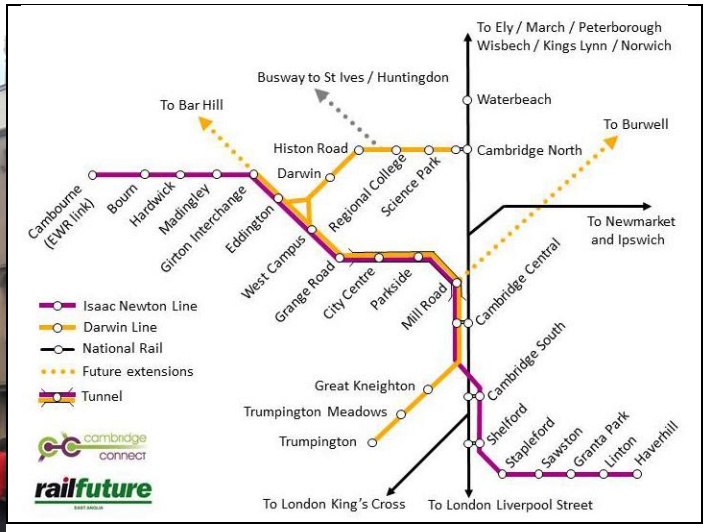
# Cambridge Connect

# Cambridgeshire Light Rail Strategy

## Submission to

## Cambridgeshire & Peterborough Combined Authority

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## Cambridgeshire Light Rail Strategy



**Cover images**: The transport strategy needs to address the challenges of population growth and climate change and help secure the health, safety and welfare of present and future generations.

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# Cambridgeshire Light Rail Strategy
# Executive summary

## The need

1. A strong, modern, integrated regional transport strategy is needed for Cambridgeshire and Peterborough, and it needs to have the capacity and quality to be fit for purpose for the 2030s and beyond.
2. The strategy needs to address pressures of growth and climate change, and help secure the health, welfare, environment and economy for present and future generations.
3. Without this strategy, coupled with supporting infrastructure, regional productivity, attractiveness and quality of life will decline.
4. Requirements to decarbonise the economy requires a major shift towards public transport, and alternatives need to be genuinely attractive and practical.
5. Our proposals are focused on one part of that strategy, i.e. mainly on Cambridge and its surrounding region. Although the heavy rail proposals extend across the full Combined Authority region, and to national level, this is not the focus of the present report. Railfuture has developed its heavy rail concepts in more detail in separate submissions.

## Scale and pace of growth coupled with climate change

6. The scale and pace of growth and the demands of climate change, together with needs for improvements in air quality and to support active travel, all strongly show the need for strategies going forward to be radically different to those adopted in the past.
7. In particular, traditional solutions for transport improvements, such as reliance on buses and busways alone, are unlikely to provide the transformative change needed. The evidence strongly suggests they will not deliver the scale of change required.
8. Buses and busways will not have the capacity to deliver on modal shift objectives and are unlikely to support the scale of demand for mass transit needed on core axes.

## The need for Leadership

9. The Cambridgeshire and Peterborough Combined Authority should show real strategic leadership in regional transport, fundamentally changing the narrative to a low carbon economy, and set objectives for major improvements to public transport in support of productivity, access to education, social inclusion, and improved health and well-being.
10. The rich Cambridge tradition of leadership in science and technology should be integral to our regional public transport delivery. We should aim for first-class, not mediocrity.

## Proven and practical

11. While ambition for improvements should be high, it also needs to be grounded and practical. We therefore advocate adoption of proven solutions rather than speculative ideas that remain in need of much further research.
12. Investments need to be within reasonable and achievable bounds, and within reach of proven and practical financing mechanisms.

13. The pressures of growth and climate change exist today, and appropriate solutions need to be delivered now, not at some time in the future.
14. Even if we begin to implement proven solutions today, they will take at least five years to become operational. It is critical that we stop kicking the can down the road and get on with delivering the solutions we need today. The time for can-kicking with interim solutions that will not deliver the fundamental improvements needed has run out.

## Meeting objectives – a Backbone of Mass Transit

15. To address these multiple challenges, we believe there is a need for a different approach to that adopted in the past. In particular, we need a core backbone of mass transit across Cambridge in the zone of highest demand.
16. Light rail represents the most practical, well-developed and proven technology to provide that backbone of mass transit in the zones of highest demand.
17. The light rail network we propose is focused on Cambridge, and clearly this does not cover Peterborough. This is beyond the focus of our report, and there is an opportunity for Peterborough communities to work with the Combined Authority to develop and bring forward solutions suited to their needs as part of the overall strategy.
18. Railfuture has brought forward practical proposals for further development of the heavy rail network which is complementary to our light rail proposals.

## Integration with buses and trains

19. Light rail on its own is not a panacea, and nor is it suited to roll out in all places. Rather, the investment should be targeted where need is greatest, and it should connect closely with bus and train services at efficient interchanges.
20. Our proposals are designed to be complementary to bus and train services across the wider region, supporting them and enabling practical connecting links into and across the core. This can be achieved by implementing integrated digital timetabling and ticketing, and provision of improved information technologies. These improvements should form a key component in the strategy for the region.
21. Increased support for active travel should be a major component of the strategy, and this should be designed to integrate with the backbone of mass transit at interchange points.
22. Our network is designed for Cambridge so that almost 90% of the built-up areas along the line axes lie within an 8-min cycle ride or 20 minute walk.

## The network

23. We propose a backbone of light rail lines on two main axes for mass transit: the Isaac Newton Line and the Darwin Line. The Isaac Newton Line extends from Cambourne to Haverhill via Cambridge City Centre and Addenbrookes / Granta Park. The Darwin Line extends from the Cambridge Science Park to Trumpington via Eddington, the West Campus and City Centre. These lines would wholly replace the existing southern busway and the busways planned by GCP for CSET and C2C.
24. The two priority lines are proposed in two initial phases, which broadly extend a distance of ~20 minutes travel from the Cambridge city core.
25. Both lines integrate closely with stops on the heavy rail network at Cambridge Central

and Cambridge North stations, and in future at Cambridge South and Cambourne. The lines would share a short single tunnel of ~2.6 km in Cambridge City.

26. We recognise plans for major developments on the east side of Cambridge, and anticipate extending lines there at Phase Three. We anticipate this component of the network would be elaborated as plans for the east of Cambridge are more fully developed. The network is designed so an eastern extension can be easily incorporated.
27. We recognise the tunnel increases investment needs, although we note that it would also deliver major increased benefits. In particular, it enables a fully integrated and segregated light rail route across the region, allowing integrated, fast and reliable services to the city core and to all major employment sites around Cambridge.
28. The tunnel addresses critical practical constraints of space and the river barrier in the centre of Cambridge, and while more expensive it would repay the investment.
29. The tunnel is likely to be more deliverable than a surface solution because of vital heritage and environmental constraints in Cambridge: strong public opposition to mass transit through the inner city at the surface seems likely.
30. The tunnel enables improvements to the urban realm, and in particular frees up space for improvements to support active travel – cycling lanes and pedestrianisation. It also makes the urban realm safer for pedestrians and cyclists by removing much heavy transport infrastructure. It would greatly reduce pollution at the surface, including from particulates produced by rubber tyred buses.
31. The tunnel enables rapid access to the city core, providing a practical and efficient alternative to people so they can leave cars at home. Moreover, the alternative is more likely to make demand measures such as a Congestion Charge or Workplace Parking Levy more acceptable to the public.
32. The network is designed to support all of the major employment / residential / educational / and health centres across Cambridge. In particular the Darwin Line supports the northern part of the city such as Arbury and Kings Hedges, dramatically improving social inclusion and opportunities in a relatively deprived part of Cambridge.
33. The network provides and improves access for all sectors of the community to key facilities, and to wider transport links. Phase Three extensions will develop this further, including links to the east and north, including to Bar Hill (currently poorly served) and the expanding centre of Northstowe. In time, we envisage the northern busway would be converted to light rail, although this is not put forward as an immediate priority.
34. The network is designed to protect key landscapes surrounding Cambridge by following existing major transport routes such as the A428 to the Girton Interchange, and in the south following the former rail route to Haverhill. The network thus offers greater protection to the environment than plans being put forward by the GCP for the CSET and C2C schemes, while also offering greater transport and economic benefits.
35. The Girton Interchange has been identified as a key strategic node on the regional transport network. There are opportunities to locate a coach station at this site, linked to light rail, thus reducing the need for coaches and buses to enter the city centre. This would be a major benefit for the city and the tourist industry, as well as to coach companies who currently face major difficulties with congestion.

## Connecting the campuses

36. The University of Cambridge and its colleges are pivotal to the success of the Cambridge Phenomenon. This is a rare and globally unique context that cannot be easily reproduced elsewhere. It should be celebrated and supported
37. The success has driven the University expansion into three distinct and separated sites: West Cambridge Campus and Eddington, the City Campus, and the Biomedical Campus.
38. Current transport links are now inadequate to support close interaction across these campuses and with the colleges. For the modern University of Cambridge, with its links to industry, there is a need to join up the campuses by effective and fast transport links, including to science and technology business clusters.
39. Joining up the campuses with good transport links is needed to maintain and strengthen cross-disciplinary interactions and research that are fundamental to Cambridge success. We believe the GCP City Access Strategy will not be adequate to meet these needs.
40. There is also the need to create good links between the University and centres of business activity, such as the Science Park, Babraham and Granta Park to name a few.

## Why light rail?

41. Light rail is selected as the mode of choice for the mass transit backbone because it is proven to be more effective at driving modal shift than buses, and is more attractive as an alternative for car drivers. It is capable of delivering on the objectives of modal shift and on supporting the economy and growth coming forward in a way that buses cannot.
42. Light rail is well established and technically supported, with billions of miles of safe operation world-wide. There has been massive investment in the technology already and there is a very competitive supplier market. There are also options to support tram-train.
43. Light rail is environmentally superior with zero emissions at the street, including almost zero fine particulates (buses emit harmful fine particulates from tyre, road and brake wear) and no waste rubber tyres. Light rail eliminates these sources of pollution.
44. Light rail has a much lower overall lifetime carbon footprint than buses / busways.
45. Light rail has superior capacity, which future-proofs the system for Cambridge growth and will be able to meet the future needs for modal shift in a rapidly-changing economy.
46. Light rail is fast, reliable, frequent, comfortable, and affordable – it has all the ingredients needed to make it a genuinely attractive public transport alternative.
47. Modern light rail can operate driverless, extending hours and reducing costs.
48. Light rail has limitations in flexibility and reach, and this is why there remains a need for close integration with bus services, as well as with active travel, and cars. Beyond the backbone of mass transit and train lines, buses offer more flexibility and reach for public transport. With well-designed stops, active travel and other modes can work closely with mass transit. This approach is proven as successful in hundreds of cities world-wide.
49. The more limited flexibility of light rail may also be considered a benefit. It provides fixed and permanent infrastructure which is powerfully attractive to investment. This enables greater confidence in the local transport network, and thus locational decisions with greater value added.

## Is Cambridge too small?

50. We show that many cities throughout Europe similar in size to Cambridge, and smaller, have successful light rail. It is clearly possible; the challenge is to change the UK narrative.
51. In the context of Cambridge economic activity, its role in the UK economy, pressures of growth, the need for major behavioural change because of climate change (modal shift), the need for the right capacity to meet demand, outstanding heritage and environmental values that need protection, and the range of options for investment, we believe Cambridge is not too small. We need to plan for needs in the 2030s and beyond now.

## Costs and financing

52. We project a budget of £1.4 - £1.8 bn to deliver the Isaac Newton Line and the Darwin Line in Phases One and Two over a period of 4 to 8 years, which is similar to the recent A14 road upgrade.
53. The tunnel and underground station represents ~ one quarter of the proposed initial investment. It is important to deliver the tunnel early in the process so that significant benefits, and revenue, can start to be realised quickly. The tunnel could be built in less than a year based on the speed of tunneling achieved by Crossrail, so tunnel construction speeds should not be perceived as a major barrier.
54. Given the light rail schemes proposed would wholly replace the current GCP busway plans, it is reasonable to assume that City Deal funds could be redeployed, which could provide an initial base of ~£400M in finance.
55. It seems reasonable to assume a sizeable proportion of Devolution Deal funds for the Combined Authority could be allocated to the scheme.
56. Our budget includes the link from Granta Park to Haverhill, which is an expensive component outside of the current City Deal scope. This represents ~£250M, which could be funded through an alternative mechanism such as the Restore Your Railways fund.
57. This would leave ~ £1bn of additional funds to raise. While challenging, there are a range of finance mechanisms that could be deployed. These could include some or a combination of a Business Rates Supplement (as successfully employed for Crossrail), the new National Infrastructure Bank (loan or guarantee), Section 106, and bonds. Other mechanisms such as a Congestion Charge, Workplace Parking Levy, Land Value Capture could also be explored. Significant finance was raised for the Northern Line extension to Battersea using similar mechanisms.
58. While the additional investment is a challenge, it is important to recognise that unless any investment achieves the objectives of the intervention it will fail to realise the benefits to the community.
59. Under-investment runs a very real risk of failing to deliver on important priorities that are needed to transform transport in this region, specifically to address the twin challenges of growth and climate change. We believe the strategy put forward in this document would contribute substantially to improving our prospects of meeting those challenges.
60. We hope the Combined Authority for Cambridgeshire and Peterborough will find our submission helpful, and that the arguments put forward will be found compelling and given serious consideration. We are keen to cooperate to create a better future.

Summary appraisal of light rail vs busways for Cambridgeshire


| CONSIDERATION | GCP Busways | | Cambridgeshire Light Rail (CLR) | |
|---|---|---|---|---|
| Network | • Where fully segregated, flexibility similar to light rail.<br>• Where not segregated, buses in congestion, impacting speed / reliability / reputation<br>• Busway to Waterbeach not needed – use heavy rail connected to light rail within city.<br>• Slow and congested within city. | | | • Fully segregated – reliable, fast, minimal collision risk.<br>• Network to Cambourne / Granta Park / Science Park similar.<br>• Higher ability to generate modal shift (proven).<br>• 40 km core network covers high demand areas.<br>• Interchange with buses: integrated ticketing / timetabling.<br>• Fast, frequent service connects with buses & heavy rail network. |
| Rubber vs Rails | • Standard diesel / hybrid bus; in time battery electric<br>• Rubber- tyres produced from oil.<br>• Buses = tyre / road pollution. Not suited to tunnel.<br>• Buses at metro frequency = potholes. | | | • Standard technology, proven, highly sophisticated.<br>• Billions invested in Light Rail Vehicle development.<br>• Rails address road pothole problems. Excellent in tunnel.<br>• Rails inflexible, but permanent, encourages investment. |
| Tunnels | • No tunnel currently proposed. Cheaper.<br>• Surface running – potential congestion.<br>• City access more difficult if roads closed without a good alternative. | | | • Short, simple tunnel (2 portals) to meet essential needs.<br>• Automatic light rail proven deliverable for tunnel operations.<br>• Tunnel improves access speed, frequency, reliability, capacity. |
| Safety | • Busway / articulated bus safety lower than light rail.<br>• Heavy buses at high frequencies impose on cyclists and pedestrians, reducing their safety, especially in city. | | | • Very safe. Proven over billions of miles.<br>• Best safety record possible. Segregated way safer in city tunnel.<br>• Rails add to safety by providing physical guidance. |
| Environment & Health | • Lower energy efficiency = less sustainable.<br>• Higher particulate pollution from tyres = health risks.<br>• High volume of waste rubber tyres.<br>• Higher greenhouse gas emissions over scheme lifetime | | | • Most energy efficient, less power needed, highly sustainable.<br>• Lowest possible particulate pollution.<br>• Superior technical solution for environment / health.<br>• Lower greenhouse gas emissions over scheme lifetime. |
| Costs | • Lower capex to install segregated roadway.<br>• Electric buses cheaper.<br>• Bus lifetimes short – higher materials / carbon / energy.<br>• Higher opex & high road maintenance costs. | | | • Higher capex for permanent rails.<br>• Light Rail Vehicles (LRVs) more expensive.<br>• LRVs last longer – lower embodied materials / carbon / energy.<br>• Lower whole-life costs. |
| Financeability / Economic benefits | • City Deal finance (£500 m) sufficient for several busways.<br>• Lower investor confidence profile for bus scheme.<br>• Bus schemes less attractive to investors.<br>• Gross Value Added lower from bus schemes.<br>• Lower gains in economic productivity. | | | • Higher investment needed up front for light rail.<br>• High investor confidence profile for light rail scheme.<br>• Proven solution provides investors with confidence.<br>• Permanent infrastructure provides investor confidence.<br>• Gross Value Added higher from light rail scheme – more attractive, generates greater associated investment.<br>• Higher gains in economic productivity. |
| Delivery of benefits | • Modal shift poor compared to light rail.<br>• Bus mode share ~8% - need to shift to 25-30%.<br>• Insufficient capacity to meet scale of growth / demands of climate change. Not future-proofed.<br>• Buses unable to deliver change on scale required. | | | • Strong modal shift, as evidenced in other cities with light rail.<br>• Proven, dependable, reliable: deliverable today.<br>• Attractive and able to deliver change at scale required.<br>• Future-proofed capacity for growth / Climate Change. |

# 1. Introduction

**A strong regional transport strategy is necessary for Cambridgeshire and Peterborough, and it needs to have the capacity and quality to be fit for purpose for the 2030s and beyond. The strategy needs to be customised for our region, designed to address the challenges of growth and climate change, and to help secure the health, welfare, environment and economy for present and future generations.**

**Railfuture East Anglia** and **Cambridge Connect** have collaborated with a range of local, regional and national organisations and companies to develop proposals that aim to contribute to the strategy for transformative public transport in Cambridgeshire.

We have developed these plans in close cooperation with **UK Tram**, the national industry body established to support and provide advice on light rail and tram development in the UK.

Other organisations and companies we are collaborating with include:

- **Amey** – public transport operations
- **Ankura** – metro / infrastructure financing & management
- **Cameron McKenna Naburro (CMS)** – infrastructure legal / regulatory services
- **COLAS Rail** – rail infrastructure delivery
- **COWI** – tunneling / scheme delivery project management
- **OTB Engineering** – tunneling, geotechnical engineering, rail infrastructure

We have been actively engaged with community groups such as the Parish Councils of Barton, Coton, Great Shelford, and Stapleford, Cambridge Past Present & Future, Cambridge Ahead, Smarter Cambridge Transport, Rail Haverhill and many more. Numerous public presentations have been given, including to Residents Associations, at various Colleges, in the University of Cambridge, Cam Cycle, Railfuture, at Light Rail conferences, and to a range of businesses. Particular attention has been given to route alternatives for the CSET and C2C busway schemes being developed by the Greater Cambridge Partnership (GCP).

Key advisors are:

- **Ian Brown**, CBE, Director of Policy at Railfuture. Ian's achievements include the Docklands Light Railway, London Overground, extension of East London Line, Croydon Tramlink, Crossrail, expansion of Oyster Card fare facilities, as well as advising both nationally and internationally on rail and light rail developments.
- **Peter Cushing:** former Managing Director of Metrolink, Manchester. Currently advising Midland Metro, Edinburgh Tram and internationally.
- **Colin Robey**: Leads UK Tram Centre of Excellence. 50 years' experience in the rail industry. At Centro he was responsible for rail franchise and tramway concession management, including extensions in Birmingham and Wolverhampton.

# 2. Scheme influences

This document includes an overview of the Cambridgeshire context, which has a key influence on the transport strategy we propose. For example, regional population dynamics, the economy, existing spatial patterns of employment, and the needs of stakeholders all play a key part in shaping the type of transport strategy that is desirable for the region. A key question guiding our overall approach is – what kind of place and society do we want for Cambridgeshire in the future?

Our strategy is designed to establish a well-integrated mass transit backbone in the core of the region, where demand and needs for mass transit are highest, linked to bus and coach services, the heavy rail network, and improved infrastructure for cycling and walking to provide wide regional reach. Links to public transport systems from the existing road network will also be important. Interchange would be enhanced by integrated (digital) ticketing and joined-up timetabling. The core mass transit backbone can be extended over time.

Core objectives of our strategy are to:

1. **Change patterns of behaviour to use of public transport and active modes of travel;**
2. **Support a growing population (housing), employment and a dynamic economy;**
3. **Support social inclusion and improve access to key services (e.g. education, health);**
4. **Protect environmental and heritage values and enhance the urban realm.**

The strategy aims for a transformative shift towards use of public transport across the region. In order to be successful in driving modal shift on the scale required we believe the scheme adopted needs to be genuinely attractive, which means it needs to be fast, frequent, reliable, convenient, safe, comfortable and affordable. We aim for an excellent public transport network that people will actively choose, rather than take because they have been forced.

The strategy we propose will require greater investment than a bus network alone, although the benefits will be much greater, enduring and positive for society and the environment.

**Figure 1**. Docklands Light Railway. The initial investment of £220M (at today's prices) has proved transformative and the scheme has been enormously successful.

# 3. Population

The scale of growth in Cambridgeshire, Cambridge City and South Cambridgeshire have led to, and will continue to present, major challenges in the region for housing and transport, and for the equity and welfare of the population.

The Cambridge City Deal recognised the need for investment to address these challenges, although the scale of change is now coupled with other demands which have assumed much greater prominence since the original City Deal was agreed. In particular, we need to step up further to address the challenges of climate change and biodiversity loss in the context of the major regional population growth being witnessed.

**Table 1.** Cambridgeshire population trends 2011-31.

| Unit | 2011 | 2031 | Increase | % increase |
|---|---|---|---|---|
| Cambridge City | 123 900 | 154 050 | 30 150 | **24.3** |
| South Cambs | 148 800 | 196 860 | 48 060 | **32.3** |
| *Subtotal* | *272 700* | *350 910* | *78 210* | ***28.7*** |
| | | | | |
| Cambridgeshire | 624 180 | 794 200 | 170 020 | **27.2** |

Data source: Cambridgeshire County Council Research Group
https://data.cambridgeshireinsight.org.uk/dataset/2018-based-population-and-dwelling-stock-forecasts-cambridgeshire-and-peterborough

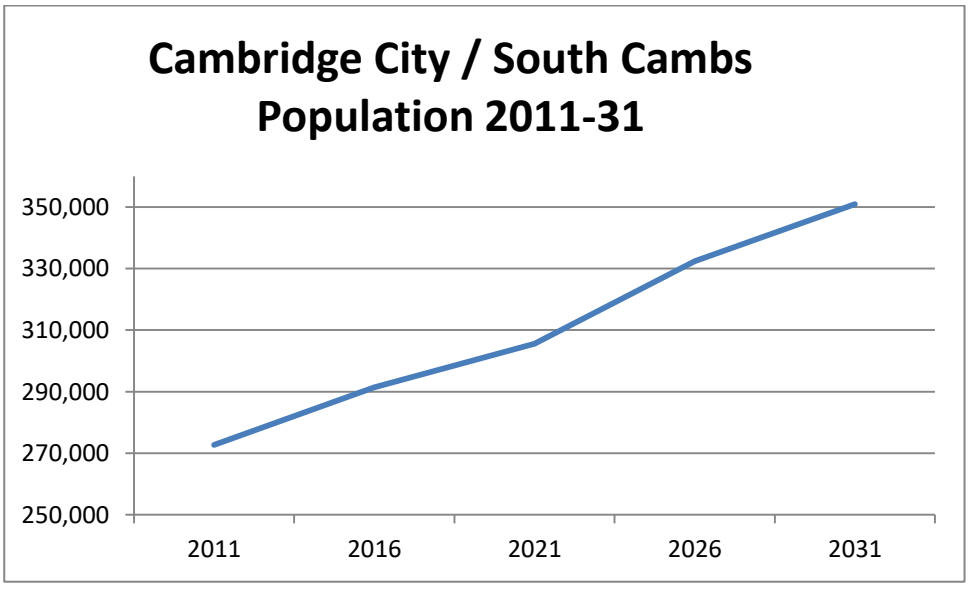



**Figure 2.** Cambridge city / South Cambridgeshire population trends

**Table 2.** Greater Cambridge Partnership new housing projections to 2031

| Development | Houses | % Houses | Residents[1] | % Residents | Jobs | %Jobs |
|---|---|---|---|---|---|---|
| Northstowe | 9500 | 19 | 22800 | 19 | 3500 | 9 |
| Waterbeach Barracks | 8500 | 17 | 20400 | 17 | 5800 | 14 |
| West Campus / Eddington | 3000 | 6 | 7200 | 6 | 6800 | 17 |
| Cambridge Northern Fringe | 2950 | 6 | 7080 | 6 | 3600 | 9 |
| Cambridge East | 1700 | 3 | 4080 | 3 | 1000 | 2 |
| Cambridge Southern Fringe | 4400 | 9 | 10560 | 9 | 10500 | 26 |
| Hinxton / Babraham / Granta Park | | 0 | | 0 | 5200 | 13 |
| Bourn Airfield | 3500 | 7 | 8400 | 7 | | |
| Cambourne West | 1500 | 3 | 3600 | 3 | 2800 | 7 |
| St Neots East | 3700 | 7 | 8880 | 7 | | |
| RAF Wyton | 3750 | 7 | 9000 | 7 | | |
| Alconbury Weald | 5000 | 10 | 12000 | 10 | | |
| Ely North | 3000 | 6 | 7200 | 6 | | |
| Cambridge City Centre[1] | | 0 | | 0 | 1800 | 4 |
| | **50500** | **100** | **121200** | **100** | **41000** | **100** |

Greater Cambridge City Deal website retrieved 03 Mar 2016
http://www.cambridgeshire.gov.uk/citydeal/info/2/transport/9/transport

**SUMMARY**

| Projection | Houses | New Residents[2] | Jobs |
|---|---|---|---|
| INCREASE | 50,500 | 121,200 | 41,000 |

1. GCP information made no projection for city centre houses.
2. Residents based on average number of occupants per house = 2.4 (UK average, Office of National Statistics).

More recently, major development sites have been identified in the first proposals of the new Greater Cambridge Local Plan, which will guide development to 2041. These show several new developments coming forward, in particular in the NE of Cambridge, which reflects decisions taken by Marshall about the future of Cambridge Airport (Table 3, Fig 3). These development projections indicate that the scale of growth is expected to continue through the 2030s. Moreover, new developments are being contemplated that were not previously envisaged. These data have significant implications for transport strategies being developed for the region. Unfortunately, the planning and projections that led to the agreement of the City Deal, and subsequently for expansion of local busways, are based on old data and a fresh look should be taken at whether both the City Deal funding package and the busway solutions will be adequate for the region over the planning horizon that we are now considering.

**Table 3.** Housing development projections to 2020 – 2041 (Greater Cambridge Shared Planning Service).

| Development | Houses | Residents | % of Total |
|---|---|---|---|
| Northstowe | 6345 | 15228 | 13 |
| Waterbeach Barracks | 5330 | 12792 | 11 |
| Cambridge Northeast | 3900 | 9360 | 8 |
| Marleigh | 1300 | 3120 | 3 |
| Cambridge East | 2850 | 6840 | 6 |
| Darwin Green | 2478 | 5947 | 5 |
| Eddington | 3142 | 7541 | 6 |
| Clay Farm | 151 | 362 | 0.4 |
| Bourn Airfield | 2460 | 5904 | 5 |
| Cambourne West | 2590 | 6216 | 5 |
| Cambourne | 1950 | 4680 | 4 |
| Trumpington Meadows | 302 | 725 | 1 |
| North of Cherry Hinton | 1200 | 2880 | 2 |
| Worts Causeway | 430 | 1032 | 1 |
| Great Shelford | 100 | 240 | 0.3 |
| Sawston | 418 | 1003 | 1 |
| Melbourne | 140 | 336 | 0.4 |
| **Total** | **35086** | **84206** | |

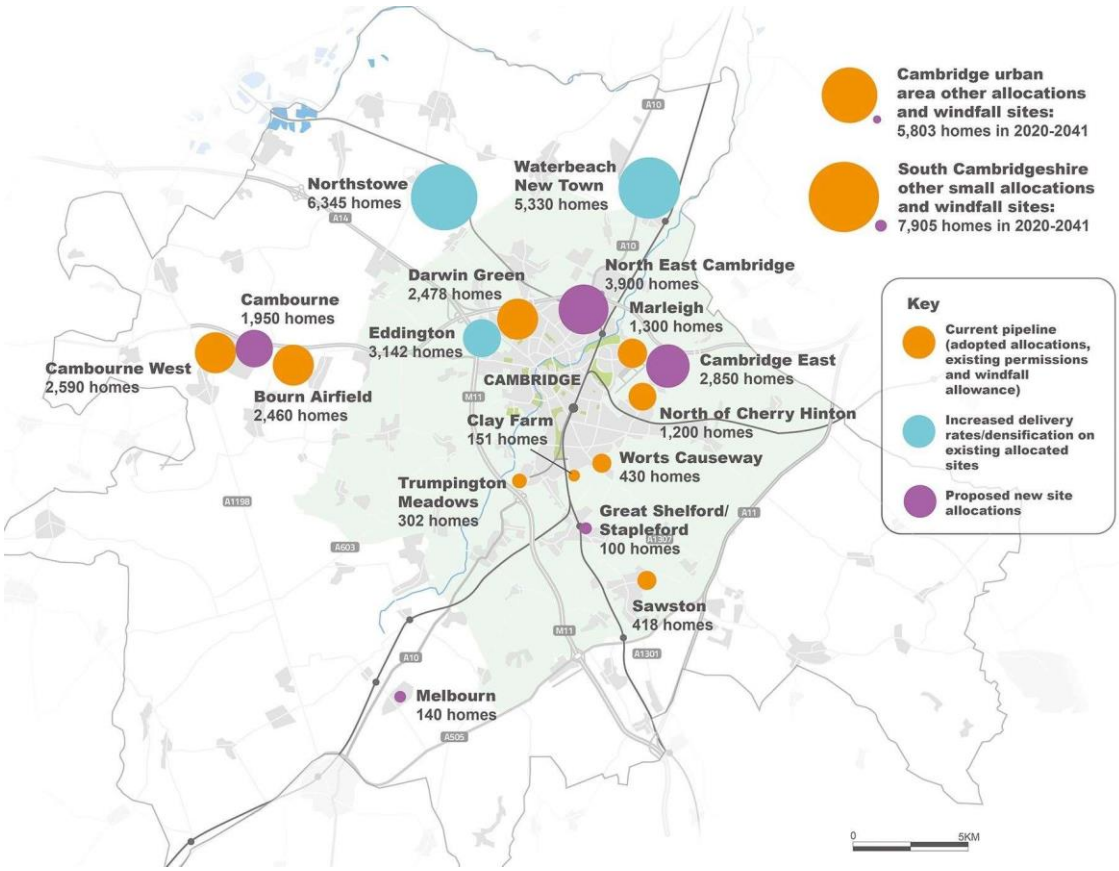



**Figure 3.** Greater Cambridge Partnership housing development projections to 2020 – 2041 Map: Greater Cambridge Shared Planning Service

# 4. Economy

**Statistics:**

- Cambridge is Europe's largest technology cluster.
- >£30bn in annual revenue generated by 20,000 registered companies – greater than the City of Manchester.
- ~ 54,000 people employed by more than 4,500 Knowledge-Intensive (KI) firms within 25 miles of Cambridge.
- Employment growth of 7.4% per annum since 2011.
- If growth in Cambridge Life Sciences continues at the same rate, a further £1bn will be added to the Cambridge economy by 2032, adding 6000 more jobs.


**Figure 4.** Biomedical Campus & simulated view of AstraZeneca HQ (AstraZeneca press resources)

**Cambridge Science / Business Parks – technology employment centres**

Babraham Research Campus
Cambridge Biomedical Campus
AstraZeneca locating at BioMedical Campus
Cambourne Business Park
Cambridge Business Park
Cambridge Research Park
Cambridge Science Park
Capital Park
Chesterford Research Park
Granta Park
ideaSpace
Peterhouse Technology Park
St John's Innovation Centre
University of Cambridge West Cambridge site
Vision Park
Wellcome Trust Genome Campus

…Further science parks are planned…

# 5. Education

- University of Cambridge one of top 3 universities in the world.
- Major employer: 11,500 staff and 24,450 students.
- Three main campuses: West Campus (+ Eddington 3000 homes, 2000 student flats), Cambridge city, and Biomedical Campus.
- Strong links with business and driver of innovation and economic growth.
- University / Colleges are globally significant for their heritage and environment.
- The campuses need effective links to support science / collaboration and to colleges.
- Isolation of campuses threatens to weaken cross-disciplinary interaction and college roles and vitality, one of the great strengths of Cambridge.
- Anglia-Ruskin University also significant employer and major student population.
- School access by private car continues to influence congestion levels.

**Figure 5.** World-renowned Trinity College, University of Cambridge.

# 6. Commuter demand

**Table 4.** Projected commuter demand on light rail at peak in Cambridge 2031

| Year | Commuter journeys peak (000/h[1]) | % by light rail | Pax /h |
|---|---|---|---|
| 2031 | 52.4 | 15 | 7859 |
| 2031 | 52.4 | 20 | 10,478 |
| 2031 | 52.4 | 25 | 13,100 |

1. Inward commuter journeys per hr at peak, excluding non-commuter and tourist journeys. Assumes travel in 2.5 h peak window. See data on passenger numbers in Revenue section below.

Light rail is recognised as ideal for passenger demand in the region of "3000-11,000 pax per hour" per direction (International Union for Public Transport (UITP)).

Assuming an equal distribution of commuters arriving from all four directions, one light rail line extending along an axis in two directions could potentially serve around half of the pool of 52,000 commuters. If 15% of those commuter journeys were by light rail, ~ 2000 pax/hr would commute from each of the two directions at peak. If 20% of commuter journeys were by light rail, this would rise to ~2600 per/hr, and for 25% this would be 3275 per/hr. The commuter demand projected within a few years of scheme commissioning would approach the "ideal" as suggested by the UITP. However, both tourism and non-commuter demand are excluded from this projection, which needs to be added to the base-level of commuter demand as discussed below.

It should be noted that many European cities with light rail (e.g. Lausanne, Freiberg) show much higher shares of public transport usage, and up to 35% of journeys in some places.

# 7. Tourism demand

Tourism demand is not included in the commuter demand estimate above, yet is a key economic driver with **8.1 million visitors** contributing ~**£835 million per year** to the Cambridge economy and accounting for ~22% of local employment.

Cambridge Light Rail would convey tourists to the heart of the city centre from the central Rail Station and the proposed coach station at the Girton Interchange. Currently, these journeys are generally made by car, taxi, bus or walking. For many visitors walking is not practical. Light rail could therefore replace inefficient journeys made by other vehicles, which themselves cause congestion and degrade air quality.

**Table 5.** Tourism demand for light rail in Cambridge 2031.

| Tourists pa[1] | Proportion of tourists as users | No. of users pa | No. journeys pa (2 ways) | Fare | Revenue pa (£M) | Tourist users / d | Tourist users / h[2] |
|---|---|---|---|---|---|---|---|
| 8,100,000 | 20% | 1,620,000 | 3,240,000 | £3.00 | 9.7 | 4438 | 888 |

1. Number of tourists per annum assumed at same level as 2017.

2. All tourist arrivals per hour assumed to occur over a 5 hr period.

If 20% of tourists use the light rail line – potentially a low estimate – this would equate to 3.2M journeys per annum (both ways), with an estimated annual revenue of almost £10M per year. Given 20% of tourists using light rail, this would be 4438 users per day. Assuming these tourists arrive over five hours in the morning, the demand from tourism would be ~900 people per hour. When added to commuting demand above, this suggests demand on the light rail line would be in the range of 3000 to 4000 people per hour at peak (at least from Cambridge Central Station into the city). This lies at the lower range of 'ideal' for light rail according to the UITP early in the scheme lifetime, with capacity for expansion in the future.

Cambridge Rail Station had a pre-pandemic footfall of ~12M passengers per year. We anticipate this will continue to grow by 2031, feeding demand on the Isaac Newton Line.

# 8. Non-commuter demand

The above estimates exclude non-commuters. Travel for reasons other than work has been shown to comprise the majority of journeys undertaken in Cambridge. For example, the Cambridge Access Study showed that only around one quarter of all journeys made are for commuting. The vast majority of journeys are for other purposes such as recreation, health care, meeting friends and family, education, entertainment, etc.

Non-commuter demand is likely to be more diverse and less predictable than commuter or tourist demand, as the destinations would be more widely spread (eg. visits to friends and family). However, hospital and education visits would attract demand onto the light rail because the network has been designed to service many of these major facilities.

We have not yet undertaken work on non-commuter demand, but when this is added to both commuter and tourist demand, it seems highly likely that in the 2030s the total demand would lie within the range of "3000-11,000 pax per hour" per direction considered 'ideal' by the UITP.

**Figure 6**. Road traffic on the A14 near Girton Interchange

# 9. Network model

The network model proposed by Railfuture / Cambridge Connect is designed to combine the strengths of multiple modes. Key aspects of the model:

- Leverage the strength and capacity of the existing and planned heavy rail network, including EW Rail and Wisbech line;
- Use light rail as a core backbone where mass transit capacity is needed in urban / regional environment and heavy rail is not practical;
- **Enable efficient interchange with bus services** extending flexibly and more cost-effectively across the wider region. Light rail backbone serves & enables these bus links;
- Ensure travel across modes is efficient and affordable by **joined-up timetabling and ticketing** (i.e. **bus partnerships / franchising** an essential component of system);
- Design light rail backbone to support key regional residential areas / employment centres / health services / educational facilities;
- Distribute light rail stops so they encourage and support cycling and walking;
- Specialised, effective mass transit on core backbone connected with bus services.

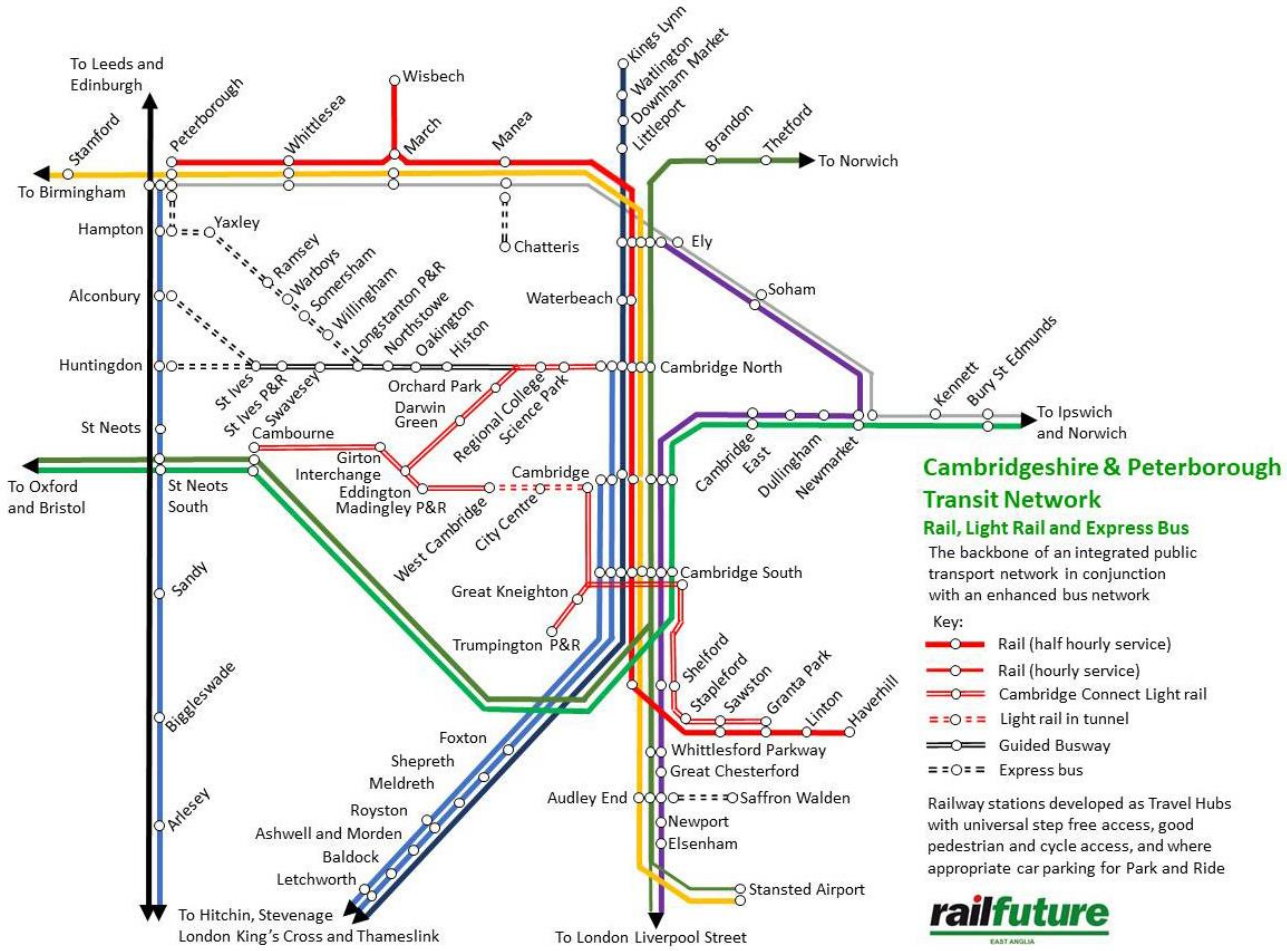



**Figure 7**. Railfuture network model, showing the regional context of Cambridge Connect.

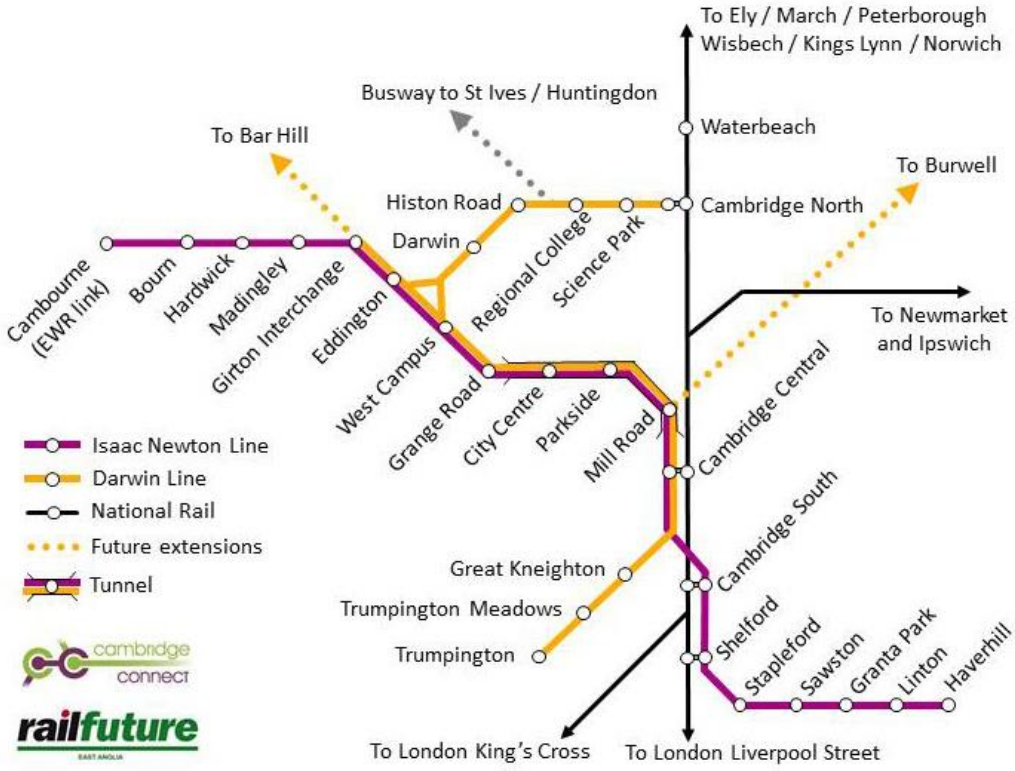



**Figure 8**. Cambridge Connect network model.

# 10. Cambridgeshire Light Rail

- Isaac Newton Line and Darwin Line, delivered in two phases.
- Multimodal links to buses / coaches and Park & Ride.
- Accessible to walking / cycling across network.
- Regional integration at interchange hubs, and coach station at Girton Interchange.
- Integration with heavy rail at Cambridge Central, Cambridge North, Cambridge South, and Shelford stations.
- Leveraging major investment already made in heavy rail network, building further on these strengths.
- Link to East- West Rail at Cambourne, Cambridge South, Cambridge Central etc.
- Tunnel provides fully segregated line and protects heritage / urban realm.
- Eastern extension to be brought forward with Marshall airfield and other housing / commercial developments in the future, perhaps near the end of 2020s.
- Regional extensions to Bar Hill, Haverhill, Burwell etc. at Phase Three.

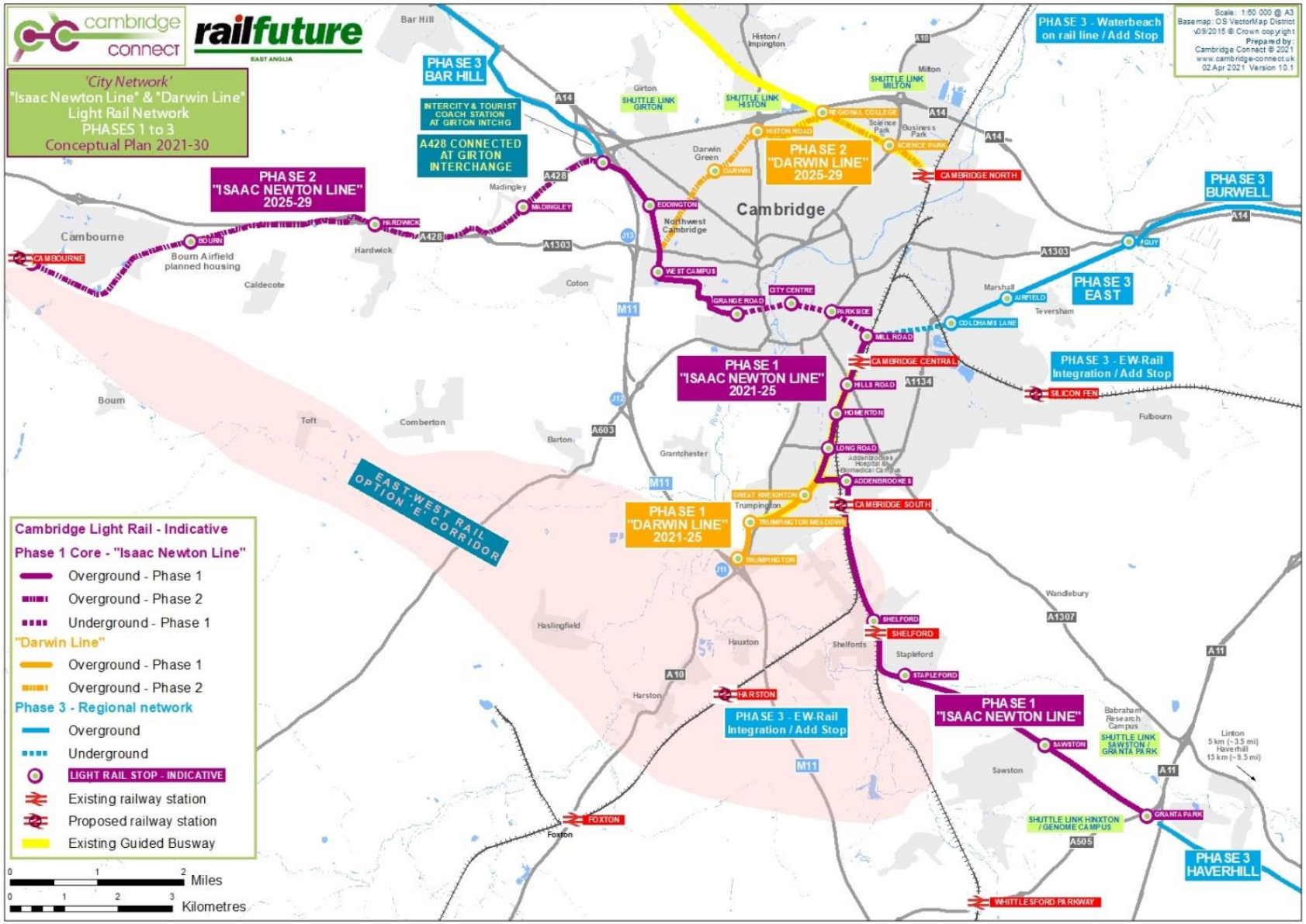



**Figure 9.** Cambridge City / local area light rail network.

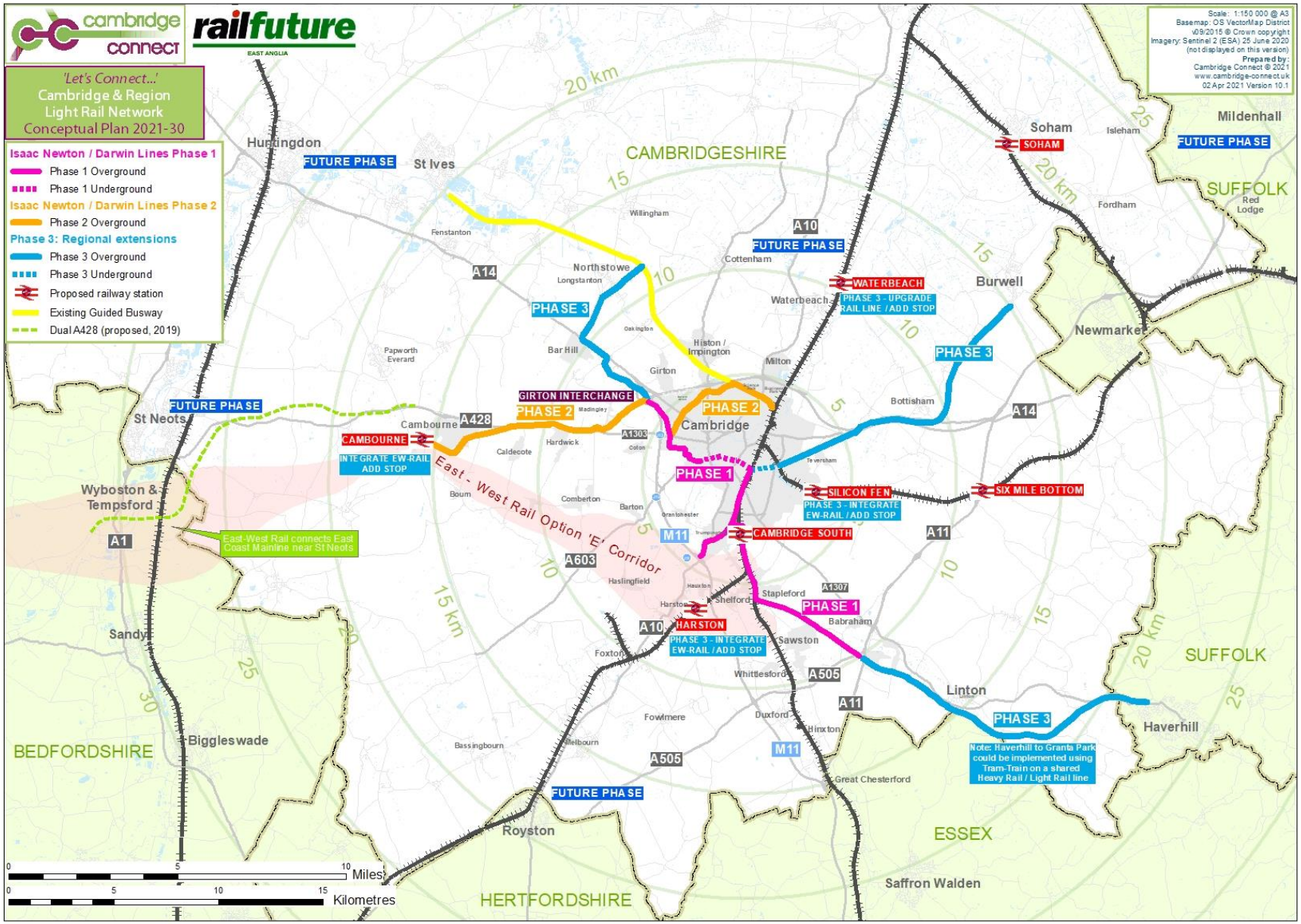



**Figure 10.** Regional light rail network for the long-term.

# 11. Urban realm

- What kind of place do we want to live in?
- **Healthy** – clean air and water, green spaces, safe, active travel, vibrant, equitable, diverse and non-discriminatory, employment opportunities, rich culture.
- Vibrant communities with high quality of life.
- **Attractive** and **positive public transport** making employment, health and educational services, leisure, colleagues, friends and family **accessible**.
- Pedestrian and cycle friendly.
- A city where people choose public transport because it meets needs and is attractive.
- "In Vienna people **enjoy using public transport** because it is **fast** and **comfortable**, and allows them to read or use their mobile devices" (Institute for Mobility Research 2016 – *Mobility trends in cutting-edge cities*).
- There is scope to improve the urban realm. What makes public transport attractive?
- Convenient
- Reliable
- Safe / Clean / Comfortable
- Affordable
- Fast

**Figure 11**. Light rail and cycle-friendly urban realm in Amsterdam.

# 12. Environment

- The **Climate Emergency** demands **major** change in our behaviour.
- Transport accounts for ~one-third of harmful emissions.
- Changes made to transport by modal shift and more environmentally sound technology can make a major contribution to reducing emissions.
- Light rail is proven to be more effective at generating modal shift. It is more powerful at attracting people to make the switch from cars. Light rail has ~3 times the ridership occupancy level than buses in England (excluding London).
- Light rail near zero emissions at point of use.
- Buses emit fine particulates (PM10, PM2.5) from rubber tyre, brake and road wear to the air, land and watercourses, affecting natural ecosystems. **Light rail avoids this source of pollution**.
- Public transport vehicles travel millions of miles over their lifetime, with emissions and waste continuous during operation. Many pollutants are cumulative in the environment. For example, tyres have been identified as the largest source of microplastics in the environment. **Light rail avoids this source of pollution**.
- Light rail is at least twice as energy efficient as buses. Rubber tyres have ~10 times the rolling resistance as rails.
- Lower power demand by light rail in operation = lower electricity demand, and fewer power stations required for transport. This also lowers operational costs.
- Waste rubber tyres are produced by buses. **Light rail avoids this source of pollution**.
- Modern tyres include synthetic plastics derived from fossil fuels. **Light rail avoids this source of pollution**.

**Figure 12**. Tens of thousands of waste tyres will be produced by Bus Rapid Transit over the scheme lifetime. This waste can be eliminated by adopting light rail for mass transit.

- In addition, because up to 3 buses are required to equal the capacity on light rail, at least 12 rubber tyres (more with double-axle / twin-tyre buses) are needed to carry the same load, with wear and pollution increased accordingly.
- Light rail vehicles are more durable than buses; this allows a lower embodied carbon footprint. For example, DLR vehicle life 25 years, compared to 8-10 years for bus.
- Carbone4 / Alstom show carbon emissions for Bus Rapid Transit are higher than for light rail.
- Operational $CO_2$ emissions for light rail ~35% lower than electric Bus Rapid Transit.
- There is a need to take carbon and other pollutant emissions fully into account over the operational lifetime of schemes.

## GREENHOUSE GAS: TRAMWAY A CLEAR WINNER

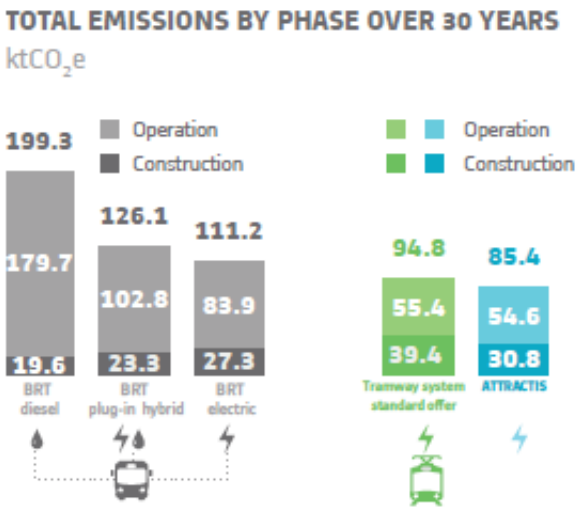
So which transport system has the best environmental performance over the lifecycle?

According to the Carbone 4 study, on the reference case route, and over a 30-year period, the tramway would have a smaller carbon footprint than any type of BRT.

Although BRTs offer short-term advantages during the busway construction and bus manufacturing phases, the tramway system is a clear long-term winner, with much lower overall lifetime emissions, thanks to its better operation and maintenance performance and the longer lifetime of the trams.

Due mainly to the combustion of diesel to power the bus, **a diesel BRT's total lifetime emissions are more than twice as high as the ones of a tramway system**.

For the same reason, a plug-in hybrid BRT system emits about 30% more greenhouse gas (GHG) than a tramway system over its lifetime. The BRT system also uses more electricity than the tramway one with a similar transport capacity.




Even a fully-electric BRT system has 17% higher lifetime emissions than a tramway system, since a city would need to operate a large fleet of buses to achieve the same transport capacity as 20 trams, resulting in 3.6 times more annual bus vehicle kilometres travelled.

Carbone4 / Alstom 2016. *Tramways or bus rapid transit: which is greener*? A study of the lifecycle $CO_2$ emissions of tramway & BRT systems.

**Figure 13**. Carbon footprint of Bus Rapid Transit vs light rail.

# 13. Health

- Fine particulates from rubber tyre, brake and road wear are a known health hazard. Particulates from tyres are equivalent to diesel tailpipe emissions.
- Studies have shown PM2.5 can travel to the brain in 15 mins.
- Electric buses emit fine particulates from rubber tyre and brake wear at levels equivalent to tailpipe emissions from diesel vehicles.
- Electric light rail is superior for air quality.
- Good public transport supports employment opportunities / mental health. Public transport access to jobs especially important to disadvantaged sectors of community.
- Provide good access to public health facilities and hospitals, especially important for older people, those on lower incomes, or without cars.
- Green spaces are valuable for walking and recreation, and for the physical and mental health of communities. Routes should be selected to minimise impacts on these spaces.

# 14. Heritage

- Cambridge is one of the top ten heritage cities in the UK. The colleges and The Backs are the equivalent of a World Heritage Site.
- Public transport solutions need to respect the globally iconic heritage values and environment of Cambridge and its surroundings.
- Vehicle and bus traffic in sensitive areas degrades environmental / heritage values and the quality of the urban realm.
- Damage to nearby Green Belt should be avoided wherever possible, recognising the importance of these landscapes to the Cambridge setting.

# 15. Accessibility

- Light rail vehicles are typically designed with low floors and wide doors to enable easy access. The design makes access easier for the disabled and those with children.
- Many light rail vehicles are designed to accommodate cycles, which could be made a feature in Cambridge, encouraging active travel in combination with public transport.
- The Cambridge and local region network is designed so that ~ 90% of city and local village residences lie within a 20 min walk or 8 min cycle ride to a stop.

- Stops are strategically located and spaced to encourage walking / cycling. They are typically spaced 1 km apart, which is the distance recommended by the UITP and widely adopted.
- There is a need to maintain inner city access to ensure continued city vitality in the face of challenges from changing shopping patterns. Closing the city to traffic without a realistic and attractive alternative for access will impact the economy and business.

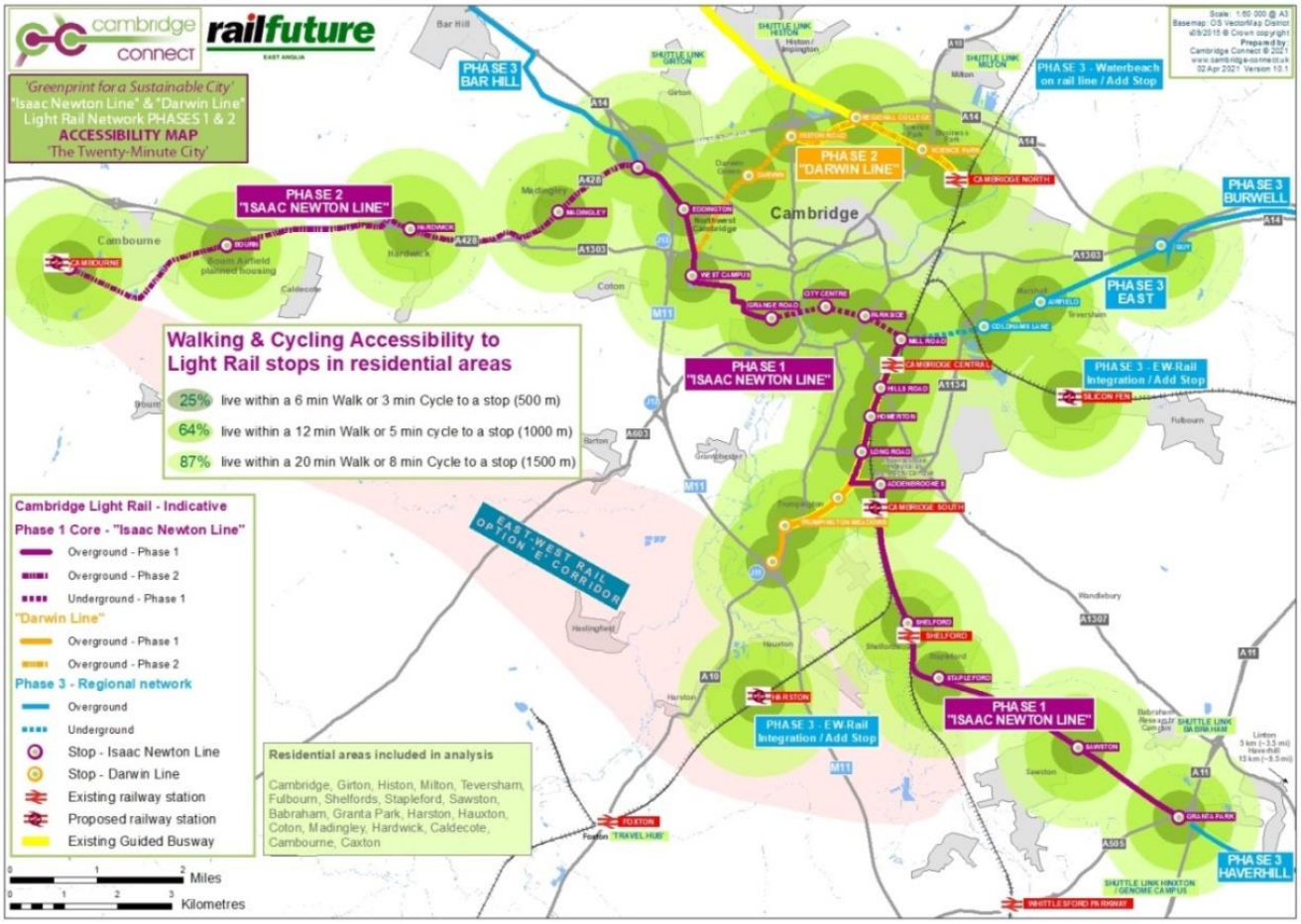



**Figure 14**. Accessibility of the city / local region light rail network.

**Figure 15**. Accessible light rail vehicle in Grenoble.

# 16. Tunnel

A short single tunnel of 2.6 km linking Cambridge city with both the Cambridge Rail Station and the West Campus can provide the critical link to enable seamless journeys from east to west and north to south.

**This tunnel would tie the public transport network extending to the whole region together. The benefits extend far beyond Cambridge City.**

The tunnel is designed to be as short, simple and pragmatic as possible, with two portals, one near the Cambridge Rail Station (potentially at the existing carpark) and the other near Grange Road (precise location to be determined). A diameter of ~4.8 m would accommodate a standard light rail vehicle and allow for an 800 mm safety walkway along the tunnel. Bi-directional operation can be provided using two bores. Another option for bi-directional operation is a single larger bore of 8.3 m. This latter option could be considerably cheaper and also have a lower construction footprint than the twin-bore option.

This tunnel and city underground station would require investment of ~£450M (the larger bore tunnel could be under £400M), although the benefits of creating a fully integrated network with Cambridge city at the core are enormous. By contrast the CAM tunnel proposal was almost five times in length, with four portals and two underground junctions, with high associated costs. The tunnel proposed here is much simpler and more practical to deliver.

We recognise that a version of our scheme with a shorter tunnel, or without one, could be possible, although this would require some route adjustments and compromises. Street-running trams are implemented in numerous historic cities elsewhere, and we have given the option careful consideration. While this option could be cheaper, it would present its own challenges. The difficulties include crossing the river and potential constraints related to heritage concerns, which could lead to public opposition. Disruption during construction could also be an issue. These types of concerns convince us that a short tunnel represents the most practical option for Cambridge to achieve the goal of a fully integrated and transformative public transport solution for the region.

**Benefits**

- Fully integrated network connects the major transport axes.
- Fast, reliable, fully segregated connections from city to Rail Station, Biomedical Campus, and West Campus – e.g. 4 min journey from city to rail station.
- Major reduction in congestion.
- Major improvements in connections from disadvantaged areas to employment sites (e.g. Kings Hedges / Arbury to city centre, Addenbrookes etc.).
- Enhanced city access to maintain / improve urban vitality (e.g. internet challenges).
- Deliverable – crossing River Cam difficult without tunnel.
- Practical – avoids disruption of traffic during construction.
- Avoids most sewage, water and electrical services, historic buildings and

archaeology, and the costs of dealing with those near surface.

- Enables pedestrianisation while maintaining good access.
- Enhances urban realm and safety by removing heavy vehicles.

**Disadvantages**

- More expensive – high up-front capex.
- Some aspects technically more difficult to construct (hence expense).
- Underground station harder to access than at surface.
- Fewer stations / stops owing to expense.
- Additional security.

**Figure 16**. Access to tunnel for light rail line via escalator in Copenhagen.

# 17. Costs

**Table 6.** Estimated cost of 'Isaac Newton Line' and 'Darwin Line' (Phases One and Two)[1]

| Component | U-ground (km) | O-ground (km) | Total (km) | Stops[2] | U-ground £M[3] | O-ground £M[4] | Total £M |
|---|---|---|---|---|---|---|---|
| Isaac Newton Line Phase One | 2.6 | 17 | 19.7 | 16 | 392 | 529 | 921 |
| Darwin Line Phase One | - | 2.2 | 2.2 | 3 | - | 57 | 57 |
| *Phase One subtotal* | *2.6* | *19.2* | *21.9* | *19* | *392* | *586* | *978* |
| Isaac Newton Line Phase Two | - | 11.7 | 11.7 | 4 | - | 295 | 295 |
| Darwin Line Phase Two | - | 6.5 | 6.5 | 5 | - | 165 | 165 |
| *Phase Two subtotal* | - | *18.2* | *18.2* | *9* | - | *460* | *460* |
| **Newton Line + Darwin Line** | **2.6** | **37.4** | **40.1** | **28** | **392** | **1046** | **1438** |

1. Estimate includes lines, tunnel, 2x u-ground stations, surface stations, rolling stock, depot.
2. Existing Cambridge Central and Cambridge North Rail Stations and proposed Cambridge South Rail Station are counted as stops.
3. Underground costs based on £73.5 M/km and INCLUDES two underground stations @ £100M each. Published cost of underground Métropole Nice Côte D'Azur Line 2, Railway Gazette (Oct 2015) and estimated cost of 5 m diameter tunnel in Cambridge geology of £73.5M/km for bi-directional tunnel.
4. Surface light rail cost of £20-30M /km B. Menzies (2015) quoted Cambridge News 03 Feb 2015. £25M/km used above.

The cost of Phase One is estimated at £978M, with ~40% of this cost being for the tunnel and underground stations (£392M). This level of investment is similar to that made in the first phase of the Nottingham NET tram system (£800M).

This cost estimate is based on an approximate cost of £25M / km for light rail line development, with £74M /km for bi-directional tunnel construction. We are currently undertaking further work on these general costings.

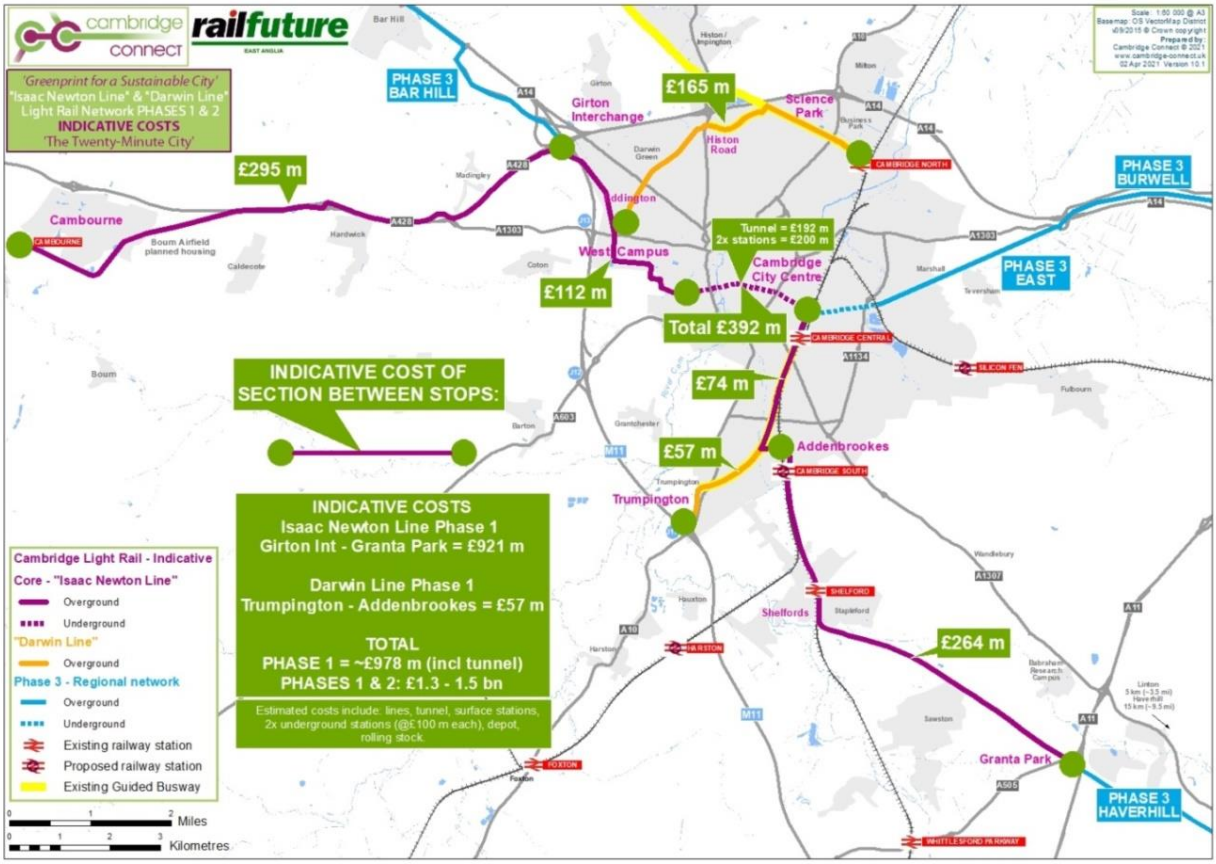



**Figure 17**. Costs of light rail by network component.

# 18. Cost comparisons

| Nottingham NET | A14 upgrade |
|---|---|
|  |  |
| £852m | £1500m |

# 19. Revenue

Revenue is estimated at approximately ~£20 million per year in 2031 based on the commuter and population data and assuming an average fare of £2.00 (Table 7).

This projection **excludes tourists and excludes non-commuter journeys**. In practice, commuters comprise only a small percentage of journeys per day: the Cambridge Access Study showed commuting comprised only 23% of all journeys made. The projections therefore represent an underestimate of demand. More comprehensive research is needed on demand from all potential users of a light rail network in Cambridge.

**Table 7**. Numbers of commuter journeys and revenues.

**Commuters (per day)**

| Year | Cambridge Working Residents | Commuting WITHIN Cambridge /d | Commuting OUT OF Cambridge /d | Commuting INTO Cambridge /d | Total INTO / OUT & WITHIN /d | Commuter journeys To-From = x2 /d |
|---|---|---|---|---|---|---|
| 2011 | 60 000 | 44 000 | 16 000 | 51 000 | 111 000 | 222 000 |
| 2031 | 70 800 | 51 920 | 18 880 | 60 180 | 130 980 | 261 960 |

**All commuter journeys and revenue (per year)**

| Year | Journeys Per day Total journeys commuters /d | Journeys Per Year (M) Total /y | Journeys Per Year (M) By Light Rail 20% | Revenue per year (£M) (20% of commuter journeys by Light Rail, avg fare £2.00) |
|---|---|---|---|---|
| 2011 | 222 000 | 55.5 | 11.1 | 22.2 |
| 2031 | 261 960 | 65.6 | 13.1 | 26.2 |

In comparison, Orléans, France, is smaller than Cambridge (see Table 9), has a light rail network of ~30 km, and yet ridership in 2018 was 23 million journeys. This suggests the estimates made above are very conservative, which is understandable since they only take into account commuter demand at this stage. Moreover, a mode share of only 20% is used.

# 20. Financing

A wide range of potential sources of finance could be examined. Some of these may have already been investigated by the Combined Authority.

- City Deal (£500 M)
- Devolution Deal (£600 M)
- National Infrastructure Bank
- Cambridge Green Infrastructure Bond
- Public Private Partnership
- Commercial investors (e.g. pension funds)
- International investment

- Public Works Loans Board
- HM Treasury / Department for Transport investment.
- Asset-Backed Financing / Tax Increment Financing / Business Rates Uplift
- Community Infrastructure Levy (CIL)
- Section 106 revenue
- Workplace Parking Levy (WPL)
- Road User / Congestion Charge
- Regional / local authority financing

City Deal funds would be repurposed on the basis that the C2C / CSET busways would be replaced by the scheme (and possibly other projects – e.g. we believe Waterbeach can be served well by the heavy rail line and the need for a new busway is not clear). We can explore some scenarios that could close the financing gap with the City Deal. As indicative examples, it might be possible to assemble a package of finance to meet needs as suggested in Table 8.

**Table 8**. Possible financing package scenarios.

| **Financing Scenario A** | **Amount (£M)** | **Financing Scenario B** | **Amount (£M)** |
|---|---|---|---|
| City Deal | 300 | City Deal | 300 |
| CPCA Infrastructure fund | 200 | CPCA Infrastructure fund | 300 |
| Business Rates Uplift | 300 | Public Private Partnership | 300 |
| National Infrastructure Bank | 200 | Green Infrastructure Bond | 500 |
| Green Infrastructure Bond | 500 | Public Works Loans Board | 100 |
| **Finance package A total** | **1500** | **Finance package B total** | **1500** |

Other sources of finance, such as a Workplace Parking Levy (WPL), Community Infrastructure Levy or some form of congestion charging could also be examined. These types of sources would need to be agreed through political processes, although a WPL has already been demonstrated as successful in Nottingham. There may be important social equality issues to be considered when deploying these types of mechanisms.

Some of the costs we have included within our scheme budget could be taken off balance sheet. For example, £80M has been allocated for rolling stock, and this could be leased rather than made as a capital purchase. There could be other opportunities for reducing capex in a similar manner.

Finance packages for major infrastructure projects are routinely put together in the UK. There could be a range of options worthy of consideration and a number of our collaborators have considerable practical experience and expertise in this area.

# 21. Is Cambridge too small?

It has often been claimed that Cambridge is too small for light rail. Is that actually true? There are at least 19 cities in France of a size similar to Cambridge or smaller with light rail / tramways. Many more cities of similar size in Germany, the Netherlands, Sweden, Denmark and Switzerland also have light rail / trams. It is clearly possible for smaller cities to implement light rail, although in the UK this has not yet happened to the same extent. This is probably in part because light rail requires higher up-front investment. Yet, those cities where light rail / trams are implemented typically see a much higher share of journeys by public transport.

There are several other reasons why Cambridge is **not** too small:

- Cambridge economy much larger than other cities of its size.
- Cambridge population ~350,000 when nearby communities in South Cambs included.
- The pace of growth in Cambridge is the fastest in the UK: capacity needs to be adequate for the future.
- The high level of tourism inflates demand in Cambridge, which not available in many other cities.
- Heavy rail patronage in Cambridge higher than Nottingham and Derby combined.

**Table 9.** Small to medium-sized cities in France with light rail / tramways[1]

| City | Lines | Stations | Length (km) | Popn | Length / person (m) |
|---|---|---|---|---|---|
| Reims | 1 | 23 | 11.2 | 182,592 | 0.061 |
| Le Havre | 2 | 23 | 13 | 172,074 | 0.075 |
| Saint-Étienne | 3 | 38 | 11.7 | 172,023 | 0.068 |
| Grenoble | 5 | 71 | 36 | 160,215 | 0.225 |
| Dijon | 2 | 35 | 19 | 153,003 | 0.124 |
| Angers | 1 | 25 | 12.3 | 150,125 | 0.082 |
| Cambridge (City) | 2 | 24 | 40 | 154,050[2] | 0.260 |
| Le Mans | 2 | 35 | 18.9 | 144,244 | 0.131 |
| Clermont-Ferrand | 1 | 34 | 15.9 | 141,463 | 0.112 |
| Brest | 1 | 28 | 14.3 | 139,386 | 0.103 |
| Tours | 1 | 29 | 15.5 | 134,803 | 0.115 |
| Besançon | 2 | 31 | 14.5 | 116,952 | 0.124 |
| Orléans | 2 | 49 | 29.3 | 114,375 | 0.256 |
| Mulhouse | 3 | 29 | 16.2 | 112,063 | 0.145 |
| Rouen | 1 | 31 | 15.1 | 110,755 | 0.136 |
| Caen | 2 | 34 | 15.7 | 107,229 | 0.146 |
| Nancy | 1 | 28 | 11.1 | 104,072 | 0.107 |
| Avignon | 1 | 10 | 5.2 | 90,305 | 0.058 |
| Aubagne | 1 | 7 | 2.8 | 45,303 | 0.062 |
| Valenciennes | 2 | 48 | 33.8 | 42,851 | 0.789 |

1. Bouquet, Y. 2017. The renaissance of tramways and urban redevelopment in France. *Miscellanea Geographica* **21** (1): 5-18.
2. Population is projected to 2031 (data from Cambridgeshire County Council Population Research Group 2018) to take into proper account the strategic planning horizon.

**Figure 18**. Caen: population ~107K. Light rail replaced bus rapid transit because rubber tyred vehicles rapidly wore out roads (tracking), leading to high operational maintenance / costs, and impacting reliability / ride quality / patronage.

https://en.wikipedia.org/wiki/Caen_tramway#/media/File:Tramway_Caen_1008_et_1022.jpg

**Figure 19**. Lausanne: population ~150K. Light rail adopted when city population was ~126K. Includes tunnel.

By Grez [GFDL (http://www.gnu.org/copyleft/fdl.html) or CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0)], via Wikimedia Commons

**Table 10**. Case study of Lausanne, a city similar in size to Cambridge.

| | Cambridge | Lausanne |
|---|---|---|
| City population | 125 000 (2011)<br>154 050 (2031) | 125 759 (1991 opened)<br>146 372 (Nov 2015) |
| Regional population | 350 000 (2031):<br>South Cambs (commuter basin) | 309 000 (Mar 2015): Lausanne commuter basin. |
| City area | 40.7 $km^2$ | 41.4 $km^2$ |
| Regional area | 901.63 $km^2$ | ? |
| Modal share | 8% (bus) | 40% (includes metro & bus) |
| Number of lines | Two (Isaac Newton + Darwin) | Two (M1, M2). New line in devlpmt. |
| Number of stations | 28 | 29 |
| System length | 40 km | 13.7 km |
| Length underground | ~2.6 km | ~7.5 km |
| Length dedicated alignment | 92% segregated. | Mainly segregated. |
| Length on street | Several street crossings at grade. | Some street crossings at grade. |
| Service frequency | Every 5-10 min. | 3 min central; 6 min elsewhere. |
| Top / Average speed | 80 / 33 km/h | 60 km/h; Avg 20 km/h (M2) |
| Track gauge | 1435 mm | 1435 mm |
| Catenary-free? | As appropriate | M1 No; M2 Yes |
| Automatic operation | Yes (eg Docklands Light Railway) | M1 No; M2 Yes |
| Total cost | Newton + Darwin ~£1.5 bn | M2 £333M (2008) |
| Cost per km | £37.5M /km | M2 £56.4M /km |
| Passengers /year | 13.1M (2031) | 40M (2014) |
| Operating revenue (annual) | £26.2M – assumed 13.1M pax journeys @ £2.00 average fare. | £100M – assumed 40M pax journeys @ £2.50 average fare. |
| Typical fare | ~£2 - £4 | ~£4 peak 2h for two zones |

# 22. Existing GCP transport measures

- Construct bus lanes / busways to regional population centres – buses proceed to Cambridge city centre. GCP strategy plans a massive increase in bus traffic in the inner city narrow streets, competing with cyclists and pedestrians.
- City Access Strategy published in August 2021, but appears similar to proposals made seven years ago, which led to resistance and protest by city business and residents.
- Lack of means to link busway limbs together to form integrated network across the region. Buses therefore likely to suffer from congestion in city centre.
- Busway schemes lack capacity and are not future-proofed for the 2030s in view of the growth already coming forward.
- GCP proposed inner city road closure at peak time with a view to forcing people to take the bus. Strong concerns about this option being harmful for the city economy and business led to protests, and the proposal was scrapped several years ago.
- Strong community opposition to both CSET and C2C busways. High concern about unnecessary damage to Green Belt environment and amenity when potentially viable alternatives exist.
- Busway schemes not aligned with community aspirations or needs. Large numbers of buses in the city will degrade the quality of the environment of the city.
- Park & Ride expansions / additions. Greenways and cycle route / path improvements.
- Improve traffic signaling.
- Schemes constrained by funding available in the City Deal.
- Expenditure to date: ~£100M yet limited delivery after almost seven years.
- Significant difficulties experienced in delivery of larger GCP schemes and substantial community opposition. Likely to lead to costly challenges at Public Enquiries.
- The GCP strategy was developed prior to 2015, based on a model formulated for the previous busway.
- Major developments in the science and understanding of climate change have occurred since the GCP strategy was formulated. In particular there are new requirements for decarbonisation in order to meet agreed net-zero targets.
- These changes have very practical implications for how we need to change our behaviour, systems and infrastructure going forward. This is particularly the case for transport, which accounts for around one-third of emissions.
- Questions should be raised about whether the old strategy remains fit for purpose for the 2030s and beyond?
- The solutions put in place now must have capacity and resilience to meet the needs of future generations. We believe the evidence strongly suggests that busways will not be adequate to meet the twin challenges of growth and climate change in 2030s, nor be sufficient to support the continued growth of the regional economy.

# 23. Light rail and busways compared

Cambridge Connect has undertaken an appraisal of the benefits of light rail compared to buses and busways in the context of implementation in the Cambridgeshire context. A summary of our assessment against a range of criteria is presented in Table 11. Performance of each option against each set of criteria was assessed on a qualitative scale ranging from poor to excellent. A quantitative assessment was beyond current resources, and the assessment represents expert opinion expressed by those collaborating on the exercise (Cambridge Connect, Railfuture, CMS, Amey, Ankura, UK Tram). The full and more detailed criteria and appraisal are presented in Appendix Four.

The appraisal concludes that light rail performs better on almost all criteria, including environment, health, modal shift, economic benefits, safety, durability, reliability, attractiveness, comfort, capacity, and technology. However, it is recognised that light rail construction would cost more. While construction costs are higher, it is likely that the Wider Economic Benefits of the scheme and Gross Value Added across the region would also be much higher than a bus-based approach.

A tunnel incurs a substantial share of the costs, although the benefits of a tunnel are also very high. Whole-life and operational costs of light rail are considered lower, with light rail requiring around half the energy to provide the same level of service as buses. Light rail is also more durable, and has proven ability to operate driverless. The latter aspect could substantially reduce staff costs, which form a major share of operating expenditure.

Buses have greater flexibility when operating off the busway alignment, and thus have a greater reach. However, when operating on a segregated busway buses are constrained in the same way as light rail. In our model, buses form an integral part of the overall public transport solution, providing extended reach into areas where mass transit provided by light rail cannot penetrate. Electric buses are also cheaper to buy than light rail vehicles, although when capacity is taken into account this differential diminishes. In addition, it is also feasible to lease light rail rolling stock rather than purchase, which can help reduce up-front costs.

One key to making this model attractive lies in delivery of good interchanges, which can be achieved by provision of a frequent service on the mass transit light rail line, integrated (digital) ticketing and joined-up timetables. As is evident from transit systems combining light rail and buses in Europe, all of this is possible using current and proven technologies.

Our model exploits the strengths of both buses and light rail working together. Each mode has its own strengths and weaknesses, and by combining the strengths of both a superior overall solution can be provided. Buses perform poorly for mass transit, and have not been shown to be good at driving modal shift. On the other hand, buses are relatively cheap and can provide a more extended reach, so in this way the more extensive network needed can be provided much more cost-effectively using standard electric buses.

It is essential that substantial modal shift is achieved, and the combination of light rail with good connecting bus services, as well as improved facilities for active travel, we believe offers the strongest model for public transport in the Cambridgeshire region in the long-term.

**Table 11.** Summary appraisal of light rail vs busways for Cambridgeshire


| CONSIDERATION | GCP Busways | | Cambridgeshire Light Rail (CLR) | |
|---|---|---|---|---|
| Network | • Where fully segregated, flexibility similar to light rail.<br>• Where not segregated, buses in congestion, impacting speed / reliability / reputation<br>• Busway to Waterbeach not needed – use heavy rail connected to light rail within city.<br>• Slow and congested within city. | | | • Fully segregated – reliable, fast, minimal collision risk.<br>• Network to Cambourne / Granta Park / Science Park similar.<br>• Higher ability to generate modal shift (proven).<br>• 40 km core network covers high demand areas.<br>• Interchange with buses: integrated ticketing / timetabling.<br>• Fast, frequent service connects with buses & heavy rail network. |
| Rubber vs Rails | • Standard diesel / hybrid bus; in time battery electric<br>• Rubber- tyres produced from oil.<br>• Buses = tyre / road pollution. Not suited to tunnel.<br>• Buses at metro frequency = potholes. | | | • Standard technology, proven, highly sophisticated.<br>• Billions invested in Light Rail Vehicle development.<br>• Rails address road pothole problems. Excellent in tunnel.<br>• Rails inflexible, but permanent, encourages investment. |
| Tunnels | • No tunnel currently proposed. Cheaper.<br>• Surface running – potential congestion.<br>• City access more difficult if roads closed without a good alternative. | | | • Short, simple tunnel (2 portals) to meet essential needs.<br>• Automatic light rail proven deliverable for tunnel operations.<br>• Tunnel improves access speed, frequency, reliability, capacity. |
| Safety | • Busway / articulated bus safety lower than light rail.<br>• Heavy buses at high frequencies impose on cyclists and pedestrians, reducing their safety, especially in city. | | | • Very safe. Proven over billions of miles.<br>• Best safety record possible. Segregated way safer in city tunnel.<br>• Rails add to safety by providing physical guidance. |
| Environment & Health | • Lower energy efficiency = less sustainable.<br>• Higher particulate pollution from tyres = health risks.<br>• High volume of waste rubber tyres.<br>• Higher greenhouse gas emissions over scheme lifetime | | | • Most energy efficient, less power needed, highly sustainable.<br>• Lowest possible particulate pollution.<br>• Superior technical solution for environment / health.<br>• Lower greenhouse gas emissions over scheme lifetime. |
| Costs | • Lower capex to install segregated roadway.<br>• Electric buses cheaper.<br>• Bus lifetimes short – higher materials / carbon / energy.<br>• Higher opex & high road maintenance costs. | | | • Higher capex for permanent rails.<br>• Light Rail Vehicles (LRVs) more expensive.<br>• LRVs last longer – lower embodied materials / carbon / energy.<br>• Lower whole-life costs. |
| Financeability / Economic benefits | • City Deal finance (£500 m) sufficient for several busways.<br>• Lower investor confidence profile for bus scheme.<br>• Bus schemes less attractive to investors.<br>• Gross Value Added lower from bus schemes.<br>• Lower gains in economic productivity. | | | • Higher investment needed up front for light rail.<br>• High investor confidence profile for light rail scheme.<br>• Proven solution provides investors with confidence.<br>• Permanent infrastructure provides investor confidence.<br>• Gross Value Added higher from light rail scheme – more attractive, generates greater associated investment.<br>• Higher gains in economic productivity. |
| Delivery of benefits | • Modal shift poor compared to light rail.<br>• Bus mode share ~8% - need to shift to 25-30%.<br>• Insufficient capacity to meet scale of growth / demands of climate change. Not future-proofed.<br>• Buses unable to deliver change on scale required. | | | • Strong modal shift, as evidenced in other cities with light rail.<br>• Proven, dependable, reliable: deliverable today.<br>• Attractive and able to deliver change at scale required.<br>• Future-proofed capacity for growth / Climate Change. |

# 24. Community engagement

Cambridge Connect and Railfuture have worked closely with local communities in developing our light rail network and strategy. In particular, work has focused on alternatives to the busways being developed for Cambourne to Cambridge (C2C) and Cambridge South East Transport (CSET) between Addenbrookes Hospital and Granta Park. We have also engaged closely with Rail Haverhill, and Railfuture has made a bid to the government Restore Your Railway fund for evaluation of this route, the results of which are pending.

In principle Cambridge Connect supports a transport strategy that provides excellent public transport options to communities. However, these improvements need to be delivered while protecting to the maximum extent possible important landscape, environmental, heritage and community values – all of which are under threat by the scale and pace of regional growth. In particular, new transport routes should, where possible, co-align with existing transport corridors and infrastructure to minimise further degradation of regional landscape and environmental values. These values have already been severely eroded over the centuries, and Cambridgeshire has one of the worst records on ecological degradation in the UK. **Protection of landscapes and Green Belt from unnecessary severance and degradation from transport schemes should therefore be a high priority in any regional transport strategy**.

Working with local communities, Cambridge Connect and Railfuture have examined alternative routes to the C2C and CSET busways and made formal submissions in public consultations, and have been active in supporting the communities assemble evidence for less damaging alternatives.

### Cambourne to Cambridge – C2C

In the case of C2C, we support provision of excellent public transport links between Cambourne and Cambridge. However, we consider an alternative route co-aligned with the A428 highway and which proceeds via the strategically important Girton Interchange has stronger merit than the preferred GCP route. The Cambridge Connect proposals were reviewed by the transport consultancy i-Transport as part of the work they undertook for Coton Parish Council in their submission to the C2C Independent Audit, and they concluded that the route has merit and no obvious 'show-stoppers'. Cambridge Connect submitted this alternative for consideration by the C2C Independent Audit, which concluded:

> **"The hybrid A428 Co-alignment scheme is a compromise between the other two that incorporates some of their features but avoids the riskier elements. In this sense it is more viable and closer aligned to the scheme objectives than the others. Nevertheless, it is likely to perform less well on cost and other performance metrics while potentially scoring higher on environmental and social impact."**

The Independent Audit also noted that Cambridge Connect had not undertaken a detailed appraisal of the route, and therefore had not submitted extensive evidence in support of the alternative. The intent of the submission, however, was not to make a detailed appraisal – something beyond the resources of Cambridge Connect, and unreasonable to expect – but rather to raise the alternative for consideration on the grounds of a reasonable concept which clearly would need to be validated in detailed work. In this respect, we do not consider the

comments made in the Independent Audit implying we should have undertaken more detailed appraisal to be fair: this is not our job as members of the public, but rather the job of the authorities responsible for bringing schemes forward. The GCP should properly investigate all reasonable alternatives before proceeding with a preferred route that will damage the Green Belt, and **both i-Transport and the Independent Audit have concluded the A428 co-aligned route is a reasonable alternative for detailed consideration**.

Moreover, the A428 co-alignment alternative is supported by many in the community, and by the American Cemetery, because it would protect more of the Green Belt at the same time as delivering an excellent public transport link (e.g. see Appendix Two, and as outlined below).

The route we propose via the Girton Interchange would take less than two minutes longer to get to Cambridge from Cambourne than the route preferred by the GCP. Balanced against this, the route ensures the public transport route is integrated with the Girton Interchange, which is **one of the most strategically important road junctions in the region**, connecting the M11, A14 and A428 highways. This allows the public transport network to be connected to regional centres such as Bar Hill and (rapidly growing) Northstowe in the future, as well as enables development of an inter-regional coach / bus station at the interchange connected by the light rail link into Cambridge and to surrounding centres.

It is important to note that routing the C2C public transport route via the Girton Interchange does NOT REQUIRE the road interchange itself to be fully enabled at this time. This could be undertaken in the future, or not at all, and this work is not necessary for the Girton Interchange route to be strategically beneficial:

- it keeps options open for the future;
- it allows for onward links to important centres like Bar Hill and Northstowe;
- it serves to protect environmental and community values which lie at the heart of the strong opposition to the GCP preferred C2C route; and
- it allows a regional coach station to be located at the Girton Interchange connected via a light rail link into the city, employment centres, health and educational facilities, and to surrounding communities.

The outline proposal for an alternative route for C2C submitted to the C2C Independent Audit by Cambridge Connect is provided in Appendix One.

In 2019 Cambridge Connect collaborated with the Coalition of Parish Councils to the west of Cambridge to agree a 'Letter of Community Consensus' on the Girton Interchange. This letter called for consideration of fully enabling an all-ways road junction at the Girton Interchange, and importantly also called for:

> **"the strategic importance of the Girton Interchange be fully recognised by ensuring it is integrated with any mass transit scheme taken forward to the west of Cambridge".**

This 'Letter of Community Consensus' was supported by a wide range of MPs, District Councillors, Parish Councils and Community Groups across the region to the west and north of Cambridge, and was submitted to the Secretary of State for Transport and the Secretary of State for Housing, Communities and Local Government. It was copied to the Combined Authority, GCP and Highways England amongst other stakeholders. The community

represented by the signatories comprises more than 30,000 residents. The letter is provided in Appendix Two.

### Addenbrookes to Granta Park – CSET

Cambridge Connect and Railfuture have collaborated with the Great Shelford and Stapleford Parish Councils in development of the 'Shelford Rail Alignment (SRA)' alternative to the GCP's preferred route for CSET, including working with i-Transport in their technical assessment of the alternative. The rationale for the SRA alternative is in summary:

- Follows former railway line to Haverhill;
- Avoids further severance and damage to landscape adjacent to villages of Great Shelford and Stapleford, adjacent to the important regional ecological sites of the Gog Magog Hills, Wandlebury and Magog Downs and also the important landscape and amenity values of the River Granta in this locality;
- More directly serves the community by passing through the villages, with stops in the heart of the villages. This will offer better community access, and will be safer for users of the public transport rather than isolated in the countryside as proposed by the GCP;
- Closely connected to the mainline railway with a convenient interchange at Great Shelford.

The i-Transport report (2021) commissioned by the Parish Councils concluded that the GCP CSET route was brought forward based on a number of false assumptions suggesting the SRA was not feasible. The professional transport analysis made by i-Transport concluded that the route is feasible, although it is recognised that it might be more expensive and further work would need to be undertaken to consider properly all aspects of how it would operate and be optimised.

We support the i-Transport conclusions, and further suggest that work undertaken on the reinstatement of the railway to Haverhill would help further inform choices of the best option for public transport in this region. Moreover, this could show how a reinstated heavy rail line could work in combination with light rail. In this context, we consider the GCP has given insufficient consideration to these alternatives and has not demonstrated a necessity to cut across the Green Belt with a new alignment and major bridge on the River Granta in the way that is proposed.

Transport proposals in the vicinity of, and have the potential to impact, the villages of Great Shelford and Stapelford include CSET, East-West Rail, Cambridge South Station, Haverhill line reinstatement, and increasing frequency of trains on existing mainlines to serve the growing population. A key community concern in this context is the cumulative effect of all of these developments, and there is concern that schemes are being developed in silos. The regional transport strategy needs to consider the cumulative impacts and develop adequate mitigation. For example, the level crossings in these villages are becoming increasingly impractical because of the frequency of closures. **Cambridge Connect and Railfuture have proposed grade separation of the mainline railway in Great Shelford should be brought forward, and planned and delivered as part of regional transport schemes.**

Cambridge Connect and Railfuture made formal submissions to the GCP public consultation on CSET in 2019. The Cambridge Connect submission is provided in Appendix Three.

# 25. Team – Brief bios

Cambridge Connect is established as a small company and is currently operated on a voluntary basis. Work is undertaken in collaboration with a range of individuals, companies and organisations on an informal basis. Brief biographical sketches of individuals who have played substantive roles in the development of the Cambridge Connect concepts and proposals are provided below.

### Dr Colin Harris PIEMA – Director, Cambridge Connect

Dr Colin Harris is Director of the environmental planning consultancy *Environmental Research & Assessment*, based in Cambridge. Colin was educated at the University of Otago (BA Hons, First), University of Western Ontario (MA), and University of Cambridge (PhD), specialising in environmental management and spatial planning. He has worked in this field for 25 years and is a Practitioner in the Institute of Environmental Management and Assessment. His principal professional focus is on environment, sustainability and strategic spatial planning. Colin established *Cambridge Connect Transit Ltd* in 2015 to promote an evidence-led strategy to address Cambridge transport challenges. He has collaborated with a broad group of people to develop the evidence-base for light rail in Cambridge, and design of a segregated light rail network delivery strategy. He has published and presented widely on the subject.

### Peter Wakefield – Vice-Chair, Railfuture East Anglia

Peter Wakefield was chair of Railfuture East Anglia until 2017, a role he held for over 20 years. In this role he advocated for public transport improvements, recognising the crucial link between a quality railway and sustainable economic development. For example, Peter pioneered the Railfuture campaign to restore East – West links between Cambridge and Oxford, an effort which is now close to practical delivery. Peter was closely involved in the successful campaign to establish a new station at Cambridge North, and for restoring the rail link to Wisbech. Peter has detailed knowledge of the rail industry, network and operations. Peter is interested in helping decision makers to make prudent forward-looking plans for the rail network and public transport services. Peter has played an key role on the Rail Freight Committee of Railfuture, has contributed to numerous submissions to government and consultations, and has been a spokesperson on topical issues. Peter has played the lead role in the Cambridge Connect initiative for Railfuture.

### John Howland-Jackson – CEO, Nikko Asset Management Europe

John joined Nikko AM in 2014 and was appointed CEO in 2018. John is responsible for all aspects of the business across Europe, Middle East and Africa (EMEA) and Nikko AM's continuing growth strategy. John has an extensive background in international capital markets in particular and has held senior executive positions with leading financial institutions over many years. Prior to joining Nikko, he spent almost 15 years with the Dutch ING Group as Head of its Wholesale Banking Operations in Japan, the Asia Pacific region and the UK & Middle East. Having started his career with the UK Merchant Bank Kleinwort Benson he has also worked for JP Morgan, Nomura Securities Group and the NatWest Group. John holds a BA in Jurisprudence from Oxford University and is a qualified Barrister-at-Law (Inns of Court Law School and Middle Temple 1972).

### Ian Brown CBE FCILT – Railfuture / UK Tram

In a career spanning over 40 years, Ian Brown has made an outstanding contribution to public transport and the rail industry in the UK and internationally. His extensive achievements include playing a leading role in establishing the Docklands Light Railway and the London Overground, the major extension of the East London Line, the integration of Croydon Tramlink into TfL and the expansion of Oyster 'pay as you go'. Ian retired as Managing Director of TfL's London Rail in 2011 after 10 years in the role, and was honoured with a CBE in 2011 for services to the railway industry. Ian is a Vice President of Railfuture, and is on National Board of Directors. As Director of Policy, Ian has been instrumental in determining Railfuture's policies at a strategic level and has written several of its submissions to the Department for Transport. Ian is also a Board Member of UK Tram and leads its Centre of Excellence programme.

### Peter Cushing – UK Tram

Peter Cushing was until recently Director of Manchester Metrolink, with responsibility for the day to day operation and delivery of a £1.8bn capital programme, retiring in 2017. He has extensive operating experience at board level and working with senior local and central government bodies delivering major capital programmes in the UK and overseas. Peter provided leadership in migration / transition planning, merger planning and organisation design in a variety of Light Rail Transit and Metro assignments in the UK and abroad. He has been a senior figure in other consultancy projects including operations and commercial analysis roles for DfT, and several major rail bids. Peter played a lead role in establishment of the UK Light Rail Safety Standards Board. He is presently advising Midland Metro, Edinburgh Trams and consulting internationally on light rail.

### James Hanson – Ankura

James manages the EMEA Construction Advisory team. He is a Civil Engineer with over 20 years industry experience in managing large and complex capital projects. James specialises in advising and assisting clients in project development, risk strategy, project controls and in the selection of project team and contracting organisations. James has extensive experience in the transport sector with expert knowledge of the financial, contractual and supply chain risks involved in delivery of railway projects. He has advised on major contractual, commercial and technical risks associated with capital delivery, operation and maintenance of railway projects, and advised on time and budget management. He has undertaken risk management reviews of vendor construction contracts, pre and post signature. Prior to Ankura, James was Managing Director of Navigant's Global Construction Advisory practice which was acquired by Ankura in 2018. Previously James was a Partner at PwC and worked for both its UK and Middle East Capital Project & Infrastructure practices.

### Misbah Uddin – Ankura

Misbah is a Managing Director at Ankura specialising in transport and infrastructure project and finance advisory with over 17 years of experience. He is a government advisory and PPP specialist with particular knowledge and experience of the transport sector and infrastructure finance. His global experience and expertise includes business case development and review, cost/financial modelling, benchmarking, project due diligence, and project structuring advice to procuring authorities as well as bid-side advice to investors and contractors. Notable past clients in the rail sector include the DfT, TfL, National Express, Dubai Roads & Transport Authority, RATP and various other public and private transport sector investors and operators. Prior to Ankura, Misbah worked for PwC in both its UK and

Middle East Corporate Finance and Capital Project & Infrastructure practices. Prior to that, he worked for Booz Allen Hamilton advising clients on a wide range of UK and international transport projects.

### David Moore – CMS

David Moore is a Partner in the Infrastructure & Projects Team at the law firm CMS Cameron McKenna Nabarro Olswang LLP. David read engineering at the University of Cambridge and gained professional qualifications at the Chester College of Law. David specialises in the development and operation of transport infrastructure and is a specialist in the rail sector. He has over 20 years' experience advising on the development and operation of rail infrastructure (including as a PPP), rail franchises (both bidding and during operations), rolling stock procurement (including maintenance arrangements), operational issues, rail regulation and industry arrangements. He also has extensive experience developing and operating other transport infrastructure and acts for both private sector and public sector clients in the UK and internationally. He has been recognised by the legal directories as "*a judicious and intellectually astute transport projects lawyer*".

### Paul Hollinghurst – Railfuture

Paul Hollinghurst is Secretary of Railfuture East Anglia, and has played an active role in numerous transport projects, including feasibility studies and business cases relating to reinstatement of railways to Wisbech and Haverhill. Paul has written analysis reports for Railfuture on topical issues, and has been a regular contributor to Rail East. He is a resident of Cambridge with first hand local knowledge and extensive practical experience of public transport services. Paul is an engineer for a semiconductor company working on 5G mobile phone chip technologies.

### Dr Mark Brown – Amey

Mark is Development Director of Amey's Consulting and Rail business where he leads strategic planning. He was previously Group Development Director at Halcrow. Mark is an economist with 30 years' experience in the transport sector. He has worked on a wide variety of highway, rail and development projects in over 20 countries and is widely published in project economics, rail planning and asset management. Mark is a director of the Wales and Borders Train Operating Company that is responsible for train operations throughout Wales, on behalf of Transport for Wales.

### Angela Chadwyck-Healey

Angela is Patron of the Cambridge and District *Citizens Advice Bureau* and President of the *Arthur Rank Hospice Charity*. She was a founder committee member for *Cambridge 2030*, which aims to make Cambridge a more equal city by 2030. Through this work and also involvement in community resident's associations, amongst other activities, she has developed an excellent understanding of community needs. In particular, Angela recognises the need for a rapid transport system for those that live and work in the Cambridge region to provide reliable access to work, and for meeting other needs such as health care, education and leisure. She has supported Cambridge Connect since its inception because light rail is the only proven mode of transport that has the capacity to provide the service required, especially for future generations.

# 26. Declarations of interest

### Ankura, Amey, COLAS Rail, COWI, CMS and OTB Engineering

These companies are agnostic in terms of specific transport modes and are involved in a wide range of public transit delivery schemes, including both bus and rail. They are interested in helping to deliver a successful transport scheme in the Cambridgeshire region on a commercial basis. None have vested interests in any specific transport solution for Cambridgeshire, rail-based or otherwise, and have freely offered their knowledge and expertise in order to help deliver an evidence-led solution with the best chance of success. Collaboration has been on an informal basis to date.

### Cambridge Connect

Cambridge Connect was founded on the principle of helping to design, develop and deliver the best public transport scheme for Cambridgeshire based on evidence, and is agnostic in terms of specific transport modes provided they meet quality and deliverability criteria. Evidence reviewed led to the conclusion that light rail offers the most promising technology for delivery of a successful mass transit backbone in Cambridgeshire, and this would need to integrate with all other modes. Conceptual design work has therefore focussed on light rail as the core of the mass transit scheme. Work has been undertaken on both a cost-recovery and / or voluntary basis, and in future Cambridge Connect aims to continue this work on a commercial basis.

### Railfuture and UK Tram

These non-commercial groups aim to promote and support the public interest in rail-based transit in the United Kingdom in general. They have no commercial interests in the outcome for Cambridgeshire. These groups formed natural partners in the project because they possess substantial expertise in the field.

# 27. Appendices

Appendix One: Cambridge Connect formal submission to GCP C2C Independent Audit.

Appendix Two: Letter of Community Consensus on Girton Interchange.

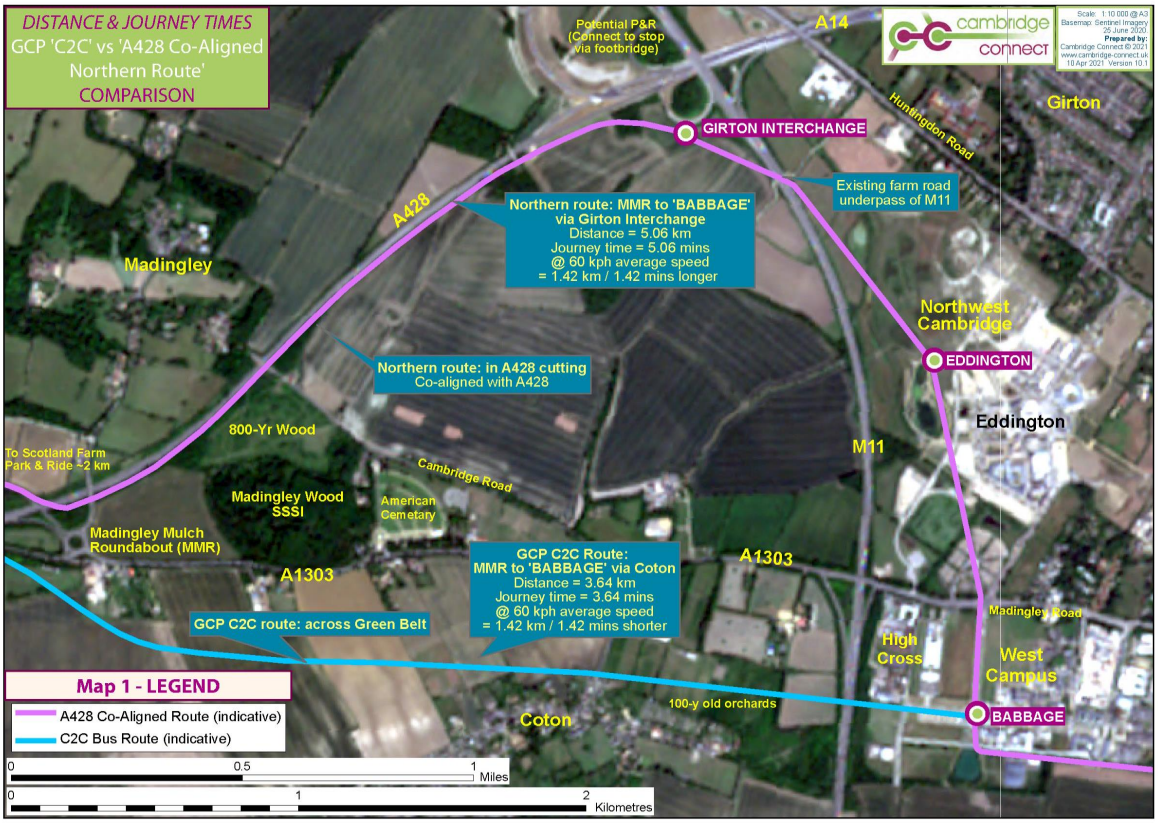
Appendix Three: Cambridge Connect formal submission to GCP CSET Public Consultation.

Appendix Four: Comparison of GCP Busways with Cambridgeshire Light Rail.

# Appendix One

## Cambridge Connect formal submission to GCP C2C Independent Audit.

# Cambourne - Cambridge Bus Road (C2C) Independent Audit




Submission prepared by Colin M. Harris

25 April 2021 (v1)

cambridge connect

# Contents

# 1 Introduction

Cambridge Connect was initiated to promote a strategic and sustainable approach to public transport in Cambridgeshire. Emphasis is placed on an integrated and multi-modal approach to meeting the transport needs for Cambridge and the surrounding region. We recognise the need to link local solutions into broader regional strategies. Cambridge Connect has coordinated with a range of individuals, companies and organisations in developing its proposals. In particular, Railfuture and UK Tram have played a prominent role in the overall development of a light rail network for the region.

This submission made to the Cambourne – Cambridge Bus Road (C2C) Independent Audit focuses on an alternative to the preferred scheme proposal by the Greater Cambridge Partnership.

The alternative proposal is co-aligned with the A428 over a critical part of the route, and would avoid severance of, and landtake within, the Green Belt in this area (Figure 1).

# 2 Summary conclusions

In summary, Cambridge Connect:

1 Supports development of a new public transport route to the west of Cambridge following a fully segregated alignment immediately adjacent to, and co-aligned with, the A428 highway in the section between Madingley Mulch Roundabout and the Girton Interchange.

2 Does not accept the assumption by the GCP that an alternative fully segregated public transport route aligned to avoid severance of, and impacts on, the Green Belt is not possible, in particular because this conclusion is not supported by thorough and adequate evidence.

3 Does not support the route preferred by the GCP because of unacceptably high and unnecessary impacts on the Green Belt and on the highly valued rural landscape which lies in close proximity to Coton and Cambridge in general, which have not been sufficiently taken into account.

4 Does not support the current proposals of the GCP for the large Park & Ride at Scotland Farm, the size of which is likely to encourage and support travel by private cars to that point. Rather investment should instead consider any additional P&R, if deemed necessary, with emerging plans for both East-West Rail (EWR) and the CAM 'metro' public transport network.

5 The COVID-19 pandemic has demonstrated that current approaches to public transport delivery do not have sufficient resilience to operate effectively in the face of such shocks. The current bus road proposals are based on old approaches from the last century, and do not have sufficient resilience to cope with similar potential scenarios in the future. At a minimum, the C2C scheme should be paused to allow detailed consideration to changes that are necessary to build in greater resilience to our public transport systems, especially those for access to critical services such as healthcare and research centres.

6 Supports the submission made by the Coton Parish Council, which includes the independent technical report prepared by specialist transport consultancy i-Transport which forms an integral part of the submission by Coton Parish Council.

7 A series of maps and figures illustrating the A428 co-aligned alternative to the C2C preferred alignment is provided with this submission.

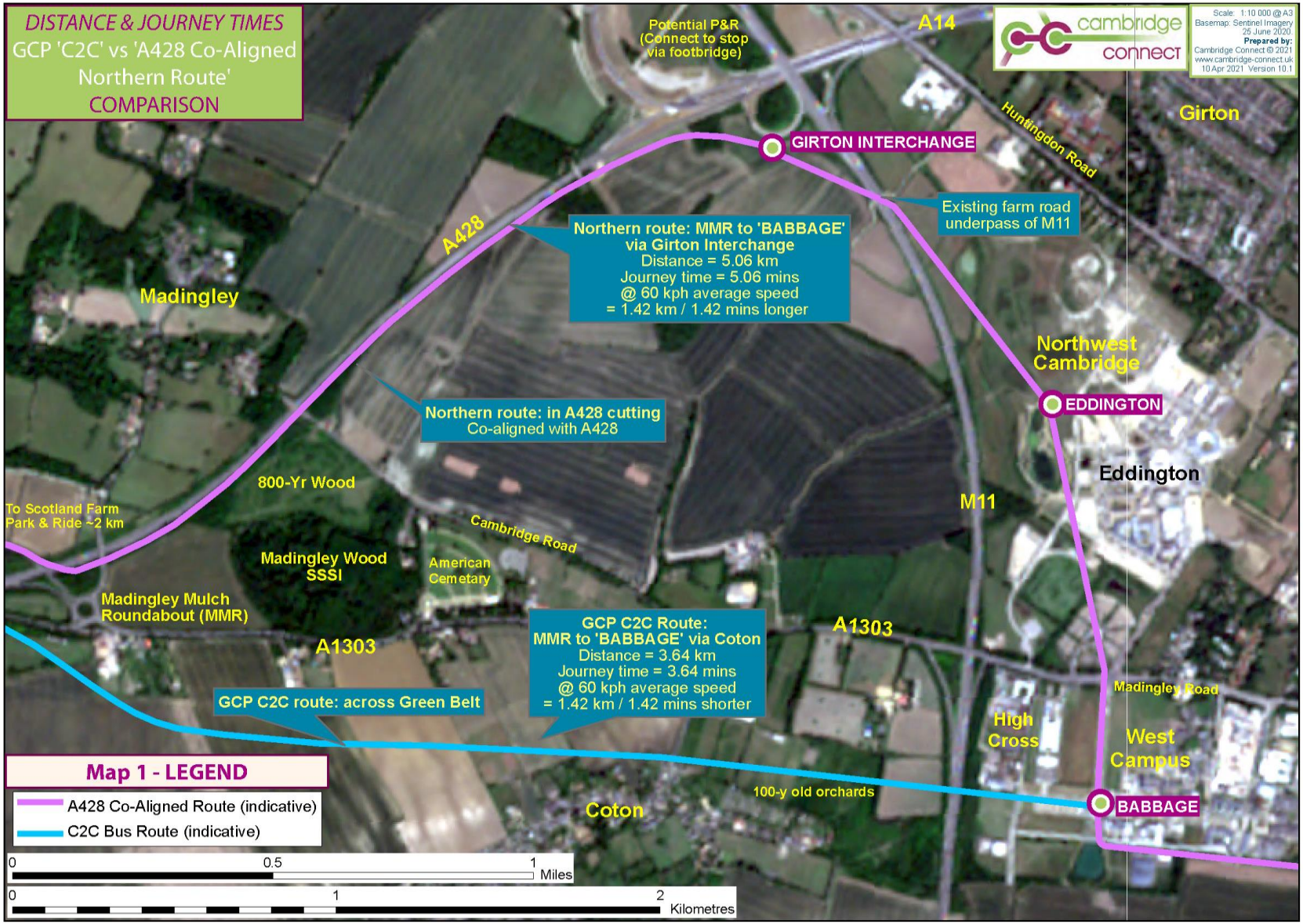



**Figure 1**. A428 alternative C2C alignment – co-aligned with the A428 in section from Madingley Mulch to West Campus overview.

# 3 Long-term transport planning

Cambridge Connect considers that infrastructure development needs to be fit-for-purpose for the region with a planning horizon into the 2030s and beyond. The key drivers of economy, population, demand, education, science & technology environment & heritage, and social & cultural values all need to be taken into account with a long-term view, and these need to be balanced against the cost and investment needed for future generations.

It is important that communities are tightly integrated into future public transport provision, and this is vital to ensure the best possible up-take of the services, and to provide excellent connections for residents.

Before progressing new busways or bus roads, a detailed plan for delivery of the long-term strategy for Cambridgeshire public transport needs to be set out and adopted. Local solutions should then be designed so they integrate seamlessly into the overall strategic plan, both in terms of technologies used for the 'metro' and also the routes. This strategy should be at an advanced stage of development when implementing local solutions, even if this would mean a short-term delay in delivery of some local improvements. This approach would avoid waste and bring cost-savings over the medium-term.

# 4 Implications of the pandemic

The implications of the current COVID-19 pandemic for public transport are major and cannot be ignored. The pandemic has demonstrated that we need to design our public transport systems to be more resilient to shocks. The science tells us that COVID-19 is unlikely to be the last pandemic we face. It is clear that current approaches and systems have been inadequately designed and prepared for such challenges.

The authorities should carefully consider the implications for bus-based solutions which are inherently based on existing models, which have been shown to lack the capacity and technologies to enable more resilience in public transport. While light rail is by no means a panacea, it does have the substantial advantage of much greater capacity than buses, and in this it has the potential to be much more flexible and resilient to future shocks.

Before rushing to deliver a bus road solution – with major damage to the local landscape – the authorities should carefully consider how improved resilience can be built into our public transport systems. This is particularly the case in C2C which should play a vital role in servicing communities and education facilities, as well as the City Centre, to which key workers need continued access during pandemics.

# 5 Sustainability

Around one third of energy consumption is used on transport (MacKay, 2009: *Sustainability without the hot air*: p.118). The evidence shows that rail remains the most energy-efficient means of public transport available, being at least twice as efficient as buses and up to 18 times more efficient than cars. Improving the energy efficiency of our transport systems must be a key consideration in our choice of transport solutions. This approach is consistent with commitments made at the 2015 Paris Summit on Climate Change, and with the more recent declarations by the UK Government of the 'Climate Emergency' and in specific carbon reduction targets, in particular with respect to the need to adopt more sustainable approaches to city planning and transport. Light rail has been demonstrated to drive higher levels of modal shift than buses. These important conclusions have been emphasised at recent Climate summits.

Light rail also performs much better than other public transport on pollutant emissions. Fine particulate pollution is released by rubber-tyred vehicles, and these pollutants enter the atmosphere, terrestrial and water systems. These emissions have been shown to account for as much particulate pollution as released by vehicle tail-pipes, so even if the proposed buses were electric a substantial air pollution problem remains. Rubber tyres are largely made from synthetic plastics, which take a very

long time to degrade. The microplastics from wear enter into aquatic and terrestrial systems, and are taken up by organisms. In addition, large numbers of waste tyres are produced, and for a high frequency metro operation this could lead to many hundreds or thousands of waste tyres per year. The C2C proposals do not address these aspects of sustainability adequately.

Light rail is more sustainable for metro operation than buses because it consumes substantially less power than rubber-tyred buses, owing to the low rolling resistance of steel wheels on rails (~ one tenth of rubber tyres on road). Light rail lines may also offer benefits through more sustainable water drainage systems than the extensive tarmac / concrete needed for bus roads.

These considerations, in particular with respect to the selection of mode for transport delivery (ie bus or light rail) need to be reviewed and taken into more consideration in the development of the C2C scheme.

# 6 Alternative to the alignment proposed by GCP

6.1.1 **Cambridge Connect strongly opposes the alignment proposed by the Greater Cambridge Partnership for C2C**.

6.1.2 The Girton interchange is one of the most important strategic junctions in the region, being as it is at the crossroads of nationally and regionally important highways of the M11, A14, A428 and A1307 (Huntingdon Road). However, the GCP has specifically excluded this from detailed consideration for reasons which do not hold up to scrutiny. The assessments that have been made to date have been based on poor and superficial evidence.

6.1.3 Maps 1-5 and two figures presented below outline how the alternative alignment along the A428 highway (suggested by Cambridge Connect) could be configured.

6.1.4 From Madingley Mulch Roundabout the alignment could proceed on either side of the A428 to the Girton Interchange, although maps presented here illustrate only the option for the alignment on the south / southeast side of the A428. An alignment on the north side would also seem feasible, although would need investigation of options for crossing to the south (and hence to the West Campus) at some point either at or before the Girton Interchange.

6.1.5 The alignment presented to the south / southeast of the A428 highway would proceed immediately alongside the A428 highway (co-aligned to the side of the highway with appropriate barrier separation), follow under existing bridges over the A428, then from the Girton Interchange proceed under the M11 using an underpass (in the area where the M11 is already elevated and an underpass currently exists), thence south via the general vicinity Eddington and the Madingley Park & Ride to the West Campus. This proposal is necessarily indicative at this stage, although it has been confirmed that the proposal is viable at a high level of consideration and as such warrants detailed investigation as a realistic alternative before the C2C scheme alignment should be further progressed.

6.1.6 Inadequate evaluation has been made of this alternative, and others, which seems to have occurred because the C2C scheme has been based on a number of false assumptions. Most important amongst those has been the assumption that the Girton Interchange option should not be considered as a potential route because it would take too long to deliver and is more complex and costly. This assumption fails to consider that the route could be delivered via the Girton Interchange area without necessarily altering the Girton Interchange itself.

6.1.7 Alterations to the Girton Interchange involve changes to the road network, while the alignment presented in this alternative is separate and fully segregated from the road network and is not dependent on alterations to the Girton Interchange itself.

6.1.8 Even without alterations to the interchange itself, the alternative offers substantial benefits by co-alignment with major existing transport routes and also by avoiding sensitive Green Belt and heritage resources, while still serving the communities and scheme objectives. The alternative therefore represents a realistic alignment that could be brought forward irrespective of whether or not Highways England make alterations to the interchange itself.

6.1.9 Thus, a connection into, and integration with, the Girton Interchange is a not a necessary part of such an alignment. However, if adopted, that option would be available when and if this is considered desirable and affordable in the future. An alignment via the general location of the Girton Interchange, without alterations to it, enables it to be future-proofed for future developments by ensuring that the C2C route proceeds via the immediate vicinity of what is arguably the most important strategic junction in the region.

6.1.10 The assumption has also been made that the route via the Girton Interchange would represent a diversion that would compromise the attractiveness of the public transport route between Cambourne and Cambridge because of the extra distance. However, we have shown that the alternative route would add only approximately 1 ½ minutes to journey times on a segregated route compared to the preferred C2C route. When considered against the range of major benefits of the alternative alignment, this small journey time penalty is acceptable.

6.1.11 The alternative route would directly support the community of Eddington. Moreover, the route would open up opportunities for onward connections to communities such as Bar Hill and Northstowe in the future.

6.1.12 The C2C route makes an unnecessary incursion into Green Belt and development of major infrastructure for a busy transport route across relatively tranquil and unspoiled rural landscapes of high aesthetic value. It will impact local ecology and recreational uses, as well as commercial farms. It will create additional severance of the Madingley Hill and Bin Brook valley from local communities. These values have not been given sufficient consideration in the decision to pursue this route. The GCP preferred C2C route requires major new land-take from the Green Belt. There is insufficient justification for this because a feasible route via the A428 / M11 exists utilising existing transport corridors.

6.1.13 The GCP route runs counter to policies that seek to minimise the impact of infrastructure and development on Green Belt land, and against policies that seek to protect landscapes of high value. The landscape affected is immediately adjacent to one of the very few elevated sites in the Cambridge region, namely Madingley Hill. This site is already compromised by the A1303 highway, and a further major public transport route across this landscape will further degrade and despoil the remaining high landscape values.

6.1.14 The focus of this submission has been on the section of alternative between Madingley Mulch Roundabout and the West Campus because this section represents a major strategic failing in the C2C scheme. There are also significant failings in Hardwick and the City Centre.

6.1.15 Cambridge Connect has wider proposals for an integrated scheme across the Cambridge region using light rail, including for a short tunnel (2.6 km) extending from near the West Campus through the city centre to the Cambridge Rail Station. Details of these proposals can be accessed on the Cambridge Connect website (www.cambridge-connect.uk). These wider proposals address deficiencies in the C2C scheme within the Cambridge city centre, where a coherent plan for practical public transport that is transformative of journeys is largely missing from the GCP C2C scheme. The existing plans for how C2C would work within the City Centre are inadequate and fail to show how the scheme would be delivered in an integrated and coherent manner without significant impacts on city residents and businesses.

## *6.2 Opportunities for long-term gains – developing an integrated approach to improvements in rail and public transport in Cambridge*

6.2.1 Future developments of the heavy rail network need to be taken into consideration. For example, developments such as Cambridge South Station, East-West Rail (EWR), and service improvements more generally will influence activity and services on the main rail lines.

6.2.2 C2C should not be progressed without detailed planning for integration with CAM.

6.2.3 C2C should not be progressed without detailed planning for integration with EWR.

# 7 Park & Ride proposal by GCP

7.1.1 Cambridge Connect opposes the proposed Park & Ride at Scotland Farm, and considers it in the wrong location. Cambridge Connect supports some form of new Park & Ride in the general vicinity of Cambourne.

7.1.2 However, as a general principle, it is important that the location selected and size is appropriate and can be practically integrated with future development of the CAM and EWR.

FOLLOWING BELOW: SUPPORTING MAPS AND FIGURES

# DISTANCE & JOURNEY TIMES
## GCP 'C2C' vs 'A428 Co-Aligned Northern Route' COMPARISON

Scale: 1:10 000 @ A3
Basemap: Sentinel Imagery 25 June 2020.
**Prepared by:**
Cambridge Connect © 2021
www.cambridge-connect.uk
10 Apr 2021 Version 10.1

Potential P&R (Connect to stop via footbridge)

A14

Girton

Huntingdon Road

GIRTON INTERCHANGE

Existing farm road underpass of M11

A428

**Northern route: MMR to 'BABBAGE' via Girton Interchange**
Distance = 5.06 km
Journey time = 5.06 mins
@ 60 kph average speed
= 1.42 km / 1.42 mins longer

Madingley

Northwest Cambridge

EDDINGTON

**Northern route: in A428 cutting**
Co-aligned with A428

Eddington

800-Yr Wood

M11

To Scotland Farm Park & Ride ~2 km

Cambridge Road

Madingley Wood SSSI

American Cemetary

Madingley Mulch Roundabout (MMR)

A1303

**GCP C2C Route: MMR to 'BABBAGE' via Coton**
Distance = 3.64 km
Journey time = 3.64 mins
@ 60 kph average speed
= 1.42 km / 1.42 mins shorter

A1303

**GCP C2C route: across Green Belt**

Madingley Road

High Cross

West Campus

100-y old orchards

Coton

BABBAGE

### Map 1 - LEGEND

- A428 Co-Aligned Route (indicative)
- C2C Bus Route (indicative)

0 0.5 1 Miles

0 1 2 Kilometres

# C2C INDICATIVE ALTERNATIVE ALIGNMENT

Northern Route to Girton Interchange Co-Aligned with A428

Alignment at Madingley Mulch Roundabout

Scale: 1:1000 @ A3
Basemap: ArcGIS Imagery
**Prepared by:**
Cambridge Connect © 2021
www.cambridge-connect.uk
10 Apr 2021 Version 10.1

To Madingley 1km

To Girton Interchange 2.5km

To Scotland Farm Park & Ride ~2 km

New bridge over A428 for public transport

A428 in cutting

A428

8m

Bridge starts here (approx)

Alignment passes under Bridge

Co-aligned with A428 Width = 8 m

A428 Offramp & bridge

A428 Westbound slip road

Church Lane to Madingley

**A428 Co-Alignment Positives**

+ Follows existing major transport alignment
+ Follows A428 cutting to reduce noise
+ Car traffic reduced = noise reduced
+ Protects important landscapes
+ Avoids fragmentation of Green Belt
+ Minimises environmental impacts
+ Avoids American Cemetary
+ Avoids Madingley Wood SSSI
+ Avoids Eight Hundred Wood
+ Fully segregated, practical & deliverable

**Madingley Mulch Roundabout (MMR)**

A1303 St Neots Road to Hardwick

To Hardwick 2km

A1303 Madingley Rise

To Cambridge 5.6km

**Map 2 - LEGEND**

Proposed Alternative Alignment (width 8 m)

0 50 100 Metres

cambridge connect

# C2C INDICATIVE ALTERNATIVE ALIGNMENT

Northern Route to Girton Interchange Co-Aligned with A428

A428 cutting at Madingley

**A428 Co-Alignment Positives**

+ Follows existing major transport alignment
+ In A428 cutting to reduce noise
+ Car traffic reduced = noise reduced on A428
+ Protects important landscapes
+ Avoids American Cemetary
+ Avoids Madingley Wood SSSI
+ Avoids Eight Hundred Wood
+ Avoids Green Belt fragmentation

Scale: 1:1000 @ A3
Basemap: ArcGIS Imagery
**Prepared by:**
Cambridge Connect © 2021
www.cambridge-connect.uk
01 Mar 2021 Version 10.0

Madingley

Potential Madingley stop if alignment on N side of A428 (optional)

A428

8m

Indicative upper level of cutting slope (~8 m (25 ft) vertically above A428)

Potential Madingley stop (optional)

Bridge buttress here (approx)

Co-aligned with A428 Width = 8 m

Alignment passes under Bridge

Cambridge Road

Trinity Cottages

Alignment in cutting with retaining wall

No landtake from Eight Hundred Wood

Eight Hundred Wood

## Map 3 - LEGEND

Proposed Alternative Alignment (width 8 m)

0 50 100 Metres

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# C2C INDICATIVE ALTERNATIVE ALIGNMENT

Northern Route to Girton Interchange Co-Aligned with A428

Option - Co-Aligned Southeast side of A428

**A428 Co-Alignment Positives**

+ Strategic location future-proofed for onward links
+ Follows existing major transport alignments
+ Avoids fragmentation of Green Belt
+ Minimises environmental impacts - reduces road traffic
+ Avoids American Cemetary (Grade I Listed)
+ Supports Eddington / West Campus
++ Fully segregated, practical & deliverable

Scale: 1:5000 @ A3
Basemap: ArcGIS Imagery
**Prepared by:**
Cambridge Connect © 2021
www.cambridge-connect.uk
01 Mar 2021 Version 10.0

To Dry Drayton 3km
Bar Hill 4 km

A1307

A14 westbound causeway

M11

A14 offramp to Huntingdon Road

A14 Eastbound link

Girton

A14

To Science Park 4km

Potential P&R & Coach Station

Pedestrian overbridge from P&R / Coach Stn to Metro stop

Potential Offramp from A428 eastbound to P&R / Coach Station via underpass of A14 westbound causeway

GIRTON INTERCHANGE

Huntingdon Road

M11

A428

C2C Northern route via Girton Interchange
(1 min 45 sec longer)

Expand existing M11 Underpass

Parallels M11

To Eddington 0.75km
West Campus 2km
Cambridge 4km

## Map 4 - LEGEND

Proposed Alternative Alignment (width 8 m)

0 50 100 200 300 400 500 Metres

cambridge connect

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

# C2C INDICATIVE ALTERNATIVE ALIGNMENT

Route Co-Aligned with A428 via Eddington

West Campus layout - key constraints

Scale: 1:5000 @ A3
Basemap: ArcGIS Imagery
**Prepared by:**
Cambridge Connect © 2021
www.cambridge-connect.uk
01 Mar 2021 Version 10.0

Eddington

Madingley Park & Ride

A1303

J13

Public Transport Route Junction Option B

Public Transport Route Junction Option A

Madingley Road

M11

Ancient orchards

Public Transport Route GCP Option w M11 bridge

West Campus

Wilberforce Road

To City

## Map 5 - LEGEND

Proposed Alternative Alignment (width 8 m)

0 50 100 200 300 400 500 Metres

cambridge connect

**Indicative schematic of cutting on A428 at Madingley** - view west. Typical cross section. Dimensions in metres (approx).

## PRESENT SITUATION

Trinity Cottages

~60 m to bridge




## WITH PUBLIC TRANSPORT LANES CO-ALIGNED WITH A428

Trinity Cottages

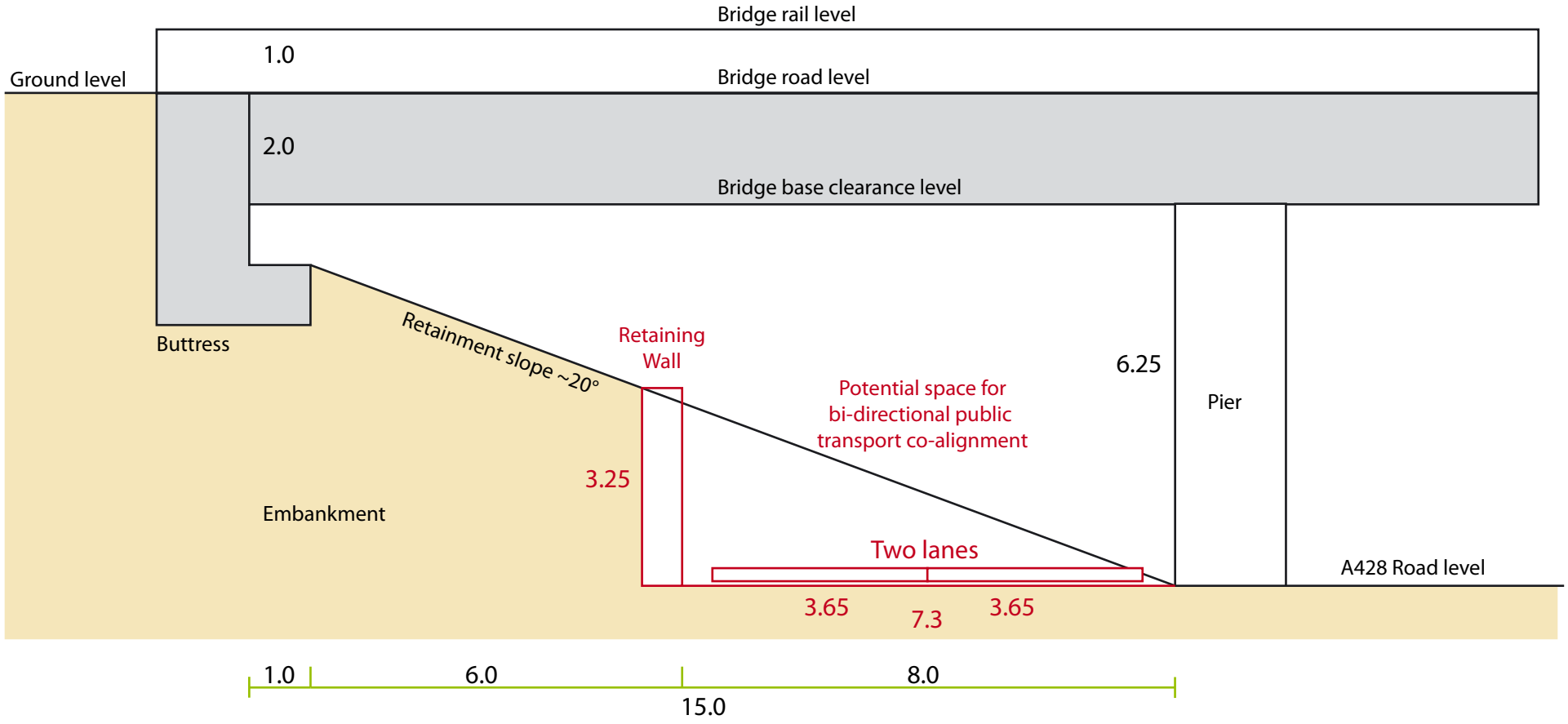
~60 m to bridge




APPROX SCALE


METRES

**Schematic of bridges on A428** - south side, view west. Typical cross section. Dimensions in metres (approx).




Madingley dimensions - 15.0 m from pier to buttress edge, 6.25 m height from A428 road level to clearance under bridge.

Church Road dimensions - 16.0 m from pier to buttress edge, 8.0 m height from A428 road level to clearance under bridge.

A428 MMR Offramp dimensions - 15.0 m from pier to buttress edge, 5.0 m height from A428 road level to clearance under bridge.

## **Appendix Two**: Letter of Community Consensus on Girton Interchange (dated 2019).

**LETTER OF COMMUNITY CONSENSUS**
**FROM CAMBRIDGE PARISH COUNCILS, DISTRICT COUNCILLORS AND COMMUNITY GROUPS**

01 May 2019

**The Rt. Hon. Chris Grayling MP**
**Secretary of State for Transport**

cc: The Rt. Hon. **James Brokenshire** MP, Secretary of State for Housing, Communities and Local Government

Heidi Allen MP for South Cambridgeshire
Daniel Zeichner MP for Cambridge
Lucy Fraser MP for East Cambridgeshire
James Palmer, Mayor, Cambridgeshire & Peterborough Combined Authority
Councillor Bridget Smith, Leader of South Cambridgeshire District Council
Councillor Lewis Herbert, Leader of Cambridge City Council
Rachel Stopard, CEO Greater Cambridge Partnership
Jim O'Sullivan, CEO Highways England

Dear Secretary of State,

**Open Letter of Community Consensus on the need for all-ways connectivity at the Girton Interchange serving the M11, A428, A14 and A1307 at Cambridge.**

The Girton Interchange is a key strategic junction on the Cambridge regional road network, connecting the M11, A14, A428 and A1307. The junction is severely hampered by a lack of all-ways connectivity. Enabling full connectivity will provide faster and more efficient connections on the road network, help to alleviate some of the long-standing congestion problems in the region and facilitate regional transport links to support economic growth. Moreover, it will improve connections between new housing developments west of Cambridge, the M11 motorway and the rapidly growing biotechnology cluster south of Cambridge city. Longer-term, the junction is vital to proposed improvements to east-west links.

**Purpose of this letter**

We are a group of Parish Councils and South Cambridgeshire District Councillors, representing over 30,000 people living in communities in and near Cambridge, and selected community interest groups. We note the letter from the Greater Cambridge Partnership (GCP) to Highways England (19 Oct 2017) regarding the urgent need for all-ways connectivity at the Girton Interchange; we welcome the consensus among local governments, the Combined Authority for Cambridgeshire and Peterborough, the GCP, MPs and business groups to progress this scheme; and we warmly welcome the positive indications from Highways England for delivery in due course.

We are concerned, however, that Highways England has not yet committed to include the Girton Interchange in the Road Investment Strategy (RIS-2) work period between 2020 and 2030, and that no clear plan has yet been articulated.

We write to express, in the strongest terms possible, our support for this development, which is long overdue, and to request that it be given urgent priority.

**Requests for urgent action**

1. **We request that work on improvements to the Girton Interchange to enable all-ways connectivity be accelerated and given urgent priority as part of the strategic transport improvements needed in this region.**
2. **We request that the strategic importance of the Girton Interchange be fully recognised by ensuring it is integrated with any mass transit scheme taken forward to the west of Cambridge.**
3. **We request that improvements help to reduce, and not exacerbate, the already detrimental impacts of traffic on the local road network and on the immediately surrounding communities.**
4. **We request that present proposals to constrict the capacity of the A428 eastbound where it joins the A14 at the Girton Interchange, from the present two lanes down to one lane, be reconsidered in anticipation of future needs.**
5. **We request that, where practicable, this work be integrated with on-going work on the A14 to make the most cost-effective use of resources and supporting works already mobilised.**
6. **We request that funding be made available and that all stakeholders work together to give their full commitment, with the aim of delivering these improvements by 2023 at the latest.**

The letter from the GCP and MPs and the response from Highways England are encouraging, and we are pleased that support is broad and analysis is underway. However, we note that these improvements have been called for by the community for more than twenty years, with little action to date. Much as we welcome the ongoing work of Highways England, there is currently no commitment to a timetable for completion of the improvements at the Girton Interchange. We believe the time for clear, unambiguous action has arrived, and a plan and timetable for delivery of this essential infrastructure is urgently needed.

In summary, all-ways interconnections at this critical junction are in the local, regional and wider national strategic interest and are in need of urgent action by all relevant parties.

If it would be helpful, we would be pleased to meet you or your officials to provide more information on the views of the community on the scheme.

We look forward to hearing from you.

**Coalition of Parish Councils**

**Steve Jones**
**Chair**

***Cambridge Connect***

**Dr Colin Harris**
**Director**

## Parish Councils, District Councillors and Community groups expressing support for this letter

**The Coalition of Parish Councils** comprising Arrington, Barton, Bourn, Boxworth, Caldecote, Caxton, Comberton, Connington, Coton, Croxton, Dry Drayton, Elsworth, Eltisley, Eversden, Grantchester, Hardwick, Knapwell, Longstowe, Madingley, and Toft parish councils.

Girton Parish Council and South Trumpington Parish Council, which are not members of the Coalition, also have endorsed the letter. Cambourne Town Council has also long-expressed support for all-ways connectivity at the Girton Interchange.

**South Cambridgeshire District Councillors**:

- Cllr Ian Sollom (Harston & Comberton) (the Parishes of Barton, Comberton, Coton, Grantchester, Harlton, Harston, Haslingfield, Hauxton and South Trumpington)
- Cllr Philip Allen (Harston & Comberton)
- Cllr Tony Mason (Harston & Comberton)
- Cllr Grenville Chamberlain (Hardwick) (the Parishes of Hardwick and Toft)
- Cllr Tumi Hawkins (Caldecote) (the Parishes of Bourn, Caldecote, Childerley, Kingston, Little Gransden and Longstowe)
- Cllr Tom Bygott (Girton) (the Parishes of Dry Drayton, Girton and Madingley)
- Cllr Dr Shrobona Bhattacharya – Cambourne
- Cllr Ruth Betson – Cambourne

**Selected Community interest groups**:

- Cambridge Ahead
- Cambridge Connect
- Cambridge Past, Present & Future
- Federation of Cambridge Residents Associations (FeCRA)
- Smarter Cambridge Transport

## Background

On 19 October 2017 an open letter was written from the Greater Cambridge Partnership to Jim O'Sullivan, Chief Executive of Highways England regarding the Roads Investment Strategy 2 (RIS2) – M11 in Cambridgeshire. This letter noted a clear consensus within our region for the improvements to the Girton Interchange, as indicated by the broad representation in the letter of local government, the academic and business communities, and Members of Parliament for Cambridge City and South Cambridgeshire.

Martin Fellows, Regional Director of Operations (East) Highways England, responded on 17 Nov 2017 that the agency is assessing the strategic road network (SRN), including pressures on the M11 and the case for improvements at Girton Interchange, which will feed into RIS2. Following consultation, the Investment Plan for RIS2 will continue to be developed over 2018. In due course the Secretary of State for Transport will decide on priorities for RIS2, to be published in 2019.

The Girton Interchange is a key strategic junction on the regional road network, which is severely hampered by a lack of all-ways connectivity. Enabling connectivity will provide faster and more efficient connections on the road network, help to alleviate some of the long-standing congestion problems in

the region, facilitate regional transport links and support economic growth. Moreover, it will improve connections between areas west of Cambridge, such as Cambourne, and the M11 motorway, and support the increasing population. Longer-term, the junction is vital to proposed improvements in East-West links between Cambridge, Milton Keynes and Oxford, as recommended by the National Infrastructure Commission.

We recognise that some villages lying in close proximity to the Girton Interchange are already significantly affected by noise and air pollution from the current road system. It is important therefore that improvements should help to reduce, and do not exacerbate, any impacts on local communities.

**Coalition of Parish Councils**

The Coalition of Parish Councils to the West of Cambridge was formed to provide a coordinated voice on planning issues.

**Cambridge Connect**

Cambridge Connect was formed in 2016 to promote enduring and sustainable transport for Cambridge, in particular a light rail metro with an underground in the historic city core. The Girton Interchange is considered a key node on the network, where the metro would link with important strategic highways. Cambridge Connect works closely with Railfuture, UK Tram and Rail Haverhill, amongst others.

More information on Cambridge Connect is available at www.cambridge-connect.uk

## Address for Correspondence

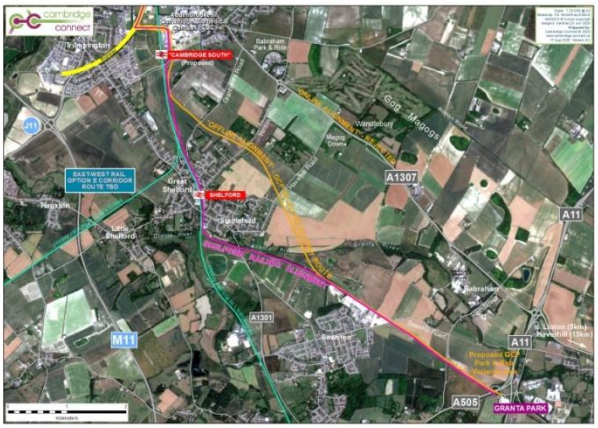
Dr Colin Harris
Director
Cambridge Connect
12 Silverdale Avenue
Coton, Cambridge CB23 7PP

Email: colin.harris@cambridge-connect.uk
Tel: 01954 212 847

# Appendix Three

## Cambridge Connect formal submission to GCP CSET Public Consultation.

# Cambridge Southeast Transport (CSET)
# Greater Cambridge Partnership
# Public Consultation




Prepared by Colin M. Harris
14 December 2020 (v1)

cambridge connect

# Contents

# 1 Introduction

Cambridge Connect was initiated to promote a strategic and sustainable approach to public transport in Cambridgeshire. Emphasis is placed on an integrated and multi-modal approach to meeting the transport needs for Cambridge and the surrounding region. We recognise the need to link local solutions into broader regional strategies.

Within the immediate Cambridge region, we have proposed a light rail line from the Girton Interchange in the northwest to Granta Park in the southeast, via the University West Campus, city centre, Cambridge Central Rail Station, Addenbrookes, Great Shelford, Stapleford and Sawston. The line would extend ~22 km (~14 mi) and we call this route the 'Isaac Newton Line' (Figure 1) (Harris *et al*. 2019). The light rail line would follow existing and former rail alignments, run underground within the historic city core, and follow the busway alignment between Cambridge Central Rail Station and Addenbrookes. Extensions to the 'Isaac Newton Line' light rail backbone are possible in due course, for example to Haverhill and Cambourne.

This approach would provide a transformational long-term solution for Cambridge that is both scalable in terms of capacity and extendible to key destinations as demand and finances allow. Cambridge Connect is coordinating with Railfuture and UK Tram in developing these proposals and engaging with local organisations (e.g. CPPF, local parishes and Rail Haverhill) and residents.

Cambridge Connect understands that the Greater Cambridge Partnership has presently excluded light rail from consideration. However, we believe this decision should be reconsidered and light rail should form part of the strategic long-term approach to meeting transport needs in Cambridgeshire.

Reconsideration of light rail is needed because it is clear from Steer (2019) that the **costs for the Cambridgeshire Autonomous Metro (CAM) will be comparable to Cambridge Light Rail**. The original conclusion that CAM could be delivered for one-third of the cost of light rail has been shown to be wrong (Steer 2019). The business case for CAM was 'compelling' and would be stronger with light rail, which is able to deliver greater modal shift than buses. It is therefore **essential that the strategy for metro delivery in Cambridgeshire is thoroughly reviewed to include light rail**.

Notwithstanding the above views regarding light rail, we recognise the Greater Cambridge Partnership (GCP) has presently committed itself to bus-based solutions. In the context of this response to the public consultation therefore, our focus is on the selection of route rather than the mode of vehicle that would travel on that route. We have therefore made our evaluation of proposals for a fully segregated **bus road** following the Shelford Rail Alignment (Figure 2), not light rail.

Our evaluation is informed in part by detailed evidence developed by an independent evaluation of the option of a public transport route from Granta Park to Addenbrookes that broadly follows the Shelford Rail Alignment (Figure 2). This evaluation was commissioned by the Parish Councils of Great Shelford and Stapleford in 2020 and undertaken by the professional transport specialist consultants i-Transport, London. Specifically, this professional review critically examined evidence underpinning the report to the GCP prepared by Mott MacDonald published in May 2020.

# 2 Summary conclusions

In summary, Cambridge Connect:

1 Supports development of a new public transport route in the Southeast following the alignment of the existing and former rail lines via Great Shelford / Stapleford. **A fully segregated public transport route along the entire Shelford Railway Alignment, including through the villages adjacent to the existing rail line, has been shown to be feasible by independent specialist transport consultants**.

2 Does not accept the conclusion by the GCP (as advised by Mott MacDonald in May 2020) that a new public transport route (whether light rail or busway) aligned with the existing and former rail line through Great Shelford / Stapleford is not feasible because the conclusion is not supported by thorough and adequate evidence.

3 Does not support the route proposed by the GCP because of unacceptably high and unnecessary impacts on the Green Belt and on the highly valued rural landscape which lies in close proximity to Gog Magog Hills and Magog Down, which have not been sufficiently taken into account.

4 Does not support the current proposals of the GCP for the large Park & Ride on the A11, the size of which is likely to encourage and support travel by private vehicles. The old approach of large Park & Rides is out-moded, and the focus and investment should instead be made in delivering a first class public transport network with a more distributed model of access nodes.

5 Supports some form of Park & Ride at Granta Park, although of more modest scale and the location should support delivery of a new public transport route to Haverhill, which will strongly influence demand for Park & Ride at this location. The location selected does not appear best suited to supporting a practical segregated public transport route to Haverhill. Delivery of the link to Haverhill should be accelerated, and should be planned in an integrated way with any Park & Ride proposals. We propose the route to Haverhill should follow the broad alignment of the former railway and be implemented using light rail.

6 The COVID-19 pandemic has demonstrated that current approaches to public transport delivery do not have sufficient resilience to operate effectively in the face of such shocks. The current bus road proposals are based on old approaches from the last century, and do not have sufficient resilience to cope with similar potential scenarios in the future. At a minimum, the CSET scheme should be paused to allow detailed consideration to changes that are necessary to build in greater resilience to our public transport systems, especially those for access to critical services such as healthcare and research centres. For example, light rail has the potential to offer greater resilience through its superior passenger capacity, potentially allowing services to operate with higher social distancing in place and better margins of safety. While we do not see light rail as a panacea, it is concerning that the GCP seems to be pressing ahead as though nothing has changed.

7 Supports submissions made by Cambridge Past Present & Future, the Parishes of Great Shelford and Stapleford, Magog Down Trust, Railfuture, and Smarter Cambridge Transport related to CSET.

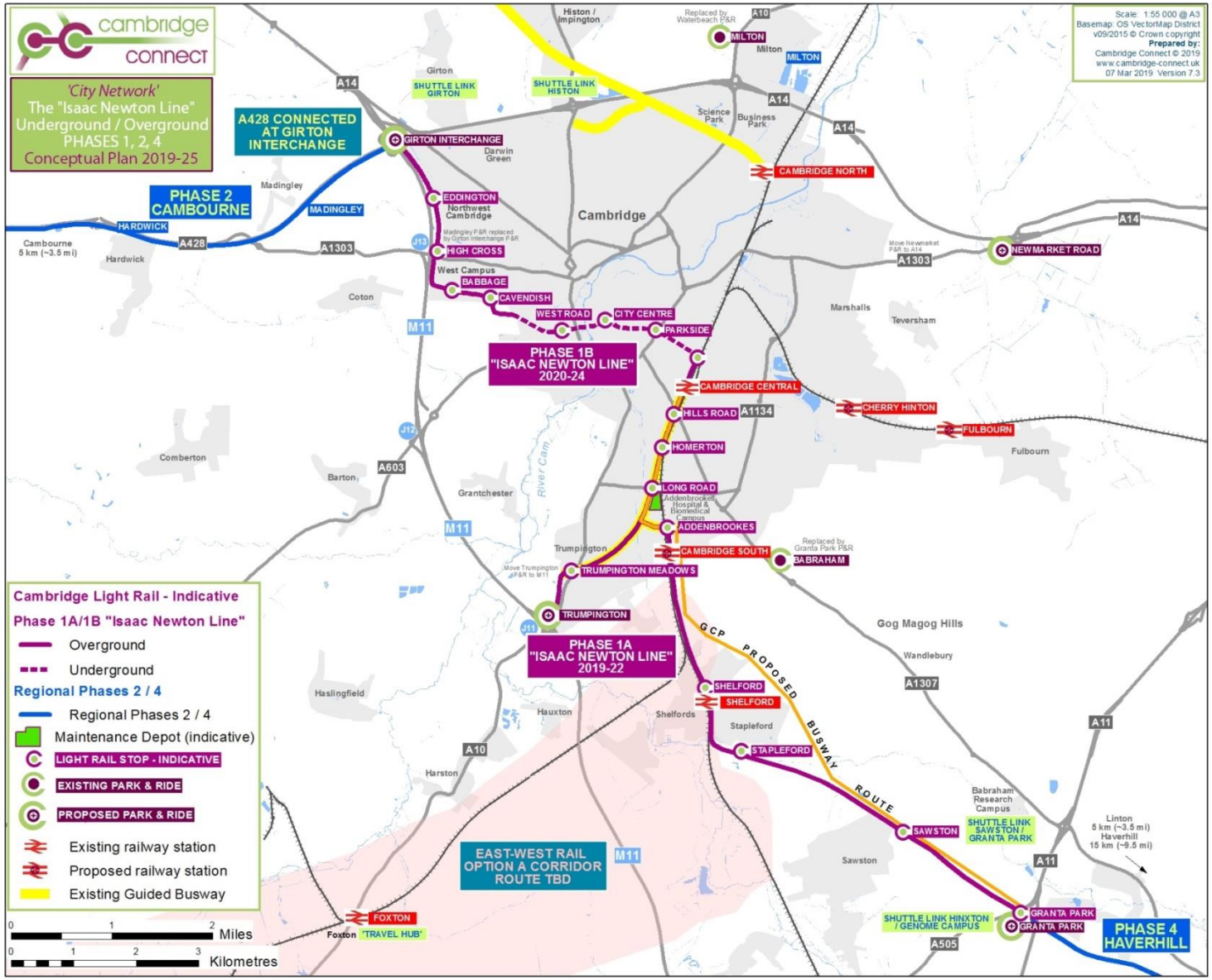



**Figure 1**. The Cambridge Connect 'Isaac Newton Line' and the proposed GCP Cambridge Southeast Busway (CSET).

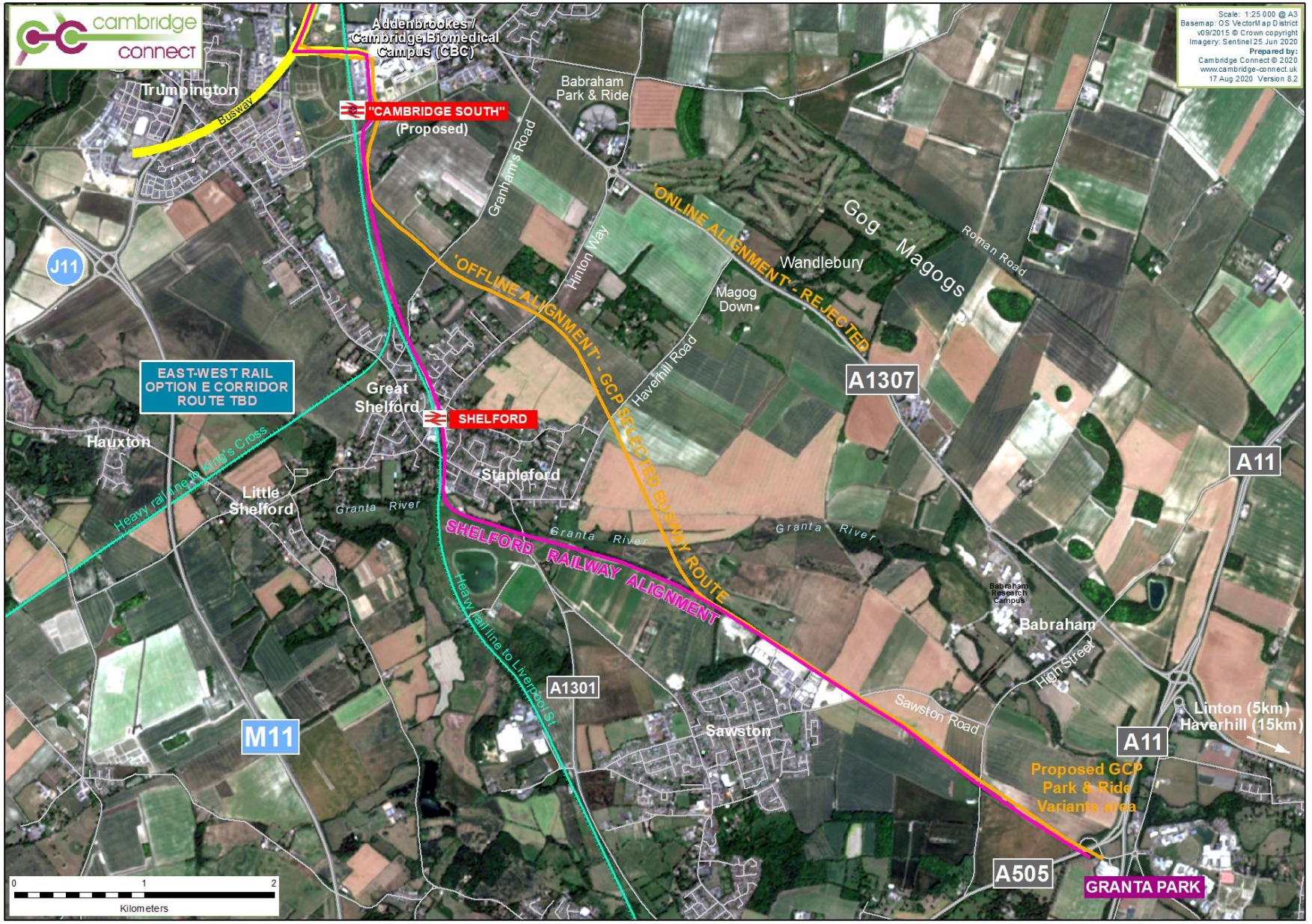



**Figure 2**. The Shelford Rail Alignment compared against the 'Offline Alignment' adopted by the GCP for progression (Map: Cambridge Connect 2020).

# 3 Long-term transport planning

Cambridge Connect considers that infrastructure development needs to be fit-for-purpose for the region with a planning horizon into the 2030s and beyond. The key drivers of economy, population, demand, education, science & technology environment & heritage, and social & cultural values all need to be taken into account with a long-term view, and these need to be balanced against the cost and investment needed for future generations.

It is important that communities are tightly integrated into future public transport provision, and this is vital to ensure the best possible up-take of the services, and to provide excellent connections for residents. Where practicable, and when balanced against the environmental impacts of other options, public transport should seek to achieve well-connected communities.

Before progressing new busways, a detailed plan for delivery of the long-term strategy for Cambridgeshire public transport needs to be adopted. Local solutions should then be designed so they integrate seamlessly into the overall strategic plan, both in terms of technologies used for the metro and also the routes. This strategy should be at an advanced stage of development when implementing local solutions, even if this would mean a short-term delay in delivery of some local improvements. This approach would avoid waste and bring cost-savings over the medium-term.

# 4 Implications of the pandemic

The implications of the current COVID-19 pandemic for public transport are major and cannot be ignored. The pandemic has demonstrated that we need to design our public transport systems to be more resilient to shocks. The science tells us that COVID-19 is unlikely to be the last pandemic we face. It is clear that current approaches and systems have been inadequately designed and prepared for such challenges.

The GCP should carefully consider the implications for bus-based solutions which are inherently based on existing models, which have been shown to lack the capacity and technologies to enable more resilience in public transport. While light rail is by no means a panacea, it does have the substantial advantage of much greater capacity than buses, and in this it has the potential to be much more flexible and resilient to future shocks.

Before rushing to deliver a bus road solution – with major damage to the local landscape – the GCP should carefully consider how improved resilience can be built into our public transport systems. This is particularly the case in CSET which will play a vital role in servicing essential healthcare facilities, to which key workers need continued access and especially in pandemics.

# 5 Sustainability

Around one third of energy consumption is used on transport (MacKay, 2009: 118). The evidence shows that rail remains the most energy-efficient means of public transport available, being at least twice as efficient as buses and up to 18 times more efficient than cars. Improving the energy efficiency of our transport systems must be a key consideration in our choice of transport solutions. This approach is consistent with commitments made at the 2015 Paris Summit on Climate Change, and with the more recent declaration by the UK Government of the 'Climate Emergency', in particular with respect to the need to adopt more sustainable approaches to city planning and transport. These important conclusions have been underscored at recent Climate summits.

Light rail also performs much better than other public transport on pollutant emissions. Fine particulate pollution is released by rubber-tyred vehicles, and these pollutants enter the atmosphere, terrestrial and water systems. These emissions have been shown to account for as much particulate

pollution as released by vehicle tail-pipes, so even if buses were electric a substantial air pollution problem would remain. Rubber tyres are largely made from synthetic plastics, which take a very long time to degrade. The microplastics from wear enter into aquatic and terrestrial systems, and are taken up by organisms. In addition, large numbers of waste tyres are produced, and for a high frequency metro operation this could lead to many hundreds or thousands of waste tyres per year.

Light rail is more sustainable for metro operation than buses because it consumes substantially less power than rubber-tyred buses, owing to the low rolling resistance of steel wheels on rails (~ one tenth of rubber tyres on road). Light rail lines may also offer benefits through more sustainable water drainage systems than the extensive tarmac / concrete needed for bus roads.

# 6 Light rail: general benefits for Cambridge Southeast

The 'Isaac Newton Line' would substantially address transport needs to the south of Cambridge in the general area of the A1307 highway by linking the bioscience campuses at Granta Park / Babraham to the biomedical campus at Addenbrookes and to the central rail station and city centre. In the southeast Cambridge region, the 'Isaac Newton Line' would:

- Provide a light rail 'backbone' extending from Granta Park in the southeast to Girton Interchange in the northwest, linked to the heart of Cambridge city;
- Integrate with the heavy rail network at Cambridge Central Rail Station, at Great Shelford, and at the proposed new Cambridge South Station at Addenbrookes;
- Provide multimodal links to bus / coach and Park & Ride services at key interchanges – for example the A11 / A505. Similar multimodal links would be provided at Junction 11 on the M11 / A10 and at the Girton Interchange on the A428 / A14 / M11;
- Provide a new Park & Ride near the A11 / A505 junction, close to the A1307 and Granta Park, which would serve the surrounding region (although smaller than proposed by GCP);
- Provide reliable, fast and frequent public transport into the heart of Cambridge from the south, meeting public transport objectives in this region;
- Provide a reliable, fast and frequent link between the three University campuses;
- Connect the Babraham Campus and Granta Park employment centres and other research institutes and businesses in the south of Cambridge directly with the Biomedical Campus, the city centre, and University West Campus;
- Provide an excellent public transport service that could be linked to Hinxton / Wellcome Trust and Babraham Campus developments by short and cost-effective shuttle services, which could in the future be fully automated;
- Relieve vehicle traffic pressure on the A1307 / Hills Road by attracting people onto the alternative light rail route, which would provide rapid travel into the centre of Cambridge without congestion;
- Directly serve the villages of Sawston, Stapleford, the Shelfords, Abingdon and Babraham (the latter by shuttle) with a high-quality, reliable public transport system;
- Enable improvements in the links to Haverhill and Linton, which could be served directly by a light rail extension from Granta Park to Haverhill;
- Serve potential growth in housing and development to the south of Cambridge, including in the long-term to lower cost housing areas such as Haverhill;

- Serve and strengthen business connections at the South Cambridge Business Park;
- Serve the Football Club grounds in Sawston by excellent public transport, which would reduce potential congestion associated with game fixtures;
- Directly serve Sixth Form Colleges and the University Technical College at Long Road and Hills Road, better linking these to the villages of the Shelfords, Stapleford and Sawston;
- Encourage walking / cycling from nearby residential areas and employment centres to strategically located stops on the public transport network;
- Foster a more sustainable city and region, protecting its rich heritage and environmental values, with light rail being the best technology for air and water quality.

# 7 Specific comments on route proposed by GCP

**Cambridge Connect strongly opposes the route proposed by the Greater Cambridge Partnership to link Addenbrookes to Granta Park on the following grounds**.

## *7.1 Practical feasibility, constraints and costs*

7.1.1 Cambridge Connect notes that WSP (2018: 2) highlighted "Stakeholders and members of the public … indicated a preference for new infrastructure to follow, where possible, the route of the dismantled railway on the grounds this is an established and accepted transport corridor".

7.1.2 Cambridge Connect also notes WSP (2018: 2) pointed out that "Transport modelling… identified a significant benefit from routing Strategy 1 close to the settlements of Sawston, Stapleford and Great Shelford, where the introduction of intermediate passenger stops would offer the most significant step change in user behaviour, with access to approximately 2800 dwellings within 800 metres of the route that would result in a pronounced mode shift away from private car travel, more than other options tested".

7.1.3 WSP (2018: 4) noted the "unguided nature of the design requires a more traditional carriageway width of 7.3m, based upon DMRB TD 27/95 fig4.4a), that is greater than that required for a kerb or track guided busway".

7.1.4 WSP (2018: 7-8) concluded: "A route following the dismantled railway through to Great Shelford was considered; unfortunately this is not viable for a road based Public Transport system given the lack of available space alongside the existing … railway, particularly at Great Shelford station … encompassed by residential and commercial development that precludes taking a new route that by-passes the station and platforms that abut the railway...". However, **no factual evidence** (such as measurements and identification of potentially affected structures) **in support of this conclusion was presented** in WSP (2018).

7.1.5 Mott MacDonald (2019) referred to the work by WSP (2018) that considered the old rail route and concluded "Given that using the former railway alignment through Shelford has previously been considered unfeasible, this was not considered further at this stage". While this seems to suggest that the WSP conclusion was taken 'as read', despite the lack of evidence, Mott MacDonald did carry out some further site technical evaluation of the specific section through Great Shelford, since part of their report identifies potential constraints along this section and includes cost estimates to address those constraints.

7.1.6 The Mott MacDonald (2019) Technical Note also concluded that a public transport route through Great Shelford parallel to the existing and former rail alignment is not feasible. However, the Technical Note **did not conclude that the physical constraints could not be**

**overcome** (listed in Section 6 of the Technical Note), but rather drew the conclusion that it would be more costly.

7.1.7 The work to overcome the practical constraints, while perhaps more difficult and expensive in certain places, nevertheless could be delivered through an additional investment to address the physical constraints.

7.1.8 Mott MacDonald (May 2020) concluded clearly that a route through the villages **was** technically feasible. This report demonstrates a feasible route could be implemented, provides detailed diagrams, and shows a short section of Chaston Road being adopted for "shared use". However, Mott MacDonald (2020) concluded that the route was not feasible on other grounds, but did not undertaken a proper like-for-like comparison with the route through the villages, and nor did it undertake an evaluation of the impacts on the environment by proceeding through the Green Belt landscape as proposed by GCP. The Mott MacDonald conclusions therefore cannot be relied upon because the report fails to consider important evidence that has a material bearing on the outcome.

7.1.9 The report by independent transport professionals i-Transport, commissioned by Great Shelford and Stapleford Parish Councils in 2020, demonstrated that – contrary to Mott MacDonald (2020) conclusions –**a fully segregated public transport route along the entire Shelford Railway Alignment, including through the villages adjacent to the existing rail line, is feasible**. Small amendments to the assumed layout design would enable this full segregation.

7.1.10 i-Transport further showed that deliverability with a revised approach following the Shelford Rail Alignment would only directly affect up to four residential properties. While we agree that property demolitions should be avoided wherever possible, they should not take over-riding precedence against other factors such as protection of the Green Belt. If this were to be the case, this would give undue weight to the interests of several properties / residents against wider benefits for the entire community over the long term. We do not believe such an approach – as appears to be taken by the GCP – to be justified in the CSET context.

7.1.11 i-Transport have examined issues such as Passenger Demand, Cost and Environment at a high level at this stage, and while further appraisal will be required, they noted that the Mott MacDonald (2020) conclusions appear subjective and poorly evidenced, and are therefore unreliable.

7.1.12 In our view there is strong evidence that the route option through Great Shelford / Stapleford has been dismissed prematurely by the GCP on the basis of insufficient evidence.

7.1.13 A clear distinction needs to be made between practical physical constraints (physical possibility) and budget constraints (need to consider costs versus benefits, or availability of funds). Mott MacDonald (2019, 2020) shows the practical physical constraints can be solved. Therefore, should the route through the villages be preferred, the question of feasibility becomes more a matter of cost, rather than one of pure physical constraints *per se*.

7.1.14 This is important, because while the cost of addressing the physical constraints of the route through Great Shelford has been estimated, the *value* of the Green Belt and its associated landscape, ecology, farm production (i.e. potential losses owing to 'orphaned' fields), and recreational benefits have not been assessed.

7.1.15 Neither have the additional costs of an alignment through Great Shelford been considered against the substantial additional economic benefits that would accrue by locating the public transport route at the heart of the community, as confirmed by WSP (2018) (see Section 7.1.2). These economic benefits would accrue both by fostering ridership on public transport, and also by improving the accessibility of businesses located within the villages of Great Shelford and Stapleford to people coming from outside of these communities. This would contribute to

improved economic activity and vibrancy in the villages. Additional economic benefits would accrue by reductions in the number of car journeys that would be made to access the stops.

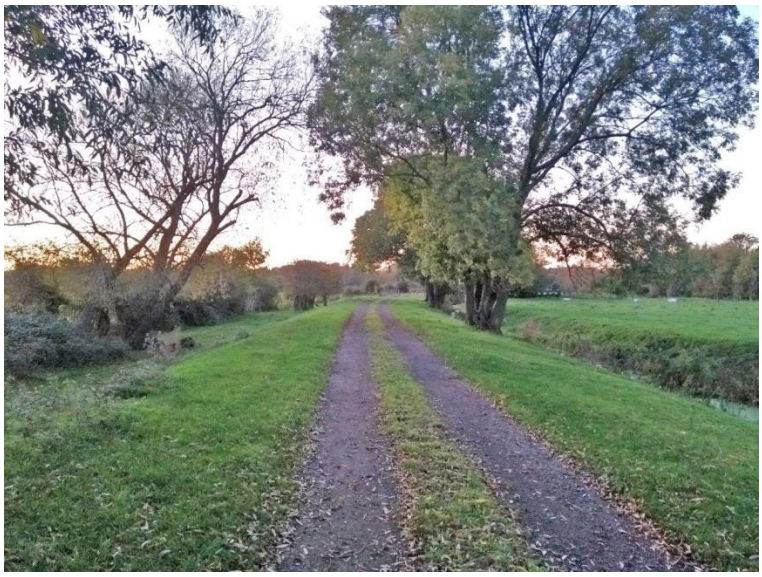


**Figure 3:** Much of the former rail alignment remains as an elevated embankment suitable for reinstatement (Photo: C. Ross 2019).

7.1.16 Both the WSP (2018) and the Mott MacDonald (2019, 2020) Technical Notes are based on a non-guided road-based public transport alignment. This option would require greater land-take than a light rail option, which has physical guidance by rails. As such, their conclusions on feasibility, both in terms of physical space and cost, do not apply to light rail. An assessment of the feasibility of light rail following the former rail line route remains needed.

7.1.17 A preliminary examination of Croydon Tramlink shows that it is possible to align a light rail line alongside a heavy rail line with minimal separation (Figure 4). While we have not carried out detailed investigations, this suggests that a light rail line along the Great Shelford route may be significantly more feasible, and perhaps less costly in some respects, than the proposed busway. For example, it is likely to have narrower width requirements, and require fewer physical barriers to separate the railway from the public transport route.

7.1.18 In addition, the GCP has made no assessment of the feasibility of small sections of single-track alignment where there are particular constraints on space at 'pinch-points'. This type of approach is currently successfully implemented at pinch-points on the southern Cambridge Guided Busway. We understand that modern signaling systems are capable of managing short single-track sections such as might be needed without significant delays. A proper assessment of this option should be undertaken, not only for light rail but also for the bus-based solution.

7.1.19 The GCP route has three at-grade crossings, each of which increase costs. The alternative light rail line as proposed below in Section 6.4 has one at-grade crossing, reducing costs. While the proposed grade separation would cost more at Granham's Road, this could be shared with other stakeholders, lowering costs to be paid for through this specific scheme.

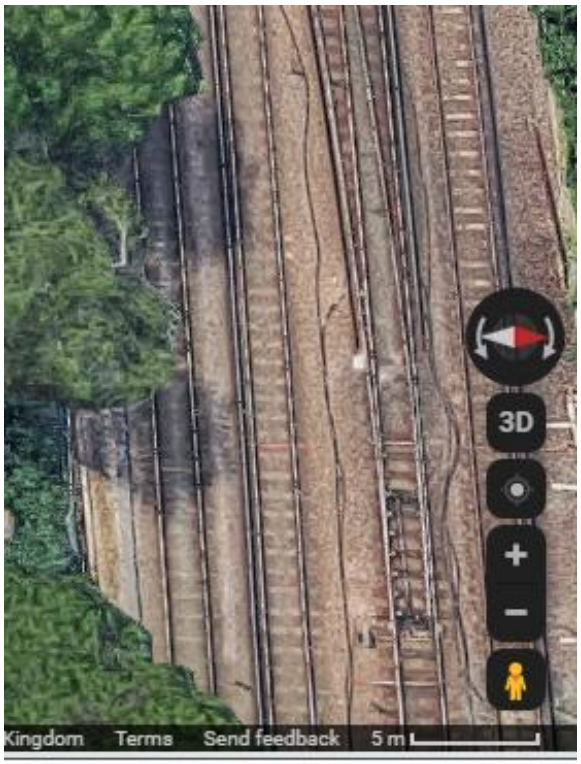



**Figure 4:** Croydon Tramlink alignment immediately west of Beckenham Junction station. The light rail line is at far left, while the remaining three lines are heavy rail. (Image: Google Maps 2019).

## *7.2 Improved connectivity and integration*

7.2.1 The route proposed by the GCP is isolated and approximately one km and uphill from centres of the villages of Great Shelford and Stapleford. It is thus not well-integrated with the community along the route. This distance is a barrier to residents and makes public transport use less likely, suppressing potential modal shift, which runs counter to the scheme purpose.

7.2.2 The distance to the new line will dissuade many from walking to the stops. This may encourage people to drive to the nearest stop, with knock-on implications for parking and congestion. While this may be mitigated to some degree by provision of a connecting bus service from the village to the new public transport line, and perhaps imposition of parking restrictions, this introduces additional and unnecessary barriers to use of public transport.

7.2.3 A public transport route going through the heart of the villages would be more accessible to the community, and as noted in WSP (2018) is also the clear preference of the local communities. This would promote use of the service, and lead to an outcome that is more environmentally, socially and economically sustainable. This approach would help to drive the much-needed modal shift, one of the scheme's overall objectives. Evidence shows that this effect is even greater where the public transport provided is light rail (Harris *et al.* 2019).

7.2.4 Close alignment with the heavy rail line within Great Shelford enables co-location of the Rail Station and light rail stop. This would facilitate easy interchange between light rail and heavy rail, improving public transport options for the community, and improving its attractiveness. The GCP route is isolated and fails to achieve this close connectivity.

7.2.5 Co-location of the Rail Station with a light rail stop would be an opportunity for improvements to the urban realm in this location, e.g. offering commercial opportunities for cafes etc.

7.2.6 The scheme should be planned in an integrated way with cycling, pedestrian and vehicle provisions. Public transport and cycleway / pedestrian paths do not always need to be running

immediately alongside of each other. There are opportunities to reduce permanent way width where necessary by using alternative and separate routes for cycling / pedestrians.

## 7.3 *Environmental benefits, landscape values and sustainability*

7.3.1 The GCP route makes an unnecessary incursion into Green Belt and development of major infrastructure for a busy transport route across relatively tranquil and unspoiled rural landscapes of high aesthetic value. It will impact local ecology and recreational uses. It will create additional severance of the Gog Magog Hills and Magog Down from local communities. These values have not been given sufficient consideration in the decision to proceed with this route.

7.3.2 The GCP route requires major new land-take from the Green Belt. There is insufficient justification for this because a feasible route through Great Shelford and Stapleford exists utilising the existing transport corridor and the former railway line.

7.3.3 The GCP route runs counter to policies that seek to minimise the impact of infrastructure and development on Green Belt land, and against policies that seek to protect landscapes of high value. The landscape affected is immediately adjacent to one of the most iconic and high-value elevated sites in the Cambridge region, namely the Gog Magog Hills and Magog Down. This site is already compromised by the major A1307 highway, and a further major public transport route across this landscape will further degrade and despoil the remaining high landscape values.

7.3.4 It is preferable for the new infrastructure to follow the general route of the dismantled railway, which is an established and accepted transport corridor.

7.3.5 A major question left unanswered in the GCP documentation and analysis is: how is the loss of Green Belt, landscape, ecology and recreational use valued and compared against the costs (in £) of addressing the physical constraints of the route through the villages?

7.3.6 In the long-term, an additional capital expenditure to protect those important values could be considered small in comparison to the benefit of protecting a highly valued landscape and rural environment for the long-term. There is difficulty in reconciling these different types of values, although the attempt needs to be made or there is an unacceptable risk that highly valued landscapes, Green Belt, local ecology and habitat, and aesthetic values will be wrongly disregarded in the decision-making.

## 7.4 *Opportunities for long-term gains – developing an integrated approach to improvements in rail and public transport at Cambridge Southeast*

7.4.1 Future developments of the heavy rail network need to be taken into consideration. For example, developments such as Cambridge South Station, East-West Rail, and service improvements more generally will influence activity and services on the main rail lines.

7.4.2 The frequency of trains on the line through Great Shelford, and the length of trains, are likely to continue to increase. This has significant implications for practical operation of the two level crossings in Great Shelford. Already, lengthy periods of barrier down-time are common on these level crossings, and the crossings also significantly constrain the rail network. It is increasingly apparent that effective and efficient operation of train services along this line will require grade separation at busy crossing points.

7.4.3 Grade separation is likely to be needed for the main rail line in the near future, and bringing forward its delivery to coincide with delivery of a light rail link between Granta Park and Addenbrookes could benefit from cost-sharing with Network Rail. This approach could offer a win-win both for Network Rail, the GCP and the Combined Authority when providing the new

public transport route. It would also be a major benefit to the local community. It is important to consider these issues now so that schemes can be optimised to meet all objectives and are fit-for-purpose well into the future.

7.4.4 Cambridge Connect supports detailed investigation into options for grade-separated crossings of the main rail line on Granham's Road and Station Road/ Hinton Way in Great Shelford, and suggests that this should form an integral part of the overall scheme for public transport delivery because it should have a material influence on which options are selected.

7.4.5 An approach to address the grade separation problem in a way that integrates with public transport improvements in Cambridge Southeast has been outlined by Peter Wakefield, Vice-Chair of Railfuture East Anglia. In this submission, we will refer to this proposal as the 'Grade Separation Proposal'. Cambridge Connect supports the general approach in the Grade Separation Proposal, and believes it should be given detailed consideration for delivery of any public transport solution in Cambridge Southeast. We recognise Grade Separation would be complex and that detailed studies and plans will need to be developed.

7.4.6 In summary, the outline Grade Separation Proposal proposes a new road bridge on Granham's Road to provide grade separation over the existing heavy rail line, and this would also span the parallel light rail line that we propose from Great Shelford to Addenbrookes. The Grade Separation Proposal includes closure of the current at-grade crossing on Station Road / Hinton Way, with provision of an alternative vehicle route over to the newly-bridged Grantham Road. Pedestrian / cycle access along Station Road / Hinton Way would be continued via a modern, wide ramped, fully accessible and well-lit subway under the railway.

7.4.7 The Grade Separation Proposal would result in vehicles using Granham's Road for access to the A1307, and the Station Road / Hinton Way would become for local traffic only, with no through-route. The proposal assumes that a bridge or subway for vehicles would be impractical on Station Road / Hinton Way. The proposal supports a light rail line parallel to the existing and former rail line between Addenbrookes and Granta Park, as originally proposed by Cambridge Connect, Railfuture and UK Tram.

7.4.8 The new public transport route proposed by the GCP requires three at-grade crossing points with existing roads (Babraham Road, Haverhill Road, Hinton Way). These crossings will require full control by traffic lights, and will both slow public transport along the route as well as create additional constraints on vehicular traffic flow. Moreover, every crossing point contributes to additional safety risks.

7.4.9 The Grade Separation Proposal would result in only one at-grade crossing point along the light rail route instead of three, and this would be in the same location as shown by the GCP on Babraham Road. Reducing the number of crossings would significantly improve the speed and safety of the public transport route, and also improve flows for traffic needing to travel to/from the A1307 and Great Shelford.

7.4.10 Cambridge Connect urges the GCP and Combined Authority to give full consideration to the Grade Separation Proposal with a view to examining its delivery in combination with the light rail options presented in our submission following the alignment along the existing and former rail lines through the village of Great Shelford.

7.4.11 Greater consideration needs to be given to the integration of the proposed Cambridge South Station with CSET. The new station needs to be planned taking into consideration the needs for grade separation nearby and potential implications for the Great Shelford Station.

# 8 Park & Ride proposals by GCP

8.1.1 Cambridge Connect supports some form of new Park & Ride in the general vicinity of Granta Park. It has not been possible for us to make site-specific assessments and therefore cannot recommend one location over another based on site characteristics.

8.1.2 However, as a general principle, it is important that the location selected can be practically integrated with future development of the proposed segregated public transport route to Haverhill, which should be implemented using light rail.

8.1.3 The size and scale of the Park & Ride should be planned in conjunction with delivery of the Granta Park – Haverhill public transport route, because a high proportion of demand for the Park & Ride is likely to arise from residents along this route and from Haverhill. The proposed size of the Park & Ride appears considerably larger than needed, should these other considerations be given detailed attention.

8.1.4 In this respect consideration should be given to opportunities for a metro model with more 'distributed Park & Ride' sites, where stops on the metro network accommodate much smaller areas of parking where practical. This approach would reduce demand for very large Park & Ride sites that concentrate high levels of local impacts with large areas of land-take / usage. Distributed parking at metro stops could result in less intrusive developments for parking, with more pedestrian and cycle access, although it is acknowledged that this could mean more, but smaller, sites.

# 9 References

Harris, C.M, Brown, I., Cushing, P., Wakefield, P. & Hollinghurst, P. 2019. *Greenprint for a sustainable future: Cambridge Light Rail*. Report by Cambridge Connect, Railfuture & UK Tram. Available from:

http://www.cambridge-connect.uk/wp-content/uploads/2019/04/Cambridge-Connect-Greenprint-30Mar2019-v8-LR.pdf

MacKay, David J.C. 2009. Sustainable energy – without the hot air. UIT Cambridge Ltd, Cambridge.

Mott MacDonald. 2019. Technical Note: 'Feasibility of Old Railway Alternative Route' (16 Aug 2019).

Mott MacDonald. 2020. CSET Phase 2: Shelford Railway Alignment - Design Development and Feasibility Assessment (18 May 2020). Report prepared for GCP.

Steer 2019. Cambridgeshire Autonomous Metro Strategic Outline Business Case. Report prepared for the Greater Cambridge Partnership and Cambridgeshire and Peterborough Combined Authority.

WSP 2018. 'Technical Note: Strategy 1 Route Study'. REF: 70012014-TN-010 Strategy 1 Route Assessment. (13 July 2018).

## Appendix Four

Comparison of GCP Busways with Cambridgeshire Light Rail.

GCP Busways


Light Rail


Alternative Scheme Profiles:

# Qualitative Comparison of the Greater Cambridge Partnership Busways and Cambridgeshire Light Rail (CLR)

20 November 2021

ankura ankura.com

amey

C/M/S/ Law.Tax

cambridge connect

railfuture EAST ANGLIA

UK Tram

# SUMMARY

Poor Weak Average Good Excellent

| CONSIDERATION | GCP Busways | | CLR | Cambridgeshire Light Rail (CLR) |
|---|---|---|---|---|
| Network | • Where fully segregated, flexibility similar to light rail.<br>• Where not segregated, buses in congestion, impacting speed / reliability / reputation<br>• Busway to Waterbeach not needed – use heavy rail connected to light rail within city.<br>• Slow and congested within city. | | | • Fully segregated – reliable, fast, minimal collision risk.<br>• Network to Cambourne / Granta Park / Science Park similar.<br>• Higher ability to generate modal shift (proven).<br>• 40 km core network covers high demand areas.<br>• Interchange with buses: integrated ticketing / timetabling.<br>• Fast, frequent service connects with buses & heavy rail network. |
| Rubber vs Rails | • Standard diesel / hybrid bus; in time battery electric<br>• Rubber- tyres produced from oil.<br>• Buses = tyre / road pollution. Not suited to tunnel.<br>• Buses at metro frequency = potholes. | | | • Standard technology, proven, highly sophisticated.<br>• Billions invested in Light Rail Vehicle development.<br>• Rails address road pothole problems. Excellent in tunnel.<br>• Rails inflexible, but permanent, encourages investment. |
| Tunnels | • No tunnel currently proposed. Cheaper.<br>• Surface running – potential congestion.<br>• City access more difficult if roads closed without a good alternative. | | | • Short, simple tunnel (2 portals) to meet essential needs.<br>• Automatic light rail proven deliverable for tunnel operations.<br>• Tunnel improves access speed, frequency, reliability, capacity. |
| Safety | • Busway / articulated bus safety lower than light rail.<br>• Heavy buses at high frequencies impose on cyclists and pedestrians, reducing their safety, especially in city. | | | • Very safe. Proven over billions of miles.<br>• Best safety record possible. Segregated way safer in city tunnel.<br>• Rails add to safety by providing physical guidance. |
| Environment & Health | • Lower energy efficiency = less sustainable.<br>• Higher particulate pollution from tyres = health risks.<br>• High volume of waste rubber tyres.<br>• Higher greenhouse gas emissions over scheme lifetime | | | • Most energy efficient, less power needed, highly sustainable.<br>• Lowest possible particulate pollution.<br>• Superior technical solution for environment / health.<br>• Lower greenhouse gas emissions over scheme lifetime. |
| Costs | • Lower capex to install segregated roadway.<br>• Electric buses cheaper.<br>• Bus lifetimes short – higher materials / carbon / energy.<br>• Higher opex & high road maintenance costs. | | | • Higher capex for permanent rails.<br>• Light Rail Vehicles (LRVs) more expensive.<br>• LRVs last longer – lower embodied materials / carbon / energy.<br>• Lower whole-life costs. |
| Financeability / Economic benefits | • City Deal finance (£500 m) sufficient for several busways.<br>• Lower investor confidence profile for bus scheme.<br>• Bus schemes less attractive to investors.<br>• Gross Value Added lower from bus schemes.<br>• Lower gains in economic productivity. | | | • Higher investment needed up front for light rail.<br>• High investor confidence profile for light rail scheme.<br>• Proven solution provides investors with confidence.<br>• Permanent infrastructure provides investor confidence.<br>• Gross Value Added higher from light rail scheme – more attractive, generates greater associated investment.<br>• Higher gains in economic productivity. |
| Delivery of benefits | • Modal shift poor compared to light rail.<br>• Bus mode share ~8% - need to shift to 25-30%.<br>• Insufficient capacity to meet scale of growth / demands of climate change. Not future-proofed.<br>• Buses unable to deliver change on scale required. | | | • Strong modal shift, as evidenced in other cities with light rail.<br>• Proven, dependable, reliable: deliverable today.<br>• Attractive and able to deliver change at scale required.<br>• Future-proofed capacity for growth / Climate Change. |

# GCP Busways


# Light rail


- **Scheme Profiles**
- Comparative Analysis

ankura

amey

CMS Law.Tax

cambridge connect

railfuture EAST ANGLIA

UK Tram

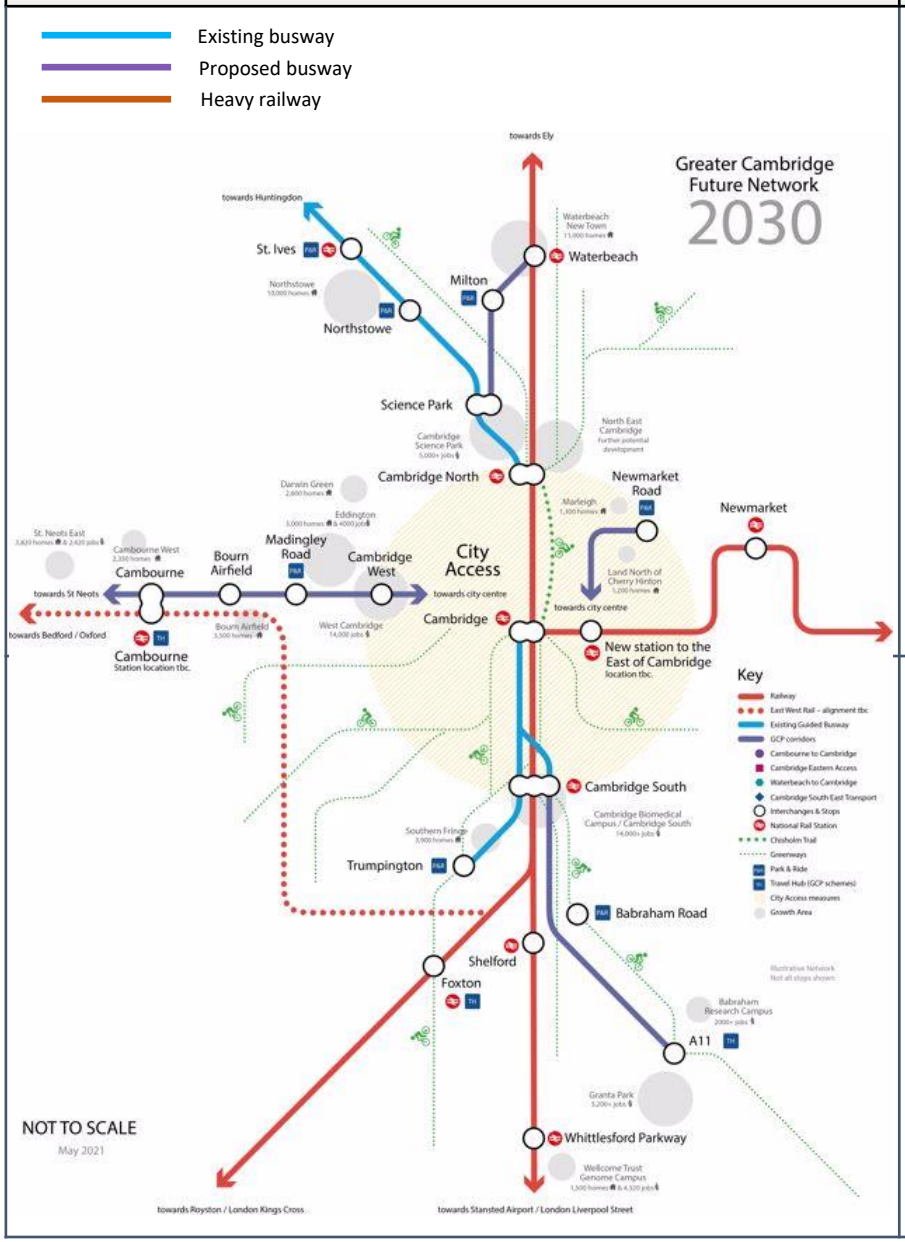
# Scheme profiles – key characteristics

| Characteristic | GCP Busways | Cost (£m) | Cambridgeshire Light Rail (CLR) | Cost (£m) |
|---|---|---|---|---|
| Mode | Bus with rubber tyres on tarmac or concrete road | | Light rail vehicle with steel wheels on rails | |
| Power | Electric batteries. Recharging at termini / supercapacitors at stops. Charging infrastructure. OLE / ground power supply options not currently available. Hydrogen potential. | | Electric Overhead Line Equipment (OLE), with options for Electric ground supply, or batteries charging at termini / supercapacitors at stops. Hydrogen potential. | |
| Guidance | Driver steering on roads. | | Driverless automatic mode possible. Physical steel rails. | |
| Network length[1] | ~45 km (incl. busway to Waterbeach). (~£11 m/km) | 500 | ~40 km (including tunnel) (~£25 m/km excl tunnel) | ~1432 |
| Tunnel length | None | | ~2.6 km (Phases 1 & 2) (one fifth of CAM) with 2 portals | ~273 |
| Segregation | Busways fully segregated. City not segregated. | | Fully segregated >95% of network | |
| Service frequency | Assumed ~5-10 mins at peak within city, beyond city ~15 mins | | ~5 mins within city, ~15 mins beyond city. | |
| Max speed | 100 kph (60 mph) | | 100 kph (60 mph) | |
| Autonomy | Driver required. Autonomous operation unknown. | | Automatic operation available today. Driver optional. | |
| Number of vehicles | 200 (@ ~£400K ea) | 80 | 40 (@ ~£2 m ea). | 80 |
| Vehicle capacity | 50 – 100 | | 100 – 300. Capacity future-proofed. | |
| Vehicle longevity | 10 – 12 years (estimated bus life) | | 25 years (proven) (e.g. DLR vehicle life up to ~30 yrs) | |
| Vehicle length / width | 9 – 12 m / 2.2 – 2.7 m | | 18 – 37 m / 2.4 – 2.7 m | |
| Vehicle weight | 7.5 – 13 tonnes dependent on length | | 16 – 20 tonnes dependent on length | |
| City stops | Unknown | | 22 | |
| Underground stations | None | | x1 (City Centre) | ~100 |
| Depots | x2 (owing to number of buses required) | ? | x1 | 40 |
| Operating costs | ~£4.00 per vehicle kilometre (estimate)[2] | 30 pa | ~£5.00 per vehicle kilometre[3] | 40 pa |

1. Based on average UK scheme costs (excluding DLR; Ref 18) scaled to 2019 prices , multiplied by an optimism bias of 1.4. Half of this cost (£15 m per km) has been estimated for busway conversion since many costs will not be required (eg alignment, moving services, land purchases, etc.).
2. Operating costs uncertain. Eg, road maintenance. is excluded for buses, while for light rail it is included. A true comparison is needed, taking into account road maintenance, which is significant.
3. Based on Metrolink & others analysed by P. Cushing 2019. NB: DLR & Metrolink operate at profit, Nottingham NET breaks even. Revenue-earning capacity needs to be taken into account.

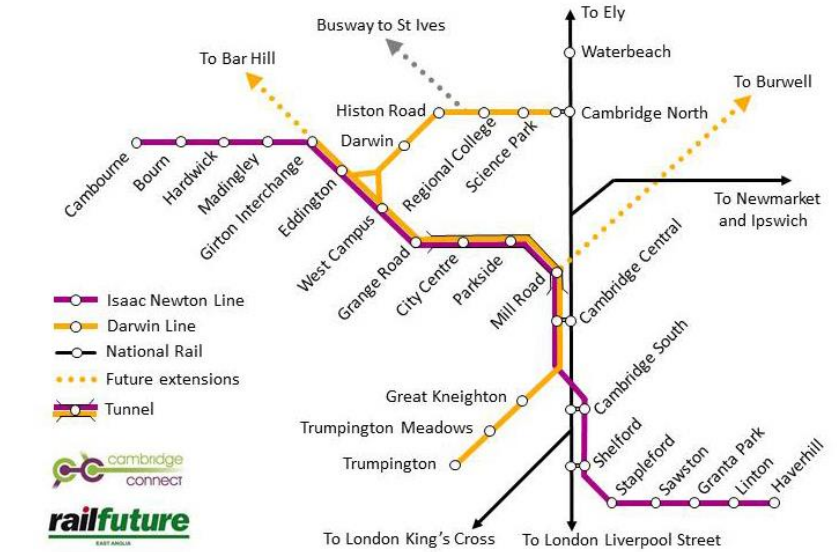
# Scheme profiles – network maps

## GCP Busways

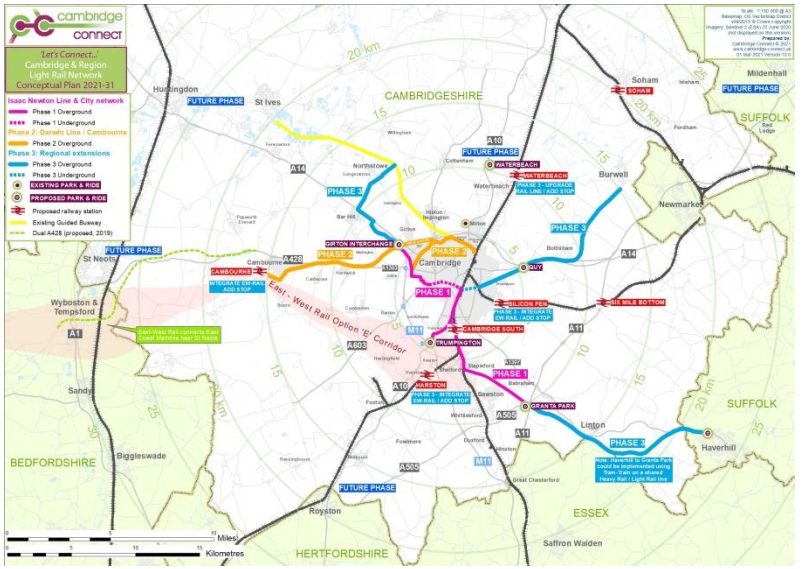



## Cambridgeshire Light Rail (CLR)

### CITY




### REGION



## GCP Busways


## Light rail


- Scheme Profiles
- **Comparative Analysis**

ankura · amey · CMS Law.Tax · cambridge connect · railfuture EAST ANGLIA · UK Tram

# NETWORK

Poor | Weak | Average | Good | Excellent

| CONSIDERATION | GCP Busways | | CLR | Cambridgeshire Light Rail (CLR) | Ref. |
|---|---|---|---|---|---|
| Segregation | • If fully segregated similar to CLR.<br>• City unsegregated using road network. Where unsegregated, benefits lost. Potential to restrict or charge for car access, though remains uncertain & raises equity questions. | | | • Fully or mainly segregated across light rail network.<br>• Segregated network similar to busways<br>• Connecting bus services to remote destinations. | |
| Stop Accessibility | • Network stops frequent and accessible. | | | • Accessibility good at surface, but constrained over 2.6 km tunnel length. | |
| Service Reliability | • If fully segregated similar to CLR, but road maintenance issues.<br>• If unsegregated, exposed to congestion constraints, with impact on speed and reliability with impact on capacity for modal shift. | | | • Speed and reliability more reliable & predictable – high reputation.<br>• Maintains high levels of customer satisfaction, which encourages modal shift. | 15, 16, 17, 18 |
| Longevity & Permanence | • If fully segregated similar to CLR.<br>• Roads less durable than rails, require frequent maintenance.<br>• If unsegregated doubts about longevity / continuity of service – services can easily be withdrawn.<br>• Locational investment decisions faced with greater uncertainty | | | • Permanent track provides long term investor confidence that infrastructure will be enduring.<br>• Locational investment decisions are based on permanence and confidence. | |
| Network Topology & Flexibility | • If fully segregated, same flexibility as CLR | | | • Permanent track less flexible than bus. | |
| | • More flexible on normal roads.<br>• CGB shows few routes extend beyond the busway, and routes on rural roads are unlikely to be cost-effective.<br>• Flexibility unlikely to be realised in reality owing to economics. | | | • Permanent network backbone provides confidence<br>• Feeder bus services/ Park & Ride links at stops can offer required flexibility in service over a wider area.<br>• Track can be extended where / when needed as future demand becomes manifest (phased). | |
| Power Requirement | • Higher power requirement to deliver similar service level; greater exposure to risk of power capacity constraints.<br>• Higher costs over scheme lifetime.<br>• Battery option only, and technology immature.<br>• Hydrogen potential in future. | | | • Most efficient power usage; lower risk of power capacity constraints, but risk of network-level failures.<br>• Lower whole scheme lifetime costs.<br>• Options for OLE, ground feed, battery or hydrogen (future).<br>• Power delivery via OLE more efficient, but visual intrusion. | |

# RUBBER vs RAILS

Poor Weak Average Good Excellent

| CONSIDERATION | GCP Busways | | CLR | Cambridgeshire Light Rail (CLR) | Ref. |
|---|---|---|---|---|---|
| Maintenance | • Road wear: proportional to the fourth power of axle weight. Wear exacerbated by high frequency.<br>• Repetitive tracking on single path (e.g. optical guideway) exacerbates wear, with constant potholing (e.g. Caen rubber-tyred 'guided buses' beset by road maintenance problems – unreliability & high costs led to replacement by light rail).<br>• Road maintenance costs; not clear whether road maintenance included in busway costings.<br>• Cambridge Guided Busway: major maintenance needed after 8 y, despite theoretical 40 y lifetime.<br>• Maintenance costs need to be accounted for in the whole-life cost appraisal of buses. | | | • Rail / trackbed transfers vehicle loads using well-understood engineering.<br>• Rail engineering proven to be durable and effective over hundreds of years of experience.<br>• Rails address the road wear problem.<br>• Rail maintenance required but comparatively less.<br>• Rail maintenance costs are accounted for in budgets and paid out of operational revenues.<br>• Light rail is replacing busways where whole-life costs are taken into account. | 1 |
| Autonomous operation | • Autonomous operation delivery unknown. | | | • Automatic operation deliverable today. Autonomous rail vehicles likely deliverable before road because of physical guidance. | |
| Friction / efficiency | • High tyre friction; low energy efficiency. | | | • Very low friction; most energy efficient.<br>• Steel wheels on rails have ~15% of the rolling resistance of rubber tyred vehicles. | 2 |
| Power requirement | • Significantly more power required to deliver an equivalent service level owing to substantially lower energy efficiency of rubber-tyred vehicles.<br>• Higher power requirements inflates operational costs. | | | • Light rail requires the lowest possible power to deliver the required service level because of its high efficiency.<br>• Less energy required to run light rail vehicles than buses to deliver the same service level. | 2 |
| Resuspension of Particulates | • Approx 27% of non-exhaust particulates are derived from resuspension of particles along route.<br>• Large tyre > road contact surface increases particulate resuspension and recycles harmful pollutants into air. | | | • Lowest possible contact area of wheel to rail (size of 5p piece) – particulate resuspension lower. | 13 |
| Passenger experience | • High ride quality claimed but road subject to wear / potholes over time, leading to deterioration in quality; impacts on passenger satisfaction with ride. | | | • High ride quality proven and consistent over lifetime of rail light rail vehicle with appropriate maintenance. | 1, 15, 16, 17, 18 |
| Flexibility | • Flexibility to operate on normal roads using a standard bus.<br>• More flexible in theory but unsuited to mass transit. | | | • Less flexible as light rail operates only on permanent track<br>• Specialised system that delivers mass transit very well | |

# TUNNELS

Poor Weak Average Good Excellent

| CONSIDERATION | GCP Busways | | Cambridgeshire Light Rail (CLR) | | Ref. |
|---|---|---|---|---|---|
| Tunnel Configuration | • None, surface only. | | | • One simple linear tunnel with two portals.<br>• Tunnel length ~2.6 km (Phases 1 & 2).<br>• Tunnels size to meet legal and safety requirements. Diameter twin-bore ~4 -5 m OR single bore ~8 m.<br>• Includes 800 mm side access way<br>• Standard twin or single bore tunnel. | 8, 9 |
| Capacity | • Operating at surface impacts other users such as pedestrians, cyclists, deliveries, etc.<br>• Surface operation has capacity constraints for future. | | | • Tunnel capacity future-proofed. | |
| Safety | • Elevated safety risks of large vehicles at surface for pedestrians / cyclists.<br>• Cyclists, pedestrians and car drivers are regularly injured and some have been killed by buses on the Cambridge busways | | | • Safety proven worldwide and UK (e.g. DLR).<br>• Very low risk – rails provide physical guidance, proven safe.<br>• In-tunnel 800 mm wide along-track accessway assumed. | |
| Tunnel operations | • N/A | | | • Low particulate emissions and zero engine emissions make light rail better suited to use inside confined tunnel space.<br>• Lower heat venting needed without rubber tyres.<br>• Twin bore tunnel would have cross passage linkages and comply with legal, safety and practical requirements.<br>• Need for escape routes, but short tunnel length and simple configuration. | |
| Heritage / urban realm | • Heavy transport infrastructure at surface negatively impacts on city heritage /urban realm by bus congestion.<br>• Surface pollution increases with bus emissions from tailpipes, tyre and brake wear, degrading urban realm. | | | • Protects heritage / urban realm by placing heavy transport infrastructure underground. | |
| Tunnel cost | • Zero | | | • Expensive, but benefits very high. | |

# ENVIRONMENT, SAFETY & HUMAN HEALTH

Poor Weak Average Good Excellent

| CONSIDERATION | GCP Busways | | CLR | Cambridgeshire Light Rail (CLR) | Ref. |
|---|---|---|---|---|---|
| Energy Efficiency | • ~ Double the energy requirements.<br>• Regenerative braking transfers energy back to power plant.<br>• Battery will wear out / lose capacity over time. | | | • Rail is most energy efficient form of mass transit.<br>• Low energy requirement is significant cost saving: energy consumption accounts for large proportion of operational costs.<br>• Regenerative braking transfers energy back to power plant. | 2 |
| Emissions & Particulate Pollution | • Zero emissions from electric motor at point of operation.<br>• Particulate pollution from tyre, road & brake wear.<br>• Particulates elevated by heavy vehicles and tyre footprint.<br>• Fine particulates harmful to human health –as important as tail pipe emissions.<br>• Microplastics from tyres discharged into water / ecosystems. | | | • Zero emissions from electric motor at point of operation.<br>• Low levels of particulate pollution from rail / wheel / brake wear.<br>• Lower levels of fine particulates.<br>• Best option for human health. | 3, 4, 5, 6, 7, 13 |
| Waste & sustainability | • Thousands of waste tyres, which may be recycled into other uses, including burning for fuel, though energy inefficient.<br>• Battery waste disposal may be significant issue.<br>• Raw materials for batteries are non-renewable. | | | • Low waste. Durable. Steel recyclable.<br>• If OLE used, no waste batteries, and power can be sourced from sustainable, renewable sources.<br>• Longer vehicle life = more sustainable use of materials / embodied energy. | |
| Noise | • Electric vehicles low noise – rubber tyre roar at speed.<br>• Improvement on diesel buses. | | | • Electric vehicles low noise – rail screech if not well-maintained.<br>• Improvement on diesel buses and on rubber-tyred vehicles. | |
| Carbon Footprint | • If segregated, road & guideways may result in more construction carbon. | | | • Rails may elevate construction carbon cf roadway structures.<br>• Carbon-free steel is being manufactured today.<br>• Low-carbon cement could be considered for tunnel. | 12 |
| | • Modal shift offsets construction carbon and carbon from energy consumed. Modal shift lower than light rail.<br>• Higher operational carbon emissions owing to lower energy efficiency, depending on power sources. | | | • Modal shift offsets construction carbon and carbon from energy consumed. Modal shift more certain.<br>• Lower operational carbon owing to higher energy efficiency, depending on power sources.<br>• Carbon footprint lower than BRT over scheme lifetime. | |
| Collision Risk | • Busway safety lower than light rail. No physical guides. | | | • Segregated operation minimises collision risk / lowers costs.<br>• Accidents risks very low – one of safest modes that exists.<br>• Light rail one of the safest forms of public transport. 15x safer than buses, and 24x safer than cars.<br>• Operational speed, reliability, revenue and reputation all maintained at high levels. | 10 |
| | • Collision risk elevated on shared roads. *"Collisions in shared road space are a significant operational cost."*<br>• Elevated risks of injury / death on shared road spaces<br>• Speed, reliability, revenue & reputation suffer from collisions. | | | | |
| Visual Impact | • Concrete / tarmac roadway including cuttings, and potential structures for guidance, signs etc. | | | • OLE catenaries, if used, and tracks including cuttings.<br>• Catenary not required if ground feed or battery adopted (hybrid approach could minimise visual intrusion in sensitive areas). | |

# COSTS & ECONOMIC BENEFITS

Poor | Weak | Average | Good | Excellent

| CONSIDERATION | GCP Busways | | Cambridgeshire Light Rail (CLR) | | Ref. |
|---|---|---|---|---|---|
| Overall cost & risk | • £500 m for partially segregated network.<br>• Lower cost but unlikely to deliver modal shift required or economic benefits at the same level as light rail. |  |  | • ~£1.3 – 1.7 bn for Phase 1 & 2 network.<br>• Proven technology deliverable, low financial risk.<br>• More costly, but greater benefits. | 9, 15, 16, 17, 18 |
| Tunnel cost & risk | • Zero cost, but risks lack of capacity, poor connectivity and impacts on urban realm, heritage and amenity. |  |  | • ~£273 m for 2.6 km tunnel with 2 portals.<br>• Simple short tunnel to reduce costs.<br>• Tunnel size and costs predictable / low risk. | 9 |
| Underground station cost | • Zero. |  |  | • ~£100 m per station.<br>• 1 station proposed. | 9 |
| Segregated way costs | • Capital investment lower for existing roads. |  |  | • Initial capital investment in steel track higher.<br>• Whole life costs more favourable (see below). | |
| | • Capital investment significant for segregated bus roads. |  | | | |
| Vehicle costs | • ~£200K-£400K per electric bus.<br>• Shorter quoted vehicle life. |  |  | • ~£2 m per vehicle (costs vary in competitive market)<br>• Proven long vehicle life (e.g. DLR). | 9 |
| Operational costs | • Operational road maintenance costs will be high.<br>• More power needed to deliver service, escalating operational costs.<br>• Replacement tyres elevate operational costs.<br>• Autonomous operation not currently deliverable, necessitating drivers and increased staff costs. |  |  | • Lower operational costs (eg. lower power requirements, no waste tyres, longer vehicle life, high durability of permanent way).<br>• Automatic operation currently deliverable, which could reduce need for drivers and staff costs. | |
| Economic benefits | • **Lower Gross Value Added** to economy.<br>• Lower Benefit to Cost Ratio (BCR).<br>• Lower efficiency (poor ridership levels).<br>• **Low economic productivity gains** (less congestion with **modestly improved** public transport links) |  |  | • **Higher Gross Value Added** to economy.<br>• Higher Benefit to Cost Ratio (BCR).<br>• Improved efficiency.<br>• **High economic productivity gains** (higher modal shift & less congestion with **great** public transport links) | |

# FINANCEABILITY, DELIVERABILITY

Poor Weak Average Good Excellent

| CONSIDERATION | GCP Busways | | CLR | Cambridgeshire Light Rail (CLR) | Ref. |
|---|---|---|---|---|---|
| Investor confidence | • City Deal finance in place. | | | • Modern, standardised technologies, inter-operable<br>• Proven modern technology = low risk.<br>• Higher investor confidence.<br>• City Deal finance re-purposed will build investor confidence. | |
| Operational Revenue | • Buses unlikely to attract strong operational revenue. | | | • Likely higher farebox revenues as light rail will generate greater modal shift than buses.<br>• Rail greater "trip generative effect" than guided bus.<br>• Link with bus services at periphery to stimulate those services, not compete with them. | 15, 16, 17, 18 |
| 3rd Party Revenue Potential | • Lower potential revenue with bus-based brand | | | • Higher potential revenue opportunities (vehicle advertising / station naming rights) from higher quality image. | |
| Land Value Capture | • Appeal poor, so land value uplift poor. | | | • Permanence attractive for housebuilders, investors and buyers. | 11, 19 |
| Legal Approvals | • Approvals straightforward in principle.<br>• In practice, strong community opposition and Public Inquiry challenges are likely. | | | • Light rail network deliverable via standard, well established Transport & Works Act Order procedures.<br>• Tunnel operation straightforward in terms of legal / safety approvals as already proven (e.g. DLR).<br>• Strong community support likely. | |
| Deliverability | • Proven technology.<br>• Practicality of non-segregated way in city not clear – bus congestion.<br>• Greater power needs raise questions about power supply availability and upgrades to support frequent electric bus services (assumes all buses are powered by rechargeable electric batteries).<br>• Deliverable within available City Deal finance. | | | • Proven technology; many recent precedents; clear process for consents; proven passenger attraction; etc.<br>• Power supply upgrades may be needed.<br>• More attractive to investors because of proven record with highly positive public reputation.<br>• Raising finance still challenging, but City Deal could fund a significant proportion, leaving ~£1 bn to raise. | |

# OVERALL SUMMARY

Poor Weak Average Good Excellent

| CONSIDERATION | GCP Busways | | Cambridgeshire Light Rail (CLR) | |
|---|---|---|---|---|
| Network | • Where fully segregated, flexibility similar to light rail.<br>• Where not segregated, buses in congestion, impacting speed / reliability / reputation<br>• Busway to Waterbeach not needed – use heavy rail connected to light rail within city.<br>• Slow and congested within city. |  |  | • Fully segregated – reliable, fast, minimal collision risk.<br>• Network to Cambourne / Granta Park / Science Park similar.<br>• Higher ability to generate modal shift (proven).<br>• 40 km core network covers high demand areas.<br>• Interchange with buses: integrated ticketing / timetabling.<br>• Fast, frequent service connects with buses & heavy rail network. |
| Rubber vs Rails | • Standard diesel / hybrid bus; in time battery electric<br>• Rubber- tyres produced from oil.<br>• Buses = tyre / road pollution. Poor in tunnel.<br>• Buses at metro frequency = potholes. |  |  | • Standard technology, proven, highly sophisticated.<br>• Billions invested in Light Rail Vehicle development.<br>• Rails address road pothole problems. Excellent in tunnel.<br>• Rails inflexible, but permanent, encourages investment. |
| Tunnels | • No tunnel currently proposed. Cheaper.<br>• Surface running – potential congestion.<br>• City access more difficult if roads closed without a good alternative. |  |  | • Short, simple tunnel (2 portals) to meet essential needs.<br>• Automatic light rail proven deliverable for tunnel operations.<br>• Tunnel improves access speed, frequency, reliability, capacity. |
| Safety | • Busway / articulated bus safety lower than light rail.<br>• Heavy buses at high frequencies impose on cyclists and pedestrians, reducing their safety, especially in city. |  |  | • Very safe. Proven over billions of miles.<br>• Best safety record possible. Segregated way safer in city tunnel.<br>• Rails add to safety by providing physical guidance. |
| Environment & Health | • Lower energy efficiency = less sustainable.<br>• Higher particulate pollution from tyres = health risks.<br>• High volume of waste rubber tyres.<br>• Higher greenhouse gas emissions over scheme lifetime |  |  | • Most energy efficient, less power needed, highly sustainable.<br>• Lowest possible particulate pollution.<br>• Superior technical solution for environment / health.<br>• Lower greenhouse gas emissions over scheme lifetime. |
| Costs | • Lower capex to install segregated roadway.<br>• Electric buses cheaper.<br>• Bus lifetimes short – higher materials / carbon / energy.<br>• Higher opex & high road maintenance costs. |  |  | • Higher capex for permanent rails.<br>• Light Rail Vehicles (LRVs) more expensive.<br>• LRVs last longer – lower embodied materials / carbon / energy.<br>• Lower whole-life costs. |
| Financeability / Economic benefits | • City Deal finance (£500 m) sufficient for several busways.<br>• Lower investor confidence profile for bus scheme.<br>• Bus schemes less attractive to investors.<br>• Gross Value Added lower from bus schemes.<br>• Lower gains in economic productivity. |  |  | • Higher investment needed up front for light rail.<br>• High investor confidence profile for light rail scheme.<br>• Proven solution provides investors with confidence.<br>• Permanent infrastructure provides investor confidence.<br>• Gross Value Added higher from light rail scheme – more attractive, generates greater associated investment.<br>• Higher gains in economic productivity. |
| Delivery Risk | • Modal shift poor compared to light rail.<br>• Bus mode share ~8% - need to shift to 25-30%.<br>• Insufficient capacity to meet scale of growth / demands of climate change. Not future-proofed.<br>• Buses unable to deliver change on scale required. |  |  | • Strong modal shift, as evidenced in other cities with light rail.<br>• Proven, dependable, reliable: deliverable today.<br>• Attractive and able to deliver change at scale required.<br>• Future-proofed capacity for growth / Climate Change. |

# References


| Ref | Source / Evidence / More Info |
|---|---|
| 1 | Caen, France: guided bus caused excessive road wear / maintenance costs / frequent disruption – replaced by light rail. |
| 2 | MacKay, David J.C. 2009. *Sustainable energy – without the hot air*. UIT Cambridge Ltd, Cambridge. |
| 3 | Amato, F., Flemming R. Cassee, Hugo A.C. Denier van der Gon, Robert Gehrig, Mats Gustafsson, Wolfgang Hafner, Roy M. Harrison, Magdalena Jozwicka, Frank J. Kelly, Teresa Moreno, Andre S.H. Prevot, Martijn Schaap, Jordi Sunyer, Xavier Querol. 2014. Urban air quality: The challenge of traffic non-exhaust emissions. *Journal of Hazardous Materials* **275**: 31-36. |
| 4 | Grigoratos, T. & Martini, G. 2014. Non-exhaust traffic related emissions. Brake and tyre wear PM. Literature review. Joint Research Centre, Institute of Energy and Transport, European Commission, Luxembourg. |
| 5 | Hann, S., Darrah, C., Sherrington, C., Blacklaws, K., Horton, I. & Thompson, A. 2018. Reducing Household Contributions to Marine Plastic Pollution. Report for Friends of the Earth by Eunomia Research & Consulting. FoE and ERC, Bristol. |
| 6 | Barlow, T. 2014. Briefing paper on non-exhaust particulate emissions from road transport. Transport Research Laboratory. Client Project Report CPR1976. |
| 7 | Amato, F. (Ed) 2018. *Non-Exhaust Emissions. An urban air quality problem for public health impact and mitigation measures*. Academic Press, Elsevier. |
| 8 | Steer 2018. Greater Cambridge Mass Transit Options Assessment Report. Report prepared for the Greater Cambridge Partnership and Cambridgeshire and Peterborough Combined Authority. |
| 9 | Steer 2019. Cambridgeshire Autonomous Metro Strategic Outline Business Case. Report prepared for the Greater Cambridge Partnership and Cambridgeshire and Peterborough Combined Authority. |
| 10 | Scott Ith, Transport Director, Salt Lake City Tramway – pers. comm. 2017. |
| 11 | TfL 2017. Land Value Capture: https://www.london.gov.uk/sites/default/files/land_value_capture_report_annexes_transport_for_london.pdf |
| 12 | European Environment Agency 2019. *Specific CO2 emissions per passenger-km and per mode of transport in Europe.* https://www.eea.europa.eu/data-and-maps/daviz/specific-co2-emissions-per-passenger-3#tab-chart_1 |
| 13 | Lawrence et al., 2013 Source apportionment of traffic emissions of particulate matter using tunnel measurements. *Atmospheric Environment* 77: 548-557. |
| 14 | CPIER (Cambridgeshire & Peterborough Independent Economic Review) 2018. Final Report |
| 15 | Knowles, R. & Ferbrache, F. 2014. *An investigation into the Economic Impacts on Cities of Investment in Light Rail Systems*. UKTram, June 2014. |
| 16 | APPLRG (All Party Parliamentary Light Rail Group/pteg) 2010. Light Rail & the City Regions inquiry: Final Report February 2010. |
| 17 | Steer Davies Gleave / PTEG. 2005. What light rail can do for cities: a review of the evidence. Final Report February 2005. |
| 18 | DfT (Department for Transport) 2011. Green light for light rail. Report on light rail by the UK DfT. |
| 19 | Suzuki, H., Murakami J., Hong Y-H, & Tamayose B. 2015. Financing Transit-Oriented Development with Land Values. World Bank: Urban Development Series. |
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