

Transport for London

**Upper Lee Valley Transport  
Modelling and Bus Priority Study**

**BPN02 – Bus Performance and  
Challenges: Long Term  
Requirements**

Final | 8 February 2018

This report takes into account the particular instructions and requirements of our client

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

Job number 254684

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# 1 Introduction

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The Upper Lee Valley Opportunity Area (hereafter referred to as the ULV) covers an area of approximately 3,880 hectares around and along the River Lea in north-east London. The ULV stretches south of the M25 up to the Stratford Olympic Park encompassing three Outer London boroughs: Enfield, Haringey and Waltham Forest, and one Inner London borough: Hackney.

The Opportunity Area Planning Framework (OAPF) previously published by the GLA in 2013 identified the potential for 20,000 new homes and 15,000 new jobs to be delivered in the ULV by 2031.

**Since the OAPF was first published, the case for Crossrail 2 (CR2), the new rail route linking Surrey to Hertfordshire via Central London and the ULV, has strengthened.** In addition to this, a number of transport improvements have been implemented or are committed. The latest population growth projections<sup>1</sup> have shown a significantly increased growth rate, with London's short-term projection suggesting a population of 10.89 million by 2041.

**In light of the increased population growth projections and the new Crossrail 2 scheme, TfL now estimates that up to 50,000 new homes and 20,000 new jobs could be delivered in the ULV.**

Future growth will put pressure on the transport network within the Upper Lee Valley. While the proposed CR2 will play a key role in delivering sustainable growth, initiatives set in the Draft Mayor's Transport Strategy (MTS), such as the Healthy Streets agenda and an improved bus network, will undoubtedly play an important part in supporting the ULV by providing local access to wider social and economic benefits.

One of the objectives of the OAPF and MTS is to improve the 'whole journey experience' of passengers, which includes all public transport and, hence, buses. For London Buses, the MTS also sets targets to improve accessibility, reliability, and journey times, and explore new forms of operations such as on-demand services and rapid transit corridors.

TfL has appointed Arup to undertake strategic modelling and assess options for bus priority initiatives in the area in the short, medium and long term to support an update to the previous Transport Study for the OAPF and meet these policy drives.

## 1.1 Background

The first interim deliverable, the **Bus Performance and Challenges: Short and Medium Term Requirements Report**, explored the performance of the current network, drawing on BODs, Oyster and iBus information recently collected. The study then identified challenges affecting bus operations and opportunities relating to ULV growth in the short-medium term. Mitigation measures will be identified following a site visit.

Simultaneously, Arup undertook **strategic modelling in LTS, Railplan and Saturn** to represent the forecast ULV growth in the context of the 2021, 2031 and 2041 planned transport network. This work was presented to the abovementioned London boroughs and the

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<sup>1</sup> <https://data.london.gov.uk/demography/population-projections/>

GLA during a workshop. It is documented in the Upper Lee Valley Transport Study Model Forecasting Report and presentation.

In the context of the Bus Priority Study this report is the second deliverable:

- Bus performance and challenges - short and medium term requirements;
- **Bus performance and challenges - long term requirements;**
- Bus performance and challenges - recommendations.

A final report will follow, capturing the workshop discussion and conclusions and presenting the final bus priority recommendations.

## 1.2 Aims of the study

An investigation of bus network operations in the long term is crucial in light of the planned changes in growth and infrastructure for the ULV. Some areas will see a **dramatic change in terms of growth**, with major residential and employment centres coming forward where presently there is little in terms of land use and, consequently, in terms of bus service connectivity. The key planned infrastructure change will be Crossrail 2, which introduces a much higher service frequency along the West Anglia Main Line (WAML). This will likely affect travel patterns across the ULV and the relationship between rail and bus interchange.

This report draws on the previous Transport Study to anticipate the long-term implications for bus network performance in a **with/ without Crossrail 2 future scenario**. This report aims to:

- **identify the bus priority measures**, enhancements to service frequencies and/or provision of new links **with and without further rail improvements**;
- **critique** TfL's existing list of **bus priority locations** as to their applicability and accuracy **for the with/without rail improvement** long term scenarios; and
- **determine** the extent to which active travel '**switchable trips**' may have an **impact on bus demand** in the long term.

## 1.3 Document structure

This document is organised as follows:

- **Section 1: Introduction** - providing the background to the study and identifying the objectives;
- **Section 2: Assessment data and methodology** – describing the information forming the basis of the analysis and stating the methodology adopted;
- **Section 3: Bus network performance in the long term** – presenting the bus network key findings related to a with and without Crossrail 2 scenario;
- **Section 4: Challenges and opportunities** – summarising opportunities and challenges of the with and without Crossrail 2 scenario; and
- **Section 5: Conclusions and recommendations** – reporting the key findings and presenting the areas for improvement.

## 2 Assessment data and methodology

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### 2.1 Introduction

The London bus network is dynamically reviewed and changes are introduced relatively quickly in response to evolving transport needs. The network review, plan and procurement system contributes to this successful management. Currently the route service contracts run for five years with the potential for a two-year extension period based on performance. **This system allows a timely revision of the network needs whilst providing an incentive for operators to meet standards of quality and good performance.**

The five-yearly bus network review process means that the constraints and opportunities identified in this report for the long term (15 to 20 years' timescale) can be regarded strategically, and their local applicability will be reviewed within the five-yearly system at the appropriate time. **Specific routes may change in the intervening period, but the principles outlined in this report should still apply.**

### 2.2 Data and analysis methodology

#### 2.2.1 Methodology

This bus study has been informed by the strategic models developed for the ULV Transport commission, alongside information on planned growth and infrastructure. The outputs of the models and forecast growth, alongside bus specific aspirations identified in the MTS, form the basis of identifying challenges and opportunities for a 'with' and 'without' Crossrail 2 (CR2) scenario.

Once the challenges and opportunities of the 'with' and 'without' Crossrail 2 case have been identified, commentary on network coverage, capacity and interchange in the long term is provided at a more local scale looking at specific corridors and interchanges.

**Careful interpretation is required in the Transport Study models as they do not allow for an all-round understanding of bus performance** - for instance, only the morning peak period has been modelled. Nevertheless, the morning peak is the most critical period for bus network performance and, given the objectives set for this study, the data and methodology set here are fit for purpose.

#### 2.2.2 Data and assumptions

##### Transport Study inputs

Railplan and HAM are part of the Transport Study suite of models. They have undergone local validation and have been found suitable for this commission. The forecast bus network performance in the long term was determined by observing the ULV Transport Study models' performance in the context of buses and highways.

The Transport Study model scenarios which have been reported are:

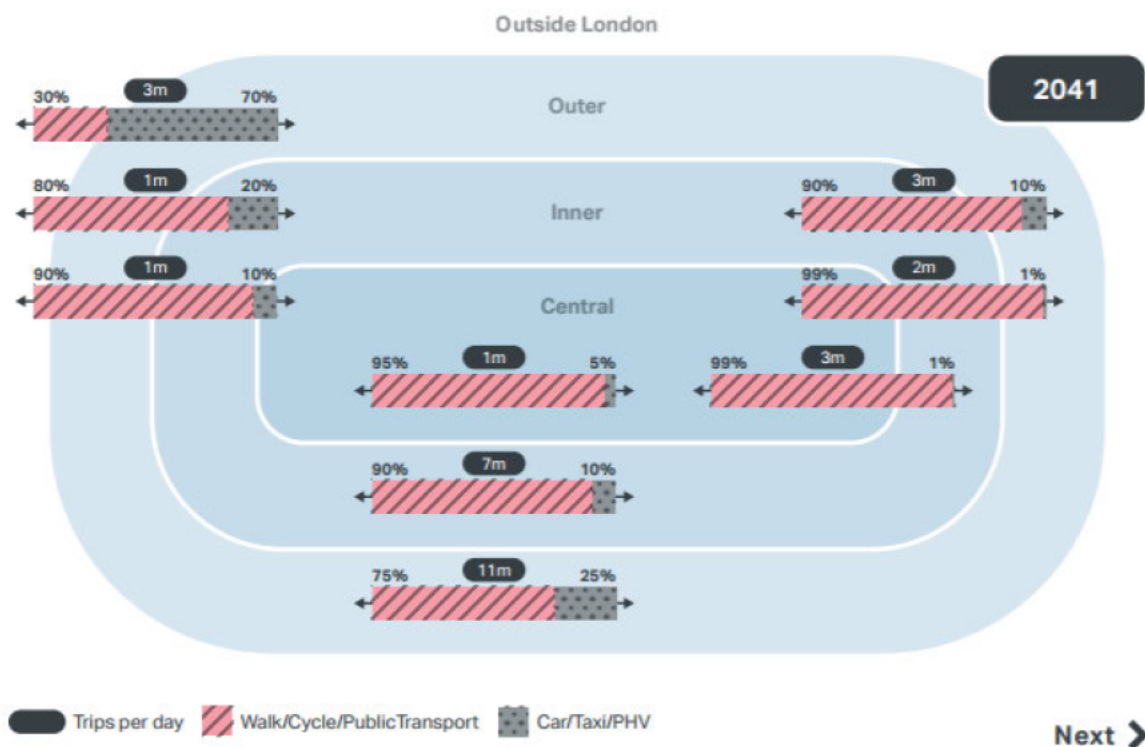
- ULV 2031 Forecast model – including the committed infrastructure and the latest ULV development forecast;

- ULV 2041 Forecast model - including the committed infrastructure plus Crossrail 2 and the latest ULV development forecast; and
- ULV ‘switchable trips’ (or ‘low car’) test – including the infrastructure as described above but assuming a higher sustainable and public transport mode share for the ULV developments.

Following discussion with TfL, the first two scenarios were deemed suitable to identify the ‘with’ and ‘without Crossrail 2’ future cases.

The last scenario is a Sensitivity test<sup>2</sup> looking to provide an indication of the effects of a higher public transport and sustainable trips mode share in the ULV. This last test should be regarded in the context of the Draft MTS, which is aiming to deliver in the 80% of London travel by sustainable modes or public transport in the long term (Figure 1).

**Figure 1 Mode shares for travel within and between Central, Inner and Outer London (source: Draft MTS, GLA 2017)**



Railplan reports on the rail, London Underground and bus networks. It is the industry software used to forecast the most likely travel patterns and user choices in a public transport network<sup>3</sup>.

Outputs from Railplan were used to inform this study, showing:

<sup>2</sup> For the purpose of this study the ‘switchable trips’ have been represented in the models following the TfL ‘low car’ methodology redistributing trips from the highways (HAM) to the public transport (Railplan) models.

<sup>3</sup> Specifics on the models including the committed and planned infrastructure can be found in the ULV Forecast Report



- The forecast bus passenger volumes;
- The rail to bus interchange passenger volumes; and
- The bus network saturation.

### **Highway Assignment Model (HAM)**

TfL's North London Highway Assignment Model (NoLHAM) considers the routing of vehicles and congestion on the London road network. The model also assesses delays generated at junctions and on long stretches of road to determine which routes vehicles are likely to travel along.

The NoLHAM model was consulted<sup>4</sup> to inform the understanding of future road network performance and requirements and indicate which corridors are likely to need priority measures to support growth.

### **Growth assumptions (LTS)**

The ULV growth assumptions were provided by the boroughs and TfL at the start of the Transport Study and were then processed through the London Transportation Studies model (LTS). LTS is a strategic multi-modal model and is used to prepare forecast travel growth for the assessment of large infrastructure and policy changes.

Considering the proposed CR2 alignment and latest population growth projections, TfL estimates that the ULV could provide up to 50,000 new homes and 20,000 new jobs. Furthermore, additional growth could be accommodated along the CR2 route outside the ULV. For the purpose of this present study, Broxbourne (north of the M25) is accounted for in the growth projections as this would have an effect on the ULV transport network.

Assumptions used to inform LTS are set out in **Section 3**, distinguishing between development dependent on CR2 and development which is not dependent on CR2.

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<sup>4</sup> Specifics on the models including the committed and planned infrastructure can be found in the ULV Forecast Report

## 3 Bus network performance in the long term

### 3.1 Context – the ULV in the long term

#### 3.1.1 Forecast growth

##### Overall ULV growth

Information provided by TfL and the relevant boroughs shows that by 2031, the Upper Lee Valley and Broxbourne area could benefit from an additional 89,000 new households and 46,000 new jobs compared to the 2011 baseline. **This forecast includes the ULV Crossrail 2 dependent development, which is estimated to account for an overall 8% by 2031 and 100% by 2041.**

The tables below illustrate the household (**Figure 2 and Table 1**) and employment (**Figure 3 and Table 2**) anticipated growth experienced in a number of key areas within the ULV for 2031 and 2041, in comparison with the 2011 baseline numbers.

**Figure 2 ULV household growth assumptions by borough**

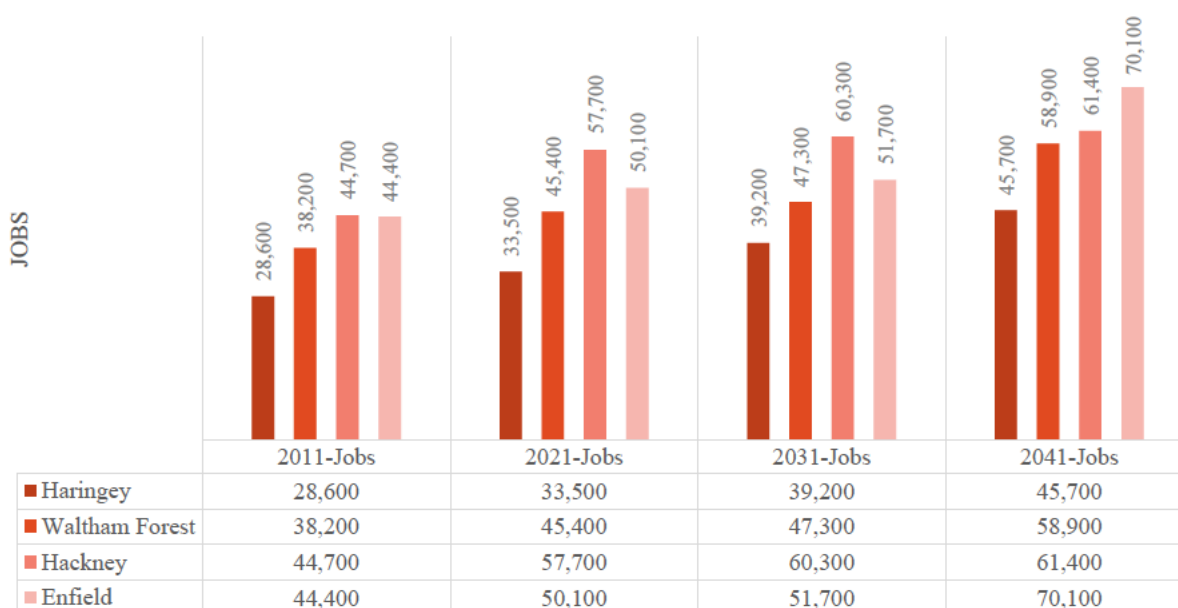


**Table 1 ULV Forecast household growth**

Area	% Growth 2011-2031	% Growth 2011-2041
Northumberland Park/ Tottenham Hotspur	>100%	>100%
Meridian Water	>100%	>100%
Blackhorse Lane AAP	>100%	>100%
Tottenham Hale	>100%	>100%
Manor House	75%-100%	>100%
Woodberry Down	75%-100%	>100%
Enfield Lock	<20%	50%-75%
Brimsdown	<20%	>100%
Ponders End	20%-50%	>100%
Lee Bridge	75%-100%	>100%

The forecast household growth assumptions above show that by 2031, the southern area of the ULV is predicted to experience the greatest increase in housing in areas such as Meridian Water and Tottenham Hale, with northern areas such as Brimsdown and Enfield Lock experiencing a similar growth rate by 2041.

**Figure 3 Employment growth assumptions by borough (source: LTS rounded figures)**



**Table 2 ULV Forecast employment growth**

Area	% Growth 2011-2031	% Growth 2011-2041
Northumberland Park/ Tottenham Hotspur	50%-100%	>100%
Meridian Water	25%-50%	>100%
Blackhorse Lane AAP	10%-25%	50%-100%
Tottenham Hale	>100%	>100%
Manor House	50%-100%	>100%
Woodberry Down	50%-100%	>100%
Enfield Lock	25%-50%	50%-100%
Brimsdown	10%-25%	25%-50%
Ponders End	10%-25%	50%-100%
Lee Bridge	10%-25%	>100%

By 2041, all areas within the ULV are forecast to experience an increase in jobs to some extent. Most areas will have achieved at least a 50% increase, with some areas experiencing an increase in excess of 100%.

**Not evident from the above statistics, but equally important to highlight, is the change of employment type.** Planning policy objectives for the ULV seek to encourage a move away from industry and warehouse type employment land use to a more office and retail industry based land use.

The forecast growth in employment and housing in the long term will shape new travel patterns within the ULV, and between the ULV and the wider area.

### 3.1.2 Bus network proposals

#### The Draft Mayor's Transport Strategy (MTS)

The Draft Mayor's Transport Strategy (June 2017) sets a vision of improved reliability and journey experience on public transport and improved streets for all Londoners, with a focus on the quality of the environment and encouraging people to walk and cycle more. For buses, the MTS sets specific objectives:

- **Convenience** – buses should be available where and when needed;
- **Reliability** – buses should be achieving the target performance;
- **Accessibility** – an increased proportion of the network should be accessible for people with disabilities;
- **Whole journey experience** – buses are often part of a Londoner's journey (even as a connecting mode) and, as such, buses should offer a better quality of journey experience;
- **Well-designed gateways** – bus stations and facilities are busy thoroughfares and points of reference for communities, they should be easy to use and orientate through; and
- **Affordability** – the Mayor has committed to keeping fares fixed until 2020 and has implemented the hopper fare on buses.

The MTS also identifies specific policies and proposals in the context of a 'with Crossrail 2' scenario.

**Policy 13** states that *the quality of bus services will be transformed to offer faster and more reliable [...] public transport while being integrated with and complementing rail and underground networks.*

The integration of buses and rail services is particularly key in the context of Crossrail 2. Considering the change in bus to rail interchange passengers, there will most likely need to be an enhancement of the current infrastructure facilities to meet the 'whole journey experience' and 'well-designed gateways' MTS objectives.

The MTS also describes *the need to accommodate changing travel demands* and suggests *measures should include new type of services such as express routes, to cater for the changing patterns of demand.*

Provision of new direct and express services connecting new centres with CR2 stations may need to be considered in order to strengthen orbital connectivity. Express orbital services may

attract significant demand in future, according to the land use patterns of employment and housing in the ULV.

The MTS identifies the ULV as an opportunity area and **Policy 17** highlights that *to support the new growth in suburban London there will be the need to use the full public transport network, by means of extending the public transport where needed.*

Public transport in general, and buses in particular, has a role to play in the promotion of the night-time economy, providing 24-hour accessibility. 24-hour operation of bus routes in the ULV should be reviewed in the absence of night services on other public transport modes.

CR2 could provide the infrastructure needed to support 200,000 new homes and 200,000 new jobs, but could also present an impetus for people to use public transport and walk and cycle to the stations. As part of the CR2 package, new bus services could support development of parts of the Upper Lee Valley, encouraging sustainable travel.

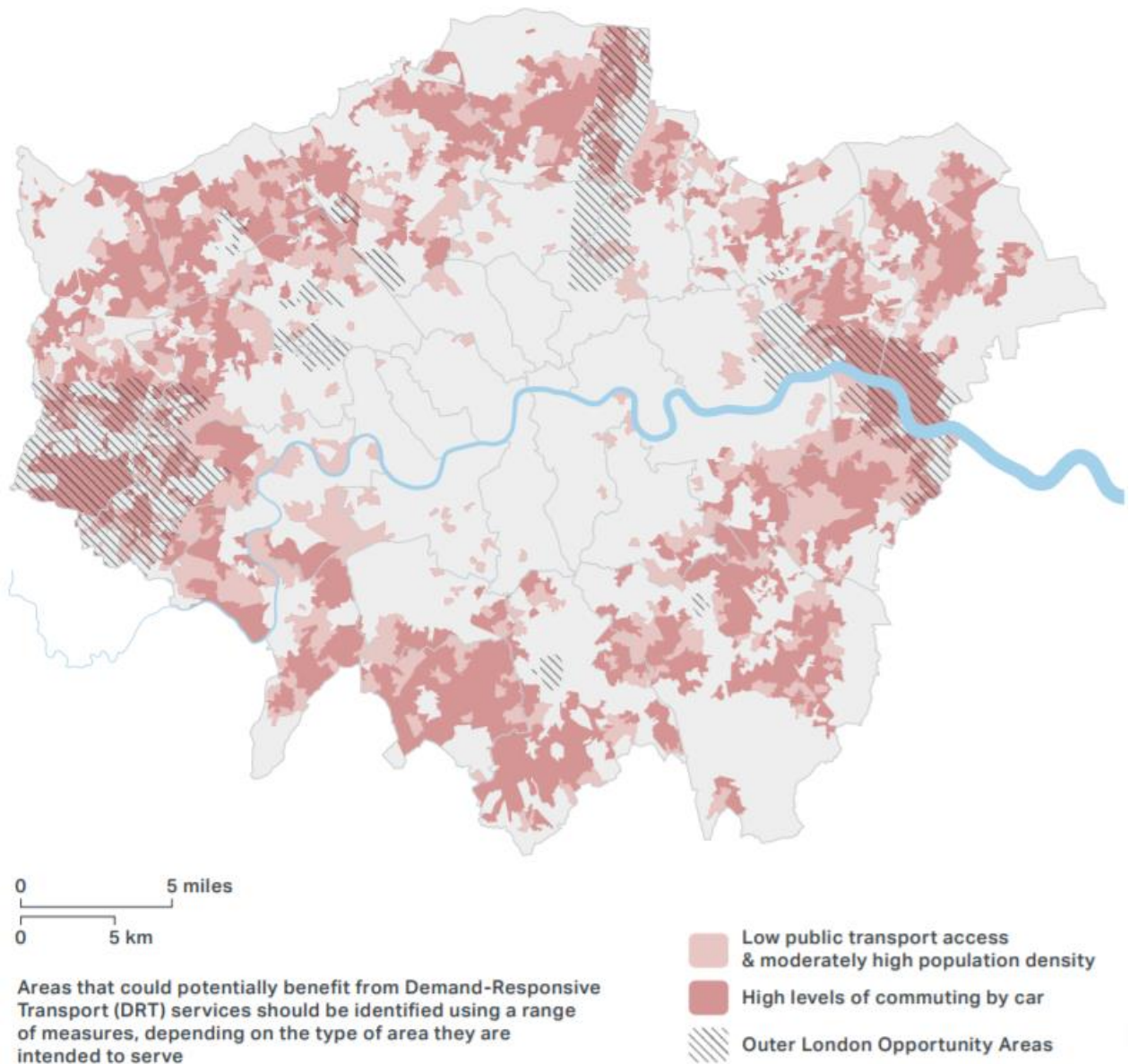
**Proposal 85** states that *major transport infrastructure should be complemented with improvements to local bus services, bus priority and infrastructure to enable high-density development and thus spread the benefits of the investment.*

With CR2 in the ULV therefore there are opportunities for further improvements on the local bus network, to bring wider benefits.

**Proposal 86** introduces bus transit networks in outer London Opportunity Areas: *the Mayor, through TfL and the boroughs, will pilot bus transit networks in outer London Opportunity Areas with the aim of bringing forward development, either ahead of rail investment, or, to support growth in places without planned rail access.*

This is applicable to a ULV scenario with or without Crossrail 2. In addition to conventional bus transit networks, it is important to explore new ‘mobility’ models that might enable wider growth e.g. demand-responsive services where demand may not be high enough to introduce a regular bus service. The MTS identifies Outer London areas with low PTAL and high car reliance as opportunity areas in which to explore demand-responsive transport. The northern section of the ULV (within LB Enfield) is one of these areas, as shown in **Figure 4**.

**Figure 4 Areas that could benefit from demand-responsive transport services (source: Draft MTS, GLA 2017)**



The MTS also provides an indication of the bus improvements programme within the implementation plan, indicating the cost and timescale of each key initiative (**Table 3**).

**Table 3 MTS bus improvements programme (source: MTS Implementation Plan)**

Bus	Cost	Short Term 2017-2020	Med. Term 2020-2030	Long Term 2030-2041
Retrofit and procure cleaner buses	M	✓	✓	✓
Develop bus network to meet existing and future demand	M	✓	✓	✓
Deliver wheelchair-accessible bus stops	L	✓		
Deliver bus priority network	M	✓	✓	
Deliver the LEBZ (including bus priority)	L	✓	✓	
Pilot bus transit networks in Opportunity Areas	L		✓	✓
L=low (<£100m) M=medium(£100=£1bn) H=high(>£1bn)				

### ULV Opportunity Area Planning Framework (OAPF)

The previous Transport Study accompanying the OAPF did not consider buses in relation to Crossrail 2 specifically, although a comprehensive analysis of bus network operations and performance in supporting ULV growth up to 2031 was carried out, and noted:

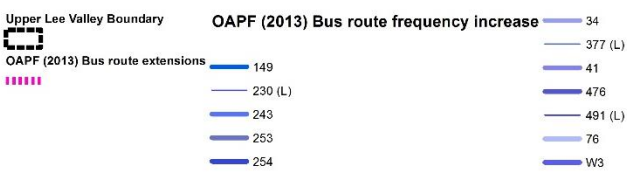
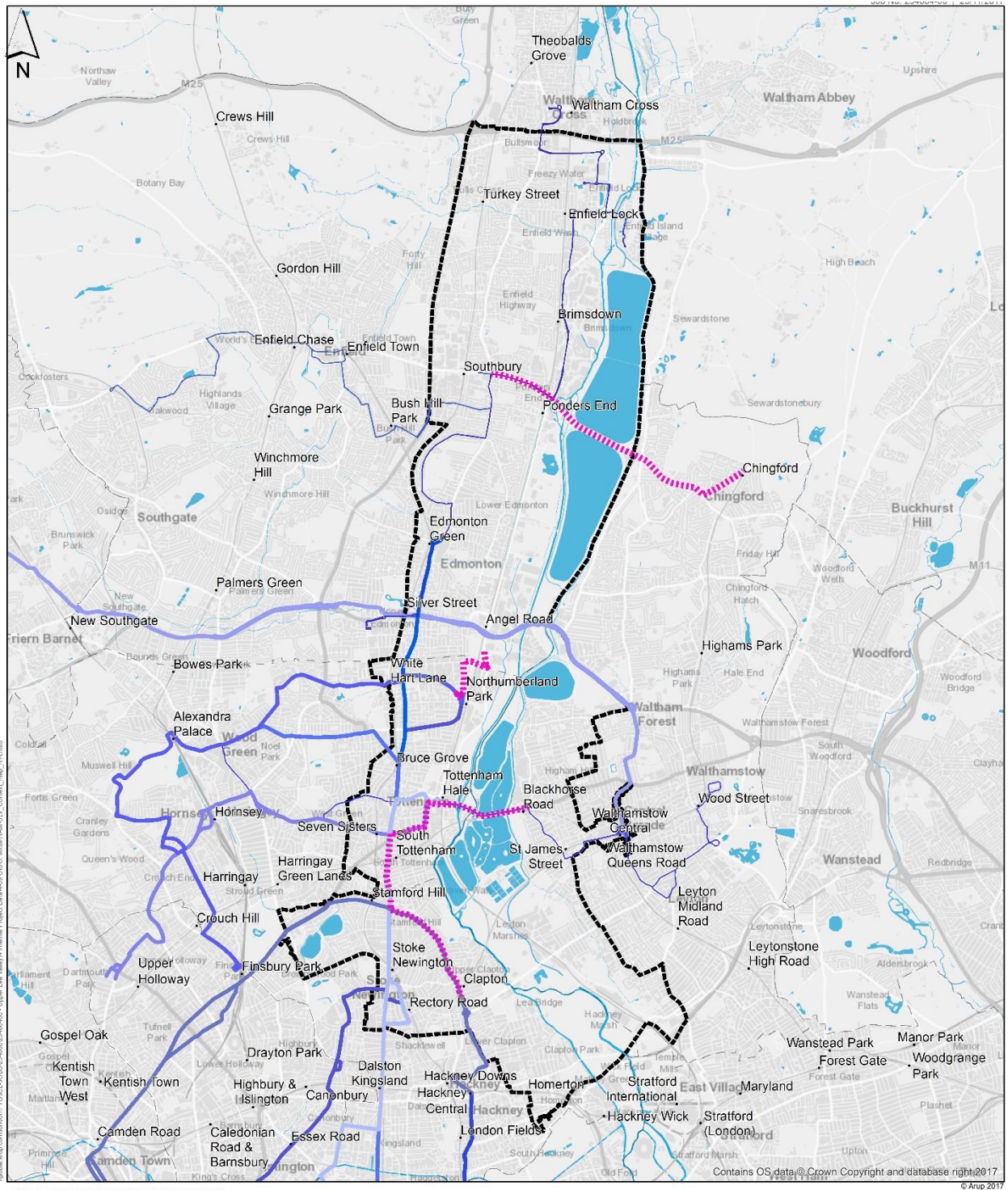
*The A1010 corridor from Tottenham Hale to Edmonton Green and Turkey Street has a particularly high bus usage and this correlates closely with the Opportunity Area's pockets of high population density and relatively low car ownership. Whilst there are some areas that are less well served, these largely consist of low density industrial areas or undeveloped sites where demand is not currently perceived to justify increased service provision. The bus network will come under strain as a result of growth in the Opportunity Area and there will be a need to improve bus services to cater for the extra demand.*

As part of the previous Transport Study, proposals for new bus routes were presented:

- Route LV1 from Brimsdown to Tottenham Hale via Meridian Way/Watermead Way with a frequency of 5 buses per hour (bph); and
- Route LV2 from Tottenham Hale to Walthamstow via Watermead Way, Angel Road, North Circular, Chingford Road and Hoe Street with a frequency of 5 bph.

Indicative bus service changes were also identified to support growth in the Upper Lee Valley. These are shown in **Figure 5**, illustrating changes to frequency or routes extensions.

**Figure 5 ULV OAPF (2013) bus improvements**



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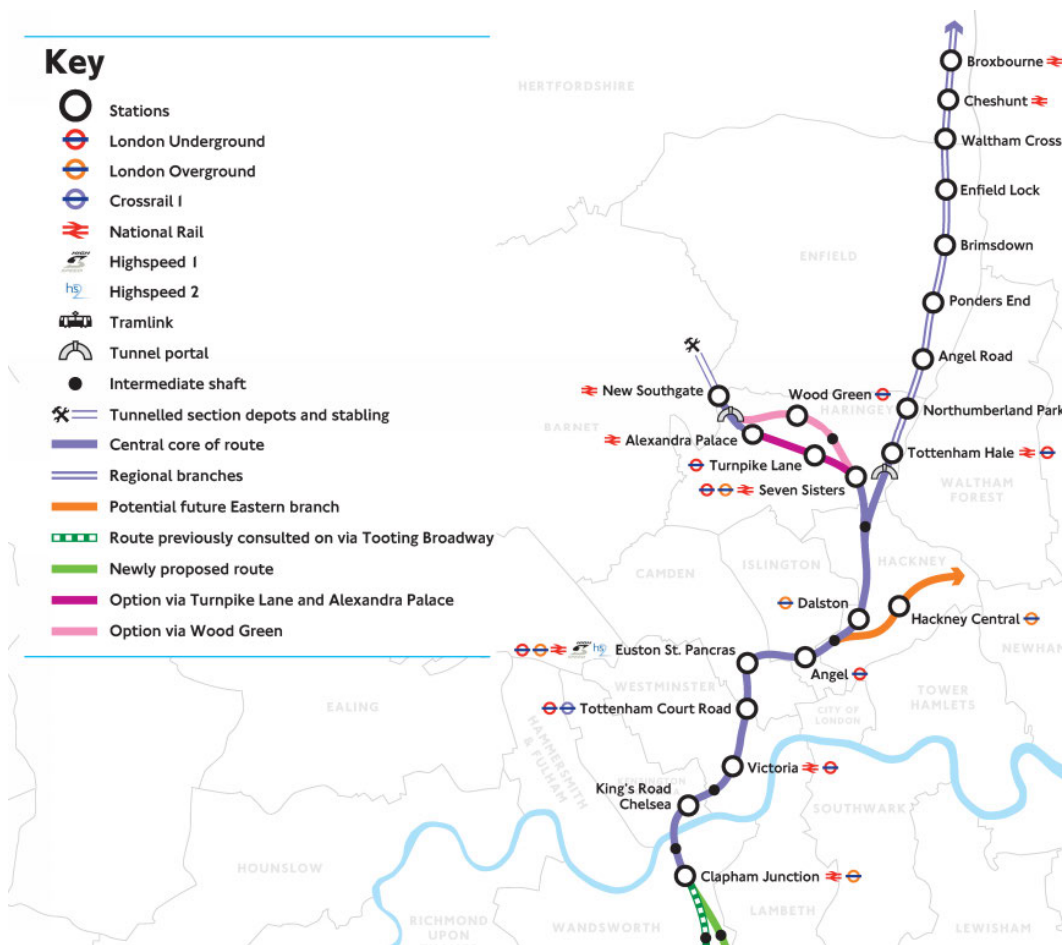
### 3.2 With Crossrail 2 scenario

The introduction of CR2 will inevitably alter patterns of public transport usage to/from/within the ULV. The proposed scheme includes a couple of route alignment options relevant to the ULV, as shown in **Figure 6**.

The main CR2 alignment impacting on the ULV would be the Tottenham Hale branch which could run alongside the West Anglia Main Line (WAML) and north towards the Hertfordshire region via Broxbourne. Furthermore, just outside the ULV study area there could be a branch connecting to Alexandra Palace/ New Southgate.

The forecast shows that, when operational, CR2 would quickly become the main public transport service in the ULV, in some cases dramatically changing the rail to bus interchange dynamic and providing crowding relief in areas of Central London.

**Figure 6 Extract of the Crossrail 2 route showing the ULV (source: <http://crossrail2.co.uk/>)**



### 3.2.1 Forecast bus patterns

Under the ‘with Crossrail 2 scenario’ it is forecast that all ULV areas will experience growth in public transport use. As shown in **Figure 7**, with Crossrail 2 serving the ULV, the following changes in bus patronage are forecast in the morning peak period:

- **Bus demand would continue to be drawn to the Victoria line** in areas which are not served by CR2 (such as Walthamstow Central) and along the A104 Lea Bridge Road, thus potentially affecting routes 48, 55 and 56;
- **There would be an increase in orbital bus demand feeding into the CR2 stations**, such as in proximity of Brimsdown (route 191 might need to be revised due to changes in level crossings), Ponders End and Angel Road (route 34 and 444 at Meridian Water may need to be changed); and
- **Bus patronage could decrease on bus services that are now paralleled by the CR2 alignment** (such as the A1010 corridor Hertford Road/ Fore Street between Brimsdown/Turkey Street and Tottenham Hale).

In addition to the above, changes in bus passenger volumes can also be observed further away from the ULV study area:

- An increase in demand on A1003 Friern Barnet Road into New Southgate station (the terminus of the Wood Green branch of CR2) affecting routes 43, 221, 232 and 382;
- An increase in demand on A105 High Road/Green Lanes into Wood Green/Alexandra Palace CR2 station affecting routes 121, 141, 232 and 329; and
- A significant increase in demand into Dalston CR2 station locally from Hackney Central/Hackney Downs via A1207 affecting routes 38, 242, and 277.

Figure 7 Bus Passenger Volume Differences Base Year to ULV 2041

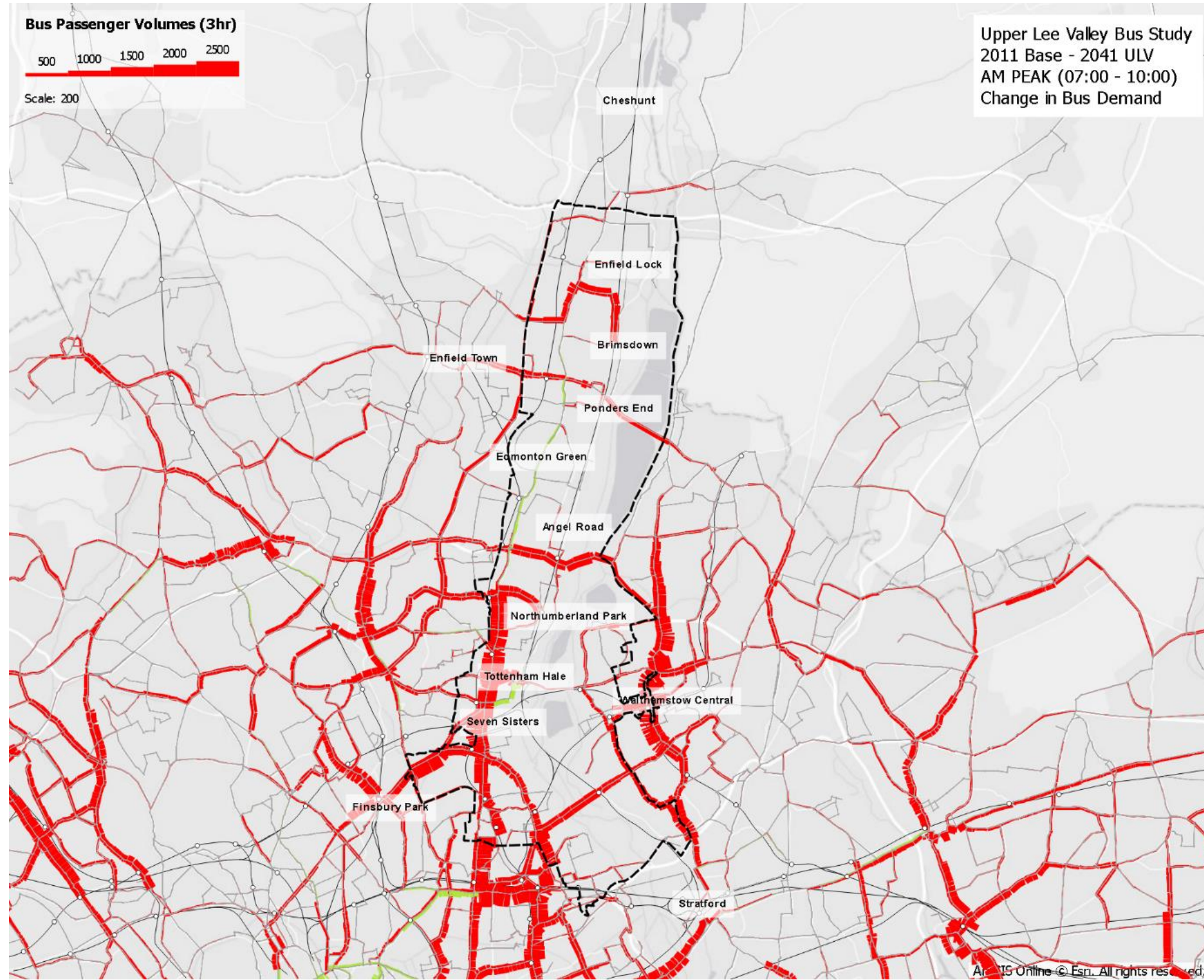
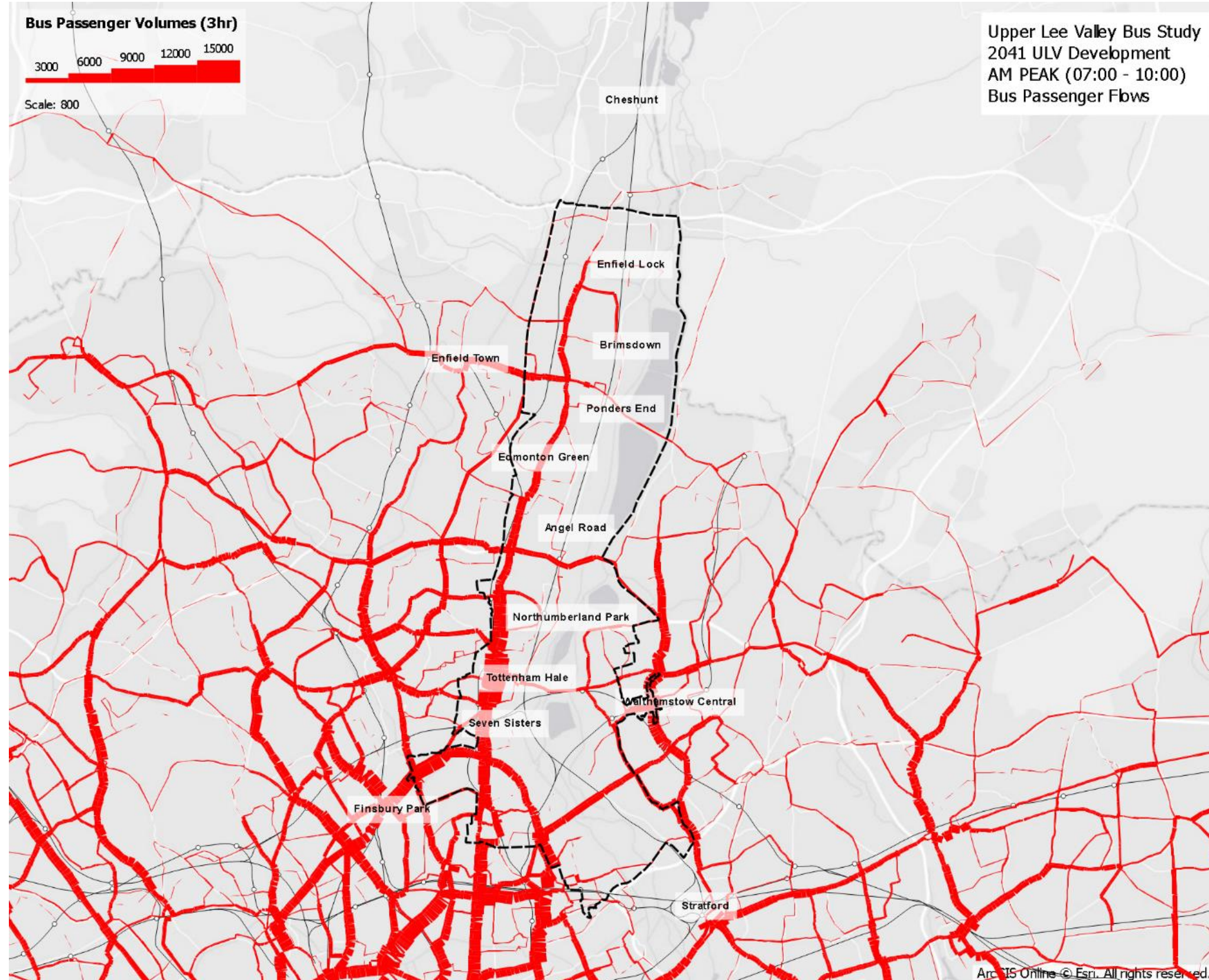


Figure 8 Bus Passenger Volumes ULV 2041



**Figure 8** shows absolute bus network passenger volumes and is useful to identify the busiest corridors in terms of forecast patronage in the long term.

Similar to the baseline model, sections of the A1010 corridor between Edmonton Green and Stoke Newington are the busiest. **The A1010 still appears to have the most significant bus passenger demand despite the marginal reduction in passenger flows in the section north of Edmonton Green** (identified in **Figure 7**) and despite the competitive London Overground line (Enfield Town to Liverpool Street) running parallel.

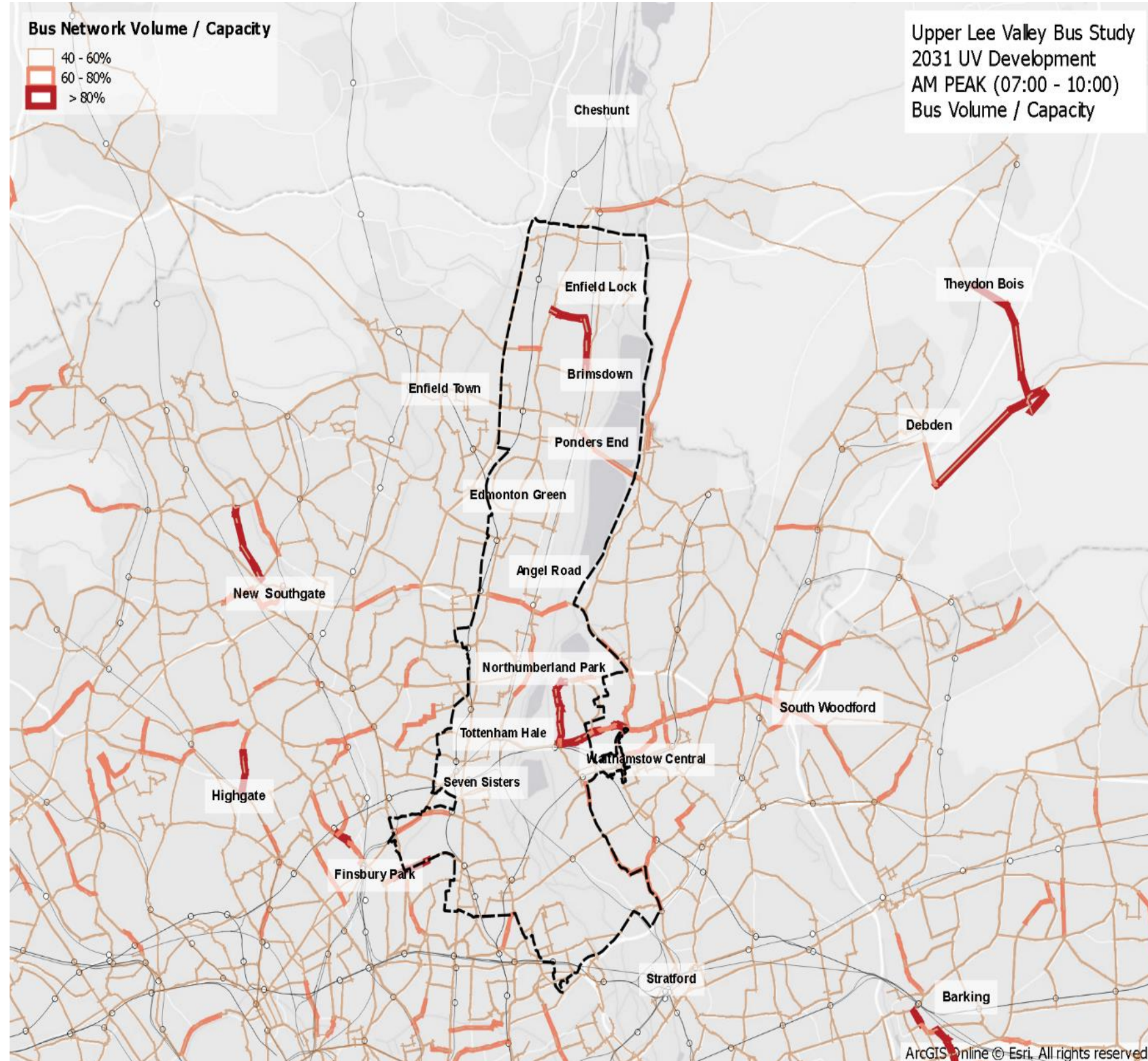
Overall, the busiest corridors in the ULV ‘with Crossrail 2’ scenario are:

- The A503 Seven Sisters Road and Amhurst Park Road – moving passengers between Finsbury Park, Seven Sisters and Stamford Hill;
- The A107 Clapton Common – moving passengers between Seven Sisters, Clapton and Hackney; and
- The A112 Hoe Street/ Chingford Road – moving passengers between Chingford, Walthamstow Central and Leyton.

To a lesser extent, some key east-west routes also present noticeable passenger volumes:

- The A104 Lea Bridge Road – between Clapton and Whipps Cross;
- The A406 North Circular – between Walthamstow and the A10; and
- The A110 Southbury Road – between the A10, Enfield Town and Cockfosters.

Figure 9 Bus Links Volume over Capacity ULV 2041



**Figure 9** helps to identify bus network ‘pinch points’. The plot indicates forecast total capacity against total volume (VoC) of all bus lines running across each link. As shown in the plot, potential crowding is likely to occur and the following should be considered:

- **The connectivity between Enfield Lock and Brimsdown will need to be reviewed** to adequately provide for public transport connectivity in light of the increased demand to/from the new CR2 stations and potential level crossing closures; and
- **The Blackhorse Road and Selbourne Road corridors are likely to be over capacity in the long term.** These corridors were identified for improvement in the short-term priority assessment as well.

Sections of the bus network providing for east-west connectivity are likely to experience an increase in saturation close to critical (60-80%):

- The A110 section between Ponders End and Kings Head Hill – linking Chingford to Ponders End;
- The A406 between the A1010 and Chingford Road – linking to Angel Road (Meridian Water) and Silver Street stations; and
- Seven Sisters Road and Amhurst Park – linking Finsbury Park, Stamford Hill and Seven Sisters.

### 3.2.1 Forecast highway corridor performance

Changes in highway flows are expected to focus primarily along strategic corridors away from the ULV main bus network. However, some local re-routing and delays might be expected as a consequence of new development and infrastructure.

**Figure 10** shows **traffic increases along the A406 and nearby road network, in the section between the A1010 Fore Street and the A112 Chingford Road**. This might be attributable to additional traffic and could indicate that the road network is under pressure, hence delays might be expected and could affect bus journey times.

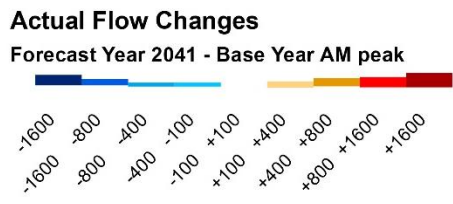
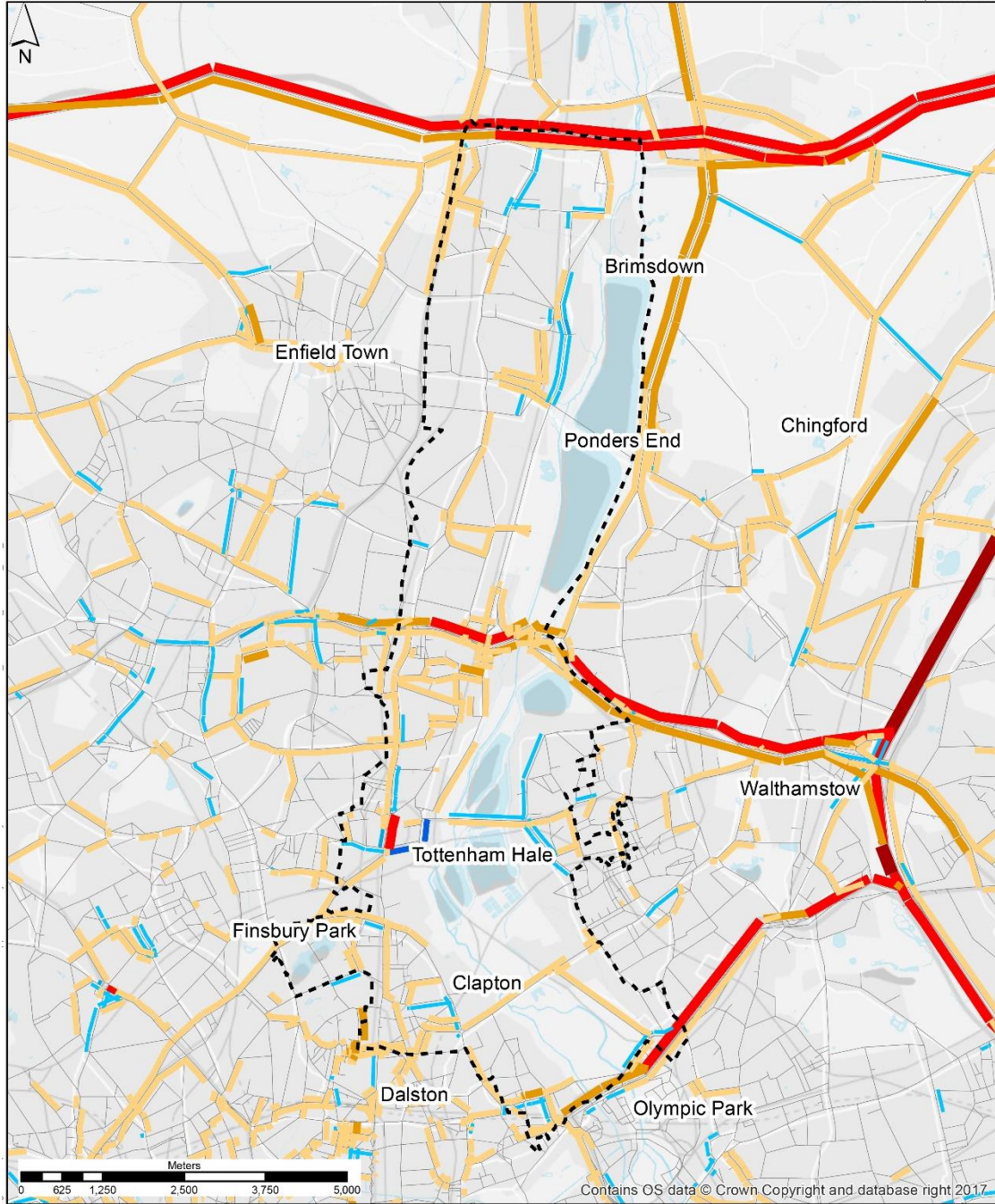
Similarly, **traffic re-routing can be observed around Brimsdown and Enfield Lock**, with local traffic increases southbound along the A1055 Mollison Avenue north of Enfield Lock and along the A105 south of Brimsdown. This might be attributable to highway changes introduced as a result of the rail line capacity enhancements needed for CR2 and some level crossings being closed, **potentially affecting bus journeys either by forcing re-routing or due to increased delay**.

**Figure 11** shows overall junction delays and highlights increases in delays. Delays greater than two minutes are likely to be experienced at junctions along the A10, with other smaller delays experienced at a number of points along the route.

Currently the A10 is a strategic route carrying the most significant volume of north-south traffic in the ULV. Buses share the traffic lanes in the section between the A406 North Circular and the M25. In this section, the A10 is a dual carriageway with two lanes per direction and generous three to four lanes flared sections approaching the junctions. South of the A406, buses have long sections of dedicated bus lanes, although these tend to terminate ahead of the junctions.

Some of the key east-west routes, such as the A105 Lea Park Road, the A406 North Circular and the A503 Ferry Lane and Lea Bridge Road are also forecast to be affected by junction delays.

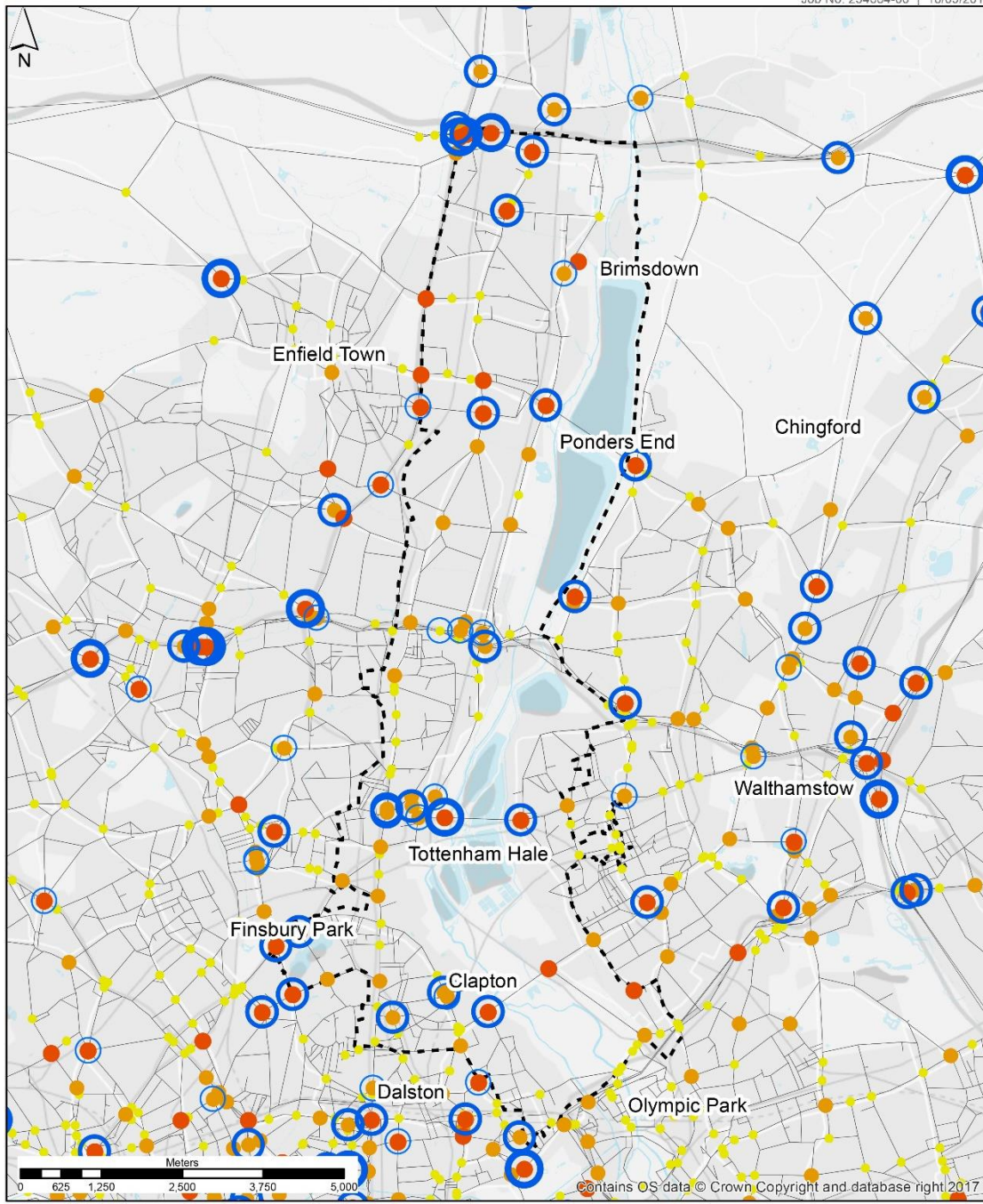
**Figure 10 Base Year to ULV 2041 flow changes**



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**Figure 11 Base Year to ULV 2041 junction delay changes**



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**Junction Delay**

Forecast Year 2041 AM peak

- + 15-60 (sec)
- + 60-120 (sec)
- + >120 (sec)

**Increases in delay**

- 45 - 60 (sec)
- 60 - 120 (sec)
- > 120 (sec)

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### 3.3 Without Crossrail 2

In the scenario where the ULV area growth relies on improvements to the bus network and potentially on new forms of transport, instead of CR2, the bus network priorities are likely to include:

- **Network coverage expansion** – some of the areas identified for growth are currently not sufficiently served by public transport (Mollison Avenue/ Bullsmore Lane);
- **Increase in service frequency** – as increased pockets of demand will trigger demand for higher frequencies; and
- **Improvements to reliability and journey time** – some corridors that are currently under-performing are likely to under-perform in future and there will be a need to address bus priority to deliver reliable bus services in the short, medium and long term.

The ULV Opportunity Area aligns with the MTS vision for Healthy Streets and increased sustainable transport in Outer London. **Some of the alternative bus measures can be considered independently of CR2, for instance demand responsive and bus rapid transit solutions.**

The OAPF sets objectives to deliver high levels of employment in the ULV, reinforcing new local and district centres. These objectives can be delivered largely through an efficient network of buses and sustainable travel solutions.

#### 3.3.1 Forecast bus patterns

Radial demand (north-south corridors) accounts for the most significant part of the demand in this scenario, although smaller increases are appreciable on the key east-west routes such as the A406 North Circular and the A110 Southbury Road (**Figure 12**).

The following key radial routes are forecast to become increasingly busy:

- The **A1010/ A10 corridor** will experience the most significant growth in passenger demand south of White Hart Lane towards Central London. The A1010 corridor will most likely experience increased demand in both directions;
- The **A503 Seven Sisters Road** will likely experience passenger demand growth. The forecast suggests this might be towards Central London in the morning period (and in the opposite direction in the evening) particularly in the section between Stamford Hill and Finsbury Park; and
- The **A112 Chingford Road** will experience an increase in passenger demand southbound and northbound leading towards Walthamstow Central station.

In addition to the above, decreases in bus patronage can also be observed further away from the study area:

- Flow decreases in **areas served by the Piccadilly Line** suggests there might not be demand for a connection by bus to a less crowded service in the future (i.e. National Rail); and
- Decrease in bus demand on the **A112 northbound into Stratford**, which could be due to new DLR rolling stock releasing additional capacity.

Figure 12 Bus Passenger Volume Differences Base Year to ULV 2031

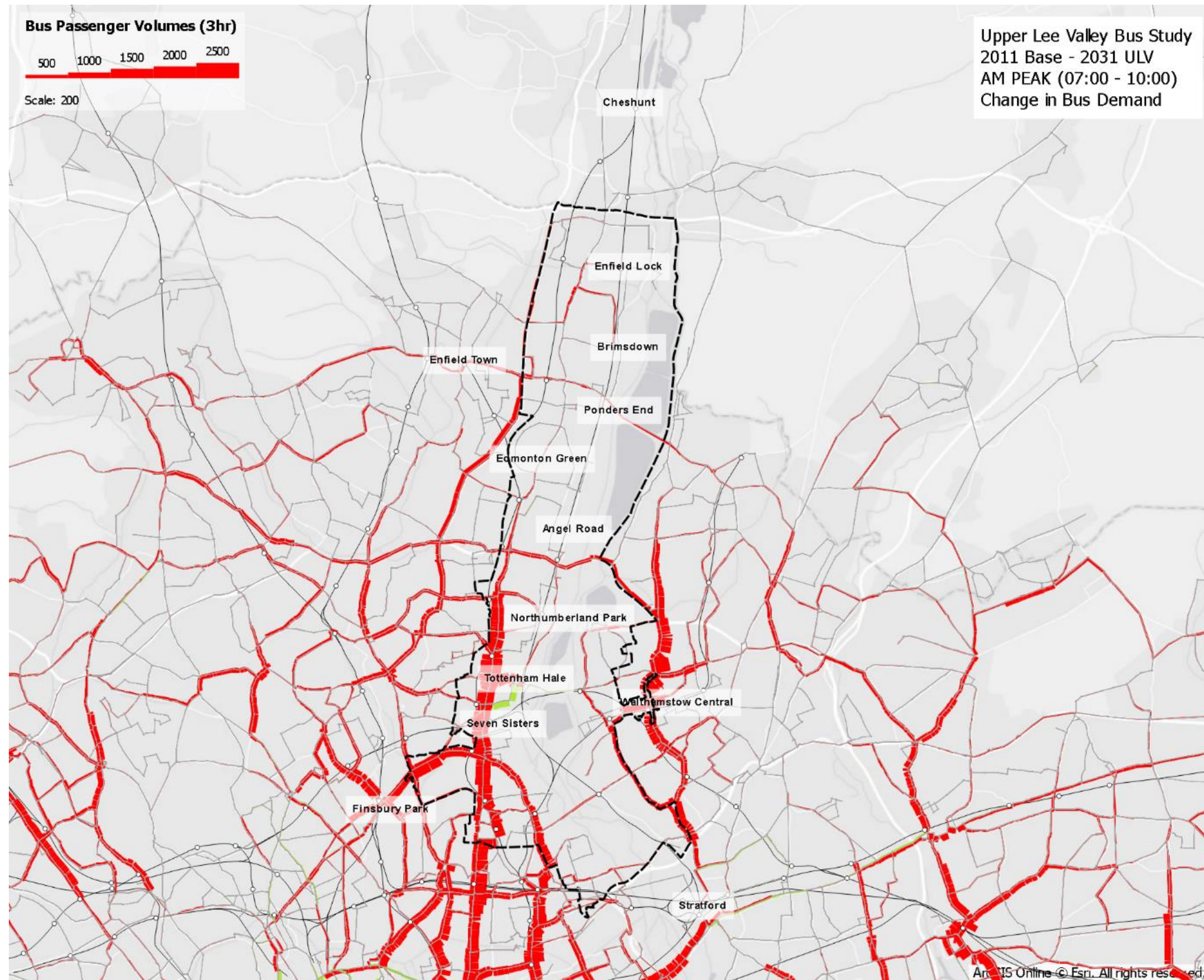


Figure 13 Bus Passenger Volumes ULV 2031

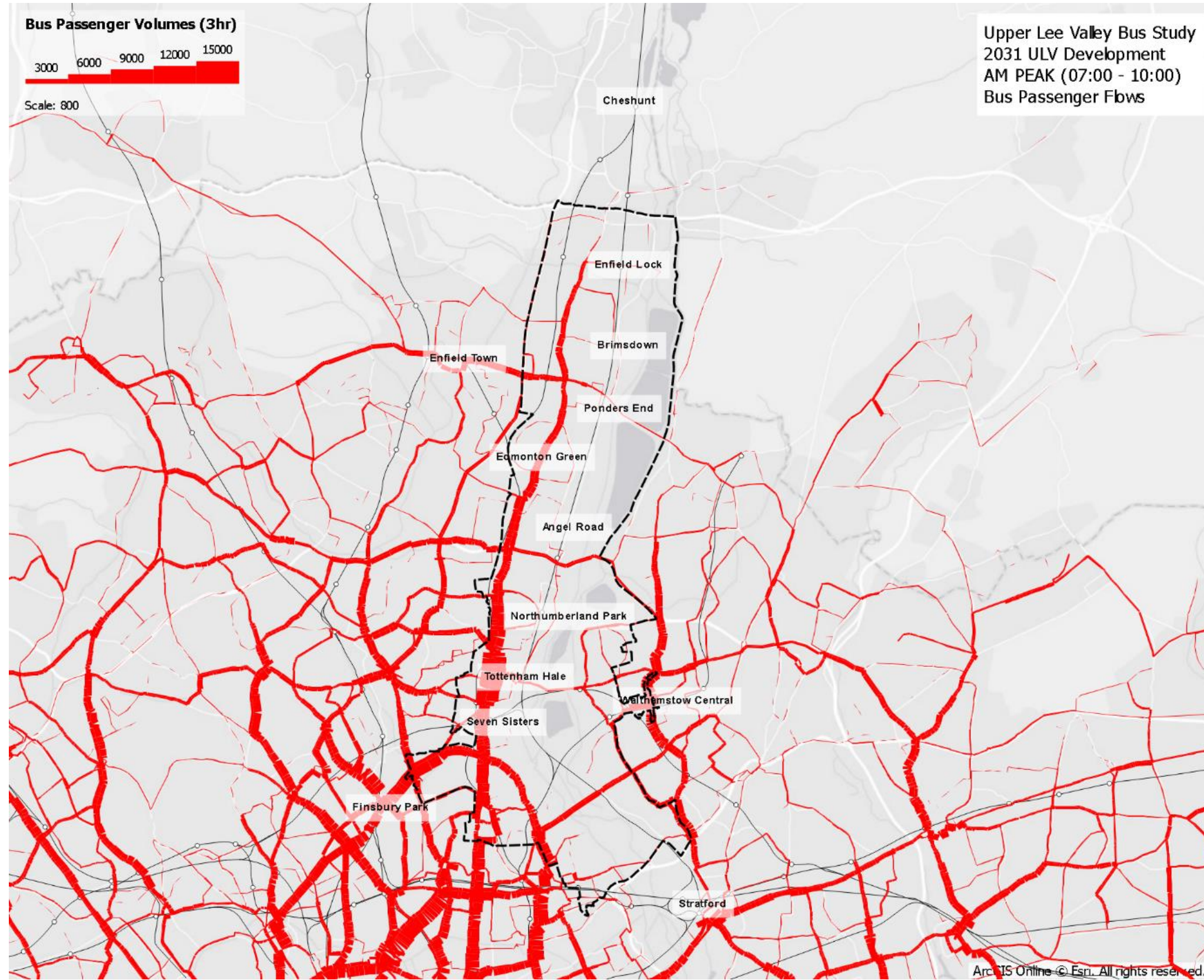
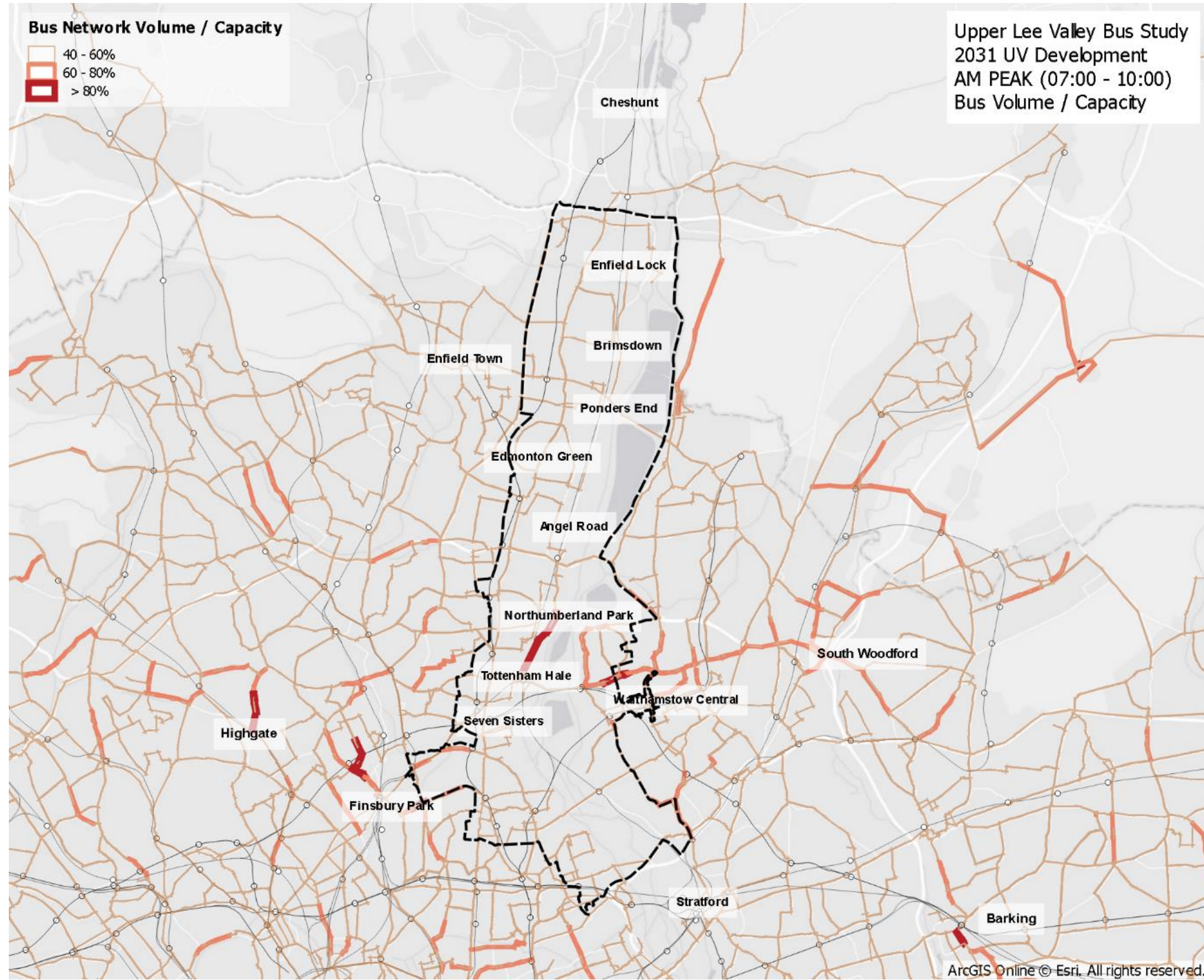


Figure 14 Bus Links Volume over Capacity ULV 2031



**Figure 13** shows absolute bus passenger volumes per link. This plot is useful to identify the busiest corridors in terms of passenger volumes. Overall, bus patronage in this scenario is similar to the ‘with Crossrail 2’ scenario and the baseline scenario, demonstrating London’s reliance on buses irrespective of large scale rail interventions. This indicates key demand corridors that could be considered for priority consolidation (segregated road space, smart signalling, priority over general traffic, faster boarding) or upgrade to rapid transit or light rail.

The bus travel patterns suggest that buses are feeders for key London Underground and Overground interchanges, with some stations showing crowding (Seven Sisters, Tottenham Hale and Walthamstow Central). In this scenario, the A1010 corridor is the busiest in the ULV network. **The A1010 appears to have the most significant bus passenger demand despite the parallel provision of the London Overground Enfield Town to Liverpool Street line.** This might be attributable to the much higher frequency of buses along the A1010 corridor. There are approximately 9-10 bus services per direction every fifteen minutes compared to one Overground service every fifteen minutes. This triggers a ‘turn up and go’ expectation that cannot be met by the Overground at its present frequency.

Overall, the busiest corridors in the ULV ‘without Crossrail 2’ scenario appear to be:

- **The A1010 corridor south of Enfield Lock;**
- **The A503 Seven Sisters Road and Amhurst Park Road** – moving passengers between Finsbury Park, Seven Sisters and Stamford Hill;
- **The A107 Clapton Common** – moving passengers between Seven Sisters, Clapton and Hackney; and
- **The A112 Hoe Street/ Chingford Road** – moving passengers between Chingford, Walthamstow Central and Leyton.

To a lesser extent, some key east-west routes also present noticeable passenger volumes:

- The A406 North Circular – west of Silver Street; and
- The A110 Southbury Road – between the A10, Enfield Town and towards Cockfosters.

**Figure 14** shows the forecast total capacity against total volume of all bus services running across each link (Volume over Capacity – VoC). As shown in the plot, potential crowding on buses is likely to occur:

- In proximity of the major ULV developments such as Meridian Water and Tottenham Hale/White Hart Lane, between the growth areas and leading to/ from Tottenham Hale station;
- Blackhorse Road and Selbourne Road, which are in close proximity to the Blackhorse Lane Area Action Plan (AAP).

These corridors do not provide high capacity and have only limited bus priority. Therefore, there are opportunities to easily improve and tackle these ‘pinch points’.

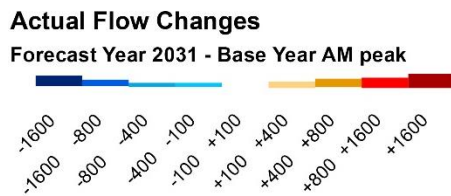
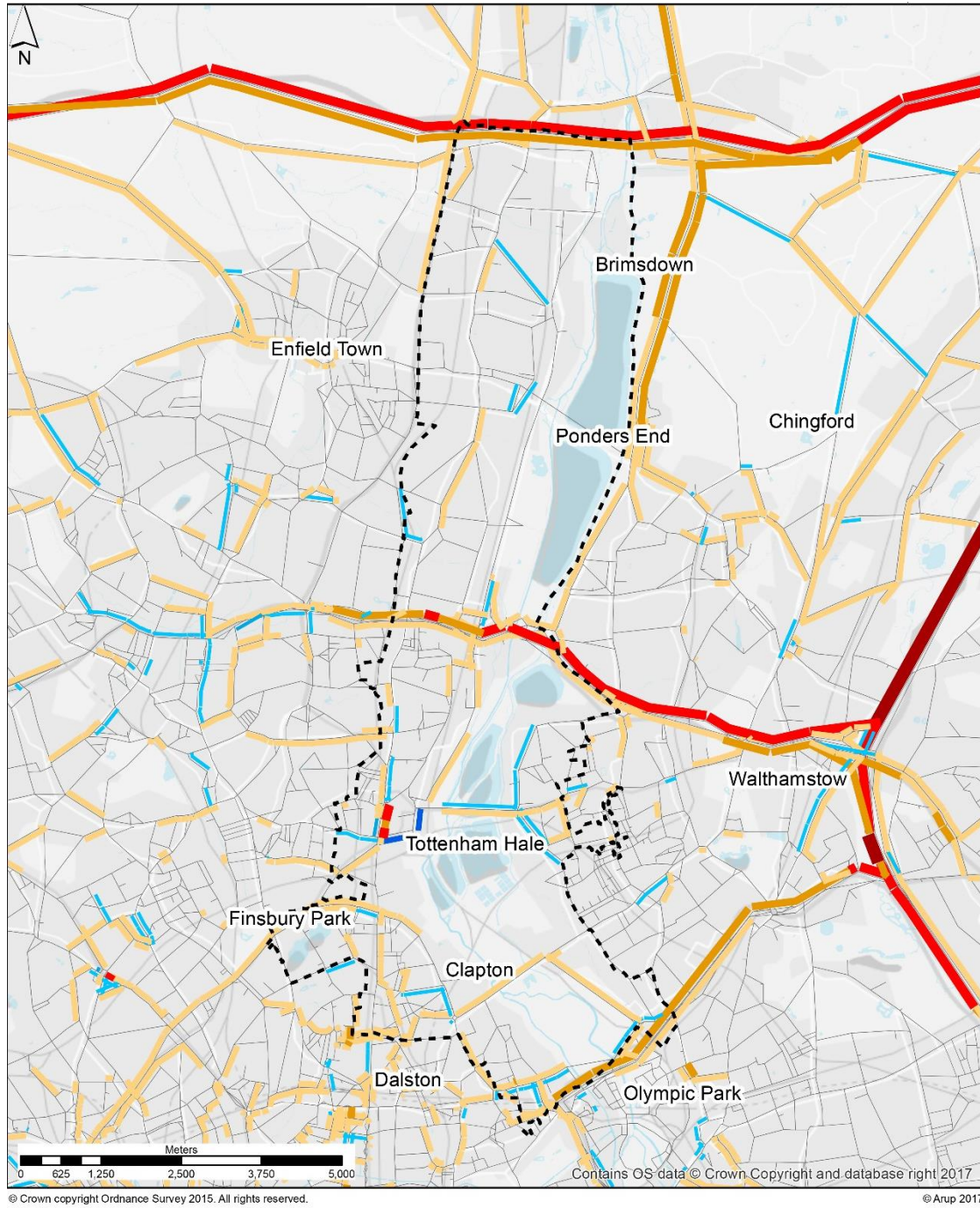
### 3.3.2 Forecast highway corridor performance

**Figure 15** shows that significant changes occur on the strategic road network. Traffic flows increase along the M25, A406 and A12 eastbound towards the M11 and along the M11 northbound following a similar pattern to the ‘with Crossrail 2’ scenario.

**Local highway re-routing is discernible around Leaside Road, Meridian Way and the approaches to the A406**, suggesting increased traffic pressure might force indirect routing and rat-running to local roads. **Local re-routing is also noticeable around Tottenham Hale, along the A1010 High Road and the A503 Ferry Lane linking to Blackhorse Lane and Walthamstow**. This is possibly due to the Tottenham Hale gyratory work and ‘Enjoy Waltham Forest’ cycle scheme on the A503.

Highlighted in **Figure 16** are the changes occurring on the ULV highway network from the baseline to the forecast 2031 year. **Delays are likely to occur approaching Junction 25 of the M25**. Highways England has recently consulted on a capacity improvement project to address these capacity issues. More locally, and corresponding to local traffic increases and re-routing, junction delays are likely to be concentrated around the A503 Ferry Lane/ Forest Road corridor. ‘Enjoy Waltham Forest’ has recently completed a cycle scheme in this location, which might have an impact on traffic routing and hence bus journey time.

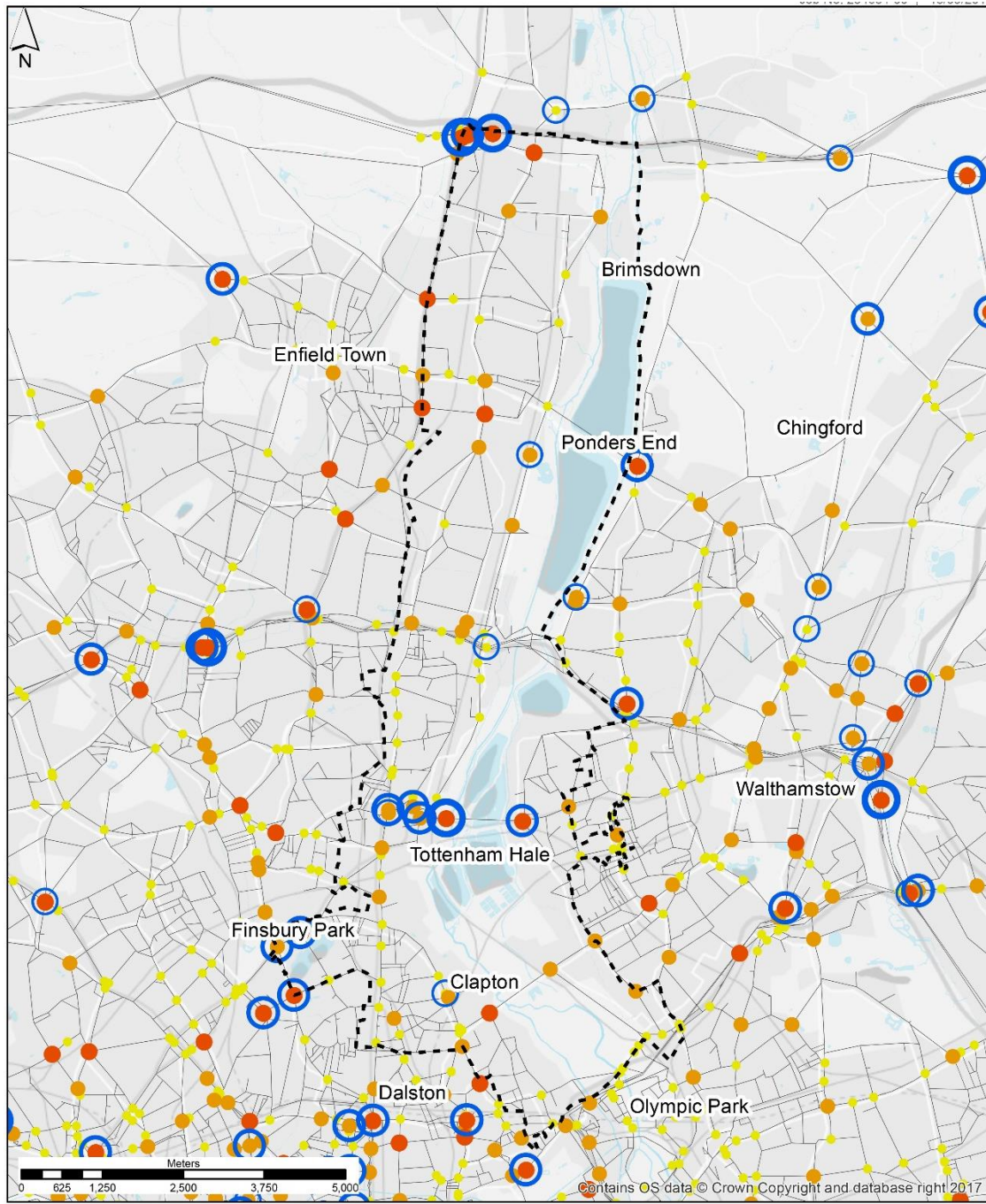
**Figure 15 Base Year to ULV 2031 flow changes**



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**Figure 16 Base Year to ULV 2031 junction delay changes**



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**Junction Delay**  
**Forecast Year 2031 AM peak**

- + 15-60 (sec)
- + 60-120 (sec)
- + >120 (sec)

**Increases in delay**

- 45 - 60 (sec)
- 60 - 120 (sec)
- > 120 (sec)

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### 3.4 Interchange

Improved public transport hubs that enable better integration of London's public transport are a key element of the MTS priorities. **Crossrail 2 will affect the operations of key public transport interchanges and will put pressure on the local stations in the study area.** The key interchanges, mostly bus to London Underground at Tottenham Hale, Seven Sisters, Walthamstow Central and bus to London Overground at Edmonton Green were found to be some of the busiest spots in the ULV (*BPN01 – Bus Performance and Challenges: Short and Medium Term Requirements*). These will experience operational challenges derived from increased demand, to some extent, regardless of Crossrail 2.

The levels of bus patronage and traffic delays at the approaches to interchanges were found to impact on bus operations as they increase delays and affect passenger experience. These interchanges will be put under further pressure with more passengers accessing the London Underground and London Overground services and more passengers using buses to travel to/from the station.

**Figure 17** shows how morning peak period bus passengers alighting at key bus to London Underground and London Overground interchanges are likely to increase.

Despite the increased number of bus alighters, and overall increased number of arrivals at the stations, the proportion of passengers interchanging bus to rail is likely to drop after the opening of Crossrail 2. This could be because people might be more willing to walk and cycle or because mixed use development means shorter trip distance as employment and housing is co-located. Locations such as Tottenham Hale might become a destination in their own right.

The level of service and suitability of the interchange layout of Tottenham Hale, Seven Sisters, Walthamstow Central and Edmonton Green should be evaluated in light of the long-term morning peak period passenger interchange forecast:

- Tottenham Hale – rail and London Underground (LU) interchange passenger flows are forecast to increase significantly from the baseline to 2021 following the STAR implementation and first developments coming forward. Rail/LU interchange passengers will represent 36% of the total passenger volume in 2031 and 28% in 2041 (post CR2). Bus to rail interchange will see an increase in the number of bus passengers alighting to change to rail/underground (reaching 2,500 passengers circa for the 2041 peak period), however, the overall bus to rail interchange passengers will decrease from 45% to 36% from 2021 to 2041.
- Seven Sisters – rail and LU interchange passenger flows for Seven Sisters station alone are forecast to decrease, however, if a link to South Tottenham station is provided there would be an increase in bus alighters by 50% and in station entries by 32%. Bus to rail passengers will follow a similar trend, increasing to 7,300 and 6,700 (peak period passengers) by 2031 and 2041 respectively, maintaining a 40-45% bus to rail passenger interchange ratio.
- Walthamstow Central – rail and LU interchange passengers are forecast to only increase marginally, however, the bus to rail/LU interchange passengers are forecast to increase by 82% from 2021 to 2031 and by 110% from 2021 to 2041, reaching 16,700 peak period passengers in 2041. The bus to rail interchange at Walthamstow Central is one of the highest in the ULV and is forecast to maintain a level of circa 60% independently of CR2.

- Edmonton Green –The bus to rail passenger interchange here represents circa 40% of the total bus alighters. This is forecast to decrease only slightly from 2031 to 2041.

**Figure 17 Forecast passenger bus to rail interchange at key LU and Overground hubs**



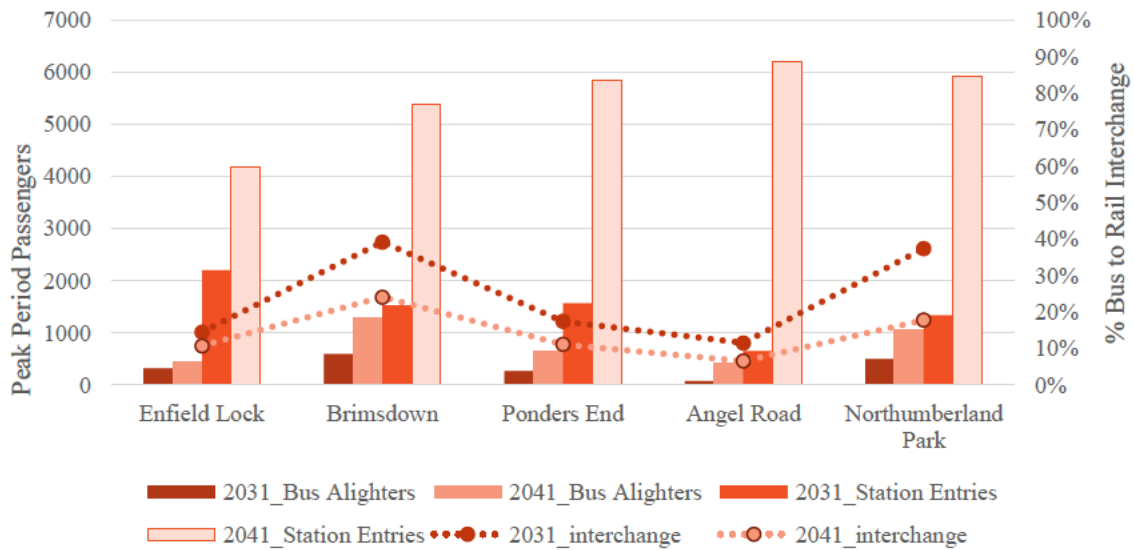
In addition, the increased rail frequency brought by Crossrail 2 will pull additional demand from buses to rail at (currently) relatively local stations: Enfield Lock, Brimsdown, Ponders End, Angel Road/ Meridian Water and Northumberland Park. These local stations along the WAML are forecast to see an increase in flows from an average 1,500 to 7,000+ passengers per peak period. Some of these stations do not have adequate inter-modal interchange facilities (bus, walk, cycle, car drop-off) and will require interchange facilities to be assessed and provided:

- Enfield Lock – the peak period entries and exits at the station are forecast to increase +45% from 2031 to 2041 with the total two-way peak forecast to reach 5,870 peak period passengers;
- Brimsdown – the peak period entries and exits are forecast to increase by +75% from 2031 to 2041, reaching 7,330 peak period passengers in 2041;
- Ponders End – passenger flows are forecast to increase +77% from 2031 to 2041, reaching 7,960 peak period passenger entries and exits;
- Angel Road/ Meridian Water – the forecast peak period entries and exits are forecast to increase +42% from 2021 to 2031 and +89% to 2041, reaching 9,440 peak period passengers; and
- Northumberland Park – peak period entries and exits are forecast to increase by +77% from 2031 to 2041, reaching a total of 9,590 passengers per peak period.

The future Crossrail 2 stations (in particular, Brimsdown, Angel Road and Northumberland Park) will require assessment to better provide for bus to rail interchange, with provision of

bus stops, stands, information and priority measures to shorten dwell times and ease traffic flow for buses.

**Figure 18 Forecast passenger bus to rail interchange at new Crossrail 2 stations**



Much more significant improvements will be required to cater for the doubled or quadrupled passenger numbers arriving/ leaving the stations by other modes (walking and cycling). Considering the forecast changes in movements to/ from the ULV stations, interchange facilities should be benchmarked against ‘best practice’ criteria for interchanges.

**Table 4** shows the key impacts of the forecast interchange modelling benchmarked against the TfL interchange design themes and principles.

**Table 4 Interchange design themes and principles<sup>5</sup> (source: TfL)**

Interchange Design Principle	Forecast modelling/ Actions
<b>Efficiency</b> <ul style="list-style-type: none"> <li>• Operations</li> <li>• Movement within an interchange facility</li> <li>• Movement within the wider interchange zone</li> <li>• Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Increased station entry and exits                             <ul style="list-style-type: none"> <li>○ Assess movement corridors capacity to cater for passenger movement within the station interchange</li> <li>○ Assess the facilities for waiting, staff</li> <li>○ Assess accessibility levels</li> <li>○ Assess legibility and way-finding</li> </ul> </li> </ul>
<b>Usability</b> <ul style="list-style-type: none"> <li>• Accessibility</li> <li>• Safety and accident prevention</li> <li>• Personal security</li> <li>• Protected environment</li> </ul>	<ul style="list-style-type: none"> <li>• Changes in bus to station interchange patterns                             <ul style="list-style-type: none"> <li>○ Assess facilities capacity to cater for passenger movement between buses and station</li> <li>○ Assess accessibility levels and legibility and way-finding between the bus and station</li> <li>○ Assess the urban realm quality and perception of the space between buses and station</li> </ul> </li> </ul>
<b>Understanding</b> <ul style="list-style-type: none"> <li>• Legibility</li> <li>• Permeability</li> <li>• Way-finding</li> <li>• Service information</li> </ul>	<ul style="list-style-type: none"> <li>• Significantly increased passengers arriving at station by walk and cycle modes</li> </ul>
<b>Quality</b> <ul style="list-style-type: none"> <li>• Perception</li> <li>• Built design</li> <li>• Urban realm</li> <li>• Sense of place</li> </ul>	<ul style="list-style-type: none"> <li>○ Assess the station capacity to cater for walking and cycling at the station</li> <li>○ Assess the quality and accessibility of the environment surrounding the station</li> <li>○ Evaluate the perception and quality of the public realm</li> <li>○ Evaluate the sense of place and the potential for improvement within new developments</li> </ul>

<sup>5</sup> <https://tfl.gov.uk/info-for/urban-planning-and-construction/interchange>

### 3.5 Switchable trips

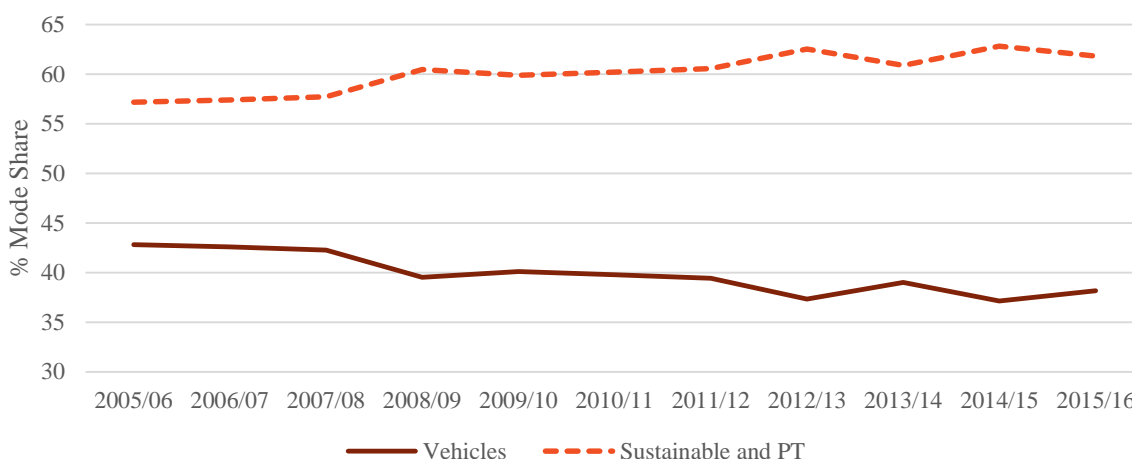
The Healthy Streets agenda promoted by the GLA aims to make London’s streets healthier, safer and welcoming for everyone and will have an impact, in the long term, on the way Londoners move.

Evidence collected suggests that walking, cycling and public transport trips have increased over the last ten years, gaining 4.6% over vehicle based travel (**Figure 19**). More recently, there has been a policy push to improve the street environments and encourage people to be more active and walk, cycle and spend time in the streets.

With the London Plan and Draft MTS, the GLA is raising awareness of the economic, social and health benefits deriving from keeping Londoners active by encouraging sustainable travel.

**With the Draft MTS, the Mayor has set a target mode share of 80% of trips to be made by either sustainable modes or public transport by 2041.** Compared to the current 64% this is an increase of +16% in public transport and sustainable modes and is broadly aligned with the recent mode share trends.

**Figure 19 London mode share 2006-2016 (source: LTDS)**



**Initiatives such as the Mini-Hollands have led to ‘place-making’, cycle training, soft and hard infrastructure being delivered across two of the ULV boroughs: LB Waltham Forest and LB Enfield.**

Furthermore, the recently completed Cycle Superhighway 1 connects the City with White Hart Lane in LB Haringey on a corridor parallel to the A1010/A10. It is reasonable to assume that, over time, more road space reallocation schemes will be brought forward in line with the Healthy Streets and MTS agenda.

The ULV Transport Study included a sensitivity test aiming to represent this future scenario of increased sustainable and public transport trips and has included the proposed public realm and cycle schemes along the A1010 and A105 in LB Enfield<sup>6</sup>.

**Figure 20** shows the flow differences between the forecast ULV and the sensitivity test including the ‘low car’ and cycle schemes. Traffic reduction is shown in light blue. Traffic

<sup>6</sup> Scheme testing was agreed at the Forecast Modelling Boroughs Workshop (12 October 2017)

reductions are expected along the corridors that will undergo traffic calming and cycle scheme provision, in this case specifically the A1010 and A105. Traffic will likely re-route through nearby and parallel corridors, shown in the plot in amber, and therefore adequate management shall be planned for this scenario.

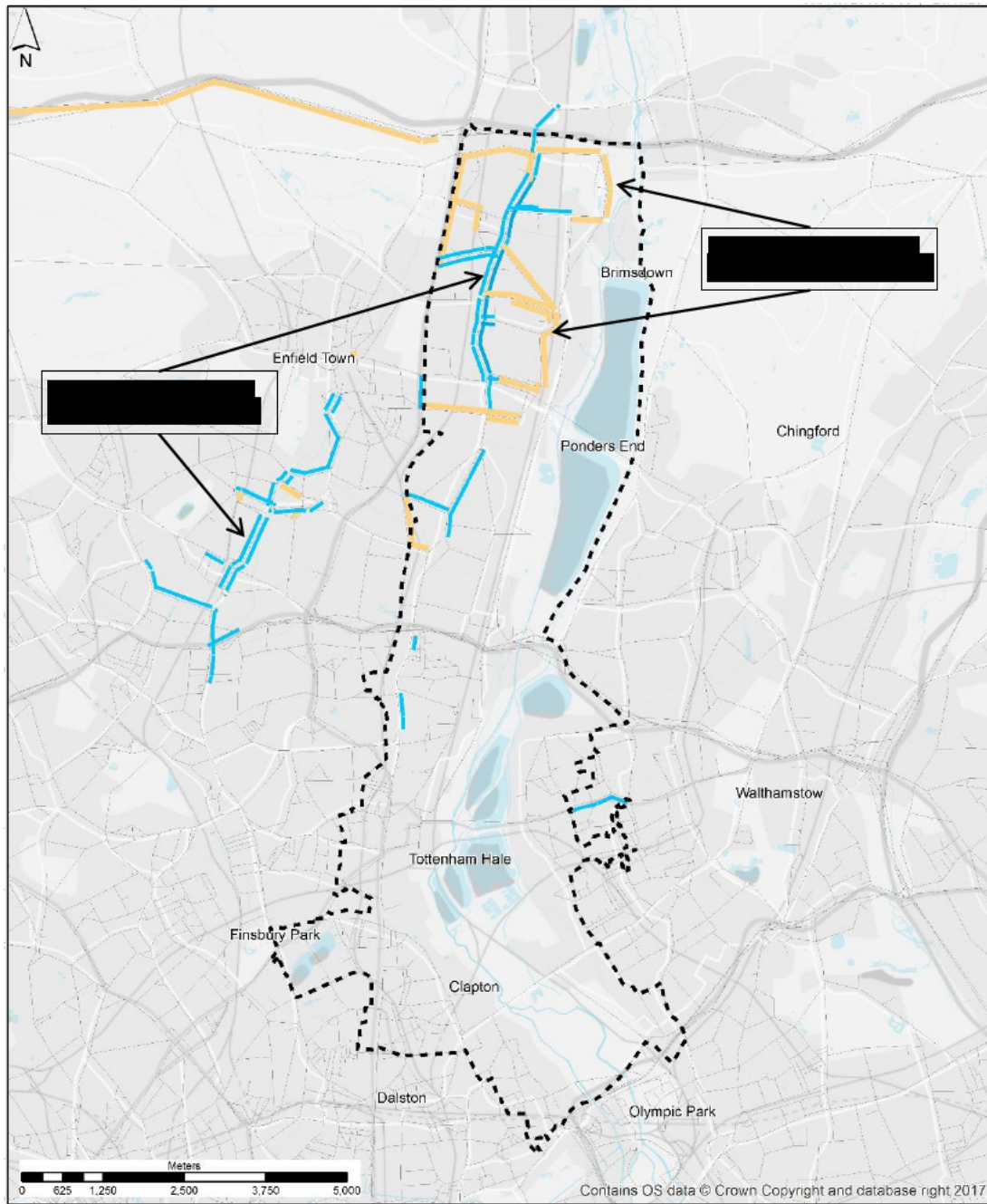
**In the long term, these schemes are likely to push traffic away towards parallel corridors and therefore the traffic relief could improve bus journey times** along the A1010 and A105.

The ‘switchable trips’ change due to increased public transport patronage in the ULV is likely to be focused:

- Along the A406 North Circular which is currently served by two bus routes (444 and 34) in proximity of the Meridian Water and Angel Edmonton development areas and Angel Road Station; and
- Along the A1055 Watermead Way between Northumberland Park and Tottenham Hale which is currently served by the 192 bus routes.

The changes in bus patronage can be seen in **Figure 21**, with increases in red and decreases in green.

**Figure 20 Low Car Cycle schemes test to ULV 2031 flow differences**

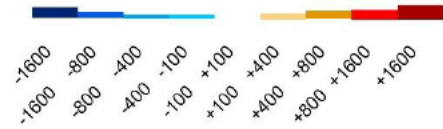


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**Actual Flow Changes**

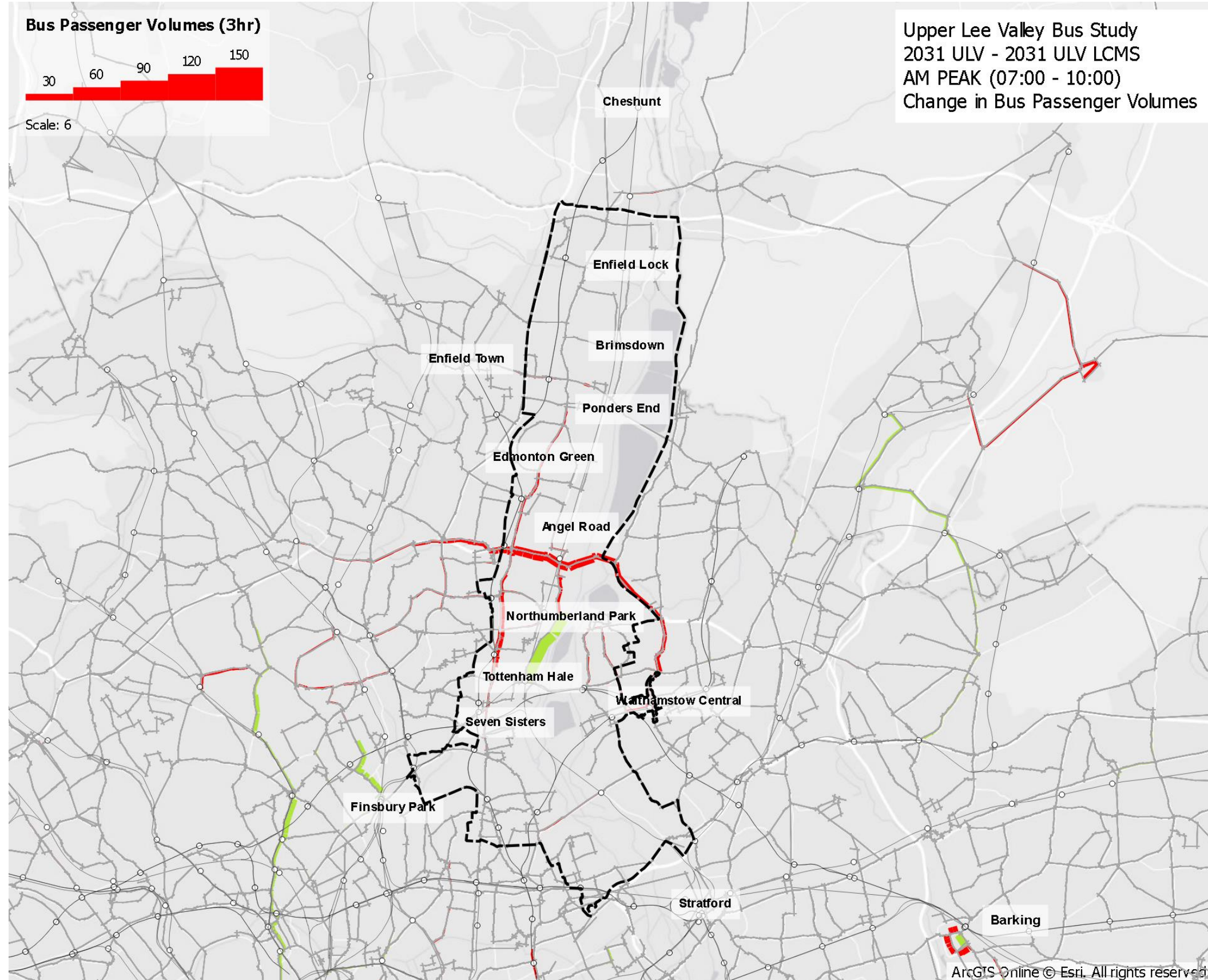
**CycleSchemes 2031 - Forecast Year 2031 AM peak**



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Figure 21 Bus passenger volume differences between Switchable trips and ULV scenario



## 4 Challenges and opportunities

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### 4.1 ULV overview

A summary of both ‘with’ and ‘without’ CR2 is set out in this chapter, considering the strategic effects and implications for the ULV bus network and the consequent implications on a more local scale (Section 4.2).

The previous section highlighted the effect of CR2 on bus patronage. The modelling also shows that there will be challenges affecting bus operations in the ULV independently of CR2.

#### 4.1.1 Challenges and opportunities common to both ‘with’ and ‘without’ Crossrail 2

The forecast public transport and highway work suggests similar results along a few of the consolidated bus patronage corridors and busy interchanges in both the ‘with’ and ‘without’ CR2 scenarios.

**Bus patronage along key corridors shows resilience to rail improvements associated with CR2 and therefore it is reasonable to assume that the busiest bus corridors will likely show high patronage independently of Crossrail 2.**

Most of the high patronage corridors are radial routes feeding the key LU and rail interchanges. These locations will likely require increased bus passenger capacity and priority measures in order to deliver services to customers’ expectations and meet the MTS objectives for bus priority.

Modelling showed that the A1010/A10 corridor, the A112 Chingford Road/ Hoe Street and the A503 Seven Sisters Road/ Amhurst Road corridor are forecast to carry the most significant proportion of bus demand in both the ‘with’ and ‘without’ scenarios. Currently, these corridors also show localised junction delays which might increase in future, particularly around Tottenham Hale, Ferry Lane and at the approaches to Walthamstow Central Bus Station.

#### The A1010/A10 corridor

The A1010 was found to be amongst the busiest and slowest corridors looking at the current iBus information. The route patronage forecast suggests consistently increasing demand in all forecast scenarios (2031 and 2041), particularly in the section between Edmonton Green and Stoke Newington.

LB Haringey and LB Enfield are looking to consolidate the ‘high street’ role of the A1010 by promoting public realm schemes and supporting local development infill to provide housing and retail. Consequently, in the long term, the A1010 route will most likely experience increased street activity. The overall corridor length, the ‘high street’ character and road-space reallocation schemes, such as cycle super highways and traffic calming, are likely to affect the feasibility of delivering further bus priority measures.

The ‘switchable trips’ highway model test suggests that, in the long term, significant traffic flows (100 to 400 PCU hr) could be diverted away from the A1010 corridor as a result of the

traffic calming and cycle schemes being implemented. These schemes aim to encourage sustainable trips and will most likely result in a lower operational road speed. As general traffic re-routes away from the A1010 (and A105), the traffic relief along the corridor could bring journey time benefits for buses.

The A1010 growing forecast patronage demand and the place making vision brings challenges and opportunities in the long term:

- **Increased passenger demand along the already busy corridor** – while opportunities to improve capacity/ frequency and priority measures are limited;
- **The ‘high street’ and cycle schemes** – the road-space reallocation and public realm schemes are likely to push general traffic away from the corridor, contributing in the long term to improve journey times, but there are still challenges in the short and medium term; and
- **Overground competitiveness** – the significant difference in service frequency results in higher bus patronage. However, further modelling testing as part of the forecast mitigation packages suggests that an additional two trains per hour might result in a significant shift of patronage from the A1010 bus corridor to the parallel London Overground. This could be due to better journey time reliability from the Overground.

Bus routes that duplicate rail links could be rationalised if TfL believes some demand will be abstracted by the Overground. Fewer vehicles on the road could contribute to improving bus performance and the regulation of headways.

### **A503 Seven Sisters/ Amhurst Park/ Forest Road**

The A503 Seven Sisters Road section between Finsbury Park station (Victoria and Piccadilly line), Manor House (Piccadilly line) and Seven Sisters (Victoria line) is also one of the busiest corridors in terms of bus patronage and is likely to experience increased demand in future.

Four bus routes serve the A503. Bus lanes are provided along the full section of the corridor but generally terminate ahead of the junctions. The iBus data showed that the southbound direction is one of the slowest sections of the ULV bus network, with recorded speeds of 8mph.

Part of the demand along this section of the A503 corridor could be caused by the fare zone change. Manor House and Finsbury Park are within zone 2 while Seven Sisters is within zone 3. Therefore, passengers take the bus from zone 3 to zone 2 and then interchange to London Underground services. Buses have no fare zones and so financial savings are possible as passengers only need a zone 1-2 travelcard.

The highway and public transport modelling presented future challenges:

- **Junction delays** – in the forecast highway scenario, the local increase in traffic flows shows that this is likely to result in delays at the junction of Seven Sisters Road with Green Lanes (Manor House) and Woodberry Grove; and
- **Increased patronage** – the forecast scenario shows increasing bus patronage along the A503. No capacity issues were identified on the A503 link. However, higher levels of boarding and alighting will result in longer dwell times at stops, and associated delays to journey times. Further to the east, in proximity to Blackhorse Road and the junction with

the A112, the A503 Forest Road will likely experience increased patronage and also delays due to the local traffic re-routing.

### **A112 Chingford Road/ Hoe Street**

The A112 leading to Walthamstow Central London Underground and Bus station is likely to experience increased levels of bus demand. This corridor is also one of the busiest in terms of bus patronage in the baseline. The station is served by twenty day and five night bus routes, providing high frequency and good connectivity to and from Walthamstow Central.

The highway approach is along a single carriageway road with one lane per direction and flares at the junctions. Bus gates and signal priorities are in place at the approach to the bus station entrance.

A very significant proportion of the Walthamstow Central bus station alighters are interchanging to underground and rail in the peak period - over 60%.

The forecast scenario highlights challenges and opportunities:

- **Increased bus patronage** – particularly along the A112 approaches to Walthamstow Central bus station, which is one of the busiest sections of the ULV bus network with high frequencies already provided and limited opportunities to provide additional buses;
- **Highway delays** – the bus network in proximity of Walthamstow Central and along the A112 is likely to experience increased delays in the long term, attributable to traffic congestion and due to the cycle infrastructure schemes in proximity of the station access junction; and
- **Increased street activity** – significantly increased journeys to and from the station are forecast to be completed on foot or by cycling. The increased street activity along the A112 will likely result in delays to buses.

### **Interchanges**

Seven Sisters, Walthamstow Central and Tottenham Hale are the key bus to rail interchanges in the ULV in terms of passenger volumes. Walthamstow Central is the busiest of the three in terms of combined bus and station arrivals. Edmonton Green also represents a key interchange bus to Overground, although the volume of passengers is not as significant.

Bus to rail interchange and, in general, station arrival/ departure patterns are going to be strongly influenced by future growth, both with and without CR2. Walthamstow Central has a high share of bus alighters interchanging to rail/London Underground/London Overground, at around 60%. Bus alighters are expected to grow, both in 2031 and 2041, maintaining similar patterns of bus to rail interchange.

Edmonton Green passenger volumes are expected to grow in terms of both bus alighters and station entries in absolute numbers. However, the overall percentage of interchange passengers between bus and rail is forecast to decrease.

Seven Sisters and Tottenham Hale will see a significant increase in station passengers following the opening of CR2. These stations will mostly experience an increase in station entries in the peak period (morning) while the bus to rail interchange is expected to decrease significantly. Considering the CR2 interchange and development opportunities, it is plausible to assume that most of the new passengers will arrive either by rail, walking or cycling. This

will result in a change of the movement patterns within the stations and the surrounding space.

### **Possible influence of ‘switchable trips’**

Part of the Transport Study modelling included a test to represent the potential ‘switch’ of trips from highways to active travel and public transport. Traffic calming schemes and cycle schemes were included in this test scenario.

The traffic modelling analysis suggests that, where traffic calming and cycle schemes are implemented, traffic is diverted onto nearby roads, leading to improvements in terms of traffic volumes and a decreased risk of buses being impacted by general traffic congestion.

In terms of public transport, the impacts are likely to result in increased bus trips along the A406 corridor near Meridian Water and Angel Road station and a decrease of bus trips along the A1055 in proximity of Tottenham Hale and Northumberland Park.

## **4.1.2 Challenges and opportunities specific to ‘with’ and ‘without’ Crossrail 2**

### **East-West corridors**

Crossrail 2 is key to catalyse public transport development and usage in Outer London boroughs. Without the increased rail capacity and frequency brought by CR2, unlocking some of the most prominent sites in the ULV could be challenging. In turn, development growth means a greater impetus for public transport investment.

The forecast Crossrail 2 modelling showed an impact on bus patterns. The new rail link is forecast to become the main public transport line in the ULV and consequently will affect buses serving the area. A ‘pull’ towards the future Crossrail 2 stations in LB Enfield is evident from the forecasts.

The forecast demand for east-west connectivity in the ULV is to some extent constrained by the current service availability and routing. **The modelled ‘pull’ to and from the future Crossrail 2 stations and developments could be taken as evidence that an opportunity to investigate orbital connectivity in Outer London** exists, in particular, considering the new transport hubs and jobs provided.

### **Unlocking growth**

In a ‘without Crossrail 2’ scenario, **providing bus network improvements in response to challenges would result in investments being focused on already well accessible areas, such as the southern end of the ULV**, thereby increasing the gap in public transport provision between the Inner and Outer boroughs in the ULV. It would be difficult to achieve an increase in public transport patronage, especially in the ULV area corresponding to LB Enfield and north of the A406, without providing a competitive public transport network.

**In a scenario where regeneration is to go forward independently of major rail improvements (such as Crossrail 2), a comprehensive network of highly reliable alternative public transport services will be needed to support sustainable regeneration in Outer London.** This is also important to achieve the MTS targets of delivering a high mode share of sustainable transport and delivering reliable bus services that would enhance the ‘whole journey’ experience.

Consideration could be given to providing new services such as Bus Rapid Transit (BRT) and Demand Responsive Transport (DRT) solutions to achieve the mode shift away from private vehicles. BRT and DRT better serve different types of demand patterns. BRT is appropriate for dense and localised demand patterns. DRT is appropriate for low and dispersed demand patterns. As such, these should be carefully considered in relation to planned future growth and development aspirations.

Planning in a holistic manner, including a degree of flexibility and potential for adaptation, might be necessary to enable future changes and integration of the bus network as disruptive technologies, AVs and other advances in infrastructure may have an impact on bus operations and demand.

## Interchange

Levels of passenger numbers as well as customer expectations are expected to increase at stations along the future Crossrail 2 alignment. Most of these stations, with the exception of Ponders End, are currently classified as DfT category 'E' or 'F' type interchanges, meaning that their layout and facilities (e.g. concourse, platform, stairs, lifts, staff numbers) are fit for much smaller passenger numbers.

**Enfield Lock, Brimsdown, Ponders End, Angel Road and Tottenham Hale are forecast to increase passenger numbers by two or four times the current levels and all facilities and space surrounding the station should be re-assessed to ensure that it is fit for purpose.**

The bus to rail interchange, and bus alighters, are set to double, although they are not set to reach such a significant increase as the total station entries. Adequate bus to rail interchange facilities should be provided.

More importantly, the remaining passengers moving to and from the station will likely arrive by means other than buses, such as walking and cycling, and this will require adequate public space including waiting areas, crossings, and cycle stands, etc. to be provided near the stations.

## 4.2 Local considerations

Considerations on a more local level, looking at the proposed Opportunity Areas accessibility and travel patterns can be found in the schedules included in **Appendix A**, to the rear of this report.

The schedules should be regarded as indication only of bus priority, level of service and network coverage in light of the long term vision for the ULV developments.

The proposed development offer in the ULV is very varied, ranging from low-scale in-fills in consolidated high street environment to new large scale mix-use regeneration. The bus offer will in time adapt to serve the evolving uses and demand.

## 5 Conclusions and recommendations

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### 5.1 Summary

The ULV Opportunity Area (OA) covers an area of approximately 3,880 hectares around and along the River Lea in north-east London. Since the Opportunity Area Planning Framework was first published in 2013 the case for Crossrail 2 (CR2) has strengthened. Considering the increased population growth projections and the new Crossrail 2 scheme, TfL now estimates that up to 50,000 new homes and 20,000 new jobs could be delivered in the ULV.

The OA will see a dramatic change in terms of growth, with major residential and employment centres coming forward where at the moment there is little in terms of land use and consequently in terms of bus services.

The key planned infrastructure change will be Crossrail 2, introducing much higher service frequency along the West Anglia Main Line (WAML). Crossrail 2 will affect travel patterns across the ULV and the relationship between rail and bus interchanges.

Drawing on the previous Transport Study modelling, this report interrogates the potential long-term implications of a with and without Crossrail 2 scenarios on bus network performance in the ULV.

### 5.2 With and Without Crossrail 2

Some of the key challenges and opportunities will be common to both the ‘with’ and ‘without’ Crossrail 2 scenarios:

- Increased passenger demand along already busy radial corridors, such as A1010/A10 and A112, with little opportunity to implement ‘hard priority’ due to the implementation of cycle schemes and increase in pedestrian activity;
- Junction delays due to local increase in traffic flows, particularly along the A503;
- Bus to rail interchange and, in general, station arrival/ departure patterns are going to be strongly influenced by future growth at key underground and rail interchanges that present challenges for changes (Tottenham Hale, Walthamstow Central, Seven Sisters).

### 5.3 With Crossrail 2

The ‘with’ Crossrail 2 modelling has highlighted opportunities for orbital bus network improvements and significant challenges in terms of station interchange and public realm.

The introduction of Crossrail 2 in the modelling shows an increase in orbital bus demand along Forest Road, the A406 and A110, and between Enfield Lock and Brimsdown in the ULV. A similar ‘pull’ could be observed in proximity of the Southgate Crossrail 2 terminal. This represents an opportunity to revise orbital connectivity to respond to new patterns of demand.

The overall increase in passengers at key bus stations and London Underground/Overground interchanges (Walthamstow Central, Seven Sisters and Tottenham Hale) will pose a challenge in terms of accommodating passenger movement and bus station operations.

Significant increases in passenger arrivals are forecast at the new Crossrail 2 stations, most of which currently have low patronage and minimal interchange facilities and staff. The most significant increase in station entries will be by modes other than bus, such as walking and cycling, and therefore adequate space surrounding Crossrail 2 stations will be required to ensure that the stations, bus and cycle facilities are sufficient to cater for the expected passengers. Improved public realm and interchange facilities could be delivered as part of development coming forward in the ULV.

Considering the MTS and previous OAPF (2013) proposals around buses, in the context of Crossrail 2 there appear to be opportunities to reassess the role of buses in the ULV in synergy with development in the OA and new stations. Bus network enhancements were proposed in the previous OAPF but these were focused on the south of the ULV. MTS Policies 13 and 17 set a scenario for buses to improve their offer, complementing London Underground and London Overground, and representing an opportunity to support growth and regeneration in suburban areas. This is important to spread the economic and social benefits of Crossrail 2.

## 5.4 Without Crossrail 2

In the absence of Crossrail 2, or major WAML improvements, the bus network will likely experience challenges along the busiest corridors and interchanges.

In a ‘without’ Crossrail 2 scenario, there will be an increased demand for buses along radial corridors (A1010/A10 and A112) which are already saturated. This might pose a challenge in terms of space to provide bus priority measures and may result in investment being focused on already well accessible areas, such as the southern end of the ULV, thereby increasing the gap in public transport provision between the Inner and Outer boroughs in the ULV.

Provision of the proposed cycle and traffic calming schemes in the ULV in the long term may help to deliver improvements for buses, as well as walking and cycling. This is on the assumption that people may shift from cars to walking or cycling, and general traffic will re-route away from the main radial routes while cycle schemes are implemented, thereby improving bus journey times in the long run.

The Draft MTS supports growth in Outer London and suburban areas encouraging alternative public transport measures to be explored. Dependent on the growth location and agenda, a BRT or DRT solution could be explored to support development and provide a credible alternative to use of private cars.

## 5.5 Next Steps

We have identified the challenges and opportunities posed in the short, medium and long term for the bus network in the ULV. The next step is to set out a series of potential measures which could ensure that buses are prioritised and remain an attractive mode of sustainable travel. The long list of potential measures will then be prioritised in consultation with key stakeholders.



# Appendix A

## Brimsdown, Freezywater and Innova Park

The North East Enfield (NEE) AAP, adopted in June 2016, sets the growth scenario for a large area from the M25 to Ponders End to the south and from the boundary with Epping Forest to the A10 Great Cambridge Road to the west.

The Brimsdown Industrial Estate located to the east of the study area between the WAML and the Lea Valley Regional Park is characterised by employment buildings, warehousing, distribution and manufacturing uses. The NEE AAP identifies the opportunity for regeneration within the estate, improving the quality of the environment. Part of the southern estate has been released from SIL designation and can be developed.

To the northern edge of the NEE AAP are Freezywater and Innova Business Parks. The first hosts high quality distribution centres. The proximity of strategic roads is key to the success of the area. Innova comprises a mix of uses including housing, an Academy, commercial business and warehouses.

Freezywater and Innova Park have been identified for potential to build further industry and provide employment opportunities.

## Considerations

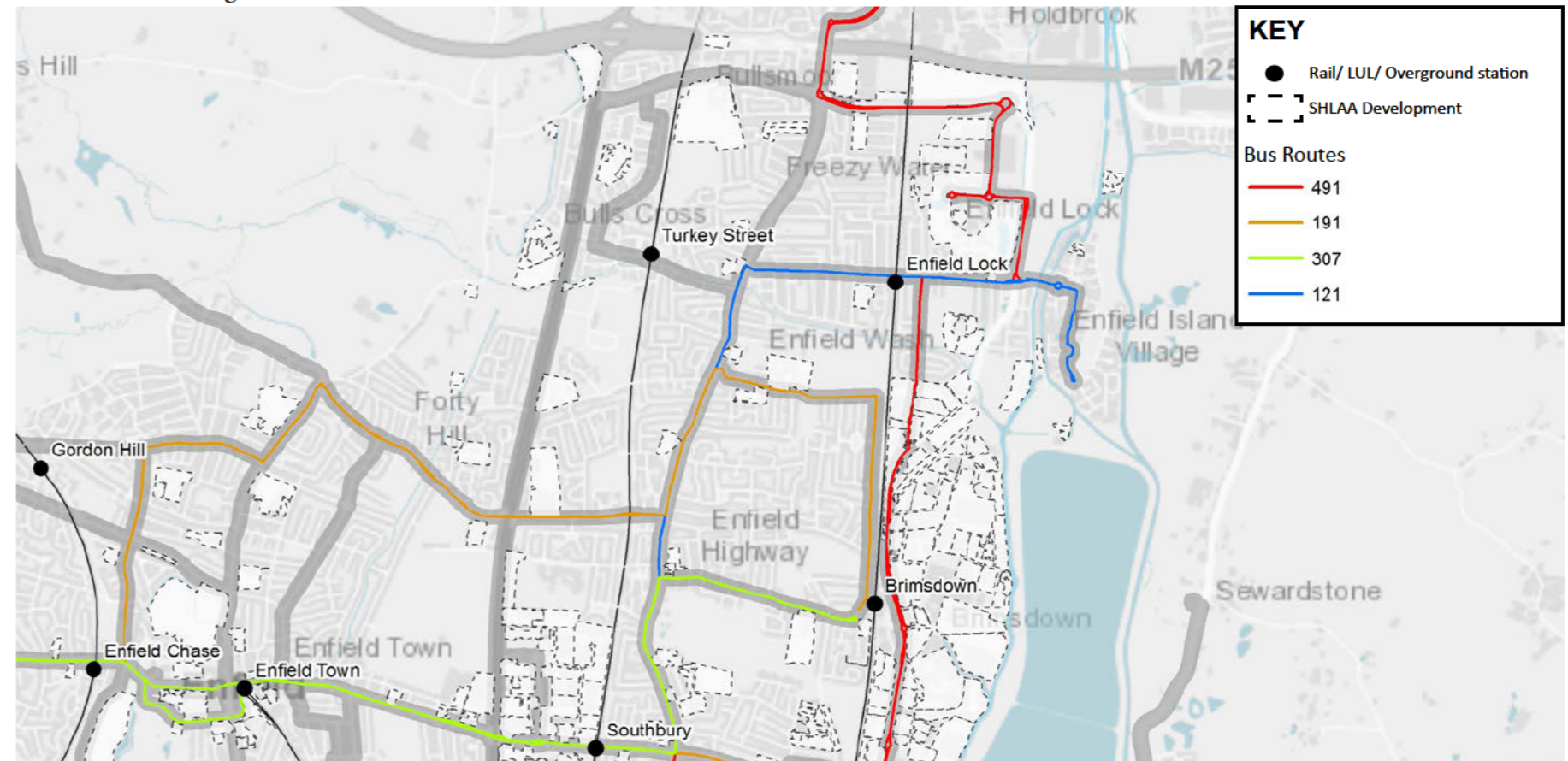
**Accessibility** - The Opportunity Area currently presents a 'poor' level of public transport accessibility. This is forecast to change following Crossrail 2. Due to the lack of crossing points over the WAML and the waterways, however, the benefits in terms of accessibility might be limited.

**Forecast** - The increased bus patronage feeding to/from Brimsdown station and the area around Hertford Street is likely to put the bus links under pressure that serve the new Crossrail 2 station. Furthermore increased demand for public transport access to and from Brimsdown, Freezywater and Innova Park is to be expected in relation to the shift towards a more varied employment land use.

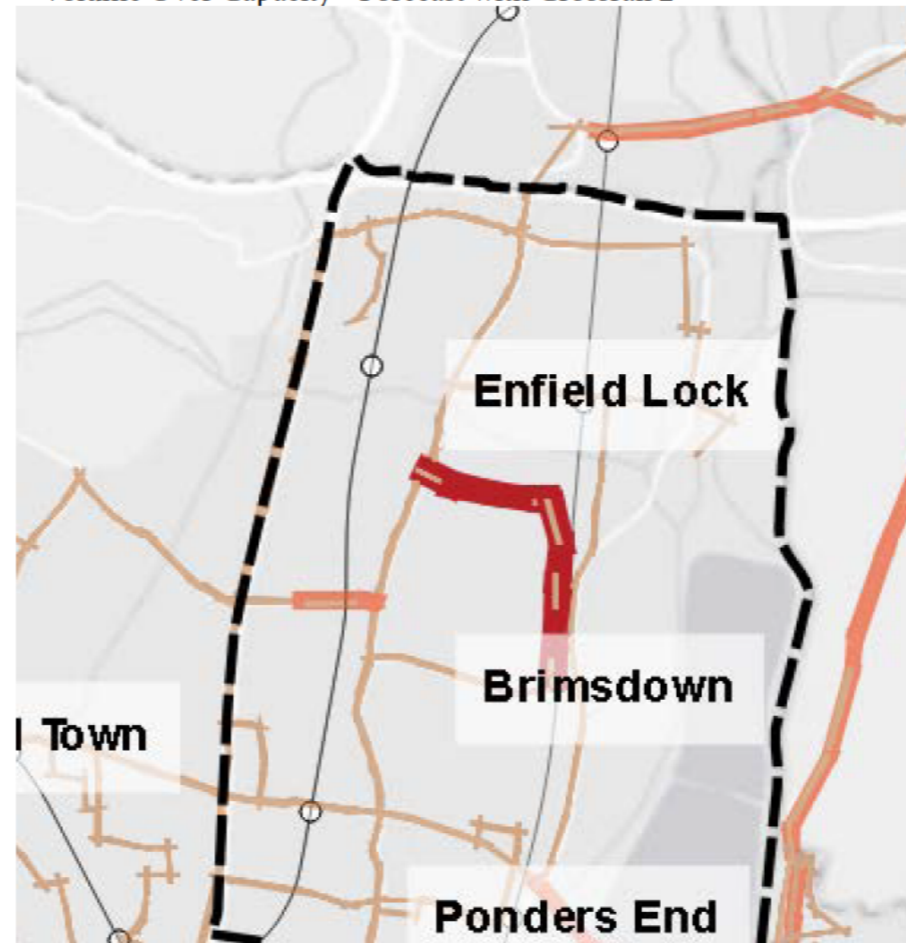
**Network coverage** - The bus network links the key centres and high streets, Waltham Cross, the A1010 Hertford Road and Enfield Town. Currently the 121 and 491 routes serve the key areas, with the 307 linking Brimsdown station and Enfield Town. Crossrail 2 proposals might alter the highway network and will most likely require restructuring of some routes (eg 121). The proposed Opportunity Area development sites are large and bus coverage within the sites could be improved.

**Travel patterns** - Travel demand in the area is likely to build up between the closest high streets, the A1010 Hertford Road and Waltham Cross, the new Crossrail 2 stations and the new employment sites. Connectivity to the east is limited for buses by the reservoirs and waterways, although walk and cycle connectivity is possible.

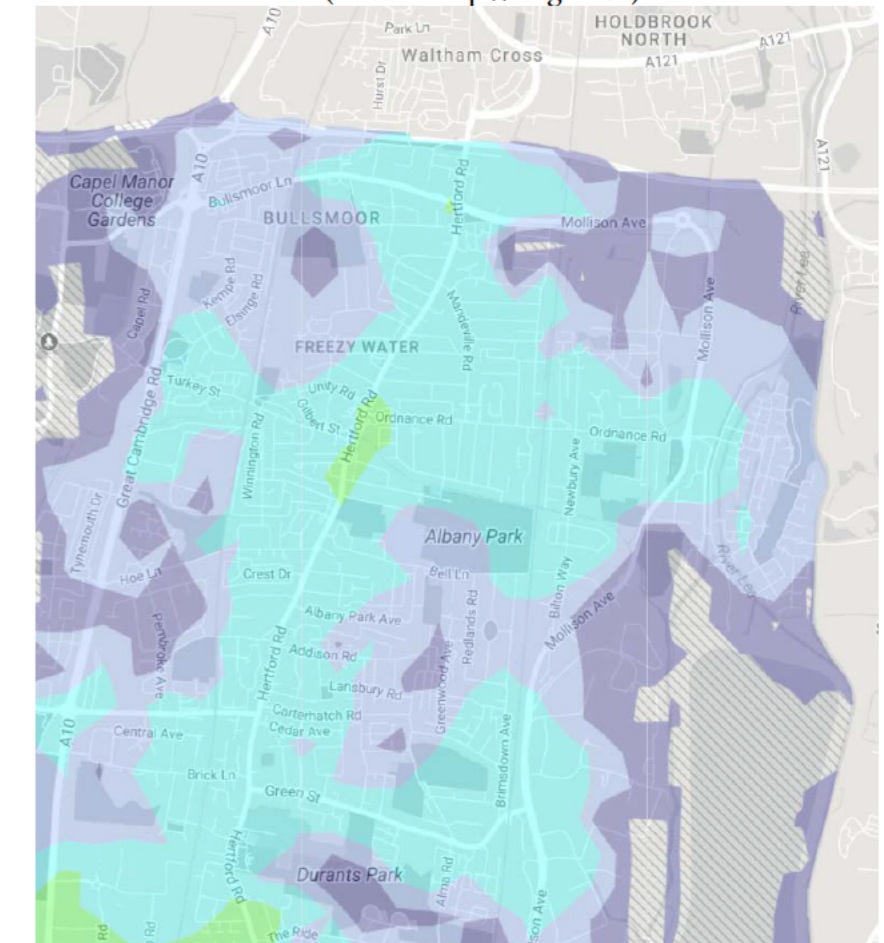
Bus routes serving the area



Volume Over Capacity - Forecast with Crossrail 2



PTAL Forecast - 2031 (source: <http://tfl.gov.uk>)

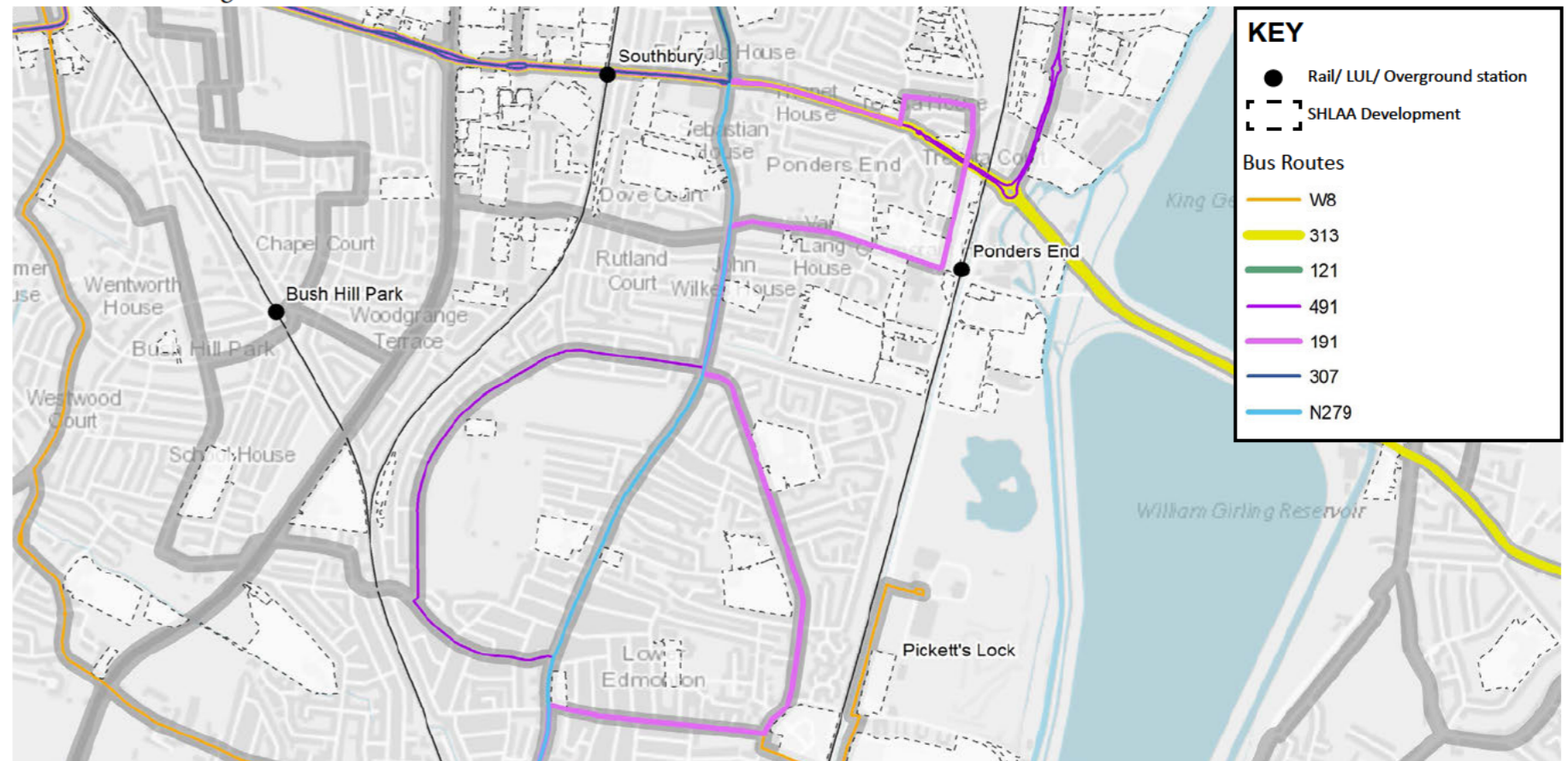


## Ponders End, the High Street and Pickett's Lock

Ponders End, a lively centre in North East Enfield along the A1010 Hertford Road, is one of the development areas identified in the NEE AAP. A number of character areas have been identified within the AAP including Ponders End High Street, the Alma Housing Estate and Ponders End station. These areas are set for regeneration, with new development and public realm improvements. The Waterfront area is envisioned as employment-led mixed use development.

Pickett's Lock, south of Ponders End station along the A1055 Meridian Way, has the potential to provide high quality sports and recreation facilities. Initiatives to progress this vision include enhancing the leisure cluster with new facilities and better synergies between uses with improved links. Public realm improvements are proposed to increase visibility and ease of access.

Bus routes serving the area



## Considerations

**Accessibility** - PTAL is very good in proximity to Ponders End High Street (Southbury station), with numerous routes serving the location. The development area in close proximity to Ponders End station, however, is less well connected and PTAL decreases to 'poor' towards Pickett's Lock. Whilst Ponders End station and its environs will see an increase in PTAL following Crossrail 2, locations further away, such as Pickett's Lock, will rely on buses to boost public transport accessibility.

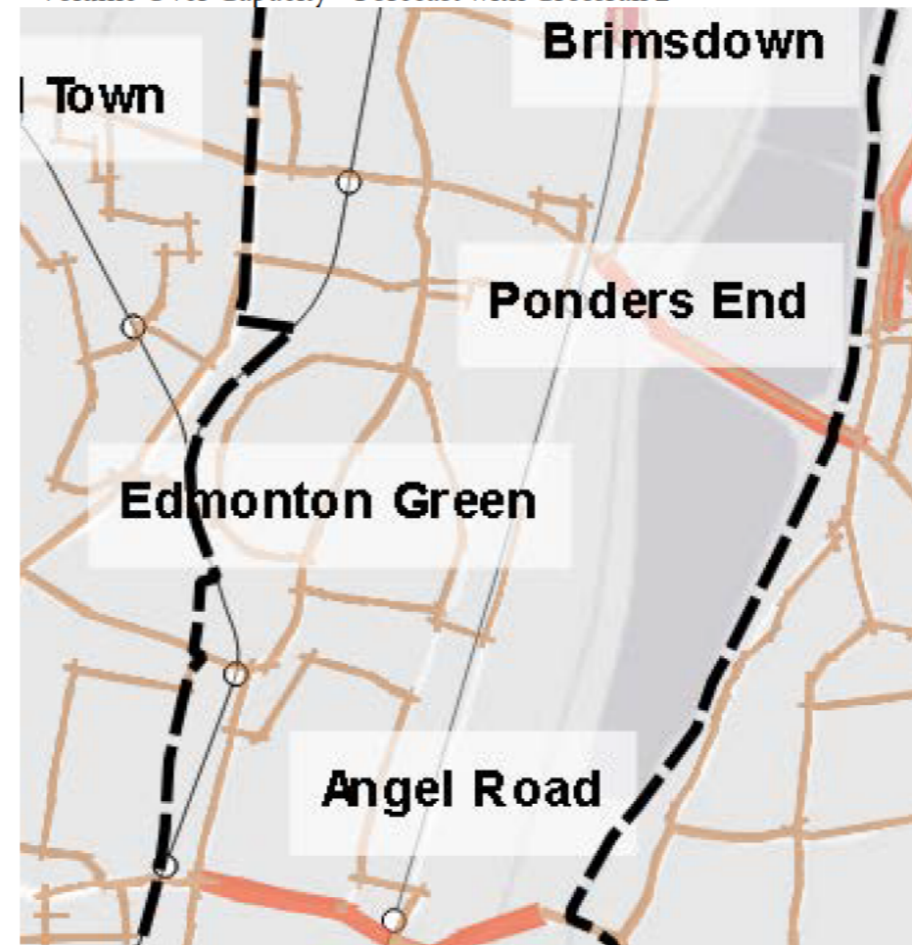
**Forecast** - The railplan modelling shows that increased bus patronage feeding to/from Ponders End station is likely to put bus links under pressure along Lea Park Road following the opening of Crossrail 2.

**Network coverage** - The network coverage is good with numerous bus routes serving the development areas, the closest town centres and transport hubs either directly or with one interchange. The A1055 Meridian Way and Pickett's Lock are the only areas currently not sufficiently well covered by the bus network.

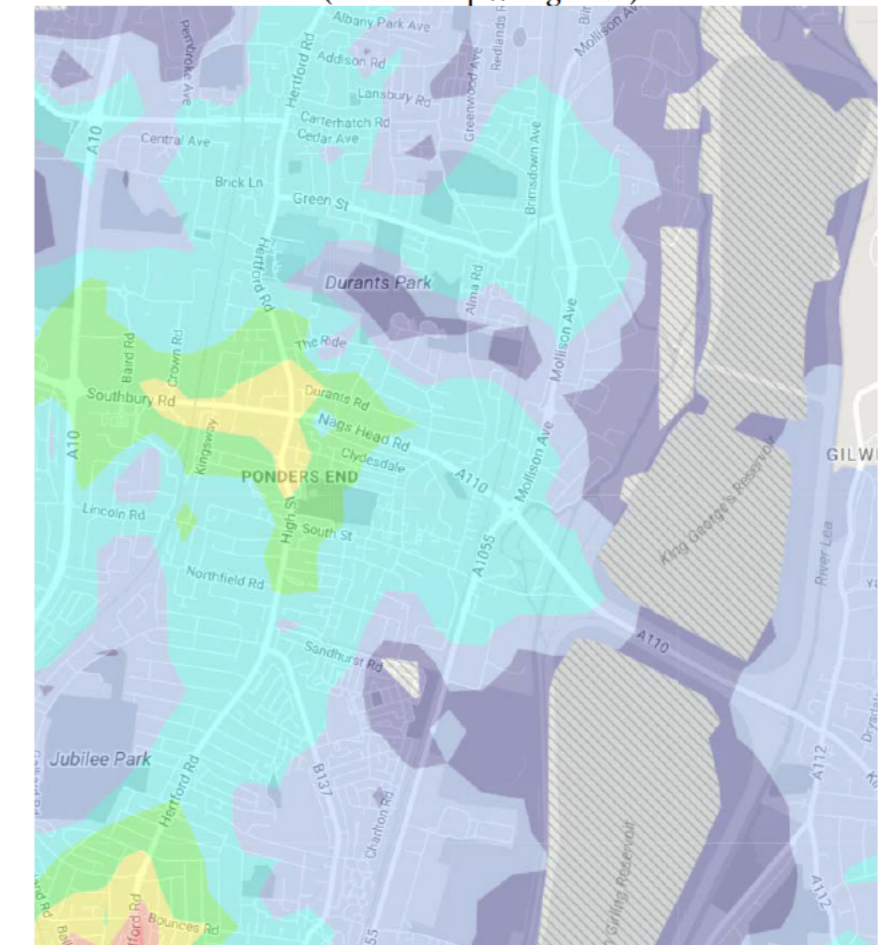
**Travel patterns** - Travel demand in the area is likely to change along the A110 Nags Head Road leading to and from Enfield Town and along the A1010. Limited bus network coverage is provided to/from Chingford and the A1055 at the moment and it is reasonable to assume that:

- i) the new Crossrail 2 services are likely to increase bus patronage to/ from Chingford and Ponders End station, and
- ii) the new housing and employment developments at Alma Road and the Waterfront will require better connectivity to the high street and leisure facilities at Pickett's Lock.

Volume Over Capacity - Forecast with Crossrail 2



PTAL Forecast - 2031 (source: <http://tfl.gov.uk>)



## Meridian Water, Edmonton Eco Park and Angel Road Retail Park

The Meridian Water Opportunity Area is located in the south eastern corner of LB Enfield. The borough has recently consulted on the updated Edmonton Leaside AAP which designated Meridian Water as a new centre in the ULV, providing up to 10,000 new homes and 6,700 new jobs. The A406 North Circular and the Lea Valley Regional Park bind the site. As part of the wider development, a new station will be delivered within the Masterplan which will replace Angel Road and could in future be served by Crossrail 2.

The first phase of Meridian Water, including the new station and platforms, was recently granted planning permission for 725 dwellings and ancillary uses.

The Angel Road Retail Park is a relatively small big-box area north of Meridian Water and within the Edmonton Leaside Industrial Estate. Following recent market trends and the London Plan policy it might be possible to redesignate Angel Road Retail Park and promote the site for mixed employment uses.

In terms of regeneration opportunities in Central Leaside, the redevelopment of Edmonton Eco Park will provide the next generation of waste services and would kick-start the provision of the Lee Valley Heat Network.

## Considerations

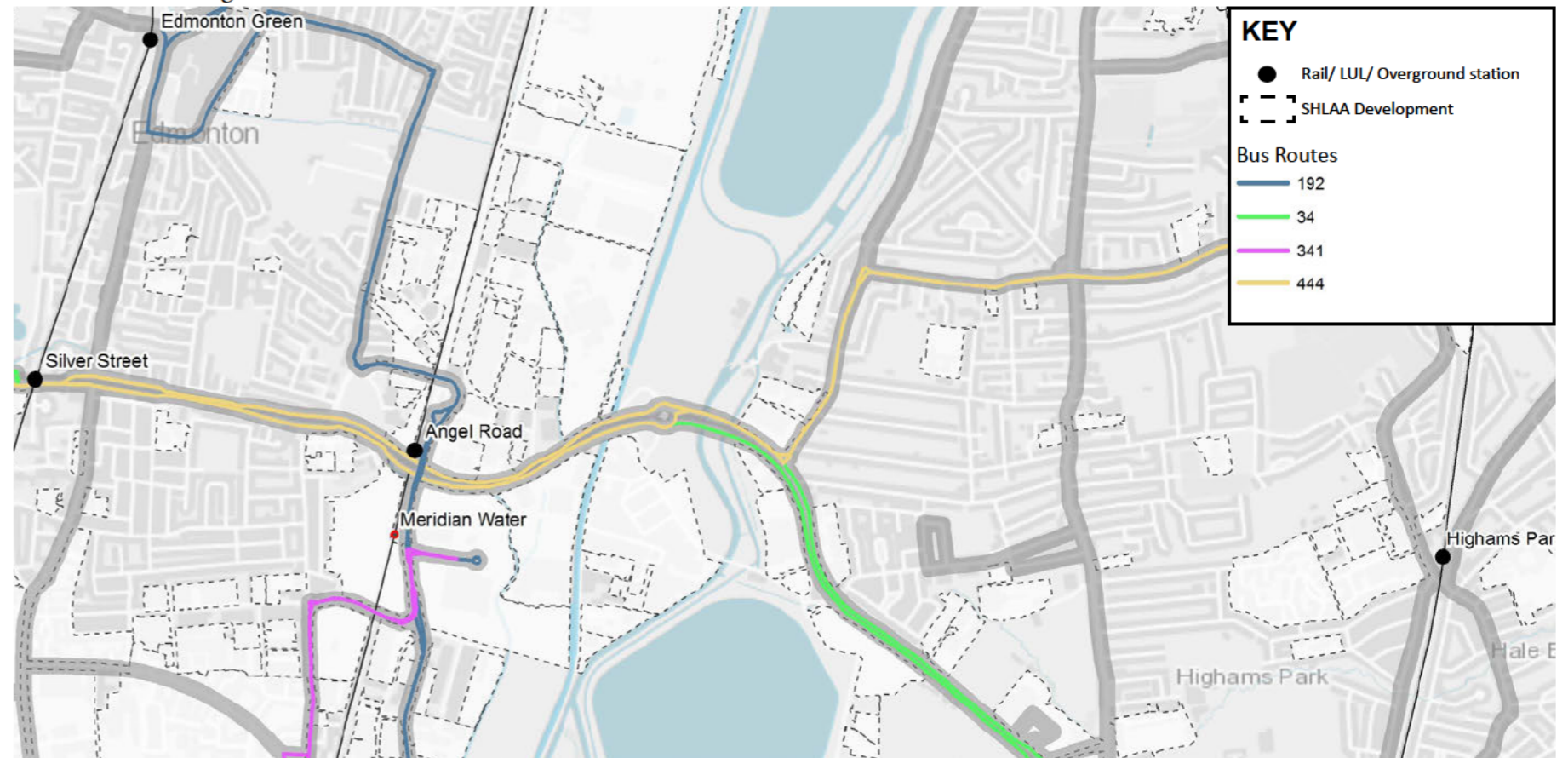
**Accessibility** - There is currently poor PTAL in this location. Crossrail 2 (or significant rail frequency improvements along the West Anglia Main Line) is likely to greatly improve accessibility in the area surrounding the stations (Angel Road, or the new Meridian Water station). The new masterplan will be instrumental in delivering adequate connectivity to/from the station. The industrial area to the north of the A406 North Circular will rely on buses to improve accessibility. With or without Crossrail 2, a network of buses will be necessary to enhance the PTAL.

**Forecast** - Increased bus demand feeding to/from Angel Road (Meridian Water) station is to be expected following the opening of Crossrail 2. The bus routes linking the station with the surrounding areas are likely to be under pressure, particularly the East-West links (the A406 North Circular).

**Network coverage** - The network coverage could be improved along the A1055 Meridian Way and potentially along new routes provided within the Opportunity Areas.

**Travel patterns** - Travel demand in the area is forecast to build up along the East-West routes. Currently the bus network coverage is insufficient to model with precision where and how travel patterns would be developing in future.

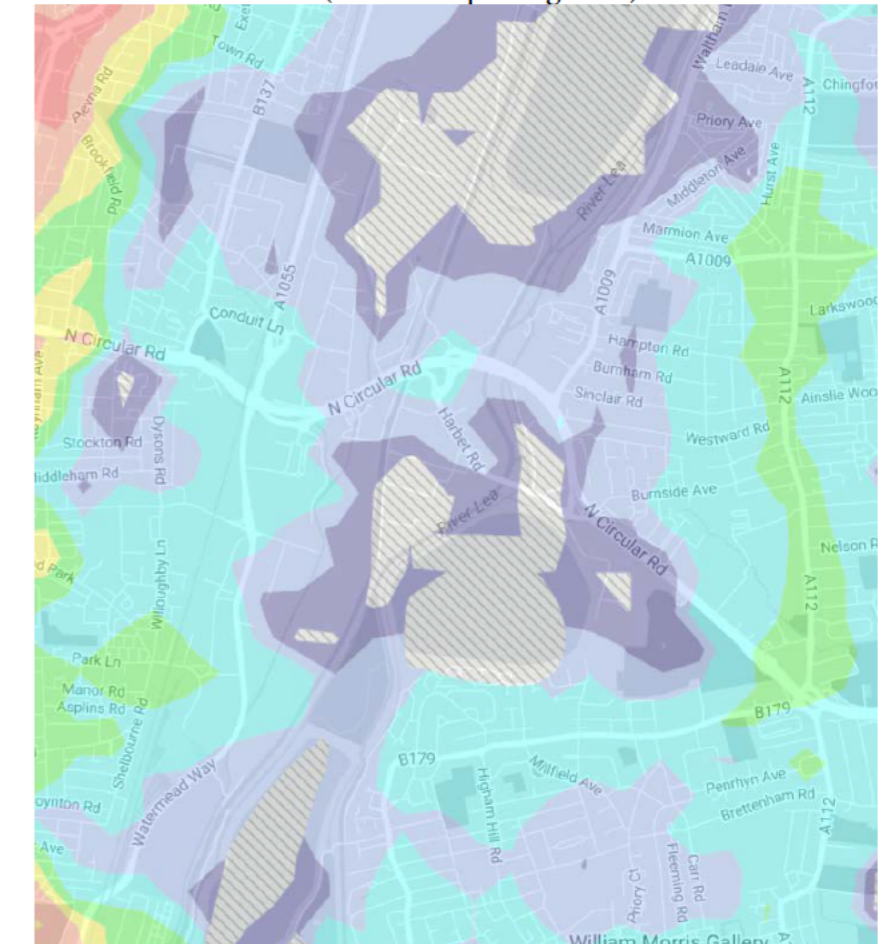
Bus routes serving the area



Volume Over Capacity - Forecast with Crossrail 2



PTAL Forecast - 2031 (source: <http://tfl.gov.uk>)

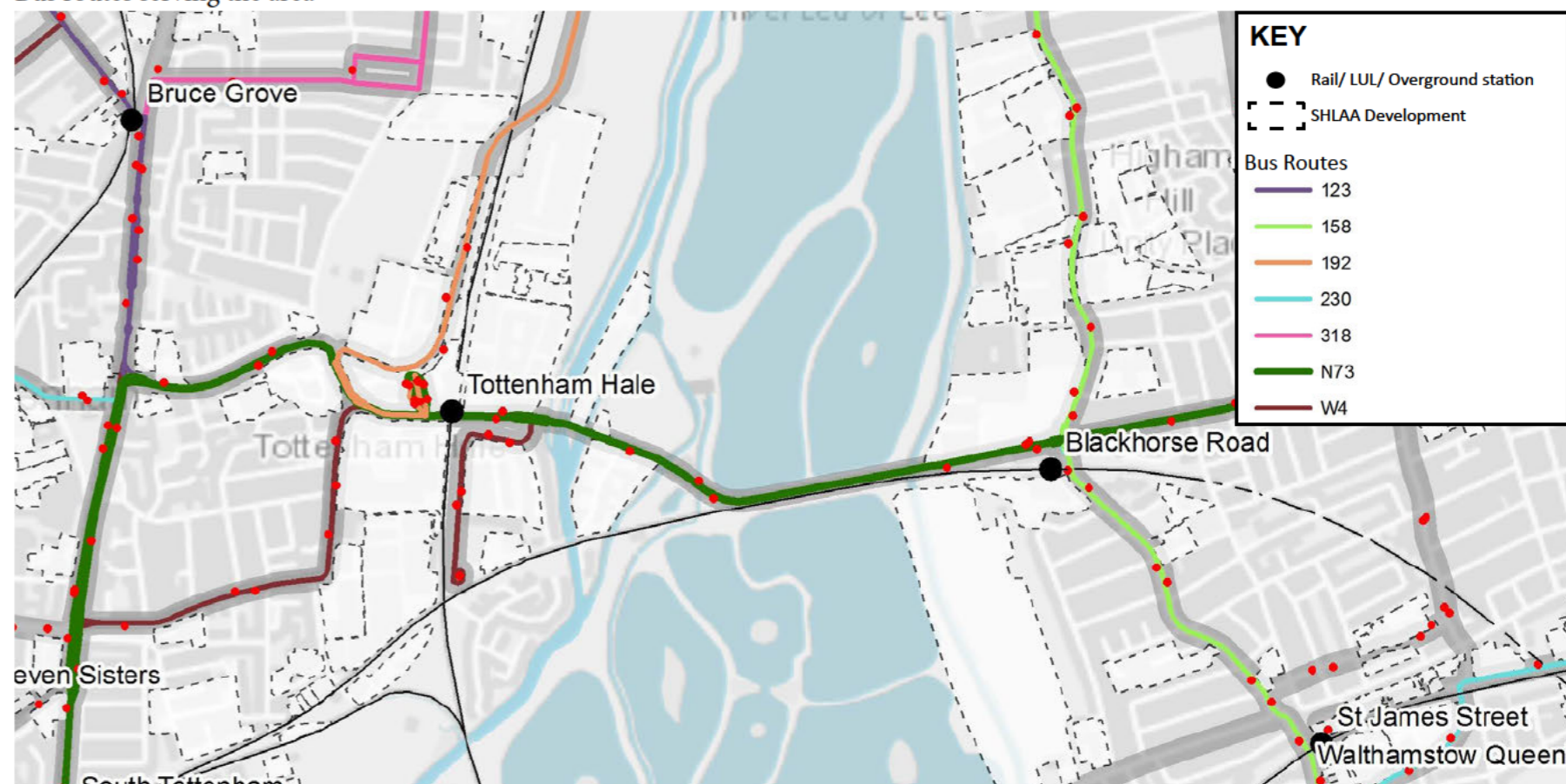


## Tottenham Hale and Blackhorse Lane

The London Borough of Haringey is promoting the regeneration of the area surrounding Tottenham Hale station, seeking a status of 'District Centre'. The vision for the area is to become a distinctive, high quality, diverse and vibrant commercial destination. The Tottenham Hale site capacity assessment shows opportunities in excess of 5,600 residential units and 85,000 m2 of commercial and town centre uses.

The Blackhorse Lane Opportunity Area, in the London Borough of Waltham Forest, comprises a number of development opportunities located east of the Lockwood and Maynard reservoirs and north of Forest Road. The AAP was adopted by LB Waltham Forest in 2015. The document identified the potential for up to 2,500 new homes and 1,000 jobs alongside new services and improved connectivity. Waltham Forest council's vision is to evolve Blackhorse Lane into a mixed-use area, providing new homes, small scale local businesses and commercial space.

Bus routes serving the area



## Considerations

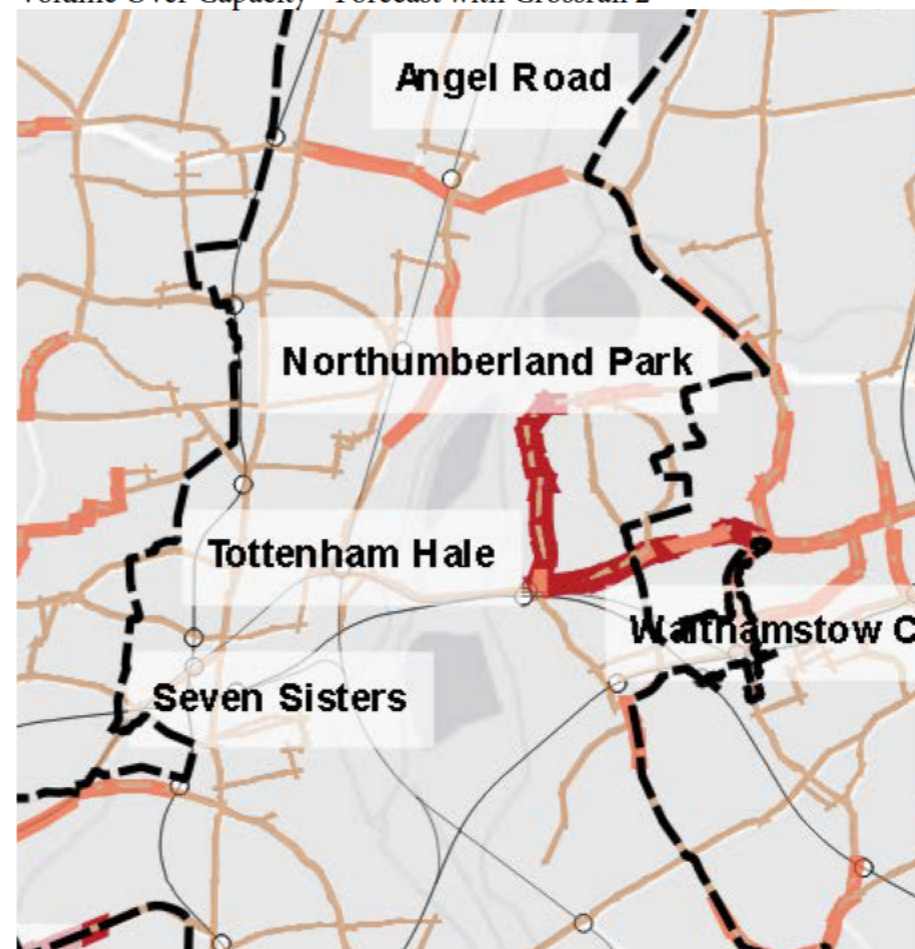
**Accessibility** - In proximity of Tottenham Hale station, PTAL is excellent. The Blackhorse Lane AAP, however, covers a wide area and PTAL falls quickly, north of Forest Road.

**Forecast** - The railplan plot shows increased bus patronage in proximity to Blackhorse Road station. This might result in a requirement for additional bus capacity along Forest Road and Blackhorse Lane, approaching Blackhorse Road station.

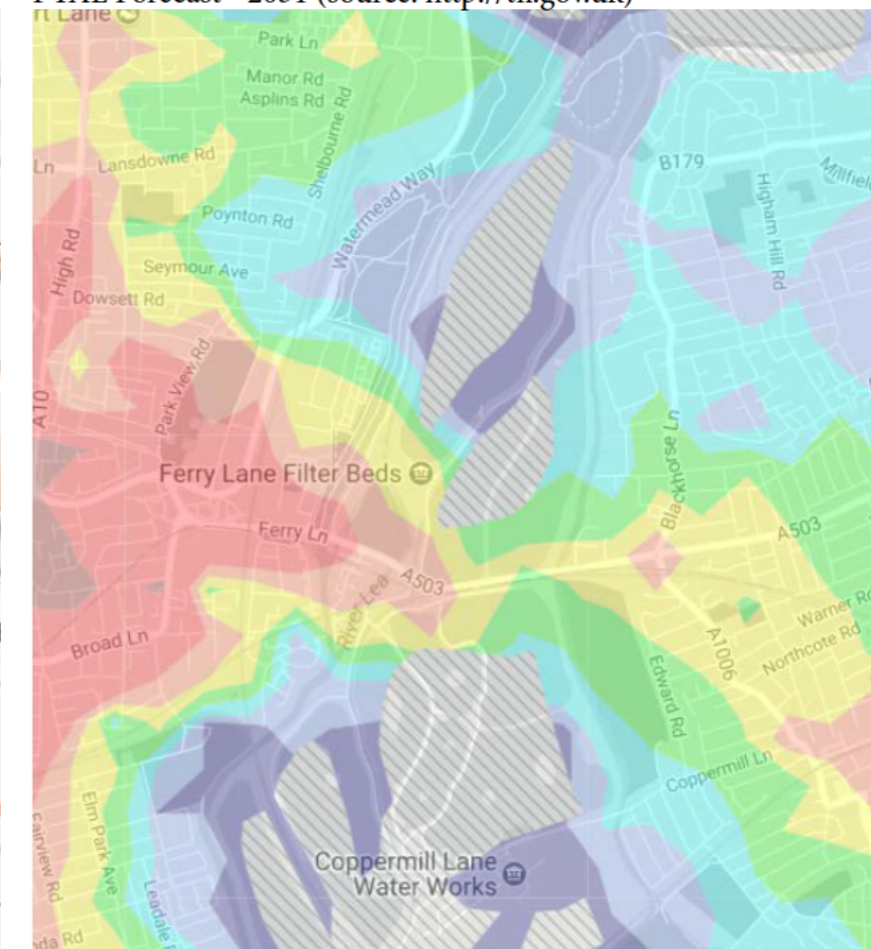
**Network coverage** - Both the Tottenham Hale and Blackhorse Lane development areas are directly served by buses, with a number of bus stops situated close to the future development areas.

**Travel patterns** - Travel demand in the area is forecast to build up consistently along Blackhorse Lane (bus route 158) in the 'without' Crossrail 2 railplan forecast. 'With' Crossrail 2, an increase in bus demand along the A503 Ferry Lane/ Forest Road is to be expected. This link will also most likely be subject to increased delays due to traffic re-assignment and local cycle schemes.

Volume Over Capacity - Forecast with Crossrail 2



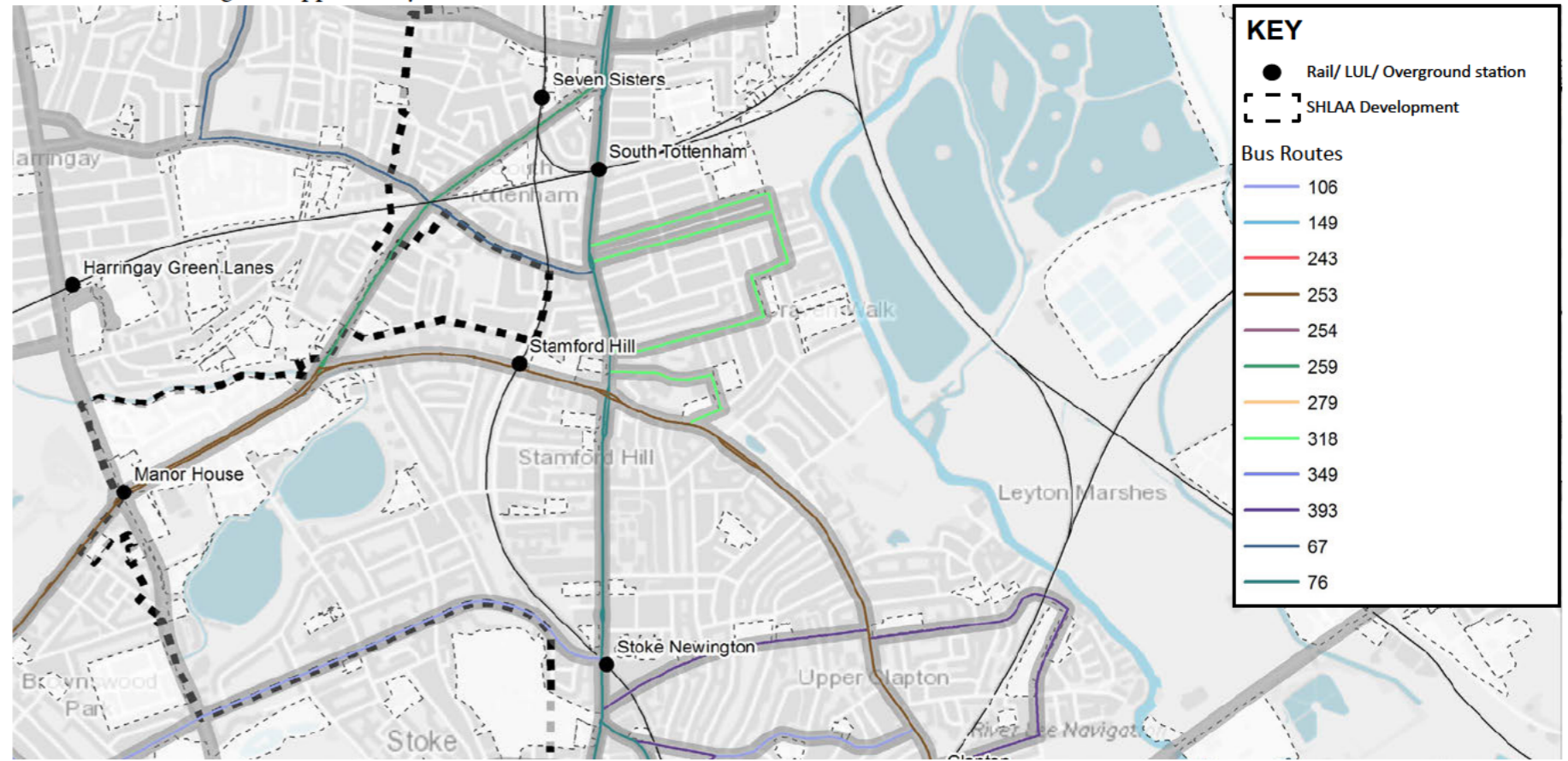
PTAL Forecast - 2031 (source: <http://tfl.gov.uk>)



## Seven Sisters, Stoke Newington and Manor House

The Seven Sisters Opportunity Area is identified as the area around Seven Sisters station. The vision focuses on the enhancement of the public realm and transport interchange, as well as improvements to the retail and mix of land uses. Stoke Newington is located at the southern end of the Opportunity Area and covers Stoke Newington High Street, the southern part of Stamford Hill and the eastern part of Church Street. There is potential within Stoke Newington for high quality mixed-use development. This includes investment in shop frontages, public realm and highway management. A long term aspiration is to remove the gyratory system. Stamford Hill is located at the southern end of the Opportunity Area and forms part of the link between the Upper and Lower Lee Valley Opportunity Areas. There are opportunities at Stamford Hill for more intensive activity and an improved retail offer within the centre. Manor House is located at the western edge of the Upper Lee Valley Opportunity Area. The Woodberry Downs masterplan, which is one of the main housing growth areas in the Upper Lee Valley, occupies the area east of Manor House station (north and south of the A503 Seven Sisters Road).

Bus routes serving the Opportunity Area



## Considerations

**Accessibility** - The Opportunity Area along the southern end of the A10 High Road presents excellent public transport accessibility, with numerous bus routes serving the corridor. Crossrail 2 is likely to have minimal impact in this area in terms of PTAL score due to the already excellent levels of public transport provision.

**Forecast** - Increased bus demand is to be expected along the A10, one of the main bus corridors in the ULV. However, the railplan modelling shows a spike in demand between Stamford Hill and Manor House. In the same section the forecast traffic shows the potential for junction delays.

**Network coverage** - The network coverage is good with numerous bus routes serving the Opportunity Areas and providing links between stations and local centres.

**Travel patterns** - Travel demand in the area is likely to build up along the existing bus corridors, with a spike in demand between Stamford Hill and Manor House.

Volume Over Capacity - Forecast with Crossrail 2



PTAL Forecast - 2031 (source: <http://tfl.gov.uk>)

