Annex 15

Mass Rapid Transit - Vision and Options
Introduction

Annex 15 sets out a high level vision and potential options for a Mass Rapid Transit system across Hertfordshire. This builds upon the following set out in Hertfordshire County Council’s Local Transport Plan 4 (page 105):

A passenger transport link offering greater speeds and reliability than traditional bus services, linking Hemel Hempstead Rail Station in the west to Welwyn Garden City in the east, with potential future extensions to Hertford and Harlow.

The service would be expected to operate relatively free from the impacts of traffic congestion using bus priority measures and segregation.

The scheme seeks to remedy some of the current east west connectivity deficiencies in the county and enhance interurban connectivity. The scheme could potentially serve park and ride sites on the edges of the towns it serves. The scheme is highly flexible and could be brought forward in stages or evolved from gradual bus priority enhancements on its route. This enhances its deliverability and alignment with bus improvements that could come forward in the short and medium term. It can be delivered at much lower cost than rail or light rail alternatives, and importantly offers greater flexibility on the destinations it serves in the future which could change depending on long term land use plans.

Passenger transport vehicles could develop considerably in the next 15 years, potentially being early adopters of fully autonomous technology, which could significantly reduce their operating costs. Other developments such as with regard to fuel, engine technology and ticketing systems could result in more ‘train like’ levels of service, challenging existing perceptions of bus and rail comparisons.

Connectivity to St Albans could be provided by bus or via an interchange with the Abbey Line but this will need to be assessed as part of the consideration of long term options in the Watford-St Albans corridor.

The scheme could serve, and its delivery be supported by, development and increased development density along its route, this should therefore be a consideration in further development of local land use plans.

The remainder of this annex considers the overarching aim of a Mass Rapid Transit; why it is needed; the general concept of a Mass Rapid Transit and the criteria it would need to meet; the overarching connectivity strategy; potential transport technology options; potential phasing and routing; and alternatives to a Mass Rapid Transit.
Overarching aim of a Mass Rapid Transit in Hertfordshire

The overarching aim of a Mass Rapid Transit in Hertfordshire is set out below. It is important to define an overarching aim to build consensus around what a Mass Rapid Transit system is intended to be. It can also be used to influence the development of the scheme and develop a more detailed set of objectives and outcomes as part of more detailed work at a later stage.

A fast and reliable, express inter-urban passenger transport network linking major urban settlements within the A414 corridor to facilitate sustainable travel and address the pressure of delivering significant growth in housing and jobs.
Why is MRT needed?

- Aside from the existing Greenline 724 bus service which runs between Harlow and Watford, there are no direct public transport services east-west across Hertfordshire.
- Existing public transport journey times are long across the corridor.
- There is expected growth in housing and employment across the county which will generate new cross-county journeys.
- Investment in high quality public transport has the potential to reduce congestion on the A414 by encouraging modal shift.
- It will also improve Hertfordshire’s image by providing a sustainable form of mass transit for east-west inter-urban trips.

76% of commuting trips to towns on the A414 Corridor are made by car. ... but only 5% of these are made by bus.

In the majority of the A414 Corridor, less than 35% of employees live and work in the same town but this could change in the future.

The current journey time between Hemel Hempstead and Welwyn Garden City on the 300/301 bus is 75 minutes compared to 30 minutes by car.

<table>
<thead>
<tr>
<th>Journey Times</th>
<th>Greenline 724 (timetabled)</th>
<th>Car (estimated)</th>
</tr>
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<tbody>
<tr>
<td>Watford - Hatfield</td>
<td>60 mins</td>
<td>30 mins</td>
</tr>
<tr>
<td>Hatfield - Harlow</td>
<td>70 mins</td>
<td>30 mins</td>
</tr>
<tr>
<td>Hertford - Harlow</td>
<td>25 mins</td>
<td>20 mins</td>
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Why a Mass Rapid Transit in Hertfordshire is needed

- The A414 corridor already experiences significant traffic congestion and poor journey time reliability today. With the estimated level of growth, traffic issues are predicted to persist and intensify in the future on the A414 and also on adjoining and parallel routes.

- A series of highway and junction improvements are put forward in the draft A414 Corridor Strategy, including M1 Junction 8 and A414/A1081 London Colney Roundabout. These are not intended to eradicate congestion. At the very most they may only be expected to manage future levels of traffic congestion so they are no worse than they is today.

- Continuing to build additional highway infrastructure to a level which can accommodate all traffic and significantly reduce congestion both now and to maintain this improved level of service over a long period is not considered affordable or sustainable. A more efficient way of using existing infrastructure therefore needs to be found.

- Evidence in the draft strategy has identified that the A414 is used by a variety of trips, including shorter distance trips within towns but also trips between towns along the A414 Corridor. The private car is the default travel mode choice for many people for a variety of reasons. The absence of an attractive, direct, frequent and high quality public transport service running east-west across Hertfordshire is likely to be a factor in people’s mode choice.

- Passenger transport services including buses can be a more space efficient way of transport people using existing infrastructure. Many of the car journeys occurring along the A414, especially during weekday peak periods, involve people driving alone, for example to/from work. A single decker bus has the potential to carry up to 75 passengers however a bus would occupy the space of around 2 cars carrying potentially only 2 drivers on the road.

- If all of the 50,000 estimated new homes in the corridor area generated just one additional car on the A414, and if all the cars lined up in a queue, the queue could stretch around 290km in length. That is almost six times the length of the A414. Many new households will have access to more than one car.

- If the A414 becomes a less attractive route in the future because of traffic congestion, motorists with no mode alternative will continue to drive, seeking out alternative and less appropriate routes such as along country lanes and through residential areas.
General concept and criteria for a Mass Rapid Transit in Hertfordshire

1. Ability to interchange easily between different modes of travel
2. Frequent services to minimise wait times
3. Reliable services
4. Distinctive branding and marketing
5. Integrated ticketing
6. High quality waiting facilities
7. Better-than or equal-to journey times compared to the private car
8. Dedicated Infrastructure – minimise mixing with general traffic
9. Linked to major transport hubs
10. Linked to key developments and major employment centres
11. Supporting sustainable growth
Transportation Options

There are a wide variety of potential transport technology options which could be adopted for a Mass Rapid Transit. For simplicity, the following have been considered at this stage.

Other options (or hybrids of options) could be also considered which are not captured in this report including automatic light vehicles, ultra light rail and affordable very rapid transit.
Capacities

The passenger loading capacity of different transport options is presented below. This includes passenger seating and standing capacity. Passenger capacity could be a key factor in future decision making in terms of how to transport as many people in an efficient and cost effective way.

**Single decker bus**
- typical capacity: **60-75**

**Double decker or articulated bus**
- typical capacity: **90-105**

**Tram typical capacity:** **100-210**
Bus Rapid Transit (Non Guided)

- Bus rapid transit provides faster, more reliable journeys by giving buses priority
- Uses a mix of segregated bus lanes, standard bus lanes and bus priority traffic signals
- Bus rapid transit integrates well with other forms of transport

- It needs to be accompanied by a distinct marketing and branding campaign
- To help differentiate it from more traditional forms of local buses, a BRT system needs to be accompanied by improved waiting facilities including shelters and real time information screens
- Shorter journey times / improved journey time reliability makes it a viable alternative to the car
### Bus Rapid Transit (Non Guided)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td>• Cheaper than light rail and guided bus</td>
<td>• Bus priority technology is not always as efficient as envisaged</td>
</tr>
<tr>
<td>• Penetration of town centres utilising existing roads (with bus priority technology)</td>
<td>• Faster speeds and reduced journey times could be achieved with a guided busway</td>
</tr>
<tr>
<td>• Easier to retrofit to modern/automated technology</td>
<td>• May not be distinctive enough from ordinary buses to attract passengers – it may not represent a significant enough step-change in public transport service provision.</td>
</tr>
<tr>
<td>• Potential to fund through S106 contributions, growth deals and other funding arrangements</td>
<td></td>
</tr>
<tr>
<td>• More reliable and faster journey times than ordinary bus services</td>
<td></td>
</tr>
<tr>
<td>• Adaptable routes which could not happen with light rail</td>
<td></td>
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<tr>
<td>• Higher value for money</td>
<td></td>
</tr>
<tr>
<td>• More flexible service routings than guided bus and light rail</td>
<td></td>
</tr>
<tr>
<td>• Vehicles can be upgraded (potential to switch to electric-powered and autonomous or semi-autonomous technology)</td>
<td></td>
</tr>
<tr>
<td>• Could be delivered and operational within a shorter timescale than some alternatives</td>
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</table>
Bus Rapid Transit (Non Guided) Case Study

Fastrack - Kent

- First opened in 2006
- Includes signal priority, reserved lanes and dedicated busways
- Three fare zones and tickets are sold on the bus, at stops or on an app
- Links Southeastern rail network at Dartford, Bluewater shopping centre, Gravesend and Ebbsfleet international
- Core network of 40km, half of the routes operate on dedicated bus-only roads where no other services run
- 2 million passengers in the first 14 months of operation
Overview of non-Guided / Part-Guided Bus Rapid Transit

- Non-guided BRT schemes can offer higher value for money and they can have a significant impact in terms of increasing ridership levels in local areas.
- They can make existing routes and corridor seem more attractive for bus travel.
- Routes can be modified more easily than alternative options such as guided busways—this flexibility had a positive impact on the Fastway scheme in Sussex after it was initially opened.
- The business case for non guided BRT schemes can be very positive. This outcome can be achieved by having development growth clustered around transport hubs along the route.
- More reliable journey times can attract additional passengers as it creates a positive image.

Non-Guided/Part Guided BRT - Considerations for the A414 Corridor

This option offers the most flexibility for the corridor. Services will be able to run into the centre of towns and would require less upfront investment than the other options. It could be implemented in the short term and could then evolve into one of the alternative options. However it may struggle to achieve desirable levels of patronage in the short term unless an effective branding and marketing strategy is in place along with integrated ticketing to facilitate more seamless multi-modal journeys.
Bus Rapid Transit (Guided)

- Guided BRT comprises of segregated carriageways for buses
- Stops, with platforms akin to a railway line, are found along the segregated busways, with links into urban centres
- Carriageways are designed so cars are unable to use the route
- Footways/cyclepaths can run alongside the busway – crossings do not need to be grade-separated
- Journey times are faster because buses are fully separate from other traffic and therefore are able to achieve higher speeds
- Suitable for tighter alignments where it would not be feasible for buses to reach high speeds safely
- Higher quality of buses which have to be specifically designed
## Bus Rapid Transit (Guided)

### Advantages
- Cheaper than light rail
- Potentially easier to retrofit to modern/automated technology than light rail
- More reliable journey times (more limited mixing with general traffic)
- Journey times faster with guided busway bypassing areas of congestion
- Does not need the same level of patronage as light rail
- Better image than ordinary buses – can present itself as a step-change in public transport service provision
- Vehicles can be upgraded (potential to switch to electric-powered and autonomous or semi-autonomous technology)

### Disadvantages
- Many UK examples of inter-urban guided busways follow former railway alignments
- Bus priority technology is not always as efficient as envisaged
- May not have a modern attractive image compared to light rail
- Higher costs than non guided bus rapid transit – construction of guideway can be costly and requires on-going maintenance
- Inflexibility – one guided bus cannot overtake another
Bus Rapid Transit (Guided) – Case Studies

Cambridge-St Ives Guided Busway

- Began operation in 2011
- Longest guided busway in the world, two guided sections make up 16 miles of the route
- Built along two disused railways
- Passengers are required to purchase tickets before boarding
- Cyclepath/bridleway alongside some sections of the route
- 2.5 million trips taken in first year of operation

Luton-Dunstable Guided Busway

- Opened in September 2013
- Built on the route of a disused railway
- 8.3 miles in length, of which 4.8 miles is guided track with a maximum speed of 50mph
- Connects Dunstable, Houghton Regis and Luton (with Luton Airport)
- Three years to construct, included seven new bridges, reconstruction of three bridges, bus stops and a new transport interchange at Luton Airport
- 350,000 passenger journeys in first three months of operation
Overview of Guided Bus Rapid Transit

- Guided BRT schemes can generally offer good value for money and can outperform expectations in performance including patronage growth, journey time reliability, passenger satisfaction and reductions in general traffic on parallel routes.
- There is some potential for guided BRT schemes to be adaptable for future technology, although there is not much evidence of this in the UK.
- Guided busways may be situated further from built-up areas, especially if they are built along former transport corridors such as disused railways (such as the Cambridge Busway and Luton Dunstable Busway examples). Therefore high quality transport hubs with good local connections are really important.
- It is a higher cost option when compared against non-guided BRT schemes, but much cheaper than tram/light rail. If marketed in the most effective way, it could alter the public perceptions about buses and could achieve similar levels of benefits to a light rail system.

Guided BRT - Considerations for the A414 Corridor

In practice, a guided MRT can include some non-guided sections which will enable MRT services to reach areas along the corridor where it is not possible to implement guided tracks. However significant investment will be needed for construction and finding sufficient space for guideways could be challenging. Guideways may not be required to enable MRT vehicles to reach sufficient speed, i.e. a similar level of comfort and efficiency could be achieved by dedicating roadspace without guideways to MRT services.
Light Rail/Tram

- Light Rail and Tram systems are popular due to their speed and high capacity
- Tracks can either be on street or on segregated rails (including former railway alignments)
- Popular in urban centres – less so between towns
- Typically lighter and shorter than conventional trains
- Trams are able to run through the centre of urban areas, with stops close to the final destination
- Compatible with pedestrians within town centres
- Have a good image in comparison with local buses.
- Depending on specification, can have much higher capacities than conventional buses
Light Rail / Tram

**Advantages**
- Higher passenger carrying capacity than buses
- Accessible and visible stops
- Penetration of urban centres with permanent, visible infrastructure
- Predictable, regular and reliable journey times and service patterns (depends on frequency of light rail/tram)
- High quality of ride throughout the entire journey
- Physical integration – often ‘designed-in’ (e.g. to major rail or bus station or major developments)
- Adaptable – light rail can operate in urban and suburban environments; can leave the city and run on railway tracks, even in mixed operation with heavy traffic.

**Disadvantages**
- High investment costs - Bus Rapid Transit could carry similar passenger numbers for a lower investment
- Requires high level of segregation and priority at junctions
- Generally lower proportion of seats to standees
- Trams may not be designed for longer distance, inter-urban journeys
- Inflexibility of route e.g. in case of breakdown or a temporary street closure due to a special event or parade
- Inflexibility of tram - one tram cannot overtake another
- Longer development time scale – between emergence of the first idea to the opening of the line (compared to non-guided bus rapid transit, and potentially guided bus rapid transit)
Light Rail/Tram – Case Studies

Croydon Tramlink

- Operation commenced in 2000
- 39 stops along 17 miles of track, a mixture of street track shared with other traffic, dedicated track on roads and off-street
- Tickets are available either on PAYG or paper tickets, and include London Travelcards
- All stops have disabled access, Passenger Information Display, a ticket machine, and most have seats/shelters
- 27 million passenger journeys in 2015/2016

Midland Metro

- First section opened in 1999
- Operates between Birmingham and Wolverhampton, on street in urban areas and on rail tracks between the cities
- 13 miles in length with a top speed of 43.5mph
- There is a smart-card system in place, but paper tickets can also be bought. Fares are distance related
- Around 6 million passengers use the Metro a year
Overview of Light Rail / Tram

- Light rail transit (LRT) or trams can be the public transport backbone of medium to large-scale cities and can also serve as a feeder to other forms of transport in larger urban conurbations such as heavy rail.
- Successful LRT/tram schemes have stops which are integrated with other forms of public transport, near interchanges and park and ride sites.
- The system can be multifunctional, operating both underground and at surface level, within street environments and on segregated alignments.
- It is considered to be a good intermediate transport mode for capacity needs which range between 3,000 and 11,000 passengers per hour, per direction.

Light Rail/Tram - Considerations for the A414 Corridor

The Abbey Line could be adapted to light rail and this could enable more frequent services which can extend on into Watford and St Albans urban centres. However, it will be extremely costly to extend LRT fully to serve all other towns along the corridor and an entirely new alignment(s) off-road may need to be found on the inter-urban sections as trams are unlikely to be able to run on the high-speed sections of the A414 dual carriageway. Light Rail is therefore not considered a suitable, county-wide option.
Autonomous Mass Transit Corridor

- The form this will take is still emerging as this is a new technology
- Autonomous vehicles require no driver and use sensors to detect their environment
- Passengers are free to spend travel time as they wish
- Currently this is only being tested on a small scale, however there is the potential for mass autonomous transit
- This option could be an evolution of an existing mode as opposed to an entirely new, replacement mode of travel

It is not possible at this stage to identify advantages or disadvantages of an autonomous mass transit as there is a great deal of uncertainty around what this could entail and few or no examples of a mass autonomous network.
Autonomous Mass Transit – Emerging Examples

There are some emerging examples of smaller-scale autonomous transit systems.

**Sion Driverless Bus (Switzerland)**
- Began operating in December 2015
- Carries 11 passengers along 1.5km route through the Old Town
- 60,000 passengers in the first 2 years
- Maximum speed of 45 km/h but are currently restricted to 20 km/h
- Currently plans to expand the service and test the shuttles in heavier traffic and traffic lights

**Roaming – EasyMile**
- Autonomous electric bus which seats up to 8 passengers, or 7 with a wheelchair
- Used to meet first mile/last mile requirements of a trip
- Used in Gelderland county in the Netherlands between Ede-Wageningen railway/bus station and Wageningen University and Research Centre, called 'WEPod'
Autonomous Mass Transit—overview

- Autonomous vehicle use is one of the dramatic possibilities for the future of transport. It could profoundly affect both private and public forms of transport.
- Research is progressing in this field with many trials for small-scale autonomous transit underway. Pilot studies for mass autonomous transit are yet to take place in the UK.
- There is a significant amount of central government funding which has been made available to support the development of autonomous transport.
- Consideration may need to be given to how current or emerging mass transit links will need to be adapted to accommodate autonomous vehicle technology in the future.

**Autonomous Mass Transit - Considerations for the A414 Corridor**

A great deal of uncertainty surrounds this option. It could offer the most opportunities as well as a set of technical, political and legislative challenges which could make implementation in a planned, coordinated way extremely difficult.

More certainty will come as new technologies emerge, travel behaviours adapt and industry best practice develops. In practice, this option would represent a later evolution of the MRT as opposed to something developed from the outset.

However, does Hertfordshire want or need to be at the forefront of this given the risks and uncertainties involved?

What is crucial therefore is that if a mass autonomous transit system is a longer term option, the short term option needs to be designed in such a way that it could be easily and cost effectively adapted in the future, and that it does not lead to redundant infrastructure and technology.
Comparison of costs

<table>
<thead>
<tr>
<th></th>
<th>Bus Rapid Transit (non-guided)</th>
<th>Bus Rapid Transit (guided)</th>
<th>Light Rail / Tram</th>
<th>Mass Autonomous Transit System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicative capital cost per km</td>
<td>£1.65m</td>
<td>£6.75m</td>
<td>£11.25m</td>
<td>£?</td>
</tr>
<tr>
<td>Indicative operating cost per route km pa</td>
<td>£60,000</td>
<td>£60,000</td>
<td>£200,000</td>
<td>£?</td>
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<tr>
<td>Potential Benefits to Cost Ratio</td>
<td>2 – 2.5</td>
<td>1 – 1.5</td>
<td>&lt;1</td>
<td>?</td>
</tr>
<tr>
<td>Potential delivery timescale</td>
<td>2 – 5 years</td>
<td>3+ years</td>
<td>5+ years</td>
<td>?</td>
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</tbody>
</table>
The MRT will need to form part of an integrated system of sustainable transport services and routes, facilitated by integrated ticketing, shared digital services and platforms, joined up infrastructure to facilitate seamless interchange, and co-ordinated timetabling.
Preferred Option

A bus-based Mass Rapid Transit is considered to be the most suitable option to progress at this stage. Further more detailed work will be required to explore the feasibility of a bus-based system.

The remainder of this Annex considers routes, service patterns and potential indicative cost ranges on the basis of a bus-based system.

Abbey Line

The position of Hertfordshire County Council is that it supports the continued use of the Abbey Line as a heavy rail operation whilst seeking improvements which would increase service frequencies.

Alternatives to a Mass Rapid Transit

There is currently very limited end-to-end public transport services within the corridor. An hourly bus service operates between Watford and Harlow but journey times are much longer than those of the car. Passengers are therefore required to make at least one change of bus or train. A journey by train would most likely require a passenger to travel via London.

The evidence reviewed as part of this draft Corridor Strategy has determined that a mixture of trip types occur along the corridor. Some trips are shorter distance and occur between adjacent towns. Other trips occur over a longer distance, whilst end-to-end travel for instance between Hemel Hempstead and Harlow is less common.

The corridor is heavily car-focused at present and experiences significant weekday peak period traffic congestion along certain links (including the A414 in Hemel Hempstead and Hertford) and at many key junctions (including A1(M) Junction 4 and the A414/A1081 London Colney Roundabout). The strategy has proposed a selection of highway interventions including a Hertford bypass and junction enhancements, however traffic modelling has indicated that whilst these interventions will provide some relief to congestion they are not expected to solve congestion entirely in the longer term.

In line with the objectives and policies of HCC’s Local Transport Plan 4 and the adopted and emerging Local Plans in the area, this draft corridor strategy has determined that it would not be appropriate or sustainable to continue catering for car trips by providing additional highway improvements over and above the selection proposed. Additional highway interventions could take the form of brand new highway links, the widening of existing carriageway to three or more lanes and the replacement at-grade roundabout and signal-controlled junctions with grade-separated junctions akin to those of a high-speed motorway. Whilst there could be a shorter term benefit in terms of cutting down journey times and reducing queues, the additional highway capacity provided could in due course be occupied by additional traffic which is attracted to use the A414 as a result of the improvements made. Furthermore, the A414 already performs the function of an alternative to the M25 especially when major incidents occur on the motorway, therefore providing a high capacity, high-speed highway corridor would not be in the interest of Hertfordshire and catering for more local journeys which are occurring within the county.
One of the underlying reasons for the corridor’s traffic congestion issues is a lack of attractive and viable alternatives which forces people to use a car. There are numerous local bus services however these can be perceived as being slower and less reliable, taking circuitous routes and making multiple stops to collect passengers, and they do not link together all of the corridor’s settlements.

The concept of a Mass Rapid Transit has been put forward as a viable alternative to the car for inter-urban journeys. Its overarching aim is a fast and reliable express inter-urban passenger transport network linking major urban settlements within the A414 corridor to facilitate sustainable travel; to address the pressure of delivering significant growth in housing and jobs; and to provide a step change in capacity and service provision to maintain and enhance Hertfordshire’s local economy and competitiveness.

A MRT could take different forms. This draft Corridor Strategy has considered different options at a high level. For example, it could take the form of a dedicated bus-fleet running on existing roads or using some dedicated bus lanes and priority traffic signals; or that it could run along its own dedicated guided busway; or that it could take the form of a tram system running along its own track system largely segregated from existing roads. At this stage, there is no preferred option being put forward. However, it is considered that to deliver a MRT in a shorter timeframe and in a form which is affordable and does not require very significant and disruptive infrastructure works, a bus-based system may be a more preferable way forward. More detailed feasibility studies and a business case of viable options will be required following this strategy.

A public transport alternative to a MRT which has been dismissed on the basis of likely cost and value-for-money is a heavy-rail based system. This east-west rail corridor would need to link together the various north-south radial rail corridors feeding into London from the West Coast Main Line in the west and the West Anglia Main Line in the east. There have in the past been various railway branch lines that criss-crossed parts of the corridor however many of these closed between the 1950s and 1970s, including routes between Hemel Hempstead and Harpenden, St Albans and Hatfield, Welwyn Garden City and Hertford, and between Hertford North and Hertford East stations.

Parts of these former rail lines have since been built on or they now function as attractive leisure routes including parts of the National Cycle Route Network. These railways mostly operated separately so it would not have been possible for a passenger to have made a journey by rail from for instance between Hemel Hempstead and Hertford without making at least one change.

Furthermore, many of these former railways comprises a single track. It is considered that to provide a fast, inter-urban heavy-rail based service, two tracks would be required at least on parts of the route to enable two trains to pass. Any re-opening of these former rail corridors would most likely require significant engineering and land purchase.

Sections of the north-south main line railways would need some form of upgrade as would stations to accommodate additional tracks and/or platforms. The existing cycle tracks would need to be diverted onto new routes elsewhere or space provided alongside the tracks to accommodate the cycle tracks.

A further alternative would be to develop an entirely new rail alignment however this would be extremely costly and unlikely to reach the centres of urban settlements without very significant land purchase, demolition of existing buildings and the construction of bridges and tunnels.
Phasing of MRT

The MRT is likely to be delivered in phases and could evolve over time to respond effectively to changes in transport technology and travel patterns and behaviours. It is considered that non-guided bus rapid transit will offer the most flexibility in terms of being adapted at a later point in time to be compatible with new emerging transport technologies. In contrast, light rail/tram might be the least flexible option because it will require a significant level of up-front investment in terms of construction of tracks and overhead cables which may become obsolete at a later point in time if autonomous or semi-autonomous mass transit technologies do not require the tram's infrastructure to operate.

For example...

**SHORT TERM**
MRT is introduced on key sections as a fast, branded traditional bus service with some bus priority at key bottlenecks. The most congested sections will be prioritised.

**MEDIUM TERM**
More dedicated routes enabling faster journeys for MRT will be developed and the network extended as further growth in housing and employment comes forward.

**LONG TERM**
MRT vehicle fleet is upgraded to become autonomous or semi-autonomous (and fully electric powered), and routes are shared with smaller autonomous vehicles.
Connectivity Strategy

A Mass Rapid Transit needs to connect the key urban areas along the A414 Corridor. Services could connect to major transport hubs, town centres, key employment areas and/or new edge-of-town parkway interchanges and suburbs.
The exact route alignment needs to be examined in more detail as part of a feasibility study.

The broad alignment shown here would take the MRT through some but not all of the major towns along the corridor, making more use of the existing A414 road. This means the MRT will bypass some urban centres including St Albans and Welwyn Garden City. This may help to achieve faster journeys between towns and the MRT could avoid some congested urban centres and there will be more opportunity for segregated road space and bus priority. However, good local connectivity to edge-of-town interchanges will be required.
Potential service configuration

A range of MRT services could operate across different lengths of the entire corridor, or the entire length. Further analysis of operational requirements and viability will need to be undertaken however based on analysis of existing journey patterns, the MRT could comprise of a several services which cover overlapping lengths of the corridor. There will be a need for attractive interchanges if people need to travel between two towns which are not directly connected by the MRT. The below journey times are only indicative and will be dependent upon service routes and the provision of priority lanes and traffic signals.

*Specific stops/interchanges are not shown on this graphic*
It will not be feasible for an MRT to connect to all places. An integrated travel network will be required for an MRT to be successful, encompassing all modes of travel - car, bicycle, walking and local bus.

Some local bus routes will be reconfigured and improved to act as feeder services to the MRT.

Walking and cycling networks will be improved to provide better local links to MRT interchanges.

Some MRT interchanges could be located at stations on major railway corridors including the West Coast Main Line and East Coast Main Line; at edge of town locations; adjacent to major employment areas (including Maylands and Hatfield Business Park), and in town centres.

MRT Interchanges will be high quality, providing a range of facilities including seating, shelters, real time information, wi-fi access and cycle parking. Some interchanges could have enhanced facilities including car parking/drop-off, lockers etc.
Accessing a Mass Rapid Transit in Hertfordshire – types of interchanges

A Mass Rapid Transit needs to be distinct from conventional local bus services. It may run along its own route or use existing local roads. To provide a more express type of service, MRT services will most likely make fewer stops than a conventional bus. High Quality interchanges could be located in different types of locations, depending on the route.

**Urban Interchange**
A high quality inner urban bus stop or mini interchange primarily served by MRT and potentially local bus services, with smaller-scale waiting facilities and cycle parking. Linked to surroundings by footways and cycle routes.

**Edge-of-Town Interchange**
A high quality edge of town bus stop or mini interchange primarily served by MRT and potentially local bus services, with smaller-scale waiting facilities and cycle parking. Linked to surroundings by footways and cycle routes. Some small-scale car parking may be provided in some locations.

**Inter-Modal Hub**
A major transport hub in an urban centre or edge of town location which facilitates interchange between bus, coach and or train and provides larger-scale waiting facilities, cycle parking, cycle hire and (potentially) limited car parking and is connected to its surroundings by footways and cycle routes.
Branding a Mass Rapid Transit in Hertfordshire

Distinct branding of MRT services will be a key tool for enhancing passenger experience and attracting people to use the services.

A unified branding initiative should be rolled out across the entire fleet of MRT vehicles and supporting infrastructure including stops/interchanges, tickets and digital services including apps and website.
How a bus-based Mass Rapid Transit could be accommodated on Hertfordshire’s roads

Where the A414 road itself currently comprises of a dual carriageway, there may be opportunity to convert one carriageway into a segregated MRT route and the other carriageway into a two-way single carriageway road. This option may be most suitable within urban areas where there is a greater need for MRT segregation and where currently a dual carriageway road is causing severance to people living and working on either side who may find it difficult to access public transport.

This might not be an appropriate intervention, or feasible on all parts of the corridor, therefore some sections of the A414 could remain dual carriageway. For instance, to the south of St Albans the existing dual carriageway could remain, whereas sections within Hemel Hempstead and Hertford could be converted as shown in the image below.

**NOW**  Segregated, high speed dual carriageway

**IN THE FUTURE**  Multi-use transport corridor
As shown on the previous page, there may be opportunity in some locations to convert the existing A414 dual carriageway into a segregated MRT linkway + two-way single carriageway road. Interchanges would be linked with pedestrian crossings and segregated cycleways would run alongside the MRT linkway.
It will be important for people to be able to interchange easily between the more traditional local bus services and MRT services, especially where MRT routes are located away from urban centres. The graphic shown above shows how local bus stops and MRT interchanges could be linked together with safe and attractive footways and cycle routes.
Where interchanges may be located on the edges of towns, there will need to be high quality local connections to residential and employment areas. These connections might include footways and cycle routes which are segregated from traffic, connections to local roads that enable people to be dropped off by private vehicle or for limited car parking, or even dedicated link ways for small autonomous pods that would facilitate the first/last mile of someone's journey to access the MRT.
Types of facilities that could be provided at Mass Rapid Transit service interchanges

**Cycle Parking**
- Sheltered and secure parking for bikes, potentially cycle lockers for overnight or longer term use
- Showers and changing facilities could be provided
- Cycle hire at larger interchanges to encourage cycling for the onward journey

**Local Connectivity**
- High quality footways and cycle routes to link stops and interchanges to surrounding residential and employment areas to encourage active travel
- Connections to other local bus services

**Waiting Facilities**
- High quality waiting facilities encourages use of the MRT
- Smaller stops would include shelters, seating, real time information displays and step free access as a minimum
- Larger interchanges would include the above as well as waiting rooms with refreshment facilities

**Car Parking**
- Drop off areas for taxis and private vehicles
- Some limited parking at larger interchanges in more remote areas, functioning as a park and ride
- Car parking limited to encourage use of active travel and public transport
Transit Oriented Development

What is likely to be an important factor in the longer-term success and viability of a Mass Rapid Transit system through Hertfordshire is the pattern of development. Consideration could be given to the location of development which is not yet identified beyond the current set of adopted and emerging Local Plans, and identify opportunities to facilitate more transit-oriented development.

Transit Oriented development is the creation of compact, walkable, pedestrian-oriented, mixed-use communities which are centred around high quality public transport systems. Development can be in the centres of existing urban areas where higher density development already occurs, or it could be on the outer edges of urban areas.

In the case of a Mass Rapid Transit system through Hertfordshire, it could route through the centres and/or around the edges of urban areas. Around the edges, it may be more feasible to provide dedicated infrastructure such as priority lanes and traffic signalling than in inner urban areas.

Local feeder links will be necessary to enable people to access MRT interchanges which are located away from urban centres. To imagine the next wave of potential housing and employment development, beyond 2036, this could be clustered around key public transport routes and hubs, including a MRT.

Transit-oriented development can reduce dependence on driving, reduce an area’s negative impact on the environment and improve connectivity in outer urban areas.

Features of transit-oriented development include walkable design with pedestrians as the highest priority, transport hubs as prominent features especially within urban centres, public squares fronting transport hubs, a mixture of land uses clustered around transport hubs, and transport networks designed for pedestrians and cyclists.
Mass Rapid Transit - Package Components and indicative cost range

The table below and on the subsequent four pages sets out a potential schedule of component interventions for each of the Mass Rapid Transit service routes. These tables are intended to only provide an indicative breakdown of what types of interventions may be required for each MRT service route. The indicative cost range estimates are provided in 2018 prices. Clearly if the MRT was progressed in the longer term the associated cost could be higher than that shown here.

Components shaded in grey and italicised feature in more than one MRT route, assuming Route A were to be delivered first. The order in which MRT Routes are delivered is not confirmed at this stage.

The following assumes the Abbey Line is retained as a heavy rail route. Any potential longer term conversion of the Abbey Line into a more integrated Mass Rapid Transit system will incur additional costs including removal of tracks and overhead cables, reconstruction of stations/station platforms etc.

### Mass Rapid Transit—Route A
Watford-St Albans via Garston, Bricket Wood, How Wood and Park Street

<table>
<thead>
<tr>
<th>Component ID</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRT-RA1</td>
<td>Introduction of bus priority on the A405 between M25 J21a and M1 J6</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT RA2</td>
<td>Introduction of bus priority on the A412 and at the Dome Roundabout (if feasible)</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA3</td>
<td>Upgrade of selected bus stops within St Albans to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA4</td>
<td>Upgrade of selected bus stops within Watford to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA5</td>
<td>Local highway works in St Albans to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA6</td>
<td>Local highway works in Watford to accommodate priority signals and roadspace for MRT services, including access onto Reeds Crescent and/or A412 St Albans Road</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA7</td>
<td>Potential conversion of part of the former Croxley rail link to facilitate MRT services between Whiggenhall Road and Ascot Road</td>
<td>£25m - £50m</td>
</tr>
</tbody>
</table>
### Mass Rapid Transit—Route B

Watford-Welwyn Garden City via A405 Garston, Bricket Wood, How Wood, Park Street, London Colney & Hatfield

<table>
<thead>
<tr>
<th>Component ID</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRT-RB1</td>
<td>Park Street Hub with associated connections to the A414</td>
<td>£5m - £10m</td>
</tr>
<tr>
<td>MRT-RB2</td>
<td>London Colney North MRT Interchange</td>
<td>£2.5m - £5m</td>
</tr>
<tr>
<td>MRT-RB3</td>
<td>A414 MRT priority signals and roadspace at London Colney Roundabout, Colney Heath Longabout and A1(M) Junction 3</td>
<td>£2.5m - £5m</td>
</tr>
<tr>
<td>MRT-RB4</td>
<td>Upgrade of selected bus stops within Hatfield to facilitate MRT services, including those at University of Hertfordshire De Havilland Campus, Parkhouse bus station, town centre and railway station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB5</td>
<td>Local highway works in Hatfield to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB6</td>
<td>New Mill Green MRT Interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB7</td>
<td>Upgrade of selected bus stops within Welwyn Garden City to facilitate MRT services, including bus station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB8</td>
<td>Local highway works in Welwyn Garden City to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA1</td>
<td>Introduction of bus priority on the A405 between M25 J21a and M1 J6</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT RA2</td>
<td>Introduction of bus priority on the A412 and at the Dome Roundabout (if feasible)</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA4</td>
<td>Upgrade of selected bus stops within Watford to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA6</td>
<td>Local highway works in Watford to accommodate priority signals and roadspace for MRT services, including access onto Reeds Crescent and/or A412 St Albans Road</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RA7</td>
<td>Potential conversion of part of the former Croxley rail link to facilitate MRT services between Whiggenhall Road and Ascot</td>
<td>£10m - £25m</td>
</tr>
</tbody>
</table>
### Mass Rapid Transit—Route C
#### Hemel Hempstead-Welwyn Garden City via Park Street, London Colney and Hatfield

<table>
<thead>
<tr>
<th>Component ID</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRT-RC1</td>
<td>Upgrade of selected bus stops within Hemel Hempstead to facilitate MRT services, including Hemel Hempstead railway station and town centre interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RC2</td>
<td>New Jarman Park MRT Interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RC3</td>
<td>New Maylands/East Hemel Hempstead MRT Interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RC4</td>
<td>Local highway works in Hemel Hempstead to accommodate priority signals and roadspace for MRT services along the road</td>
<td>£10m - £25m</td>
</tr>
<tr>
<td>MRT-RC5</td>
<td>A414 MRT priority signals and roadspace at Park Street Roundabout</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB1</td>
<td>Park Street Hub with associated connections to the A414</td>
<td>£5m - £10m</td>
</tr>
<tr>
<td>MRT-RB2</td>
<td>London Colney North MRT Interchange</td>
<td>£2.5m - £5m</td>
</tr>
<tr>
<td>MRT-RB3</td>
<td>A414 MRT priority signals and roadspace at London Colney Roundabout, Colney Heath Longabout and A1(M) Junction 3</td>
<td>£2.5m - £5m</td>
</tr>
<tr>
<td>MRT-RB4</td>
<td>Upgrade of selected bus stops within Hatfield to facilitate MRT services, including those at University of Hertfordshire De Havilland Campus, Parkhouse bus station, town centre and railway station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB5</td>
<td>Local highway works in Hatfield to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB6</td>
<td>New Mill Green MRT Interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB7</td>
<td>Upgrade of selected bus stops within Welwyn Garden City to facilitate MRT services, including bus station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB8</td>
<td>Local highway works in Welwyn Garden City to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
</tbody>
</table>
### Mass Rapid Transit—Route D
Hatfield-Waltham Cross via Welwyn Garden City, Hertford, Amwell, Hoddesdon, Broxbourne & Cheshunt

<table>
<thead>
<tr>
<th>Component ID</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRT-RD1</td>
<td>New South East Welwyn Garden City MRT Interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD2</td>
<td>Local highway works in Hertford to accommodate priority signals and roadspace for MRT services, including conversion of dual carriageway to single carriageway road + dedicated MRT linkway</td>
<td>£10m - £25m</td>
</tr>
<tr>
<td>MRT-RD3</td>
<td>Upgrade of selected bus stops within Hertford to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD4</td>
<td>Local highway works in Ware to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD5</td>
<td>Upgrade of selected bus stops within Ware to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD6</td>
<td>New Amwell MRT Interchange</td>
<td>£2.5m - £5m</td>
</tr>
<tr>
<td>MRT-RD7</td>
<td>Local highway works in Broxbourne towns to accommodate priority signals and roadspace for MRT services</td>
<td>£2.5m - £5m</td>
</tr>
<tr>
<td>MRT-RD8</td>
<td>Upgrade of selected bus stops within Broxbourne towns to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB4</td>
<td>Upgrade of selected bus stops within Hatfield to facilitate MRT services, including those at University of Hertfordshire De Havilland Campus, Parkhouse bus station, town centre and railway station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB5</td>
<td>Local highway works in Hatfield to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB6</td>
<td>New Mill Green MRT Interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB7</td>
<td>Upgrade of selected bus stops within Welwyn Garden City to facilitate MRT services, including bus station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB8</td>
<td>Local highway works in Welwyn Garden City to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>Component ID</td>
<td>Description</td>
<td>Cost</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>MRT-RE1</td>
<td>A414-Gilston Sustainable Corridor</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RE2</td>
<td>New Gilston MRT Interchange (sustainable transport hub)</td>
<td>£2.5m - £5m</td>
</tr>
<tr>
<td>MRT-RE3</td>
<td>Local highway works in Harlow to accommodate priority signals and roadspace for MRT services</td>
<td>£10m - £25m</td>
</tr>
<tr>
<td>MRT-RE4</td>
<td>Upgrade of selected bus stops within Harlow towns to facilitate MRT services, including Harlow railway station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB7</td>
<td>Upgrade of selected bus stops within Welwyn Garden City to facilitate MRT services, including bus station</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RB8</td>
<td>Local highway works in Welwyn Garden City to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD1</td>
<td>New South East Welwyn Garden City MRT Interchange</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD2</td>
<td>Local highway works in Hertford to accommodate priority signals and roadspace for MRT services, including conversion of dual carriageway to single carriageway road + dedicated MRT linkway</td>
<td>£10m - £25m</td>
</tr>
<tr>
<td>MRT-RD3</td>
<td>Upgrade of selected bus stops within Hertford to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD4</td>
<td>Local highway works in Ware to accommodate priority signals and roadspace for MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD5</td>
<td>Upgrade of selected bus stops within Ware to facilitate MRT services</td>
<td>£1m - £2.5m</td>
</tr>
<tr>
<td>MRT-RD6</td>
<td>New Amwell MRT Interchange</td>
<td>£2.5m - £5m</td>
</tr>
</tbody>
</table>
A summary of potential indicative cost range estimates (indicatively in 2018 prices) for each route are shown below. An indicative cost range is provided for each route as a unique cost, plus the cost of other overlapping routes to provide a total cost for each route if they were developed in isolation. The cost estimates do not include the cost of the MRT vehicle fleet, depots and on-going maintenance.

It should be reiterated that these are very indicative cost range estimates. No detailed feasibility work has been undertaken at this stage. Subject to public consultation and sufficient funding, more detailed studies will be required at a later point to explore all aspects of a Mass Rapid Transit, and this work could identify alternative options and priorities to those presented in this Annex. Design and engineering work is required to generate more accurate cost range estimates which could result in the overall route costs and cost for the entire MRT system increasing or decreasing above/below those presented in the

<table>
<thead>
<tr>
<th>MRT Route</th>
<th>Indicative cost range estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Route A</strong></td>
<td>Unique Route Cost £31m - £65m</td>
</tr>
<tr>
<td></td>
<td>Including cost of other overlapping routes -</td>
</tr>
<tr>
<td><strong>Route B</strong></td>
<td>Unique Route Cost £15m - £32.5m</td>
</tr>
<tr>
<td></td>
<td>Including cost of other overlapping routes £29m - £68m</td>
</tr>
<tr>
<td><strong>Route C</strong></td>
<td>Unique Route Cost £14m - £35m</td>
</tr>
<tr>
<td></td>
<td>Including cost of other overlapping routes £29m - £68m</td>
</tr>
<tr>
<td><strong>Route D</strong></td>
<td>Unique Route Cost £20m - £48m</td>
</tr>
<tr>
<td></td>
<td>Including cost of other overlapping routes £25m - £60m</td>
</tr>
<tr>
<td><strong>Route E</strong></td>
<td>Unique Route Cost £15m - £35m</td>
</tr>
<tr>
<td></td>
<td>Including cost of other overlapping routes £33m - £78m</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>Total Cost (excluding overlaps between routes) £95m - £215m</td>
</tr>
</tbody>
</table>
Potential extensions to the Mass Rapid Transit

The draft Corridor Strategy identifies the potential need for a Mass Rapid Transit system between Hemel Hempstead, Watford and Harlow. There is further potential scope to extend a MRT in the future to serve the needs of existing or planned communities and proposed developments. At the eastern end of the envisaged MRT network, the town of Harlow is expected to expand significantly as part of a Garden Town initiative. Large developments including Gilston are planned around the town. The MRT will certainly need to serve the Gilston development which will lie to the north of the A414 corridor. A mobility hub within the Gilston development will act as a focal point for MRT services, local buses and active travel. The Gilston development will be built out over a number of years and is likely to generate travel demand not just towards Harlow (including the railway stations) but also to areas to the east, west and north. A network of sustainable transport corridors are proposed across the Garden Town to connect all of the planned new communities.

Destinations to the west would be served by a MRT through Hertfordshire, however locations to the north and east such as Bishop’s Stortford, Stansted Airport and other parts of Essex could also generate trips from Gilston and the wider Garden Town. Similarly, trips could be generated from areas of Essex including along the A414 and A120 corridors. In the absence of high-quality, frequent public transport connections east-west across Essex, an extended MRT system could provide a much improved cross-boundary public transport service.

Towards the western end of the envisaged MRT route, MRT extensions or enhanced connectivity with other passenger transport services could be considered towards Luton and Heathrow Airports.

Any MRT extensions will be subject to study and consultation with stakeholders.