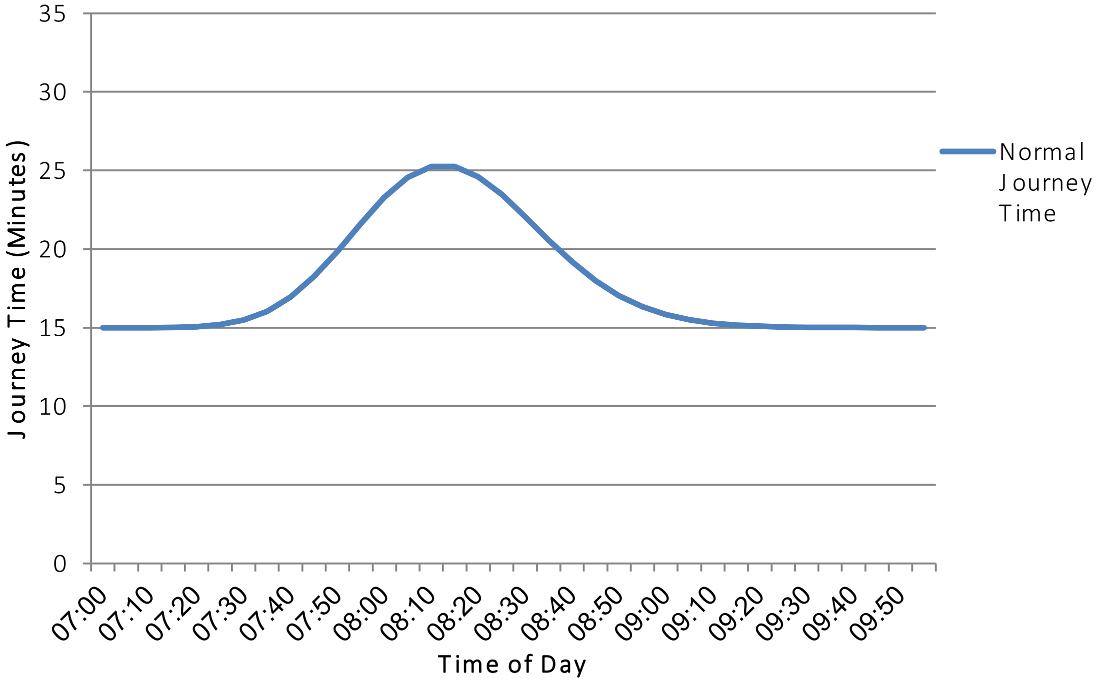
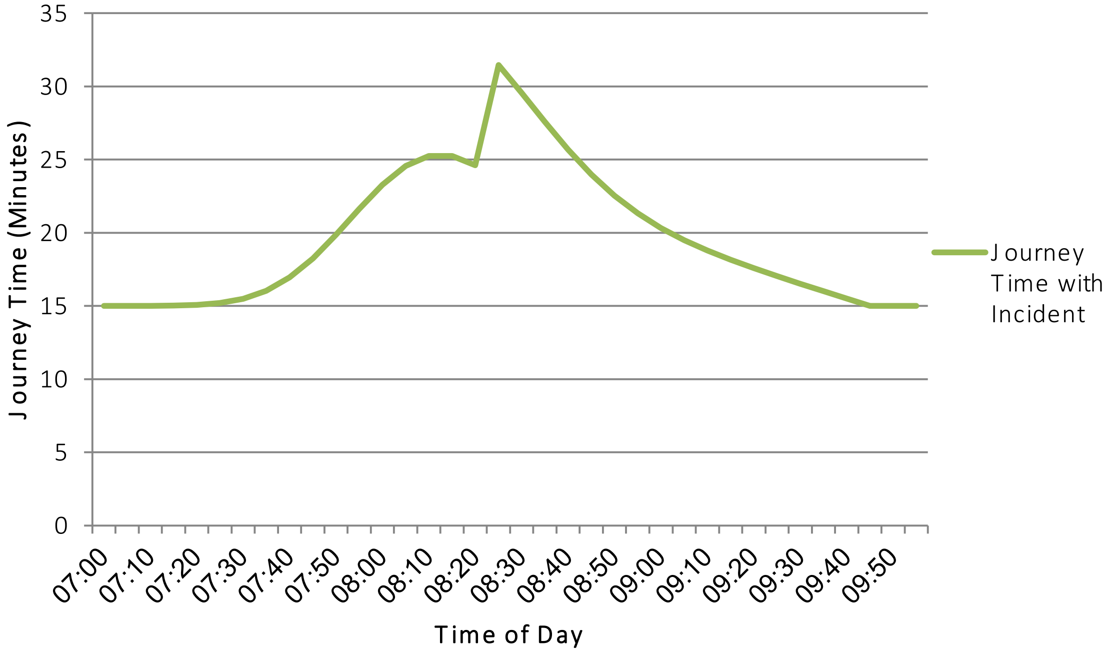
[64] The link between congestion and variability is well established from previous research listed in WebTAG (UNIT A1.3: User and Provider Impacts (November 2014)

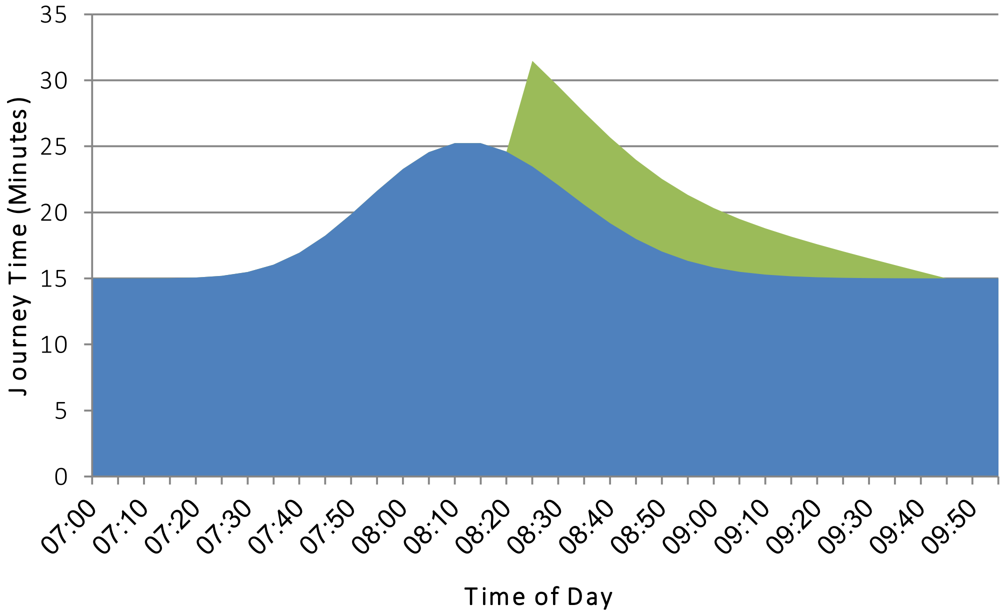
journey times through the northbound bore (based on example data, for the purpose of illustrating the effect an incident has) with and without an incident.





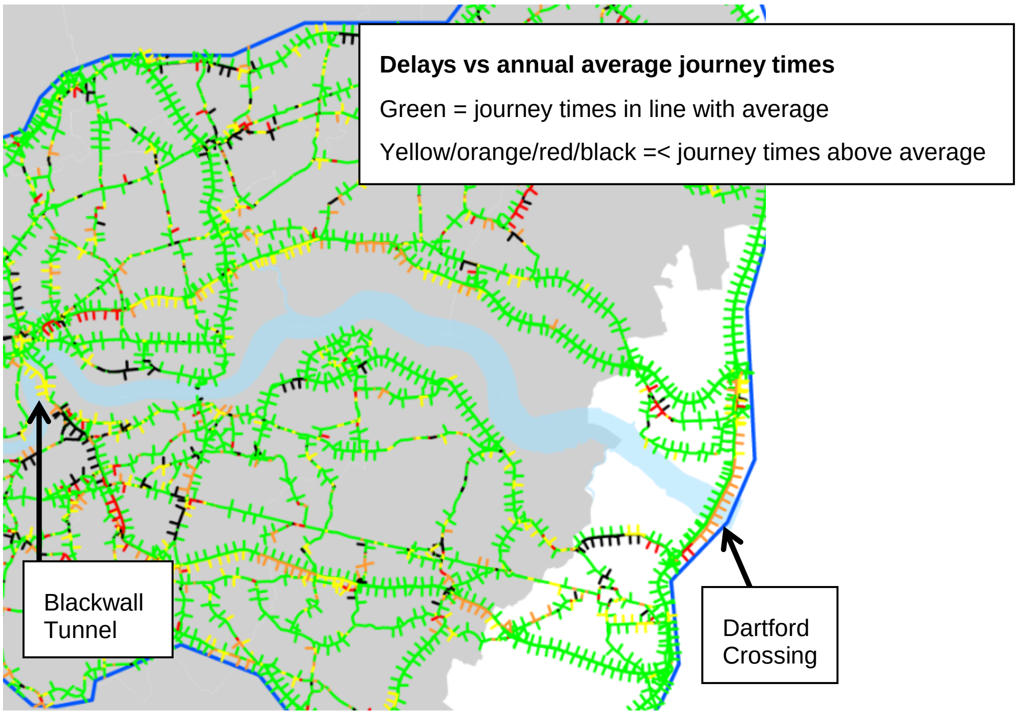
D.3.5 The first graph shows that users' journey time increases at times when demand to use the tunnel are highest, in this example in the three-hour AM peak period. The second graph shows the impact on journey time in the event of an incident that requires closure of the tunnel (in this example the time of the incident is 0820hrs, and the duration of the resultant closure is 8 minutes). The incident results in a spike in journey time, followed by a period where journey times are higher than normal whilst the network recovers.

D.3.6 The cumulative impact that the incident has on journey times over the period is illustrated by the area shaded green in the graph below.



D.3.7 Clearly the timing of incidents, their duration and their impact varies; some incidents will have a much smaller impact on journey times whilst other will have a greater impact. But in times when the network is congested, incidents have a significant impact; effectively there is no scope to 'erase' the delay caused by a brief closure at peak times because the tunnel is at capacity, and therefore all users are exposed to its impacts. On occasions when there are major incidents which require a longer closure of the tunnel, the network can take much longer to recover and impacts can be felt until demand for the tunnel falls substantially after the PM peak.

Case study: An example of a large incident at the Blackwall Tunnel



On Wednesday 16 January 2013 there was a breakdown in the southbound bore at 07:15, followed by a breakdown in the northbound bore just before 08:00. Data from the London Congestion Analysis Project suggests that the first incident manifested in additional delay on the A102 southbound and A13 westbound of around 20 minutes; the second in 30 minutes additional delay approaching the Blackwall Tunnel northbound.

The data shows there was additional delay at the Dartford Crossing in the southbound direction, which was likely to be related to motorists reassigning to this route as a result of the first incident. There was also additional delay on the A20 and A206 inbound/westbound, which is likely to be related to reassignment in response to the second incident. Total delay to Blackwall Tunnel northbound users totalled around 1 hour when compared to normal conditions, and users of the wider network were impacted by additional delay as motorists reassigned to alternative river crossings.

D.3.8 In practice, the frequent occurrence of incidents and high levels of congestion results in a high degree of journey time variability and the standard deviation in journey times during peak times is high. The figures below illustrate the spread of journey times recorded on 2013 weekdays in the AM and PM peak hours from the Sun-in-the-Sands roundabout (A2/A102 junction) to the south and the Bow Interchange (A11/A12 junction) to the north.

Figure D-8: 2013 northbound journey time variation (weekdays 07:00-10:00, school term time)

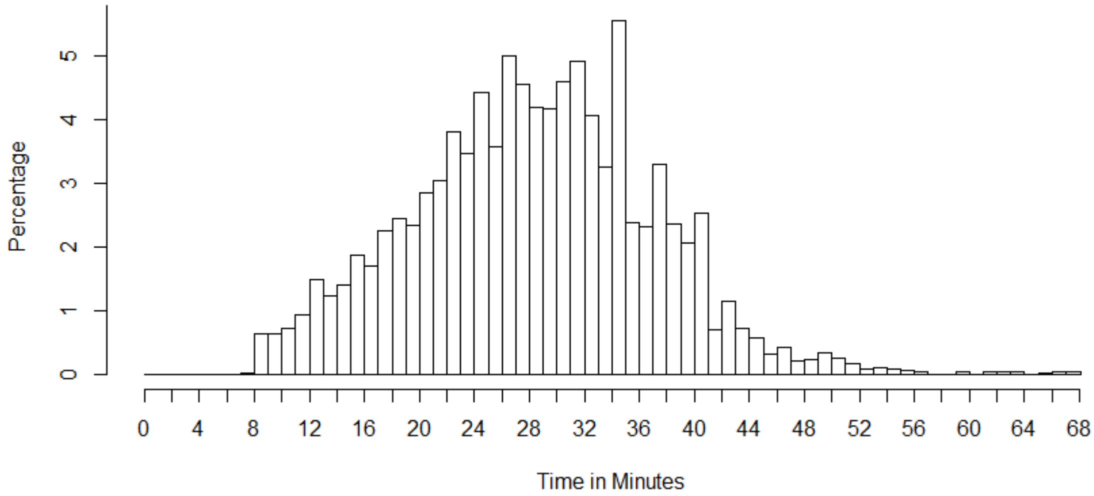
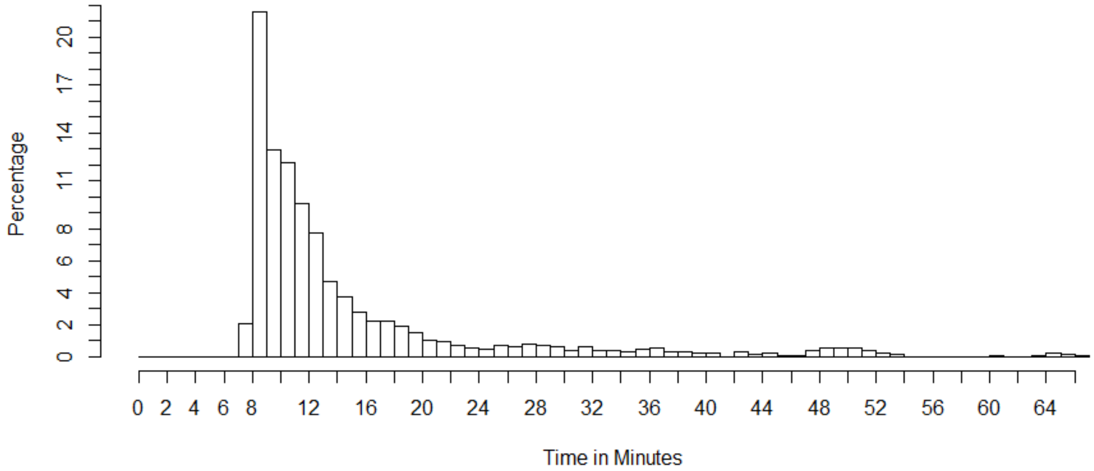


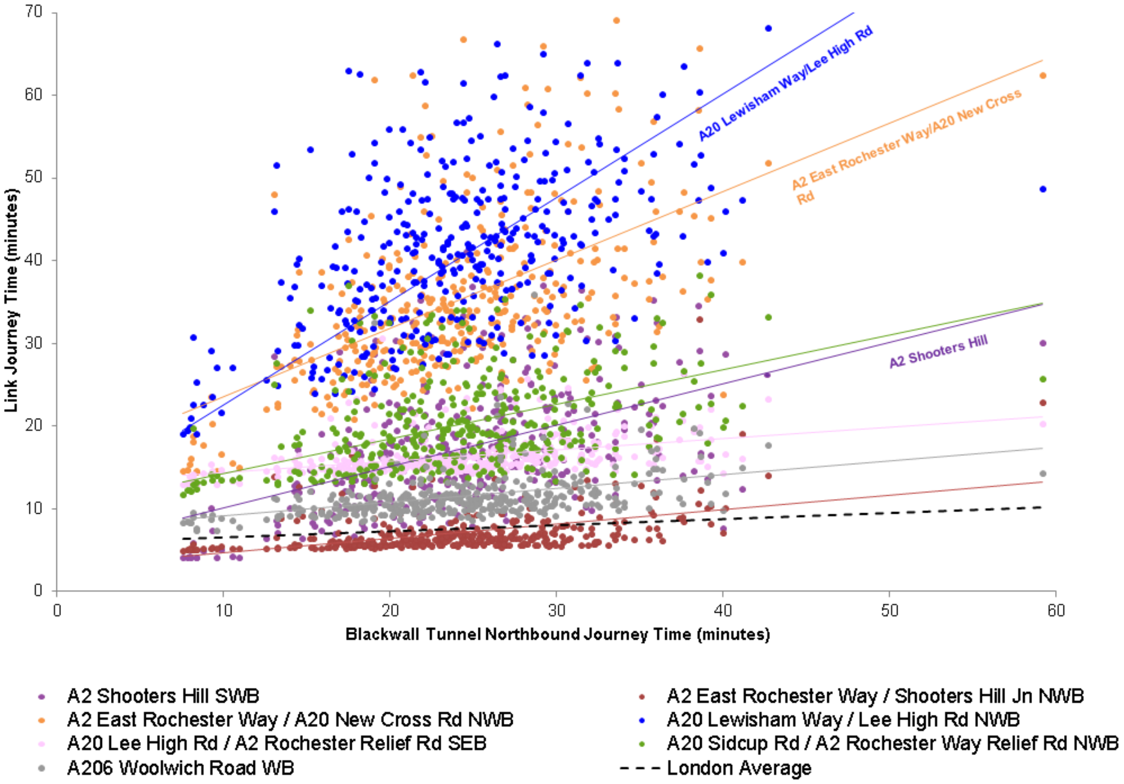
Figure D-9: 2013 northbound journey time variation (weekdays 16:00-19:00, school term time)



D.3.9 The AM peak graph indicates significant variability in journey time through the northbound bore. Journey time reliability for all vehicular traffic through the Blackwall Tunnel is 80% meaning eight out of ten journeys achieve, within five minutes, the nominal journey time from Sun-in-the-Sands roundabout to Bow roundabout. The TLRN average is 89%. Presently, under free-flow conditions vehicles take around one minute to travel 1km. During the AM peak it typically takes around four minutes to travel 1km.

D.3.10 In addition to the impacts that incidents can have on congestion and journey times on the approaches to the tunnel and the local areas, incidents that result in a closure of longer than a few minutes can also lead to significant performance issues on the wider road network. An analysis of journey time data for the local highway networks in the vicinity of the Blackwall Tunnel suggests there is some correlation between delays at the Blackwall Tunnel and surrounding highway corridors, with the network to the south of the tunnel more affected than the network to the north. Links that are particularly strongly affected are the A20 Lewisham Way/Lee High Road (north-west bound), the A2 East Rochester Way to New Cross Road (north-west bound) and the A2 Shooters Hill (west bound), as illustrated in the graph below.

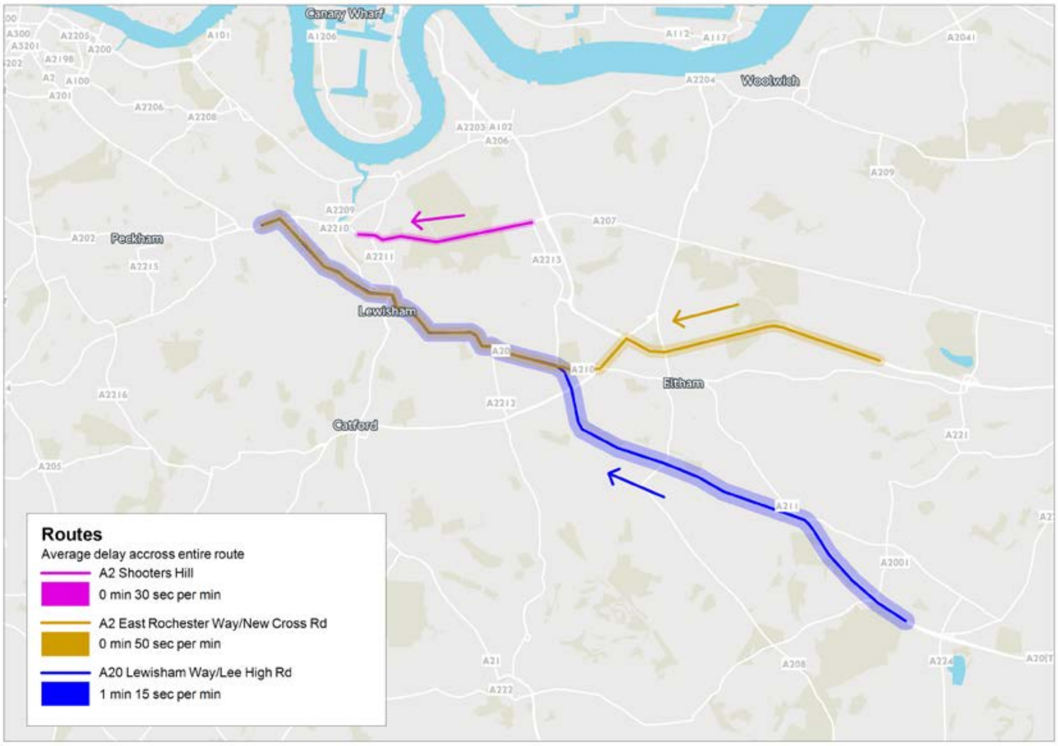
Figure D-10: Impact of A102 Blackwall Tunnel Approach journey time on other road corridors



D.3.11 For every additional minute of delay for journeys northbound through the Blackwall Tunnel, vehicles travelling on the A20 Lewisham Way/Lee High Road corridor experience an increased journey time of 1 minute 15 seconds. Vehicles on A2 East Rochester Way corridor experience an increased journey time of 50 seconds, whilst vehicles on the A2 Shooters Hill corridor experience an increased journey time of 30 seconds.

D.3.12 This correlation suggests that the performance of the A2 and A20 corridors is related to the performance of the Blackwall Tunnel; when there is an incident at the northbound tunnel or higher than usual levels of congestion users start to divert to these corridors, in doing so creating additional demand and delay. The network to the north of the tunnel appears to be less sensitive to changes in journey time on the A102 Blackwall Tunnel Northern Approach, however there is some correlation between AM peak journey times on this corridor and the A12 southbound and A13 westbound, suggesting some diversion towards central London during incidents at the southbound tunnel.

Figure D-11: Figure 8-1: Additional delays experienced on links when there is delay at the Blackwall Tunnel northbound



D.3.13 An analysis of journey time data therefore suggests that incidents at the Blackwall Tunnel have an adverse impact not just on users of the tunnel, but on the journey times of other road users using surrounding highway corridors, particularly to the south of the tunnel. This includes local traffic not making cross-river trips and bus services.

D.4 How would the Silvertown Tunnel scheme improve reliability and resilience?

D.4.1 The first section of this note describes how the reliability and resilience of the current cross-river highway network in east London is adversely impacted by a lack of alternative crossings, the ability of existing crossings to meet demand and their susceptibility to incidents and closures. These factors combined result in a sub-optimal network which leads to unreliable journey times for users and poor levels of service when incidents and closures occur.

D.4.2 The Silvertown Tunnel scheme would provide a new high-capacity higher geometric standard highway crossing within close proximity to the Blackwall Tunnel, and as part of the scheme user charges will be implemented at both Silvertown Tunnel and Blackwall Tunnel to manage levels of demand. The scheme would help to improve the current reliability and resilience of the highway network, primarily by facilitating:

- reduced congestion;
- fewer incidents; and
- the ability to divert vehicles when incidents and closures occur.

D.4.3 In addition to the day-to-day benefits listed above, the scheme will also enable improved asset management of the Blackwall Tunnel and considerably enhance network resilience in the event of a long-term closure of the Blackwall Tunnel. Each of these points is considered in more detail below.

Reduced congestion

D.4.4 Under the proposed charging scenario, traffic flows through both tunnels are not expected to be any higher than flows through the Blackwall Tunnel in an un-charged scenario, noting that flows will of course be spread between the tunnels. The scheme is not expected to lead to a significant increase in highway travel demand, but rather to better manage the levels of traffic crossing the river via this corridor; in doing so, congestion that is caused by both high levels of demand and incidents will be reduced, particularly at peak times. By reducing congestion, the scheme will reduce the day-to-day variability of users' journey times and hence increase the reliability of their journeys.

Fewer incidents

D.4.5 The majority of current closure incidents at the Blackwall Tunnel are caused by over height vehicles attempting to access the northbound bore. By providing an adjacent alternative route with full dimensional clearance, supported by a signage strategy to direct over height vehicles to use the Silvertown Tunnel, the scheme is expected to considerably reduce the number of over height vehicle incidents and the resultant delay these incidents cause.

D.4.6 It is anticipated that over height vehicle incidents at the Blackwall Tunnel could be reduced by around 80% subject to the operational strategy which is implemented for both Tunnels. Whilst the strategy would be confirmed closer to the time of opening, the Scheme presents the opportunity for all HGVs to be routed via the Silvertown Tunnel as a means of preventing any future over-height vehicles at the Blackwall Tunnel should this be deemed necessary.

D.4.7 Congestion incidents will reduce significantly, whilst a modest reduction in other incidents (e.g. road traffic collisions) is also expected to occur as a proportion of current Blackwall Tunnel traffic diverts to the Silvertown Tunnel, which is closer than the current adjacent crossings and is better able to accommodate higher volumes of traffic.

Ability to divert vehicles

D.4.8 Not only will the number of incidents be reduced, the impact of incidents that do occur will lessen considerably for both tunnel users and users of the wider network. This applies particularly in the case of relatively infrequent major incidents which result in a tunnel closure for periods in excess of a few minutes. In cases where a closure of the Blackwall Tunnel is required, users will be directed to use the Silvertown Tunnel – a diversion of around 3km depending on the users' origin and destination. This compares favourably with much lengthier diversions to other crossings, and minimises delay caused to other road users when significant numbers of vehicles seek to divert from Blackwall Tunnel to other crossings.

Improved asset management

D.4.9 The Silvertown Tunnel scheme would also be expected to improve network reliability through improved asset management. The lack of alternative crossings makes undertaking maintenance of the Blackwall Tunnel extremely difficult. The northbound tunnel bore is over 115 years old and whilst it has recently undergone extensive maintenance, including the installation of new generation fire safety and ventilation systems, there will be a point in the medium- to long-term when further extensive refurbishment works are required for instance to meet new regulations or safety standards.

Figure D-12: Maintenance of the northbound tunnel bore

D.4.10 Currently, maintenance at the Blackwall Tunnel is undertaken during overnight periods where possible. The Silvertown Tunnel scheme would provide much greater operational flexibility, allowing for planned maintenance of either tunnel to be completed at regular intervals and potentially in a quicker and/or more cost-effective manner than currently. The resulting effects upon traffic will be much improved compared to those of the present maintenance arrangements.

Improved long-term resilience

D.4.11 Most incidents at the Blackwall Tunnel are dealt with quickly, and where tunnel closures are required they are usually implemented for only a few minutes. Whilst the likelihood of a long-term closure of the Blackwall Tunnel is low, the impacts on users and the east London highway network would be significant.

D.4.12 In the event of a major incident, a tunnel closure would be required to deal with the incident, to inspect the tunnel and to undertake any repairs that are necessitated by the incident. The length of the closure would clearly depend on the nature and severity of the incident. In most cases only one bore would need to close, though in exceptional cases it may be necessary for both bores to be closed together. Possible causes of a long-term closure of the tunnel, from say several days to several months, include the following:

- Major fire
- Major toxic spillage
- Major collision
- Structural failing
- Flood
- Terrorist attack

D.4.13 A robust asset management plan is in place to ensure the risk of a long-term closure is minimised, and mitigation is in place where appropriate. Nonetheless, the Blackwall Tunnel is a critical piece of infrastructure and the risk of a long-term closure remains. The likelihood of a major fire at the tunnel, for instance, is estimated at approximately 1 in every 270 years and in such a scenario it is expected that a closure of about six weeks would be required for demolition and replacement. If the structure were to buckle as a result of being exposed to very high temperatures, a closure period of six to twelve months might be required.

Long-term tunnel closures

The northbound bore of the Blackwall Tunnel is 1,350m long, and the southbound bore is 1,174m. There are 10 further road tunnels in the UK with a length of 1km or above, and across the world it is estimated that there could be around 500 road tunnels which are longer than 1km. Since 1980 there have been at least four major tunnel disasters worldwide at tunnels over 1km in length which have resulted in large numbers of casualties and/or extended closures:

Tunnel	**Nature of incident**	**Year**	**Fatalities**	**Closure time**
Mont Blanc Tunnel, France	Fire	1999	39	3 years
Caldecott Tunnel, USA	Fire	1982	7	11 months
Sierre Tunnel, Switzerland	Collision	2012	28	1 day
Sasago Tunnel, Japan	Collapse	2012	9	2 months

In recent years there have been no long-term closures of the Blackwall Tunnel due to major incidents; a bomb which exploded near to the south portal of the tunnel on 18 January 1979 caused only limited damage. Elsewhere in London, a bus fire within the Limehouse Link tunnel on 31 October 2005 resulted in damage to the tunnel lining and the tunnel being closed for a period of 15 days for the completion of repairs.

D.4.14 In the event of a long-term closure of the Blackwall Tunnel, the majority of its users would be expected to divert to the Silvertown Tunnel. The Silvertown Tunnel would be the best placed alternative for accommodating trips that would otherwise be made via the Blackwall Tunnel, both geographically and in terms of capacity. Should a long-term closure of the Blackwall Tunnel be required, the scheme would therefore significantly boost the resilience of the road network and minimise the impacts that a long-term closure would otherwise have, including on adjacent river crossings with a lower capacity.

D.5 The impacts of a Blackwall Tunnel closure with and without the Silvertown Tunnel

D.5.1 The impact of Blackwall Tunnel closures on the wider road network with and without the Silvertown Tunnel in place have been subject to initial assessment using RXHAM. Reference Case and Test Case scenarios were run with a 25% capacity reduction imposed on the Blackwall Tunnel, simulating the impact of a 15-minute Tunnel closure.

D.5.2 Note that the outputs described in this section should be treated with some caution for two reasons. Firstly, the Test Case which was considered for the purpose of this initial assessment was based on slightly different assumptions from that of the Assessed Case. Secondly, a modelled 25% capacity reduction is not congruent with an unplanned 15-minute closure in one key respect: the modelled scenario assumes that all drivers have perfect knowledge of road network conditions before they begin their journey. Unplanned closures of the Blackwall Tunnel will result in some drivers changing their route mid-way through a journey, including on the immediate approaches to the Tunnel portals, and such reactive behaviour will have additional impacts on the road network not captured by the model.

D.5.3 The results from this initial assessment therefore represent an approximate guide to the relative impacts the Scheme could have in the event of a 15-minute Blackwall Tunnel closure, and the results from the Assessed Case could be expected to be slightly different. The figures below summarise the impacts on the RXHAM simulation area of a 15-minute closure of the Blackwall Tunnel with and without the Silvertown Tunnel scheme in place in terms of overall travel time, average speed and queued traffic at the end of the modelled time period.

Figure D-13: RXHAM simulation area 2021 travel time (PCU-hours) – Blackwall Tunnel 15-minute closure

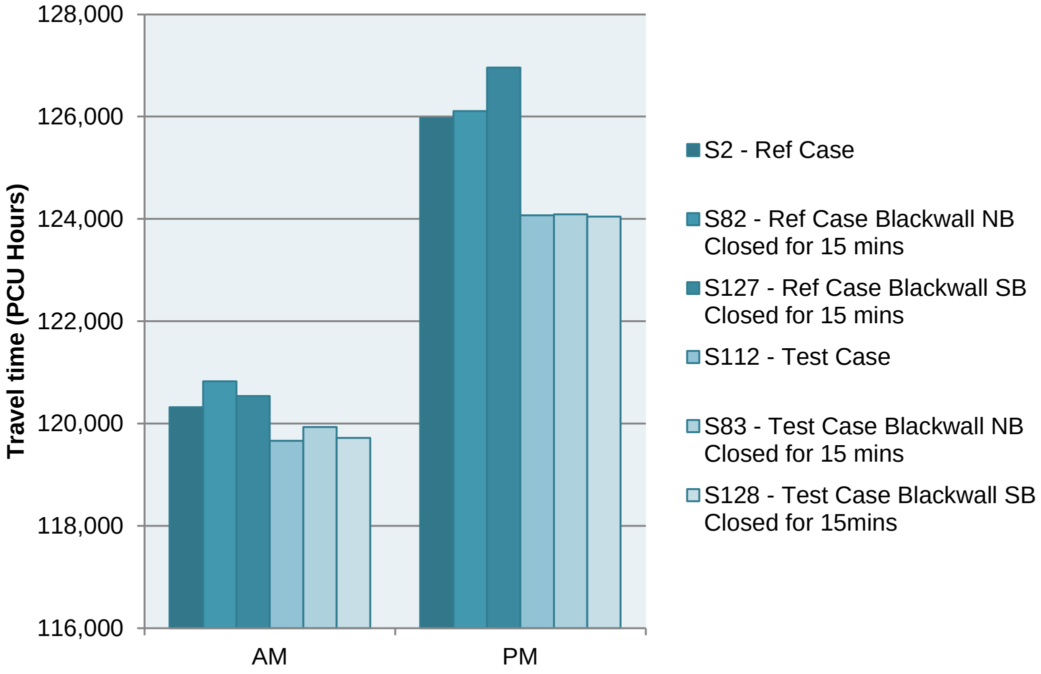


Figure D-14: RXHAM sim area 2021 average speed (kph) – Blackwall Tunnel 15-minute closure

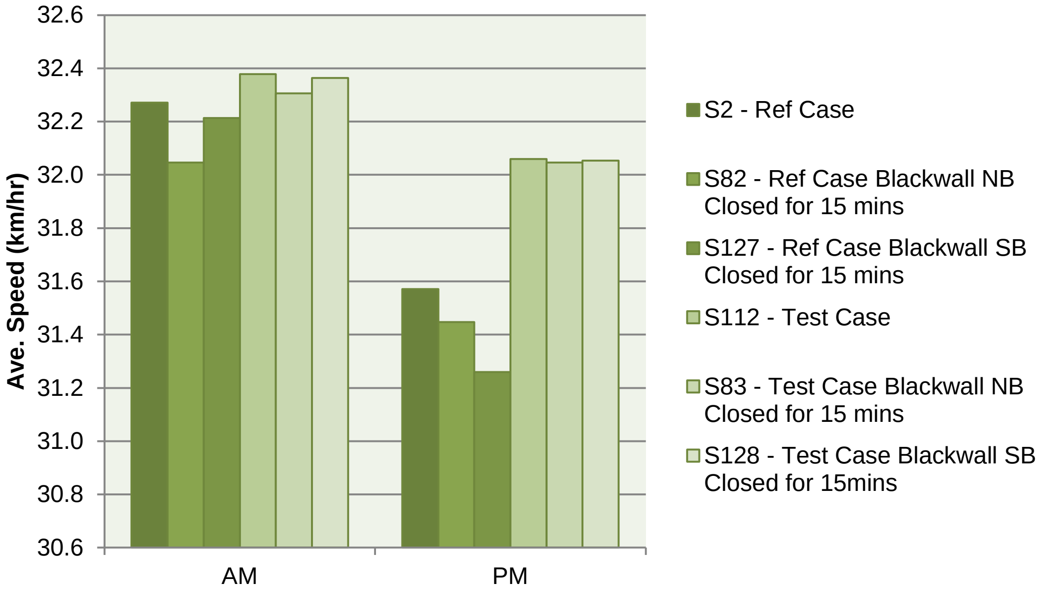
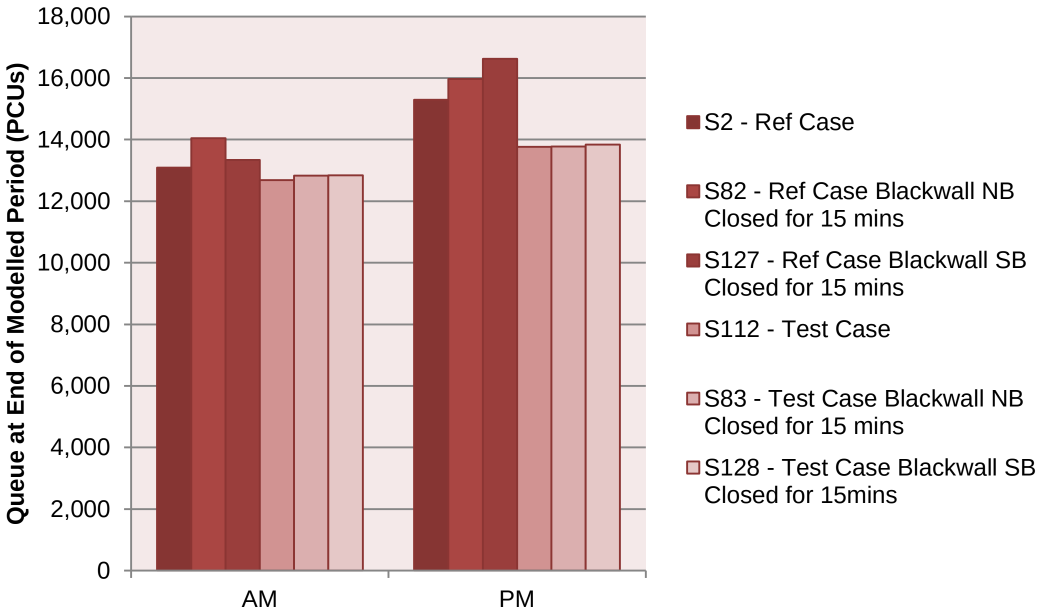


Figure D-15: RXHAM sim area 2021 queued demand (PCUs) – Blackwall Tunnel 15-minute closure



D.5.4 The graphs indicate the impact of the Silvertown Tunnel scheme in mitigating for Blackwall Tunnel closures. In terms of queued demand at the end of the AM peak hour for example, a 15-minute closure of the northbound bore results in a 7% increase in queued traffic in the Reference Case, but only a 1% increase in the Test Case with the new tunnel in place.

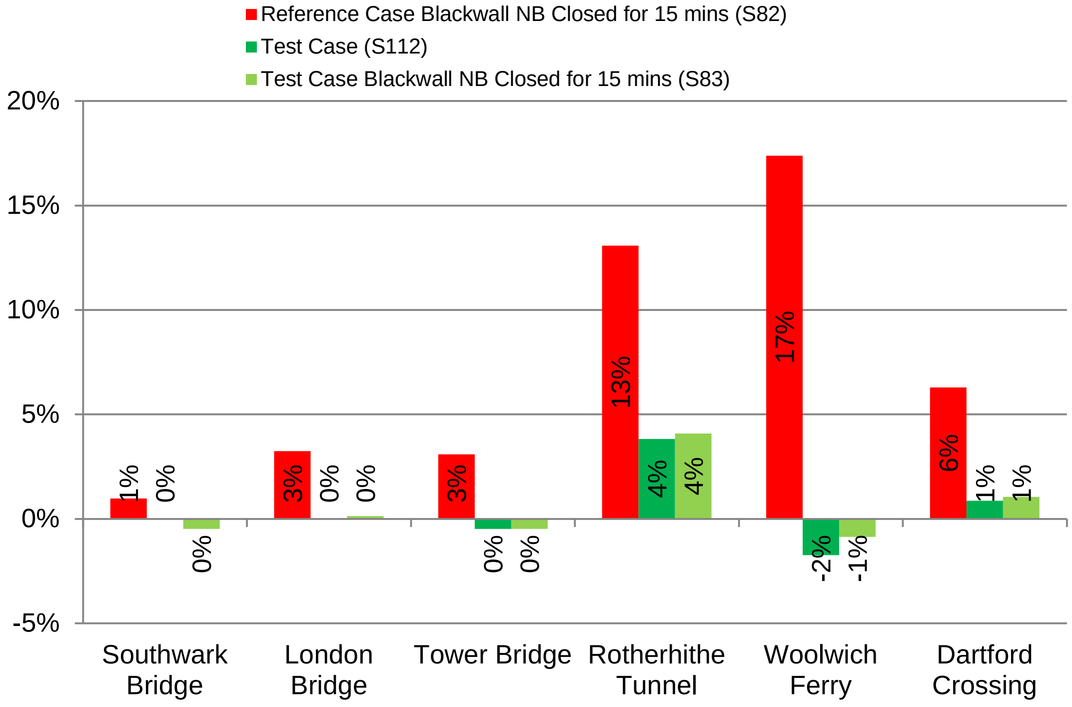
D.5.5 Similarly in the PM peak hour, a 15-minute closure to the southbound bore increases Reference Case queued demand by 9% but the Test Case impact is only 1%. In both peak periods, the Test Case including a 15-minute

Blackwall Tunnel closure performs better than the Reference Case with Blackwall Tunnel open for the full hour.

D.5.6 The model also indicates that the Silvertown Tunnel scheme would mitigate the impact of Blackwall Tunnel closures on other river crossings. The figure below for example indicates that a 15-minute northbound closure at Blackwall in the AM peak hour results in significant increases in demand for adjacent river crossings when compared with the 2021 Reference Case, notably the Rotherhithe Tunnel (13%), the Woolwich Ferry (17%) and the Dartford Crossing (6%).

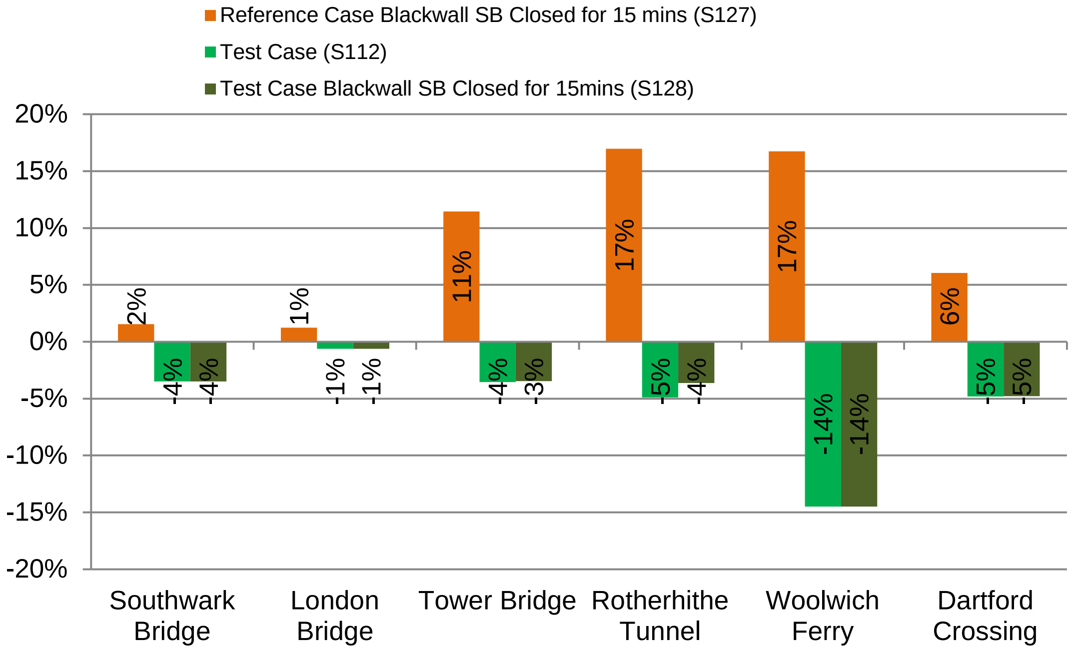
D.5.7 In contrast, a 15-minute closure in the Test Case does not significantly increase demand at these crossings. The graph does indicate that the Test Case itself is expected to result in a small increase in demand at the Rotherhithe Tunnel (4%) and the Dartford Crossing (1%) when compared with the Reference Case, as a result of traffic re-assigning to avoid the user charge applied in the Assessed Case.

Figure D-16: Adjacent crossings forecast change in AM peak northbound demand flow from 2021 Reference Case



D.5.8 In the PM peak hour a similar pattern is evident in the opposite direction, as shown in the figure below. A 15-minute closure of the southbound Blackwall bore in the Reference Case results in demand increases of 6% at the Dartford Crossing, 11% at Tower Bridge, 17% at the Woolwich Ferry and 17% at the Rotherhithe Tunnel. In contrast, very little demand change is evident at adjacent crossings between the Test Case and the Test Case with closure scenarios, and when compared with the Reference Case; demand decreases in the PM peak hour at all adjacent crossings regardless of the closure.

Figure D-17: Adjacent crossings forecast change in PMP southbound demand flow from 2021 Reference Case



D.5.9 As indicated earlier in this report, many of the aforementioned river crossings are expected to operate at or beyond capacity in the 2021 Reference Case. The demand increases associated with Blackwall closures would therefore result in extensive queuing and delay on the approach roads to these crossings, as evidenced in the RXHAM simulation area modelling outputs described above.

D.6 Summary

D.6.1 A key objective of the Silvertown Tunnel scheme relates to improving the reliability and resilience of east London river crossings, which in effect means reducing the variability of users' journeys and improving the ability of the network to provide an acceptable level of service when incidents occur. Poor reliability and resilience affects all users of the highway network and is a particular issue for users of the Blackwall Tunnel, being the worst performing corridor on the TLRN in terms of journey time performance.

D.6.2 The factors which negatively impact on the reliability and resilience of the existing cross-river highway network in east London can be summarised as follows:

- Lack of alternative crossings and the distance between them – this primarily affects resilience

- The capacity of existing crossings to meet demand – this affects both resilience and reliability
- The susceptibility of existing crossings to closure – this primarily affects reliability

D.6.3 Current issues with the reliability of the Blackwall Tunnel are, to a significant degree, linked to congestion and incidents. As described in the above sections, it is known that congestion is a particular issue at the Blackwall Tunnel and that congestion is getting worse. It is also known that the tunnel is susceptible to a disproportionate number of incidents and closures. The nature of the approach roads to the Blackwall Tunnel and the high level of demand mean that small changes in the volume of vehicles trying to use the tunnel can have a big impact on journey times, exacerbated by the fact that there are few alternatives routes for crossing the river.

D.6.4 Both high traffic volumes and occurrence of incidents result in a reduction in network capacity, which in turn leads in increased journey times and greater journey time variability. These factors combined result in a sub-optimal network which leads to unreliable journey times for users and poor levels of service, particularly when incidents and closures do occur.

D.6.5 The Silvertown Tunnel scheme would provide a new high-capacity, higher geometric standard highway crossing within close proximity to the Blackwall Tunnel.

D.6.6 On a day-to-day basis, the Silvertown Tunnel scheme will improve reliability and resilience by reducing congestion, facilitating fewer incidents and providing the ability to divert vehicles when incidents and closures occur.

D.6.7 Should a long-term closure of the Blackwall Tunnel be required, the Silvertown Tunnel scheme would therefore significantly boost the resilience of the road network and minimise the impacts that a long-term closure would otherwise have, including on adjacent river crossings with a lower capacity.

APPENDIX E – IMPACT ON ADJACENT RIVER CROSSINGS

E.1 Overview

E.1.1 The Silvertown Tunnel would be located almost adjacent to the Blackwall Tunnel. The tunnels would share a common approach road and would both be subject to user charging, and in many respects would function as a combined crossing. The proposed Silvertown Tunnel scheme is expected to dramatically reduce delays at the Blackwall Tunnel, with users of the crossing expected to experience free-flow conditions and in some cases more direct connections.

E.1.2 The effects of the Silvertown Tunnel scheme on adjacent crossings – namely the Rotherhithe Tunnel to the west and the Woolwich Ferry to the east – are expected to be minimal. The purpose of this note is to summarise the expected impacts of the scheme on these crossings. It also considers the case for introducing user charges at adjacent crossings, as has been proposed by consultation respondents, on the basis of the evidence presented.

E.2 Expected impacts on adjacent river crossings

E.2.1 The Silvertown Tunnel scheme would provide additional cross-river capacity and connectivity, thereby benefitting users of the Blackwall and Silvertown tunnels by:

- Reducing congestion;
- Reducing the frequency of incidents at the Blackwall Tunnel, in particular those incidents caused by over-height vehicles, as the Silvertown Tunnel would provide full dimensional clearance for tall vehicles; and
- Improving resilience in the event of closures of the Blackwall Tunnel, as users would be able to divert to the Silvertown Tunnel.

E.2.2 The implementation of a charge to use the tunnels would provide TfL with an effective mechanism for managing demand and ensuring that the scheme's objectives are met. The charge could be amended to match conditions at the time the scheme opens or if circumstances change such that the impacts of the scheme are different from those expected. For instance the charge could potentially be adjusted in future to reduce the impact of the scheme on adjacent river crossings if demand at adjacent crossings was greater than expected.

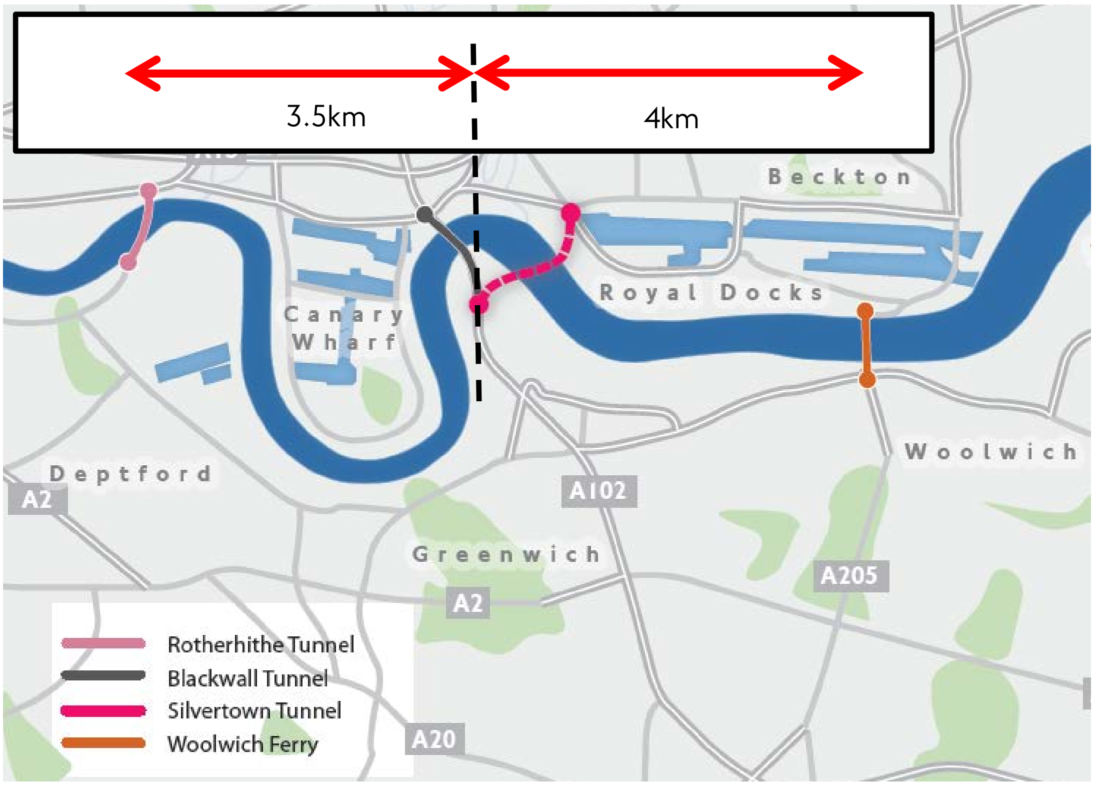
E.2.3 While the user charging aspect of the Scheme would of course cause some drivers to reconsider their travel options, it is anticipated that the additional financial cost of crossing the river on the A102 corridor would be largely offset by significantly reduced journey times, leading to little change in demand at the aggregate level. Hence it is not expected that the Scheme would have a significant material impact on adjacent river crossings.

E.2.4 This also reflects the capacities of the crossings, their position in relation to their typical 'catchments', and their connections to the strategic highway networks.

E.2.5 As the crow flies the Rotherhithe Tunnel is located approximately 3.5km to the west of the point where the approach road to the proposed Silvertown Tunnel would diverge from the A102, and the Woolwich Ferry is located approximately 4km to the east. The distances by road are longer south of the River Thames.

E.2.6 Highway routes to these crossings are not high capacity, and are congested in peak times, meaning that routeing cross-river trips via either of these crossings would typically incur considerable additional journey time compared to the option of using the Blackwall or Silvertown tunnels.

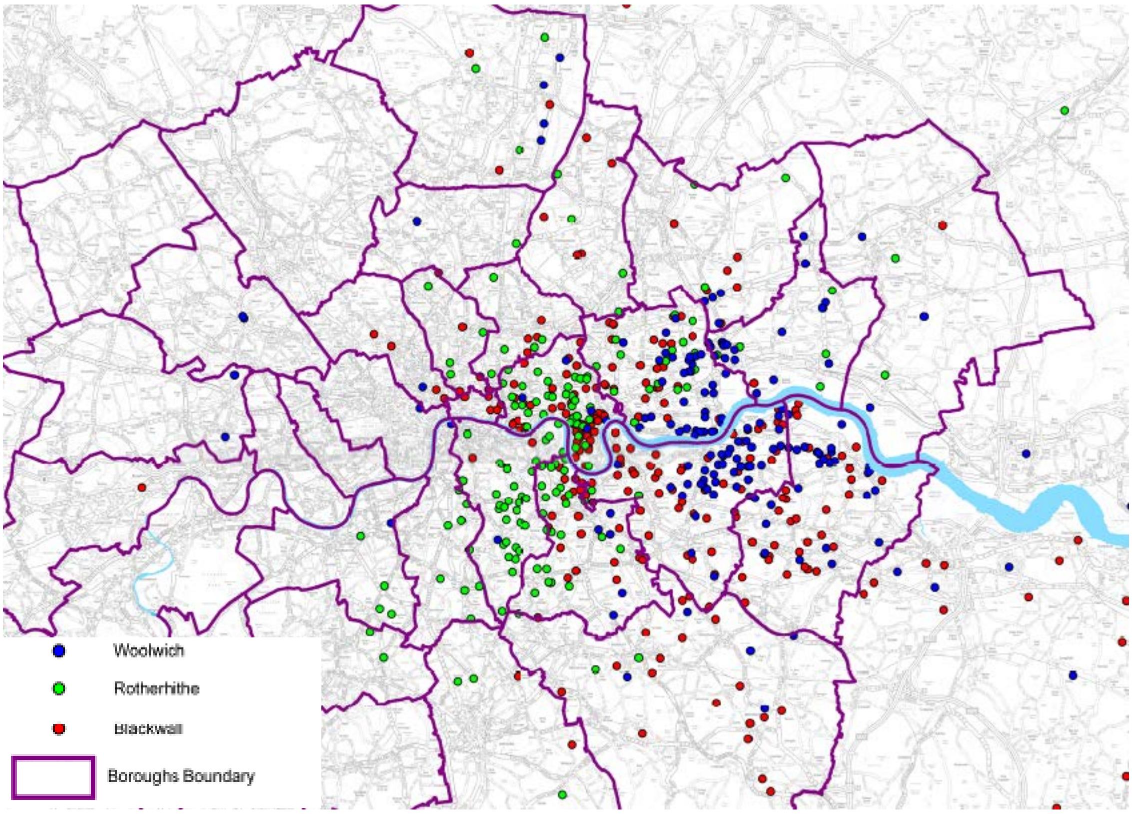
Figure E-1: Location of the Silvertown Tunnel in relation to adjacent crossings



E.2.7 The adjacent crossings themselves are also of significantly lower capacity – the Blackwall and Silvertown tunnels would have a combined capacity of approximately 5,000 PCUs per hour per direction, while the capacity of the Rotherhithe Tunnel is around 25% of this and the capacity of the Woolwich Ferry is much lower, below 5%. Both of the adjacent crossings operate at or close to capacity in peak times, hence there is little available capacity to accommodate new trips and any new trips that were made would incur additional delay.

E.2.8 The geographic distance between the crossings also means they serve different catchment areas, albeit there is clearly a degree of overlap between them. The figure below shows the origins and destinations of existing users of the Rotherhithe Tunnel, Blackwall Tunnel and Woolwich Ferry for northbound trips, based on 2012 surveys. Analysis of the origin and destination data suggests that the Blackwall Tunnel has a large catchment area with origins and destinations spread over a wide area, reflecting its high capacity and direct connections to several major routes. The Rotherhithe Tunnel has a smaller catchment area with a bias of trips from the south-west to the north-east, while the Woolwich Ferry has a much more local catchment, with a bias to the east.

Figure E-2: Origins and destinations for northbound trips



E.2.9 Given the journey times associated with use of the adjacent crossings and their limited capacity (particularly the Woolwich Ferry), at the aggregate level it is considered that the charge incurred by Blackwall/Silvertown Tunnel users would be offset by quicker and more reliable journey times. While there will clearly be variance in users' values of time, for most users a diversion to an un-charged Rotherhithe Tunnel or Woolwich Ferry would not be worthwhile when the additional trip length and journey time are factored in.

E.2.10 Users that do opt to divert to the adjacent crossings are expected to be offset to some degree by users that choose to divert from the adjacent crossings to the Blackwall and Silvertown Tunnels on the basis that the quicker journey time and improved reliability are deemed to outweigh the charge incurred. In addition, over-height vehicles (above 4.0m in height) would have a new choice of routing via the A102 as the Silvertown Tunnel would provide full dimensional clearance.

E.2.11 By reducing the number and impact of incidents at the Blackwall Tunnel, the scheme would also reduce the likelihood of knock-on delay and disruption to adjacent crossings as Blackwall Tunnel users seek to divert to alternative routes. When there are incidents and closures at the Blackwall Tunnel at present, the adjacent crossings experience increased demand and user delay, particularly during major incidents (for instance a tunnel closure in excess of a few minutes occurring in peak periods) when impacts can be severe. (Note that the reliability and resilience benefits of the Silvertown Tunnel scheme – both to users of the Blackwall and Silvertown Tunnels and to users of other crossings – are not captured in the RXHAM modelling outputs.)

E.2.12 Overall therefore, based on the rationale above, demand for the adjacent crossings is not expected to change considerably as a result of the Silvertown Tunnel scheme. The scheme will also reduce the likelihood of the adjacent crossings being impacted by incidents at the Blackwall Tunnel.

Strategic highway modelling

E.2.13 The outputs from the strategic highway model (RXHAM) of the Assessed Case illustrate the scale of potential changes in traffic flow at the adjacent crossings. The forecast actual flows for the adjacent crossings for 2021 are shown in the table below.

Table E-1: Cross-river traffic flows (PCUs) at Rotherhithe and Woolwich (Assessed Case and Reference Case, 2021)

Time of day	Direction	Rotherhithe Tunnel		Woolwich Ferry	
		Reference case	Assessed case	Reference case	Assessed case
AM peak	N/B	1,164	1,210	205	205
	S/B	937	985	182	203
Inter peak	N/B	1,072	1,073	172	180
	S/B	747	846	158	188
PM peak	N/B	1,210	1,210	205	191
	S/B	1,046	1,039	205	205

E.2.15 The table shows that, at peak times, actual flows at the adjacent crossings are expected to remain broadly similar and significant changes in flows are not expected.

E.2.16 At the Rotherhithe Tunnel, in the AM peak hour, flows are expected to rise by around 45 PCUs in both directions (4-5%). In the PM peak hour flows are expected to remain the same in the northbound direction and fall marginally in the southbound direction by around 7 PCUs (-1%).

E.2.17 At the Woolwich Ferry, the change in flows is smaller but this should be considered in the context of the much lower capacity. In the AM peak hour, flows are expected to remain the same in the northbound direction and increase by around 21 PCUs (12%) in the southbound direction. In the PM peak hour flows are forecast to reduce by around 14 PCUs (7%) in the northbound direction and remain the same in the southbound direction.

E.2.18 The biggest change for both crossings is in the southbound direction of the inter peak period, when actual flow is forecast to increase by around 99 PCUs (13%) at the Rotherhithe Tunnel and by around 30 PCUs (19%) at the Woolwich Ferry. In both cases the crossings are not operating at full capacity in the Reference Case and are able to accommodate an increase in demand during this period.

E.2.19 In busy periods, traffic flows at the adjacent crossings are effectively ‘capped’ by the crossing capacities, with the maximum hourly capacities per direction being around 1,200 PCUs at the Rotherhithe Tunnel and 200 PCUs at the Woolwich Ferry. Where demand to use a crossing exceeds its capacity, queues begin to form (thereby increasing delay), and for this reason it is also useful to consider the demand at the adjacent crossings – that is, the total volume of traffic seeking to use them in any given modelled time period. The changes in demand flow at the adjacent crossings are shown in the graphs below.

Figure E-3: Demand at Rotherhithe (Assessed Case and Reference Case, 2021)

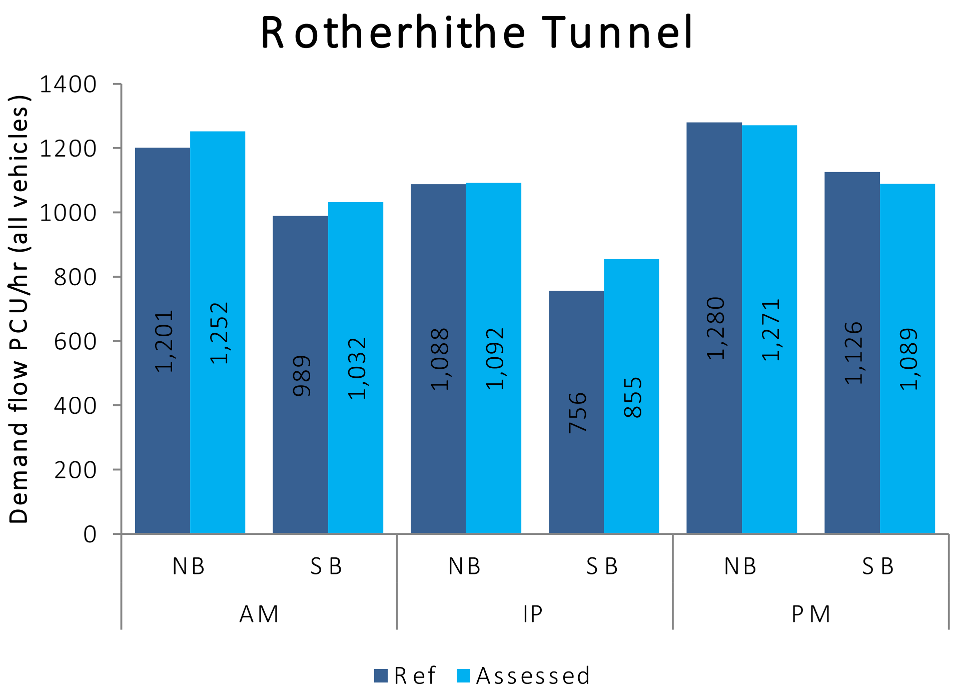
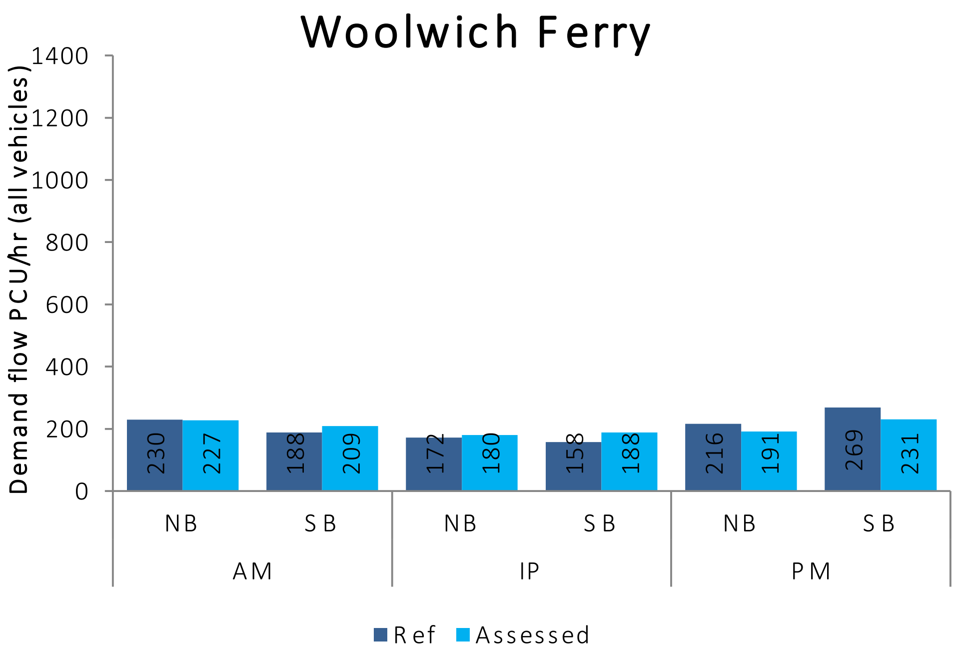


Figure E-4: Demand at Woolwich (Assessed Case and Reference Case, 2021)



E.2.20 The figures show, as with actual flows, the changes in demand at the adjacent crossings are generally minimal as a result of the Silvertown Tunnel scheme. At the Rotherhithe Tunnel, there would be a marginal reduction in demand at the busiest period (northbound direction in the PM peak hour). The same applies to the two busiest periods at the Woolwich Ferry (northbound direction in the AM peak hour and southbound direction in the PM peak hour). This reflects the pronounced improvements in conditions at the Blackwall and Silvertown tunnels, encouraging drivers to route through these crossings. By reducing demand for the adjacent crossings at these times, when demand to use the crossings exceeds available capacity, the Assessed Case reduces levels of queuing and the associated delay that would otherwise occur in the Reference Case.

E.2.21 The figures do indicate some increase in demand for the adjacent crossings at other times, most notably the northbound direction of the AM peak hour at the Rotherhithe Tunnel (increase of around 50 PCUs). This represents an increase of around 4% and would not be expected to have a significant impact on delay of trip times for this part of the network.

E.2.22 In the inter peak period, when the adjacent crossings are not operating at capacity, the figures show demand would increase marginally at both crossings as a result of the Silvertown Tunnel scheme. This suggests that, due to the deterrence effect of the charge, some Blackwall Tunnel and Silvertown Tunnel users would divert to the adjacent crossings during quieter periods when journey times to use these crossings are at their lowest. This is not expected to have an adverse impact on the highway network or the Ferry itself as overall demand would be within capacity during these periods.

E.2.23 Overall, the modelling outputs suggest that demand for the adjacent crossings is not expected to change significantly as a result of the Silvertown Tunnel scheme, and in fact could reduce marginally at the times when they are busiest and demand most exceeds their capacity. Changes in all cases are small, with the biggest changes seen outside of the busiest periods.

E.3 Considerations around charging at the adjacent crossings

E.3.1 The most recent consultation on the Silvertown Tunnel scheme elicited recommendations from some respondents that user charges should be considered at adjacent crossings to help mitigate an anticipated increase in traffic demand there. However, the information above does not indicate a strong need for such a measure. In order to implement a charge at the adjacent crossings, clear evidence that this is required would be necessary; in fact the modelling outputs do not indicate a significant increase in demand for the adjacent crossings at peak times nor major adverse impacts on the highway network.

E.3.2 Implementing a charge at the adjacent crossings could also trigger re-routeing of traffic wherever there is a convenient, un-charged alternative route (as is expected at the adjacent crossings to a limited extent as a result of the scheme).

E.3.3 Overall therefore, TfL does not consider that there is a strong case for implementing a user charge at adjacent crossings as part of the Silvertown Tunnel scheme.

APPENDIX F – CHANGES TO THE BUS NETWORK

F.1 Summary and policy links

F.1.1 It is critical that the Silvertown Tunnel is well-integrated with the wider transport and highway network in order to achieve maximum benefits. This includes new bus networks, bus priority measures and strengthening the position of North Greenwich as a local public transport hub. The Silvertown Tunnel will provide greater capacity not only by providing an opportunity for new or enhanced routes but also by accommodating double-deck buses. It will also be a more attractive bus proposition owing to more reliable journey time and greater resilience.

F.1.2 With the Silvertown Tunnel in place, both it and the Blackwall Tunnel will be charged. Buses are an important mitigation measure for user charging, especially where these charges (and other journey relevant costs such as fuel) exceed the cost of a bus journey. Buses would also provide an alternative for those people who are able to switch from car to public transport, thereby reducing congestion at the Blackwall Tunnel and providing a sustainable alternative.

F.1.3 The bus proposals for the Silvertown Tunnel directly contribute to the four strategic objectives of the National Policy Statement (NPS) for National Networks, which forms the basis of the examination of the DCO application. These objectives are as follows:

- Networks with the capacity and connectivity and resilience to support national and local economic activity and facilitate growth and create jobs;
- Networks which support and improve journey quality, reliability and safety;
- Networks which support the delivery of environmental goals and the move to a low carbon economy;
- Networks which join up our communities and link effectively to each other.

F.1.4 Furthermore, bus links via the Silvertown (and Blackwall) Tunnel enhance the scheme in meeting wider Government policy objectives on environment and social impacts, sustainable transport, and accessibility – as referenced in the NPS.

F.1.5 Current constraints on the optimal use of buses in south-east London are the physical and operational limitations of the Blackwall Tunnel and the general lack of road-based river crossings serving in the area. At present, one bus route, the 108, uses the Blackwall Tunnel and this service is severely impacted by congestion, reliability and resilience issues affecting all traffic on this corridor.

F.1.6 Direct bus routes also provide a competitive offer in terms of journey time and cost in comparison to mixed bus and rail or underground journeys and lower income groups rely more heavily on buses as a form of public transport. Furthermore new bus services can be implemented much quicker and at a fraction of the cost of rail-based alternatives. Hence cross-river bus services can offer a realistic alternative and/or additional mode choice.

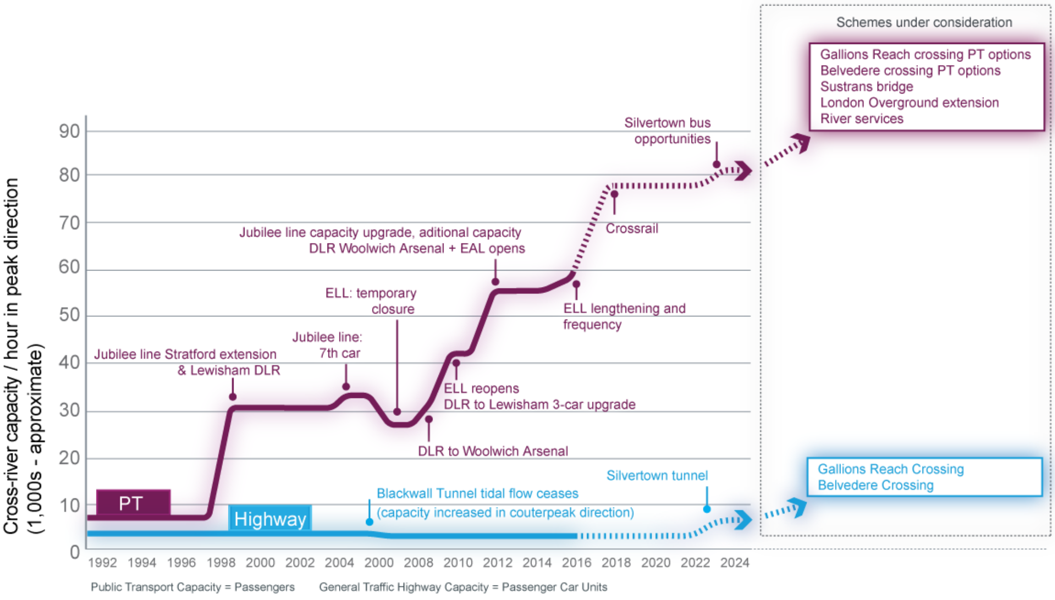
F.2 Background and objectives

F.2.1 Buses are a sustainable and affordable form of transport and are particularly important in south-east London where there is less rail infrastructure than in the rest of London.

Barriers to cross-river bus travel in the Blackwall corridor

F.2.2 The smaller number of river crossings east of Tower Bridge has historically influenced travel patterns in east and south-east London. A lot of the more recent investment in cross-river transport in this part of London has been rail based (see figure below). This has begun to influence historical travel patterns as well as the design of the bus network where buses now play a key role in accessing rail hubs.

Figure F-1: Changes in cross-river capacity since the early 1990s



F.2.3 The northern portal of the Blackwall Tunnel connects to the A12 which is in itself a barrier to bus travel. The A12 is segregated from its hinterland. This means there is no quick or high quality access to bus stops from the surrounding area. Furthermore, the A12 does not provide direct routeings to key local destinations such as Canary Wharf and the Royal Docks.

F.2.4 Due to the height restrictions at the Blackwall Tunnel it is only possible to operate single-deck buses, which limits capacity. More importantly however, as a result of congestion and incidents (including the frequent closure of the tunnel), the time taken to travel through the Blackwall Tunnel has a relatively high degree of variability. Variable journey times impact on the ability of buses to keep to timetable. For customers, this results in a poorer service in the form of longer waits at bus stops. For operators, it means longer recovery times in bus schedules to mitigate the impact with consequently higher operating costs as more buses and drivers are needed to operate the service.

8.3.9 TfL measures reliability for high-frequency bus routes (five buses per hour or higher) based on the time waited by passengers at stops in excess of the average scheduled wait time. This is known as the excess wait time (EWT) and is measured in minutes. EWT on the route 108 for the period from 3 July 2013 to 2 July 2014 was 1.21 minutes, which was 25% longer than the average EWT for all high frequency bus routes in RB Greenwich and LB Newham[65] for the same period. This figure is an annual average and EWT during the peak periods would be higher. Overall journey times in the peaks are affected by day to day congestion as well as incident related congestion. Figure F-2 shows the journey time difference of Route 108 in the AM peak compared to more free-flowing conditions between 22:00 and 23:00. The northbound end-to-end journey takes an additional 20 minutes in the AM peak compared to the late evening and the southbound journey an additional 15 minutes.

F.2.5 Journey time reliability for all vehicular traffic through the Blackwall Tunnel is 80% meaning 8 out of 10 journeys achieve, within 5 minutes, the nominal journey time from Sun-in-the-Sands roundabout to Bow roundabout. The TLRN average is 89%. Presently, under free-flow conditions vehicles take around one minute to travel 1km. During the AM peak it typically takes around four minutes to travel 1km.

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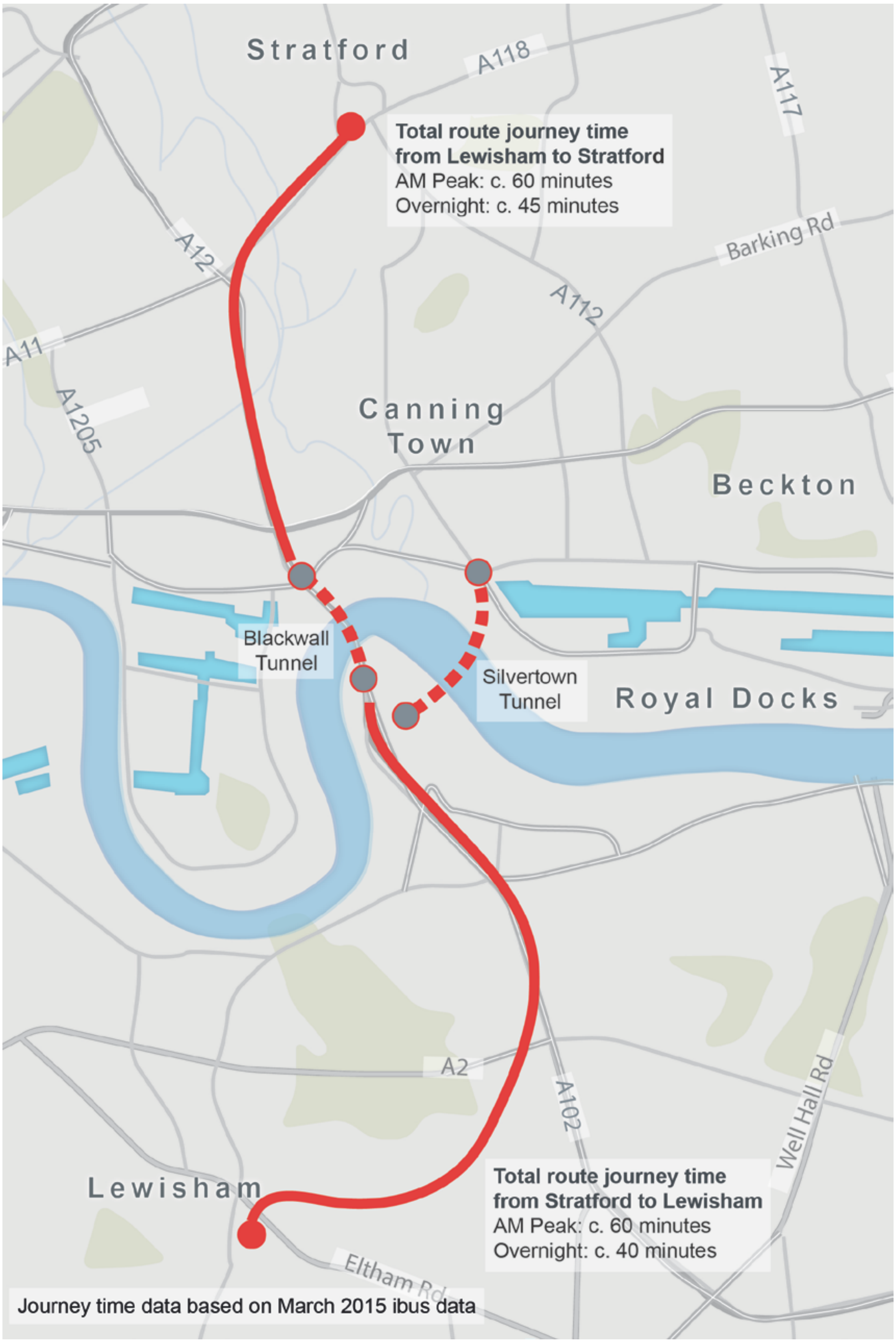
[65] LB Newham was selected over LB Tower Hamlets as being more representative because Tower Hamlets includes parts of the Central Activities Zone

Figure F-2: Route 108 end to end journey time



Opportunities of the Silvertown Tunnel

F.2.6 The Silvertown Tunnel, with one lane in each bore reserved for buses and HGVs, would improve resilience, add more capacity and, through user charging, manage demand for travel across the river. For buses, this could lead to improved reliability and more consistent and faster journey times, increased operating frequencies and, potentially, the addition of more cross-river routes to connect locations north and south of the River Thames.

F.2.7 The Silvertown Tunnel thus presents a significant new network opportunity for enhancing the current cross-river bus services and for enabling new services to become operational. This will serve as a means for improving public transport in south-east London and linking previously unconnected areas, thus opening up new labour markets, jobs and destinations for leisure and personal business. Buses are an important mode for accessing employment in east London and would provide an alternative for those people who are able to switch from car to public transport, thereby reducing congestion at the Blackwall Tunnel and providing a sustainable alternative.

Objectives

F.2.8 The objectives of this note are:

- To examine the existing situation including current demand and the current bus network and the potential for new direct links
- To examine future demand
- To outline corridors to be served by buses in future
- To illustrate an example package of routes along these corridors which has been devised for model testing

F.2.9 The study area for this note is south-east London, defined as the boroughs of Tower Hamlets, Newham and Barking and Dagenham on the north side of the Thames; and Greenwich, Lewisham and Bexley to the south.

F.3 Existing situation

Current demand

F.3.1 Data from the London Travel Demand Survey (LTDS) has been used to appraise the current levels of demand for cross-river travel in east and south east London. Due to the weighting applied to LTDS data, this cannot be provided at finer granularity than borough level. The boroughs considered here are RB Greenwich, LB Bexley and LB Lewisham on the south side, and

LB Newham, LB Tower Hamlets, and LB Barking & Dagenham on the north side of the river.

F.3.2 The figures below show the average daily trips and destinations from the host boroughs of RB Greenwich, LB Newham and LB Tower Hamlets. In order to give an indication of future demand for travel in these boroughs, the figures also show the Opportunity Areas and Areas for Intensification identified in the London Plan. All modes of travel are shown, both public and private transport.

F.3.3 The Greenwich plan shows that around 9,000 trips take place between RB Greenwich and LB Tower Hamlets and between RB Greenwich and LB Newham in each direction per day. This includes all modes. Only a small number of trips takes place between RB Greenwich to LB Barking and Dagenham. This pattern is not unexpected considering the relatively good transport provision between Greenwich and Tower Hamlets and Newham in form of the DLR and Jubilee Line, and the relatively poor connections to Barking and Dagenham. Connections from Greenwich to Barking and Dagenham involve a public transport interchange or can be made by car. Another factor (and an influence on the public transport levels) is the greater density of employment and leisure destinations in Tower Hamlets and Newham acting as greater trip attractors than those in Barking and Dagenham.

Figure F-3: Average daily trips to and from Greenwich (based on 2011-2014 data)

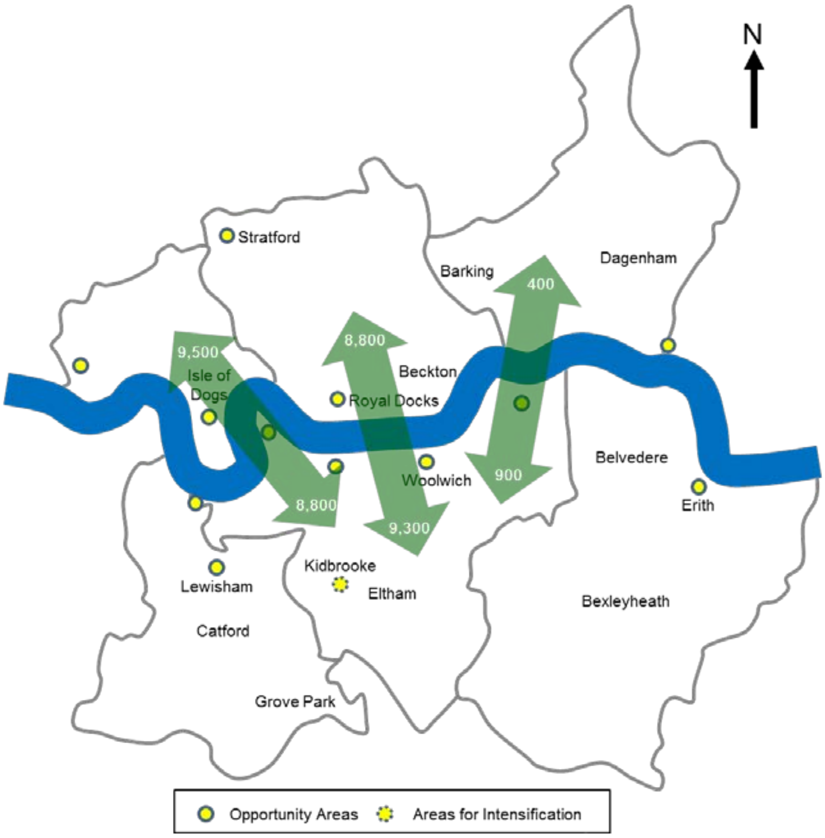


Figure F-4: Average daily trips to and from Newham (based on 2011-2014 data)

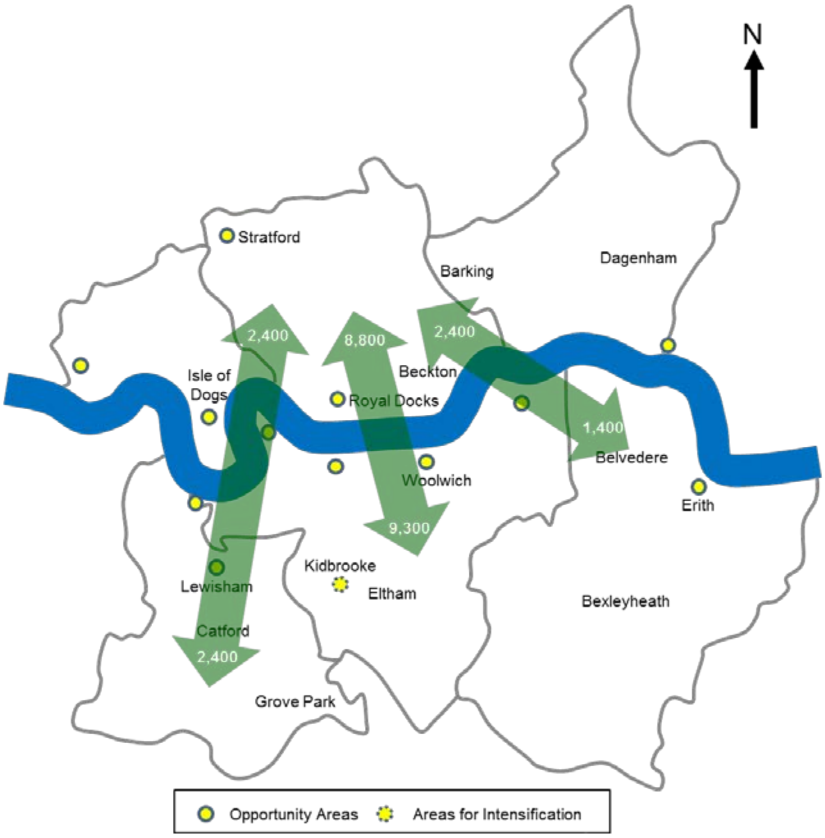
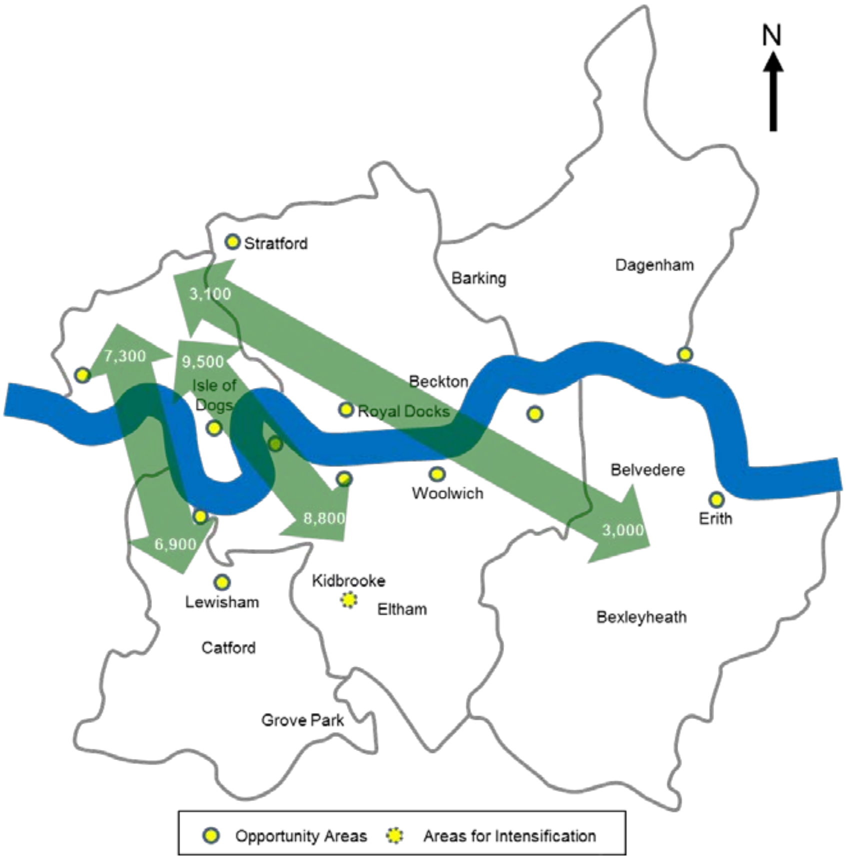


Figure F-5: Average daily trips to and from Tower Hamlets (based on 2011-2014 data)



F.3.4 The Newham plan indicates that the largest number of trips is made to and from RB Greenwich (8,000-9,000 daily each way). Around 2,400 trips take place between LB Newham and LB Lewisham in each direction. 60% of these are made by public transport which is most likely to include the DLR and bus services as well as bus/underground/rail interchanges. There are also a small number of trips between LB Newham and LB Bexley.

F.3.5 The Tower Hamlets plan shows that there is a high number of trips between LB Tower Hamlets and LB Lewisham (8,000-9,000 daily each way). Around 80% of these are made by PT as Lewisham is connected by DLR, national rail services (via the city) and is well served by bus routes to central London. There are also around 3,000 trips between LB Bexley and LB Tower Hamlets, again reflecting the situation of Tower Hamlets as a major employment destination.

F.3.6 In summary, the LTDS data presented here shows a fairly high level of current demand which is based on current trip generators and attractors and transport provision. The location of several Opportunity Areas and Areas for Intensification in these boroughs means that there is a strong potential for trips between these locations to increase in future. This is an important consideration in the development of river crossing options such as the Silvertown Tunnel.

Overview of existing bus services and network conditions

F.3.7 Unlike west London where many bus routes make cross-river movements owing to the greater availability of crossing points, there is only one bus route to the east of Tower Bridge that crosses the river at Blackwall Tunnel as shown in the figure below.

Figure F-6: Existing cross river bus connectivity east of Tower Bridge

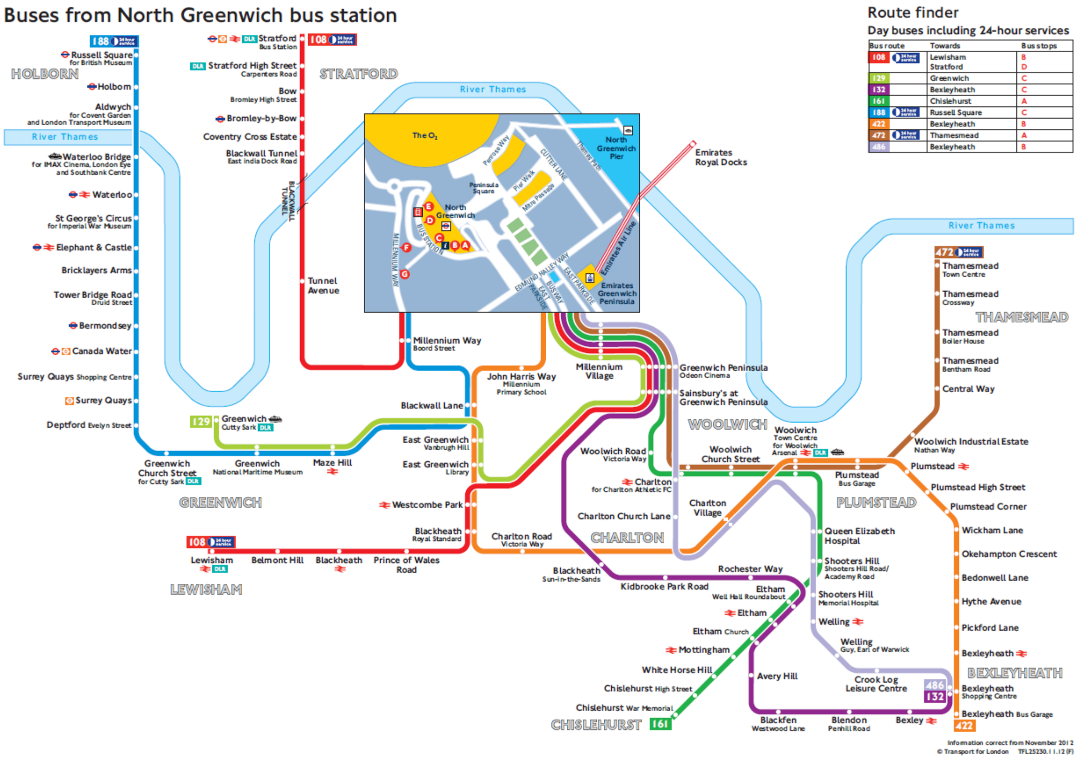
F.3.8 Bus route 108 runs from Lewisham to Stratford serving North Greenwich and crosses the river via the Blackwall Tunnel. It provides a 24-hour service with frequencies of up to six buses per hour (bph) Monday to Saturday daytimes (four bph evenings and Sundays and two bph during the night). The route uses single-deck buses due to the height constraints through the Blackwall Tunnel, though additional double-deck journeys operate in the late evening between North Greenwich and Lewisham to assist with people departing events at The O2.

F.3.9 There are around 10,400 trips per weekday on the 108 of which around 2,560 (25%) travel through the tunnel. At night there are around 500 trips per weekend night (lower on week nights) with around 62% travelling through the tunnel.

F.3.10 Therefore, locations such as North Greenwich and Greenwich Town Centre are important in facilitating bus-to-bus interchange from the wider network to the 108. A similar function is served by Stratford Bus Station and Canning

Town Bus Station on the north side. For illustrative purposes this note focuses on the south side connections and an overview of bus routes serving North Greenwich is shown in the figure below.

Figure F-7: Bus routes serving North Greenwich station



Route finder

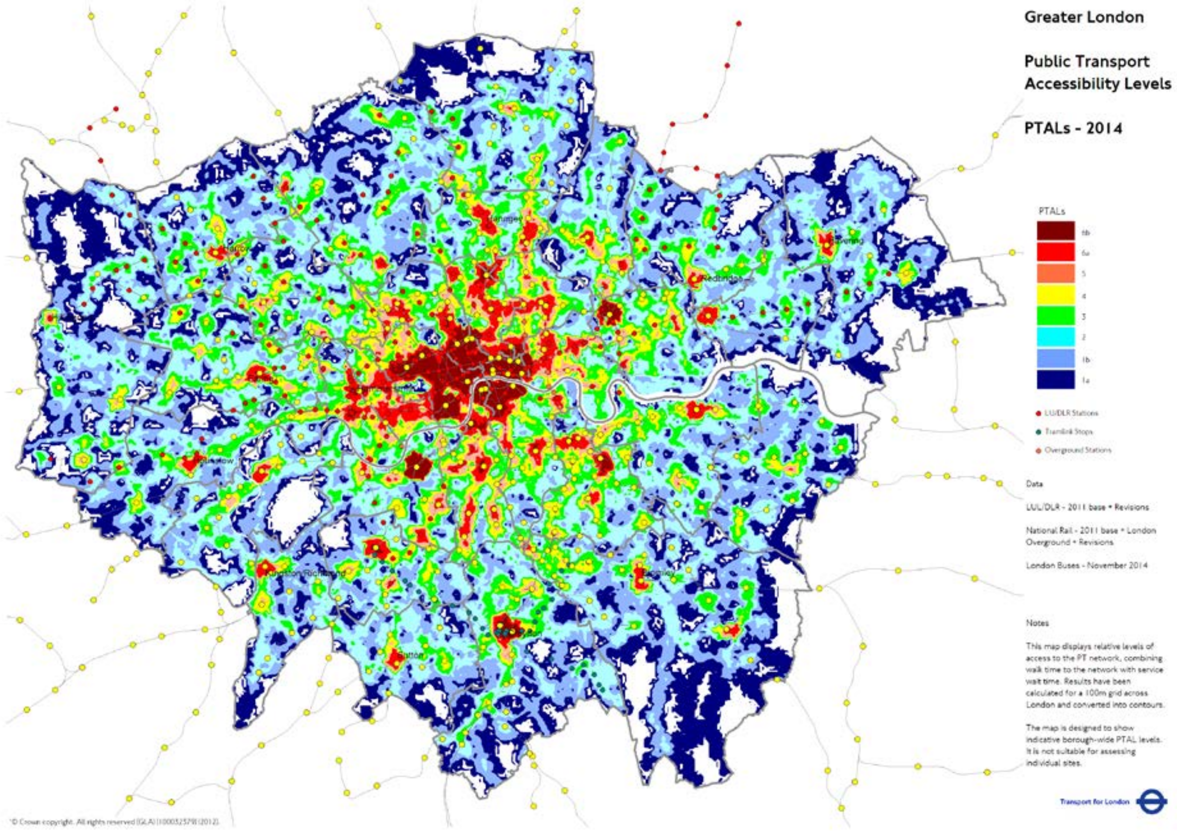
Day buses including 24-hour services

Bus route	Towards	Bus stops
108 24 hour service	Lewisham Stratford	B D
129	Greenwich	C
132	Bexleyheath	C
161	Chislehurst	A
188 24 hour service	Russell Square	C
422	Bexleyheath	B
472 24 hour service	Thamesmead	A
486	Bexleyheath	B

F.3.11 In addition to bus-to-bus or bus-to-underground interchange at North Greenwich, the Woolwich Ferry piers are well integrated with local bus routes. This enables passengers to travel from the south or east of Woolwich by bus, alight and then cross the river as a pedestrian using the Woolwich Ferry, before boarding another bus service to reach Canning Town or Stratford.

F.3.12 Public transport accessibility in east and south-east London is generally poorer compared to central and west London. The figure below provides an overview of Public Transport Accessibility Levels (PTALs) across London. The hotter the colours, the higher the levels of public transport accessibility are.

Figure F-8: Greater London Public Transport Accessibility Levels



F.3.13 The rail network largely provides radial links to central London and current bus networks converge on key station hubs, leading to rail-heading, and provide a certain amount of infill coverage to local centres.

F.3.14 Due to the comparative ease of implementation and route flexibility buses are the ideal public transport solution to meet rapidly emerging demand and to provide orbital connections between south east and east London. North Greenwich is therefore an important transport hub, and although served by a number of bus routes, these do not consistently reach into all parts of the borough and beyond.

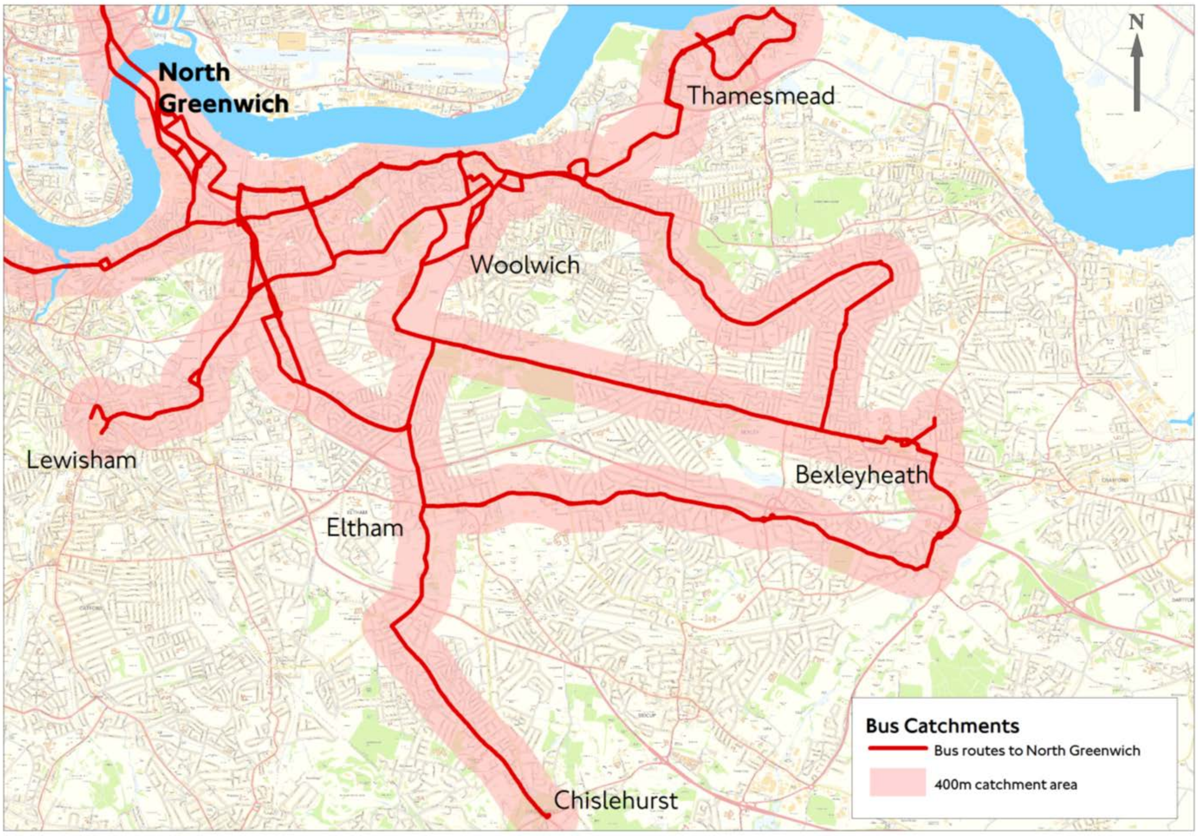
F.3.15 The figure below illustrates that although the northern edge of Greenwich is well served by direct routes to North Greenwich, large parts of Plumstead and Eltham (in RB Greenwich) and parts of the neighbouring boroughs of Bexley and Lewisham do not lie within 400m of a direct bus route to North Greenwich. These include the population centres of:

- East Thamesmead (LB Bexley);
- South of Woolwich Town Centre including Plumstead (RB Greenwich);
- Eltham (RB Greenwich);
- South Lewisham (LB Lewisham);

- North East Kidbrooke (RB Greenwich).

F.3.16 However, the majority of these areas do lie within 400m of a bus route which enables the opportunity to undertake a bus-to-bus interchange in order to access North Greenwich or bus-to-rail interchange to access other parts of London including those north of the Thames. This is, of course, a longer and more costly journey than a direct connection, and may act as a deterrent to using PT for this type of trip, or as a deterrent to undertaking the trip at all.

Figure F-9: Extent of south east London region within 400m of a bus route which provides connections to North Greenwich



F.3.17 Finally, at present in the event of a cross-river disruption of the Jubilee Line at North Greenwich, the alternatives are limited including the DLR and foot tunnel at Greenwich to the west and the DLR and foot tunnel at Woolwich to the east as well as the EAL. Additional cross-river bus services provide additional alternatives in such circumstances.

F.4 Future situation

Future demand

F.4.1 The figures below show population and employment projections for a range of London Transportation Studies (LTS) zones. These show high levels of population growth in south-east London; particular hot spots including

Kidbrooke, Eltham, Greenwich riverfront as well as north and central Lewisham including Catford. Clusters of employment growth to the north of the river include the Isle of Dogs, Beckton, the Royal Docks and Stratford. Cross-river bus services present an opportunity to connect the areas of population growth with employment.

F.4.2 The centres of population and employment growth will generate new demand for public transport. Conversely, the introduction of new (public) transport initiatives will make particular localities for attractive for people and business, hence stimulating growth in itself.

Figure F-10: Population change by LTS zones from 2011 to 2021

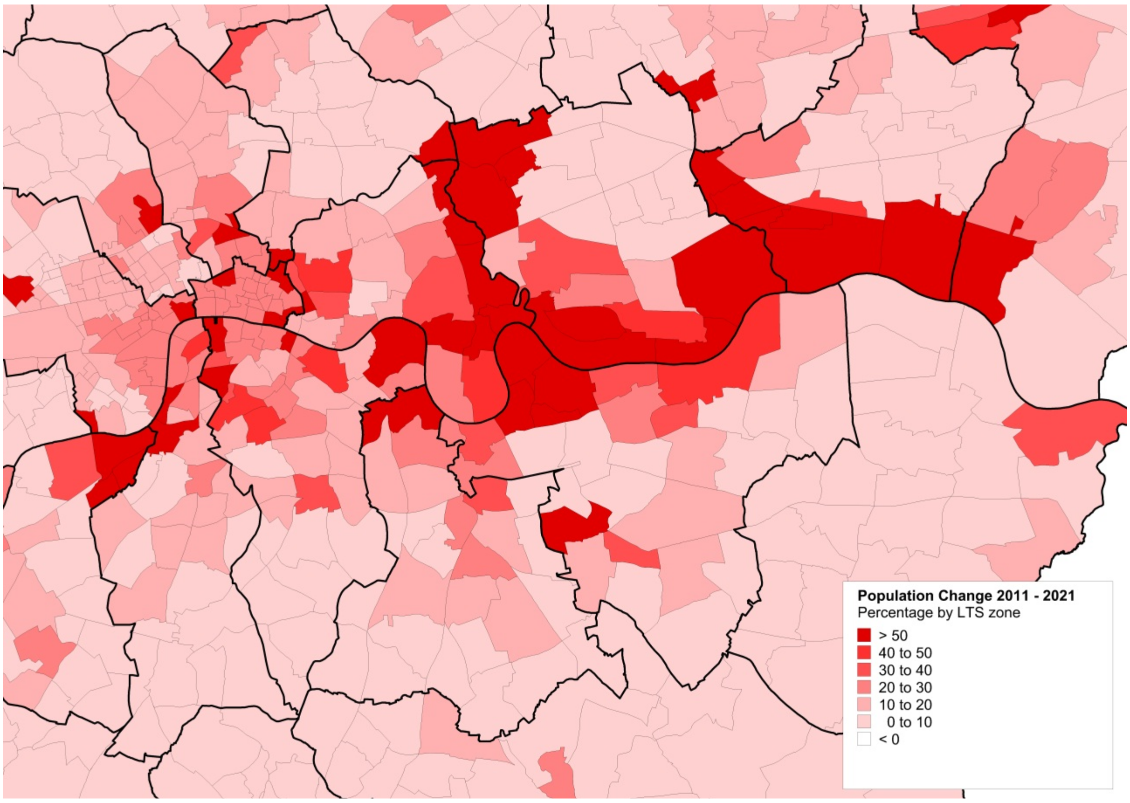


Figure F-11: Population change by LTS zones from 2021 to 2031

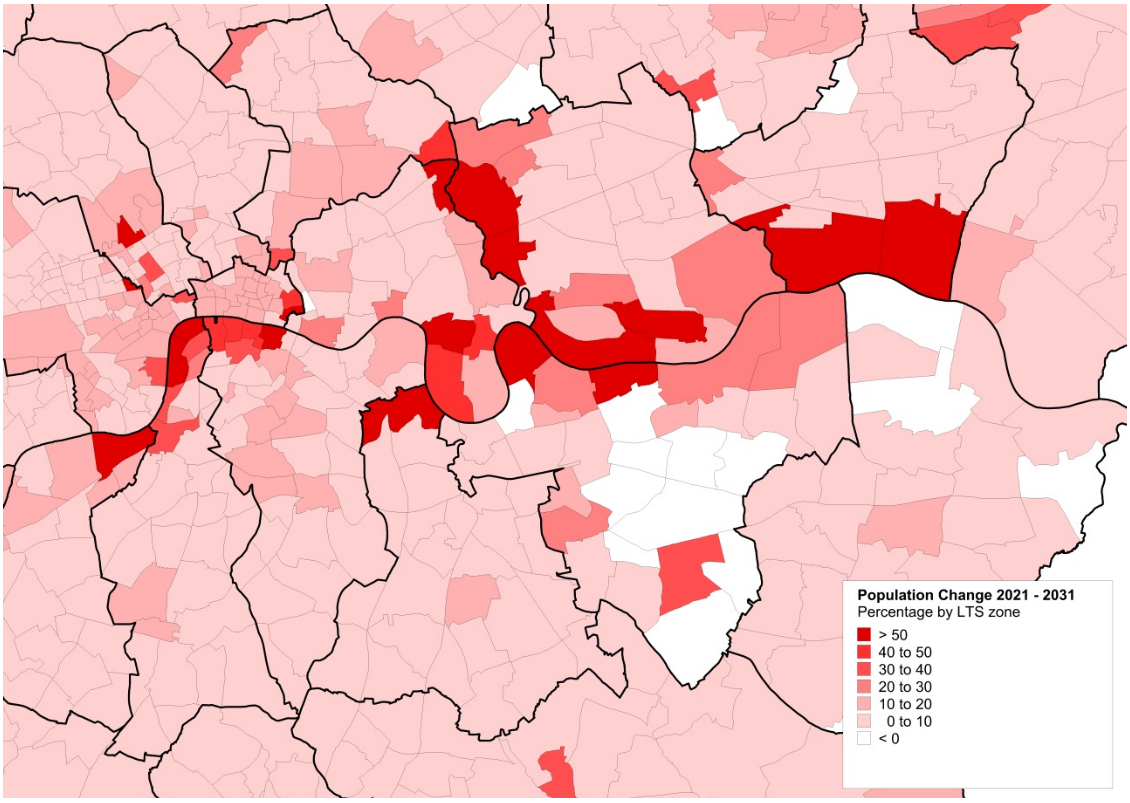


Figure F-12: Employment change by LTS zones from 2011 to 2021

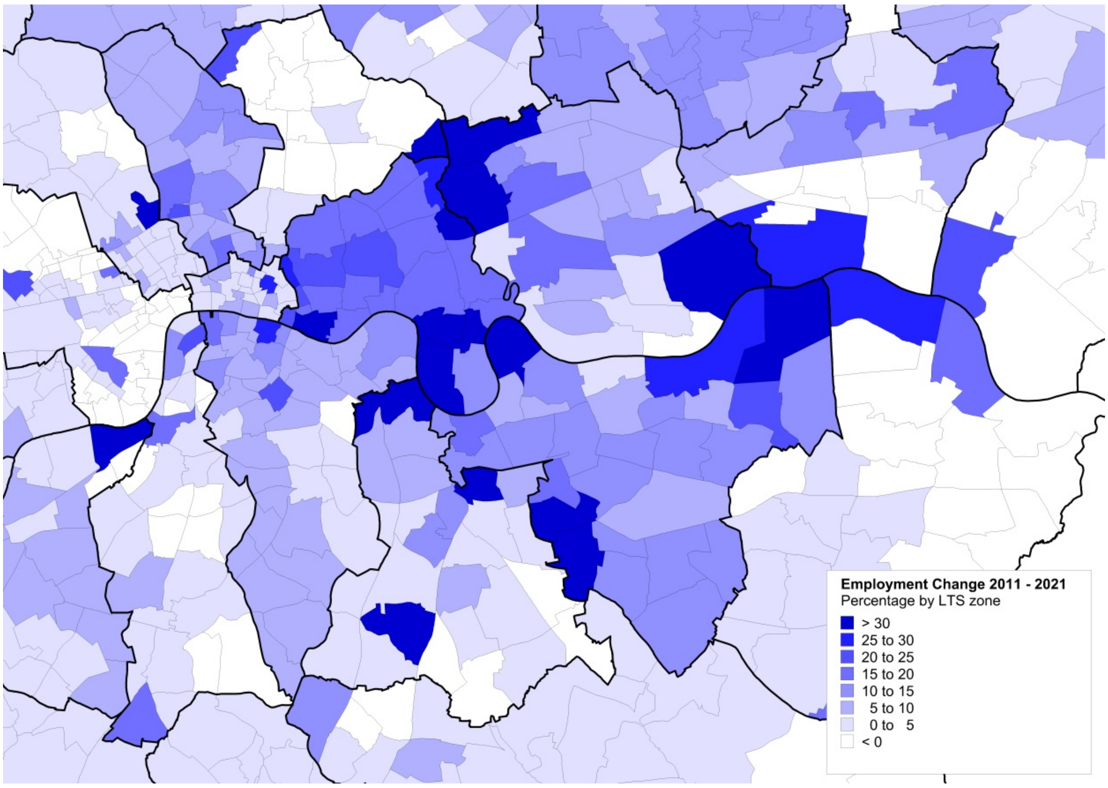
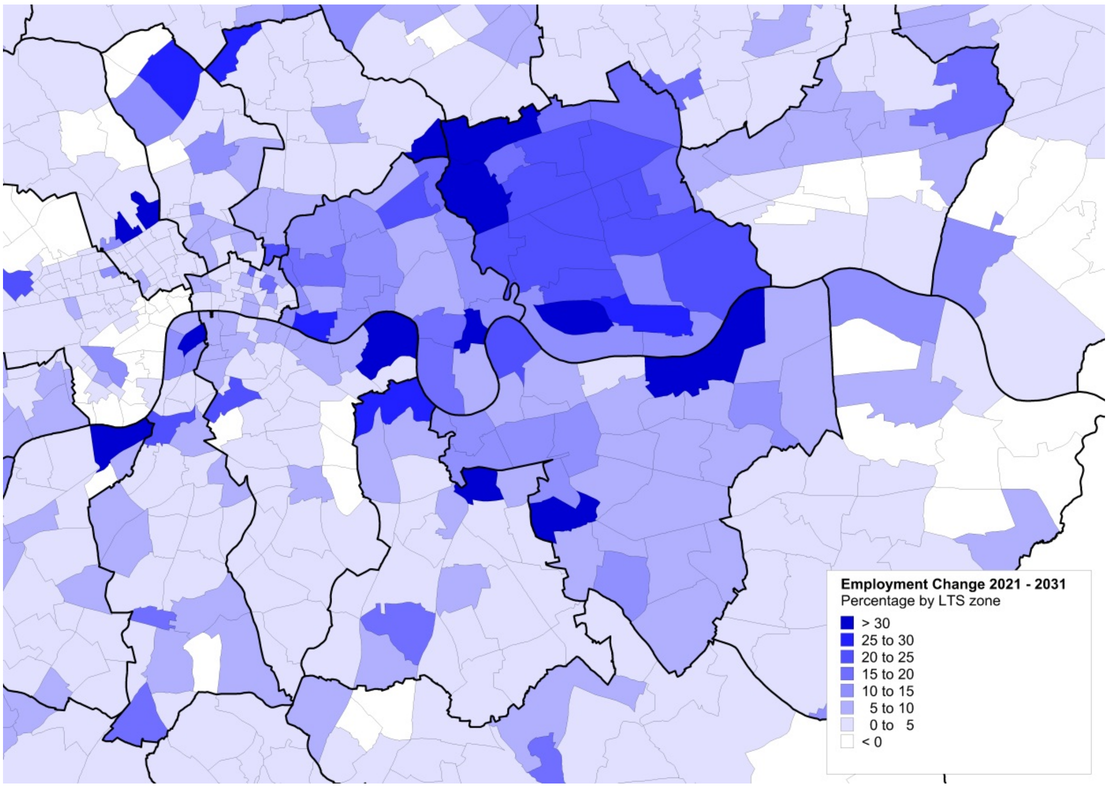


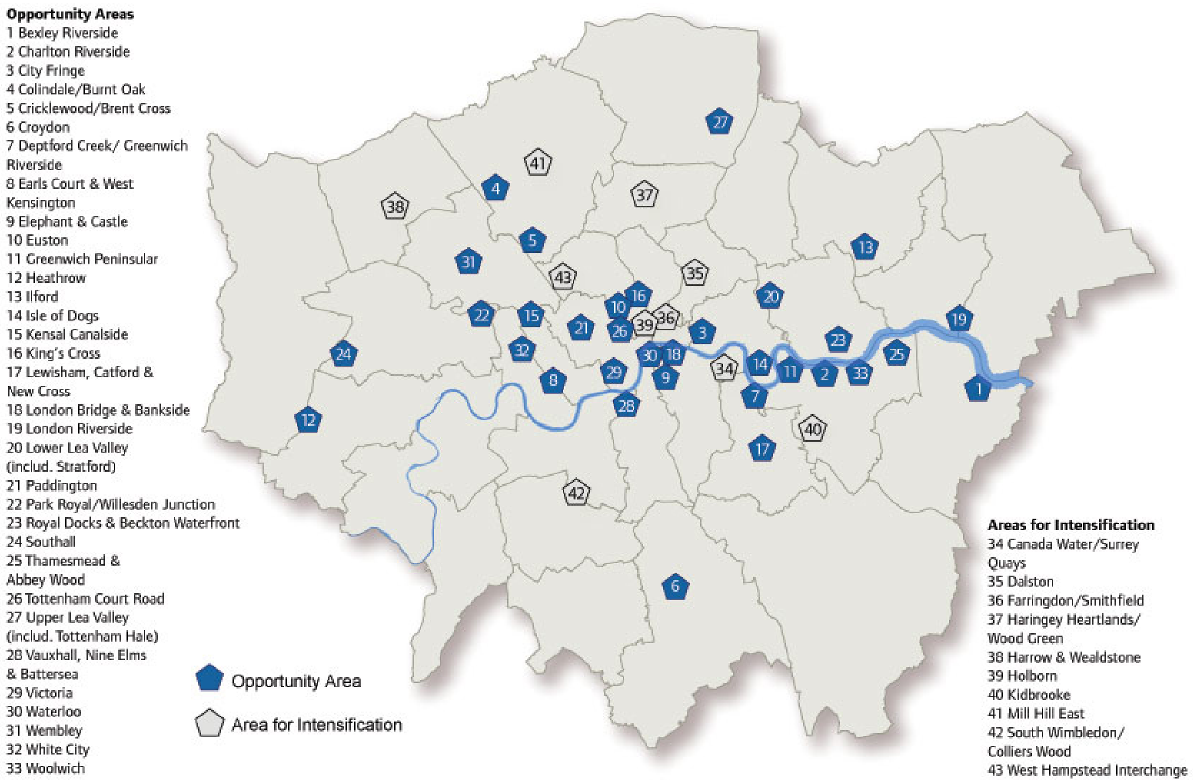
Figure F-13: Employment change by LTS zones from 2021 to 2031



F.4.3 The Mayor's London Plan identifies 33 Opportunity Areas and ten Intensification Areas. Of these, eight are located in the wider study area (see figure below).

F.4.4 The development of these areas will generate new demand between new origin and destination pairs. This could be served (at least in part) by new or extended bus routes where there are currently no direct routes. Areas where both growth is expected and there could be a benefit from new direct routes include: Greenwich Peninsula, Royal Docks and Beckton Waterfront, Charlton Riverside, Lewisham (including Catford and New Cross), Lower Lee Valley (including Stratford), Woolwich, Thamesmead and Abbey Wood and Kidbrooke.

Figure F-14: Opportunity Areas and Areas for Intensification



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Greater London Authority 100032379 (2009)

The London Plan Review Draft Consultation Plan (2009)

The potential for buses to support regeneration objectives

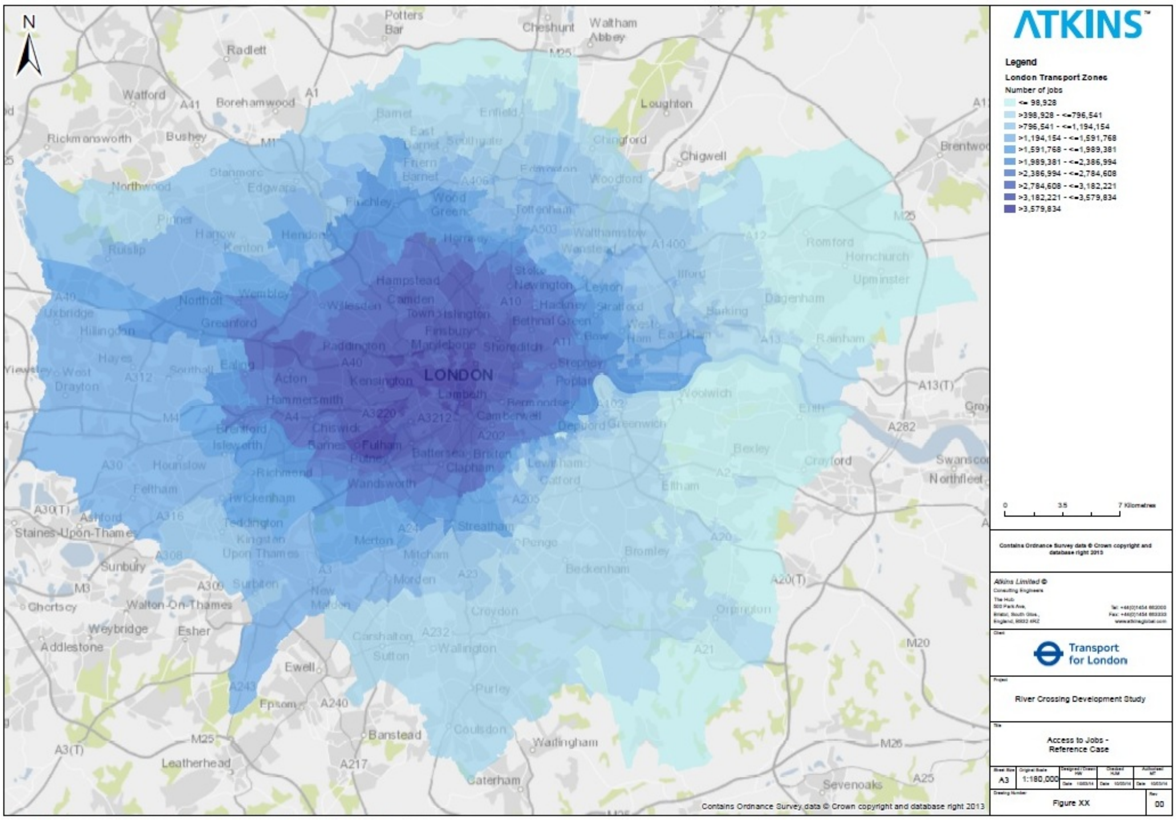
F.4.5 The growth potential within the Opportunity Areas identified is unlikely to materialise without additional investment in strategic transport links. All boroughs in east London recognise the importance of such links within their respective regeneration strategies, both in terms of supporting higher levels of inward investment and job creation, and to enable improved access to employment from within east London:

- The Greenwich Growth Strategy clearly states that its key objective is, 'to promote strategic transport links to support inward investment, business competitiveness and growth and access to key areas of employment opportunity';
- The Newham Core Strategy states that its aim is to 'secure investment in strategic transport networks which will lever investment and regeneration into Newham, further integrating the borough with the rest of London and overcome major physical barriers to movement' – it identified the need for 'strategic bus network investment, including bus priority', as a key part of this strategy.

F.4.6 Improving access to jobs for local residents is a priority for the east London boroughs as levels of unemployment are amongst the highest in the country, alongside high concentrations of deprivation, particularly on the northern side of the river.

F.4.7 High levels of unemployment and deprivation are partly a result of the relatively poor access to jobs that exists in east London, particularly by road. The figure below illustrates that large parts of inner east London have fewer jobs accessible than those in the inner west, as well as the 'cliff-edge' effect of the immediate drop off in access to jobs caused by the barrier effect of the river.

Figure F-15: Number of jobs accessible by road



F.4.8 A step change in the frequency and connectivity of bus routes serving East London is likely to have a highly beneficial effect in improving the number of jobs accessible for local residents, potentially contributing to reducing unemployment and deprivation.

F.4.9 Furthermore, businesses will have access to a greater potential labour market, making the area more attractive for inward investment and the creation of new employment opportunities locally. This is particularly important given the distribution of new employment floor space – the northern side of the river has over twice as much floor space as the south. This is likely to lead to a much greater level of demand for travel across the river. If the ability to make these journeys is constrained by limited capacity and poor reliability (as is the case currently at the Blackwall Tunnel), there is a risk that businesses and developers will choose to go elsewhere.

F.4.10 This is supported by the results of the River Crossings Business Survey undertaken in 2014, which identified that half of all businesses would take on additional employees if cross river capacity was improved. New bus routes would also be an important part of the public transport mix required to support the level of growth being planned for.

F.4.11 Work to define the change in access to employment opportunities, as well as the number of new businesses that might locate in the area is still ongoing.

The potential role of buses linking to destinations which are already served by rail

F.4.12 Further potential beneficiaries from new direct cross-river bus links are those who currently use the bus to travel to a cross-river rail connection such as the DLR, Jubilee line or National Rail. Especially lower income groups rely more heavily on buses as a form of public transport. Hence cross-river bus journeys to some destinations can offer a realistic alternative and/or additional mode choice.

F.4.13 A bus-rail interchange incurs a ‘cost penalty’. A single bus journey is currently charged at £1.50 compared to e.g. an additional £1.70 for a Zone 2 underground fare. Furthermore, in terms of time, WebTAG suggests an interchange penalty of 5 to 10 minutes of in-vehicle time for each interchange.

Future network objectives

F.4.14 Two key objectives of the Silvertown Tunnel are to improve resilience and road network performance around the Blackwall Tunnel. Achieving these objectives will unlock cross-river travel by bus.

F.4.15 Considering the current cross-river bus route using the Blackwall Tunnel (route 108), it would be expected to perform better in terms of reliability and journey times as a result of reduced congestion at the Blackwall Tunnel. At present, closures of the Blackwall tunnel (including for night-time maintenance) can result in route 108 being operated in two sections either side of the Thames, or a lengthy diversion via Tower Bridge, resulting in a poor service for passengers. With the Silvertown Tunnel in place, route 108 can be diverted via the Silvertown Tunnel in the event of closures of the Blackwall Tunnel.

F.4.16 Many other local bus routes which currently suffer delays on the surrounding road network when the Blackwall Tunnel is closed or congested will also benefit from the more reliable network with the Silvertown Tunnel in place.

F.4.17 The most important impact on public transport is the opportunities the Silvertown Tunnel will create for new cross-river bus services to improve public transport links between east and south-east London. The Silvertown Tunnel is designed to accommodate double-deck buses, thus providing operational flexibility in the bus routes that could be extended across the River Thames[66], as well as greater capacity. It is currently proposed that one lane in each direction will be reserved by buses and HGVs through the tunnel bores which will further enhance reliability and reduce bus journey times. This configuration has the potential, over time, to deliver in excess of 60 buses per hour in each direction.

F.4.18 Furthermore, the alignment of the Silvertown Tunnel will provide a new direct road link between the Greenwich Peninsula and the Royal Docks as well as Canary Wharf (via the Lower Lea Crossing) – all major growth areas. This improved connection to local land uses will enable the bus network to efficiently provide for cross-river travel demand in a manner that will be attractive to prospective bus passengers.

Future corridors

F.4.19 A potential future network of bus corridors has been developed on the basis of the above analysis and feedback received from the 2014 public consultation and from stakeholder engagement. The corridors provide direct routes where they do not currently exist, as identified in the analysis and connect areas of low public transport accessibility as well as future development.

F.4.20 The focus has primarily been on links between RB Greenwich and LB Lewisham and the north side of the Thames. This is because areas further to the east on the south side, such as Thamesmead and Plumstead will benefit from comparatively easy bus to rail interchange following the introduction of Crossrail. North of the river the corridors cover key development and employment destinations including the Royal Docks, Canary Wharf, Stratford and Canning Town.

F.4.21 Detailed bus service proposals to connect locations north and south of the river will be worked up in increasing detail nearer to the opening of the

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[66] This decision will also depend on London Buses operational planning for Silvertown Tunnel incidents since double-deck buses cannot use the Blackwall Tunnel.

tunnel. This is because lead-in times for bus route changes are relatively short (circa 2 years) which enables the future situation to be better taken into account. Linking existing communities and supporting regeneration areas will be key objectives in planning the bus service changes. Development of the bus network will be undertaken in close consultation with stakeholders and there will be full consultation on proposals before plans are confirmed. Development of the bus network will be an on-going process even after the tunnel opens.

F.4.22 It is acknowledged that not all cross-river service gaps can be filled by a direct bus route. The role of North Greenwich as a local transport hub facilitating interchange therefore becomes increasingly important.

Figure F-16: Silvertown potential for future bus corridors

F.5 Example network

F.5.1 Based on the corridors identified and comments received through the 2014 Silvertown Public Consultation[67], an example route network of 37.5 buses per hour has been developed. The purpose of this is to illustrate what a network using the Silvertown Tunnel (and Blackwall Tunnel) could look like based on expected demand and travel patterns – in terms of number, location, length and frequency of routes – and to test a set of routes as part

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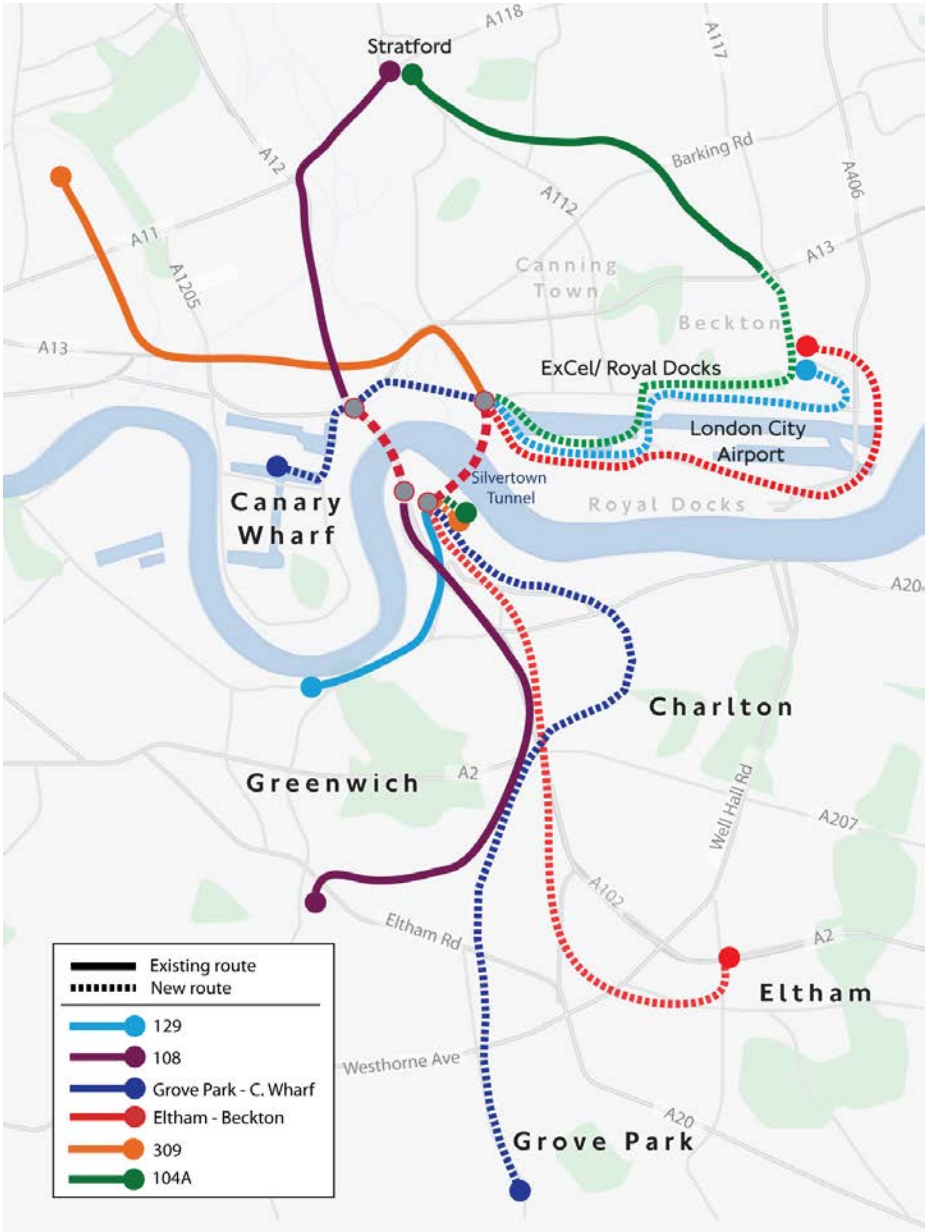
[67] Silvertown Tunnel public consultation. Analysis report. March (2015)

of the Silvertown traffic and economic assessments. An illustration of this network is shown in the figure below.

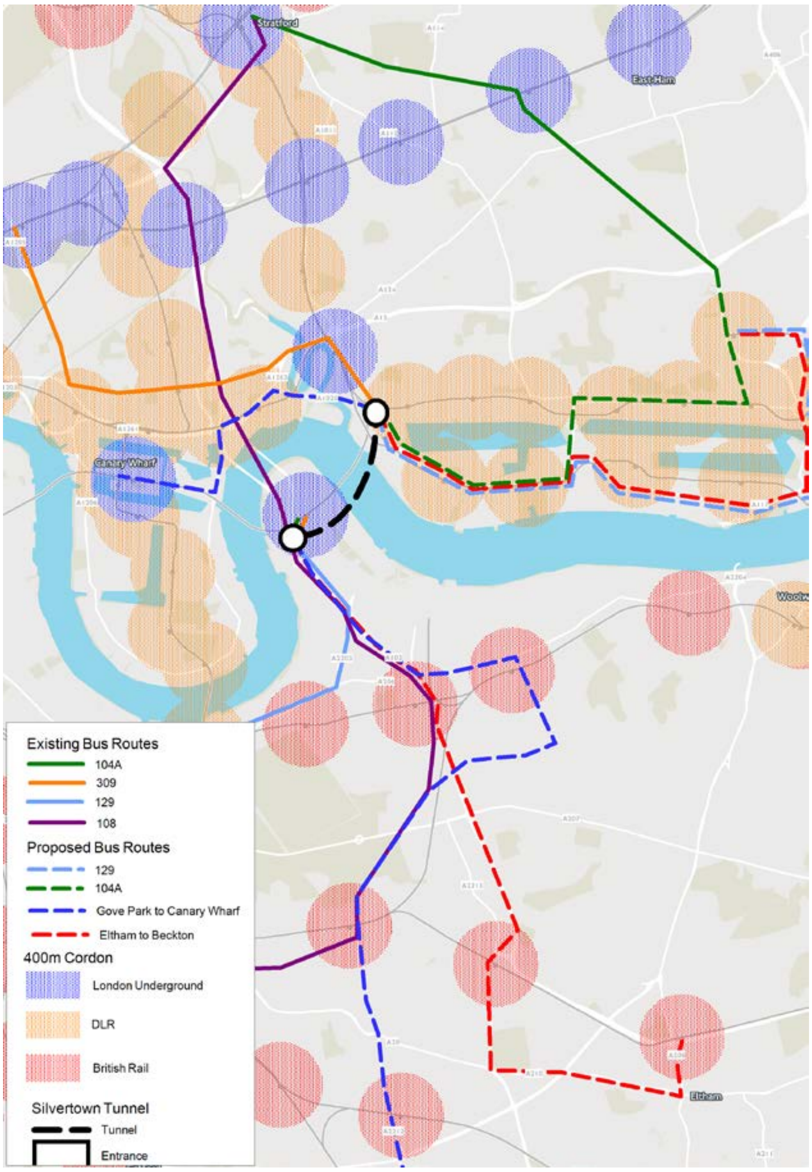
Figure F-17: Example route network



F.5.2 As stated previously, the routes shown are indicative of what may be achieved through the introduction of Silvertown Tunnel and more reliable journeys. However, further work to ascertain operating costs, passenger demand and journey times is required before individual bus route enhancements can be consulted upon and agreed. This work will follow the principles of bus network planning where a network is not prescribed for future years but develops in response to demand and grows accordingly. However, the analysis in this appendix demonstrates opportunities that are under consideration and the potential of the Silvertown Tunnel that creates the opportunities for a network with an excess of 60 buses per hour per direction in the long term.

F.5.3 The figure below shows cross-river rail catchment and the complementary nature of the tested bus network in filling in the gaps.

Figure F-18: Example route network complementing cross-river rail transport



F.5.4 The table below provides details on the routes which are set within the time and distance constraints of bus route operations.

Table F-1: Summary of the example network for model testing

Route	Summary of changes	Rationale
108 (Lewisham Town Centre/Stratford Bus Station)	Increase in frequency	Both Lewisham and Stratford are Opportunity Areas, where future development will generate and/or attract additional trips. Population and employment growth is predicted for both Lewisham and Stratford as well areas along the route such as the Greenwich Peninsula. Furthermore the improved reliability of the service as a result of Silvertown is likely to attract additional demand which will be catered for by increasing the frequency of the service.
129 (Greenwich Town Centre/North Greenwich Station)	Extension from North Greenwich to Beckton and increase in frequency	The route extension connects both Greenwich Town Centre and North Greenwich with the Royal Docks which is an Opportunity Area and a focus of significant future development. Strong population and employment growth is predicted along the entire route. The additional trips generated will require additional capacity which is addressed by the frequency increase.
309 (London Chest Hospital/Stephenson St)	Extension from Canning Town to North Greenwich	This comparatively short extension enhances the transport hub function of North Greenwich. Population and employment growth is predicted along the entire route.
104A (Manor Park/Stratford)	New route (covers part of existing 104) including extension to North Greenwich	The route was developed as part of the south Newham bus review in light of the planned development in the Royal Docks. It is therefore not yet committed. The proposed extension to North Greenwich strengthens its position as a transport hub and supports predicted population and employment growth in the Royal Docks and Stratford.
Grove Park – Canary Wharf	New route	The route provides a direct connection between south Lewisham (borough), areas of expected population growth in Charlton and Canary Wharf, thus connecting residential communities with employment. Bus to bus interchange from south east London to Canary Wharf will also be possible.
Eltham – Beckton	New route	The route provides a direct connection between Eltham and Kidbrooke (both areas where strong population growth is expected) and the Royal Docks which is an Opportunity Area as well as to London City Airport. Bus to bus interchange to the airport will also be possible.

Bus priority

F.5.5 Local bus priority will maximise the benefits of the planned dedicated bus and HGV lane through the Silvertown Tunnel. The opportunities for bus priority at the tie-in junctions will be assessed as part of the detailed design stage which is anticipated to commence in 2016.

F.5.6 TfL has highlighted the importance of future investment in bus priority and have allocated funds towards a portfolio that will support growth and improve reliability in the current TfL Business Plan.

F.5.7 The Bus Priority Delivery Portfolio will support London’s economy by reducing the impact from expected increases in traffic and congestion on bus journey times and reliability by the easing of movement of all traffic but particularly buses through key junctions along identified bus routes. It will also unlock Opportunity Areas identified in the London Plan, increasing the mode share of the bus at these locations. Achieving these aims will protect the bus passenger experience at designated locations throughout London; and enable London to continue moving, growing and working.

F.5.8 The Bus Priority Delivery Portfolio will support London’s economy by reducing the impact from expected increases in traffic and congestion on bus journey times and reliability by the easing of movement of all traffic but particularly buses through key junctions along identified bus routes. It will also unlock Opportunity Areas identified in the London Plan, increasing the mode share of the bus at these locations. Achieving these aims will protect the bus passenger experience at designated locations throughout London; and enable London to continue moving, growing and working.

F.5.9 The Bus Priority Delivery Portfolio includes a number of schemes on the local road network in the vicinity of the portals. These schemes are currently at various stages of the development and implementation process and will support growth and improve bus reliability in the vicinity of the Silvertown Tunnel. Details are shown in the table below.

Table F-2: Local bus priority measures

Location	Summary of initiative
Plumstead Road	Extension of westbound bus lane from Plumstead station towards Woolwich. At concept design stage.
Bugsby's Way	Westbound bus lane on Bugsby's Way was implemented in January 2015 by local developer as part of a Section 106 agreement.
North Greenwich	Study on Pilot Busway carried out to identify improvements to the existing busway alignment and operation. This will feed into Masterplanning work being carried out by the developer. Further bus lane schemes on Commercial Way/Bugsby's Way and Peartree Way at feasibility stage.
Asian Business Port	Potential bus only ramp linking Strait Road and Royal Albert Way. At feasibility stage.
Royal Albert Basin	Potential bus only road, east of Gallions Reach. At feasibility stage.

F.5.10 These schemes are being assessed outside of the Silvertown Tunnel project but routes via the Tunnel would also benefit from these improvements. As the detail of bus routes is being finalised, bus journey times will be assessed as part of a road network assessment. The implementation of additional bus priority measures through the Bus Priority Delivery Portfolio may be considered. Any schemes proposed for inclusion should be seen to be likely to support TfL's strategic goals and satisfy other financial and economic constraints.

F.5.11 The initial focus for scheme selection will be identifying a need for a scheme through data analysis. This selection process reviews schemes based on a combination of need, impact, deliverability and likely value for money.

F.6 Summary

F.6.1 The data presented in this appendix shows that there currently is demand for cross-river travel in the study area. This demand is focused on existing development (trip generators and attractors) and current transport provision. As described, there is likely to be significant unmet demand for cross-river bus services owing to the constraints placed on bus services by having only one river crossing in the area, and the problems of congestion and resilience associated with that.

F.6.2 In the future, this demand is likely to grow, meaning that the need for improved cross-river connections by bus is even greater. Eight Opportunity and Intensification Areas have been identified in the wider study area and significant population and employment growth is expected in this part of London.

F.6.3 A cross-river bus network via the Silvertown Tunnel would play an important role in connecting these areas. The new tunnel will provide greater capacity not only by providing an opportunity for new or enhanced routes but also by accommodating double-deck buses. It will also be a more attractive bus proposition owing to more reliable journey time and greater resilience. With the Silvertown Tunnel in place, both it and the Blackwall Tunnel will be charged, and buses are an important mitigation measure for user charging, especially where these charges (and other journey relevant costs such as fuel) exceed the cost of a bus journey.

F.6.4 As the analysis in this appendix has demonstrated, it is critical that the new tunnel is well-integrated with the wider transport and highway network in order to achieve maximum benefits. This includes putting in bus priority measures and strengthening the position of North Greenwich as a local PT hub. New and enhanced bus routes should be focused on areas where current PT provision is relatively low and where residential areas need to be connected with employment centres, and where other future provision (such as Crossrail) will not meet these needs. There is also potential for passengers to switch from current bus-to-rail journeys so all-bus trips if the routes are attractive and reliable. The design of the tunnel includes a dedicated bus and HGV lane, which in itself will help to improve journey time reliability. Buses are a highly sustainable and affordable mode of transport and can be operated flexibly in response to demand and highway conditions. The Silvertown Tunnel is an excellent opportunity to achieve more and better cross-river connections by bus.