

**Madingley Road / A428 Cambourne to
Cambridge Corridor Study**
Draft Interim Report
Cambridge City Deal Partnership

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Executive summary

This report provides the Cambridge City Deal Partnership with information on the A428 corridor study, which looks specifically at public transport improvement options between Cambourne and Cambridge. The introduction to the report provides background information on the option selection process undertaken during Phase 1, which was completed in August 2014. The body of the report then sets out the initial assessment of results from the study. The final chapter then sets out the development and option shortlisting process which will be undertaken in advance of the final report which will be published in late 2015.

The A428 corridor is one of the key radial routes into Cambridge with high levels of current and planned housing growth. Parts of the route currently suffer from heavy congestion, poor journey times and journey time reliability during peak hours.

The Transport Strategy for Cambridge and South Cambridgeshire (TSCSC) and the Cambridge and South Cambridgeshire Submitted Local Plans identify a series of transport proposals to provide for increased travel demand over the period to 2031 including that arising from future development.

At peak periods the transport network in the city already operates at or near capacity and additional vehicular trips would be difficult to accommodate, increase congestion and delay, damage the environment and worsen the quality of life of those who live and work in the city. The TSCSC therefore focuses on achieving reliable, safe and convenient access to and around the city for non-car modes of transport. For shorter trips walking and cycling are the focus, while for medium and longer distance trips public transport is the primary focus.

On the A428 corridor, the TSCSC includes proposals for a congestion free public transport corridor into the city. This would;

- Provide a fast, timely and reliable alternative for current travellers into the city, removing buses from congestion on part or all of the A1303 between the A428 and the city centre;
- Provide additional transport capacity for trips from development proposed and planned within the TSCSC;
- Provide high quality pedestrian and cycle facilities alongside the public transport provision.

The Cambridge City Deal Partnership commissioned the A428 Phase 1 study in April 2014 in accordance with Department for Transport (DfT) guidance for transport scheme appraisal (WebTAG).

The early study work identified the problems and challenges of the A428 corridor, and established the objectives that any interventions should achieve before proceeding to option generation and assessment. These objectives included:

- Congestion free public transport serving the corridor (including new developments) in order to avoid an increase in current congestion levels and PT journey times.
- Public transport serving key current/future trip generators in the A428 corridor (west of the M11), including Cambourne and Bourn Airfield.
- Public transport serving key current/future trip attractors in Cambridge – Cambridge City Centre and other employment sites (i.e. Science Park, Addenbrooke's).

Phase 1 work allowed a good understanding of the characteristics of the corridor to be obtained before deriving potential solutions. Concepts were generated and refined through a series of workshops and assessments against an agreed framework in order to generate shortlisted set of options for further consideration and detailed assessment.

Status of this report

Phase 2 of the project is currently in progress. The aim of this phase is to develop the shortlisted options for further assessment to inform an outline business case for a scheme. Initial assessment of the shortlisted options has been undertaken to identify key risks and determine their feasibility.

At this stage stakeholder engagement should be undertaken before proceeding to detailed option assessment, as the development and appraisal of the options should be informed by stakeholders' views. Consulting with stakeholders not only provides an indication of the level of support or otherwise to the

options that form the scheme, but can also inform the design and appraisal process by challenging which options are appropriate, and potentially generating alternative solutions for a better outcome.

Consultation will need to be undertaken in advance of any decisions on final options to consider and facilitate necessary input in the development of the scheme.

Shortlisted options

There are a number of potential solutions that have the ability to achieve the objectives of the scheme. Six options have been assessed during Phase 1 of the study as best achieving these objectives and therefore have been shortlisted for consultation and further assessment.

City Deal funding will be released from government in three tranches. Initial prioritisation by the City Deal Executive Board indicates the A428/A1303 corridor scheme may be delivered in two tranches.

- Tranche 1 (to 2020) would include the section between Madingley Mulch roundabout, and Cambridge city centre.
- Tranches 2/3 (up to 2030) would include the section between Madingley Mulch Roundabout and Caxton Gibbet.

This phasing may change as outputs from this study and other City Deal work are further considered by the City Deal Board and the partners.

The options generated from Phase 1 of the study were therefore divided into sub-sections to reflect these Cambridge City Deal Partnership funding requirements. All options assume the existing Madingley Road Park & Ride site continues to operate.

Options for the eastern section of the corridor (tranche 1) comprise:

- Option 1A – Online eastbound bus lanes from the A1303 / A428 junction along Madingley Rise¹ and Madingley Road to Lady Margaret Road;
- Option 1B – A new offline dedicated bus route running north-east from the A1303 / A428 junction, connecting in to Madingley Road just west of the M11. A further eastbound bus lane on Madingley Road would be provided to Lady Margaret Road; and
- Option 1C – A new offline dedicated bus route running north of Coton and parallel to Madingley Road and Madingley Rise to Grange Road, with a connection to the West Cambridge University site.

Tranche 1 measures address existing problems for travellers within the corridor and are therefore not development dependent.

Options for the western section of the corridor (tranche 2/3) comprise:

- Option 2A – Improvement to bus services, which will run along the existing roads with no infrastructure improvements to the A1303 / A428 junction;
- Option 2B – A new route linking Cambourne and the proposed Bourn Airfield new settlement, before services running along St Neots Road with bus priority measures in place to the A1303 / A428 junction; and
- Option 2C – A new offline dedicated bus route connecting Cambourne and Bourn Airfield before running south of Hardwick to Madingley Mulch roundabout.

Tranche 2/3 measures have a specific focus on the section of the corridor between Caxton Gibbet and the Madingley Mulch Roundabout, and primarily address the development sites on this part of the corridor.

These options were assessed against a “do minimum” option. The assumptions related to the A428 Cambourne to Cambridge Corridor Do Minimum can be set out as follows:

- Committed transport infrastructure away from the corridor is included. This includes schemes such as the A14 Upgrade from Cambridge to Huntingdon and other highway access related infrastructure for larger development sites such as Cambridge North West, Darwin Green and Northstowe; and

¹ Throughout the report the term Madingley Rise is used to refer to the section of the A1303 between Madingley Mulch roundabout and the M11.

- Bus services on the corridor are maintained at current day service levels, frequency and stopping patterns. No new bus priority infrastructure is provided.

It is recognised that market forces might lead to the existing bus services being modified (should development levels in the corridor increase), however this interim assessment leaves bus service patterns unaltered.

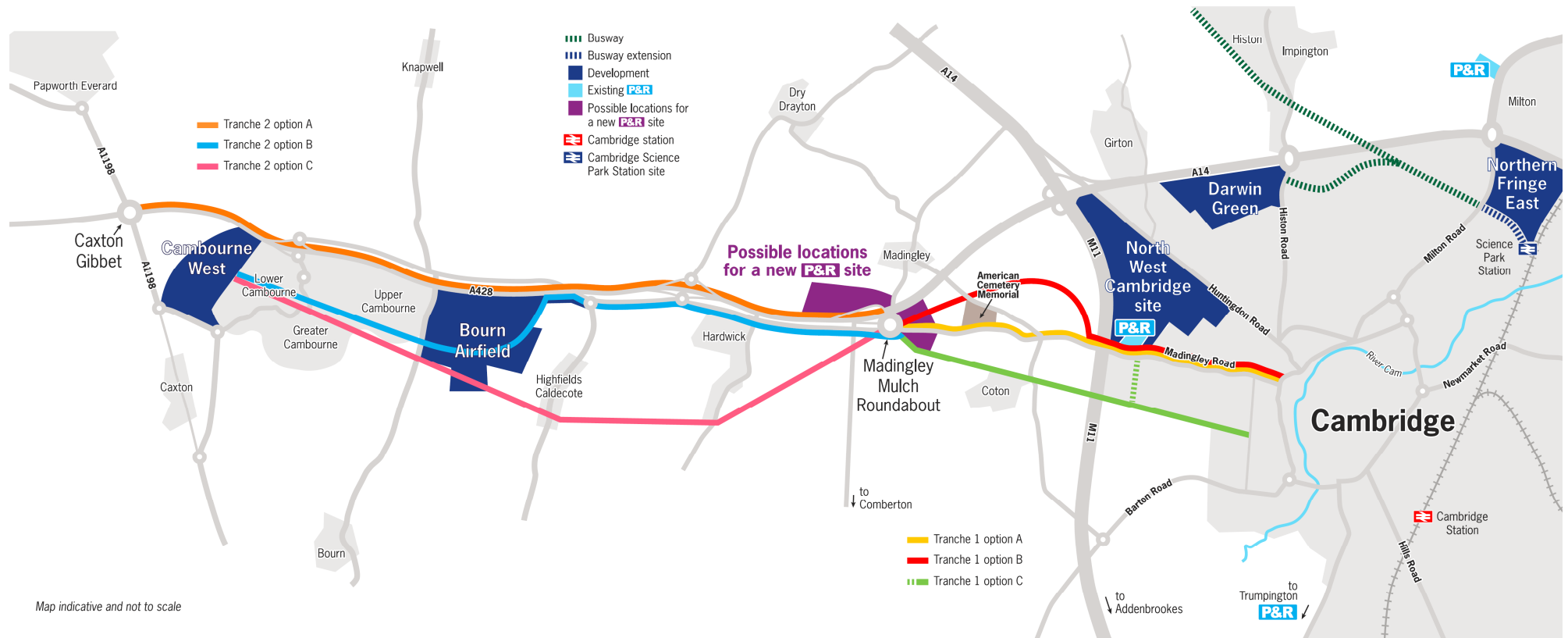


Figure 1-1 Summary of options

1. Introduction

Report aim and structure

- 1.1. This report aims to present the options developed during Phase 1 of the study, including preliminary details on their performance, feasibility and key risks. This information will enable the Cambridge City Deal Board to reach a decision on whether to proceed to consultation.
- 1.2. The report is structured as follows:
 - Introduction: containing background on the report aims and the Phase 1 study findings.
 - Option Assessment: containing preliminary results of the option assessment carried out during Phase 2 of the study.
 - SWOT analysis: tables summarising the strengths, weaknesses, opportunities and threats for each option.
 - Summary and next steps
 - Appendices: containing option outline drawings (Appendix A) and detailed junction impacts analysis (Appendix B).

Initial technical work

- 1.3. The submitted Local Plans for Cambridge City and South Cambridgeshire District include a requirement, contained within the Transport Strategy for Cambridge and South Cambridgeshire (TSCSC) for transport improvements to the A428 corridor in order to address the transport impacts of development proposals. Therefore understanding current transport issues and planning for future growth are essential to achieve the objectives in both the Local Plan and the City Deal. As such the initial technical work was based on both the existing and projected transport constraints and opportunities.
- 1.4. The technical work identified the problems and challenges of the A428 corridor, and established the transport planning objectives that any interventions should achieve before proceeding to option generation and assessment. This allowed a good understanding of the characteristics of the corridor to be obtained before deriving any solutions.
- 1.5. The A428 is already congested in peak hours, with a number of pinch points at key locations. Congestion has been identified in the Local Transport Plan, Long Term Transport Strategy and the TSCSC as a key barrier to growth along the A428 corridor.
- 1.6. The evidence shows that these problems are focused on specific sections of the corridor, particularly on the A1303, east bound into Cambridge and, to a lesser extent, on the section of the route between St Neots and Caxton Gibbet (A428 / A1198 junction). Planned growth along the corridor will, in future, add extra pressure onto already congested sections of the A428 as residents' access employment in Cambridge City Centre, Cambridge Science Park, and at the Cambridge Biomedical Campus. The evidence is clear that without intervention the A1303 cannot physically accommodate any more vehicular traffic during the morning peak and there is a danger that the current queue could extend onto the dualled A428, having an adverse impact on the fast journey times associated with this section.
- 1.7. Highways England plan to upgrade the A428 to a dual carriageway from between the A1 / A421 Black Cat roundabout and Caxton Gibbet. Although any such upgrade would not be operational for several years, this could create further pressures on the constrained highway network as it approaches Cambridge. These constraints apply both to residents in terms of accessing employment, education and other essential opportunities, and to businesses in terms of staff and customer access to their sites.
- 1.8. As anticipated, initial study findings suggest reliability and capacity are always issues that greatly affect the uptake of public transport initiatives. The optioneering feasibility study was informed by the assessment of environmental and engineering constraints. The identification process for some options was iterative as indicative alignments and other features were

altered as a result of further feasibility assessment. Options were identified by taking a whole view across the corridor, looking through both top-down (what infrastructure can be provided to support growth) and bottom-up (what growth is forecast to take place that will require infrastructure to support it) approaches. The options were identified and discussed during a series of workshops.

- 1.9. The options were assessed using a framework consistent with the DfT's 'Five Cases' model which has been developed to appraise transport business cases on the basis of HM Treasury's Green Book appraisal. Each package was assessed in terms of:
- the Strategic Case: the degree to which they were supportive of those planning objectives relating to the type and scale of intervention;
 - the Economic Case: the degree to which they were supportive of those planning objectives relating to the impact on ability to intercept trips and journey time reliability; environmental impacts; greenhouse gas emissions, social and distributional impacts;
 - the Financial case: the cost of the option;
 - the Commercial case: commercial viability of the option; and
 - the Management case: engineering feasibility, stakeholder and public acceptability.
- 1.10. Each option was scored against the criteria above using a Red/Amber/Green rating based on previously-determined definitions of what constituted each score for each criterion. Scoring was undertaken based on the team's understanding of the corridor drawn from the SWOT analysis and professional judgement. Sense checking followed to ensure spurious results did not emerge, and the sifting table and results were then verified via a peer group analysis with members of the team not involved in the initial scoring. Based on this initial sift, the six best-performing options were presented and discussed at a workshop.

Summary of Shortlisted Options

- 1.11. During the option development work further clarification on timescales for City Deal funding was received. This indicated the A428 corridor scheme would likely be delivered in two distinct tranches. Tranche 1 (to 2020) would include the part of the corridor which runs from the A428/A1303 junction at Maddingley Mulch roundabout, east to Cambridge city centre. Tranche 2/3 (up to 2030) would include the part of the corridor which runs west of Maddingley Mulch to Caxton Gibbet and assumes that one of the options of Tranche 1 had already been committed.
- 1.12. Options for the eastern section of the corridor (tranche 1) comprise:
- 1A – Online eastbound bus lanes from the A1303 / A428 junction along Maddingley Rise and Maddingley Road to Lady Margaret Road;
 - 1B – A new offline dedicated bus route running north-east from the A1303 / A428 junction, connecting to Maddingley Road just west of the M11. A further eastbound bus lane on Maddingley Road would be provided to lady Margaret Road; and
 - 1C – A new offline dedicated bus route running north of Coton and parallel to Maddingley Road and Maddingley Rise to Grange Road, with a connection to the West Cambridge University site.
- 1.13. Options for the western section of the corridor (tranche 2/3) comprise:
- 2A – Improvement to bus services, which will run along the existing roads with no infrastructure improvements to the A1303 / A428 junction;
 - 2B – A new route linking Cambourne and Bourn Airfield, before services running along St Neots Road with bus priority measures in place to the A1303 / A428 junction; and
 - 2C – A new offline dedicated bus route connecting Cambourne and Bourn Airfield before running south of Hardwick to Maddingley Mulch roundabout.

2. Option Assessment

Introduction

- 2.1. A preliminary assessment of the shortlisted options was carried out to identify key risks and determine their feasibility prior to proceeding to consultation. The preliminary assessment was necessary to ensure options were sufficiently developed to allow meaningful discussions to take place when engaging with stakeholders. Full assessment will be carried out with the benefit of the consultation and incorporated as part of the final report expected at the end of 2015.
- 2.2. While specific modelling of the individual tranches is ongoing, and will be an integral part of the continued work being undertaken on the study, the figures for journey times and patronage quoted in the following sections are estimates and may vary depending on the exact combination of subsections used.
- 2.3. The sections below present the analysis carried out under the following broad categories:
- Alignment to City Deal Criteria
 - Traffic and Operational Considerations
 - Environmental Considerations
 - Engineering Considerations
- 2.4. Whilst the individual elements of the assessment are presented below, the evaluation of all of these combined will be conducted during the remainder of Phase 2.

Alignment to City Deal Criteria

Housing

- 2.5. The Cambridge and South Cambridgeshire Submitted Local Plans identify significant future growth in housing and employment in the A428 corridor.
- 2.6. The housing numbers used as inputs for the transport model in this study are consistent with those contained in the Local Plans, but for the purposes of assessing these schemes government WebTAG guidance has been followed to control them to published forecasts.
- 2.7. The following table highlights the planned housing growth present in the model up to 2031:

Site	Housing growth nos. (model)
Cambourne	950
Cambourne West	1200
Bourn Airfield	1700 (with expansion to 3500 post 2031)
North West Cambridge	3000
Darwin Green 1	1593
Darwin Green 2 & 3	1000
St Neots	3700

- 2.8. One of the key aims of the study is to enable growth by providing connectivity between residential and employment locations, hence all options being considered support housing growth.

Employment

- 2.9. The development strategy set out in the South Cambridgeshire and Cambridge City local plans proposes 22,000 additional jobs in each district by 2031. Around 15,000 new jobs are

planned on the Cambridge Biomedical Campus, including at the relocated Papworth Hospital and at Astra Zeneca’s new Corporate Headquarters. The campus may eventually have a working population of around 30,000, making it one of the largest biomedical sites in the world. Further employment growth will continue in areas such as Cambridge Science Park and Cambridge Northern Fringe East. The West Cambridge development, directly on the A1303 is also seeking to intensify land use with additional employment sites. The adjacent North West Cambridge site has 150 hectares of mixed use development currently under construction.

- 2.10. The TSCSC recognises that to support forecast economic and population growth, travel options to major employment sites must be timely, reliable and affordable. The improvements to public transport movements proposed to the A428 corridor will link into existing and planned improved orbital routes to access these major employment centres.

Performance and Operational Considerations

Travel demand & accessibility to local centres

- 2.11. Underlying increases in demand for travel, for example due to economic growth nationally, and local growth in demand due to the development described above, are forecast to lead to substantial growth in the demand for travel in Greater Cambridge.
- 2.12. Demand forecasting has been undertaken using existing Cambridge Sub Region Model runs which take into account growth proposals included in the submitted Local Plans.
- 2.13. Figure 2-1 below summarises the forecast demand for travel in the corridor in 2031, for comparison Figure 2-2 summarises flows in 2011. This forecast demonstrates significant increases in projected demand between Cambourne and Bourn Airfield to the City Centre (from 280 people to 610 people). This clearly supports the case for public transport improvements to prevent increased congestion and provide an effective alternative mode of travel to the car.

Figure 2-1 Morning peak 3 hour demand, all modes, 2031, ‘do something’ with transport improvements (flows over 100 people shown)

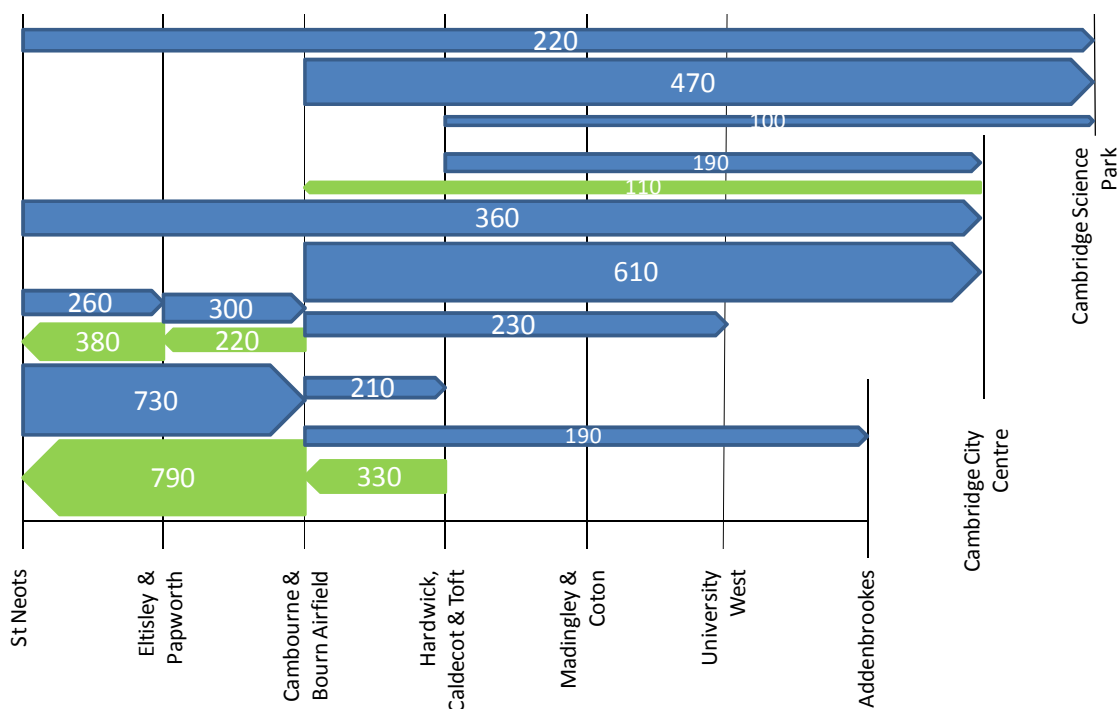
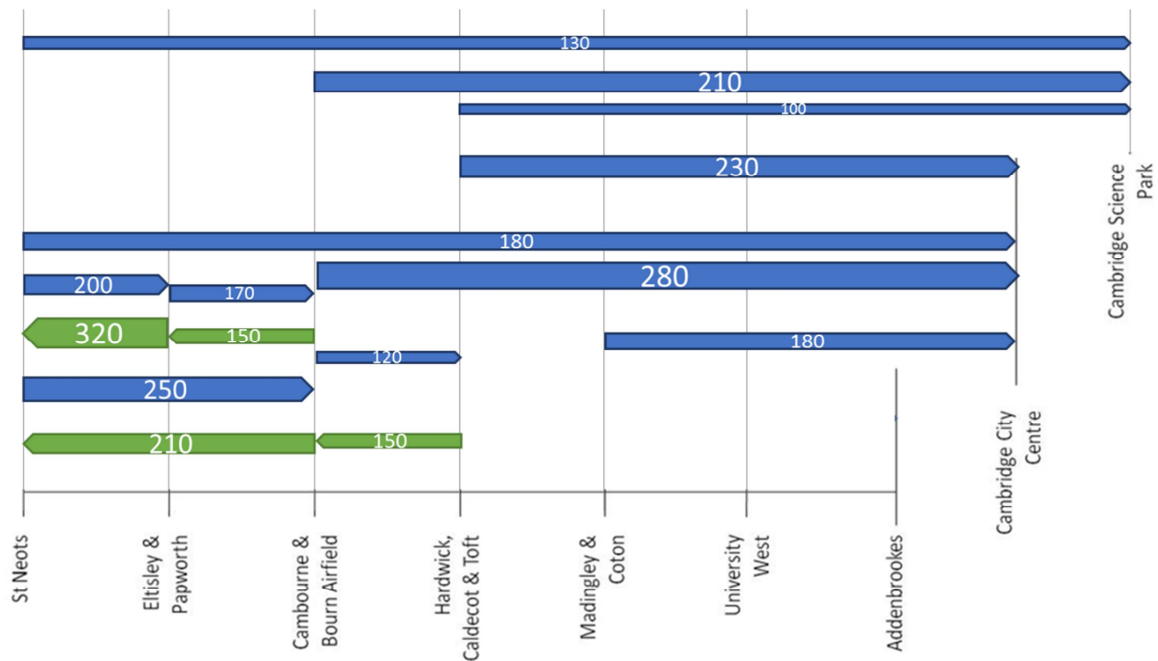


Figure 2-2 Morning peak 3 hour demand, all modes, 2011 (flows over 100 people shown)



- 2.14. It is important to understand the pattern of this demand for travel, and to consider this when assessing options to assist in the growth planned in the corridor. Any option that is developed must look to address the key demand movements that could feasibly be made by public transport.

Tranche 1 (East of Madingley Mulch)

- 2.15. Options 1A and 1B provide similar levels of connectivity. Compared to options 1A and 1B, Option 1C improves connectivity to the West Cambridge Site, but provides less connectivity to Madingley Road.

Tranche 2/3 (West of Madingley Mulch Roundabout)

- 2.16. Option 2A does not feature any public transport infrastructure between Madingley Mulch roundabout and Cambourne. Any new patronage would be due to current or new bus services accessing development at West Cambourne and Bourn Airfield from the existing road network.
- 2.17. In contrast Options 2B and 2C provide infrastructure improvements from Cambourne to Cambridge, and provide connectivity to Cambourne, Bourn Airfield and Hardwick. The connectivity is slightly different for each option, with Option 2B focussing on the existing corridor and Option 2C opening a new corridor further south of the existing and proposed development locations.

Journey Time Analysis

- 2.18. A series of journey time graphs have been produced to compare the journey times for trips from Caxton Gibbet, along the A428 and A1303, to Queen's Road by both highway and public transport. This comparison has been made for the do-minimum scenario, comparing the different options for both sections.
- 2.19. It is important to consider the journey times of each public transport option against each other, and also to see how these journey times compare against the equivalent highway time. The balance between highway and public transport journey time will be a large element in the benefits of each option, and the attraction of each option to travellers.
- 2.20. By analysing the highway journey times, it is also possible to identify if there are any other impacts (decongestion or otherwise) to the highway, as a result of the implementation of the option.

- 2.21. The performance of individual sections will be dependent upon the option for the adjacent section that is chosen. For the options that have been tested, a range is presented below where the adjacent section has an impact upon the journey times.
- 2.22. It is also important to note that the figures quoted are hourly averages which do not represent the variability of journey times that can be experienced along the route. At present variability is high in both AM and PM peaks and this is likely to grow by 2031 if no mitigation measures are introduced.

Tranche 1 Options

- 2.23. Table 2-1 below presents the comparison of the options for Tranche 1, comparing the forecast journey times by both highway and public transport. All bus journeys are going to Queens Road, although Options 1A and 1B connect to Northampton Street, while Option 1C connects to Silver Street (via Sidgwick Avenue). All highway journey times are to Northampton Street junction.

Table 2-1 Forecast 2031 AM Peak Hour Eastbound Journey Time Comparison - Madingley Mulch to Queen's Road

Option (Tranche 1)	Public Transport (minutes)	Highway (minutes)
Do Minimum	17	12
Option A	Between 9 and 10	Between 12 and 13
Option B	8	11
Option C	5	11

- 2.24. It can be seen that each of the Tranche 1 options offers a significant benefit in journey time over and above the do minimum scenario, and that these improvements also lead to the public transport journey times being lower than those along the highway. Option C offers the most improvement from the do minimum scenario, by providing a dedicated route away from the current highway for the majority of the route and since it allows bi-directional flow, it benefits users both in the AM and PM peaks. In contrast, Option 1A follows the existing route, and while there is some benefit to be obtained from the bus lanes allowing the public transport services to bypass the highway delays, this is more limited. Option 1B falls between these, by providing a combination of off and on-line improvements, with bi directional flows on the offline section.

Tranche 2/3 Options

- 2.25. Table 2-2 below presents the comparison of the options for Tranche 2/3, comparing the forecast journey times by both highway and public transport.

Table 2-2 Forecast 2031 AM Peak Hour Eastbound Journey Time Comparison – Caxton Gibbet to Madingley Mulch

Option (Tranche 2)	Public Transport (minutes)	Highway (minutes)
Do Minimum	25	7
Option 2A	Stopper - 25 Express - 8	7
Option 2B	Between 10 and 11	7
Option 2C	8	7

- 2.26. Option 2A does not propose any changes to infrastructure and journey times will largely depend on the type of service offered by operators. A direct 'express' service along the existing A428 would be faster than a service along St Neots Road (which would have the opportunity to stop to pick up passengers that an express service would not).

- 2.27. Options 2B and 2C both offer improvements above the do minimum journey times, and bring the journey times down towards the highway times. However, both of these also offer the opportunity to provide access to these services from the residential areas along the A428 corridor – something that would not be captured by an equally fast service in Option 2A.
- 2.28. Option 2C provides the greatest journey time improvement, due to the segregation of buses from other modes of transport.

Patronage

- ~~2.29.~~ Each of the options has differing connectivity to areas of the corridor and therefore provides different opportunities for users to use the new services. The total level of public transport usage for each option will therefore differ as a result.
- 2.30. The details below provide a description of the attributes of each of the options and their relative ability to attract patronage. This is followed by an indicative forecast patronage level for the scheme as a whole (Tranches 1 and 2/3 combined).

Tranche 1

Option 1A

- 2.31. Option 1A provides improvements along the existing alignment, although only in the eastbound direction. This therefore is likely to be attractive to users who travel towards Cambridge in the AM peak when corridor (eastbound) congestion is most acute.

Option 1B

- 2.32. Option 1B will provide similar incentives to eastbound movements as Option 1A, but also offers westbound improvements along the Madingley Rise section, therefore being more likely to attract the broadest range of peak period travellers. However, the PM peak benefits will not be so significant, since the improvements are uni-directional to the east of the M11.

Option 1C

- 2.33. Option 1C offers bi-directional improvements to the full length from the proposed new Park & Ride site through to Grange Road, offering improved and more reliable journey times. This option also follows a different alignment that may be more attractive to those users who wish to access both the West Cambridge University site as well as the southern side of the City Centre. Conversely, this alignment would be less attractive to those who wish to access any site directly adjacent to Madingley Road.

Tranche 2/3

Option 2A

- 2.34. Option 2A offers benefits in terms of increased frequencies for longer distance movements, also decreased journey times via a potential express service. However, the lack of additional bus priority means that the reliability of any such journey may suffer, and therefore there may be a reduced attractiveness to these services compared to the other Tranche 2/3 options.

Option 2B

- 2.35. Option 2B helps to improve both the attractiveness and reliability of services compared to Option 2A, and therefore is more likely to be used by those from Cambourne and Bourn Airfield. Bus priority measures combined with a new route through the heart of the developments will support this, although there is still interaction between the bus services and traffic, particularly at Madingley Mulch, that could influence reliability.

Option 2C

- 2.36. Option 2C provides the same service level and accessibility within Cambourne and Bourn Airfield and greater connectivity to Highfields Caldecote as well as the south of Hardwick, albeit at the expense of the north of Hardwick. The dedicated offline nature of the route

provides the greatest level of public transport priority with selective vehicle detection at highway crossings, therefore being most likely to offer reliable, and therefore attractive, services.

Potential Patronage Levels

- 2.37. While work completed to date has not considered each tranche individually, sample schemes containing elements from Tranche 1 and Tranche 2/3 have been modelled. These can be used to identify a potential forecast patronage increase if elements of both tranches were to be completed.
- 2.38. Four different sample schemes were tested, with a resultant forecast increase in public transport patronage of up to between 1,800 and 2,300 person trips in the AM peak period above the Do Minimum patronage levels. These levels of patronage are clearly dependent upon the combination of options from Tranche 1 and Tranche 2/3. The patronage would be carried by a combination of new services and new and existing Park & Ride services. These values are illustrative of the levels of patronage forecast for the schemes under consideration.
- 2.39. Ongoing work will assess how each of the different options from within each tranche perform.

Park and Ride Impacts

- 2.40. Understanding the level of Park and Ride use is a key factor to assess when seeking to establish the relative merits of each of the options proposed. While some of the options serve the western developments directly, some of them will rely more heavily on take-up of Park and Ride to establish high levels of patronage on the services.
- 2.41. In a do-nothing scenario, Park and Ride usage across both the Cambridge and Guided Busway Park and Ride sites is forecast to increase through to 2031 from current levels, with combined total car arrivals at all seven existing sites in the AM peak period forecast to reach 2,200 cars by 2031.
- 2.42. By implementing any of the options, an increase in the use of Park and Ride sites can be seen across Cambridge. The impact of changes to the level of Park and Ride usage is heavily influenced by the surrounding infrastructure and resultant connectivity to the services.
- 2.43. Each of the Tranche 1 options is likely to have a different impact upon the level of Park and Ride utilisation. Option 1A and 1B are both likely to offer benefits to the existing Madingley Road site, as well as offering a new service from the Madingley Mulch Park and Ride site. This is likely to therefore increase the take up of these Park and Ride sites.
- 2.44. Option 1C will provide the greatest benefit to the new Madingley Mulch site, with little improvement to the Madingley Road site. It is therefore most likely that while there would be a significant take up of trips at Madingley Mulch, there is unlikely to be a significant change to the use of Madingley Road. There is a possibility that some users, who may have used either Trumpington or Milton Park & Ride sites previously due to congestion in the corridor, may move to either the Madingley Road or Madingley Mulch sites as a result of the improvements to the service levels. This would depend upon the ultimate destination of the user within the City, as to if the service patterns provided offer any benefit or not. There is also the potential for there to be abstraction of users from Busway services.
- 2.45. It should be noted that these impacts are the effect on the overall Park and Ride market as a result of improvements along this single corridor. There will be impacts upon these benefits as improvements along other corridors come on-line, and these may erode the level of growth to Park and Ride services forecast here.

Congestion for Road Users

- 2.46. The analysis presented above to compare the public transport and highway journey times can also be used to give a measure of changes in congestion along the routes where PT services have been improved.

Tranche 1

Option 1A

- 2.47. Option 1A maintains highway journey times on the A1303 for general vehicular traffic between the Madingley Mulch roundabout and central Cambridge.

Option 1B

- 2.48. Option 1B reduces highway journey time on the A1303 between the Madingley Mulch roundabout and the M11 by around 10% in the AM peak period in 2031 compared to the do-minimum scenario. It does not change journey times on the A1303 between the M11 and central Cambridge.

Option 1C

- 2.49. Option 1C has very similar congestion impacts to Option B, reducing highway journey time on the A1303 between the Madingley Mulch roundabout and the M11 by around 10% in the AM peak period in 2031 compared to the do-minimum scenario, and not changing journey times on the A1303 between the M11 and central Cambridge.

Tranche 2/3.

- 2.50. Some of the Tranche 2/3 options may provide benefits to congestion in the Tranche 1 area of the study, as they may encourage car users to adopt public transport from the outset of their journey. Ongoing assessment will be undertaken to establish specific impacts.

Key Junction Impacts

- 2.51. Considering the current corridor conditions, a number of key junctions (those at which major movements in the corridor occur) have been identified on the A428 / Madingley Road corridor, as follows:
- Madingley Mulch Roundabout
 - A1303 / Coton village turn
 - A1303 / M11 Off-slip
 - A1303 / M11 On-slip
 - A1303 / Madingley Road P&R
 - A1303 / JJ Thomson Avenue
 - A1303 / Storey's Way
 - A1303 / Grange Road
 - A1303 / Lady Margaret Road
 - A1303 / Northampton Street
- 2.52. The highway model has been used to assess each of these junctions in terms of flow to capacity ratio (V/C) to give an idea of the level of stress that each junction would experience both for the "do minimum" scenario, and for the proposed options. This measure is provided by turn at each junction with the exception of the Madingley Mulch Roundabout which is assessed by approach arm, rather than turn due to modelling limitations.
- 2.53. It is generally accepted that a flow to capacity ratio in excess of 0.85 indicates that a junction is under stress. Locations where a ratio of 0.85 or above has been identified are highlighted in red in Appendix B.
- 2.54. The main locations where congestion has been identified are described below.

AM Peak (08:00 – 09:00)

- A1303 / M11 Off-Slip on the western approach from A1303 eastbound where the V/C is 1.06 in the do-minimum and between 1.06 and 1.08 in the do-something scenarios. This corresponds with currently known queues.
- A1303 / JJ Thomson Avenue on the right turn from the Cambridge North-West site (northern approach) where the V/C is 0.92 in the do-minimum scenario and between 0.87 and 0.96 in the do-something scenarios.
- A1303 / JJ Thomson Avenue on the right turn into JJ Thomson Avenue from the A1303 (West) where the V/C is 0.84 in the do-minimum scenario and between 0.67 and 0.86 in the do-something scenarios.
- A1303 / Lady Margaret Road on the left turn from Lady Margaret Road onto A1303 (East) where the V/C is 0.92 in the do-minimum and between 0.92 and 0.93 in the do-something scenarios.

PM Peak (17:00 – 18:00)

- Madingley Mulch Roundabout on the eastern approach from A1303 westbound where the V/C is 0.87 in the do-minimum and between 0.62 and 0.81 in the do-something options.
- A1303 / Coton village on all turns at the approach from Coton where the V/C is 1.06 in the do-minimum scenario and between 1.03 and 1.06 in the do-something options.
- A1303 / M11 Off-Slip on the eastern approach from A1303 westbound where the V/C is 0.97 in the do-minimum and between 0.95 and 1.05 in the do-something options.
- A1303 / JJ Thomson Avenue on the ahead and right turns from the Cambridge North-West site (northern approach) where the V/C is 1.01 in the do-minimum scenario and between 0.15 and 1.03 in the do-something options.
- A1303 / Grange Road on the approach from Grange Road where the V/C is 1.04 in the do-minimum scenario and between 1.00 and 1.04 in the do-something.
- A1303 / Lady Margaret Road on the eastern approach from the A1303 westbound where the V/C is 0.94 in the do-minimum scenario and between 0.91 and 0.94 in the do-something options.

2.55. All of the locations where the V/C exceeds 0.85 were already over capacity in the do-minimum and stress at these locations has not been caused by any of the proposed options. There are no locations where the introduction of the options gives rise to any significant increases in V/C ratio. There are some instances where the options have caused very slight increases, but mostly they cause no changes / decreases in V/C which is encouraging.

2.56. A full breakdown of the results can be seen in Appendix B.

Cycling and Walking

2.57. Potential for improved cycle and walking facilities integral to all options has been assessed qualitatively for all options.

Madingley Rise Section

2.58. From Madingley Mulch to the junction with Cambridge Road, a bi-directional cycle and footpath runs along the southern side of the carriageway. This shared use footpath crosses several junctions which provide access to residences and businesses, but these are relatively distant from one another. The shared footpath transitions to the other side of the carriageway just east of the Cambridge Road junction.

2.59. Option 1A involves widening the carriageway to introduce an east-bound bus lane. It is assumed that facilities within the corridor will remain largely unchanged, but the bus lane may provide an alternative option for those cyclists who choose to use the road. Where

opportunities exist for additional cycling facilities without impacting bus journey times, these can be considered.

- 2.60. Options 1B and 1C involve providing off-line facilities along this section. The existing facilities on Madingley Rise would remain, but additional facilities would be provided along the offline sections. The new facilities provided as part of Option 1B would require cyclists to travel along a less direct route than the current one, but may nevertheless prove attractive due to full segregation. Similarly, it is expected that the off-line facilities proposed in Option 1C may prove popular as they would provide very good connectivity to the West Cambridge site.
- 2.61. These improvements also provide users with the potential to Park and Cycle from the Madingley Mulch Park and Ride site that is included in all three Tranche 1 options.

Madingley Road Section

- 2.62. Segregated shared use footpaths run both on the north and the south side of the carriageway east of the M11. Accesses to residences and businesses are more common along this section, increasing the risk of accidents and forcing cyclists to slow down in certain sections. On-road cycleways are provided intermittently from the junction with Clark Maxwell road to the inner ring road.
- 2.63. Option 1A and 1B involve widening the carriageway to introduce an east-bound bus lane. It is proposed that facilities will remain largely unchanged, but the bus lane may provide an alternative option for those cyclists who choose to use the road.
- 2.64. Option 1C involves an offline bus route, with cycling facilities provided alongside. This will offer improved connectivity to cyclists travelling to the West Cambridge site and Grange Road.

Cambourne to Madingley Mulch Section

- 2.65. Facilities along these section are limited, with cyclists using the old A428 (St Neots Road) as an on-road route. A shared footway is provided from the junction leading to Highfields Caldecote to Madingley Mulch.
- 2.66. Option 2A does not involve delivering infrastructure along this section, and as a result it is not proposed to change existing facilities.
- 2.67. Option 2B would offer a moderate improvement to cycling facilities, as a bus route would be provided through Cambourne and Bourn which cyclists could use to avoid some of the on-road section between Cambourne and Highfields Caldecote.
- 2.68. Option 2C provides the greatest benefits, as a shared cycle and footpath would be provided alongside the off-line bus section.
- 2.69. It is worth noting the City Deal programme includes the provision of a high quality cycle and pedestrian link between Cambourne and Cambridge, irrespective of whether this is provided as part of one of the schemes described in this report.
- 2.70.

Safety

- 2.71. Analysis of road accident data between 2009 and 2013 shows that the accident rates are similar to national averages. However it was noted that there were two sections of the corridor that exhibited a greater number of accidents during the five year period.
- 2.72. These sections are located on A428 between Eltisley and Caxton Gibbet (37 accidents in 5 years), and on the A1303 between the A428 and M11 (30 accidents). Both of these areas are known to suffer congestion problems.
- 2.73. Detailed assessment of the safety implications of the proposed options has not been undertaken to date. However, improvements which tackle congestion and queuing at these two locations will be likely to have a positive impact on road safety.

Environmental Constraints

- 2.74. It is clear that from the initial overview there are many factors to consider from an environmental aspect. Cambridge is a historic city that has many heritage assets and there are important nature conservation sites in both Cambridge and South Cambridgeshire including Sites of Special Scientific Interest (SSSI). Off road alignments would involve new routes through open countryside, some of which is designated Green Belt.
- 2.75. Consideration of the environmental impacts of the proposed options is an integral part of the assessment methodology. To date only exploration of constraints and possible impacts has been undertaken, as a fully WebTAG compliant assessment would require outputs from the transport model, which will not be finalised until after consultation is undertaken.
- 2.76. The key environmental constraints are summarised below:

Assessed part of the route	Constraint	Options Affected
Segregated busway south of Hardwick to new Madingley Mulch P&R	<p>This route is sparsely populated and avoids main settlements.</p> <p>The option would have unknown impact on buried heritage resources.</p> <p>Potential loss of grade 2, 3a & 3b agricultural land and loss of protected species and habitats along route</p> <p>Hardwick Wood SSSI is a known SSSI in favourable condition (as of 2011).</p>	2C
Segregated bus link from Cambourne to Bourn Airfield	<p>The Proposed Submission Local Plan has a number of policies that would be affected by this section including - Policy SS/6: New village at Bourn Airfield; Policy NH/12 Local Green Space;</p> <p>There are a number of listed buildings in the vicinity and there would be potential loss of grade 2, 3a, 3b Agricultural land.</p>	2B, 2C
Madingley Mulch P&R (3 options for location).	<p>Only the option south of A1303 has the risk of affecting sensitive population receptors.</p> <p>All options would involve the loss of agricultural land.</p>	1A, 1B and 1C
Segregated busway from new Madingley Mulch P&R to M11	<p>Green Belt designation (Policy 4/1 in 2006 Cambridge Local Plan and Policy 4 in the emerging Cambridge Local Plan. For South Cambs, Policy ST/1 in the 2007 Core Strategy and S/4 in the emerging South Cambridgeshire Local Plan).</p> <p>Madingley Wood is a known SSSI in favourable condition (as</p>	1B

Assessed part of the route	Constraint	Options Affected
	<p>of 2012).</p> <p>The American Cemetery is classed as an historic park and garden (Grade I) and Madingley Hall is a Grade II historic park and garden.</p>	
Madingley Road bus lane	<p>Madingley Road passes through West Cambridge and Conduit Head Road Conservation areas and there are protected open spaces directly to the north of Madingley Road.</p> <p>There are various Grade II listed buildings fronting Madingley Road. AQ/Noise – The inbound nearside bus lane is largely unpopulated within 50m until east of Storeys Way so would have limited noise and air quality effects.</p> <p>Environmental considerations include Green Belt designation (Policy 4/1 in 2006 Cambridge Local Plan and Policy 4 in the emerging Cambridge Local Plan.</p> <p>South Cambridge Shire, Policy ST/1 in the 2007 Core Strategy and S/4 in the emerging South Cambridgeshire Local Plan).</p>	1A, 1B
Busway (partial route) Segregated busway south of Hardwick to Grange Road	<p>Environmental considerations include Green Belt designation (Policy 4/1 in 2006 Cambridge Local Plan and Policy 4 in the emerging Cambridge Local Plan. For South Cambs, Policy ST/1 in the 2007 Core Strategy and S/4 in the emerging South Cambridgeshire Local Plan).</p> <p>The option would have unknown impact on buried heritage resources.</p> <p>The West Cambridge Conservation Area covers a large area to the south of Madingley Road (as well as the north) including Grange Road. There are also numerous protected open spaces to the south of Madingley Road including protected verges and sports fields</p>	1C

Engineering Considerations

- 2.77. A high level assessment of the feasibility of all options has been carried out by means of a desktop study examining Ordnance Survey drawings and other available sources of information. Based on this information, all options are considered to be feasible from an engineering perspective.
- 2.78. Further examination of engineering constraints (such as ground conditions and levels) will be carried out as part of the ongoing option appraisal process. These unknowns are common to the early phases of any engineering feasibility study, and will be clarified as scheme development progresses.

Legal and Statutory Considerations

Third Party Land and Properties

- 2.79. During this stage of study the detailed design features are yet to be undertaken for either the off line and /or highway work. All options will require a degree of land take, the most significant of which will be for the provision of the new P&R at Madingley Mulch, followed by the offline options. Widening to Madingley Road as part of Options 1A and 1B will be carried out within the highway boundary if at all possible, but some locations where the existing highway widths are not sufficient for the safe passage of road users, cyclists and pedestrians may require land take.

Costs

- 2.80. Costs for each of the six options were estimated based on professional experience and by examining the cost per kilometre of previous similar options completed locally and nationally. Where uncertainty over costs exists, highest estimates have been presented, and it is anticipated that ongoing development will reduce this uncertainty and potentially reduce the costs.
- 2.81. An initial review of features along each of the routes, such as river crossings, listed buildings, sites of special scientific interest, was conducted during the option development stage. This allowed for revised alignments and helped to reduce the likely financial adjustment required to estimate the cost of the option, such as optimism bias, along with the risk associated with the delivery of the project.
- 2.82. Following the finalisation of the six options it was then possible to split them into sections in order to provide a more detailed breakdown of costs for the different elements of the options, this included junctions, major structures, park and rides, offline routes, single lane widening and areas through developers land.

Breakdown for each option

- 2.83. **Option 1A**
Park and Ride - £7million
Single lane widening with bus priority measures - £10million
Signalisation of Madingley Mulch roundabout - £1million
Total Estimated Cost for Option 1A - £18million

2.84. **Option 1B**

Park and Ride - £7million

Single lane widening with bus priority measures - £5million

Offline Route with bus priority measures at junctions including culverts- £7million

Signalisation of Madingley Mulch roundabout - £1million

Total Estimated Cost for Option 1B - £20million

2.85. **Option 1C**

Park and Ride - £7million

Signalisation of Madingley Mulch roundabout - £1million

Offline Route with bus priority measures at junctions including culverts- £14million

Bridge over M11 –£45million*

Total Estimated Cost for Option 1C - £67million

**The bridge cost is considered a high range estimate due to unknown ground conditions. This cost could be reduced by up to 50% depending on detailed assessment outcomes.*

2.86. **Option 2A**

Total Estimated Cost for Option 2A - £nominal

2.87. **Option 2B**

Realignment in Cambourne - £0.5million

Offline Route with bus priority measures at junctions including culverts- £9million

Bus priority on St Neots Road - £0.5million

One way system on St Neots Road- £0.5million

Total Estimated Cost for Option 2B - £11million

2.88. **Option 2C**

Realignment in Cambourne - £0.5million

Offline Route with bus priority measures at junctions including culverts through developers land- £12million

Offline Route with bus priority measures at junctions including culverts - £15million

Total Estimated Cost for Option 2B - £27.5million

3. SWOT Analysis

3.1. The strengths, weaknesses, opportunities and threats associated with each option have been summarised in this section. The analysis has been informed by work carried out during the initial phase of the project and the initial assessment detailed in the previous section.

Option 1A

<p>Strengths</p> <ul style="list-style-type: none"> • P&R capacity in the corridor is increased • New P&R located at onset of greatest delay on the road network • No new structures are required • Makes good use of existing infrastructure • Relatively low cost of implementation • Efficient at intercepting majority demand • Efficient at providing PT priority on links of most acute congestion in AM peak 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Inbound bus lanes will only benefit morning peak bus journeys and will not address issues with PM westbound peak congestion • The route along Madingley Rise and Madingley Road is potentially restricted by the width of the corridor available for construction • Cost of providing infrastructure along Madingley Rise and Madingley Road
<p>Opportunities</p> <ul style="list-style-type: none"> • Any works could be accommodated in the existing road network which could make links to wider strategic network of bus priority measures easier to achieve • The route beyond the A428 has the potential to deliver a route into Cambridge linking with the existing park and ride site 	<p>Threats</p> <ul style="list-style-type: none"> • Less flexible route as it uses existing highway • Possible loss of cycle amenity on Madingley Road • Environmental impacts on road facing properties

Option 1B

<p>Strengths</p> <ul style="list-style-type: none">• P&R capacity in corridor increased.• New P&R located at onset of greatest delay on the road network.• No new structures are required.• Fully segregated bi-directional route from P&R to the M11 offers benefits in both AM and PM peaks.	<p>Weaknesses</p> <ul style="list-style-type: none">• Some green field construction.• Stopping the project during construction would leave some infrastructure that may not serve any purpose to the local area or communities.• High cost to provide new infrastructure• Inbound bus lane on Madingley Road will only benefit morning peak bus journeys and will not address issues with PM peak congestion.• The route along Madingley Road is potentially restricted by the extent of the corridor available for construction.
<p>Opportunities</p> <ul style="list-style-type: none">• As the route runs through open land west of the M11, there is flexibility to alter the alignment if required.• The route beyond the A428 has the potential to deliver a route into Cambridge linking with the existing park and ride site.	<p>Threats</p> <ul style="list-style-type: none">• Lack of fixed route alignment and scale of forecast traffic change prevents certainty on a number of impacts.• Due to the various constraints, such as listed buildings and SSSI's, there is limited capability to change the route without impacting on areas that may restrict the route.

Option 1C

<p>Strengths</p> <ul style="list-style-type: none"> • P&R capacity in corridor increased • New P&R located at onset of greatest delay on the road network. • Segregated bi-directional busway offers AM and PM peak congestion avoidance on direct approach to the City. • Efficient at providing PT priority at areas of most acute congestion. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • New M11 over-bridge required. • High level of green field construction needed. • Options for crossing the M11 are limited to localised areas due to known constraints. • Improvements to journey times from existing Madingley Road P&R site would only be delivered through additional link to proposed alignment via West Cambridge University site.
<p>Opportunities</p> <ul style="list-style-type: none"> • The route runs mainly through non-built up land and there is flexibility to alter the route in this area. • Potential ease of connectivity to Western Orbital routes • Potential to upgrade cycle facilities along line of the Coton Footpath through to Grange Road. 	<p>Threats</p> <ul style="list-style-type: none"> • Unknown conditions for M11 bridge gives rise to a large range in cost. • Unknown available land through/adjacent to the West Cambridge University site. • Lack of fixed route alignment and scale of forecast traffic change prevents certainty on a number of impacts. • Stopping the project during construction would leave some infrastructure that may not serve any purpose to the local area or communities. • The constraint of the M11 and nearby Coton and the University limit any revisions that may be required to the route. • Possible environmental impact could be high.

Option 2A

Strengths <ul style="list-style-type: none">• Makes good use of existing infrastructure• Low capital costs, no new infrastructure.	Weaknesses <ul style="list-style-type: none">• Does not provide PT priority directly to/from Cambourne, Bourn Airfield or St Neots.
Opportunities <ul style="list-style-type: none">• Lack of fixed infrastructure west of Madingley Mulch allows for a range of service patterns to be adopted.	Threats <ul style="list-style-type: none">• Lack of scale of traffic change prevents certainty on environmental impact.• Change in traffic conditions on A428 could slow bus journey times without dedicated public transport priority.

Option 2B

<p>Strengths</p> <ul style="list-style-type: none">• No new structures are required.• Minimises need for green field route construction.• Makes good use of existing infrastructure.• Efficient at intercepting demand directly from Cambourne and Bourn Airfield.	<p>Weaknesses</p> <ul style="list-style-type: none">• Use of the old A428 will make journey times slower than using the dual carriageway.
<p>Opportunities</p> <ul style="list-style-type: none">• A number of the individual elements within the option could be scaled up or down whilst utilising the existing network.• Stopping the project during construction would have a lesser impact than some of the routes and any works could be accommodated in the existing road network. If the route was stopped then the improved road network will be utilised in the existing network.• Submission South Cambridgeshire Local Plan Policies require segregated public transport provision through the developments, and a bus link across the Broadway.	<p>Threats</p> <ul style="list-style-type: none">• Unknown how the route will link to/through the developers' sites and how they will be connected.• Lack of fixed route alignment through these sites and scale of forecast traffic change prevents certainty on a number of impacts.• Environmental impacts of off-line route and along St Neots Road.

Option 2C

<p>Strengths</p> <ul style="list-style-type: none"> • No new structures are required • Efficient at intercepting demand directly from Cambourne and Bourn Airfield. • Fully segregated bi-directional route from Cambourne to the new P&R offers benefits in both AM and PM peaks • Services pass close to both Highfields Caldecote and Hardwick, providing connectivity to both. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Significant green field construction. • Stopping the project during construction would leave some infrastructure that may not serve any purpose to the local area or communities. • High cost to provide new infrastructure.
<p>Opportunities</p> <ul style="list-style-type: none"> • As the route runs through non-built up land there is flexibility to change route to accommodate additional locations and nodes. • Submission South Cambridgeshire Local Plan Policies require segregated public transport provision through the developments, and a bus link across the Broadway. 	<p>Threats</p> <ul style="list-style-type: none"> • Unknown how the route will link to the developers' sites and how they will be connected. • Unknown proximity of route to wildlife site and size of wildlife sites near Highfields, Caldecote and Hardwick. • Lack of fixed route alignment and scale of forecast traffic change prevents certainty on a number of impacts. • Due to the various constraints, such as listed buildings and SSI's, there is limited capability to change the route without impacting on areas that may restrict the route or development.

4. Summary and Next Steps

Summary

- 4.1. Current congestion experienced along the A428/A1303 corridor is high, resulting in poor travel conditions for all modes of travel. Without mitigation, these conditions are forecast to get worse over time.
- 4.2. There are a number of large development proposals along the corridor. These growth areas currently have poor connections by public transport, and therefore there is little realistic alternative to car travel at this time, which without intervention would put unacceptable levels of additional traffic and therefore congestion on the highway network. It should however be noted that improvements may be forthcoming if/when the proposed developments are constructed. This would not accord with the long term vision of the Cambridge City Deal partners for a better quality of life within the Greater Cambridge area.
- 4.3. The submitted Local Plans of the Councils in both South Cambridgeshire and Cambridge City require that transport infrastructure will be in place to address the impacts of future development, reflecting the Transport Strategy for Cambridge and South Cambridgeshire. Therefore, the development and growth anticipated require appropriate interventions to facilitate desirable and realistic alternative to travel by car through the provision of high quality public transport services between key locations.
- 4.4. The initial assessments of proposed improvements indicate that providing minor bus priority and highway improvements along the corridor is unlikely to result in long-term changes to travel patterns. To enable sustainable growth and development along the corridor, an ambitious solution to provide fast, reliable and high quality public transport with attractive journey times should be delivered. Ongoing work will continue to evaluate all options and their potential to adequately provide the desired long term changes.
- 4.5. Assessment of the shortlisted options identified at Phase 1 contained within this report has shown that they have the potential to deliver the desired standard of high quality public transport in accordance with the requirements of the Cambridge City Deal Partnership.
- 4.6. The remainder of the Phase 2 of the study will be carried out after consultation, and will involve refinement of the options and a further assessment compliant with WebTAG guidance.

Next Steps

- 4.7. In line with standard Department for Transport scheme appraisal process (WebTAG) the options developed should now be presented to the public for consultation. This should be carried out before proceeding to detailed option assessment, as the development and appraisal of the options should be informed by stakeholders' views. Consulting with stakeholders not only provides an indication of the level of support or otherwise to the options that form the scheme, but can also inform the design and appraisal process by challenging which options are appropriate, and potentially generating alternative solutions for better outcomes.
- 4.8. The level of assessment undertaken so far provides sufficient information the purposes of the consultation process. Additional information may be required to be brought forward to assist stakeholder understanding as required.
- 4.9. Given the Cambridge City Deal partnership funding arrangements, any scheme may be delivered in two tranches. Tranche 1 (to 2020) would include the part of the corridor which runs from the A428/A1303 junction at Madingley Mulch roundabout, east to Cambridge City Centre. Tranche 2/3 (up to 2030) would include the part of the corridor which runs west of Madingley Mulch to Caxton Gibbet. As a result, the options for the

proposed scheme are best presented for public consultation and stakeholder engagement in this format.

- 4.10. Consultation is therefore being undertaken in advance of any decisions on final options to consider and facilitate necessary input into the development of the scheme.

Appendix A. Option Outline Maps

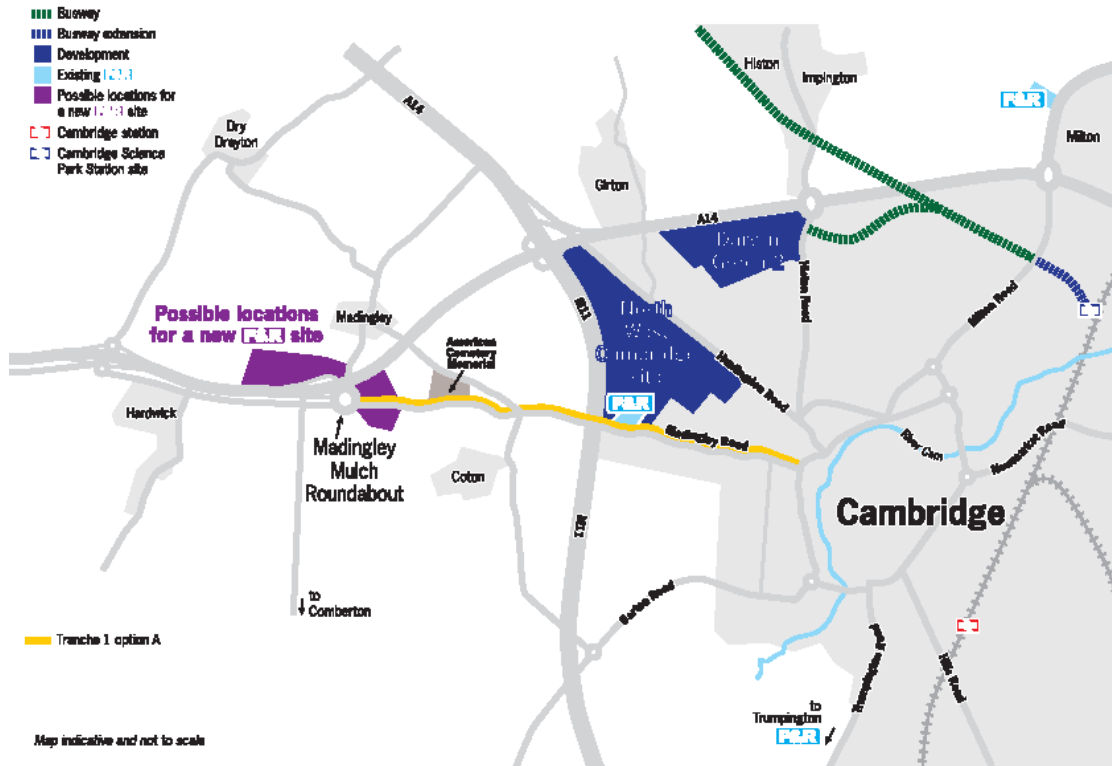


Figure A-1 Option 1A

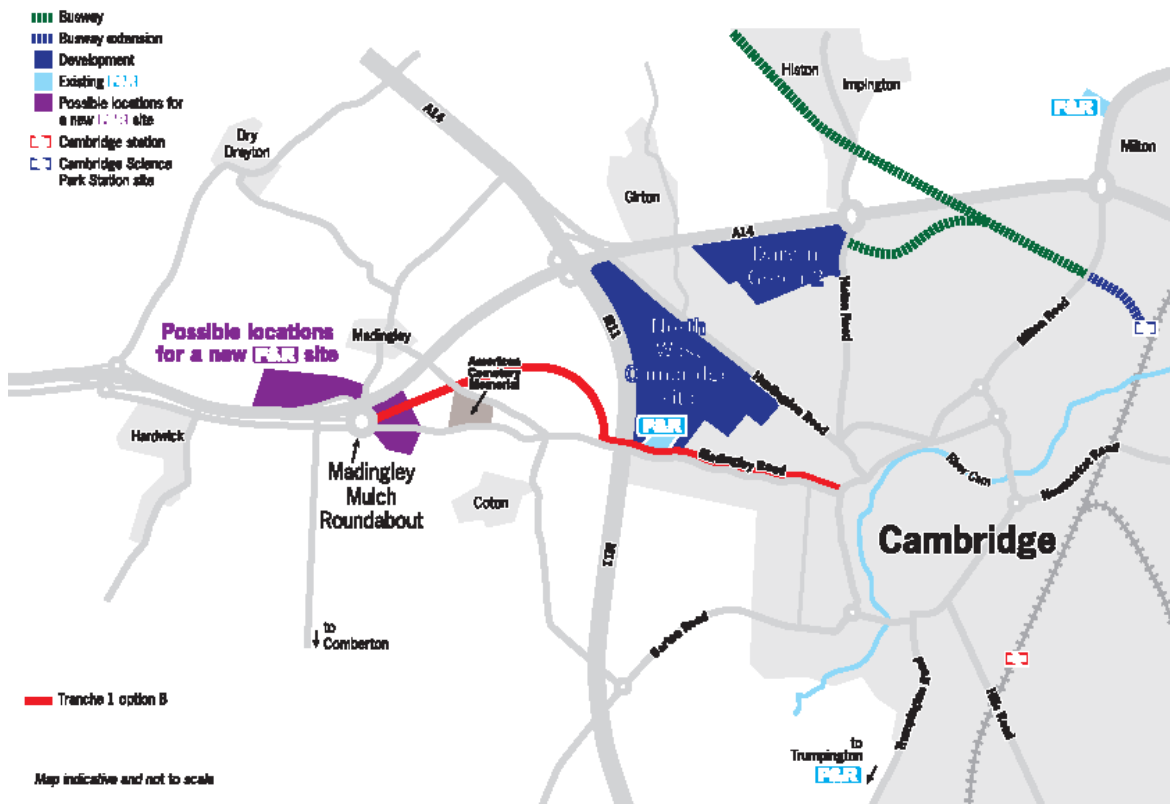


Figure A-2 Option 1B

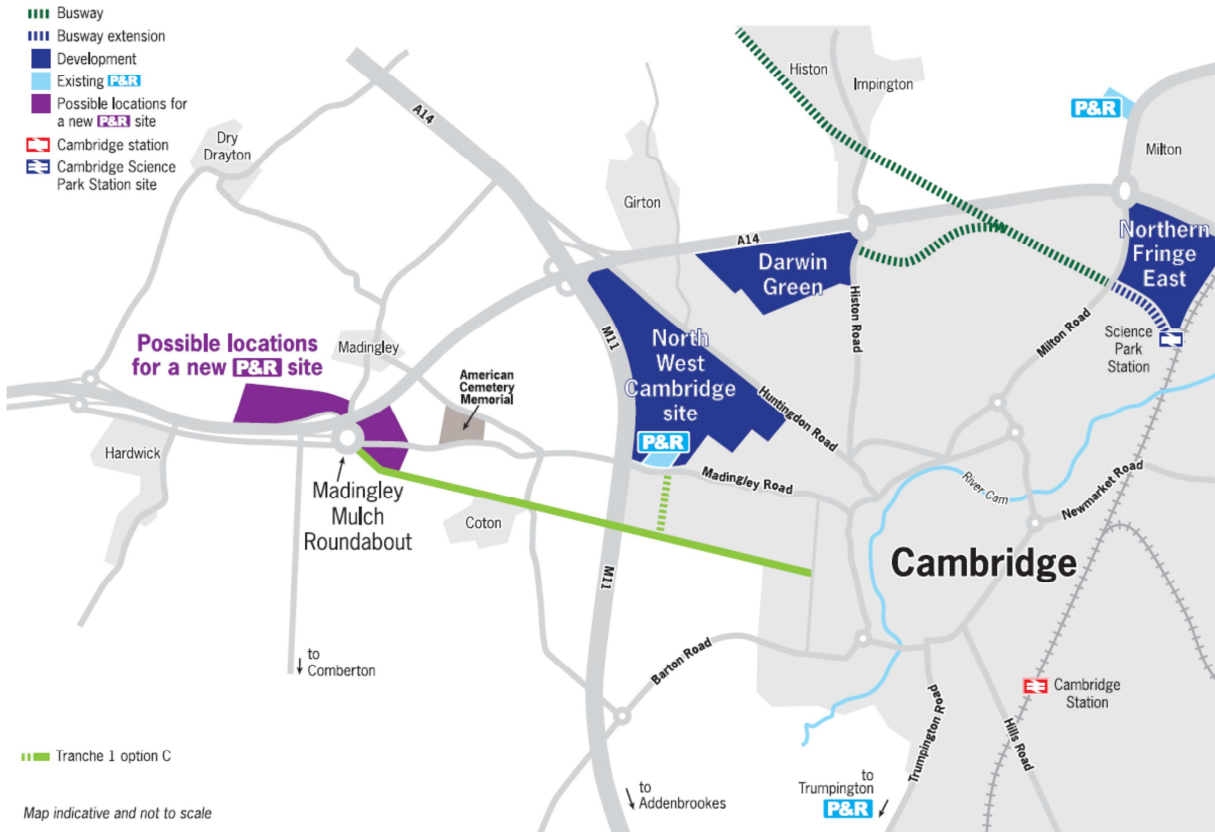


Figure A-3 Option 1C

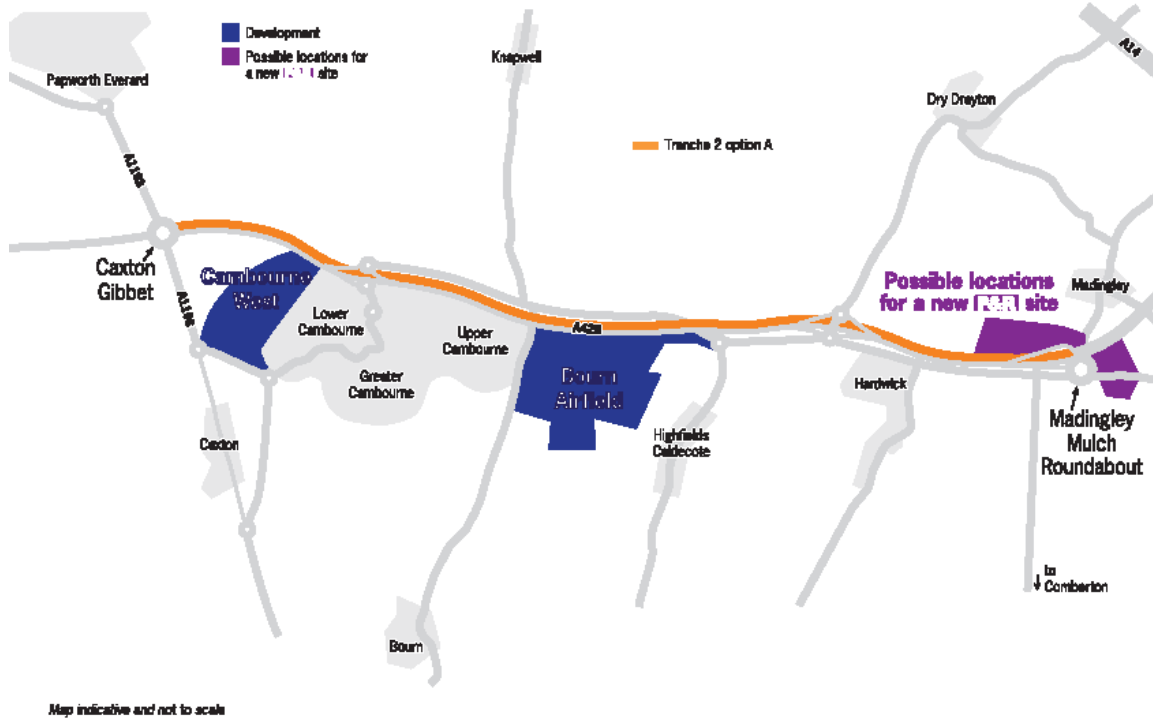


Figure A-4 Option 2A

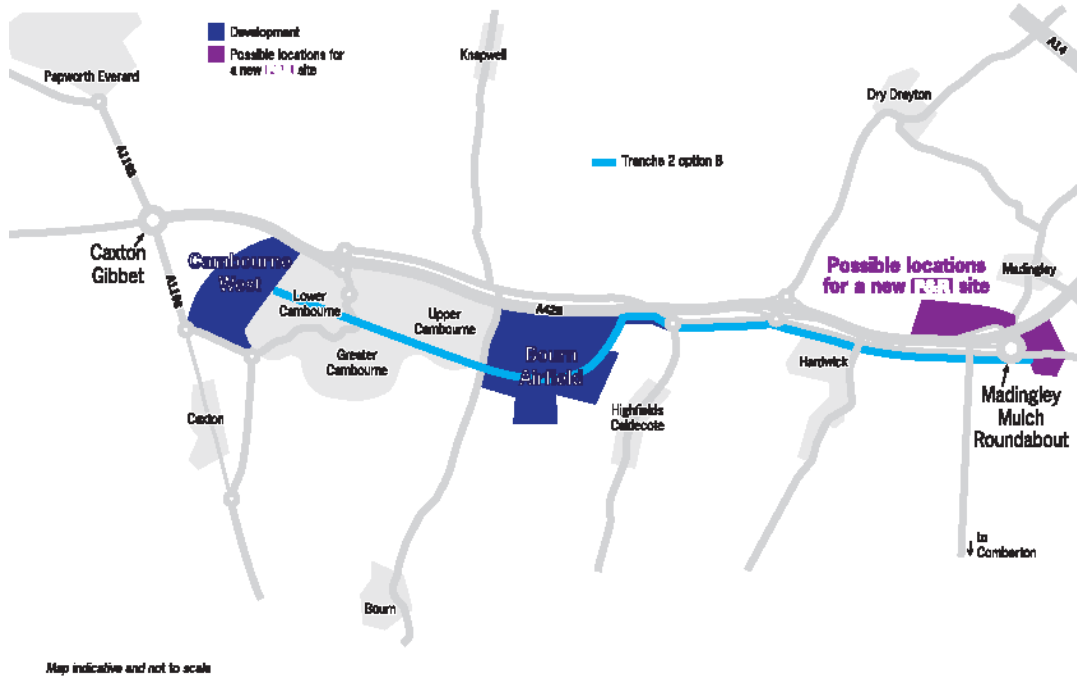


Figure A-5 Option 2B

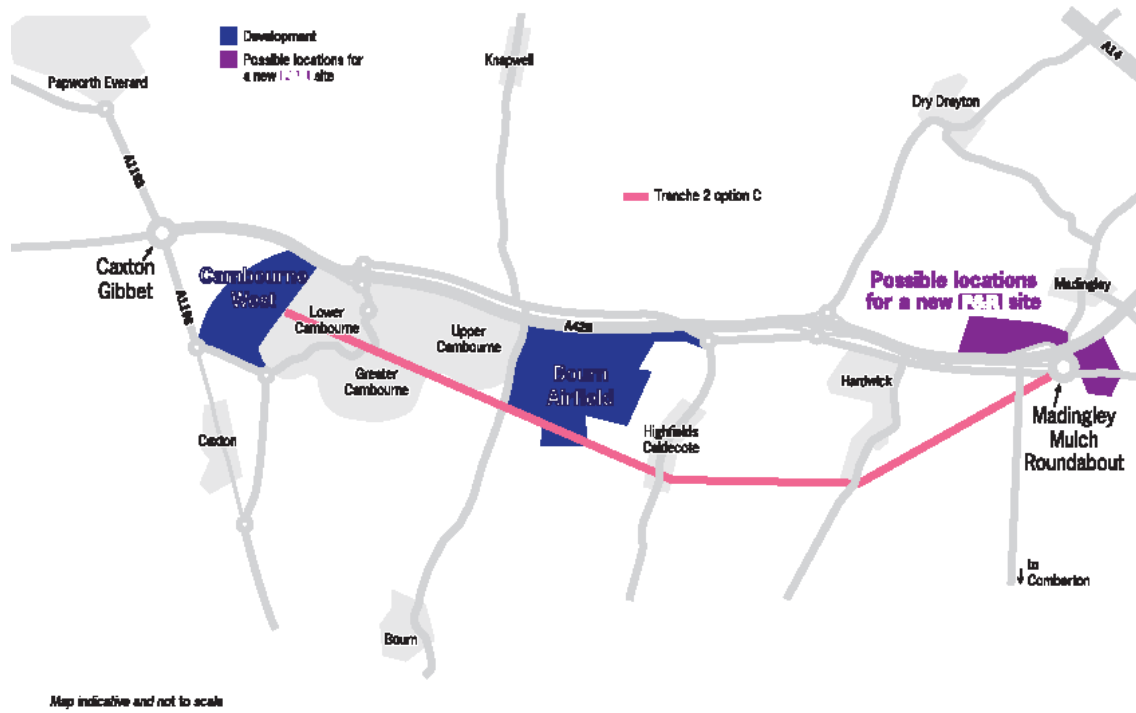


Figure A-6 Option 2C

Appendix B. Key Junction Impacts

B.1. AM Peak Hour (08:00 – 09:00)

Junction	From	To	AM PEAK: Flow to Capacity Ratio (V/C)				
			DM	1A+2A	1A+2B	1B+2C	1C+2B
Maddingley Mulch Roundabout	A428 Off-Slip	Maddingley Village	57.59	42.92	39.61	43.98	46.6
	A428 Off-Slip	A1303 (East)					
	A428 Off-Slip	Hardwick Village					
	Maddingley Village	A1303 (East)	9.39	18	8.14	19.86	19.61
	Maddingley Village	Hardwick Village					
	Maddingley Village	A428 On-Slip					
	A1303 (East)	Hardwick Village	39.03	38.05	36.17	36.93	38.5
	A1303 (East)	A428 On-Slip					
	A1303 (East)	Maddingley Village					
	Hardwick Village	A428 On-Slip	25.18	37.02	24.38	36.26	31.92
Hardwick Village	Maddingley Village						
Hardwick Village	A1303 (East)						
A1303 / Coton Village Turn	Maddingley Village	A1303 (East)	2.96	3.87	4.73	3.61	2.39
	Maddingley Village	Coton Village	32.57	31.7	31.25	33.31	33.76
	Maddingley Village	A1303 (West)	0	0	0	0	0
	A1303 (East)	Coton Village	3.11	3.71	3.25	4.6	3.98
	A1303 (East)	A1303 (West)	21.08	22.39	21.54	21.97	22.79
	A1303 (East)	Maddingley Village	13.38	14.16	14.29	14.57	13.47
	Coton Village	A1303 (West)	58.61	59.45	57.69	61.18	60.99
	Coton Village	Maddingley Village	44.42	51.45	48.77	55.83	51.95
	Coton Village	A1303 (East)	16.26	18.13	13.47	25.41	23.83
	A1303 (West)	Maddingley Village	0	0	0	0	0
	A1303 (West)	A1303 (East)	22.97	22.73	22.81	27.55	23.16
	A1303 (West)	Coton Village	55.19	53.15	53.93	47.22	54.8
A1303 / M11 Off-Slip	A1303 (West)	A1303 (East)	106.11	106.83	107.98	105.91	106.37
	A1303 (East)	A1303 (West)	63.44	67	67.42	69.74	67.25
	M11 Off-Slip	A1303 (East)	40.98	44.96	46.16	44.17	39.52
	M11 Off-Slip	A1303 (West)	17	18.4	16.54	17.5	18.85
A1303 / M11 On-Slip	A1303 (West)	A1303 (East)	54.92	57.77	58.65	62.31	53.86
	A1303 (West)	M11 On-Slip	0.51	0.8	0.79	0.64	0.48
	A1303 (East)	M11 On-Slip	8.94	10.4	9.43	9.05	9.72
	A1303 (East)	A1303 (West)	13.32	14.07	14.16	14.65	14.12
A1303 / Maddingley Road Park and Ride	Park and Ride	A1303 (East)	4.23	10.48	11.6	12.7	4.13
	Park and Ride	A1303 (West)	8.47	30.19	35.35	38.25	8.88
	A1303 (East)	Park and Ride	36.2	55.5	61.29	52.07	34.07
	A1303 (East)	A1303 (West)	23.54	23.02	22.19	21.9	25.39
	A1303 (West)	Park and Ride	18.08	45.17	52.37	41.64	13
	A1303 (West)	A1303 (East)	27.87	31.88	30.52	35.43	27.49
A1303 / JJ Thomson Avenue	Cambridge NW	A1303 (East)	77.59	68.08	66.48	74.8	71.88
	Cambridge NW	JJ Thomson Avenue	54.89	48.86	38.62	74.45	67.89
	Cambridge NW	A1303 (West)	92.45	90.91	87.12	96.62	95.5
	A1303 (East)	JJ Thomson Avenue	0.06	0.07	0.08	0.06	0.06
	A1303 (East)	A1303 (West)	28.78	41.07	41.32	35.2	29.61
	A1303 (East)	Cambridge NW	1.99	2.12	1.77	1.81	1.41
	JJ Thomson Avenue	A1303 (West)	0	0	0	0	0
	JJ Thomson Avenue	Cambridge NW	5.41	4.32	4.37	5.38	5.35
	JJ Thomson Avenue	A1303 (East)	0	0	0	0	0
	A1303 (West)	Cambridge NW	24.53	22.46	20.85	26.25	26.23
A1303 (West)	A1303 (East)	44.4	36.42	31.65	44.69	46.09	
A1303 (West)	JJ Thomson Avenue	84.26	70.19	67.18	77.32	86.88	
A1303 / Storey's Way	Storey's Way	A1303 (East)	57	51.55	51.53	53.59	56.16
	Storey's Way	A1303 (West)	50.99	56.48	54.49	56.98	51.74
	A1303 (East)	Storey's Way	7.98	9.14	9.14	9.57	8.47

Junction	From	To	AM PEAK: Flow to Capacity Ratio (V/C)				
	A1303 (East)	A1303 (West)	16.03	15.76	15.55	15.47	16.07
	A1303 (West)	Storey's Way	11.36	9.86	9.38	10.62	11.63
	A1303 (West)	A1303 (East)	22.19	18.46	16.97	22.45	22.15
A1303 / Grange Road	A1303 (East)	Grange Road	28.33	24.89	26.79	26.72	28.21
	A1303 (East)	A1303 (West)	41.68	40.26	40.6	40.45	41.49
	Grange Road	A1303 (West)	48.76	50.92	50.36	50.5	49.87
	Grange Road	A1303 (East)	14.71	14.57	14.06	14.47	15.22
	A1303 (West)	A1303 (East)	49.43	40.4	40.17	47.37	49.62
	A1303 (West)	Grange Road	81.53	76.31	80.03	79.29	79.52
A1303 / Lady Margaret Road	Lady Margaret Road	A1303 (East)	92.48	92.71	93.49	93.69	92.62
	Lady Margaret Road	A1303 (West)	36.62	35.96	35.39	37.89	37.24
	A1303 (East)	Lady Margaret Road	58.58	54.83	52.66	58.52	59.54
	A1303 (East)	A1303 (West)	32.33	29.95	30.82	30.31	32.52
	A1303 (West)	Lady Margaret Road	6.25	5.48	5.12	6.31	6.56
	A1303 (West)	A1303 (East)	68.01	58.05	55.37	64.73	67.98
A1303 / Northampton Street	Northampton Street	Queen's Road	55.29	53.18	52.77	54.28	55.51
	Northampton Street	A1303 (West)	42.75	39.34	40.63	39.83	43
	Queen's Road	A1303 (West)	47	48.42	48.67	47.41	47.91
	Queen's Road	Northampton Street	21.22	21.79	22.52	20.39	21.77
	A1303 (West)	Northampton Street	19.01	13.91	10.53	19.8	20.14
	A1303 (West)	Queen's Road	51.39	49.28	49.92	50.4	51.16

B.2. PM Peak Hour (17:00 – 18:00)

Junction	From	To	PM PEAK: Flow to Capacity Ratio (V/C)				
			DM	1A+2A	1A+2B	1B+2C	1C+2B
Madingley Mulch Roundabout	A428 Off-Slip	Madingley Village					
	A428 Off-Slip	A1303 (East)	39.28	22.92	27.1	23.97	28.84
	A428 Off-Slip	Hardwick Village					
	Madingley Village	A1303 (East)					
	Madingley Village	Hardwick Village	19.04	16.09	13.27	20.26	14.01
	Madingley Village	A428 On-Slip					
	A1303 (East)	Hardwick Village					
	A1303 (East)	A428 On-Slip	87.22	78.1	77.02	62.85	81.46
	A1303 (East)	Madingley Village					
	Hardwick Village	A428 On-Slip					
	Hardwick Village	Madingley Village	12.94	35.42	21.1	33.32	20.73
A1303 / Coton Village Turn	Madingley Village	A1303 (East)	11.03	7.67	8.61	3.42	11.18
	Madingley Village	Coton Village	41.15	38.51	39.52	30.33	42.03
	Madingley Village	A1303 (West)	0	0.01	0.02	0.01	0.01
	A1303 (East)	Coton Village	44.54	52.06	52.39	23.19	43.21
	A1303 (East)	A1303 (West)	76.1	74.02	76.91	43.27	74.92
	A1303 (East)	Madingley Village	33.52	33.13	34.14	9.01	33.58
	Coton Village	A1303 (West)	105.98	104.42	106.2	103.5	105.12
	Coton Village	Madingley Village	105.98	104.42	106.2	103.5	105.12
	Coton Village	A1303 (East)	105.98	104.42	106.2	103.5	105.12
	A1303 (West)	Madingley Village	0	0	0	0	0.59
	A1303 (West)	A1303 (East)	20.33	19.05	20.39	16.72	19.94
	A1303 (West)	Coton Village	66.72	55.01	61.14	58.06	74.98
	A1303 / M11 Off-Slip	A1303 (West)	A1303 (East)	43.24	41.35	43.71	30.94
A1303 (East)		A1303 (West)	97.23	104.06	105.08	104.64	95.83
M11 Off-Slip		A1303 (East)	83.48	75.66	76.02	68.75	83.32
M11 Off-Slip		A1303 (West)	69.32	65.37	70.16	28.06	69.43
A1303 / M11 On-Slip	A1303 (West)	A1303 (East)	58.46	55.22	56.77	53.1	57.24
	A1303 (West)	M11 On-Slip	0.7	0.36	0.44	0.18	3.25
	A1303 (East)	M11 On-Slip	10.57	13.8	12.06	12.07	10.99
	A1303 (East)	A1303 (West)	49.59	51.17	51.9	37.27	48.87
A1303 / Madingley Road Park and Ride	Park and Ride	A1303 (East)	10.04	46.23	40.75	47.34	10.21
	Park and Ride	A1303 (West)	50.51	85.86	83.46	80.36	48.93
	A1303 (East)	Park and Ride	6.34	13.73	14.88	12.51	5.17
	A1303 (East)	A1303 (West)	44.03	42.7	43.39	27.74	43.35

Junction	From	To	PM PEAK: Flow to Capacity Ratio (V/C)				
	A1303 (West)	Park and Ride	6.9	38.51	39.58	33.6	5.05
	A1303 (West)	A1303 (East)	49.31	69.23	67.82	66.32	48.64
A1303 / JJ Thomson Avenue	Cambridge NW	A1303 (East)	64.36	64.2	63.82	74.92	70.98
	Cambridge NW	JJ Thomson Avenue	101.4	51.99	66.14	15.5	103.35
	Cambridge NW	A1303 (West)	101.4	92.12	95.79	50.65	103.35
	A1303 (East)	JJ Thomson Avenue	0.04	0.02	0.02	0.02	0.04
	A1303 (East)	A1303 (West)	69.52	46.31	47.79	30.83	68.94
	A1303 (East)	Cambridge NW	54.84	70.52	69.33	77.65	56.07
	JJ Thomson Avenue	A1303 (West)	24.65	1.86	3.19	0.19	22.39
	JJ Thomson Avenue	Cambridge NW	44.7	63.13	64.62	78.1	43.72
	JJ Thomson Avenue	A1303 (East)	48.54	76.07	76.16	78.87	48.72
	A1303 (West)	Cambridge NW	76.81	72.89	73.53	79.72	76.19
	A1303 (West)	A1303 (East)	74.28	70.12	71.09	75.83	73.32
	A1303 (West)	JJ Thomson Avenue	22.41	21.49	21.54	20.07	22.38
	A1303 / Storey's Way	Storey's Way	A1303 (East)	21.32	22.28	21.63	20.73
Storey's Way		A1303 (West)	18.82	13.19	14.28	10.52	19.87
A1303 (East)		Storey's Way	18.86	21.24	21.86	23.98	19.67
A1303 (East)		A1303 (West)	27.65	20.28	20.79	16.15	26.86
A1303 (West)		Storey's Way	18.44	18.42	18.29	17.97	18.18
A1303 (West)		A1303 (East)	29.27	30.97	31.26	32.58	29.16
A1303 / Grange Road	A1303 (East)	Grange Road	25.95	21.91	22.64	20.94	26.77
	A1303 (East)	A1303 (West)	57.71	44	45.94	34.07	58.17
	Grange Road	A1303 (West)	104.2	102.24	103.12	100	104.72
	Grange Road	A1303 (East)	104.2	102.24	103.12	99.98	104.72
	A1303 (West)	A1303 (East)	35.76	33.71	34.06	35.25	35.77
	A1303 (West)	Grange Road	88.55	92.16	92.48	92.52	88.72
A1303 / Lady Margaret Road	Lady Margaret Road	A1303 (East)	57.22	55.46	56.29	54.38	56.96
	Lady Margaret Road	A1303 (West)	37.72	36.64	37.49	34.71	37.56
	A1303 (East)	Lady Margaret Road	94.86	91.89	91.78	91.22	94.5
	A1303 (East)	A1303 (West)	40.64	32.14	33.23	25.34	40.17
	A1303 (West)	Lady Margaret Road	28.12	32.83	31.35	33.24	29.8
	A1303 (West)	A1303 (East)	54.17	51.97	52.94	51.07	53.76
A1303 / Northampton Street	Northampton Street	Queen's Road	30.01	26.69	27.6	24.45	30.33
	Northampton Street	A1303 (West)	31.44	24.57	25.72	18.77	31.53
	Queen's Road	A1303 (West)	62.12	57.84	58.53	54.24	61.52
	Queen's Road	Northampton Street	28.41	28.1	28.77	24.68	28.42
	A1303 (West)	Northampton Street	30.28	27.07	28.3	26.45	29.86
	A1303 (West)	Queen's Road	31.12	31.12	31.92	30.58	30.87

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