

Cambourne - Cambridge Better Public Transport Project

Options Appraisal Report (Part 1)
392438-MMD-BCA-XX-RP-BC-0002

February 2018

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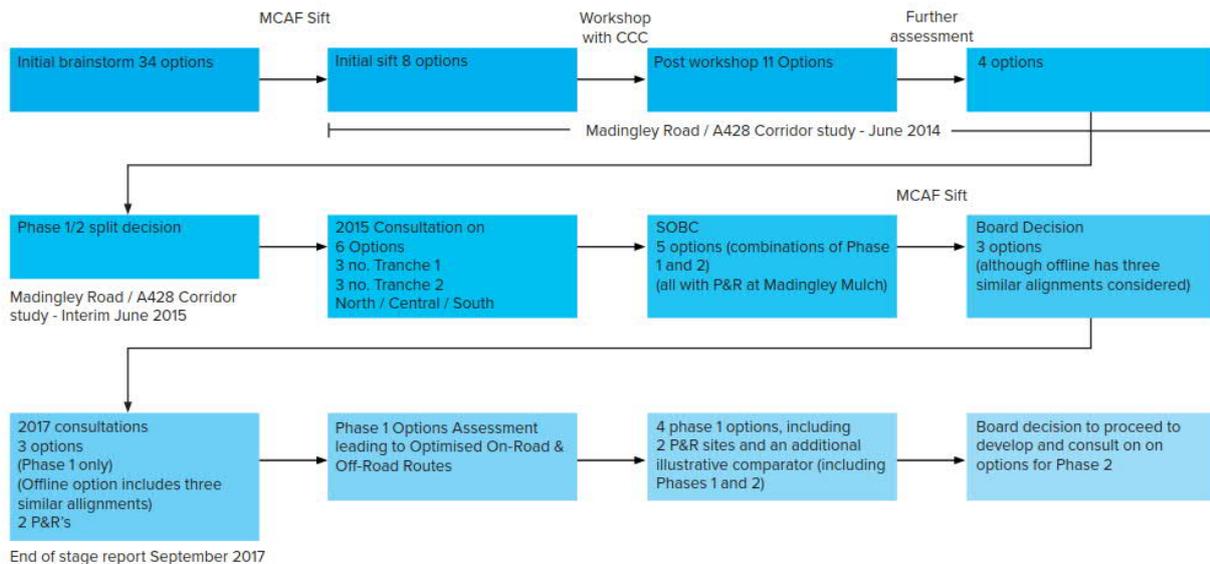
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Executive summary

In 2015 the proposed Cambourne to Cambridge Better Public Transport project was prioritised for funding by the Greater Cambridge Partnership from the City Deal. This was in response to the growing issues of congestion, poor journey times, journey time reliability along the A428/A1303 corridor during peak periods, and future demand for travel along the corridor as a result of predicted housing and employment growth. Since the project's inception, the scheme has progressed through a series of optioneering steps to identify and assess options that address these issues.

This Options Appraisal Report (Part 1) provides a summary of all optioneering work undertaken since 2014 and details further optioneering and assessment that has supported subsequent consultation. The process is summarised in **Figure 1**. This report sits in the third box from the end and concludes by recommending on-road and off-road routes that should be taken forward for further assessment.

Figure 1: Options Appraisal Methodology

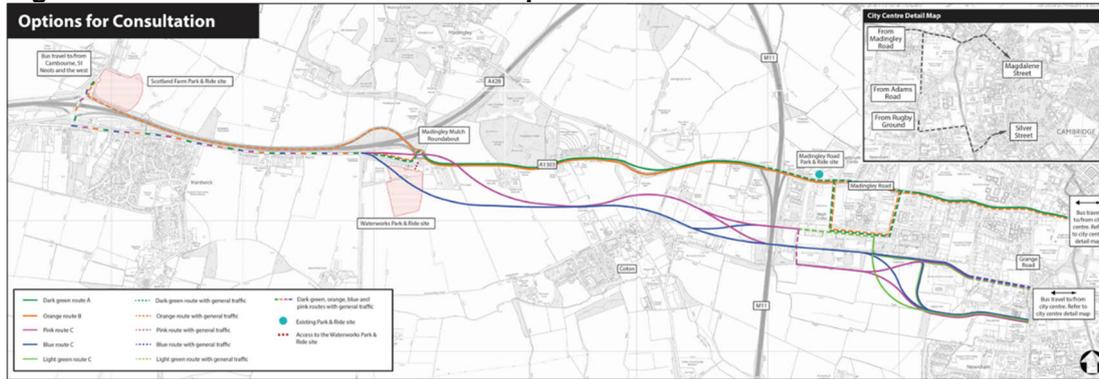


Source: Mott MacDonald

The options that were consulted on in 2017 are as follows:

- **Option A:** An on-road option which includes the introduction of an inbound public transport lane on Madingley Road between Madingley Mulch roundabout and Lady Margaret Road;
- **Option B:** An on-road tidal public transport lane on Madingley Road running between Madingley Mulch roundabout and the new entrance to Eddington (High Cross); and
- **Option C:** An off-road busway running between Madingley Mulch roundabout and Grange Road, Cambridge (Option C consists of three variants)

Figure 2: November 2017 Consultation Options



Source: GCP – Cambourne to Cambridge Better Public Transport consultation leaflet, November 2017

The appraisal of each option was undertaken using Mott MacDonald’s in-house Investment Sifting and Evaluation Tool (INSET). INSET works by applying weighted scoring to each option based on how well it meets identified criteria.

The findings of the INSET assessment have concluded that the recommended on-road option is Option A. However, a potential “optimisation” of the route has been explored to reflect the aspiration in Option B for some improvements to outbound traffic, and a need to further consider the operation of Junction 13 of the M11. Four optimised layouts were modelled using micro-simulation software PTV VISSIM which included changes to six key areas:

- Maddingley Mulch Roundabout
- Cambridge Road Junction
- M11 Junction 13
- The existing Park and Ride site access and High Cross junction
- Grange Road
- Removal of public transport lane between from university west to Storeys Way junction

The modelling showed that a number of these “optimisation” options showed benefits, such as an outbound public transport lane and public transport gate at Maddingley Mulch Roundabout, improvements to Junction 13 of the M11 and additional eastbound public transport priority at the High Cross / Eddington Road junction.

The recommended off-road option is the “Blue” route through Maddingley Mulch, Coton Village and West Cambridge, and the former Rifle Range track to Grange Road.

The recommended options will be combined with the two potential Park and Ride locations and assessed further to arrive at a final recommended option. The results of this assessment will be presented in an updated Options Appraisal Report (to be presented as Part 2). The options which will be assessed at the next stage are as follows:

- Do Minimum – Committed Schemes
- Low Cost a – Recommended on-road Phase 1 + Park and Ride at Water works
- Low Cost b – Recommended on-road Phase 1 + Park and Ride at Scotland Farm
- Do Something 1a – Recommended off-road Phase 1 + Park and Ride at Water works
- Do Something 1b – Recommended off-road Phase 1 + Park and Ride at Scotland Farm
- Illustrative Comparator – Recommended off-road Phase 1 and 2 + Park and Ride at Water works

The Illustrative Comparator is to be included in order to provide a strategic assessment including Phase 2, which will need further consultation and assessment before a final recommended scheme can be defined.

Glossary of Key Terms

BCR: Benefit Cost Ratio

Conservation Area: An area designated under Section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990 as being of special architectural or historic interest and with a character or appearance which is desirable to preserve or enhance.

Context: The setting of a site or area, including factors such as traffic, activities and land uses as well as landscape and built form.

Countryside: The rural environment and its associated communities.

Cumulative Impact: The summation of effects that result from changes caused by a development in conjunction with other past, present or reasonably foreseeable actions.

EAST: Early assessment sifting tool. Tool used by DfT.

Effect: The consequence of the scale of any change to the baseline environment, i.e. impact, on the environmental receptor, taking account of its particular value or sensitivity.

Element: A component part of the landscape (for example, roads, hedges, woods).

Enhancement: Landscape improvement through restoration, reconstruction or creation.

Environment: Our physical surroundings including air, water and land.

Environmental Impact Assessment: A formal, structured process of evaluating the likely environmental impacts of a proposed scheme, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

Form: The layout (structure and urban grain), density, scale (height and massing), appearance (materials and details) and landscape of development.

Gross Value Added (GVA): A measure of the economic productivity of an area.

HQPT: High Quality Public Transport

Heritage Asset: A building, monument, site, place, area or landscape of historic value.

Illustrative Comparator: An option including both Phase 1 and 2 which has been presented at this stage of the business case for comparative purposes.

INSET: Investment sifting and evaluation tool. Mott MacDonald's evaluation tool used in the optioneering process.

Landform: Combination of slope and elevation that produce the shape and form of the land.

Landscape: The character and appearance of land, including its shape, form, ecology, natural features, colours and elements and the way these components combine. Landscape character can be expressed through landscape appraisal, and maps or plans. In towns 'townscape' describes the same concept.

Landscape Character: The distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects

particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape.

Landscape Feature: A prominent eye-catching element, for example, wooded hilltop or church spire.

Landscape Quality: Based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character in any one place.

Landscape Sensitivity: The extent to which a landscape can accept change of a particular type and scale without unacceptable adverse effects on its character.

Land Use: The primary use of the land, including both rural and urban activities.

MCAF: Multi-criteria assessment framework used by ATKINS in the optioneering process.

Methodology: The specific approach and techniques used for a given study.

Mitigation: Measures, including any process, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual effects of a development project.

Modal shift: A shift from one transport type to another, e.g. road travel to rail travel.

Movement: People and vehicles going to and passing through buildings, places and spaces. The movement network can be shown on plans, by space syntax analysis, by highway designations, by figure and ground diagrams, through data on origins and destinations or pedestrian flows, by desire lines, by details of public transport services, by walk bands or by details of cycle routes.

MSBC: Major Scheme Business Case

OAR: Options Appraisal Report

OBC: Outline Business Case

Receptor: Something that makes up the environmental baseline e.g. humans or other biological species, elements of the physical environment including water, air, soil, assets that make up the cultural heritage of an area.

SOBC: Strategic Outline Business Case

Social and Distributional Impacts (SDI): considers the variance of transport intervention impacts across different social groups.

Strategic View: The line of sight from a particular point to an important landmark or skyline.

Sustainability: The principle that the environment should be protected in such a condition and to such a degree that ensures new development meets the needs of the present without compromising the ability of future generations to meet their own needs.

TAG: The DfT's Transport Appraisal Guidance (often referred to as WebTAG)

Topography: A description or representation of artificial or natural features on or of the ground.

Townscape: Physical and social characteristics of the built and unbuilt urban environment and the way in which those characteristics are perceived. The physical characteristics are expressed

by the development form of buildings, structures and space, whilst the social characteristics are determined by how the physical characteristics are used and managed.

Tranquillity: A state of calm or quiet.

Visual impact: Change in the appearance of the landscape as a result of development. This can be positive (i.e. beneficial or an improvement) or negative (i.e. adverse or a detraction).

Wider Economic Benefits (WEB): improvements in economic benefits that are acknowledged, but which are not typically captured in traditional cost-benefit analysis.

1 Introduction

1.1 Purpose of this Report

Following the approval of the Strategic Outline Business Case (SOBC) for the Cambourne to Cambridge Better Public Transport (C2C) project in October 2016 by the Executive Board of the Greater Cambridge Partnership (GCP), the GCP commissioned Mott MacDonald to develop an Outline Business Case (OBC) as part of the next phase of the project's development. An integral component of the OBC is the Options Appraisal Report (OAR) which, in line with WebTAG¹ guidance (Department for Transport (DfT) guidance for transport appraisal methodology), summarises all work previously undertaken to identify the need for the intervention, to identify options for addressing the identified issues and opportunities, and how those options have been refined and assessed to arrive at a recommended option.

The OAR for the C2C scheme is formed in two parts:

- **OAR Part 1** – outlines all work done up to February 2018 to inform the selection of a recommended on and off-road options for further assessment; and
- **OAR Part 2** – takes the reader through the assessment of the recommended on-road and recommended off-road options to show the selection of a final, single recommended option.

The results of the OAR Part 2 will feed directly into the OBC, along with any future reports on consultation or option assessment that will present the optioneering process alongside the wider strategic context for investment and information on the transport economic benefits of the recommended option. The OBC will also set out each of the five cases in line with DfT's 'five cases' model, itself is based on HM Treasury's Green Book appraisal guidance, covering the Strategic, Economic, Financial, Commercial and Management cases for the scheme.

In this context, this OAR (Part 1) report:

- Reviews the aims and objectives of the scheme and the need for change;
- Summarises the options development work carried out to date; and
- Selects recommended on and off-road options to be taken forward for further optioneering assessment.

In setting out the strategic context, the issues and opportunities and in summarising the optioneering process carried out to date, this report draws largely on work previously carried out as part of the SOBC development.² A full table of all previous technical reports and officer reports that have been drawn upon in drafting OAR Part 1 are set out in Appendix D.

1.2 Structure of Report

This OAR (Part 1) for the C2C scheme has been structured to align with DfT's transport appraisal model, which is detailed in Section 2. **Table** shows how this report has been aligned with the DfT process. This OAR (Part 1) will also be appended to the scheme's OBC.

¹ <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>

² All previous reports, including additional supporting documents and options plan are found on the GCP website - <https://www.greatercambridge.org.uk/transport/transport-projects/cambourne-to-cambridge/>

Table 1 Report Structure

Section	Contents	Description	Alignment with WebTAG option appraisal development steps
2	Strategic and Local Context	Reviews the strategic and Local context of the A428 transport corridor to raise the need for intervention.	
3	Scheme Background	Provides an overview of the C2C scheme's background and description of the scheme.	
4	Options Assessment Methodology	Reviews the steps in the DfT's transport appraisal process and outlines the proportionate including an options assessment methodology for the C2C scheme.	
5	Current and Future Issues and Opportunities	Reviews the evidence base for the C2C scheme based on the following: Rationale for Scheme – Policy review; Strategic Socio-Economic Review; Economic and Business; Highways Network and Traffic; Wider Transport Network Provision; How People Travel; Land Use and Development; Housing; Environmental Issues; and Underlying Drivers or Causes – the need for intervention.	Stage 1 Steps 1,2 & 3
6	Scheme Objectives and Scope	Defines 3 strategic scheme aims and objectives for the C2C scheme, including outputs and outcomes of the C2C scheme through a Logic Map.	Stage 1 Step 4
7	Stage 1 - Options Generation and Assessment	Reports on the option development process undertaken to generate and assess the initial Long List and the option assessment carried out to arrive at an initial Short List, including the three core options (1, 3a, 6) progressed to Stage 2.	Stage 1 Steps 5, 6 & 7
8	Stage 2 – Further Options Assessment	This section reviews the process to refine options to <u>recommended on-road</u> and <u>recommended off-road solution</u> .	Stage 2

Source: Mott MacDonald

2 Strategic and Local Context

2.1 Strategic Context

This chapter presents summary information on the Strategic and Local Context for investment in public transport for the Cambourne to Cambridge Corridor.

2.1.1 The Cambridge Phenomenon – a UK Success Story

Cambridge is one of the UK's most successful cities where economic success, high quality of life and quality of place are inextricably linked. The thriving hi-tech and biotech industry, which has developed since the 1960s and is known as the "Cambridge Phenomenon", accounts for 17.3% of employment³, with Cambridge boasting one of the highest concentrations of Nobel Laureates in the world.

Cambridge is one of the UK's fastest-growing and most productive cities and integral to the UK's long term economic plan which seeks to improve productivity and international competitiveness. Between 2004 and 2014 Cambridge's GVA per worker grew by 21% to £55,900, and its population grew by 14.5%.⁴ Cambridge helps the UK to compete globally, attracting high value jobs and net economic growth through internationally mobile employees in knowledge-based industries.

This success is largely due to:⁵

- A world class university that draws talent from across the globe, fostering innovation and encouraging new businesses. This has developed into a strong hi-tech and bio-medical base, with over 1,525 technology companies employing more than 54,000 people and a combined revenue over £12 billion;
- The area's scale and connectedness allow overlapping networks to develop and facilitates a culture of co-operation and cross-fertilisation between entrepreneurs and academics, and;
- Being an attractive place and competing with other world cities as a good place for business leaders and their families to live, not just a good place to do business.

Whilst economic success to date has been widely celebrated, it is now contributing to a shortage of housing and significant transport congestion that threatens to constrain further economic growth and compromise the high quality of life that exists in Cambridge.

In order for the Cambridge to continue being successful, the GCP are targeting an additional **33,500 new homes** and the generation of **44,000 new jobs** by 2031 within the Greater Cambridgeshire area.⁶ To achieve this, the infrastructure of the area needs to keep up with the area's pace of growth, including:

- Ensuring the area can grow physically to accommodate the houses and employment sites that are spread across the area;
- Maintaining the ease of movement between key economic hubs – including new economic centres such as the Addenbrooke's Bio-Medical campus to the south, and the University of Cambridge (UoC) sites to the west and north-west, and;

³ Using East of England Forecasting Model (EEFM) data, baseline forecast 2014. Relates to Greater Cambridge core high-tech and biotech industry as can be best defined in the data encompassing telecoms, computer related activity, research & development and business services.

⁴ Centre for Cities, Williams, M, March 2016: Fast Growth Cities: The opportunities and challenges ahead

⁵ City Deal, Greater Cambridge City Deal Document, 2014

⁶ GCP - <https://www.greatercambridge.org.uk/>

- Protecting and enhancing the high quality of life that contributes so significantly to the area's attractiveness and success.

2.1.2 Greater Cambridge City Deal

The Greater Cambridge City Deal (City Deal) was signed between government and the Greater Cambridge Partnership (GCP) in 2014. The City Deal is overseen by the GCP which is the local delivery body set up to oversee the delivery of the City Deal and to promote local economic growth and development.⁷ The GCP aims to enable a new wave of innovation-led growth in the Greater Cambridge area by investing in infrastructure, housing and skills thereby addressing housing shortages and transport congestion bottlenecks that would facilitate its continued growth and a continuation of the "Cambridge Phenomenon".

The City Deal is worth up to £1 billion over a 15-year period and includes an investment fund for transport improvements of £100m from government over a five-year period between 2015/16 and 2019/20.

This investment fund offers funding towards proposed infrastructure in the region to help grow and maintain Greater Cambridge's status as a prosperous economic area and to achieve the following outcomes in support of economic growth:

- Accelerated delivery of **33,500 new homes**
- Delivery of **44,000 new jobs**
- **Transport infrastructure** improvements to support this housing and employment growth while retaining the high quality of life in the region.

In order to achieve these outcomes, the GCP Assurance Framework sets out four strategic objectives that all schemes being promoted by the Greater Cambridge authorities will be prioritised against:

- **Create and retain investment** to nurture the conditions necessary to enable the potential of Greater Cambridge to create and retain the international high-tech businesses of the future.
- **Targeted business investment supporting the Cambridge Cluster** to the needs of the Greater Cambridge economy by ensuring those decisions are informed by the needs of businesses and other key stakeholders such as the universities.
- **Improve connectivity and networks** between clusters and labour markets so that the right conditions are in place to drive further growth.
- **Attract and retain skills** by investing in transport and housing whilst maintaining a good quality of life, in turn allowing a long-term increase in jobs emerging from the internationally competitive clusters and more university spin-outs.

The C2C scheme contributes to the City Deal outcomes and contributes to its objectives by aiming to provide a congestion free public transport corridor along the A428/A1303 into Cambridge, thereby providing faster, timelier, and more reliable alternatives for current travellers into the city, while also providing additional transport capacity for trips from developments proposed and planned within Greater Cambridge.

2.1.3 The Vision for Cambridge and South Cambridgeshire

The City of Cambridge and South Cambridgeshire both have draft Local Plans. These Local Plans set out the transport objectives, strategies and policies for these areas. The Transport Strategy for Cambridge and South Cambridge (TSCSC) was developed to ensure that the local

⁷ The GCP consists of five partners, including Cambridge City Council, Cambridgeshire County Council, South Cambridgeshire District Council, the University of Cambridge and the Greater Cambridge Greater Peterborough Local Enterprise Partnership.

councils plan together for transport that supports the sustainable economic growth of the county.

From the individual visions of the Cambridge and South Cambridgeshire Local Plans, and the TSCSC, a clear and distinct overall vision is set out that highlights the need for future housing and economic growth to take place in both a sensitive and sustainable manner, with any future development being done for the benefit all. New development should promote the use of sustainable modes of transport and should seek to facilitate the infrastructure required to support growth. A key focus of the transport system will be the use of sustainable modes that will centre around the use of High Quality Passenger Transport (HQPT) along dedicated passenger transport routes, offering fast and frequent links to and from key destinations. Included as part of this sustainable transport network should also be an improved system of direct cycling and walking routes. The proposed developments supported through the Local Plans would help ensure that Cambridge meets the targets set in the City Deal of accelerating delivery of over 33,500 new homes in and around the city and delivering 44,000 new jobs.

The Local Plans promote the accessibility of new housing development by HQPT, noting that new homes should be located close to employment centres or HQPT routes which provide sustainable access to the City Centre and major employment centres. The C2C scheme would support the visions of the Local Plans and the TSCSC through providing the HQPT service to new developments proposed in South Cambridgeshire. The scheme will link the new developments of Cambourne and Bourn Airfield to Cambridge City providing access to jobs and education, which in turn would contribute to economic growth for the region.

The individual Local Plans and the TSCSC have been looked at in more detail in the policy review in section 5.1.1 Policy Review.

2.1.4 The Cambridge-Milton Keynes-Oxford Corridor

The Cambridge-Milton Keynes-Oxford arc is considered a national priority due to its geographical scope that encompasses world leading research, innovation and technology centres. These are considered crucial to the UK in achieving economic growth and in having an impact on the global economy.

Due to its strategic importance, the National Infrastructure Commission was commissioned in 2016 to consider how to maximise the potential of Cambridge – Milton Keynes – Oxford corridor and address the shortages in homes and adequate labour supply. The Commission identified opportunities to create well designed and well-connected communities offering over 1 million new homes and jobs along the corridor by 2050 without changing the current Green Belt protections. With its focus on maximising the opportunities associated with the development of East West Rail and the Oxford-Cambridge Expressway – integrating mass rapid transit with these schemes to enable effective first/last mile connectivity, in a way that enhances the value of these strategic infrastructure projects⁸ These have been published in 'Partnering for Prosperity: a new deal for the Cambridge - Milton Keynes – Oxford Arc' 2017.

In order to achieve the vision, set out for 2050 the following need to be achieved:

- Completion of the East – West rail line connecting Oxford and Cambridge by 2030;
- Development of the Oxford – Cambridge Expressway;
- New rail services to Cowley and South-East Oxford by 2019; and

⁸ National Infrastructure Commission – Partnering for Prosperity: A new deal for the Cambridge-Milton Keynes-Oxford Arc_(2016)

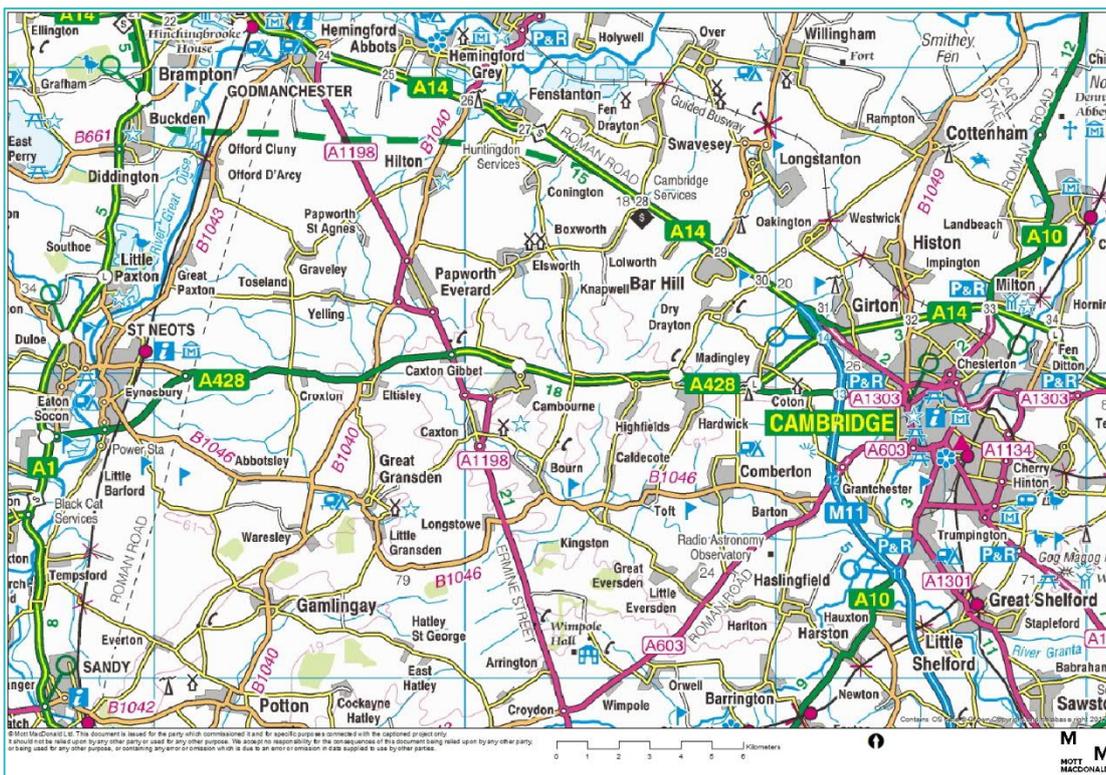
- Opening of a new rail station in South Cambridge by 2022.⁹

The A428 forms part of the east-west connections and is identified as being a road connection in need of investment in order to improve connections and be capable of opening up new housing developments and serving employment sites for future jobs growth.

2.2 Local Context

The C2C scheme is located between West Cambridge and Cambourne. The A428 corridor runs west-east from St Neots to Madingley Mulch roundabout, and then onwards along the A1303 Madingley Road into Cambridge City Centre.

Figure 3: The A428/A1303 corridor



Source: Mott MacDonald

The corridor also covers a wide area along the A428 and A1303 including:

- The existing settlements of Cambourne, Hardwick, Highfields Caldecote and Madingley.
- Future development areas of Cambourne and Bourn Airfield immediately to the south and east of the A428 at Caxton Gibbet roundabout.
- Future development area of West Cambridge immediately to the south and east of M11 Junction 13; and,
- Future development area North West Cambridge immediately to the north and east of the M11 between Junctions 13 and 14.

Both north and south of the A428 there are also a number of much smaller traditional villages including Papworth Everard, Gamlingay, Hardwick and Dry Drayton, located in an attractive landscape. All of these villages, which are commuting locations for Cambridge, are not located

⁹ National Infrastructure Commission – Partnering for Prosperity: A new deal for the Cambridge-Milton Keynes-Oxford Arc (2016)

directly on the A428 / A1303 corridor but are close enough to be considered as within its sphere of influence. The transport corridor is illustrated in **Figure 4**.

Figure 4: The A428/A1303 Transport Corridor



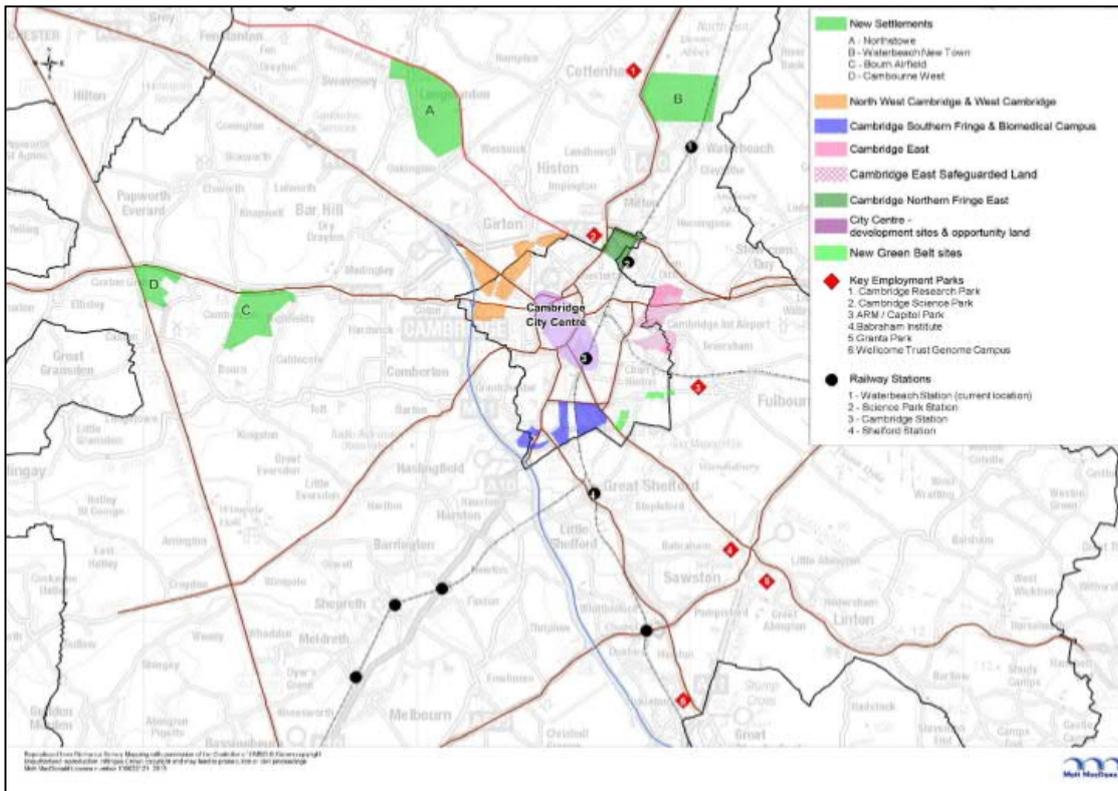
Source: Atkins, 2017, Cambourne to Cambridge Better Public Transport End of Stage Report

As can be seen in **Figure 5**, large new settlements are planned to be developed on the A428 corridor at Bourn Airfield (C) and Cambourne West (D) which need to be supported by a HQPT route to help access to employment growth areas in the city. The Greater Cambridge City Deal infrastructure investment, including the C2C scheme, aims to enable a new wave of innovation led growth through addressing congestion and other transport bottlenecks, while:

- Directly unlocking major housing and employment areas;
- Providing important links between employment and housing development;
- Enhancing the functionality of the city centre whilst recognising its role as the main entertainment and service centre for a much wider area; and
- Improving perceptions of Cambridge as a place to do business and enjoy a good quality of life, promoting inward investment from business and helping to attract and retain a highly skilled workforce.¹⁰

¹⁰ Greater Cambridge city deal – strategic Appraisal of the A428 – A1303 Bus Scheme, 2016 Mott MacDonald

Figure 5: Planned Growth in Cambridge and South Cambridge



Source: Mott MacDonald – Strategic Economic Appraisal of A428-A1303 Bus Scheme: Wider Economic Benefits (August 2016)

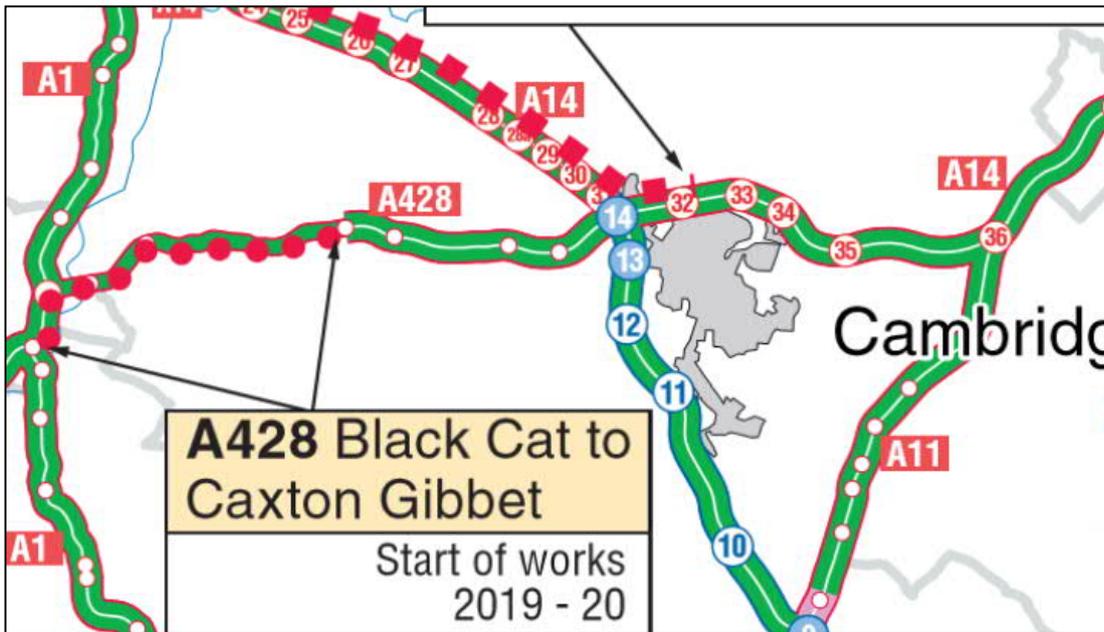
2.2.1 Existing Route Functions

The corridor has a number of existing transport functions, including:

- Forming part of the national strategic Trunk Road network providing a link between the A1 and M11 (towards the M25 and East London) and the A14 (towards the port of Felixstowe);
- Being a very busy commuter route from settlements to the west of Cambridge, such as Bedford and St Neots, as well as a large number of villages; and
- Being a significant growth corridor, supporting large scale new housing developments at St Neots, Cambourne and Bourn Airfield.

The A428 is considered a nationally important route, which is evidenced by the government's commitment to upgrading the western section of the A428 to dual carriageway to improve long distance trips, as shown in Highways England's SRN planned improvements map in **Figure 6**.

Figure 6: Highways England’s Strategic Road Network and planned improvements



Source: Highways England, Network Management Map, 2018

With regards to public transport, there is currently no railway line running along this corridor, therefore public transport is entirely based around the use of bus based services.

Local bus services are most frequent between Cambourne and Cambridge with a much lower frequency service for the smaller villages along the corridor. There are also Park & Ride sites at the western edge of Cambridge at Madingley Road that operate a service into the city every 10-15 minutes. Stagecoach also run a half hourly coach service directly along the A428, linking Oxford, Milton Keynes, Bedford, St Neots and Cambridge.

Figure 7: A428/A1303 corridor Stagecoach bus routes



Source: Stagecoach – Cambridge bus network map

2.3 Summary

The 'Cambridge Phenomenon', created through the economic success of the city since the 1960s, has created a shortage of housing and significant transport congestion. In order to continue economic growth, retain a high quality of life for residents and promote Cambridge as an attractive place to do business these issues need to be addressed. The City Deal allows GCP to create a new wave of innovation-led growth by investing in infrastructure, housing and skills to assist the estimated growth in population, jobs and economy.

The Cambridge and South Cambridge 'visions' set out in their Local Plans and the TSCSC offers a clear and distinct overall vision that highlights the need for future housing and economic growth to take place in both a sensitive and sustainable manner, with any future development being done for the benefit all.

The A428/A1303 is seen as a key corridor linking many residential areas to Cambridge. Due to its proximity and travel links to Oxford, London and Milton Keynes, this corridor is also viewed as an attractive residential area for commuters. Not only is the corridor a key link for residents of West Cambridge, it also serves as a national strategic trunk road providing a link between the A1 and M11. Plans to develop new residential dwellings along the corridor have highlighted its strategic placement to reach the City Deal targets. However, in order to support these new developments, ensuring they are well connected to existing and future employment sites, as well as other services, investment in supporting infrastructure such as transport is required. By investing in supporting infrastructure, Greater Cambridge can ensure the City Deal targets and growth along this corridor are met and that current transport related issues, such as congestion, are rectified.

3 Scheme Background and Description

3.1 Scheme Background

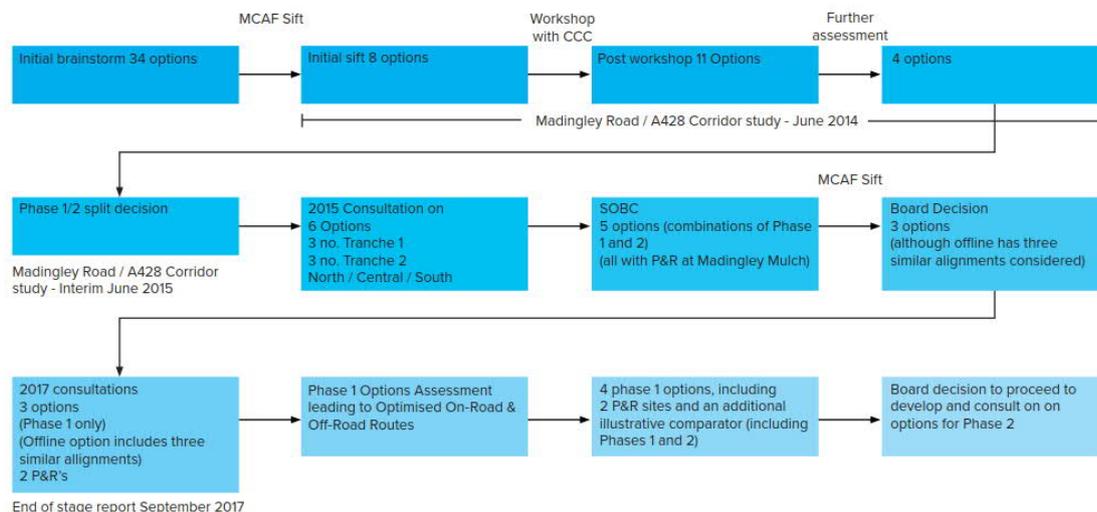
The C2C scheme received prioritisation for funding by the GCP in 2015. The scheme has since progressed through a series of options identification and assessment exercises, resulting in three options being presented in the SOBC in September 2016.

The scheme evolved in response to the issues of future demand on the local road network aligned with predicted growth. Previous studies had shown that the A428/A1303 corridor suffers from congestion, poor journey times, and poor journey time reliability during peak hours. Evidence shows that these problems are focused on specific sections of the corridor, particularly on the A1303, eastbound into Cambridge and, to a lesser extent, on the section of the route between St Neots and Caxton Gibbet (A428/A1303 junction).¹¹

The scheme aims to alleviate the impact of future growth on the already congested road network by providing high quality public transport that encourages public transport use in favour of private car use to the city centre. In order to establish high quality public transport, it must provide the highest levels of speed, reliability and capacity to and from key destinations. The scheme should allow for increased connectivity between major employment and housing sites, providing a sustainable alternative to travelling by private car along the A428/A1303 corridor.

The options packages were generated and refined through a series of workshops and assessments to ensure the process was thorough and considered a range of factors. The process is summarised in the flow diagram in **Figure 8**.

Figure 8: Option Identification and Assessment Process



Source: Mott MacDonald

¹¹ Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case – September 2016

The SOBC was submitted in 2016 and included five potential schemes that were assessed using a multi-criteria assessment and approval was given by the GCP Executive Board to progress three of the options through consultation and the development of an OBC. These options consisted of two on-road options and one off-road option (consisting of several minor variations along a similar route) between Madingley Mulch roundabout and Cambridge. The options were consulted in late 2017 / early 2018.

This OAR (Part 1) sets out the result of further assessment in order to conclude a recommended on-road and off-road option to be taken forward for further assessment in combination with the proposed Park and Ride sites.

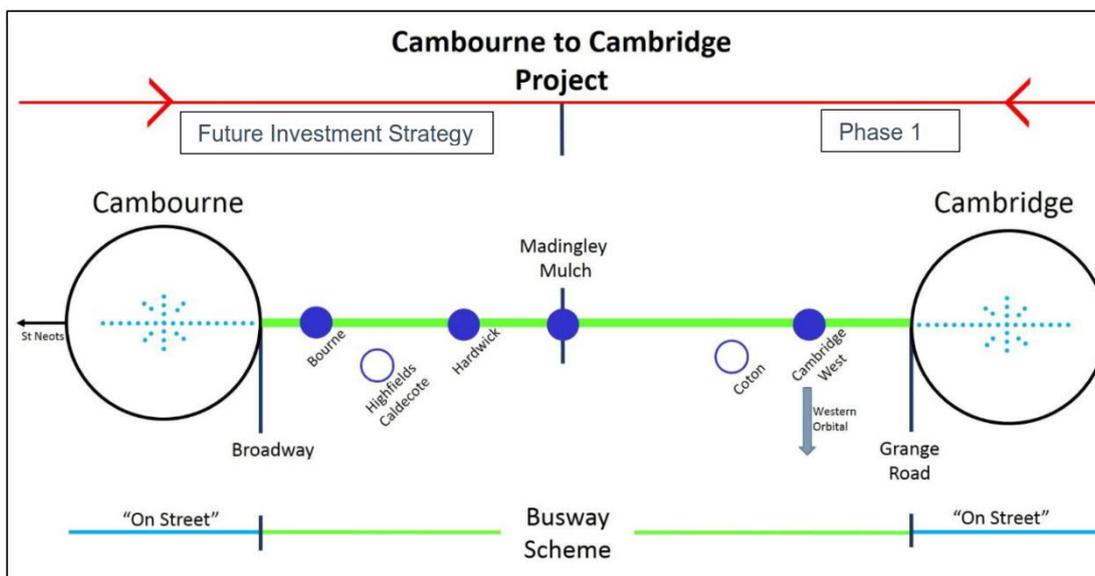
3.2 Project Description

The C2C project aims to provide a congestion free public transport corridor through a series of linked enhancements along the A428/A1303 into Cambridge. Thereby providing faster, timelier, and more reliable alternatives for current travellers into the city, while also providing additional transport capacity for trips from developments proposed and planned within Greater Cambridge.

The project aims to alleviate the impact future growth would have on along the corridor by creating a high-quality alternative to private car use. The proposed project is made up of three key elements (illustrated in **Figure 9**):

- A new public transport only scheme, or public transport lanes and priority measures from Cambourne to Cambridge, providing for faster and more reliable public transport services bypassing general traffic congestion.
- A new Park and Ride site along the route.
- New high-quality cycling and walking facilities along as much of the route as is feasible.

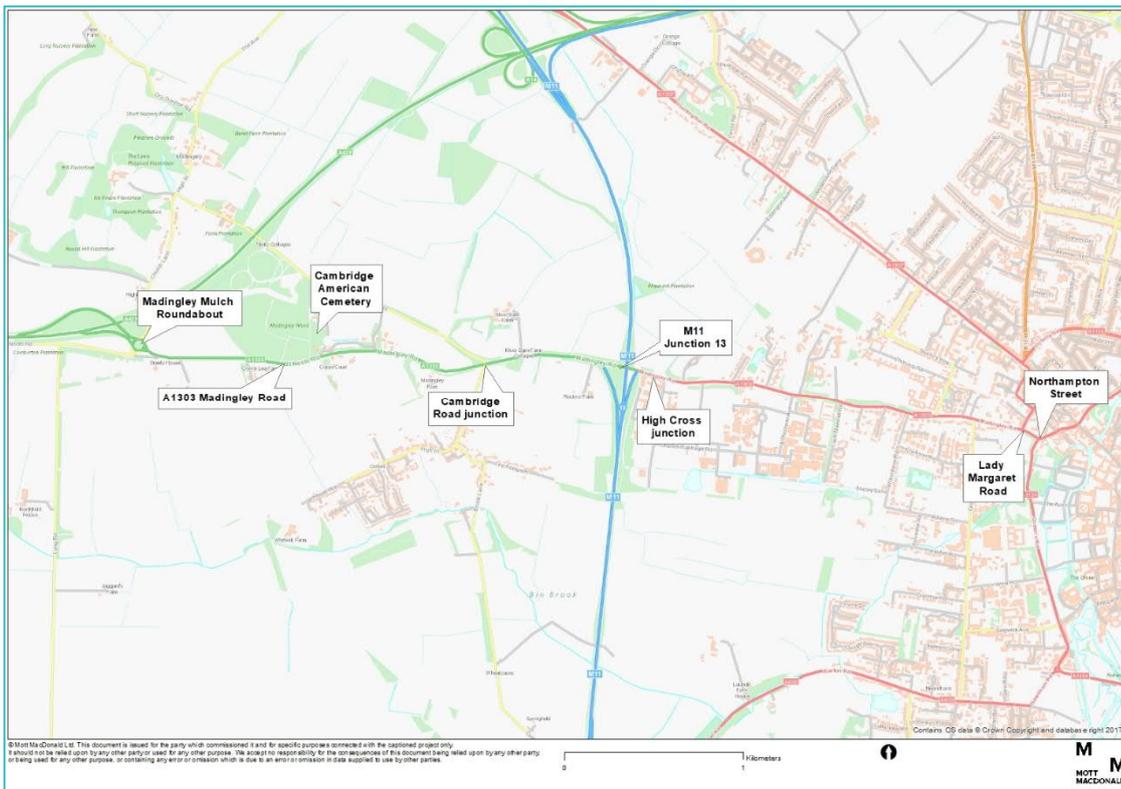
Figure 9: Elements of the C2C Project



Source: Atkins, 2017, End of stage Report

The scheme is currently being progressed in tranches to reflect the targeting of funding from the City Deal, with Phase 1 covering the route between Madingley Mulch Roundabout and the City Centre. The study area along the A1303 covered by Phase 1 is illustrated in **Figure 10**.

Figure 10: C2C Scheme Tranche 1 Study Area



Source: Mott MacDonald

3.2.1 Park and Ride Options

A key element of the C2C scheme is the inclusion of a new Park and Ride site. The options for the location of the new Park and Ride site have been considered as part of an assessment conducted by Mott MacDonald in conjunction with the main route options development.

The process for identifying the new Park and Ride site has been carried out in two stages:

- Stage 1 shortlisting; and
- Stage 2 specific site evaluation

3.2.1.1 Stage 1 - Shortlisting

Stage 1 has been completed and more detail can be found in the Mott MacDonald Report: Camboorne to Cambridge Better Public Transport Park and Ride Study.¹²

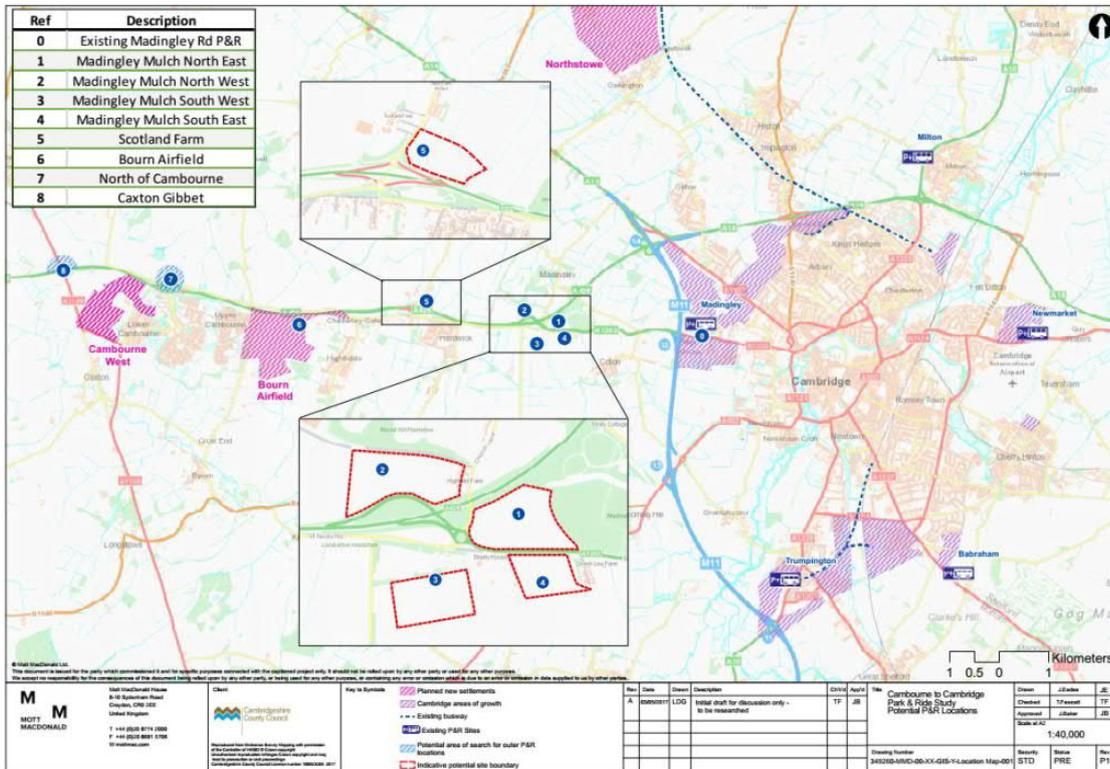
Stage 1 considered three broad location areas for a proposed new site, for which the transport characteristics and suitability for a Park and Ride site (see **Figure 11**). These were:

- A western, outer, area with potential sites including 6, 7 and 8 (all close to Camboorne);
- A central area, which includes site 5 (Scotland Farm); and

¹² Camboorne to Cambridge Better Public Transport Park and Ride Study (Ref: 377897/001/A) which can be found on the GCP website.

- An eastern, inner, area around Madingley Mulch (sites 1, 2, 3 and 4).

Figure 11: Stage 1 - Park & Ride sites



Source: Mott MacDonald - Cambourne to Cambridge Better Public Transport Park and Ride Study (September 2017)

Using Mott MacDonald’s multi-criteria assessment tool called INSET (Investment Sifting and Evaluation Tool) the nine sites were assessed. INSET is a Multi-Criteria Assessment Framework that is developed in a bespoke form for each application. In this instance it reflects the following key criteria agreed with stakeholders:

- High level theme – Policy Alignment;
- Intermediate level theme – Benefits; and
- Operational theme – Deliverability.

A summary of the results for the initial INSET can be found in **Table 2**. A full break down of the criteria and scores can be found in Appendix G of the Cambourne to Cambridge Better Bus Journey Park and Ride Study (Mott MacDonald, September 2017 - Published as Appendix M to the End of Stage Report, 2017).

Table 2: Park and Ride stage 1 short list initial selection

No.	Name	1A. High Level Theme – Policy Alignment	1B. Intermediate Theme - Benefits	1C. Operational Theme - Deliverability	Average
0	Existing Madingley Road Park and Ride	0.76	0.27	-0.20	0.27
1	Madingley Mulch North East (site adjacent to SSSI north of A1303	1.09	0.90	-0.98	0.34

No.	Name	1A. High Level Theme – Policy Alignment	1B. Intermediate Theme - Benefits	1C. Operational Theme - Deliverability	Average
2	Madingley Mulch North West (often referred to as Park Farm)	1.09	0.95	-0.98	0.36
3	Madingley Mulch South West (often referred to as water works site)	1.09	1.06	-0.73	0.48
4	Madingley Mulch South East (often referred to as Crome Lea)	1.09	0.92	-0.73	0.43
5	Scotland Farm	1.02	1.06	-0.60	0.49
6	Bourn Airfield	1.09	1.16	-0.50	0.58
7	North of Cambourne	1.21	1.15	-0.60	0.58
8	Caxton Gibbet	1.14	1.08	-1.23	0.33

Source: Mott MacDonald. Final scores shown in Table 2 are on a scale -3 to 3.

Following the assessment of the proposed Park and Ride sites five were recommended for taking forward into a further stage of assessment. They were:

- Site 0 Madingley Road;
- Site 3 Water Works;
- Site 4 Crome Lea;
- Site 5 Scotland Farm; and
- Site 6 Bourn Airfield.

Even though site 7 has the equal highest score it was not taken forward as it is similar to site 6 and site 7 has the potential interaction with the proposed future adjacent development which cannot yet be assessed as there is no developed master plan, as well as site 6 being noted in the South Cambridge Local Plan.

3.2.1.2 Stage 2 - Specific Site Evaluation

Following on from the stage 1 assessment further research and development of the short-listed Park and Ride sites was undertaken to select two options that would be taken to public consultation.

After the further development and research of the sites had been complete, an INSET assessment was undertaken using the same criteria as Stage 1. A summary of the results for the initial INSET can be found in **Table 2**. A full break down of the criteria and scores can be found in Appendix M of the Cambourne to Cambridge Better Bus Journey Park and Ride Study (Mott MacDonald, September 2017).

Table 3: Park and Ride stage 2 short list selection

No.	Name	1A. High Level Theme – Policy Alignment	1B. Intermediate Theme - Benefits	1C. Operational Theme - Deliverability	Average
0	Existing Madingley Road Park and Ride	0.62	0.28	-0.08	0.27

No.	Name	1A. High Level Theme – Policy Alignment	1B. Intermediate Theme - Benefits	1C. Operational Theme - Deliverability	Average
3	Madingley Mulch South West (often referred to as water works site)	1.09	1.03	-0.73	0.47
4	Madingley Mulch South East (often referred to as Crome Lea)	1.09	0.92	-0.73	0.43
5	Scotland Farm	0.96	1.01	-0.48	0.50
6	Bourn Airfield	1.09	0.96	-0.65	0.47

Source: Mott MacDonald. Final scores shown in Table 3 are on a scale -3 to 3.

Having reviewed the results of the INSET for stage 2, two sites were taken forward for consultation, one from the Madingley options and one from the western options, the two short-listed sites are:

- Water Works from the Madingley options
- Scotland Farm from the western options

A full breakdown of the stage 2 site selection can be found in the Cambourne to Cambridge Better Bus Journey Park and Ride Study (Mott MacDonald, September 2017).

3.2.2 Mode Choice Confirmation

3.2.2.1 Policy Support

This section focuses on the review of key local and regional policies and strategies related to the Greater Cambridge area that support a bus modal choice. They demonstrate the modal choice rationale for the scheme and why a public transport scheme along the A428/A1303 corridor has been developed.

The following extracts from local policy show the support for a public transport improvement scheme on the A428 and A1303 from Cambourne to Cambridge.

Table 4: Local and regional policies supporting a bus modal choice

Policy	How scheme supports bus modal choice
<ul style="list-style-type: none"> • Greater Cambridgeshire and Peterborough Strategic Economic Plan (SEP) 2014 	<ul style="list-style-type: none"> • “More reliable bus services on A428 corridor between St Neots and Cambridge.”
<ul style="list-style-type: none"> • South Cambridgeshire Draft Local Plan 2014 	<ul style="list-style-type: none"> • “Significant Improvements in Public Transport, including: Including a segregated bus link from Cambourne to Bourn Airfield new village across the Broadway, and on through the development to the junction of the St Neots Road with Highfields Road; Any measures necessary to ensure that a bus journey between Caldecote / Highfields and the junction of the A428 and the A1303 is direct and unaffected by any congestion suffered by general traffic.”
<ul style="list-style-type: none"> • Transport Strategy for Cambridge and South Cambridgeshire (TSCSC) 	<ul style="list-style-type: none"> • “Significant growth on the corridor at St Neots, Bourn Airfield and Cambourne is likely to exacerbate congestion on the A428 Trunk Road between St Neots and Caxton Gibbet, and on the A1303 between the A428 and Cambridge. If buses are caught in this congestion, services would not be able to offer a competitive journey experience to the private car for longer trips. The strategy would therefore focus on achieving a journey time and quality of service for buses on this corridor that equals or exceeds the equivalent car trip in peak periods, as has been achieved on the Huntingdon corridor with the Busway. In the short term, this would involve measures on the existing highway to give increased priority for buses on the inbound trip

Policy	How scheme supports bus modal choice
<ul style="list-style-type: none"> Cambridgeshire Long Term Transport Strategy (LTTS) 	<p>into Cambridge on the A1303. In the longer term, a more comprehensive solution for both inbound and outbound services would be sought".</p> <ul style="list-style-type: none"> The A1303 that forms the inner radial route between the A428 and Cambridge is frequently congested, and bus trips have no competitive advantage over a car trip on the route. As improvements to the overall capacity of the A1303 would still feed traffic into a congested city centre with no capacity to take additional car trips, the strategy for this corridor focuses on getting buses past the congestion that occurs between the A428 and central Cambridge.

Source: Mott MacDonald

3.2.2.2 Wider Transport Studies

There have been a number of studies looking at options to provide a connected transit network for the wider Cambridge area. Significant growth on the corridor at St Neots, Bourn Airfield and Cambourne is likely to represent an increased demand for vehicle access to Cambridge and may exacerbate congestion on the A428 Trunk Road between St Neots and Caxton Gibbet, and on the A1303 between the A428 and Cambridge, current vehicle flows can be seen in **Table 5**. As such the route from Cambourne to Cambridge has been named as a key corridor into Cambridge from the west.

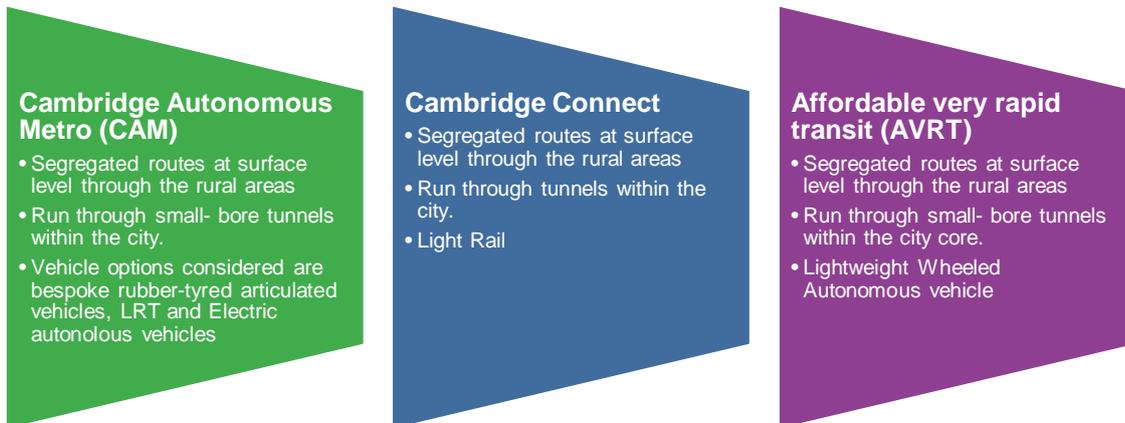
Table 5: Westbound traffic flows

AM Peak Inbound Flow Summary (Cars)		PM Peak Outbound Flow Summary (Cars)	
Peak Hour	670	Peak Hour	1,260
Am Peak Period	1,805	PM Peak Period	3,400

Source: Affordable Mass Transit for Cambridge and Wider Region, 2015

Recent studies that have been commissioned suggest moving away from a surface bus based network for public transport in Cambridge. These are summarised on the following page.

Figure 12: Recent Studies on Transport Schemes for Cambridge



Source: Cambridge Autonomous Metro ¹³, Cambridge Connect ¹⁴, Affordable very Rapid transit ¹⁵

3.2.2.3 Modal Validation

The scheme proposed in this report is supported by local and regional policy as detailed in Table 4. There have, however, been studies that have suggested alternative HQPT options, as shown in Figure 12. The common themes of the proposals are surface level routes in the rural areas and tunnelling with the city and light rapid transit such as trams or bespoke vehicles.

The possibility of tunnelling under the city at some point in the future is not mode dependent. Therefore, it can be evaluated in the route assessments in Section 8 under future proofing.

In order to ensure the robustness of the Business Case Update for the scheme, we need to review the modal choice as set out in current policy. A brief assessment of the project aims reflects the need to help existing and new communities along the A428 grow sustainably in the coming years. As such a bus based scheme is relatively quick to implement meaning that benefits can be realised faster than an option which require more extensive infrastructure. Due to technological developments in bus design and operation buses also perform well in other factors such as attractiveness of the option, how sustainable it is, what opportunities it has for further expansion and how intrusive it is.

However, it can be noted that other aspects of transit options can be incorporated to provide additional improvements, such as providing dedicated cycle and walking infrastructure along the bus route.

¹³ Greater Cambridge Mass Transit Option Assessment Report, Steer Davies Gleave, 2018 (<http://www.cambridgeshirepeterborough-ca.gov.uk/assets/Combined-Authority/Item-2.1-Additional-report-Greater-Cambridge-mass-transit-options-assessment-report-January-2018.pdf>)

¹⁴ The "Isaac Newton Line" underground /Overground Extensions A&B, Cambridge Connect, 2017 (http://www.cambridge-connect.uk/wp-content/uploads/2017/11/CambridgeConnect_NewtonLine_ExtensionAB_55K_A3_v6.3.pdf0)

¹⁵ An Affordable Mass Transit System for Cambridgeshire, Smart Cambridgeshire, 2015 (<http://www.connectingcambridgeshire.co.uk/wp-content/uploads/2015/10/Affordable-Very-Rapid-Transit-AVRT-Report.-Vol-1..pdf>)

4 Options Assessment Methodology

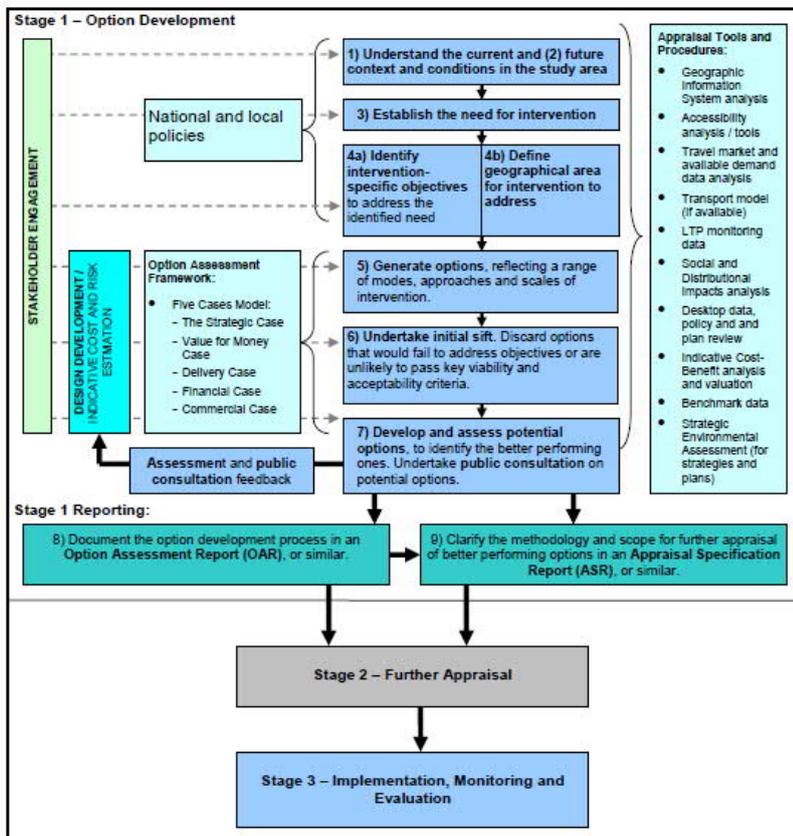
4.1 WebTAG Guidance on the Transport Appraisal process

The OAR follows the Department for Transport’s (DfT) guidance ‘The Transport Appraisal Process’ which provides detailed guidance on appraisal and the requirements needed for transport intervention. A structured approach sets out the necessary steps from initial intervention through to the detailed appraisal that supports preparation of business or investment cases to subsequent approval stages and post implementation evaluation (see **Figure 13** and **Figure 14** which illustrate the DfT process. which illustrate the DfT process).

The three stages in the DfT’s transport appraisal process are shown below:

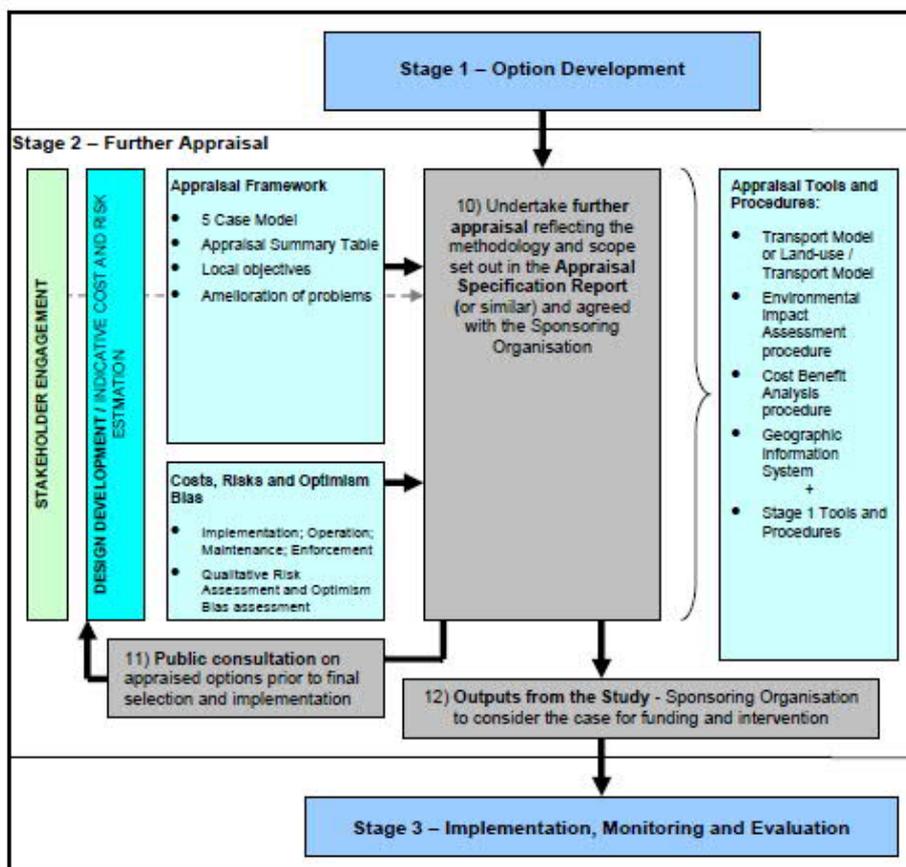
- **Stage 1** – Option Development. This involves identifying the need for intervention and developing options to address a clear set of locally developed objectives which express desired outcomes. These are then sifted for the better performing options to be taken on to further detailed appraisal in Stage 2.
- **Stage 2** – Further Appraisal of a small number of better performing options in order to obtain sufficient information to enable decision-makers to make a rational and auditable decision about whether or not to proceed with intervention. The focus of analysis is on estimating the likely performance and impact of intervention(s) in sufficient detail.
- **Stage 3** – Implementation, Monitoring and Evaluation.

Figure 13: Stage 1 of the Transport Appraisal Process (‘Option Development’)



Source: Department for Transport (2014), Transport Analysis Guidance: The Transport Appraisal Process

Figure 14: Stage 2 of the Transport Appraisal Process ('Further Appraisal')



Source: Department for Transport (2014), Transport Analysis Guidance: The Transport Appraisal Process

4.2 Methodology Summary

The options appraisal process and this report for the C2C scheme has been structured to align with Stages 1 and 2 of the DfT’s transport appraisal model outlined in Section 2.1.

Stage 1 included identifying the need for intervention and developing options to address a set of locally developed objectives derived from evidence based issues and opportunities (see Sections 3 and 4 of this report). These options were then sifted to arrive at a shortlist that was progressed to further appraisal at Stage 2 where a recommended option is identified and taken forward through an OBC and subsequently a Full Major Scheme Business Case (MSBC) process for funding and delivery.

4.2.1 Stage 1 – Options Generation and Assessment

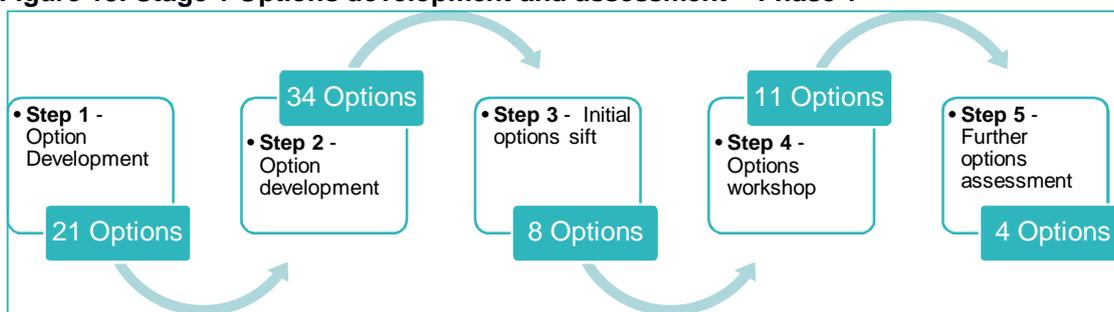
Stage 1 forms the basis of all previous options development and appraisal carried out for the SOBC published in 2016, and for subsequent further options appraisal work carried out post SOBC including that documented in the End of Stage Report in advance of public consultation in September 2017. Stage 1 was further split into two phases of development, with several steps undertaken as part of each phase. **Figure 15** and **Figure 16** shows the process undertaken to date in options development as part of Stage 1, with Section 7 of this report setting out a detailed summary.

Options development and appraisal work was carried out by Atkins and Skanska between 2014 and 2017, with input from the GCP Executive Board and key stakeholder groups such as the Local Liaison Forum (LLF). The key supporting reports are set out in Appendix D. Copies of these reports can be found on the GCP project website for the scheme.¹⁶

Stage 1, Phase 1 of the options appraisal process generated options to form a long list of potential schemes. These were then packaged together prior to sifting to reflect the fact that some options would be more effective if delivered in combination with others. The final long list of packaged options (34 options) were then taken through an initial sift. The purpose of this initial sift was not to immediately identify a recommended option, but to narrow the 'pool' of options down to a more manageable number by identifying any significant issues which were likely to prevent an option progressing at Stage 2. Options that clearly failed to address the project objectives, or any options that were unlikely to be deliverable in technical, financial, or public acceptability terms were discounted during this initial sift. The list of options was refined to 8.

Following the initial sift, an internal workshop between Atkins and Cambridgeshire County Council (CCC) resulted in additional options being added in that were adjudged worthy of further investigation. These were taken forward, along with those from the initial sift, for more detailed assessment to give greater quantification as to the potential benefits of each option (11 options). The assessment combined elements of engineering feasibility and costs with transport related market benefits and potential market capture for each of the options. The aim was to determine a shortlist of options to propose for further detailed analysis within Phase 2. The results of this stage were a short list of 4 options.

Figure 15: Stage 1 Options development and assessment – Phase 1



Source: Options development and assessment carried out by Atkins – see Appendix D for list of supporting reports

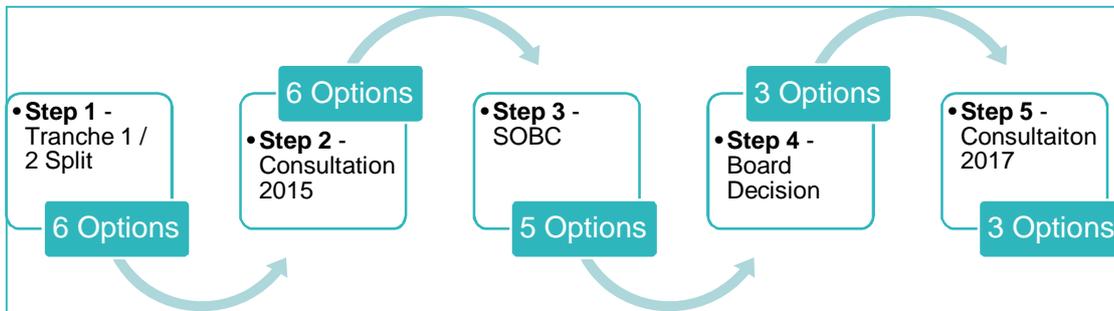
Stage 1, Phase 2 – After it was established that the City Deal funding would be released from Government in three tranches, the short-listed options from Phase 1 were revisited and divided into sub-sections to reflect the City Deal funding requirements, resulting in 6 options. A preliminary assessment of these options was carried out to identify key risks and determine their feasibility, before they were consulted on with stakeholders. Following consultation, 5 options were short listed and presented in an SOBC. These were assessed using a Multi Criteria Assessment Framework (MCAF) developed to appraise each scheme option against specific strategic goals, including scheme costs and benefits, transport impacts, risks, accessibility, environmental impacts and stakeholder support.

At the instruction of the GCP Executive Board, further options assessment was carried out post submission of the SOBC that resulted in 3 options being taken forward for further public consultation. The further options assessment was based on feedback from the LLF who had

¹⁶ GCP Cambourne to Cambridge Better Public Transport scheme website - <https://www.greatercambridge.org.uk/transport/transport-projects/cambourne-to-cambridge/>

proposed an alternative option, and whose feedback was used to update the MCAF previously used.

Figure 16: Stage 1 Options development and assessment – Phase 2



Source: Options development and assessment carried out by Atkins – see Appendix D for list of supporting reports

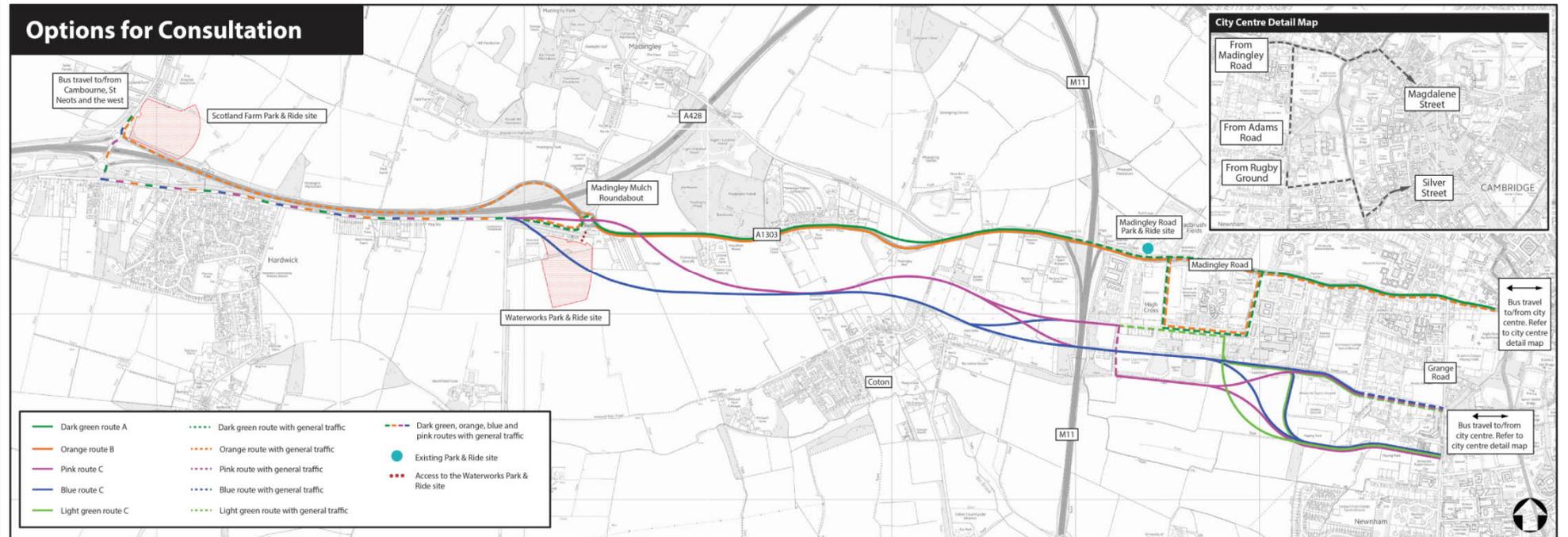
Following the submission of the SOBC, three options for this section of the scheme were taken forward for further development and public consultation (completed January 2018).

The three options consulted on are as follows:

- **Option A:** An on-road option which includes the introduction of an inbound public transport lane on Madingley Road between Madingley Mulch roundabout and Lady Margaret Road;
- **Option B:** An on-road tidal public transport lane on Madingley Road running between Madingley Mulch roundabout and the new entrance to Eddington (High Cross); and
- **Option C:** An off-road busway running between Madingley Mulch roundabout and Grange Road, Cambridge.

Figure 17 on the following page shows the scheme route options that were consulted on as of January 2018.

Figure 17: November 2017 - January 2018 consultation options



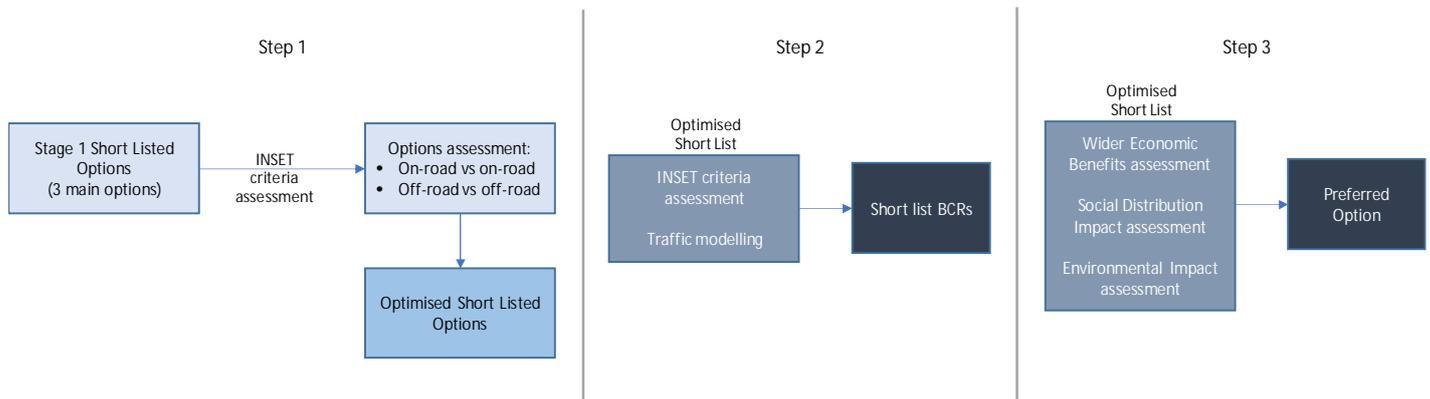
Source: Consultation leaflet, 2017-2018

4.2.2 Stage 2 – Further Options Assessment

Stage 2 of the appraisal process for this scheme aligns with Stage 2 of the WebTAG transport appraisal process. This involved further appraisal of the 3 best performing options based on the Stage 1 results in order to arrive at a Recommended Option.

Stage 2, like Stage 1, has been split into steps, with the short-listed options from Stage 1 undergoing further assessment and optimisation prior to more detailed appraisal (see **Figure 18**).

Figure 18: Stage 2 Options assessment stepped approach



Source: Mott MacDonald

Stage 2, Step 1 - The purpose of Step 1 was to refine the on-road and off-road options to arrive at a recommended for each. The process and results for Step 1 are set out in Section 7 of this report – OAR Part 1.

The assessment of the options at this step were undertaken using Mott MacDonald's in-house Investment Sifting and Evaluation Tool (INSET), which applies weighted scoring to each option based on how well an option meets identified criteria. An overview of the structure and operation of INSET is detailed in Section 8.

Stage 2, Step 2 – This Step will form the basis of the updated OAR Part 2.

Following the use of INSET, the best performing on-road and off-road options between Madingley Mulch and Cambridge (Phase 1) will be selected for more detailed appraisal. A further option that also involves new infrastructure between Cambourne and Madingley Mulch (Phase 2) will also be selected for further appraisal to illustrate any potential step change in potential benefits resulting from a higher level of investment, this will be referred to as the “Illustrative Comparator”. The appraisal will use the same selection criteria used in the INSET assessment for Step 1, but will repeat the exercise comparing the options against each other rather than simply comparing the variants of similar options i.e. the different on-road and off-road options. Each option will be assessed with one of the two Park and Ride variants.

Included in this assessment will be the detailed economic appraisal of each option based on transport user benefits using traffic modelling outputs; specifically:

- SATURN modelling to assess traffic decongestion benefits;
- SATURN modelling and observed data to assess demand, and;
- TUBA assessment of passenger benefits.

Stage 2, Step 3 – This will feed directly into, and be reported as part of the OBC.

Further appraisal of the optimised short-listed options will be carried out, including:

- Wider Economic Benefits assessment
- Social Distribution Impact assessment
- Environmental Impact assessment

In particular the high level strategic assessment of wider economic benefits will focus on understanding how the scheme will benefit the economy of Cambridge by improving labour market access into the city and supporting planned growth. This includes how development sites, for housing and employment purposes, could be supported by the highway improvements.

5 Current and Futures Issues and Opportunities in Cambridge

This section provides a summary of the current issues and opportunities pertinent to the A428/A1303 Corridor that have guided the development of the project objectives outlined in Section 6. Mott MacDonald has addressed the strategic context of the scheme by examining current and future issues in the Greater Cambridgeshire area which are reported in this OAR under the following topic themes:

- 5.1 Rational for scheme - policy review
- 5.2 Strategic socio-economic overview
- 5.3 Economy and business
- 5.4 Highways network and traffic
- 5.5 Wider transport network provision
- 5.6 How people travel
- 5.7 Land use and development
- 5.8 Housing
- 5.9 Environmental issues

A full analysis of these issues and opportunities will be presented in the OBC, to which this report will be appended.

5.1 Rationale for Project – Policy Review

This section focuses on the review of key local and regional policies and strategies that related to Greater Cambridge area alongside the C2C Project to demonstrate the policy rationale for the scheme and why intervention along the A428/A1303 corridor should be supported.

Table 6: Policy review

Policy	Key points and objectives	How scheme supports policy
National Policy		
DfT – Transport Investment Strategy (2017)	<ul style="list-style-type: none"> ● To create a more reliable, less congested and better-connected transport network. ● Responding to local growth priorities. ● Supporting the creation of new housing. ● Gaining the best value out of the network. 	<ul style="list-style-type: none"> ● HQPT along the A428 would offer an attractive alternative to private car use which would alleviate many network capacity issues and congestion; ● HQPT would support local growth priorities by providing transport links from current and future developments to areas of high economic growth in the city centre. ● By providing HQPT along the A428 corridor, this would release some congestion and help gain the best value for money along the corridor.
Highways England Road Investment Strategy 2014 (RIS1)	<ul style="list-style-type: none"> ● Providing capacity and connectivity to support national and local economic activity ● Joining our communities and linking effectively to each other ● Supporting delivery of environmental goals and the move to a low carbon economy. 	<ul style="list-style-type: none"> ● The scheme would provide better inter-urban connections and additional capacity along the A428/A1303 corridor, supporting connections between the A1 and Cambridge city centre and facilitating growth within existing and future communities along the corridor. ● The scheme would help put more people within reach of a wider range of jobs and services

Policy	Key points and objectives	How scheme supports policy
Highways England Road Investment Strategy: post 2020 (RIS2)¹⁷	<ul style="list-style-type: none"> • Create a more reliable, less congested, and better-connected transport network; • Build a stronger, more balanced economy by enhancing productivity and responding to local growth priorities and creation of new housing; and • Enhance our global competitiveness by making Britain a more attractive place to trade, invest and visit. • RIS2 has been informed by 6 strategic studies, including one looking at the Oxford to Cambridge Expressway which is viewed as a strategically important corridor that follows a broad arc from Didcot – Oxford – Milton Keynes – Bedford – Cambridge along the SRN. 	<p>through attractive, lower carbon alternative transport alternatives to private car use.</p> <ul style="list-style-type: none"> • By investing in HQPT this becomes a more attractive alternative to private car use and so help decongest the SRN whilst providing the enhanced transport network for its users. • The predicted economic growth of Cambridge and South Cambridge would be supported by HQPT available for residents of committed and existing housing developments to jobs, education and training facilities as well as leisure trips. • The A428 forms part of the Oxford to Cambridge Expressway. By investing in HQPT along this corridor, the scheme would contribute to the strategic objectives of RIS2.
Sub-national Transport Bodies (STBs) - Cities and Local Government Act 2016	<ul style="list-style-type: none"> • STBs enable areas to come together and speak with one voice on strategic transport planning with the aim to enable economic growth and development. 	<ul style="list-style-type: none"> • England's Economic Heartland covering the Oxford-Cambridge arc and the Local Authorities that fall within, have formed a partnership with the aim of becoming an STB. • An STB would have greater input into how funding is invested and transport infrastructure is used to support the region, including the A428.
Regional Policy		
Greater Cambridgeshire and Peterborough Strategic Economic Plan (SEP) 2014	<ul style="list-style-type: none"> • An integrated and reliable transport network that enables efficient movement of goods and people; • Sustainable transport capacity to support and unlock growth along key corridors / hubs; and • Good and reliable access to and between the key economic clusters. 	<ul style="list-style-type: none"> • HQPT offers a competitive time vs distance to private car which would encourage the use of PT and mode shift. This in turn would reduce congestion and improve connectivity to the west of Cambridge helping to support and unlock growth along the A428. • Increased capacity and improved public transport would facilitate development of housing land along the A428 corridor and employment areas within the city, encouraging economic growth in Greater Cambridge.
Partnering for Prosperity: a new deal for the Cambridge – Milton Keynes – Oxford Arc 2017	<ul style="list-style-type: none"> • Ensuring all jobs, homes and infrastructure developments are planned together to maximise economic benefits. • Link homes and jobs, connecting the places where people live and work. • To open up strategic sites and smaller local sites for high quality housing developments • Create inclusive, liveable places, connecting people and communities with opportunities for work and leisure¹⁸. 	<ul style="list-style-type: none"> • HQPT along the A428 corridor is being planned in line with future developments and growth predicted in the Local Plans, ensuring that new housing development have access to employment regions of Cambridge. • By supplying HQPT along the A428 corridor there would be a release of land available for future developments for South Cambridge.
Local Policy		

¹⁷ RIS2 currently out for consultation.

¹⁸ Partnering for Prosperity: A new deal for the Cambridge – Milton Keynes – Oxford Arc, 2017

Policy	Key points and objectives	How scheme supports policy
Cambridgeshire Local Transport Plan (LTP3) 2014	<ul style="list-style-type: none"> • Enabling people to thrive, achieve their potential and improve quality of life. • Supporting and protecting vulnerable people, promoting improved skills level and helping people into employment and education. • Managing and delivering the development and growth of sustainable communities • Meeting the challenges of climate change 	<ul style="list-style-type: none"> • A greater level of public transport would allow a greater choice in how to travel minimising usage of private car and encouraging sustainable travel. • Investment in public transport infrastructure would help tackle congestion by making it a more attractive alternative to private car use. • Public transport is one of the main alternatives to private car use for commuting and travel to education. Better public transport allows more people to access a wider variety of education and employment opportunities.
South Cambridgeshire Draft Local Plan 2014	<ul style="list-style-type: none"> • Support economic growth by supporting South Cambridge as a world leader • New development should enhance the area, and protect and enhance biodiversity. • To provide land for housing in sustainable locations that meets local needs and aspirations • To deliver new developments that are high quality and well-designed... which responds robustly to the challenges of climate change. • To maximise potential for journeys to be undertaken by sustainable modes of transport including walking, cycling, bus and train. 	<ul style="list-style-type: none"> • A HQPT system along the A428 corridor would significantly improve connectivity by improving journey options and times between housing areas, committed developments such as Cambourne and Bourn Airfield and major employment areas; • Better public transport services would seek to mitigate forecast levels of road traffic created by committed developments by moving people in buses which are a more sustainable means of moving large numbers of people. • Better bus services would provide a viable alternative to driving for trips into Cambridge • An important aspect of development design is to ensure that bus services are able to move efficiently. Bus infrastructure would be integrated into the design of new developments.
Cambridge City Draft Local Plan 2014	<ul style="list-style-type: none"> • Contribute to the vision of Cambridge as an environmentally sustainable city, where it is easy for people to make a transition to a low carbon lifestyle. • Meet the housing needs of the city. • Assist the creation and maintenance of inclusive, environmentally sustainable communities. • Promote and support economic growth in environmentally sustainable and accessible locations. • Support Cambridge's vibrant and thriving centres. • Ensure appropriate and timely provision of environmentally sustainable forms of infrastructure. 	<ul style="list-style-type: none"> • The delivery of HQPT would make it much easier for people to choose to live a low-carbon / low energy lifestyle. Better bus services provide a viable alternative to driving for commuting, education, personal business and leisure trips. • Bus public transport can promote development in locations which minimise the need to travel. The A428 scheme would help link various employment and research establishments across the city and make travel easy by HQPT. The scheme would boost the retail economy by enabling more people to access City Centre • Provision of PT infrastructure and services as part of housing and employment developments would enable sustainable travel choices to become an integral way of how people travel to and from new housing and employment developments.
Transport Strategy for Cambridge and South Cambridgeshire (TSCSC)	<ul style="list-style-type: none"> • Aim for more journeys to be made by bus, train, bike and on foot so that traffic levels aren't increased. • Reducing car traffic by using a variety of techniques, including limiting the available road space for cars and ensuring public transport and active travel are quicker and more convenient than private car use. • Additional Park and Ride options on the fringes of Cambridge 	<ul style="list-style-type: none"> • The development of HQPT would provide frequent and more efficient PT than what already exists, therefore being an attractive alternative to private car use • There is the opportunity to improve the Park and Ride facilities along the corridor which would encourage people to make the last part of the journey into Cambridge by bus rather than private car
Cambridgeshire Long Term Transport Strategy (LTTS)	<ul style="list-style-type: none"> • Supports sustainable growth across Cambridgeshire to 2031. • Considers longer term aspirations in support of sustainable growth to 2050. 	<ul style="list-style-type: none"> • The provision of a HQPT route along the A428 would help achieve the longer-term aspirations of sustainable growth by providing alternative means of transport from current and future developments to Cambridge City Centre and areas of economic growth.

Policy	Key points and objectives	How scheme supports policy
	<ul style="list-style-type: none"> Supports the Greater Cambridge and Greater Peterborough Growth Prospectus. 	

Source: Mott MacDonald

5.1.1 Policy Review Conclusions

The key national, regional and local policy/objectives that were reviewed can be summarised as looking to address three broad areas, including:

- Environmental sustainability;
- Economic growth; and,
- Meeting the needs of the community.

The proposed scheme meets the needs of all three by implementing sustainable transport infrastructure. The provision of additional public transport helps to link and support communities whilst reducing the need for private car travel. The resulting effect is greater participation in social and economic activities as well as reducing car journeys, congestion and supporting a lower carbon economy. For an area of rapid growth, such as Cambridge, there is a real need within public policy to meet national and local policy objectives to ensure sustainable growth isn't restricted.

5.2 Strategic Socio-Economic Review

This section summarises the socio-economic trends in Cambridge, and highlights the issues and opportunities in relation to the population, employment, unemployment, education and health factors. It includes sources from the Office of National statistics census 2011, NOMIS, OS mapping and the English Indices of Deprivation.

Table 7: Summary of socio-economic issues and opportunities

Strategic socio-economic	Issues	Opportunities
Population	<ul style="list-style-type: none"> The total combined population of Cambridge and South Cambridgeshire is approximately 275,000.¹⁹ Population projected to increase by a further 70,000 by 2031.²⁰ There would therefore be a greater demand to travel in and around Cambridge which could exacerbate existing congestion issues, in particular along corridors such as the A428/A1303 where substantial new housing is planned. 	<ul style="list-style-type: none"> Improve transport infrastructure to influence and encourage future residents to use alternatives to car journeys to work. Support the introduction of sustainable transport modes linking to new housing and employment developments to capture new trips resulting from the growth in population. A greater number of people living and working within Greater Cambridge can increase the workforce supply to take up new jobs and improve prosperity for residents.
Employment	<ul style="list-style-type: none"> 44,000 new jobs are forecasted in Greater Cambridge between 2011-2031.²¹ To accommodate the growth in forecasted jobs, significant areas of land would need to be developed for employment use. 	<ul style="list-style-type: none"> The corridor has potential to enhance employment growth in the specialist sectors that are popular in Cambridge. A greater spread of commutable employment would facilitate the economic viability of new

¹⁹ ONS 2011

²⁰ Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

²¹ East of England Forecasting Model (EEFM)

	<ul style="list-style-type: none"> • New employment sites would create greater commuter flows within Greater Cambridge, including along the A428/A1303. This would require the necessary transport infrastructure to support development, including increasing network capacity. 	<p>routes. These could link up communities where routes previously weren't feasible.</p> <ul style="list-style-type: none"> • New employment sites including the Bio-medical campus can provide a range of highly skilled jobs for Greater Cambridge residents providing they are accessible.
Unemployment / deprivation	<ul style="list-style-type: none"> • Cambridge has a relatively low unemployment figure of 2.3%, that compares favourably against the national average of 3.2%²², with a focus of highly skilled occupations. • Maintaining highly skilled labour is essential to continue the growth of Cambridge. 	<ul style="list-style-type: none"> • Achieving the economic growth forecasted in Greater Cambridge could achieve further reductions in unemployment. • Greater Cambridge has potential to target employment growth in its specialist sectors, such as hi-tech and bio-tech industries. • An increase in jobs and high skilled jobs can benefit residents in the most deprived areas providing the surrounding transport network is supportive of growth.
Education	<ul style="list-style-type: none"> • 5% of the working population have no qualifications.²³ 	<ul style="list-style-type: none"> • 43.8% of the population of Cambridgeshire hold NVQ4 and above qualifications, this is higher than the East of England Average (34.9%) and Great Britain Average (38.2%).²⁴ • Cambridge is globally renowned for its university.

Source: Mott MacDonald

5.2.1 Strategic Socio-Economic Review Conclusions

Greater Cambridge is expected to continue expanding, with a large growth in both population and levels of employment. Whilst this expansion is integral to the UK's long-term economic plan and in enabling Greater Cambridge to compete on a global stage, such growth would see additional pressures on the current transport infrastructure.

Greater Cambridge also outperforms many other areas of the country in terms of having low levels of unemployment and having large proportions of the population holding higher qualifications.

Whilst this can be viewed as a positive position for Greater Cambridge, in order to support the levels of growth forecasted, and maintain its low levels of unemployment and high levels of education population, investment in public transport enhancements to provide the required levels of additional capacity that connect people to sites of employment and educations is essential.

Transport improvements along the A428/A1303 would help address the socio-economic issues by increasing the capacity of the network and improving access to opportunities in order to support the growing population and facilitate economic growth and job creation. A reduction in journey times and travel delays would also facilitate faster access to jobs and local services, ultimately helping to sustain and further improve the quality of life experienced by those living in Greater Cambridge and along this corridor.

²² Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

²³ NOMIS 2018

²⁴ ONS 2011

What does this mean for the C2C scheme?

Cambridge’s population is set to continue growing. The highways network will have to cope with a greater demand to travel in and out of Cambridge from the west, presenting a risk that the highways network will become overloaded and congested on routes to the city centre.

This scheme presents an opportunity to support Cambridge’s growing population and workforce in conurbations to the west of the city, whilst managing the growing travel demand. The C2C scheme would help to connect such growing communities whilst enabling them to evolve and access the increasing number of jobs and opportunities in the city and on its periphery. As such, the scheme should support Cambridge’s key employment industries such as technology and innovation.

5.3 Economy and Business

This section summarises the performance of businesses and the economy of Cambridgeshire and covers key economic growth indicators, issues and opportunities. Data primarily sourced from the Local Plan and ONS data.

Table 8: Economy and business issues and opportunities

Issues	Opportunities
<ul style="list-style-type: none"> Gross weekly pay in South Cambridgeshire is £693.50 and £595.60 in Cambridge. This is higher than the East of England figure (£574.90) and Great Britain as a whole (£552.70).²⁵ GVA per head in Cambridge is £45,204 and £28,108 in South Cambridgeshire, significantly ahead of the UK average of £25,351.²⁶ This could potentially be improved if the region continues to attract highly-skilled workers through good access to employment and homes. 	<ul style="list-style-type: none"> Digital and life science businesses make Cambridge a major centre for employment in the technology sector across the UK and Europe - high value business key in supporting the economy, higher average pay attracting highly skilled workers to Cambridgeshire Beyond science and technology, Cambridge has a strong business and management sector which has grown up around the universities and the cluster businesses. Chance to increase capacity whilst providing greater East West connectivity

Source: Mott MacDonald

5.3.1 Economic and Business Review Conclusions

The Cambridgeshire area is outperforming the UK and East of England average in terms of GVA but regional disparities exist between South Cambridgeshire and the city. Increased transport infrastructure would help to distribute economic growth more evenly across the region to reach the greatest number of people.

What does this mean for the C2C scheme?

The scheme presents the opportunity to support Cambridge’s diverse and successful business base, by providing more efficient access from residential areas to employment zones which are currently developing rapidly in technology and life-science industries.

The C2C scheme could provide journey time savings for Cambridge’s residents and workers, freight, and other commercial movements across the area. Here the scheme could raise the overall productivity and increase the success of the business and enterprise in Cambridge.

5.4 Highways Network and Traffic

This section summarises issues and opportunities associated with the current highway network and traffic conditions along the A428/A1303 corridor. Issues and opportunities have been reviewed from a variety of sources such as local traffic data, congestion data and the Office of National Statistics (ONS) as well as growth predicted in the Local Plans.

Table 9: Highways network and traffic issues and opportunities

Highways Network and Traffic	Issues	Opportunities
Congestion	<ul style="list-style-type: none"> There are increasing difficulties in accessing the Madingley Road Park & Ride site due to existing congestion on the adjacent highway network. Severely congested sections of the highway network, results in unreliable journey times or large delays. A428 between Caxton Gibbet and St Neots has delays of up to 10 minutes eastbound in the morning peak and 3 minutes in the evening peak.²⁷ A1303 has delays of up to 18 minutes into city centre during morning peak.²⁸ 	<ul style="list-style-type: none"> Opportunity to reduce congestion through modal shift Reduction in congestion would improve efficiency and reliability of journey time
Strategic Road Network	<ul style="list-style-type: none"> Traffic density on Cambridgeshire's rural trunk A roads is almost twice the national average.²⁹ The highest growth since 2002 on trunk roads within the County has occurred on the A428 (25%) which is related to the development of Cambourne.³⁰ The A1303 Madingley Road is currently very busy for an urban route and congestion here is indicated to be an issue 	<ul style="list-style-type: none"> To use HQPT to encourage modal shift away from private car use along the congested SRN by providing an attractive alternative that offers competitive journey times to the city centre.
Pinch Points	<ul style="list-style-type: none"> The main highway pinch points are along the A1303 Madingley Road travelling eastbound into Cambridge, where delays of up to 18 minutes travelling into Cambridge in the AM peak, are incurred.³¹ 	<ul style="list-style-type: none"> Congestion can be reduced through modal shift away from private car use in favour of public transport and more sustainable options. This would decrease the impacts of pinch points on the local road network.

²⁷ Trafficmaster 2016

²⁸ Trafficmaster 2016

²⁹ Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

³⁰ Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

³¹ Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

Highways Network and Traffic	Issues	Opportunities
	<ul style="list-style-type: none"> The stretch of road between the A428/A1303 junction and the M11 is already a pinch point on the corridor that causes congestion for both general traffic and public transport with up to 80% of the route experiencing queuing in the AM peak.³² There is capacity for additional housing growth along this section of the corridor, which is likely to materialise in the future and this may lead to additional travel demand on the corridor compared with the current model assumptions. 	
Road Safety	<ul style="list-style-type: none"> There have been 19 serious accidents along the A1303 Madingley Road, including one fatal between 2012-17. There is one hot spot at the junction between the A1303 and Cambridge Road which has had 9 accidents (5 serious and 4 slight). There have been 24 serious accidents along the A428 between the A1 and Madingley Road roundabout between 2012-17.³³ 	<ul style="list-style-type: none"> To re-design pinch points to decrease the total amount of accidents occurring Reducing the number of private cars on the A428 (through modal shift), elements of road safety would improve.
Car Ownership	<ul style="list-style-type: none"> 85% of households have access to a car compared with the national average of 74%; 42% have access to more than one car³⁴, High car ownership is matched by high levels of employment with a bias towards highly skilled occupations. 85% of households have access to a car compared with the national average of 74%.³⁵ 42% have access to more than one car.³⁶ High car ownership is matched by high levels of employment with a bias towards highly skilled occupations. 	<ul style="list-style-type: none"> Increased bus routes would enable the mobility of the 15% who don't have access to a car.
Freight	<ul style="list-style-type: none"> The A428 is classed as a nationally and internationally important route with regards to freight as well as people trips. Many freight vehicles use the A428 to access Cambridge City which increases congestion along the corridor. 	<ul style="list-style-type: none"> By reducing congestion through HQPT there would be increased capacity on the road network, reducing pollution produced by congested freight transport.

Source: Mott MacDonald

5.4.1 Highways Network and Traffic Review Conclusions

The A428 forms part of the Strategic Road Network and is classed as a nationally important road for freight and people. Traffic density on roads around Cambridge is higher than the UK average with a number of pinch points including between the A428/A1303 junction and the M11.

Although Cambridge has high car ownership and car mode share along the A428/A1303 corridor, there is the opportunity to provide alternative sustainable modes such as HQPT and

³² Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

³³ <http://www.crashmap.co.uk/Search>

³⁴ ONS 2017

³⁵ ONS 2017

³⁶ ONS 2017

What does this mean for the C2C scheme?

The scheme presents the opportunity to ease congestion and the pressure on current pinch points along the corridor. This would support development taking place to the west of Cambridge and allow for easier access to housing and employment sites alike. It could mean that increasing numbers of commuter movements would not be to the detriment of the local communities and therefore support local economic growth.

additional cycling and walking facilities to accommodate future growth in traffic and reduce congestion the modal shift from private cars to public transport, ultimately alleviating a number of issues along the corridor. Lower private car numbers could also have a positive impact on the number of accidents by reducing levels of congestion at key pinch points, as well as improving air quality.

5.5 Wider Transport Network Provision

This section summarises the wider transport network provision in Cambridge, looking at accessibility on a mode by mode basis. The majority of data has been sourced from the Office of National Statistics, the Department of Transport and local Park and Ride data.

Table 10: Wider transport network provision issues and opportunities

Wider Transport Network Provision	Issues	Opportunities
Rail	<ul style="list-style-type: none"> The only rail stations are on the opposite side of Cambridge. There are currently no direct links to the stations from the west. Along the Cambourne - Cambridge corridor only 3% of residents use train as their main mode of transport.³⁷ Considering the location of the train stations, this implies that the majority of employment is local to Cambridge. 	<ul style="list-style-type: none"> To create better links into the city via other modes of transport. Cambridge is on the London to King's Lynn railway line, with London accessible within 45 minutes.
Bus	<ul style="list-style-type: none"> With the exception of routes 4, X5 and the Madingley Road Park & Ride, bus services are low frequency. There is limited priority for bus services, with a short bus lane on the approach to M11 Junction 13 being the only significant measure along the corridor. In the absence of substantial bus priority along the route, the congestion and delays experienced by existing bus services mean that buses offer minimal competitive advantage over private cars in terms of journey times and reliability. There are increasing difficulties in accessing the Park & Ride site due to existing congestion on the adjacent highway network. Madingley Road Park and Ride is on privately owned land and the lease will expire in 2035. 	<ul style="list-style-type: none"> The existing Park & Ride site on Madingley Road close to M11 Junction 13 has shown consistent growth in patronage Commercial bus operators will only be able to provide fast, frequent, reliable and high capacity services if they are given priority over other traffic and protection from congestion. Create a new Park and Ride on publicly owned land

³⁷ Census 2011

Wider Transport Network Provision	Issues	Opportunities
Cycling	<ul style="list-style-type: none"> • Currently there are no direct cycle connections or segregated routes between new development sites at Cambourne and Bourn Airfield and Cambridge. • There is no continuous minor road route running west to east between Cambourne and Cambridge providing safe alternative cycle routes. • Cycling is not seen as an alternative along the Cambourne to Cambridge corridor due to lack of smaller quiet roads and safe cycle friendly infrastructure. 	<ul style="list-style-type: none"> • The proposed new developments should offer 'cycle friendly' connections • 20% of residents living along the Cambourne - Cambridge Corridor do cycle to work.³⁸ • Enhanced street design could encourage further use of active travel. • More people in Cambridge than anywhere else in the United Kingdom are likely to use sustainable modes of transport to travel to work.
Walking		<ul style="list-style-type: none"> • 11% of residents living along the Cambourne - Cambridge corridor walk to work.³⁹

Source: Mott MacDonald

5.5.1 Wider Transport Network Provision Review Conclusions

Within the proposed area, public transport offers little to no competitive advantage over private cars. This has meant that car use is the dominant transport mode and as a result has caused congestion on the wider transport network. This in turn causes disruption to existing bus routes which are the only realistic alternatives given a lack of cycle and rail infrastructure.

This presents an opportunity both to enable growth in Park and Ride usage and to extend the public transport routes and services for commuters heading into the city centre, as well as creating more public transport priority infrastructure to benefit new and existing services.

Additionally, residents of Cambridge have been assessed as far more likely to use sustainable travel than anywhere else in the UK. Creation of safe cycle routes would be likely to have a beneficial impact on wider road network congestion.

What does this mean for the C2C scheme?

The frequency and reliability of public transport is poor along the A428/A1303 corridor. The scheme could present the opportunity to increase the public transport offer providing a more reliable route towards Cambridge. Better connections could also encourage further growth and development along the corridor since good transport links are key when developing new housing or employment sites.

The C2C scheme could also seize the opportunity to provide high-quality walking and cycle routes in the area, thus assisting in upholding the good quality of life that residents have benefited from in the past. Such measures could all contribute to a healthy and prosperous area.

5.6 How People Travel

This section summarises the key issues relative to how people travel within the corridor. The travel behaviour of both those living and/or working within Cambridgeshire has been explored

³⁸ Census 2011

³⁹ Census 2011

and the key findings that shaped the objectives setting and subsequent options development in this OAR are noted below. Data was sourced mainly from the Office of National Statistics and census 2011 such as journey to work trip origins and destinations.

Table 1: How people travel issues and opportunities

How people Travel	Issues	Opportunities
Travel To Work Patterns	<ul style="list-style-type: none"> 60% of people in Cambridgeshire travel by car to work, only 4% take the bus.⁴⁰ Forecast of 22,100 new jobs in Cambridge by 2031. The challenge is that these jobs would be created on a range of sites outside of the traditional City Centre area of Cambridge. This means that catering for travel demand radial corridors into city centres, becomes more of a challenge. 	<ul style="list-style-type: none"> To introduce sustainable transport solutions serving new housing and employment sites to support the take up of alternative modes for travelling to work as the city grows. There is already high use of sustainable modes such as walking and cycling (along the Cambourne - Cambridge corridor 11% walk to work and 20% cycle to work.)⁴¹
Car and Public Transport Accessibility	<ul style="list-style-type: none"> Bus services on the A428 corridor do not provide an attractive alternative to car travel. Lack of direct and continuous cycle routes from existing villages and future developments into Cambridge. 42% have access to more than one car, High car ownership is matched by high levels of employment with a bias towards highly skilled occupations.⁴² 	<ul style="list-style-type: none"> To deliver enhance transport accessibility through the introduction of new HQPT scheme. Active travel infrastructure could be introduced along the corridor. 'Enhanced' streets should be considered for the new developments to encourage residents to use alternatives to car use.

Source: Mott MacDonald

5.6.1 How People Travel Review Conclusions

Cars are the dominant transport mode within Cambridgeshire with a low uptake for buses. Walking and cycling is becoming an increasingly popular travel method but is still low when compared to private car use. The growing numbers of people engaging in active travel is an indicator of the potential opportunities of shifting people from cars to other modes. Implementing a HQPT route would help public transport to become a more attractive option and support the viability of future expansion of alternative modes.

What does this mean for the C2C scheme?

The C2C scheme could provide an opportunity to increase the percentage of people who regularly use public transport for commuting or leisure trips, by delivering a fast and reliable alternative to the car.

With walking and cycling already reasonably popular along the corridor, this scheme could be an ideal opportunity to provide further active travel improvements, to assist in removing single occupancy vehicles off the roads and improve access into Cambridge and surrounding areas.

⁴⁰ Census 2011

⁴¹ Census 2011

⁴² Atkins, 2016, Strategic Outline Business Case, Version 3

5.7 Employment Land Use and Development

This section summarises issues and opportunities associated with land use developments around Cambridge. These have been reviewed from a variety of sources including the A428 Strategic Economic Appraisal Report.

Table 2: Employment land use and development issues and opportunities

Issues	Opportunities
<ul style="list-style-type: none"> A significant level of development is planned in Greater Cambridge which would provide more than enough B-use employment space to achieve the B-use jobs target of 20,600.⁴³ There is a considerable amount of development in the pipeline post 2031, especially at the new settlements such as Northstowe, Cambourne and Bourn Airfield and sites such as West Cambridge and Northern Fringe East.⁴⁴ There is a good supply of employment space post 2031, however there are key constraints on major sites. 	<ul style="list-style-type: none"> Investments in transport infrastructure are critical to ensure high congestion levels and poor reliability issues are addressed, enabling the next wave of innovation led growth. The A428-A1303 scheme contributes towards removing bottlenecks on growth by linking key employment and housing sites together, and with the city centre.⁴⁵

Source: Mott MacDonald

5.7.1 Employment Land Use and Development Review Conclusions

Future land development opportunities around Cambridge have been identified through the Local Plans. As such there is a considerable amount of development scheduled along the A428 corridor to achieve job growth and housing growth targets. The areas of proposed housing growth need infrastructure available to connect and link to the jobs created. Investment in HQPT along the A428 would release capacity on the road network for the new developments as well as create the much-needed links to employment zones.

What does this mean for the C2C scheme?

The C2C scheme has significant potential to effectively unlock several major sites for development. The sites highlighted above are identified as being important to future employment growth within Cambridge.

The scheme could improve current transport issues whilst connecting new sites in the future.

5.8 Housing

This section summarises the and issues and opportunities raised in the Local Plan. Data is primarily sourced from ONS, census 2011 and the South Cambridgeshire Local Plan. The issues and opportunities concerning housing are summarised in the table below:

Table 3: Housing issues and opportunities

Issues	Opportunities
<ul style="list-style-type: none"> The City Deal proposes that growth up to 2031 would lead to the need for 33,500 new homes. Demand for housing in St Neots remained consistently strong even through recent recession. 	<ul style="list-style-type: none"> Cambridgeshire has the opportunity to grow physically to accommodate the houses required for the increase in population.

⁴³ Mott MacDonald, 2016, Strategic Economic Appraisal of A428 / A1303 Bus Scheme, Wider Economic Benefits

⁴⁴ Mott MacDonald, 2016, Strategic Economic Appraisal of A428 / A1303 Bus Scheme, Wider Economic Benefits

⁴⁵ Mott MacDonald, 2016, Strategic Economic Appraisal of A428 / A1303 Bus Scheme, Wider Economic Benefits

Issues	Opportunities
<ul style="list-style-type: none"> The shortage of available, and affordable, housing within a reasonable distance of key employment centres has driven an unsustainable increase in house prices. Average house prices in Cambridge have increased 50% in the last eight years, and are now 9.2 times average salary compared to 6.7 for England as a whole. Average wages in the city have not risen in line with the city's average house prices, making it increasingly difficult for people to purchase property in the city. This has associated impacts on the number of people commuting in from the surrounding villages and market towns. Over the last two decades, the strong economic performance of the City of Cambridge has created many jobs of very high value. Consequently, it has attracted a large and affluent workforce. This growth has contributed to a situation in which the demand for housing within and close to the City now far outstrips supply. 	<ul style="list-style-type: none"> Further development at Cambourne at Cambourne West will significantly expand the size of the settlement. In addition, a further new settlement is proposed on the site of Bourn Airfield. The area's economic success and high quality of life have made it an attractive place to live and work. The North-West Cambridge Development is the largest single capital project that the UoC has undertaken in its 800-year history. Outline planning permission was granted in February 2013 for the scheme, on the 150-hectare site of UoC farmland situated in between Huntingdon Road, Madingley Road and the M11. There are 8,880 committed future dwellings along the A428/A1303 corridor.

Source: Mott MacDonald

5.8.1 Housing Review Summary

Cambridge is a very attractive place to live for both its setting and economic success. The desirability of Cambridge has seen the population rapidly expand placing capacity pressure on existing housing supplies and raising prices. The local plan has highlighted the need to build an additional 33,500 houses by 2031. Of this 8,880 have already been committed to the corridor of this study with more expected in the future. Such growth highlights the pressing demand for additional transport links within the area for both current and future residents.

What does this mean for the C2C scheme?

The demand for housing in Cambridge is high and the anticipated future economic growth is likely to further increase the demand. The high value property is likely to continue to attract a skilled workforce seeking the good quality of life that has hereto existed. The scheme can support these factors by unlocking a significant amount of housing development sites and land suitable for growth.

5.9 Environmental Issues

This section seeks to address some of the specific environmental issues and opportunities effecting the Cambridge area.

Table 4: Environmental issues and opportunities

Environment	Issues	Opportunities
Air Quality	<ul style="list-style-type: none"> For vehicle movements the most significant impacts relate to air quality – from fossil-fuel powered units. Overall air pollution along the corridor is currently considered to be low (Index 2),⁴⁶ 	<ul style="list-style-type: none"> PT schemes are considered to have lower environmental impacts because they are able to move a greater number of people per unit of pollutant emitted.

⁴⁶ Air Quality England 2018

Environment	Issues	Opportunities
	however increasing levels of traffic may contribute to the deterioration of this figure although progressive improvements in vehicle technology may provide mitigation	<ul style="list-style-type: none"> If bus priority schemes are able to reduce costs to operators then it is more likely that they can invest in more modern cleaner vehicles.
Other Environmental Issues	<ul style="list-style-type: none"> It is difficult to generalise about whether PT infrastructure schemes have greater or lesser impacts than those primarily concerned with private motor vehicles. For infrastructure the impacts are potentially very varied and, depending on the precise location, can include: <ul style="list-style-type: none"> Landscape (primarily in rural areas); Townscape (primarily in urban areas); Bio-diversity; Heritage; Flooding; and Water quality. 	<ul style="list-style-type: none"> Increasing bus use would reduce the number of vehicles on the road and negate the need for new infrastructure by reducing demand on current roads

Source: Mott MacDonald

5.9.1 Environmental Review Conclusions

The most significant environmental issue is the degradation of air quality by fossil fuel powered vehicles. In addition to this, other context specific examples can stem from infrastructure developments which harm biodiversity and water quality. The easiest fix for these issues is encouraging mode shift to public transport. Buses emit less pollution as well as taking up less space on the road per person carried; this could negate the need for new infrastructure by maximising use of the current network.

What does this mean for the C2C scheme?

The scheme presents an opportunity to continue to maintain the low levels of pollution currently present along the corridor, thus contributing to upholding the good quality of life experienced in the area.

5.10 Underlying Drivers or Causes – The Need for Intervention

Sections 5.2 to 5.9 summarise the evidence of current and potential future issues associated with growth and development along the A428/A1303 corridor. A HQPT service would be central to supporting growth and mitigating impacts of the issues noted. The key underlying drivers for this need for change are summarised below:

Underlying Drivers or Causes – The Need for Intervention Summary

- Population and employment is predicted to grow in Cambridge and Cambridge South with new developments being proposed to support this along the A428 corridor.
- As housing and development progresses, greater demand to travel in and around Cambridge would exacerbate current congestion issues.
- Car ownership in Cambridge and Cambridge South is high at 85% of households having access to a car compared to the national average of 74%.
- Current public transport infrastructure cannot support the new developments, leaving little alternative than for people to travel by car.

Underlying Drivers or Causes – The Need for Intervention Summary

- The A428 is a nationally important route however there are currently severe congestion issues along the corridor including pinch points and accident clusters. These would be intensified by the new developments along the corridor and the employment growth predictions made for Cambridge.
- There is currently a lack of HQPT along the corridor. The rail stations do not serve the movements along the A428 which is also considered inappropriate for walking and cycling as a mode of transport into Cambridge.
- This, combined with the current bus services unable to offer an attractive alternative to private car use enforces the new developments to become locked into a cycle of car dependency and low use of other modes exacerbating capacity issues along the corridor.

The movement of people within and around the borough is increasing as a result of Cambridge and Cambridge South's ambitious housing and employment growth plans and rising population. The A428/A1303 is becoming increasingly key in connecting more people to greater opportunities in the city. Capacity improvements would be needed along this corridor to ensure the network remains resilient to increasing volumes of traffic and the growing population remains well connected to employment opportunities.

6 Scheme objectives and scope

6.1 Strategic Objectives and Aims for Greater Cambridge

The objectives identified for this scheme have been developed to reflect the key issues and opportunities identified in Section 5, and to align with key aims of the GCP, the City Deal, the South Cambridgeshire and Cambridge Local Plans, the TSCSC and the LTP. Central to these is supporting and creating economic growth through the development of new employment and housing, and the creation of new jobs. This includes a forecast of 33,500 new homes and 44,000 new jobs between 2011 and 2031.

In order to achieve this growth in a manner that is sustainable and also contributes to the quality of life of those living and working in Cambridge, supporting infrastructure, such as the scheme, is required. It is important that the scheme objectives capture the aim of this scheme contributing towards creating a sustainable transport network that supports growth and development, as well as improving access to key development locations and maintaining to a high quality of life.

6.2 Scheme Vision

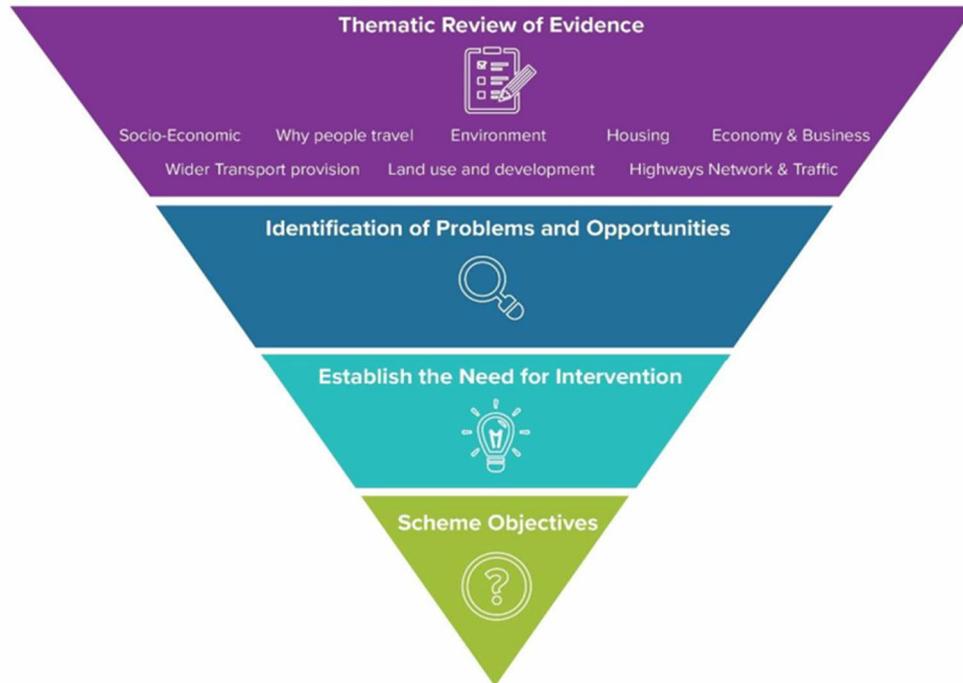
Based on the existing and future issues identified in Cambridge, the proposed overall vision for the C2C scheme is as follows:

To connect existing and new communities along the A428/A1303 to places of employment, study and key services to enable the sustainable growth for Greater Cambridge. We will deliver this through improved, faster and more reliable High Quality Public Transport (HQPT) services, together with high quality cycling and walking facilities serving a new Park & Ride site to the west of Cambridge.

6.3 Scheme Objectives

The scheme objectives were originally developed as part of the SOBC in 2016. As part of the development of an OBC, it is good practice to review the existing scheme objectives, in particular in light of any changes to policy/strategy and wider socio-demographic situation. This prompted the evidence review covered in Section 5 that led to verification of the already established problems and opportunities, and ensures that the scheme objectives work for the purpose of the OBC. The objectives generation process is detailed in **Figure 19**.

Figure 19: Objective setting process

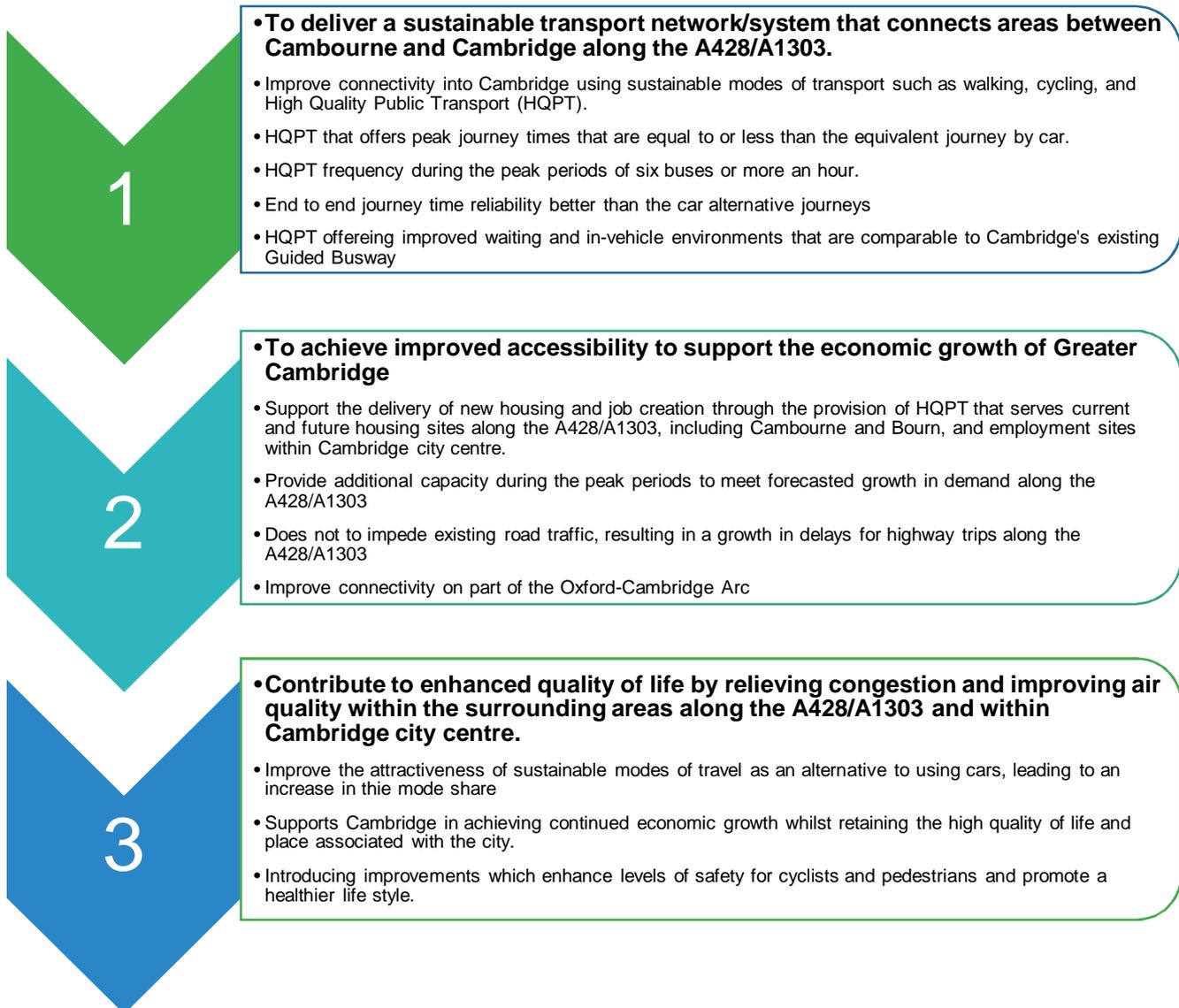


Source: Mott MacDonald

Subsequently, three strategic objectives have been identified for C2C scheme. These are set out on the following page; with each objective having a set of more specific sub-objectives. As well as being informed by the evidence and policy review, these draw on the scheme objectives as previously set out in the SOBC.⁴⁷

⁴⁷ The original scheme objectives in the SOBC were presented as High-Level Objectives, Planning Objectives and Wider Objectives (these are all presented and summarised in the SOBC). The scheme objectives as presented in this OAR reconfirm the SOBC objectives.

Figure 20: C2C scheme – scheme objectives

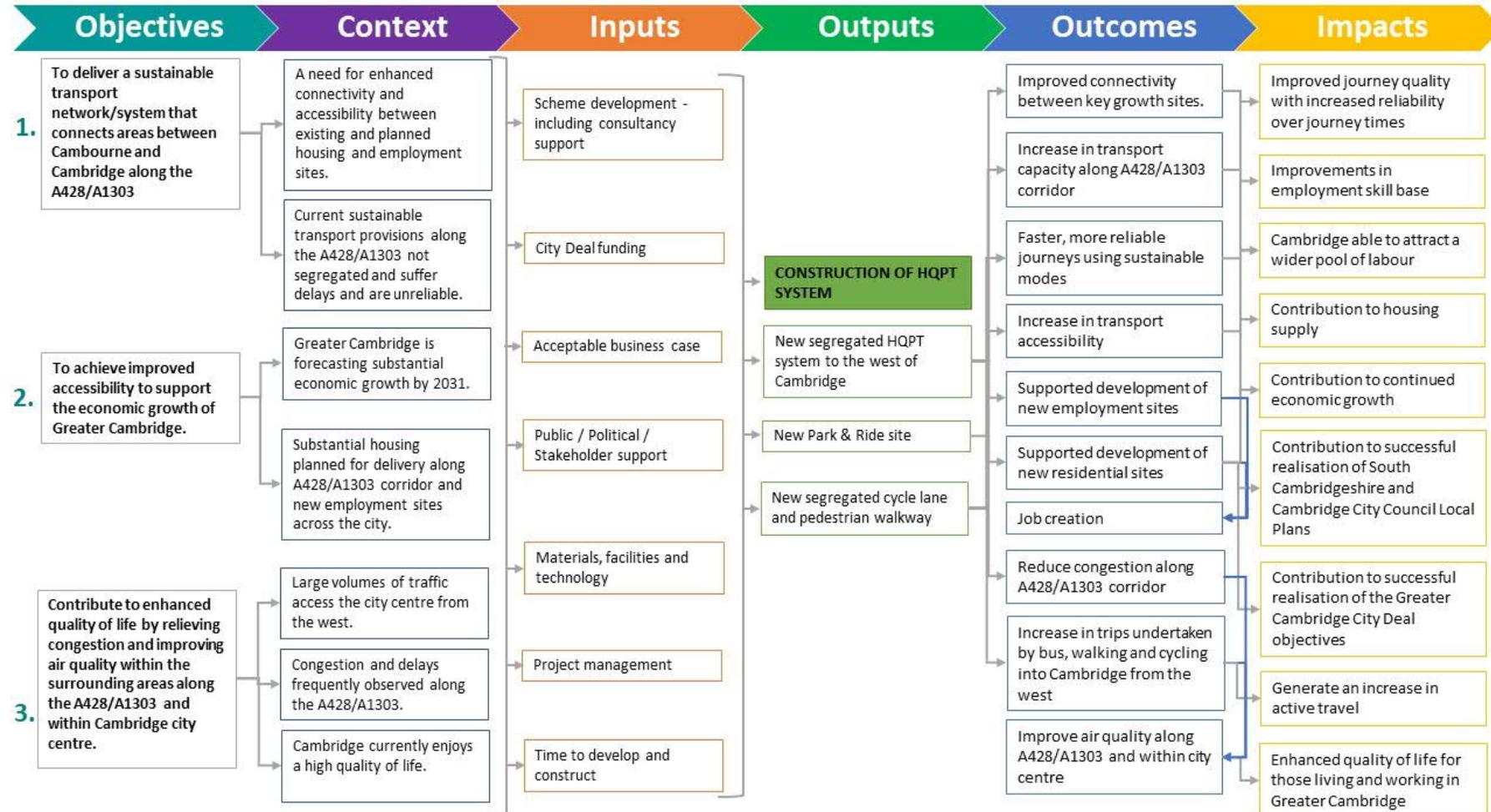


Source: Mott MacDonald

6.4 Scheme Logic Map

The delivery and expected benefits of the C2C scheme are demonstrated in a logic process map in **Figure 21**. Here, the causal pathway between the objectives of the scheme, the inputs required to deliver tangible outputs and expected outcomes as a result of the investment are shown.

Figure 21: C2C scheme logic map



Source: Mott MacDonald

7 Stage 1: Options generation and assessment

This section of the OAR summarises the steps taken as part of Stage 1 of the options generation and assessment process in accordance with WebTAG Transport Appraisal Process guidance. The supporting reports detailing the activities undertaken at each step are set out in **Table 5** below:

Table 5: Stage 1 Options development and assessment

Phase	Step	Activity	No. of Options	WebTAG step	Supporting report
1	1	Option development	21	5	Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)
	2	Further option development	34	5	
	3	Initial options sift	8	6	
	4	Workshop	11	6	
	5	Further options assessment	4	6	
2	1	Tranche 1 / 2 Split Decision	6	7	Madingley Road / A428 Corridor Study Interim Report (Atkins, June 2015)
	2	2015 Consultation	6	7	Cambourne to Cambridge Better Public Transport Consultation Report (CCC, February 2016)
	3	SOBC	5	7	Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)
	4	Board Decision	3	7	Cambourne to Cambridge Better Public Transport End of Stage Report (Atkins, September 2017)
	5	2017 Consultation	3	7	Report expected March 2018

Source: Mott MacDonald

7.1 Phase 1 - Options Development and Assessment

7.1.1 Step 1 - Option Development

Phase 1 step 1 covers the creation of the initial ideas for the route options.

Table 6: Phase 1 - Step 1 process

Option development	
Aims of step	<p>The intention of this step was to establish a broad range of options which could:</p> <ul style="list-style-type: none"> • Fully or partially overcome the current and future problems and challenges identified – the ‘bottom up’ context; and / or • Support the wider policy aspirations of Cambridgeshire County Council, Cambridge and South Cambridgeshire District Councils and other stakeholders as established through the planning objectives – the ‘top down’ context.
Criteria used in options generation	<ul style="list-style-type: none"> • Optioneering was informed by an understanding of constraints (such as environmental designations) and initial assessments of engineering feasibility. • Potential scheme elements were identified by taking a holistic 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 would require infrastructure to support it) approaches • Options were identified through workshops between Atkins and officers from Cambridgeshire County Council.
Number of Options taken forward	<p>21 (see Table 7)</p> <ul style="list-style-type: none"> • Options included individual elements comprising off-road busways, on-road bus priority enhancements, Park & Ride, and traditional bus services. • For many of the options, there were numerous variants relating to infrastructure alignments, locations, and service frequency and routing.

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

Table 17 presents the long list of options considered during Phase 1 Step 1.

Table 7: Phase 1 - Step 1 – Long list of options

No.	Options	Variants
1	Off-road busway, connecting Cambourne and Bourn Airfield before routing along the disused Bedford to Cambridge Rail Line to Trumpington.	<ul style="list-style-type: none"> Segregated or non-segregated alignment through Cambourne/ Bourn Airfield. Services continue to city centre or Science Park.
2	Off-road busway, connecting Cambourne and Bourn Airfield before routing south of Hardwick to M11 J12. On-road services can run to Trumpington.	<ul style="list-style-type: none"> Segregated or non-segregated alignment through Cambourne/ Bourn Airfield. Alignment further north to also serve Bar Hill.
3	Off-road busway, connecting Cambourne and Bourn Airfield before routing south of Hardwick and Coton, crossing the M11 to connect to the existing Madingley Road Park & Ride Site.	<ul style="list-style-type: none"> Segregated or non-segregated alignment through Cambourne/ Bourn Airfield. Route across M11 to A603 or join A603 west of M11 (north of Barton).
4	Off-road busway, connecting Cambourne and Bourn Airfield before routing north to join the existing CGB at Histon.	<ul style="list-style-type: none"> Segregated or non-segregated alignment through Cambourne/ Bourn Airfield.
5	Off-road busway, connecting Cambourne and Bourn Airfield before joining either the A428 or St Neots Road through to A428/A1303	<ul style="list-style-type: none"> Segregated or non-segregated alignment through Cambourne/ Bourn Airfield Run via A428 or St Neots Road as far as Madingley Mulch roundabout.
6	A bus bypass of Madingley Rise through a combination of on-road routing and bus gates. Optional off-road route.	<ul style="list-style-type: none"> Alternative new link from Madingley Mulch roundabout to Cambridge Road parallel and south of A428 Extra lane on A428 eb off-slip and bridge over A428 linking into Cambridge Road, avoiding MM r'bout
7	A new Park & Ride site located adjacent to the A428 / A1303 junction.	<ul style="list-style-type: none"> North of A428 junction (buses could run via bridge link in option 6). East of Madingley Mulch roundabout (north of A1303). East of Madingley Mulch (south of A1303).
8	A nearside inbound bus lane along Madingley Rise	<ul style="list-style-type: none"> Possible straightening of some sections Extend bus lane over M11 on new bridge (and straight into existing Madingley Park and Ride). Central tidal bus lane on Madingley Rise instead of inbound.
9	An off-road busway to the south of Madingley Rise, joining at the A1303 / Cambridge Road junction.	<ul style="list-style-type: none"> Continue link across A1303 into existing Park and Ride site on new bridge (as option 8)
10	A new highway link from the A428 / A1303 junction to M11 J12.	<ul style="list-style-type: none"> Also expand Trumpington Park and Ride. Close M11 Junction 13
11	A nearside inbound bus lane along Madingley Road.	<ul style="list-style-type: none"> Central tidal bus lane (outbound in evening)
12	Bus priority signalisation of the A428 / A1303 roundabout.	
13	Improvements on the western approach to the A428 / A1198 junction to provide bus priority.	<ul style="list-style-type: none"> Provide dedicated straight on bus priority lane. Grade separated junction
14	A higher frequency service between Cambourne and Cambridge.	<ul style="list-style-type: none"> Choice of destination (city centre or run to Science Park.) Stopping/fast from Bourn Airfield.
15	An express service between St Neots and Cambridge.	
16	A stopping service between St Neots and Cambridge	<ul style="list-style-type: none"> Also stop Hardwick
17	A nearside eastbound bus lane along the A428 between Barford Road (St Neots) and the A428 / A1198 junction.	<ul style="list-style-type: none"> Central tidal bus lane A shorter bus lane starting near Caxton Gibbet junction eastbound queue (i.e. Eltisbury).
18	A new Park & Ride site to the east of St Neots.	<ul style="list-style-type: none"> Locate Park and Ride at Eltisbury (back of queue)
19	A new Park & Ride site located adjacent to the A428 / A1198 junction.	<ul style="list-style-type: none"> 3 potential locations
20	A new Park & Ride site located adjacent to Barton Road north of M11 Junction 12.	<ul style="list-style-type: none"> Potential location to east of M11.
21	A bus lane along Barton Road from M11 J12 to the A1134 (Fen Causeway).	<ul style="list-style-type: none"> Eastbound bus lane from A603 / Coton Road / Grantchester Road roundabout

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

7.1.2 Step 2 – Further Options Development

Phase 1 step 2 covered the creation of complete route options through the composition of scheme packages.

Table 18: Phase 1 - Step 2 process

Further option development	
Aims of step	<ul style="list-style-type: none"> Options were packaged together prior to sifting, as most would be more effective if delivered in combination with others.
Criteria used in options generation	<ul style="list-style-type: none"> Approach adopted that would develop packages of options around what were considered to be the core options (generally the larger options, or those which characterised the wider packages). These were Options 1-5, Option 7 and Option 18. Approach was designed to ensure each element was tested at least once, and that the final packages taken forward for assessment may differ from those identified at this stage.
Number of Options taken forward	<p>34 (packages)</p> <ul style="list-style-type: none"> These were taken forward for an initial option sift.

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

7.1.3 Step 3 - Initial Options Sift

Phase 1 step 3 covers the reduction of route options to produce a shorter list of options for further assessment.

Table 19: Phase 1 - Step 3 process

Initial options sift	
Aims of step	<ul style="list-style-type: none"> The purpose of the initial sifting process was to narrow down the 34 packages to a smaller number which could be developed further and assessed in more detail.
Criteria used in options assessment	<ul style="list-style-type: none"> Packages assessed using an assessment framework consistent with the DfT's 'five cases' model, which itself is based on HM Treasury's Green Book appraisal guidance. Each package assessed in terms of its Strategic, Economic, Financial, Commercial and Management Case Each option was scored against each criterion 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
Number of Options taken forward	<p>8 (see Table 8)</p> <ul style="list-style-type: none"> Full assessment table for the initial sift can be found in Appendix B.3 of the Madingley Road / A428 Corridor Study Options Appraisal Report (June 2014). Full descriptions of each option can also be found in Appendix B.4 and maps can be found in Appendix B.1 of the Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

Table 20 presents the results of the initial options sift.

Table 8: Phase 1 - Step 3 - Initial options sift

Package	Elements	New No.	Assessment Score
1.4	<ul style="list-style-type: none"> • Busway from C/BA (southern route) + services • Caxton Gibbet Park & Ride • Madingley Road bus lane 	Option 1	37
2.4	<ul style="list-style-type: none"> • Busway from C/BA (southern central route) + services • Caxton Gibbet Park & Ride • Madingley Road bus lane 	Option 2	36
3.4	<ul style="list-style-type: none"> • Busway from C/BA (northern central route) + services • Caxton Gibbet Park & Ride • Madingley Road bus lane • Madingley Rise off-road bus link [N.B. Not included in next stage] 	Option 3	39
4.4	<ul style="list-style-type: none"> • Busway from C/BA via existing CGB + services • Caxton Gibbet Park & Ride • Madingley Road bus lane 	Option 4	38
5.2	<ul style="list-style-type: none"> • Madingley Mulch Park & Ride + services • Madingley Rise bus lane • Madingley Road bus lane • Signalise Madingley Mulch roundabout 	Option 5	37
6.2	<ul style="list-style-type: none"> • St Neots Park & Ride + services • Madingley Rise bus lane • Madingley Road bus lane • Caxton Gibbet junction improvement • A428 bus lane • Signalise Madingley Mulch roundabout 	Option 6	38
7a.2	<ul style="list-style-type: none"> • Bus C/BA – Camb via A428 + services • Madingley Rise bus lane • Madingley Road bus lane • Signalise Madingley Mulch roundabout 	Option 7	41
7b.2	<ul style="list-style-type: none"> • Bus C/BA – Camb via St Neots Road + services • Madingley Rise bus lane • Madingley Road bus lane • Signalise Madingley Mulch roundabout 	Option 8	39

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

7.1.4 Step 4 – Workshop

Phase 1 step 4 covers the workshop that was held with Cambridgeshire County Council (CCC), with 8 options were presented for discussion.

Table 9: Phase 1 - Step 4 process

Workshop	
Aims of step	<ul style="list-style-type: none"> To present the best performing 8 options from previous step to discuss with officers at CCC.
Criteria used in options assessment	<ul style="list-style-type: none"> Workshop discussion to identify any further options worthy of investigation.
Number of Options taken forward	<p>11 (see Table 8 and Table 10)</p> <ul style="list-style-type: none"> 8 options were presented for consideration at the workshop in Step 4. The outcome of the workshop was 3 further options (8 to 11) being identified as worthy of further investigation leading to 11 options being taken forward from this step Full descriptions of each option can also can be found in Appendix B.4 and maps can be found in Appendix B.1 of the Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

Table 10: Phase 1 - Step 4 – Additional options

Package	Elements	New No.
New 1	<ul style="list-style-type: none"> Busway from C/BA (northern central route) + services Caxton Gibbet Park & Ride Madingley Rise southern bus bypass to Grange Road 	Option 9
New 2	<ul style="list-style-type: none"> Busway from C/BA (northern central route) + services Caxton Gibbet Park & Ride Madingley Rise northern bus bypass to existing Madingley Road Park and Ride Site 	Option 10
New 3	<ul style="list-style-type: none"> Madingley Rise southern bus bypass to Grange Road Madingley Mulch Park & Ride and + service 	Option 11

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

7.1.5 Step 5 - Further Options Assessment

Phase 1 step 5 covers the further analysis of the 11 options from Step 4 and route option reduction.

Table 11: Phase 1 - Step 5 process

Further options assessment	
Aims of step	<ul style="list-style-type: none"> • More detailed assessment of each of the 11 options undertaken to give greater quantification as to the potential benefits of each. • Assessment combined elements of engineering feasibility and costs with transport related market benefits and potential market capture for each of the options. • Aim of the further assessment was to determine a shortlist of options to propose for further detailed analysis within Phase 2.
Criteria used in options assessment	<ul style="list-style-type: none"> • Options were assessed based using both quantitative and qualitative methods on addressing three high level criteria: <ul style="list-style-type: none"> ○ Deliverability: <ul style="list-style-type: none"> ▪ Engineering feasibility ▪ Stakeholder acceptability ▪ Environment impacts ▪ Cost and affordability ▪ Bus service commercial viability ▪ Key uncertainties ○ Benefits/impacts: <ul style="list-style-type: none"> ▪ Social and distributional impacts ▪ Journeys in scope ▪ Journey time savings over car ▪ Mode share ○ Strategic rationale <ul style="list-style-type: none"> ▪ Provides congestion free PT serving the corridor ▪ Serves key current / future trip attractors in Cambridge
Number of Options taken forward	<p>4 (see Table 12)</p> <ul style="list-style-type: none"> • These options were taken forward as at a high level they: <ul style="list-style-type: none"> ○ Met the strategic rationale for the intervention; ○ Are deliverable in engineering terms, could be affordable, and do not have any obvious 'show stoppers' that would render them undeliverable on environmental grounds or in terms of stakeholder acceptability; and ○ Could deliver significant benefits / impacts in terms of capturing demand, mode share / shift, and journey times • A summary of results can be found in the Appraisal Summary Table (AST) of the Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

The 4 options shortlisted in Step 5 are set out in Table 24.

Table 12: Phase 1 – Step 5 - Further options assessment short listed options

Option	Option description
A	Park & Ride at Madingley Mulch, signalisation of Madingley Mulch roundabout, a nearside eastbound bus lane on Madingley Rise and Madingley Road (formerly Option 5)
B	A segregated bus route through Cambourne and Bourn Airfield, with services then running via St Neots Road to Madingley Mulch roundabout, signalisation of Madingley Mulch roundabout, a nearside eastbound bus lane on Madingley Rise and Madingley Road, potential intermediate Park & Ride at Bourn Airfield (formerly Option 8)
C	A segregated bus route via Cambourne and Bourn Airfield re-joining Madingley Rise just west of the M11 having run to the north of Madingley Rise from a Park & Ride Site at Madingley Mulch, nearside eastbound bus lane on Madingley Road (formerly Option 10)
D	Park & Ride at Madingley Mulch, segregated off-road bus route south of Madingley Rise and Madingley Road – this would not include a potential intermediate Park and Ride located at Bourn Airfield due to the proximity with the new Park and Ride located at Madingley Mulch (formerly Option 8 plus Option 11)

Source: Madingley Road/A428 Corridor Study Options Appraisal Report (Atkins, June 2014)

7.2 Phase 2 - Options Development and Assessment

Stage 1 Phase 2 then took the 4 options shortlisted at the end of Stage 1 Phase 1 forward for further assessment. It considered the availability of funding and split route options to reflect finance tranches.

7.2.1 Step 1 - Tranche Split

Phase 2 step 1 covers the split of routes to align with the finance tranches.

Table 13: Phase 2 - Step 1 process

Tranche split	
Aims of step	<ul style="list-style-type: none"> To split the options in accordance with the Greater Cambridge City Deal (GCCD) funding being released from government in tranches.
Criteria used in options generation	<p>Options split according to the following tranches:</p> <ul style="list-style-type: none"> 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 and assumes that one of the options of Tranche 1 had already been committed <p>A preliminary assessment of the options was carried out prior to proceeding to public consultation, it was carried out under the following four categories:</p> <ul style="list-style-type: none"> Alignment to GCCD criteria: <ul style="list-style-type: none"> Housing. Employment. Traffic and operational consideration: <ul style="list-style-type: none"> Travel demand and accessibility to local centres. Highway network performance (including impact on congestion and journey times). Potential bus patronage. Walking and cycling. Road safety. Environmental impacts on: <ul style="list-style-type: none"> Landscape. Townscape. Heritage assets. Air quality. Noise. Engineering considerations: <ul style="list-style-type: none"> Requirement for land acquisition and legal processes. Costs. <p>A preliminary assessment of these options using SWOT analysis was carried out to identify key risks and determine their feasibility prior to proceeding to public consultation.</p>
Number of Options taken forward	<p>6 (see Table 14)</p> <ul style="list-style-type: none"> Three route options for Tranche 1 and three route options for Tranche 2/3. All options assume the existing Madingley Road Park and Ride site continues to operate. Summary of the SWOT analysis can be found in the Cambourne to Cambridge Better Bus Journey Scheme: Strategic Outline Business Case (Atkins, September 2016).

Source: Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

Table 30 presents the results of the finance tranche options split.

Table 14: Phase 2 – Step - Tranche options split

Tranche 1 (Eastern Section)		Tranche 2/3 (Western Section)	
Option 1A	On-road eastbound bus lanes from the A1303 / A428 junction along Madingley Rise and Madingley Road to Lady Margaret Road.	Option 2A	Improvement to bus services, which would run along the existing roads with no infrastructure improvements to the A1303 / A428 junction.
Option 1B	A new off-road dedicated bus route running north-east from the A1303 / A428 junction, connecting to Madingley Road just west of the M11. A further eastbound bus lane on Madingley Road would be provided to Lady Margaret Road.	Option 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.
Option 1C	A new off-road dedicated bus route running north of Coton, parallel to Madingley Road and Madingley Rise to Grange Road, with a connection to the West Cambridge UoC site.	Option 2C	A new off-road dedicated bus route connecting Cambourne and Bourn Airfield before running south of Hardwick to Madingley Mulch roundabout.

Source: Madingley Road/A428 Cambourne to Cambridge Corridor Study Interim Report (Atkins, 2015)

7.2.2 Step 2 - 2015 Consultation

Phase 2 step 2 covers the 2015 consultation and the results of further assessments. The consultation options are presented in **Figure 22**.

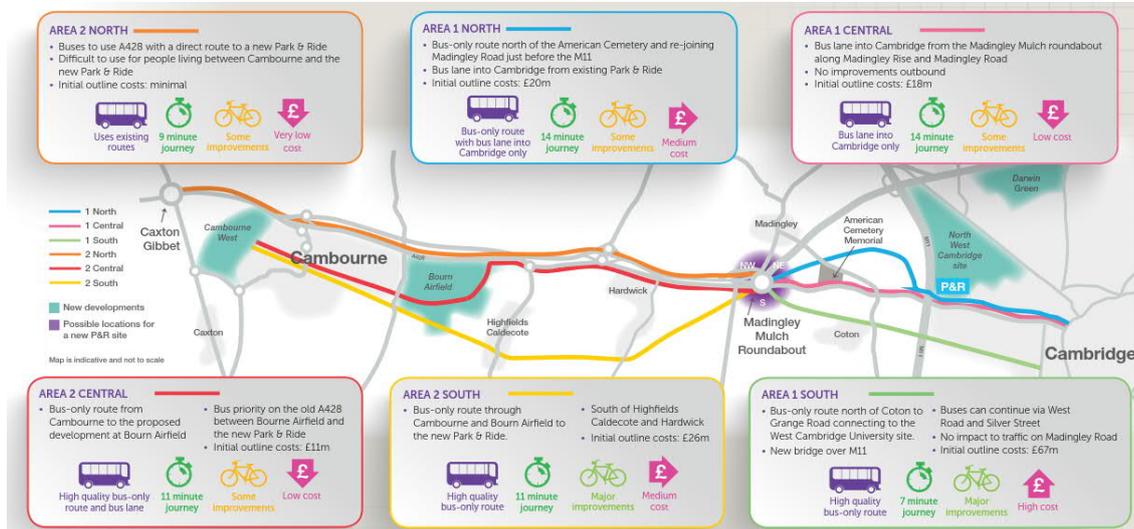
Table 15: Phase 2 - Step 2 process

2015 consultation

Aims of step	<ul style="list-style-type: none"> To present the 6 options from the previous step to stakeholders, including members of the public. To refine the options following the consultation for further assessments.
Criteria used in options generation	<ul style="list-style-type: none"> Options were presented a number of stakeholder briefings, including four members briefings. Feedback from stakeholders was received from briefing events and through surveys.
Number of Options taken forward	<p>5 (see Table)</p> <ul style="list-style-type: none"> The results of the consultation were used to create preferable route options. The summary of the findings of the consultation can be found in the Cambourne to Cambridge Better Bus Journey Consultation Report (February 2016)

Source: Cambourne to Cambridge Better Bus Journey Consultation Report (February 2016)

Figure 22: C2C scheme 2015 consultation options



Source: C2C Consultation Leaflet, October 2015

7.2.3 Step 3 – SOBC

Phase 2 step 3 covers the options assessment process that provided final results for the Strategic Outline Business Case (SOBC) and SOBC Option Assessment Report.

Table 28: Phase 2 - Step 3 process

SOBC	
Aims of step	<ul style="list-style-type: none"> Following the 2015 consultation the five options were further assessed so they could be presented to the GCP board. All the options included the proposal of a new Park and Ride at Madingley Mulch roundabout.
Criteria used in options assessment	<p>The options were assessed using a Multi Criteria Assessment Framework (MCAF), the criteria were:</p> <ul style="list-style-type: none"> Scheme cost and benefits. Transport impacts Risk Accessibility Environmental impact Stakeholder support
Number of Options taken forward	<p>5 (see Table 9)</p> <ul style="list-style-type: none"> These options were taken forward for a GCP board decision with route 3 as the recommended option as it meets the scheme objectives the greatest. The results of the assessment are summarised in Table 29. The OAR for C2C (Atkins, October 2016) recommended an amendment could be made to Option 3 to create a route with a similar level of segregation and quality to Option 3 but with a reduced cost. This is not considered a separate option but would be considered a variation to Option 3 called Option 3a.

Source: Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016) and Options Assessment Report for Cambourne to Cambridge Better Bus Journey (Atkins, October 2016)

Table 29 provides a summary description of the options considered in this Step.

Table 29: Phase 2 – Step 3 – Options summary

Option	Description
Option 1 (also known as 1A+2A)	<ul style="list-style-type: none"> Public transport lane on A1303 Public transport lane on Madingley Road
Option 2 (also known as 1B+2B)	<ul style="list-style-type: none"> Services through West Cambourne and Cambourne Segregated through Bourn Airfield Uses old A428 Segregated north of American Cemetery Public transport lane on Madingley Road
Option 3 (also known as 1C+2C)	<ul style="list-style-type: none"> Services through West Cambourne and Cambourne Segregated from Bourn Airfield to new Park & Ride Segregated south of A1303 New bridge across M11 Segregated south of Madingley Road
Option 4 (also known as 1BC+2B)	<ul style="list-style-type: none"> Services through West Cambourne and Cambourne Segregated through Bourn Airfield Uses old A428 Segregated north of American Cemetery Uses existing bridge at Junction 13 Travels through West Cambridge site, and then segregated south of Madingley Road
Option 5 (also known as 1C + 2B)	<ul style="list-style-type: none"> Services through West Cambourne and Cambourne Segregated through Bourn Airfield Uses old A428 Segregated south of A1303 New bridge across M11 Segregated south of Madingley Road

Source: Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case (Atkins, September 2016)

Table 30 presents the results of the MCAF assessment undertaken during this Step.

Table 16: Phase 2 – Step 3 - MCAF Results

Option	Description	Initial BCR	Adjusted BCR	MCAF Score (unweighted)
Option 1	This is the lowest cost option, involving provision of a bus lane on the A1303 and Madingley Road. This option is unlikely to offer a step change in capacity, connectivity and journey efficiency (i.e. combination of speed and reliability) in order to deliver a HQPT service on the corridor.	1.03	1.22	68
Option 2	This option makes use of St Neots Road, also providing a segregated bus link between Cambourne and Bourn Airfield and to bypass Madingley Rise. From here buses continue on an inbound only bus lane on Madingley Road. This option provides a compromise between fully off-road and fully on-road options.	0.48	0.49	69
Option 3	Is fully off-road between Cambourne and Grange Road. This option performs best in terms of strategic fit, mainly because the fully off-road route provides the highest level of connectivity, capacity and journey efficiency. This is assumed to make bus travel much more attractive and to deliver wider economic benefits as a result of the potential to accommodate intensification of development. This option does not add to congestion on Madingley Road as it is not on-road which indicates a good strategic fit in this area, in that it addresses HQPT objectives whilst also addressing congestion issues in this part of the corridor.	0.19	0.20	73
Option 4	This option makes use of St Neots Road, also providing a segregated bus link between Cambourne and Bourn Airfield and to bypass Madingley Rise. From here buses use the existing bridge to cross the M11 and continue through the West Cambridge site and off-road towards Grange Road. This option does not add to congestion on Madingley Road as it is not on-road which indicates a good strategic fit in this area, in that it addresses HQPT objectives whilst also addressing congestion issues in this part of the corridor.	0.04	0.02	60
Option 5	This option makes use of St Neots Road, also providing a segregated bus link between Cambourne and Bourn Airfield. A segregated bus link is also provided between the A428 / A1303 Junction and Grange Road. This option does not add to congestion on Madingley Road as it is not on-road which indicates a good strategic fit in this area, in that it addresses HQPT objectives whilst also addressing congestion issues in this part of the corridor.	0.05	0.03	57

Source: Cambourne to Cambridge Better Public Transport Project: Strategic Outline Business Case (Atkins, September 2016)

In addition to the above, a Strategic Economic Appraisal of the scheme was conducted by Mott MacDonald that concluded that Option 3 and Option 4 options were likely to deliver the most GVA benefits in terms of supporting business investment and growth and labour market mobility.⁴⁸

7.2.4 Step 4 – Board Decision

Phase 2 step 4 covers the presentation of route options to be taken forward to the GCP Executive Board.

In October 2016 a board paper was taken to the GCP Executive Board that presented the 5 options from the SOBC. Further options assessment work had also been carried out and was appended as a supporting paper to the Executive Board report. The report made a recommendation for a recommended option and location for the Park and Ride site and sought approval to develop a 'specific route alignment' with an associated new Park and Ride site, both for public consultation in Summer 2017.

However, the Executive Board requested that **3 options** be carried forward for further development and for public consultation in Summer 2017.

Table 171: Phase 2 - Step 4 process

Board decision	
Aims of step	<ul style="list-style-type: none"> Reduce the number of route options to be taken forward for consultation in Summer 2017.
Criteria used in options assessment	<p>The options were assessed against the following criteria:</p> <ul style="list-style-type: none"> GCCD agreement objectives. Strategic and Economical case. Financial, Management and Commercial case
Number of Options taken forward	<p>3</p> <ul style="list-style-type: none"> Two options were taken forward from the previously proposed routes (options 1 and 3a) as well as an option proposed by the Local Liaison Forum (option 6). Details of the route option selection can be found in the Executive Board Report (Greater Cambridge City Deal, October 2016).

Source: Executive Board Report (Greater Cambridge City Deal, October 2016)

7.2.5 Step 5 – 2017 Consultation

Following the approval by the executive board, the 3 options were taken to public consultations between 13th November 2017 and 30th January 2018.

The purpose of this consultation was to ascertain public and stakeholder views on the options, including the two Park and Ride options, to refine the options and inform the selection of the recommended option taken forward for detailed development.

⁴⁸ Mott MacDonald. (2016). Strategic Economic Appraisal of A428-A1303 Bus Scheme. Wider Economic Benefits.

8 Stage 2: Further options assessment

8.1 Introduction

This section details the assessment process of the 3 options that were consulted on at the end of Stage 1.

The following options were consulted on:

- **Option A** – On-road (inbound Public transport Lane)
- **Option B** – On-road (tidal Public transport Lane)
- **Option C** – Off-road Option (Route C consisted of several variants in routes)

The aim of this stage of assessment is to use the project vision and objectives to create a series of assessment criteria against which the off and on-road options are assessed, in order to produce a single recommended on-road option and a single recommended off-road option.

Following the assessment detailed in this report, the recommended Phase 1 off and on-road routes will be combined with the two proposed Park and Ride locations and assessed against each other, as well as options for Phase 2, to move towards a final recommended option for the C2C scheme.

8.2 Option Overview

8.2.1 On-Road – Phase 1

Route A consists of an inbound public transport lane from Madingley Mulch Roundabout to the junction with the M11. Here buses re-join general traffic until the public transport lane is reintroduced at JJ Thomson Avenue, where it continues until Lady Margaret Road where the public transport vehicle re-joins general traffic.

Route B consists of a central, tidal, public transport lane from Madingley Mulch Roundabout to the High Cross / Eddington Avenue Junction. This involves widening the existing bridge over the M11. The public transport vehicle then re-joins general traffic for the remainder of the route.

8.2.2 Off-Road – Phase 1

Route C consists of an off-road public transport route from Madingley Mulch Roundabout to Grange Road, near the city centre. The route passes to the south of the A1303, passing near Coton Village and through the West Cambridge site. Whilst buses would continue on to the city centre, and other destinations, new public transport infrastructure stops at Grange Road where buses would re-join general traffic. Various options along this route were consulted on and are assessed in this note.

There is also the option of continuing the off-road route further west, through the potential Bourn Airfield Development and into Cambourne. This was not included as part of the recent consultation, but has been consulted on during an earlier event in 2015.

8.2.3 Phase 2

As the scheme extends from Cambourne to Cambridge and the area to the west of Madingley Mulch does not currently experience as much congestion as Madingley Road, two options have

been considered for Phase 2; do nothing and the do something. At this stage, this is presented as an illustrative route option as further public consultation would need to be undertaken on Phase 2 of the scheme.

The Do Nothing option would be the public transport vehicle running on existing roads with no additional infrastructure changes. The Do Something, or illustrative comparator, would be an off-road route continuing into Cambourne through the Bourn Airfield. These two options have been included in the assessment for area 1 of the off-road route.

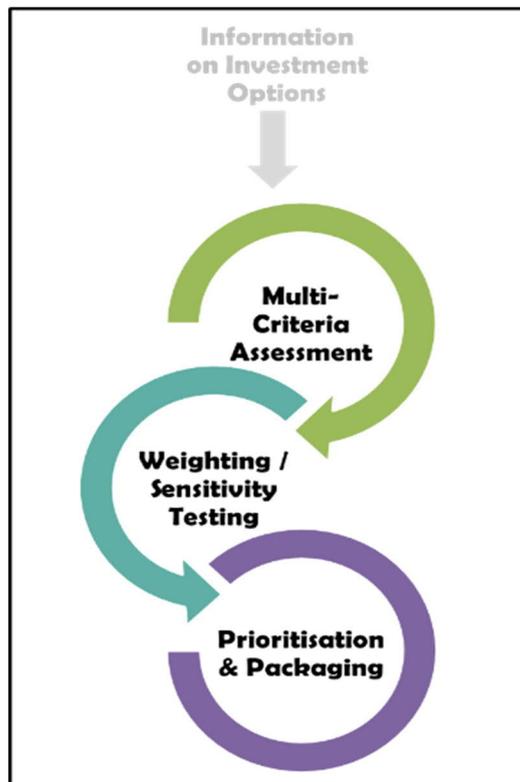
8.3 Methodology

For the Stage 2, step 1 options assessment, we applied Mott MacDonald's in-house Investment Sifting and Evaluation Tool (INSET) to assess options against criteria developed to establish how well each option aligned with a set of assessment criteria derived from the scheme objectives. This facilitated a comparison and ranking of the options and the on-road and off-road options.

8.3.1 INSET

INSET is a decision support toolkit developed in-house by Mott MacDonald which is used through the development of this scheme to carry out the initial sift. INSET is designed to be simple, flexible, replicable and transparent. It is based on Green Book compliant Multi-Criteria Decision Analysis (MCDA).

Figure 23: Mott MacDonald's Investment Sifting and Evaluation Tool (INSET)



Source: Mott MacDonald

INSET draws upon standard tools for comparing scheme options, primarily DfT's EAST (Early Assessment and Sifting Tool), and adds additional functionality to these existing tools. Mott MacDonald has developed INSET as an enhancement of EAST to support the evaluation of different options for large-scale investments and investment programmes. Crucially it enables:

- 'Active' sifting of options in real-time, supporting meetings, workshops and face-to-face engagement with a tool that can be used to facilitate discussions;
- The consideration of multiple economic scenarios as sifting and evaluation progresses, through manipulation of criteria weighting, to enable project teams to discuss what if 'issues as options are developed; and
- The assessment of potential scheme packaging. INSET can assess one option against another and can also explore the merits of options being developed in isolation or as part of a package.

8.4 Assessment Criteria

The assessment criteria for the options were generated from the scheme vision and objectives. These are grouped into the following themes that have been selected to reflect the scheme objectives:

- Policy Fit
- Contribution to Economic Growth
- Contribution to improved transport network
- Contribution to quality of life
- Stakeholder support
- Scheme Deliverability

These themes were then broken down into 37 selection criteria which will be used to assess the different route options. However, it was identified that some of the criteria, especially the high-level policies, would generate identical scoring whilst comparing Option A and B (on-road) and the variations of Option C (off-road), so they will only be used in the next step within the assessment where off-road will be compared against on-road. **Table 18** lists the assessment criteria used and grouped by theme. Also shown is the step within Stage 2 assessment that they have been used to assess the options.

Table 18: Assessment criteria used in Stage 2 further options assessment

Theme	Assessment criteria	Stage 2 step
Policy Fit	Cambridgeshire LTP3	Step 2 (OAR Part 2)
	Highways England Road Investment Strategy (RIS)	Step 2 (OAR Part 2)
	Greater Cambridge and Peterborough SEP	Step 2 (OAR Part 2)
	Greater Cambridge City Deal	Step 2 (OAR Part 2)
	South Cambridgeshire Draft Local Plan	Step 2 (OAR Part 2)
	Cambridge City Draft Local Plan	Step 2 (OAR Part 2)
Contribution to Economic Growth	Access to existing homes and jobs	Step 2 (OAR Part 2)
	Supporting house construction	Step 2 (OAR Part 2)
	Supporting job creation	Step 2 (OAR Part 2)
	Increase in GVA	Step 2 (OAR Part 2)
	Capacity	Step 2 (OAR Part 2)
	Reliability of journey	Steps 1 & 2 (OAR Part 1 & 2)

Theme	Assessment criteria	Stage 2 step
Contribution to improved transport network	Route flexibility - Links into existing public transport routes	Steps 1 & 2 (OAR Part 1 & 2)
	Walking and cycle connectivity	Steps 1 & 2 (OAR Part 1 & 2)
	Impact on existing traffic	Steps 1 & 2 (OAR Part 1 & 2)
	Journey times	Step 2 (OAR Part 2)
	Service frequency	Step 2 (OAR Part 2)
	Mode share	Step 2 (OAR Part 2)
	Connectivity to Park and Ride	Step 2 (OAR Part 2)
Contribution to quality of life	Environmental impacts - Visual Impact	Steps 1 & 2 (OAR Part 1 & 2)
	Environmental impacts – Noise	Steps 1 & 2 (OAR Part 1 & 2)
	Environmental impacts - Air Quality	Steps 1 & 2 (OAR Part 1 & 2)
	Environmental impacts - CO2 emissions	Steps 1 & 2 (OAR Part 1 & 2)
	Environmental impacts – Biodiversity	Steps 1 & 2 (OAR Part 1 & 2)
	Environmental impacts – Heritage	Steps 1 & 2 (OAR Part 1 & 2)
	Environmental impacts – Green Belt	Steps 1 & 2 (OAR Part 1 & 2)
	Safety	Steps 1 & 2 (OAR Part 1 & 2)
Scheme Deliverability	Accessibility	Step 2 (OAR Part 2)
	Scheme Cost	Steps 1 & 2 (OAR Part 1 & 2)
	Engineering feasibility - construction method	Steps 1 & 2 (OAR Part 1 & 2)
	Land acquisition required	Steps 1 & 2 (OAR Part 1 & 2)
	Impact on local road network during construction	Steps 1 & 2 (OAR Part 1 for On-Road Only & 2)
	Future proofing	Steps 1 & 2 (OAR Part 1 & 2)
	Legislative Powers	Step 2 (OAR Part 2)
Stakeholder support	Scheme Maintenance and Renewals	Step 2 (OAR Part 2)
	Public acceptability	Steps 1 & 2 (OAR Part 1 & 2)

Source: Mott MacDonald

A detailed description of each criteria used in the Step 1 assessment that is the subject of OAR Part 1 are summarised on the following page.

Reliability of journey	<ul style="list-style-type: none">Options have been assessed on the possible issues with delivering a reliable mode of transport, with higher scores being given to options which include dedicated bus lanes or junction priority and lower scores for routes which are shared with other modes, or with numerous or complex junctions with other existing roads.
Route flexibility - Links into existing bus routes	<ul style="list-style-type: none">Options have been assessed on the distance of the proposed route to existing bus routes into Cambridge and the surrounding areas. Higher scores have been given when they align to existing bus routes and lower scores have been given when they are a considerable distance away. Although the proposed stop locations have not been confirmed it is assumed that there will be a stop in/around the following locations; Cambourne, Bourn Airfield, Hardwick, University West and the new Park and Ride site.
Walking and cycle connectivity	<ul style="list-style-type: none">Options have been assessed on the proposed improvements to walking and cycle infrastructure with higher scores given for improved infrastructure and/or connectivity to existing cycle routes and lower scores given for route which reduces cycle and walking facilities or causes severance to existing routes.
Impact on existing traffic	<ul style="list-style-type: none">Options have been assessed on how they will impact existing traffic during operation. Higher scores are given when improvements such as reduced congestion due to modal shift and lower scores have been given to delays caused by bus priority or areas of shared running. This will need to be confirmed with traffic modelling which is expected to be completed for the next stage of assessment.
Environmental impacts - Visual Impact	<ul style="list-style-type: none">Options have been assessed on the visual intrusion of the route with higher scores given if the route enhances the existing landscape and lower scores where it introduces new highway infrastructure or structures.
Environmental impacts – Noise	<ul style="list-style-type: none">Options have been assessed on the proximity of the route to receptors with higher scores given if there are reductions in noise impact and lower scores if the routes will create an increase in noise in proximity to sensitive receptors.
Environmental impacts - Air Quality	<ul style="list-style-type: none">Options have been assessed on the impact the route will have on air quality with higher impacts being improvement in the air quality and lower scores indicating a decrease in the air quality of the area.
Environmental impacts - CO ₂ emissions	<ul style="list-style-type: none">Options have been assessed on the CO₂ emissions of the scheme and the embedded carbon of the construction materials, with higher scores being a reduction in CO₂ and lower scores being an increase in CO₂ emissions.
Environmental impacts – Biodiversity	<ul style="list-style-type: none">Options have been assessed on the impact on biodiversity. With higher scores given for improvements to biodiversity and lower scores for reduction in biodiversity including SSSI sites and destruction of habitats.
Environmental impacts – Heritage	<ul style="list-style-type: none">Options have been assessed based on the proximity and impact to areas of significant heritage value with higher scores given if the route enhances the heritage of the area and lower scores give in it creates any impact on the sites.
Environmental impacts – Green Belt	<ul style="list-style-type: none">Options have been assessed on the amount of land required and the impact this has on the green belt, with higher scores given if land is reclaimed and lower scores if land is required.

Safety	<ul style="list-style-type: none"> Options have been assessed on how many interactions the route has with other vehicles and the type of interaction. These will increase the opportunities for road traffic incidents. Higher scores are given if the route improves interactions with other road users and lower scores given if the route increases the risk of accidents.
Public acceptability	<ul style="list-style-type: none"> Options have been assessed on the feedback received from public consultation, stakeholder events and from the local council, with a higher score given if there is a higher proportion of support for the options and a lower score if there is a higher proportion of objections to the options.
Scheme Cost	<ul style="list-style-type: none"> Options have been assessed against each other for capital cost of each scheme including any new infrastructure required for each option as well as any alterations to existing infrastructure. As each option is expected to either have no cost or some cost impacts the scores will all be between 1 and 4.
Engineering feasibility - construction method (only on-road options)	<ul style="list-style-type: none"> Options have been assessed on the complexity of engineering required to implement the options. This has only been considered for the on-road option as there are differences between Routes A and B due to the requirement for gantries and the bridge structure over the M11. Higher scores have been given to easier to construct options with lower scores being given to more complex construction processes.
Land acquisition required	<ul style="list-style-type: none"> Options have been assessed on the amount of land required to implement the scheme, with higher scores given if land is reclaimed that had previously been developed and lower scores if land is required, with variants based on the current use of the land and its potential for agriculture or development.
Impact on local road network during construction	<ul style="list-style-type: none"> Options have been assessed on the impact to the local road network during construction. None of the options will have a positive impact on the local road network so this has been scored as no impact (4) or negative impact (1-3).
Future proofing	<ul style="list-style-type: none"> Options have been assessed on how suitable they would be for future proposed schemes which could include more extensive infrastructure or tunnelling, higher scoring has been given if the location and geometry would support future schemes and lower scoring has been given if they do not.

8.5 Areas of Assessment

For the purposes of the assessments both the off-road and on-road routes were broken down into areas.

Table 19: Overview of Option Areas

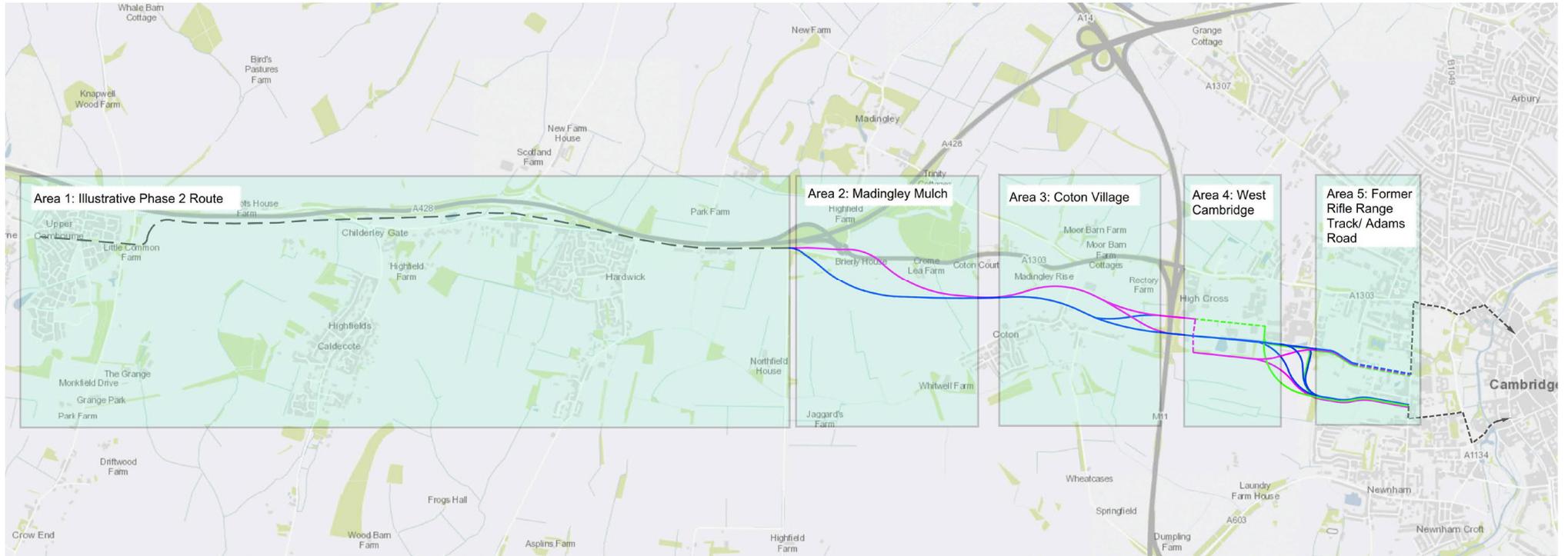
Off-road options	On-road options
Area 1: Cambourne to Madingley Mulch	Area 1: East of M11 Junction 13
Area 2: Madingley Mulch Roundabout	Area 2: M11 Junction 13
Area 3: Coton Village	Area 3: West of M11 Junction 13
Area 4: West Cambridge	
Area 5: Adams Road/Former Rifle Range Track	

Source: Mott MacDonald

8.5.1 Off-Road Areas

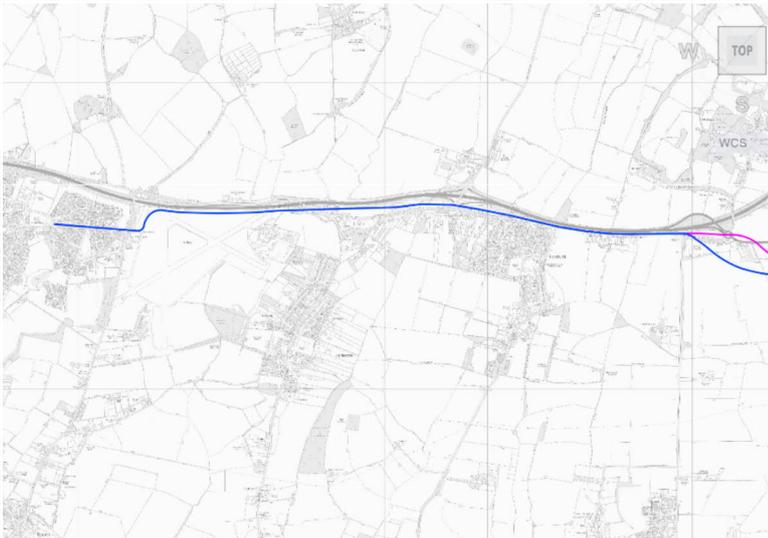
For the assessment the off-road route was split into 5 areas, the optimum route would then be compiled based on the recommended alignment in each section. The options for the connections between the areas would be considered in the next stage.

Figure 24: Off-Road Route Option Areas



Source: Mott MacDonald

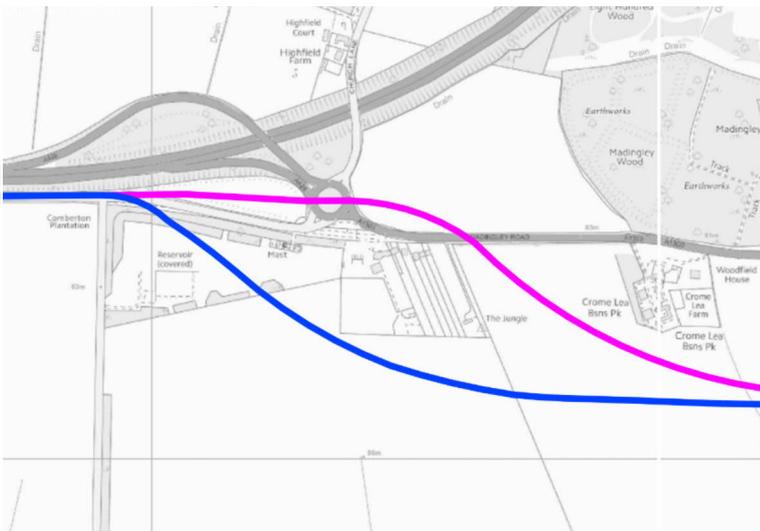
8.5.1.1 Area 1: Cambourne to Madingley Mulch



Area 1: Cambourne to Madingley Mulch

Area 1 covers the route from Cambourne to Madingley Mulch roundabout. The two options being assessed are the "do minimum" which would have the route run along the existing roads - either the A428 or St Neots Road, and the "do something" which covers an Off-Road route through Bourn Airfield and between the A428 and St Neots Road up to Madingley Mulch roundabout.

8.5.1.2 Area 2: Madingley Mulch Roundabout



Area 2: Madingley Mulch Roundabout

Area 2 covers the alignment through Madingley Mulch roundabout. The pink option creates a "hamburger" island with widening required to the roundabout. It proceeds to cross Madingley Road into a field. The blue option diverges prior to the roundabout across St Neots Road into the Water Works field.

8.5.1.3 Area 3: Coton Village



Area 3: Coton Village

Area 3 covers the alignment past the village of Coton. It also passes through Coton orchard. The pink route is further away from the village. The blue route runs closer to the village and crosses the southern edge of the orchard.

8.5.1.4 Area 4: West Cambridge Development



Area 4: West Cambridge Deveopment

Area 4 is through the West Cambridge University site after the alignment has crossed the M11. The green route runs along the existing Charles Babbage Road. The blue route runs alongside the existing walking and cycle track in front of the sports centre. The pink route would run behind the sports centre on a newly constructed busway.

8.5.1.5 Area 5: Adams Road/ Former Rifle Range Track



Area 5: Adams Road/Former Rifle Range track

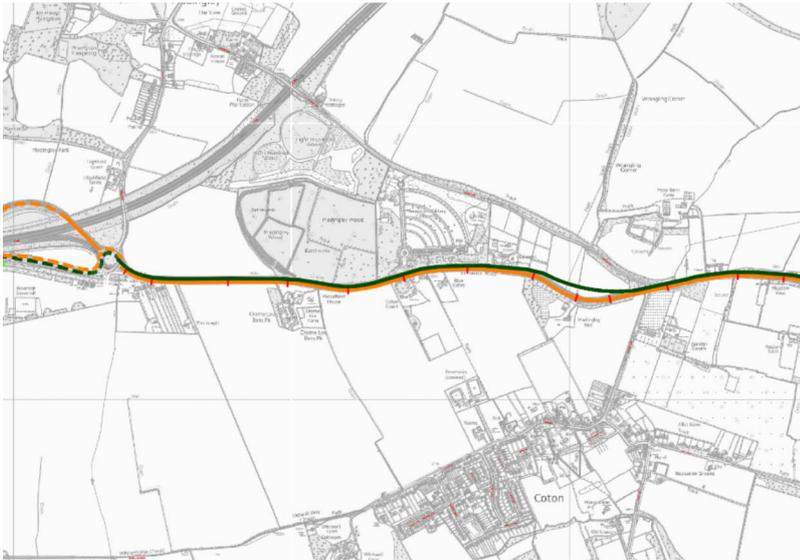
Area 5 is the end of the route, connecting into the existing bus routes around Cambridge city centre. The first option is along Adams Road. This would make a section of Adams Road bus only eastbound prior to the junction with Grange Road. The second option would be to construct a new dedicated busway along former Rifle Range track.

The link between Area 4 and Area 5 across Grange Farm is covered in section 8.9, it was selected after the recommended route options had been selected using the INSET process.

8.5.2 On-Road Areas

Whilst the off-road areas could combine different routes from each area to form the recommended route the on-road options were restricted to the recommended option either being Option A or Option B. However, to simplify the assessment the route has been split into 3 areas.

8.5.2.1 Area 1: West of M11 Junction 13



Area 1: West of M11 Junction 13

This is the area from around Madingley Mulch Roundabout to the junction with the M11 northbound offslip. This area includes the SSSI wood and American Cemetery heritage site. Option B would require gantries along this area.

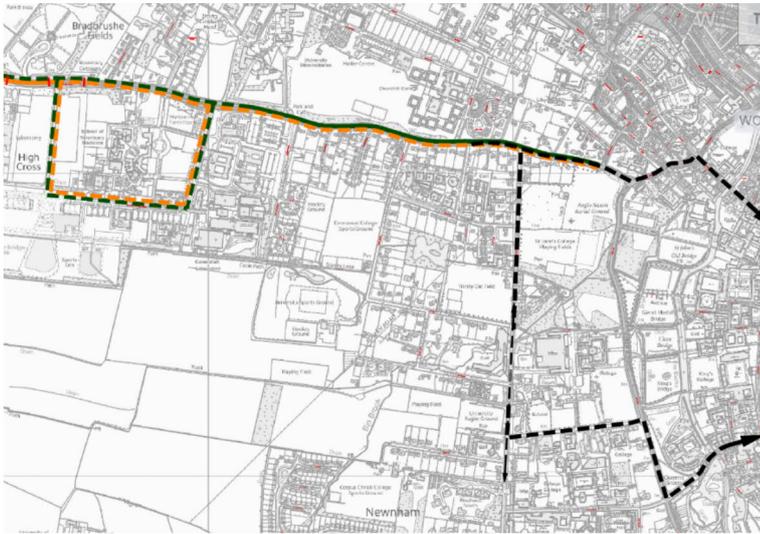
8.5.2.2 Area 2: M11 Junction 13



Area 2: M11 Junction 13

The M11 junction 13 has been selected as an area, due to Option B requiring the bridge over the M11 to be widened to accommodate the additional bus lane as well as the gantries that are required to operate the tidal busway. Option A does not require any widening to the bridge.

8.5.2.3 Area 3: East of M11 Junction 13



Area 3: East of M11 Junction 13

The route to the east of the M11 junction 13 includes the stops at the West Cambridge site and the connection to Grange Road, where the bus will continue to the centre of Cambridge. Option A has shared running through the university west development but has a dedicated bus lane from the junction with JJ Thomson Avenue to the junction with Lady Margaret Road. Option B has a tidal busway that will require gantries, until the junction with High Cross / Eddington Road where it becomes shared running.

8.6 INSET Table

INSET is the Mott MacDonald method of assessing each option based on the criteria outlined in **Table 18**. It is based on the DfT recommended EAST (Early Assessment and Sifting) approach.

8.6.1 Scoring

Each criterion could be scored from 0 to 7, with 1 - 3 being a negative impact, 4 being no or neutral impact or as existing, and 5 - 7 being positive impacts.

1 = Significant Negative
2 = Medium Negative
3 = Slight Negative

5 = Slight Positive
6 = Medium Positive
7 = Significant Positive

The above shows an overview of how the scoring range is decided but for each specific metric there is an individual scale for score.

8.6.2 Weighting

Within the INSET table there is an option to weight the scores. It was agreed that all the criteria would have a weighting of 1 but journey reliability which is a key objective of the scheme would have a weighting of 2.

8.6.3 Scores

The full INSET scoring table can be found in Annex A. The table below provides a summary of the results.

Table 20: Off-road options ranked based on INSET scores

Option	Area 1	Area 2	Area 3	Area 4	Area 5
Do Something (off-road Busway)	Ranked First	N/A	N/A	N/A	N/A
Do Minimum (public transport vehicle on existing road)	Ranked Second	N/A	N/A	N/A	N/A
Blue	N/A	Ranked First	Ranked First	Ranked First	N/A
Pink	N/A	Ranked Second	Ranked Second	Ranked Third	N/A
Light Green	N/A	N/A	N/A	Ranked Second	N/A
Adams Road	N/A	N/A	N/A	N/A	Ranked Second
Former Rifle Range Track	N/A	N/A	N/A	N/A	Ranked First

Source: Mott MacDonald

Table 21: On-road options ranked based on INSET scores

Option	West of M11	M11 Junction 13	East of M11
Route A	Ranked First	Ranked First	Ranked First
Route B	Ranked Second	Ranked Second	Ranked Second

Source: Mott MacDonald

8.7 Justification Table

The justification table shown in Annex B gives a text based explanation of the scores given in the INSET table, which has been described in more detail below.

8.7.1 Reliability of Journey

A complete assessment of the journey times cannot be made at this stage as the traffic modelling of the option was not available until the next stage of assessment. Therefore, the options have been assessed based on a high-level review of the reliability of the journey based on engineering judgement and assumptions.

8.7.1.1 Off-Road Option

From Cambourne to Madingley Mulch roundabout the off-road route runs through Bourn airfield and between the A428 and St Neots Road, the on-road route would run along either the A428 or St Neots Road. As the area does not currently experience high levels of congestion the reliability is still quite high but the off-road route is deemed to be more reliable as it would not be impacted by road traffic incidents, roadworks or potential future congestion.

Around the Madingley Mulch roundabout the blue route is deemed more reliable as there are fewer interactions with existing traffic. The blue route diverges prior to Madingley Mulch

roundabout and crosses St Neots Road, which currently is primarily used by local traffic. It has been noted as a concern from local residents that “rat running” may occur at peak times down St Neots Road, particularly if the Water Works Park and Ride site is chosen, so there may be an option to stop up St Neots Road to general traffic between Long Road and Madingley Mulch Roundabout. The Pink route crosses the roundabout creating a “hamburger” layout, and then crosses Madingley Road. Although public transport priority measures could be put in place at the roundabout, buses may experience congestion and the speed at which the vehicle will travel through the area is likely to be less than that of the blue route.

To the north of Coton Village both blue and pink options are off-road with a minor junction with Cambridge Road, so journey reliability is expected to be quite high.

Through the West Cambridge development, the blue option is off-road with a minor junction with Ada Lovelace Road, so journey reliability is expected to be quite high. The pink route would also have a junction with Ada Lovelace Road and would have a section of shared running along the road. The tight geometry of this route would be expected to impact on the speed of the vehicle and therefore the journey time. Also, the shared running would mean that the reliability is dependent on traffic conditions. For the Green route, the route is mostly shared running along Charles Babbage Road; this is also used by other public transport routes and other traffic around the site. As the area does not currently experience high levels of congestion the reliability is still quite high but speeds would be lower, and reliability is likely to worsen as the site develops and interactions with cyclists and pedestrians increase. As such the off-road route is deemed to be more reliable as it would not be impacted by road traffic incidents or potential future congestion.

Regarding the connection to Grange Road, the former Rifle Range track route is deemed as more reliable as Adams Road would have sections of shared running and the public transport lane section would have interactions with the many cyclists who use the route. As the area does not currently experience high levels of congestion the reliability is still quite high but the off-road route is deemed to be more reliable, as it would not be impacted by road traffic incidents or potential future congestion.

8.7.1.2 On-Road Options

From Madingley Mulch roundabout to the M11 junction 13 both Options A and B have dedicated public transport lanes which would give some public transport priority however there would be more junctions than the off-road route. There are also possibilities that other buses, taxis or cyclists would use the busway which may impact reliability if the public transport vehicle is caught behind a regular multi-stop service. It is recommended that if this is shown to be an issue a review of stop locations may be required. Although it should be noted that due to the tidal nature of Option B there would be a dedicated public transport lane both inbound and outbound to and from Cambridge during peak times whereas Option A would only have inbound public transport priority.

At junction 13 of the M11 Option A would be shared running with existing road vehicles, although there would be public transport priority given where the public transport lane ends by use of a public transport gate arrangement. Option B would have a dedicated public transport lane over the M11 Junction 13 which would require widening of the bridge, but is expected to provide increased journey reliability.

From the M11 junction 13 to the end of Madingley Road the dedicated public transport lane proposed in Option B finishes at the High Cross junction, from then on there is shared running, as such the reliability is not as high as the journey could be impacted by congestion on these

routes. For Option A the dedicated public transport lane restarts at JJ Thomson Avenue until the end of Madingley Road, which would give some public transport priority.

8.7.2 Route Flexibility – Link to Existing Public transport Route

There are existing public transport routes down St Neots Road, Madingley Road and within the West Cambridge development. Although the location of the public transport stops has not been confirmed, the scheme is expected to operate as an express service with limited stops in the areas of Cambourne, Bourn Airfield, Hardwick, West Cambridge and the new Park and Ride.

8.7.2.1 Off-Road Option

The off-road route would be able to connect with the existing routes along St Neots Road and at the West Cambridge development, with the green route aligning with existing public transport stops on Charles Babbage Road, allowing interchange with existing services.

8.7.2.2 On-Road Option

The on-road route is assumed to follow the stagecoach Citi 4 route, Go Whippet route X3 and connect to the U route through the West Cambridge development. There is a potential to align the route to these existing services through stop locations but without the exact stop locations it has been assumed that there is a significant distance between existing and proposed public transport routes.

8.7.3 Walking and Cycle Connectivity

8.7.3.1 Off-Road Option

The off-road route would have dedicated walking and cycle facilities through most of the areas with four exceptions, the pink route at Madingley Mulch roundabout, the blue and green route at West Cambridge and Adams Road.

The pink route at Madingley Mulch Roundabout would only have a dedicated cycle route. Whilst the buses would get priority at the junctions, cyclists would require additional infrastructure to navigate the roundabout. At the West Cambridge development, the blue and green route would utilise the existing cycleways and footways allowing for improvements to connectivity to existing facilities. Finally, there would be no changes to the Adams Road cycling provisions which cyclists currently use.

8.7.3.2 On-Road Option

Option A of the on-road options would have a 4m dedicated walking and cycle lane up to the junction with the M11, where it would tie into existing walking and cycle facilities. Then at the junction with Clerk Maxwell Road there would be a 3m dedicated footway and cycle way to the junction with Grange Road. Option B would have a 4m wide footway and cycleway from Madingley Roundabout to the High Cross junction.

8.7.4 Impact on Existing Traffic

8.7.4.1 Off-Road Option

With the off-road route there would be either no or slight impact on the existing local road network, this is due to the requirement to create some junctions with existing roads. The exception would be Madingley Road Roundabout on the pink route which would require changes to signalling to give priority to the busway at the roundabout and on the second

crossing with Madingley Road. There is also the potential reduction to existing traffic achieved through mode shift, however this will need to be confirmed with modelling.

8.7.4.2 On-Road Option

From Madingley Mulch roundabout to M11 junction 13 the on-road route would have little impact on existing traffic apart from that there would be public transport priority measures at some of the junctions. At the M11 Junction 13 Option A becomes shared with existing traffic which may cause an increase in congestion, similarly Option B becomes shared after High Cross junction. However, this could be mitigated through mode shift from cars to bus, but this will need to be confirmed with modelling.

8.7.5 Environmental Impact – Visual Impact

8.7.5.1 Off-Road Option

The on-road option in area 1 would have no change from existing, the off-road option would have a slight visual impact as it would require the removal of trees and scrub in some areas.

For area 2 the blue route crosses open fields for the majority of the route. Therefore, the public transport vehicle would be visible from distance but the infrastructure has a low likelihood of being seen. Hedgerow planting would introduce a feature not out of place with the existing views, so would be a minor impact on landscape character. The pink route has a similar impact but for a slightly shorter distance.

For area 3 the blue route crosses hillside approaching Coton at a lower elevation and distant views are shielded by the village whereas the pink route is higher on the topography and there would be greater visual impacts to the Coton Village up to Cambridge Road. The blue route would be closer to the Conservation Area of Coton Village. Introduction of hedgerow planting to shield the route would not be considered a divergent feature in the landscape, as historic mapping from 1888-1983 shows hedgerows dividing the large field north of Coton. From Cambridge Rd to M11 the blue route is in orchard and wooded area so there is limited visibility. The pink route is also in the orchard/wooded area so less visible from Coton Village but would be visible from Rectory Farm to the north, on the approach to the M11.

For area 4 the pink route is deemed to have a greater visual impact as it would replace the Coton Path which would create a higher visual impact along the southern West Cambridge boundary. The blue route would create a slight visual impact as the route would be along an alignment close to the area which is already developed: as such the presence of an intermittent public transport service along the route would create a new, but lesser, visual impact. There would also be a new structure over the existing pond but there would be significant new buildings in the area as part of the West Cambridge Development - increasing the urbanised nature of the area. The blue, pink and green routes all cross Grange Field meaning the route would be visible from neighbouring buildings to north but there would only be limited distant views from the south (passing buses may be partially visible).

For area 5 the Adams road option would result in localised hardening of landscape, especially near the boundary of the West Cambridge Conservation area adjacent to Cambridge University Sports Ground. There would also be the removal of on street parking which would change the character of the road scene itself and could be positive if it improves visibility of buildings along the road. For the former Rifle Range track option the introduction of new transport infrastructure in a rural/urban setting on the city fringe with loss of trees would alter setting and character negatively. There would also be the impact of a new junction on Grange road which would

result in increased visual impact in the West Cambridge Conservation area and in the vicinity of the listed building opposite the exit onto Grange Road.

8.7.5.2 On-Road Option

Option A would have a slight impact on the visual amenity as it would widen the road corridor through a sensitive area, The American Cemetery, and the constrained corridor in some locations would not allow much space for mitigation. Removal of mature vegetation along the roadside would also contribute to the slight visual impact. Option B would have a significant impact on visual amenity due to the requirement to have gantries erected over the length of the tidal busway, required to operate the route. Option B would also require additional structures over the A428 and the M11 to accommodate the additional public transport lane which would also have an impact on the current visual landscape.

8.7.6 Environmental Impact – Noise

8.7.6.1 Off-Road Option

For area 1 there are no noise impacts.

For area 2 there are no noise receptors within 100m of the blue option. The pink option is closer to Crome Lea business park but it is anticipated that there would be low impact.

For area 3 the blue option is anticipated to have a low noise overall but there are properties within 50m which are to be considered as sensitive receptors along Cambridge Road. M11 traffic and noise of traffic on Cambridge Road likely to mean the baseline is quite high and therefore overall difference/impact minimal. The pink option is largely located away from any sensitive receptors. It does travel alongside the Garden Centre on Cambridge Road, but this is not considered a sensitive receptor and noise from the route would be intermittent.

For area 4 the blue and green options have a low noise impact as the first sections are through the West Cambridge development and close to the M11. The pink route passes along Coton Path where this area is close to the M11 and traffic noise from the motorway is not insignificant. Intermittent public transport noise is deemed not significant in this setting but it would present an intermittent and localised noise intrusion on a rural setting in the Green Belt.

For area 5 there would be the introduction of intermittent public transport noise in the section from Grange Field to Wilberforce Road which is currently a relatively tranquil area. The route would pass a small area proposed as a village green, and the whole route is in the West Cambridge Conservation Area. This noise intrusion could change the nature of the setting in this area.

Along the former Rifle Range track, there would be an increase in traffic in an area with no traffic and within 50m of the back of buildings belonging to Clare College. This would be low density public transport traffic which would be either slowing as approaching Grange Road, or gaining speed as leaving the city. Assessed as low impact.

Increase in traffic on Adams Road close to properties but this is already an urban environment with a baseline that would likely reflect this. It is assessed as low impact with little change to the nature of the setting in this area.

8.7.6.2 On-Road Option

On both Option A and B the receptors along the route would already be accustomed to traffic noise. However, this area passes Madingley American War Cemetery which is a highly sensitive receptor and any notable increase in noise should be reported.

8.7.7 Environmental Impact – Air Quality

The off-road and on-road route would have no significant impact on air quality.

8.7.8 Environmental Impact – CO2 Emissions

8.7.8.1 Off-Road Option

In Area 1 there would be no change from existing for the on-road option. The new off-road route through the Bourn airfield and between the A428 and St Neots Road would include embedded carbon in the infrastructure, but this would be offset to some degree by the new landscape planting increasing the CO2 capture in some places.

Area 2, Area 3, Area 4 Blue and Pink routes, and Area 5 former Rifle Range track option are all similar as the embedded carbon in the infrastructure would again be offset to some degree by the new landscape planting increasing the CO2 capture in some places.

Area 4 Green route and Area 5 Adams Road route are both utilising an existing road network reducing the amount of embedded carbon in the infrastructure, but with limited opportunity for landscape planting the potential for offsetting some of the carbon is reduced.

For all areas the operational carbon is likely to be reduced due to modal shift to public transport or cycling and potential use of low-carbon vehicles.

8.7.8.2 On-Road Option

For both Option A and B through all three areas it is expected that there would be some carbon impact, but it would not have a discernible impact for either embedded or operational.

8.7.9 Environmental Impact – Biodiversity

8.7.9.1 Off-Road Option

Area 1 there would be no change from existing for the on-road option. The new off-road route would be through the Bourn airfield and between the A428 and St Neots Road, this area - although not an area of significant biodiversity or ecological significance - would require the removal of some trees and scrub.

For area 2 both routes would cause a loss of vegetation with the blue route creating a larger loss around the Water Works site. With the blue route being located across open, arable land the lost habitat would be replaced by new planting on any of the isolated fields, and the creation of a green corridor. With the pink route traveling through the arable land for a shorter distance there is a shorter length of hedgerows and green corridors created.

For area 3 compensation and enhanced corridors should be considered for the loss of habitat within the orchard. Compensation planting would also be possible near to Rectory Farm.

In area 4 the blue and pink routes would have an impact on the M11 Country Wildlife Site, with both options likely to sever the site. As both routes would follow a very similar corridor, the impacts between routes are likely to be comparable. There are records of Protected Species in

this location which may introduce the requirement for translocation areas to be explored. The pink route would also require the removal of the entire length of Coton Path Hedgerows County Wildlife Site, however, with slight route adjustments it may be possible to avoid taking the entire site, or possible to provide some mitigation along this corridor. The blue route would only impact upon half of the site and again, mitigation can be provided to minimise impacts on this site. As the green route would be using an existing road network it would not have any significant impact on the local habitats.

To access the Adams Road option in area 5 there is potential for ponds to be lost that are potentially habitats for great crested newt, and a loss of the urban woodland that surrounds the ponds. The proposed route at the former Rifle Range track would avoid the ponds and urban woodland but would impact the Bin Brook City Wildlife Site. In order to mitigate impacts on Bin Brook, a likely crossing design would be a low bridge with no change to brook channel dimensions and with opportunity to include mitigation in the design. The proposed route would also impact on Trinity Meadows, as well as vegetation and trees lining the road, some that have Tree Preservation Orders.

8.7.9.2 On-Road Option

Area 1 of the on-road option passes Madingley Wood SSSI and land take from the SSSI should be avoided. For the rest of the route widening the corridor may remove trees and hence habitats so there would be a negative impact.

8.7.10 Environmental Impact – Heritage

8.7.10.1 Off-Road Option

The nearest site of significant heritage importance is the American Cemetery on Madingley Road. However, the off-road routes diverge prior to the site so there would be a slight impact to the setting here, based on the introduction of new lighting of the route.

At area 2 there are 3 No. Cambridge Historical Environment Record (CHER) entries around Madingley Mulch roundabout that may be impacted by the pink route but as the blue route does not enter the roundabout they would be avoided.

In area 3 the Coton Village Conservation Area should be considered as a heritage area with listed buildings including the Grade I listed church. The blue route passes closer to the area than the pink route but is also set lower down in the landscape which would assist in limiting impacts to views and retain the conservation area edge whilst avoiding severance of the field. Both routes would have an impact on CHER entries, the blue route has the potential to impact 2 No. CHER entries, whereas the pink route would only have an impact on 1 CHER entry.

Area 4 has recently been redeveloped and therefore it is considered that there is unlikely to be any heritage asset that remains unimpacted, and any buried archaeology should have been recorded during the recent development. The blue route also has the potential to impact 3 CHER entries. Impact on heritage is considered to be negligible given the context within the West Cambridge site.

For area 5 the former Rifle Range track option may have a direct impact on 1 CHER entry. Adams Road is within the conservation area whereas the former Rifle Range track route is just outside it, except for the eastern end. There may be an impact on the section around Wilberforce Road / Adams Road but it is considered to be less than substantial. The new junction with Grange Road and the former Rifle Range track has potential to impact the setting

of listed buildings in the area but this is considered less than substantial given the high level of existing development in the vicinity.

8.7.10.2 On-Road Option

The on-road routes run along Madingley Road, and both options require land from the verge outside the American Cemetery, Option A for the dedicated public transport lane and improvements to the walking cycle routes and Option B for the existing road to make way for the tidal busway in the centre of the road. Any land take from the cemetery would be considered significant direct impact to the Registered Park and Garden as it is a very sensitive site of international importance.

Option B is assumed to have a significant impact due to the requirements for a gantry to operate the busway. The public transport route enters the conservation area so land take and visual impacts of gantries and other associated infrastructure should be considered due to impacts on setting of the Coton Village Conservation Area.

8.7.11 Environmental Impact – Green Belt

8.7.11.1 Off-Road Option

An initial high assessment of the potential off road options was undertaken in August 2017 by LDA. This was to provide a consistent view of the sections in accordance with Local Plan provisions which only reference the area East of the M11 known as the West Fields.

Landscape character and quality will need to be carefully considered as part of the EIA assessment, in particular to the West fields, which forms an important and sensitive part of the Greenbelt around Cambridge.

For area 1 the on-road option would have no impact. The off-road option would have a negligible impact to the green belt as the section in the green belt is between two existing roads.

For area 2, the blue route would have no adverse impact upon the openness while the pink may impact views. The eastern part nearer to Coton in the view may have some moderate impact upon the Green Belt due to potential for severance of the pink route.

Area 3 this location may have a moderate degree of harm to the Green Belt, which needs to be assessed further towards an EIA. Any route which retains the existing field structure and avoids severance is considered better than the subsequently discounted routes. The blue route follows boundaries and is situated lower down and therefore less visible in the surrounding landscape.

The western proportion of Area 4 is not within the Green Belt and the impact in this area comes from the route through Grange Farm, between Area 4 and Area 5. The Pink route is considered to have a larger impact as this would have the greatest effect on the Grange Farm Fields. The potential options in this area for the blue and green routes would have varying degrees of impact. Chapter 7 provides more detail on how this would be assessed during the next stages of work.

Adams Road is not within the Green Belt whereas a small section of the western part of the former Rifle Range track route is.

8.7.11.2 On-Road Option

There is not considered to be any change from existing for the on-road routes.

8.7.12 Safety

8.7.12.1 Off-Road Option

For the off-road route the safety of the scheme has been measured on how many interactions with existing traffic there are. As although that doesn't necessarily make the option unsafe it increases the risk of road traffic incidents, especially if the infrastructure is new to drivers.

The key differences in the off-road options are that the pink route for area 2 has two crossings, with Madingley Mulch roundabout and Madingley Road, whereas the blue route diverges prior to Madingley Mulch Roundabout and therefore has fewer junctions, especially with a potential option to close off St Neots Road to general traffic.

In area 4 the pink route would have an additional junction with Ada Lovelace Road when compared to the green and blue routes. The blue route would run close to the University of Cambridge Sports Centre and Gym which would have to be considered at detailed design.

With area 5 there have been concerns raised with the Cambridgeshire Council cycling groups about running buses down Adams Road which is currently a popular cycle route into Cambridge from the west.

8.7.12.2 On-Road Option

Option A there should be no safety issues apart from additional signals and larger junctions, however they are part of the current urban landscape of the area and should not cause any issues to other road users.

Option B, the tidal busway, has many inherent safety issues around control of the system which is not conventional. Gantries have been proposed to inform drivers as to when to use the lane which would be inbound running at peak morning times and outbound running at pm peak. There would have to be robust signalling to make sure that vehicles do not use the lane in the wrong direction. There is also a risk that general traffic would use the lane to overtake as the lanes would not be heavily trafficked, with buses only every few minutes at most.

8.7.13 Scheme costs

8.7.13.1 Off-Road Option

Area 1 has significant cost attached to the off-road route as no infrastructure is proposed in the on-road option. The blue route at Madingley Mulch is relatively simple, whereas the pink route would require changes to the roundabout itself, incurring additional cost. In West Cambridge, the blue route would require a structure over the existing drainage pond, increasing the cost of this option. The green route is the cheapest in this area as the existing Charles Babbage Road would be utilised.

8.7.13.2 On-Road Option

There would be costs associated with widening the road and for changes to junctions with Option A but these would be more for Option B due to the requirements for overhead signage gantries. At the M11 Option B which widens the bridge incurs significant extra cost. East of the M11 Option A has slightly higher costs as Option B has a shorter length of public transport lane constructed.

8.7.14 Engineering Feasibility – Construction Method

8.7.14.1 Off-Road Option

As the method of construction is similar for all off-road Options this criteria was restricted to stage 2 (OAR Part 2) as detailed in Table 182.

8.7.14.2 On-Road Option

Whilst the construction method for option A would be considered typical of highway schemes, with Option B there are not many examples of tidal roadways and no UK examples of a tidal busway. The construction method would therefore be more complex than route A. There may also be a requirement for full road closures to install the gantries and additional road closures to create the structure over the A428.

8.7.15 Land Acquisition

8.7.15.1 Off-Road Option

There would be significantly more land take required for the off-road options between Cambourne and Madingley Mulch although some of this land is within already proposed development areas. The pink route through Madingley Mulch roundabout is considered slightly worse due to the changes that would be required to the roundabout and the crossing of the A1303. The amount of land required through Coton is approximately the same between options but the pink route causes more severance to the orchard. The green route through West Cambridge has been given a slightly higher score as no land is required. The former Rifle Range track route does take existing land, whereas Adams Road uses existing highway so scores slightly better.

8.7.15.2 On-Road Option

The on-road options would require land for widening the roads to accommodate the public transport lanes. Whilst Option B widens the bridge over the M11, it does not require any significant area or land to do so. Option A scores slightly worse east of the M11 due to the additional public transport lane section between JJ Thomson Avenue and Lady Margaret Road.

8.7.16 Impact on Local Road Network During Construction

8.7.16.1 Off-Road Option

With the off-road route there would be either no or slight impact on the existing local road network during construction, this is due to the requirement to create junctions with existing roads. The off-road route between Cambourne and Madingley Mulch would affect St Neots Road as changes are required to the existing highway around Hardwick to accommodate the busway. Madingley Road Roundabout would require significant change to infrastructure to accommodate the pink route and on the second crossing with Madingley Road.

In West Cambridge, the route along Charles Babbage Road would be least disruptive as the other two routes would impact Ada Lovelace Lane. The Adams Road route would impact traffic to a greater degree than the former Rifle Range track route as it requires changes to the existing highway.

8.7.16.2 On-Road Option

Option B could have larger impacts during construction as the public transport lane is located in the centre of the carriageway, rather than to the north. Installation of the gantries could also have an impact, and is likely to require road closures.

8.7.17 Future Proofing

8.7.17.1 Off-Road Option

Future proofing is the ability for the scheme to develop into another scheme in the future. The off-road route would be new infrastructure with minimal crossings with existing roads and therefore has potential to be developed into many different options such as future rapid transit. Between Cambourne to Madingley Mulch the new infrastructure constructed for the off-road route could be converted in the future, so scores more highly than the “Do minimum” on-road route in this area. Through the West Cambridge development, the pink and green options have sections of shared running, which could limit conversion to future schemes. The former Rifle Range track route is considered more suitable for future schemes as Adams Road is along existing highway in a residential street.

8.7.17.2 On-Road Option

As the on-road options use existing infrastructure with some road widening, it has been considered that all areas do not impact on potential future schemes, but neither do they support conversion to different modes.

8.7.18 Public Acceptability

The results of the public consultation had not been received when writing this report. These will need to be reviewed and considered further when available. However, in the 2015 public consultation there was a preference for the off-road option from Cambourne to Madingley Mulch compared to an on-road option.

8.7.18.1 Off-Road Option

There are some objections from the residents of Coton Village who would prefer the pink option which is further away from the village but do not support the off-road route at all. There have been similar objections to passing through the West Field sites between West Cambridge and Grange Road.

There is some support from the University for the green route which would align with the existing public transport links on Charles Babbage Road as well as providing central public transport links to the West Cambridge Development.

8.7.18.2 On-Road Option

Option B was developed following discussions with local stakeholders, but there have been objections to the suggestions that signage gantries are required.

8.8 Grange Farm

Given the choice of “Blue” route through West Cambridge and the former Rifle Range track access track as recommended off-road alignments, there remains the need to consider potential options of alignment through Grange Farm to connect these two areas.

This location was not considered as a separate “Area” within the assessment given the multitude of options available and the final choice being largely dependent on the routes through the adjacent sections.

There are two options that are to be considered. The first takes an alignment across the existing fields, using large radii curves that would allow use of a kerb-guided busway system should that mode choice be chosen, although they could be feasible on other forms of guidance system. The disadvantages of this option are that it cuts across the fields causing a degree of severance and greater impact on the landscape, which is located within the Green Belt.

The second option stays closer to the existing field boundaries, reducing potential impacts on the Green Belt and reducing severance issues. However, the radii that would be required to reduce the land take to a minimum would not allow use of a kerb-guided public transport system, although they could be feasible on other forms of guidance system.

The image below shows the potential options.

Figure 25: Routes Across Grange Farm



Source: Mott MacDonald

As set out in the report by LDA, the impact upon the Green Belt would vary significantly depending on the route option chosen. The northern route would have negligible harm to the Green Belt and the degree of harm would increase the further the route option is situated south through the central area of the field. In the view of LDA the impact would range from minor adverse (north) to major adverse through the centre of the field. LDA are considered to have taken a conservative view. The intention is to manage the design so the impact is limited to minor adverse.

The choice of final alignment through this section will be carried forward to the next stage of assessment.

8.9 On-Road Option Optimisation

The assessment of the on-road options concluded that route A was the recommended option. However, route B the “tidal busway” has priority measures both inbound and outbound to Cambridge. An assessment and development of the design of route A has been undertaken to optimise the eastbound public transport priority measures, junction layout/signals and provisions for westbound public transport priority. This optimised design has then been modelled to assess the impact of these changes.

8.9.1 Traffic Modelling

Three options for providing public transport priority on the A1303 Madingley Road west of Cambridge city centre have been tested using micro-simulation software PTV VISSIM. The purpose of the study is to evaluate the impact of providing public transport infrastructure and junction changes on the overall operation of this stretch of road using journey time data. The existing VISSIM models produced by Atkins for the 2031 forecast were used as the starting point to develop the additional scheme options to assess.

8.9.1.1 Alterations to the Base Model

Alterations were required to the models as the scheme has developed since the last assessment, these have been detailed in Table 36.

Table 22: Alterations to Base Model

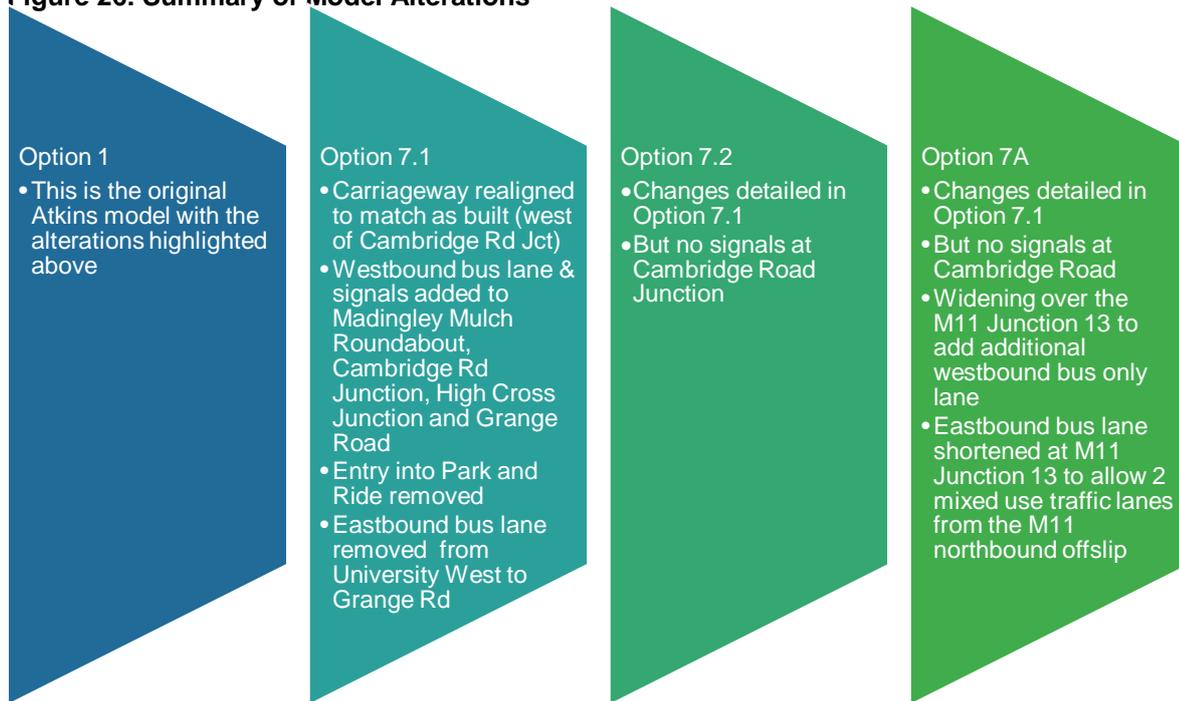
Change	Description
Park and Ride Location	The original VISSIM models produced by Atkins for the 2031 forecast assumed that the Park and Ride site was located in Crome Lea. As this has since been revised in the Park and Ride study conducted by Mott MacDonald the model has been revised to assume the Park and Ride traffic is originating from Scotland Farm and has been redistributed using the existing ratio of traffic share between St Neots and A428. Although the Park and Ride location has not been confirmed this allowed a comparative the assessment of the optimised route without having to make changes to Madingley Mulch roundabout.
Signals at Madingley Mulch Roundabout	Upon observation of the model, the coded signal setup at A1303 Madingley Road/St Neots Road was deemed unrealistic in the AM peak and seemed to be causing severe levels of delay on the Eastbound approach to this junction. The signals have therefore been manually optimised at this junction through observation in the model for just the AM peak; given the tidal nature of the demand, the PM peak did not appear to suffer the same level of congestion caused by the existing signal timings. Note that no other signal optimisation has been undertaken at this stage. It is possible that further benefits could be achieved through signal optimisation.

Source: Mott MacDonald

8.9.2 Summary of Networks Assessed

Four options have been tested which are all alterations to the original model. The alterations are made up of various combinations of junction or highway changes which have been summarised in Figure 25. Each of the optimisation options is discussed in more detail in the sections below, along with results from each of the 4 networks modelled.

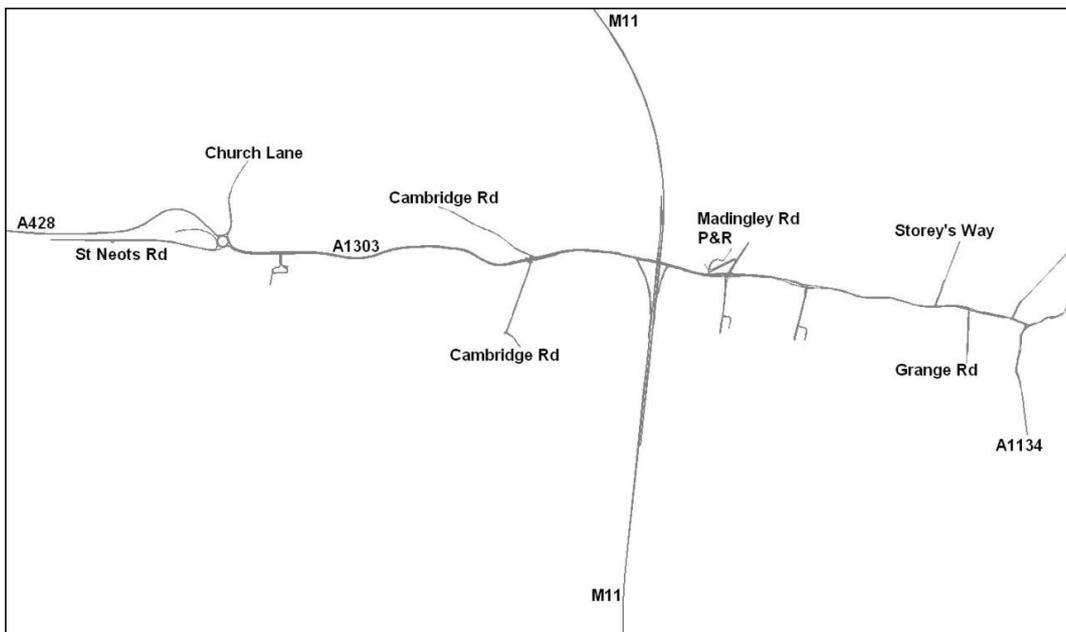
Figure 26: Summary of Model Alterations



Source: Mott MacDonald

The extent of the model is the same for all four options tested and can be seen below in Figure 26

Figure 27: Extent of VISSIM Modelling



Source: Mott MacDonald

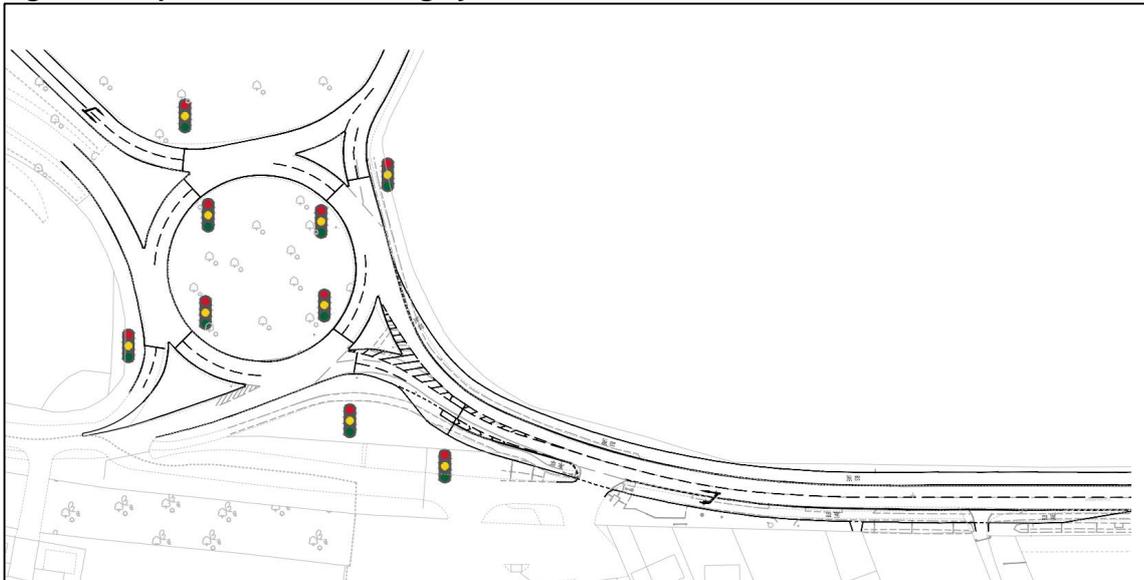
8.9.3 Key Assessment Locations

Assessments of six key areas have been undertaken to review the impact of the different models on the journey times of both buses and general traffic. The assessments focus on eastbound traffic during the AM peak and westbound traffic during the PM peak.

The sections below discuss each section in turn with summarised results showing journey time changes for general traffic and buses. More detailed results can be found in Appendix C.

8.9.3.1 Madingley Mulch Roundabout

Figure 28: Optimisation of Madingley Mulch Roundabout



Source: Skanska (2018)

For all option 7 models the carriageway has been widened on the westbound approach to incorporate a 200m public transport only lane which includes a public transport gate prior to the Madingley Mulch roundabout. This was done to allow the public transport priority over queuing traffic onto Madingley Mulch. There is also the potential to link these signals to give greater priority for the bus, but this has not been modelled as part of this assessment.

Table 23: Average Journey Time – Madingley Mulch Roundabout

Data	Time	Average Journey Time (seconds)			
		Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 1000	770	724	650	192
AM (Bus)	0700 - 1000	262	248	224	135
PM (All Vehicles)	1600 - 1900	104	109	104	104
PM (Bus)	1600 - 1900	146	144	115	114

Source: Mott MacDonald

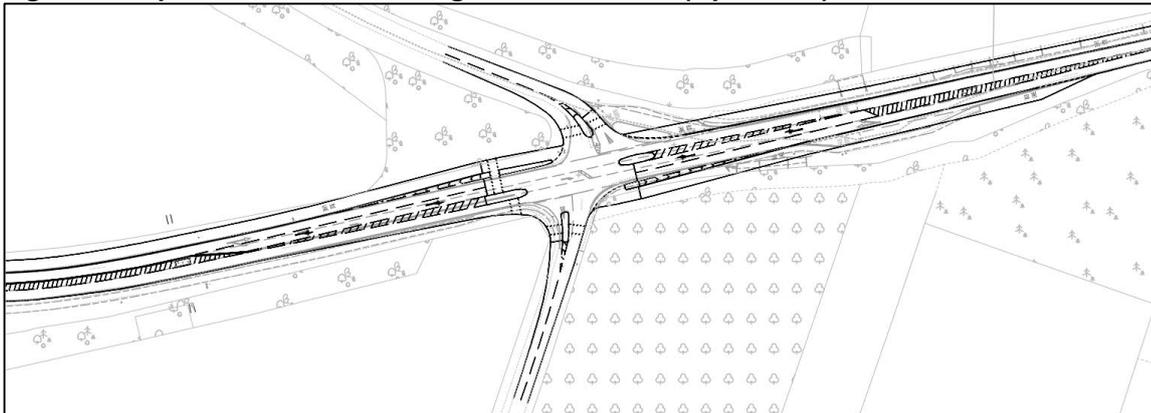
The modelling summarised in Table 37, shows that for eastbound traffic in the AM peak there is an improvement to public transport journey times for all three optimised routes with option 7A having the lowest overall journey time for both public transport and general traffic.

The modelling shows for the westbound traffic in the PM peak there is an improvement for buses with option 7A having the lowest overall journey time. There appears to be no impact to the general traffic with journey times remaining the same for most options, and being slightly worse for option 7.1.

As such it is recommended the westbound section of public transport lane and priority at Madingley Mulch roundabout is included in the recommended option.

8.9.3.2 Cambridge Road Junction

Figure 29: Optimisation of Cambridge Road Junction (Option 7.1)



Source: Skanska (2018)

All of the optimised options do not change this junction from the original Option 1, and it remains a priority junction with an eastbound public transport lane. However, for option 7.1, shown in figure 28, the junction with Madingley Road and Cambridge Road has been signalised with approximately 150m of additional outbound public transport lane with a public transport gate to give priority at the signals. The existing two outbound general traffic lanes maintained this is shown in figure X. All the other options have no signals on Cambridge Road junction.

The expected benefits are to provide some priority for westbound buses at the junction. However, it does introduce a new set of traffic signals at the junction which could lead to delays to other traffic.

Table 24: Average Journey Time – Cambridge Road Junction

Data	Time	Journey Time (seconds)			
		Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 1000	991	865	835	313
AM (Bus)	0700 - 1000	312	310	285	205
PM (All Vehicles)	1600 - 1900	350	336	305	178
PM (Bus)	1600 - 1900	189	270	157	156

Source: Mott MacDonald

The modelling summarised in table 38, shows that for eastbound buses in the AM peak there is a negligible improvement with the addition of signals and a public transport gate (option 7.1). With the greatest benefits been seen in Option 7A (no signals).

The modelling shows for the westbound traffic in the PM peak there is a slight improvement in journey times for general traffic with the addition of signals, a public transport only lane and a public transport gate (option 7.1). However, for buses there is an increase to the journey time, with option 7.1 showing the lowest overall journey time.

The modelling shows that option 7.2 and 7A have significantly more improvement to journey times compared with option 7.1. Therefore, changing the design from a priority to a signalised junction does not appear to provide enough benefits to justify inclusion in the recommended option.

8.9.3.3 M11 Junction 13

Figure 30: Optimisation of M11 Junction 13 (Option 7A)



Source: Skanska (2018)

Figure 31: Optimisation of M11 Junction 13 (Option 7.1 & 7.2)



Source: Skanska (2018)

Option 7.1 and 7.2 has an eastbound public transport lane with a public transport gate at the junction with the M11 northbound off slip. The public transport lane continues approximately 90m east of the junction then converts to a general traffic lane with another eastbound right turn only lane.

Option 7A has an eastbound public transport lane with a public transport gate to the junction with the M11 northbound off slip. However, unlike option 7.1 and 7.2 the public transport lane does not continue after the junction, instead there are two mixed use traffic turning right from the northbound off slip. The two eastbound mixed use traffic lanes are continued over the bridge

with an additional eastbound right turn only lane, the two lanes continue through to the High Cross junction.

All options have a westbound public transport only lane over the M11 bridge with a public transport gate at the junction with the M11 northbound off slip as well as the introduction of an island on the southbound M11 slip road in order to better separate traffic. With one lane westbound becoming a combined left turn for general traffic and ahead lane for buses.

The expected benefits are to provide more capacity for vehicles exiting the M11 travelling westbound with two lanes instead of one. To provide priority for buses over the M11 bridge, outbound from Cambridge and priority at the signals. Currently the southbound on slip has had issues with people thinking it was single lane. The additional island provides a clearer separation of the left turn for westbound traffic and a right turn for eastbound traffic. However, adding an additional public transport lane over the M11 bridge would require either widening of the bridge or realignment of the carriageway with another bridge to accommodate pedestrian and cyclists as a footway could not be provided in the current width of the bridge.

Table 25: Average Journey Time – M11 Junction 13

Data	Time	Journey Time (seconds)			
		Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 1000	368	220	272	172
AM (Bus)	0700 - 1000	184	114	115	104
PM (All Vehicles)	1600 - 1900	212	218	170	139
PM (Bus)	1600 - 1900	91	205	77	78

Source: Mott MacDonald

The modelling shows that for general eastbound traffic in the AM peak there is an improvement with all options but 7A gives the best result. The public transport traffic shows a similar pattern of improvement.

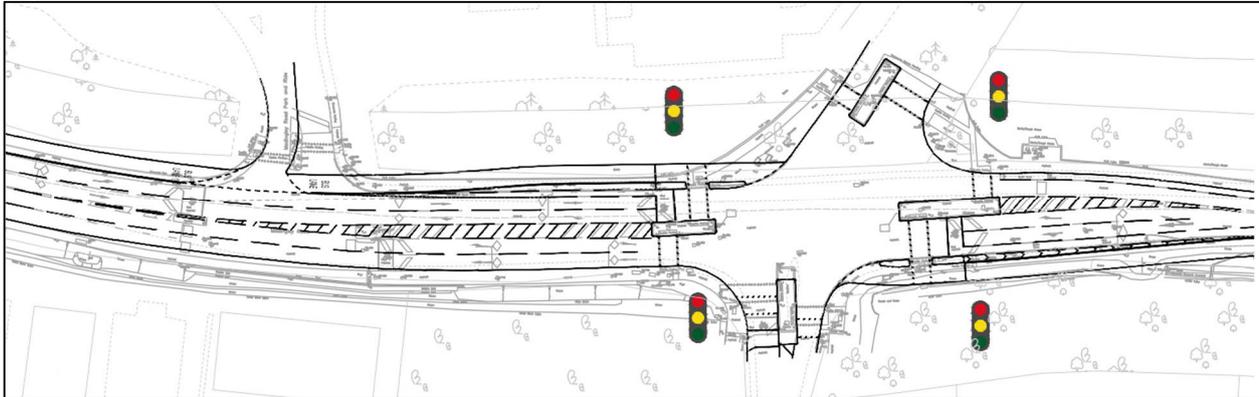
The modelling shows for the general westbound traffic in the PM peak, again the most improvement is seen with Option 7A. However, the public transport traffic shows a negligible improvement, with a large increase to public transport journey times with option 7.1.

Given the improvements to general traffic and buses at this location in options 7.2 and 7A, it is suggested that some improvement is worth undertaking.

Option 7A definitely requires the widening of the M11 junction 13 bridge while option 7.2 has costs to relocate the traffic lanes and provide an alternative pedestrian and cycle bridge. As such it is recommended that further assessment is undertaken to define the recommended solution.

8.9.3.4 Existing Park and Ride + High Cross Junction

Figure 32: Optimisation of Park and Ride and High Cross Junction



Source: Skanska (2018)

All of the optimised options have the signalised junction to the existing Park and Ride site removed with eastbound access only from the A1303 as shown in Figure 32. The Park and Ride exit has been relocated to Eddington Avenue, although this would require some reconfiguration of the internal layout of the Park and Ride site. This is intended to improve journey times for traffic by removing a set of signals from this area. However, the traffic model used for the original VISSIM models was produced for a design year where the park and ride was closed, so no traffic is allocated to enter or exit the park and ride. As such the effect these changes have on journey times cannot be modelled at this time and will be reflected in OAR2. Figure 32. The Park and Ride exit has been relocated to Eddington Avenue, although this would require some reconfiguration of the internal layout of the Park and Ride site. This is intended to improve journey times for traffic by removing a set of signals from this area. However, the traffic model used for the original VISSIM models was produced for a design year where the park and ride was closed, so no traffic is allocated to enter or exit the park and ride. As such the effect these changes have on journey times cannot be modelled at this time and will be reflected in OAR2.

At the High Cross junction, there is an additional eastbound and westbound public transport only lane with a public transport gate at the junction. This would add additional signal stages to the existing junction.

Table 26: Average Journey Time – Park and Ride and High Cross Junction

Data	Time	Journey Time (seconds)			
		Option 1 optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 1000	210	143	152	115
AM (Bus)	0700 - 1000	223	121	125	104
PM (All Vehicles)	1600 - 1900	125	346	202	192
PM (Bus)	1600 - 1900	136	231	129	129

Source: Mott MacDonald

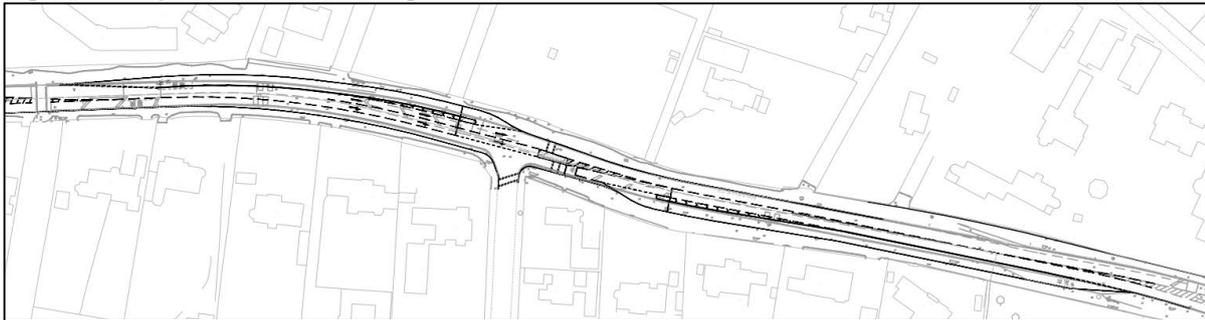
The modelling summarised in table 40 shows that for eastbound traffic in the AM peak there is an improvement to both public transport and general traffic with all models, with option 7A showing the greatest benefit.

The modelling shows for the westbound traffic in the PM peak there is negligible impact to public transport journey times whereas general traffic sees an increase in journey times.

Although the modelling for the eastbound traffic shows there is a benefit to the optimised option design the negligible or negative benefits for westbound buses and traffic suggests that public transport priority measures in a westbound direction are not beneficial to journey times. It is suggested that the area is modelled with an eastbound public transport gate only to assess whether this reduces the impact to westbound general traffic whilst maintaining the eastbound benefits.

8.9.3.5 Grange Road Junction

Figure 33: Optimisation of Grange Road Junction



Source: Skanska (2018)

The original option had a public transport only lane eastbound through a signalised junction. Now in all optimised options a public transport only lane is located on the approach to the junction with Grange Road with a public transport gate at the junction. There is also a section of additional westbound public transport only lane with a public transport gate allowing buses to avoid queues prior to the junction with Grange Road.

Table 27: Average Journey Time – Grange Road Junction

Data	Time	Journey Time (seconds)			
		Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 1000	93	92	87	101
AM (Bus)	0700 - 1000	105	91	83	112
PM (All Vehicles)	1600 - 1900	90	169	153	153
PM (Bus)	1600 - 1900	112	132	126	116

Source: Mott MacDonald

The modelling summarised in table 41 shows that for eastbound traffic in the AM peak there is a negligible impact to general traffic journey times with any option and a slight improvement to public transport traffic with option 7.2.

The modelling shows for the westbound traffic in the PM peak there is a negative impact on the journey times for both general traffic and buses.

Although the modelling for the eastbound traffic shows a slight benefit to public transport journey times the modelling suggests that this option should not be included in the recommended option.

8.9.3.6 Removal of Public transport Lane from University West to Storeys Way

For all the optimised options the public transport lane from West Cambridge development (junction with Conduit Head Road) to Storeys Way has been removed. This is to assess whether this section provides any benefit to public transport journey times.

Table 28: Average Journey Time – University West to Storeys Way

Data	Time	Journey Time (seconds)			
		Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 1000	92	78	77	86
AM (Bus)	0700 - 1000	108	100	100	104
PM (All Vehicles)	1600 - 1900	74	170	94	92
PM (Bus)	1600 - 1900	86	172	98	98

Source: Mott MacDonald

The modelling summarised in table 42 shows that for eastbound traffic in the AM peak and westbound traffic in the PM peak there is a negligible improvement to both public transport and general traffic with option 7.2 showing a negative impact for westbound public transport and general traffic.

The modelling shows there is a negligible or negative benefit for eastbound and westbound traffic. This suggests that a public transport lane in this area is not bringing significant additional benefits to public transport journey times. However, it is recommended that further assessment may be required before the decision is made to remove this section as it may benefit buses if traffic flows increase.

Should the public transport lane not be taken forward in this area, there is the potential for improved cycling facilities and cycle lanes to be provided instead.

8.9.4 Review of Overall Model Results

The modelling results have been summarised in the table 43. It can be noted that further improvements could probably be made with signal optimisation throughout the network.

Table 29: Overall Model Results and Recommendations

Area	Results	Recommendations
Madingley Mulch Roundabout (All Options)	<ul style="list-style-type: none"> Improvements to eastbound AM peak traffic (General) Improvements to eastbound AM peak traffic (Bus) No impact to westbound PM peak traffic (General) Improvements to westbound PM peak traffic (Bus) 	Modelling suggests section of westbound public transport lane and priority at Madingley Mulch should be included in the recommended option.
Cambridge Road Junction (option 7.1)	<ul style="list-style-type: none"> No Improvements to eastbound AM peak traffic (General) No Improvements to eastbound AM peak traffic (Bus) Slight Improvement to westbound PM peak traffic (General) Negative impact to westbound PM peak traffic (Bus) 	Modelling suggests the junction should not be signalised.

Area	Results	Recommendations
M11 Junction 13 (Option 7A)	<ul style="list-style-type: none"> • Improvements to eastbound AM peak traffic (General) • No improvements to eastbound AM peak traffic (Bus) • Improvement to westbound PM peak traffic (General) • No improvements to westbound PM peak traffic (Bus) 	Modelling suggests additional lanes over the M11 would be beneficial.
Park and Ride and High Cross Junction	<ul style="list-style-type: none"> • Improvements to eastbound AM peak traffic (General) • Improvements to eastbound AM peak traffic (Bus) • Negative impact to westbound PM peak traffic (General) • No improvements to westbound PM peak traffic (Bus) 	Eastbound public transport priority at the junction seems to be of benefit.
Grange Road Junction	<ul style="list-style-type: none"> • No improvements to eastbound AM peak traffic (General) • Slight improvements to eastbound AM peak traffic (Bus) • Negative impact to westbound PM peak traffic (General) • Negative impact to westbound PM peak traffic (Bus) 	Modelling suggests public transport priority measures should not be included.
Removal of public transport lane from University West to Storeys Way	<ul style="list-style-type: none"> • No impact to eastbound AM peak traffic (General) • No impact to eastbound AM peak traffic (Bus) • No impact to westbound PM peak traffic (General) • No impact to westbound PM peak traffic (Bus) 	Modelling suggests the public transport lane has little benefit. Assess potential to provide improved cycling facilities.

Source: Mott MacDonald

9 Summary

Issues of congestion, poor journey times and journey time reliability along the A428/A1303 corridor during peak periods have become a major concern for Cambridge and the Greater Cambridge area in recent years. In particular the impact this has on future demand for travel along the corridor as a result of predicted housing and employment growth, and the potential this has to constrain continued economic growth across the Greater Cambridge area if not addressed through investment in new sustainable transport infrastructure such as the C2C scheme.

This report documents the options appraisal process carried out since 2014 as part of Stage 1 of the DfT's WebTAG Transport Appraisal Process – Option Development. Through several robust steps of options generation and sifting, including workshops and the use of MCAF assessments, a long list of 21 options have been refined to 5 options. These were presented in the SOBC in September 2016. Further assessment at the request of the GCP Executive Board refined the options further to 3 options. These were then progressed to consultation in later 2017 / early 2018.

As part of the current phase of work now being undertaken to select a recommended option and develop an OBC, a review of the evidence base and scheme objectives has been carried out. The results of this is a confirmation of the issues and opportunities that previously fed into the objective setting process that was reported in earlier OARs and the SOBC, therefore providing a re-confirmation for the need for this intervention.

The objectives have also been re-cast to reflect the current position of the scheme as it progresses to a final OBC, with an overarching scheme vision now set out:

To connect existing and new communities along the A428/A1303 to places of employment, study and key services to enable the sustainable growth of Greater Cambridge. We will deliver this through improved, faster and more reliable High Quality Public Transport (HQPT) services, together with high quality cycling and walking facilities serving a new Park & Ride site to the west of Cambridge.

The scheme objectives are:

- 1. To deliver a sustainable transport network/system that connects areas between Cambourne and Cambridge along the A428/A1303.**
- 2. To achieve improved accessibility to support the economic growth of Greater Cambridge**
- 3. Contribute to enhanced quality of life by relieving congestion and improving air quality within the surrounding areas along the A428/A1303 and within Cambridge city centre.**

Using the revised scheme objectives, a series of selection criteria, grouped by themes have been developed to use in the current phase of optioneering. This forms the focus of Section 8 of this report. This aligns with Stage 2 of the DfT's WebTAG Transport Appraisal Process – Further Assessment, and has involved further assessment of the 3 options that were consulted on, to determine a recommended on-road and off-road solution. This is the first step of this current stage of appraisal to arrive at a recommended option for the C2C scheme that will then be appraised in detail for the purpose of the scheme's OBC.

The findings of the INSET assessment concluded that the recommended on-road option is Option A. However, a potential “optimisation” of the route, detailed in section 8, has been explored to reflect the aspiration in Option B for some improvements to outbound traffic, and a need to further consider operation of Junction 13 of the M11. Four optimised routes were modelled using micro-simulation software PTV VISSIM which included changes to six key areas

- Madingley Mulch Roundabout
- Cambridge Road Junction
- M11 Junction 13
- The existing Park and Ride site access and High Cross junction
- Grange Road
- Removal of public transport lane between from university west to Storeys Way junction

The modelling showed that the recommended on-road option is “Optimised” Option A. Although of the optimised models the best journey time improvement was seen from Option 7A there is a need for additional assessments to refine the option further. Specifically, there is a requirement for a further modelling of some of the key areas, a review of the land required, further improvements to cycling facilities and a review of the layout of the M11 junction 13 to improve public transport links to Addenbrookes Hospital and the Cambridge Bio-Medical Campus.

The recommended off-road Phase 1 option between Madingley Mulch and Grange Road is the “Blue” route through Madingley Mulch, Coton Village and West Cambridge, and the former Rifle Range track connection to Grange Road. The assessment also shows benefits in continuing the off-road option from Cambourne to Madingley Mulch Roundabout. However, as this was only an illustrative comparator and Phase 2 has not been subject to public consultation, this will require further development to confirm and investigate the different options available for this section.

The recommended Phase 1 on-road and off-road options and the Illustrative Comparator will be combined with the two Park and Ride locations to provide a list of options taken forward to OAR 2. The assessment will also include the Do Minimum option. Therefore the current optimised short-listed options being taken forward to the second step within Stage 2 options assessment are:

- Do Minimum
- Low Cost a - Recommended on-road Phase 1 + Park and Ride at Water works
- Low Cost b - Recommended on-road Phase 1 + Park and Ride at Scotland Farm
- Do Something 1a – Recommended off-road Phase 1 + Park and Ride at Water works
- Do Something 1b – Recommended off-road Phase 1 + Park and Ride at Scotland Farm
- Illustrative Comparator – Recommended off-road Phase 1 and 2 + Park and Ride at Water works

9.1 Next Steps

The options assessment carried out as part of the current stage of appraisal forms the basis of this report which has been titled OAR Part 1. The next step in the options assessment will be reported in OAR Part 2 and will focus on:

- INSET assessment of the optimised short-listed options – this will include the assessment of each option, with each Park and Ride option included as a variation.
- Detailed economic appraisal of each option based on transport user benefits taken from traffic modelling outputs to provide initial BCRs.

The final output from OAR Part 2 will be the optimised short-listed options with initial BCRs. Following the completion of this step within the assessment, further appraisal will be carried out on the options to examine the wider economic benefits, social distribution impact and environmental impacts of each option. These will then be presented to the GCP Executive Board with a recommendation for a recommended option.

Based on the approval of a recommended option by the GCP Executive Board following consultation and assessment of Phase 2 options, a full detailed assessment of this option will be carried out across the five cases (Strategic, Economic, Financial, Commercial and Management), to produce a final OBC.

Annexes

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A. INSET Scoring Table

A.1 Off-Road INSET Scoring

**CAMBOURNE TO CAMBRIDGE BETTER BUS JOUREYS - P&R SITE SHORTLIST SELECTION
INVESTMENT SIFTING AND EVALUATION TOOL (INSET)**

Area 1 - Cambourne to Madingley Mulch																			
No.	Name	Criteria																	WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on existing traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Land acquisition required	Impact on local road network during construction	Future-proofing	
1	Online	2: Shared (non-congested)	3: Links (Medium Distance)	4: No Change	4: No Impact	4: No or neutral Visual Impact	4: No or neutral Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	4: No or neutral Impact	4: No or neutral Impact	4: No or neutral Impact	4: No or neutral Impact	3: Preference for alternative option	4: No Cost	4: No Impact	4: No Impact	4: No Impact on potential future proposed schemes	3.88
2	Off Line	7: Offline	3: Links (Medium Distance)	6: Improved cycle infrastructure	5: Improve capacity for traffic (non-Congested area)	3: Slight Visual Impact	4: No or neutral Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	3: Slight decrease in biodiversity & Ecology	4: No or neutral Impact	4: No or neutral Impact	4: No or neutral Impact	6: Medium Stakeholder support	3: New highway infrastructure	2: Land required (greater area)	2: Medium Impact	6: Route supports future schemes with minor alignment changes	4.53

Area 2 - Madingley Mulch Roundabout																			
No.	Name	Criteria																	WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on existing traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Land acquisition required	Impact on local road network during construction	Future-proofing	
3	Blue	6: Offline (minor junction)	1: No Links	6: Improved cycle infrastructure	5: Improve capacity for traffic (non-Congested area)	3: Slight Visual Impact	4: No or neutral Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	5: Slight increase in biodiversity & Ecology	4: No or neutral Impact	3: Route through green belt (smaller area)	4: No Impact or as existing	4: No Preference overall	3: New highway infrastructure	2: Land required (greater area)	3: Slight Impact	6: Route supports future schemes with minor alignment changes	4.29
4	Pink	3: Offline with Complex junctions	1: No Links	3: Slight impact on operation of existing cycle routes	2: Offline with major junctions with existing roads	2: Visual Impact	3: Slight Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	5: Slight increase in biodiversity & Ecology	3: Route in proximity of heritage areas	3: Route through green belt (smaller area)	3: Slight interactions with other road users	4: No Preference overall	2: New highway infrastructure and complex junctions	3: Land required	1: Significant Impact	5: Route supports future schemes with major alignment changes	3.18

Area 3 - Coton Village																			
No.	Name	Criteria																	WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on existing traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Land acquisition required	Impact on local road network during construction	Future-proofing	
3	Blue	7: Offline	1: No Links	6: Improved cycle infrastructure	3: Offline but minor Junctions with existing roads	3: Slight Visual Impact	3: Slight Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	4: No or neutral Impact	3: Route in proximity of heritage areas	3: Route through green belt (smaller area)	4: No Impact or as existing	1: Numerous stakeholder Objections	3: New highway infrastructure	2: Land required (greater area)	3: Slight Impact	6: Route supports future schemes with minor alignment changes	3.94
4	Pink	7: Offline	1: No Links	6: Improved cycle infrastructure	3: Offline but minor Junctions with existing roads	2: Visual Impact	4: No or neutral Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	4: No or neutral Impact	3: Route in proximity of heritage areas	3: Route through green belt (smaller area)	4: No Impact or as existing	2: Some stakeholder Objections	3: New highway infrastructure	1: Land required (greater significance)	3: Slight Impact	6: Route supports future schemes with minor alignment changes	3.94

Area 4 - West Cambridge Development																			
No.	Name	Criteria																	WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on existing traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Land acquisition required	Impact on local road network during construction	Future-proofing	
3	Blue	7: Offline	5: Links (short distance)	5: Improved Cycle connectivity	3: Offline but minor Junctions with existing roads	3: Slight Visual Impact	4: No or neutral Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	3: Slight decrease in biodiversity & Ecology	4: No or neutral Impact	3: Route through green belt (smaller area)	2: Medium interactions with other road users	4: No Preference overall	1: New highway infrastructure and structure	3: Land required	3: Slight Impact	6: Route supports future schemes with minor alignment changes	4.18
4	Pink	6: Offline (minor junction)	3: Links (Medium Distance)	5: Improved Cycle connectivity	2: Offline with major junctions with existing roads	2: Visual Impact	3: Slight Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	3: Slight decrease in biodiversity & Ecology	4: No or neutral Impact	2: Route through green belt (closer proximity to existing development)	3: Slight interactions with other road users	4: No Preference overall	3: New highway infrastructure	3: Land required	2: Medium Impact	5: Route supports future schemes with major alignment changes	3.76
5	Light Green	2: Shared (non-congested)	6: Aligned with existing bus routes (Servicing City Centre)	5: Improved Cycle connectivity	1: Shared running	3: Slight Visual Impact	4: No or neutral Noise Impact	4: No or neutral Air Quality Impact	5: Slight Carbon savings/attenuation	4: No or neutral Impact	4: No or neutral Impact	2: Route through green belt (closer proximity to existing development)	4: No Impact or as existing	5: Some stakeholder support	4: No Cost	4: No Impact	4: No Impact	4: No Impact on potential future proposed schemes	3.94

Area 5 - Adams Road/Rugby Club																			
No.	Name	Criteria																	WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on existing traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Land acquisition required	Impact on local road network during construction	Future-proofing	
6	Adams Road	2: Shared (non-congested)	1: No Links	3: Slight impact on operation of existing cycle routes	1: Shared running	4: No or neutral Visual Impact	3: Slight Noise Impact	4: No or neutral Air Quality Impact	5: Slight Carbon savings/attenuation	2: Medium decrease in biodiversity & Ecology	3: Route in proximity of heritage areas	4: No or neutral Impact	3: Slight interactions with other road users	3: Preference for alternative option	3: New highway infrastructure	4: No Impact	2: Medium Impact	3: Route cannot support proposed underground schemes	3.06
7	Rugby Club	7: Offline	1: No Links	7: Improved cycle infrastructure and connectivity	3: Offline but minor Junctions with existing roads	2: Visual Impact	3: Slight Noise Impact	4: No or neutral Air Quality Impact	4: No or neutral Impact	3: Slight decrease in biodiversity & Ecology	2: Route has minor Impact on heritage areas	4: No or neutral Impact	4: No Impact or as existing	5: Some stakeholder support	3: New highway infrastructure	3: Land required	4: No Impact	6: Route supports future schemes with minor alignment changes	4.24

A.2 On-Road INSET Scoring

CAMBOURNE TO CAMBRIDGE BETTER BUS JOUREYS - P&R SITE SHORTLIST SELECTION INVESTMENT SIFTING AND EVALUATION TOOL (INSET)

Area 1 - West M11																				
No.	Name	Criteria																		WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on Existing Traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Engineering feasibility - construction method	Land acquisition required	Impact on local road network during construction	Future-proofing	
1	Route A	6: Offline (minor junction)	2: Links (Long Distance)	6: Improved cycle infrastructure	3: Minor bus priority at junctions	3: Slight Visual Impact	4: No Noise Impact	4: No Air Quality Impact	3: New widening and junction alterations	2: Medium decrease in biodiversity	2: Route has minor Impact on heritage areas	3: Route through green belt (smaller area)	4: No Impact or as existing	4: No Preference overall	1: New highway infrastructure and structure	4: Normal Construction methods	3: Land required	2: Medium Impact	4: No Impact on potential future proposed schemes	3.89
2	Route B	6: Offline (minor junction)	2: Links (Long Distance)	4: No Change	3: Minor bus priority at junctions	1: Significant Visual Impact	4: No Noise Impact	4: No Air Quality Impact	1: New highway infrastructure and structure	2: Medium decrease in biodiversity	1: Route has major Impact on heritage areas	3: Route through green belt (smaller area)	1: Significant interactions with other road users	5: Some stakeholder support	3: New widening and junction alterations	1: Significant disruptive construction required	3: Land required	1: Significant Impact	4: No Impact on potential future proposed schemes	3.22

Area 2 - M11 Junction																				
No.	Name	Criteria																		WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on Existing Traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Engineering feasibility - construction method	Land acquisition required	Impact on local road network during construction	Future-proofing	
1	Route A	2: Some shared running with some bus priority	2: Links (Long Distance)	6: Improved cycle infrastructure	1: Shared running	3: Slight Visual Impact	4: No Noise Impact	4: No Air Quality Impact	4: No Impact	3: Slight decrease in biodiversity	3: Route in proximity of heritage areas	4: No Impact	4: No Impact or as existing	4: No Preference overall	4: No Cost	4: Normal Construction methods	4: No Impact	3: Slight Impact	4: No Impact on potential future proposed schemes	3.61
2	Route B	7: Offline	2: Links (Long Distance)	6: Improved cycle infrastructure	3: Minor bus priority at junctions	1: Significant Visual Impact	4: No Noise Impact	4: No Air Quality Impact	4: No Impact	3: Slight decrease in biodiversity	3: Route in proximity of heritage areas	4: No Impact	1: Significant interactions with other road users	4: No Preference overall	1: New highway infrastructure and structure	1: Significant disruptive construction required	3: Land required	1: Significant Impact	4: No Impact on potential future proposed schemes	3.50

Area 3 - East M11																				
No.	Name	Criteria																		WEIGHTED SCORE FOR THEME
		Reliability of journey	Route flexibility - Links into existing bus routes	Walking and cycle connectivity	Impact on Existing Traffic	Environment impacts - Visual Impact	Environment impacts - Noise	Environment impacts - Air Quality	Environmental impacts - CO2 emissions	Environmental impacts - Biodiversity	Environmental impacts - Heritage	Environmental impacts - Green Belt	Safety	Public acceptability	Scheme Cost	Engineering feasibility - construction method	Land acquisition required	Impact on local road network during construction	Future-proofing	
1	Route A	3: Some shared running with significant bus priority	2: Links (Long Distance)	6: Improved cycle infrastructure	1: Shared running	4: No Visual Impact	4: No Noise Impact	4: No Air Quality Impact	4: No Impact	3: Slight decrease in biodiversity	2: Route has minor Impact on heritage areas	4: No Impact	4: No Impact or as existing	4: No Preference overall	2: New highway infrastructure	4: Normal Construction methods	3: Land required	3: Slight Impact	4: No Impact on potential future proposed schemes	3.56
2	Route B	3: Some shared running with significant bus priority	2: Links (Long Distance)	4: No Change	1: Shared running	1: Significant Visual Impact	4: No Noise Impact	4: No Air Quality Impact	4: No Impact	3: Slight decrease in biodiversity	2: Route has minor Impact on heritage areas	4: No Impact	1: Significant interactions with other road users	4: No Preference overall	2: New highway infrastructure	1: Significant disruptive construction required	3: Land required	1: Significant Impact	4: No Impact on potential future proposed schemes	2.83

B. INSET Justification Tables

B.1 Off-Road Justification Table

	Area 1 - Cambourne to Madingley Mulch		Area 2 - Madingley Mulch Roundabout		Area 3 - Coton Village		Area 4 - West Cambridge Development			Area 5 - Adams Road/Rugby Club	
Criteria	On Road	Offline	Blue	Pink	Blue	Pink	Blue	Pink	Green	Adams Rd	Rugby Club
Reliability of Journey	Section to be shared with existing traffic on St Neots Road. It is expected that this could affect the journey reliability. However impact is expected to be low as this section is not yet congested during peak travel times. This will need to be confirmed with traffic modelling.	Section to be completely segregated so it is expected that reliability of journey time is high.	Section to be completely segregated so it is expected that reliability of journey time is high.	Although the option is segregated due to the two junctions the first at Madingley Mulch roundabout and the second with Madingley road it is expected that the reliability of journey could not be as high as a completely offline route. Even with bus priority measures busses could be expected to slow down for each junction.	Section to be completely segregated so it is expected that reliability of journey time is high.	Section to be completely segregated so it is expected that reliability of journey time is high.	Section to be completely segregated so it is expected that reliability of journey time is high. There will be a junction with Ada Lovelace Road but as the road currently does not experience high volumes of traffic there will be a negligible impact. This will need to be confirmed with traffic modelling.	Section to be mainly segregated so it is expected that reliability of journey time is high. However there will be a section of shared running with existing traffic along Ada Lovelace Road but as the road currently does not experience high volumes of traffic, there is expected to be only a slight impact. This will need to be confirmed with traffic modelling. This route also has tight turning radii so it is expected to effect the speed of the route.	Section to be shared with existing traffic on Charles Babbage Road. So reliability could be dependent of traffic conditions and therefore the reliability is not as good as an offline options. This will need to be confirmed with traffic modelling. There is also a tight turn as you exit Charles Babbage Road which may effect the speed of the route.	It is expected that there will be negligible impact on reliability as the route will be shared with traffic on Adams Road but the road does not experience high levels of traffic. This will need to be confirmed with traffic modelling. The eastern section of Adams road will be a bus only route.	Section to be completely segregated so reliability of journey time is high.
Link in to existing bus routes	Existing bus route is along St Neots Road. However as the stop locations have not been confirmed for Cambourne or Hardwick it has been assumed that there is a medium distance between proposed and existing bus stops.	Existing bus route is along St Neots Rd. However as the stop locations have not been confirmed for Cambourne or Hardwick it has been assumed that there is a medium distance between proposed and existing bus stops.	There are no bus stops proposed on the new bus route in this area.	There are no bus stops proposed on the new bus route in this area.	There are no bus stops proposed on the new bus route in this area.	There are no bus stops proposed on the new bus route in this area.	There are a number of bus stops on Charles Babbage Road which is a short walk from this route.	There are a number of bus stops on Charles Babbage Road which is a medium walk from this route, in comparison with the blue route.	The route is along an existing bus route and provides good links to existing bus routes.	There are no bus stops proposed on the new bus route in this area.	There are no bus stops proposed on the new bus route in this area.
Cycle Infrastructure and Connectivity	There will be no change from existing.	There will be improved cycle infrastructure with a dedicated lane next to the route.	There will be improved cycle infrastructure with a dedicated lane next to the route.	Although it is proposed to have a dedicated cycle lane next to the route, traversing would likely cause delay to cyclists.	There will be improved cycle infrastructure with a dedicated lane next to the route.	There will be improved cycle infrastructure with a dedicated lane next to the route.	There will be link to the existing cycleway through West Cambridge.	There will be link to the existing cycleway through West Cambridge.	There will be link to the existing cycleway through West Cambridge.	There would be a slight impact on operation of existing cycle route as the Cambridge County cycle officers have indicated that this is a popular cycle route.	There will be improved cycle infrastructure with a dedicated lane next to the route.
Impact on Traffic	Although the route will be shared with other traffic it is in a non congested area so it is expected that there will be no significant impact on traffic. This will need to be confirmed with traffic modelling.	Small positive impact on traffic levels as there is a potential reduction achievable through mode shift. Needs to be confirmed through traffic modelling.	Small positive impact on traffic levels as there is a potential reduction achievable through mode shift. Needs to be confirmed through traffic modelling.	Significant impact on traffic as although there is a potential reduction achievable through mode shift, the route has two junctions with existing roads which may impact traffic due to bus priority measures. This will need to be confirmed with traffic modelling.	There will be no impact on traffic as the route is offline with a single junction with Cambridge Road. This will need to be confirmed with traffic modelling.	There will be no impact on traffic as the route is offline with a single junction with Cambridge Road. This will need to be confirmed with traffic modelling.	There will be a slight impact on traffic as although the route is offline it will have a junction with Ada Lovelace Road. This will need to be confirmed with traffic modelling.	There will be a slight impact on traffic as although the route is offline it has a short shared section with Ada Lovelace Road. This will need to be confirmed with traffic modelling.	There could be an impact on traffic as the route is shared with existing traffic on Charles Babbage Road. This will need to be confirmed with traffic modelling.	The option is shared running along Adams road so there could be an impact on existing traffic. Inbound traffic could be diverted down Sylvester Road and Herschel Road. This will need to be confirmed with traffic modelling.	The route will be segregated so there should be no impact on existing traffic.
Environment Impacts - Visual Impact	There is no change from existing.	Route would require additional infrastructure which could have a slight visual impact, it would also require the removal of trees and scrub in some areas. The bus route is also proposed to cross over the A428 on a new structure.	This route crosses open fields for the majority of the route. Passing buses would be visible from distance as are vehicles along the A1303 east of Madingley Mulch. The route will pass through the Waterworks site and vegetation removal here will have a slight visual impact, but with no sensitive receptors in this area the significance of this is low. The infrastructure itself has a low likelihood of being seen. Sensitive views from Red Meadow Hill could be mitigated through planting. Hedgerow planting would introduce a feature not out of place in rural area, and may reintroduce field boundaries not present now, which could be a minor improvement. Slightly shorter distance than the blue route.	The route crosses open fields for the majority of the route. Passing buses would be visible from distance as are vehicles along the A1303 east of Madingley Mulch. Sits slightly higher in the topography and therefore buses are more likely to be visible from Red Meadow Hill sensitive views. The infrastructure itself has a low likelihood of being seen. Hedgerow planting would introduce a feature not out of place in rural area, and may reintroduce field boundaries not present now, which could be a minor improvement. Slightly shorter distance than the blue route.	The alignment runs close to the village of Coton and there could be a visual impact of the route to first floor views from housing looking northwards along Whitwell Way. Crosses hillside approaching Coton at a lower elevation than the pink route, and distant views from the south (Red Meadows) are shielded by the village itself. As the route approaches Cambridge Road leaving the village on north side, it is relatively close to the boundary of the Conservation Area of Coton Village. There is an opportunity to landscape the route into the village to prevent the appearance of severance of the fields and islanding of land, as well as incorporating as part of the built up area, which would reduce the overall appearance. From Cambridge Rd to M11 the route is in orchard and wooded area so there is limited visibility from any direction.	The option although further from the village of Coton is higher up on the hill and due to the topography of the area may be more visible to a greater number of receptors, including from Red Meadow Hill and first floor properties in Whitwell Way. As the route is higher on the topography there will be greater visual impacts from Coton Village up to Cambridge Rd. From Cambridge Road the route is in the orchard/wooded area so less visible from any direction. Then for a short distance on the approach to the M11 the route will be visible from Rectory Farm to the north although this will be landscaped to minimise the impact.	There will be a slight visual impact as the route would be along an existing footway so although the area is developed the presence of a intermittent bus service along the route will create a new visual impact. There will also be a new structure over the existing pond but there will be significant new buildings in the area - increasing the urbanised nature of the area. However, where the route leaves West Cambridge and crosses Grange Field the route will be visible from neighbouring buildings to north. Distant views from the south will be limited by topography (views of passing buses).	Higher visual impact along the southern West Cambridge boundary along Coton Path (it will require Coton Path to be replaced) and crossing Grange Field the route will be visible from neighbouring buildings to north but limited for distant views from the south (Bus may be partially visible when passing). A greater potential visual impact than the Blue Route.	There will be no visual impact is this is already an existing bus route in the West Cambridge development. However, as with Blue and Pink routes the impact across Grange Field means the route will be visible from neighbouring buildings to north but only limited distant views. from the south (passing buses may be partially visible).	Localised hardening of landscape, especially in the vicinity of the boundary of the West Cambridge Conservation area adjacent to Cambridge Uni Sports Ground. No significant distant views. The impact on Adams Rd will be to remove on street parking which will change the character of the road scene itself and could be positive if it improves visibility of buildings along the road.	Introduction of new transport infrastructure in rural/urban setting on the city fringe with loss of trees will alter setting and character negatively. There will also be impact with a new junction on Grange road which will result in increased visual impact in the West Cambridge Conservation area and in vicinity of listed building opposite the exit onto Grange Road.
Environment Impacts - Noise	There is no increase due to the on-route option from existing road noise. Neutral impact	The route is in the immediate vicinity and between the existing A428 and St Neots Road. Any change in noise due to the buses would be negligible compared to existing road noise. Neutral impact	The route passes the end of residential property gardens near Madingley Mulch and passes south of the Crome Lea Business Park - but there are no receptors within 100m of route and the properties are closer to the existing noise sources along Madingley Road. So assess the impact is neutral.	The route passes between residential properties at Madingley Mulch and Crome Lea business park, but is generally 50 to 100m from any property wall. There will be a limited change to existing noise baseline on Madingley Road so assess the impact is low/neutral. Assess noise impact likely to be low/neutral	The bus route will introduce short duration and intermittent noise of low intensity. Properties within 50m to be considered as sensitive receptors along Cambridge Rd at Coton Village but this is mitigated by existing traffic on Cambridge Road and the noise from M11 traffic. Baseline noise will therefore be reasonable high relative to buses on the route. Assess noise impact likely to be low/neutral	The pink route is largely located away from any sensitive receptors. It does travel alongside the Garden Centre on Cambridge Road, but this is not considered a sensitive receptor and noise from the route would be intermittent. Assess noise impact likely to be neutral.	Low noise impact as the first section is through the West Cambridge development. Across Grange Field it will be open but there are no close residential properties. Assessed as Neutral.	The route passes along Coton Path on the south side of the West Cambridge development. However, the area is adjacent to the M11 and traffic noise from the motorway is not insignificant. Intermittent bus noise is deemed not significant in this setting but it will present an intermittent and localised noise intrusion on a rural setting in the Green Belt. The crossing of Grange Field is further from the M11 and M11 impacts are much lower, but the route is not near residential properties in this area. Assessed as low / neutral	Low noise impact as the first section is through the West Cambridge development. Across Grange Field it the route moves away from buildings and there are no close residential properties. Assessed as neutral.	Introduction of intermittent bus noise in the section from Grange Field to Wilberforce Road which is currently a relatively tranquil area. The route will pass a small area proposed as a village green, and the whole route is in the West Cambridge Conservation Area. So noise intrusion could change the nature of the setting in this area. Increase in traffic on Adams Rd close to properties but in already urban environment. Assessed as Low impact.	Increase in traffic in an area with no traffic and within 50m of the back of buildings belonging to Clare College. Low density of bus traffic which will be either slowing as approaching Grange Road, or gaining speed as leaving the city. Assessed as low impact.
Environment Impacts - Air Quality	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact	Due to low levels of traffic along the route there would be negligible changes in air quality. Assessed as neutral impact
Carbon	There will be no change from existing.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places but opportunities limited in West Cambridge. Could put in some landscaping in field to east of West Cambridge as compensation. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.	use of existing road network in West Cambridge for majority of route in this area means that embedded carbon is much less for this section. Potentially less opportunity for landscaping providing some offset along the route in West Cambridge. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as slight benefit on basis reductions in operational carbon would offset embedded carbon.	Use of existing road in Adams Road means less embedded carbon in the infrastructure than Rugby club road. Potentially less opportunity for landscaping providing some offset. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as slight benefit on basis reductions in operational carbon would more than offset embedded carbon.	There will be embedded carbon in the infrastructure which is likely to be increased carbon compared to on-route works. This will be offset by landscape planting increase CO2 capture in some places. Operational carbon is likely to reduce as vehicles become more carbon neutral - the assessment requires more detail on traffic from modelling. Assessed as neutral on basis reductions in operational carbon would offset embedded carbon.

Criteria	Area 1 - Cambourne to Madingley Mulch		Area 2 - Madingley Mulch Roundabout		Area 3 - Coton Village		Area 4 - West Cambridge Development			Area 5 - Adams Road/Rugby Club	
	On Road	Offline	Blue	Pink	Blue	Pink	Blue	Pink	Green	Adams Rd	Rugby Club
Biodiversity & Ecology	There will be no change from existing.	The new offline route would be through the Bourne airfield and between the A428 and St Neots Road this area although not an area of significant biodiversity or ecological significance it would require the removal of some trees and scrub. Assessed as slight loss in biodiversity	The new offline route would be through a field to the south of the roundabout. However, it is not believed to be an area of significant biodiversity or ecological significance. Loss of vegetation/scrub near Waterworks site but otherwise in open, arable land. Loss of habitat would be replaced by planting and infill of any isolated field areas to enhance area and create green corridor, hedgerows. Assessed as slight benefit in long term	The new offline route would be through a field to the east of the roundabout. However, it is not believed to be an area of significant biodiversity or ecological significance. Minor loss of habitat near Madingley Road but directed away from SSSI. Then through arable land. Possibility to enhance area and create green corridor, hedgerows. Assessed as slight benefit in long term.	The new offline route would be through a field to the north of Coton and through an orchard and then area of thick scrub approaching M11. To compensate loss of habitat consider compensation and enhancement of corridor by use of green lane concept. Also plan to develop a Community Orchard as in fill near Coton village Also potential for compensation planting near Rectory Farm has been discussed with land owner who is favourable. Assessed as neutral in long term.	The new offline route would be through a field to the north of Coton and through an orchard. However, it is not believed to be an area of significant biodiversity or ecological significance. Arable field, consider compensation and enhancement of corridor. Loss of habitat in orchard in approach to M11. Also potential for compensation planting near Rectory Farm has been discussed with land owner who is favourable but probably not enough to offset loss of scrub. Assessed as neutral in long term.	The new offline route would be to the south of the University West development and over an existing pond. However, it is not believed to be an area of significant biodiversity and the pond is believed to have low ecological significance. This route would result in the severance of the M11 County Wildlife Site, where there are records of protected species. Assessed as slight loss of biodiversity	The new offline route would be to the south of the University West development and over an existing pond. However, it is not believed to be an area of significant biodiversity and the pond is believed to have low ecological significance. This route would result in partial loss of the M11 County Wildlife Site and there are protected species in this area. There would be total Loss of Coton Path Hedgerows County Wildlife Site however, with slight route adjustments it may be possible to avoid taking the entire site, or possible to provide some mitigation along this corridor. Assessed as slight loss of biodiversity.	As this route starts east of the M11 County Wildlife site it has not specific impact on that site itself and there are no significant impacts to other habitats. Assessed as neutral	There will be a loss of ponds that are potential habitats for Great Crested Newts (European protected species). If these ponds are proven to be GCN habitats then alternative habitat must be provided. There will also be loss of urban woodland. Assessed as medium decrease in biodiversity	The new route will be along the rugby club road which is currently roughly paved with grass verges and trees. The route would require the verge and some trees to be removed. Impact on Bin Brook City Wildlife Site, likely crossing design would be a low bridge with no change to brook channel dimensions and with opportunity to include mitigation in the design. Impact on Trinity Meadows Loss of vegetation and trees with Tree Preservation Orders. There is potential for mitigation/enhancements possible in the area - to be determined at EIA stage. Assessed as slight impact in long term.
Heritage	There will be no change from existing. The impact is considered to be neutral.	There are no known heritage assets effected by this route. The impact is considered to be neutral.	The setting of the American Cemetery may be affected by this route but it is further away than the on-road option. The impact is considered to be neutral.	Archaeology - There are 3No. CHER entries around the Madingley Mulch roundabout that may be impacted by the route. Where practical the route would avoid these but if not then impact would be minor adverse.	Archaeology - There are several (potentially 2No.) CHER (Cambridge Historic Environment Record) entries in the path of the blue route. Heritage - The route is located in proximity to Coton Conservation Area and a number of listed buildings within Coton. This includes the grade I listed St Peter's Church. The blue route is closer to heritage assets than the pink route, however it is also set lower down, which may assist in limiting views from the Conservation Area and the Church. It is considered that any impact is likely to be less than substantial harm (having regard to NPPF para 134). The impact is considered to be minor adverse.	Archaeology - There is 1No. CHER entry in the line of the route. There is 1No. CHER entry on the southern option approach to the M11 that would be impacted. Heritage - This part of the route is located in proximity to Coton Conservation Area and a number of listed buildings within Coton. This includes the grade I listed St Peter's Church. The pink route is further north and has increased separation from the village of Coton and heritage assets than the blue route. However, it is also set on higher ground where views to the Church and the Church. It is considered that any impact is likely to be less than substantial harm (having regard to NPPF para 134). IN this area it is further from the boundary of Coton Village Conservation Area and has less impact on the conservation area as a result. The impact is considered to be minor adverse.	Archaeology - This area has been recently developed and therefore is it considered that through west Cambridge (so although there are 3No. CHER entries in the line of route these likely to have been previously disturbed by the development. There may still be unknown buried archaeology in Grange field which also has ridge and furrow recorded in the HER. It is considered that the impact is likely to be negligible or less than substantial.	Archaeology - This area has been recently developed and therefore is it considered that through west Cambridge, unlikely to be any heritage assets remaining unimpacted anyway, and any buried archaeology should have been recorded. There may still be buried archaeology in Grange field but Cambridge is subject to significant archaeological investigation so it may have already been investigated. Heritage - In relation to the setting of the Conservation Area and listed buildings within Cambridge, this part of the route will be viewed in conjunction with the West Cambridge development to the north. This area of the route is considered likely to have negligible/no impact on heritage assets. Across Grange Field, on initial review it is considered that this impact will be negligible or less than substantial harm on heritage assets. The impact is considered to be negligible.	Archaeology - This area has been recently developed and therefore is it considered that through west Cambridge, unlikely to be any heritage assets remaining unimpacted anyway, and any buried archaeology should have been recorded. There may still be buried archaeology in Grange field but Cambridge is subject to significant archaeological investigation so it may have already been investigated. Heritage - In relation to Grange Field the conclusions are the same as the Blue and Pink route, dependent upon which route option is chosen. Overall assessment is the impact is negligible.	Archaeology - no features of note in the CHER record. Heritage - This route is within Cambridge Conservation Area. It is considered that there may be some impact on the setting of the Conservation Area between the junction of Adams Road and Wiberforce Road. It is considered that this impact would be limited and would be likely to result in less than substantial harm to heritage assets (paragraph 74 of the NPPF). The assessment is minor adverse.	Archaeology - There is 1No. CHER entry and an east/west trending CHER entry that may be directly impacted by the line of route and it crosses the SW/NE trending Roman Road marked on OS Maps. Heritage - This route is adjacent to but outside of the Conservation Area, other than the far eastern part, which is within the Conservation Area. The main consideration in heritage terms is likely to relate to the impact of a new junction onto Grange Road, having regard to the setting of listed buildings along Grange Road. In particular consideration will need to be given to the grade II listed building opposite the bus way junction on Grange Road. It is considered that the route could result in less than substantial harm to heritage assets (paragraph 74 of the NPPF). The assessment is minor adverse.
Landscape - Green Belt	There will be no change from existing.	Negligible impact to green belt as majority of the route is outside greenbelt and the section in the greenbelt is between two existing roads.	As assessed by LDA the majority of this route would have no adverse impact upon the openness of the Green Belt. The eastern part nearer to Coton in the view of LDA may have some moderate impact upon the Green Belt, on the basis that this area slopes downwards towards Coton and that the bus way would require some cut & fill. This is considered by Strutt & Parker to be the worse case scenario. Assessed as being minor adverse.	As assessed by LDA the majority of this route would have no adverse impact upon the openness of the Green Belt. The eastern part nearer to Coton in the view of LDA may have some moderate impact upon the Green Belt, on the basis that this route will travel up a slope and will require a degree of cut & fill operation. This is considered by Strutt & Parker to be the worse case scenario. Assessed as being minor adverse.	This area of the route is within the Green Belt. As assessed by LDA the route option in this location is likely to have a moderate degree of harm to the Green Belt, which is considered by Strutt & Parker to be a conservative and worse case scenario. The Blue route is marginally preferred over the pink route in this area, being set lower down and less visible in the surrounding landscape. LDA identified the key issues relating to visibility of the bus route from the northern edge of the village, loss of agricultural land on this route given its closer proximity to the village and the area of land being less likely to be usable. Assessed as being minor adverse.	The site is within the green belt. As assessed by LDA the route option in this location is likely to have a moderate degree of harm to the Green Belt, which is considered by Strutt & Parker to be a conservative and worse case scenario. The pink route is marginally worse than the blue route in Green Belt terms, being set on higher ground and more visible in the surrounding landscape. Conversely, being set on higher ground there is additional space for agricultural land between the village and the busway, making this space more usable. Assessed as being minor adverse.	The western proportion of this route is not within the Green Belt. The eastern proportion of this route crosses Grange Field and is within the Green Belt. As set out in the report by LDA, the impact upon the Green Belt will vary significantly depending on the route option chosen. It should be noted that the alignment of route options have changed slightly in this area since the LDA report was commissioned, however the findings of their report remain valid and have been used to inform this section. The northern of the route options along Adams Road will have negligible harm to the Green Belt and the degree of harm will increase the further the route option is situated south through the central area of the field. In the view of LDA the impact will range from minor adverse (adjacent to Adams Road) to major adverse through the centre of the field. LDA are considered to have taken a conservative view. The intention is to manage the design so the impact is limited to minor adverse.	The western proportion of this route is not within the Green Belt. The eastern proportion of this route crosses Grange Field and is within the Green Belt. As set out in the report by LDA route options that directly cross Grange Field are likely to have a high level of impact upon the Green Belt within this section. This is considered by Strutt & Parker to be a worst case scenario. Both of the route options within the pink route are on this basis likely to have major adverse impact upon the Green Belt in the view of LDA. It should be noted that the alignment of route options have changed slightly in this area since the LDA report was commissioned, however the findings of their report remain valid and have been used to inform this section. LDA are considered to have taken a conservative and worse case view.	The western proportion of this route is not within the Green Belt. The two options around Grange Field are within the Green Belt, but will have significantly different impacts, accounting for the report by LDA. It should be noted that the alignment of route options have changed slightly in this area since the LDA report was commissioned, however the findings of the report have remained valid and have been used to inform this section. The first option, which is adjacent to Adams Road and the Sports Pavilion is likely to have a low degree of harm to the Green Belt, conversely the second option, which travels directly through Grange Field is likely to have the highest impact upon the Green Belt of all the options. The impact is therefore either likely to be negligible/minor adverse or major adverse, depending on the route selected.	The route is not within the green belt.	Part of this route is within the Green Belt towards the west, with the eastern part being situated within the City Development Boundary. The impact upon the Green Belt in this section is considered to be negligible.
Safety	It is expected that there will be no impact on safety as the route is as existing.	It is expected that there will be no impact on safety as the route offline.	It is expected that there will be no impact on safety as the route offline.	Although the route is not inherently unsafe it does have more junctions with existing traffic which increases the potential for road traffic incidents.	It is expected that there will be no impact on safety as the route offline.	It is expected that there will be no impact on safety as the route offline.	Although the route is not inherently unsafe it does have a shared section with existing traffic which increases the potential for road traffic incidents.	Although the route is not inherently unsafe it does have a shared section with existing traffic which increases the potential for road traffic incidents.	Although the route is not inherently unsafe it does have a shared section with existing traffic which increases the potential for road traffic incidents.	Although the route is not inherently unsafe it does have a shared section with existing traffic which increases the potential for road traffic incidents.	It is expected that there will be no impact on safety as the route offline.
Public acceptability	From the 2015 consultation the overall preference was for the offline route (Area 2 Central).	From the 2015 consultation the overall preference was for the offline route (Area 2 Central).	Although the results of the latest public consultation have not been received the initial consultation has shown there is no overall preference.	Although the results of the latest public consultation have not been received the initial consultation has shown there is no overall preference.	Although the results of the latest public consultation have not been received the initial consultation has shown there is a number of objections to this route and it's proximity to the village of Coton.	Although the results of the latest public consultation have not been received the initial consultation has shown there is no overall preference.	Although the results of the latest public consultation have not been received the initial consultation has shown there is no overall preference.	Although the results of the latest public consultation have not been received the initial consultation has shown there is no overall preference.	Although the results of the latest public consultation have not been received the initial consultation has shown there is some stakeholder support for this route.	Although the results of the latest public consultation have not been received the initial consultation has shown there is no overall preference.	Although the results of the latest public consultation have not been received the initial consultation has shown there is no overall preference. However, the Cambridgeshire County council cycling group have shown preference for this option.
Cost	There will be no change from existing.	There would be cost for new highway infrastructure and junctions.	There would be cost for new highway infrastructure but as the road will divert prior to the Madingley Mulch roundabout there will be no cost to alter the junction.	There would be cost for new highway infrastructure as well as junctions through the Madingley Mulch roundabout and Madingley Road.	There would be cost for new highway infrastructure and junctions.	There would be cost for new highway infrastructure and junctions.	There would be cost for new highway infrastructure and junctions.	There would be cost for new highway infrastructure and junctions.	There will be no change from existing.	There would be some minor infrastructure costs.	There would be cost for new highway infrastructure.
Land acquisition required	No land will be required as the route is on existing roads.	Land will be required for this route although the land is not in use or not suitable for development.	More undeveloped land will be required for this route compared to the pink route. However it is within the green belt.	Land will be required for this route. although the land is not developed. However it is within the green belt and nearer to a SSSI site.	Land required for this route. There is potential to cause severance to a small parcel of land owned by the orchard.	Land required for this route. There is potential to cause severance to the majority of land owned by the orchard.	Land will be required through the existing University West development.	Land will be required to the south of the existing University West development.	No land would be required. However, the land would be owned by the university.	No land would be required.	Land would be required from the rugby club.
Impact on local road network during construction	There will be no change from existing.	Due to the location of the offline route between A428 and St Neots Road there is expected to be some impact on the local road network during construction especially in areas where the existing road needs to be moved.	There could be some impact on St Neots road when the route crosses the existing road or St Neots road is stopped up near Madingley Mulch roundabout.	There could be a significant impact on the local road network due to required changes to the Madingley Mulch roundabout and the crossing of Madingley Road.	There could be minimal impact on the local road network as all work could be offline with minimal work required for the junction with Cambridge road.	There could be minimal impact on the local road network as all work will be offline with minimal work required for the junction with Cambridge road.	There could be minimal impact on the local road network as all work could be offline with minimal work required for the junction with Ada Lovelace Road.	There could be minimal impact on the local road network as all work could be offline with minimal work required for the junction with Ada Lovelace Road.	There could be minimal impact on the local road network as all work could be offline with minimal work required for the junction with Ada Lovelace Road.	As the road will be shared with existing traffic it is expected that there could be an impact on traffic during construction.	The route is offline so there will be no impact on local road network during construction.

Criteria	Area 1 - Cambourne to Madingley Mulch		Area 2 - Madingley Mulch Roundabout		Area 3 - Coton Village		Area 4 - West Cambridge Development			Area 5 - Adams Road/Rugby Club	
	On Road	Offline	Blue	Pink	Blue	Pink	Blue	Pink	Green	Adams Rd	Rugby Club
Future-proofing	There will be no change from existing.	The offline route provides opportunity for potential future schemes.	The route provides opportunity for potential future schemes.	The route provides opportunity for potential future schemes but the infrastructure around Madingley Mulch roundabout could cause issues.	The route provides opportunity for potential future schemes.	The route provides opportunity for potential future schemes.	The route provides opportunity for potential future schemes with minor changes.	The route provides some opportunity for potential future schemes but the non segregated sections could cause issues.	The route does not provide additional opportunity for potential future schemes due to the restrictions imposed by Charles Babbage Road.	The offline route does not provide additional opportunity for potential future schemes due to the restrictions imposed by Adams Road.	The offline route provides opportunity for potential future schemes with minor changes.

B.2 On-Road Justification Table

Criteria	Area 1 West of M11 junction		Area 2 M11 junction		Area 3 East of M11 junction	
	Route A	Route B	Route A	Route B	Route A	Route B
Reliability of Journey	Route has dedicated bus lanes from Madingley Mulch roundabout to the M11 junction and priority at major junctions. However the dedicated bus lanes are primarily inbound to Cambridge so the reliability of bus journeys outbound will be as existing.	Section to have dedicated bus lane from Madingley Mulch roundabout to M11 junction The lane is tidal, which means it would reverse during evening peak times so this will provide some journey reliability four outbound traffic from Cambridge.	Route has proposed shared traffic over the M11 junction with some priority at the junctions.	Route has a dedicated bus lane over the M11 junction. The lane is tidal, which means it would reverse during evening peak times so this will provide some journey reliability four outbound traffic from Cambridge.	Route has some areas of dedicated bus lanes and priority at major junctions. However it will still not be as reliable as an offline option. Also the dedicated bus lanes are primarily inbound to Cambridge so the reliability of bus journeys outbound will be as existing.	Section to be predominately shared after the M11 junction.
Link in to existing bus routes	Existing bus route is along St Neots Road and Madingley Road. However as the stop locations have not been confirmed it has been assumed that there is a Long distance between proposed and existing bus stops.	Existing bus route is along Madingley Road. However as the stop locations have not been confirmed it has been assumed that there is a Long distance between proposed and existing bus stops.	Existing bus route is along Madingley Road. However as the stop locations have not been confirmed it has been assumed that there is a Long distance between proposed and existing bus stops.	Existing bus route is along Madingley Road. However as the stop locations have not been confirmed it has been assumed that there is a Long distance between proposed and existing bus stops.	Existing bus route is along Madingley Road and University West development. However as the stop locations have not been confirmed it has been assumed that there is a Long distance between proposed and existing bus stops.	Existing bus route is along Madingley Road and University West development. However as the stop locations have not been confirmed it has been assumed that there is a Long distance between proposed and existing bus stops.
Walking and cycle connectivity	With the additional changes to the route it is proposed that the walking and cycle infrastructure is improved.	With the additional changes to the route it is proposed that the walking and cycle infrastructure is improved.	With the additional changes to the route it is proposed that the walking and cycle infrastructure is improved.	With the additional changes to the route it is proposed that the walking and cycle infrastructure is improved.	With the additional changes to the route it is proposed that the walking and cycle infrastructure is improved.	There will be no change from existing.
Impact on Existing Traffic	Priority will be given to buses at junctions which may result in a slight delay to existing traffic. However by improving bus reliability there could be a modal shift reducing the traffic on the existing route.	Priority will be given to buses at junctions which may result in a slight delay to existing traffic. However by improving bus reliability there could be a modal shift reducing the traffic on the existing route.	Priority will be given to buses at junctions which may result in a slight delay to existing traffic. There will also be shared running which may lead to increased congestion in these areas.	Priority will be given to buses at junctions which may result in a slight delay to existing traffic. However by improving bus reliability there could be a modal shift reducing the traffic on the existing route.	Priority will be given to buses at junctions which may result in a slight delay to existing traffic. There will also be shared running which may lead to increased congestion in these areas.	Priority will be given to buses at junctions which may result in a slight delay to existing traffic. There will also be shared running which may lead to increased congestion in these areas.
Environment impacts - Visual Impact	There will be some changes to junctions and possible land take to accommodate additional bus only lanes. This would require increase in the width in the corridor which would result in significant vegetation removal and therefore result in a slight visual impact.	Route would require gantries to control the tidal busway which will have a significant visual impact, it would also require the removal of trees and scrub in some areas. The bus route is also proposed to cross over the A428 on a new structure.	Removal of mature vegetation along the line of route will result in a slight visual impact.	Route would require gantries to control the tidal busway and a new structure to widen the bridge over the M11. This will have a significant visual impact.	Although there will be some changes to junctions and possible land take to accommodate additional bus only lanes the route is currently used for bus transit so there will be negligible visual impact.	Although there majority of the route is shared there are still sections after the M11 junction which will require gantries to control the tidal busway so there will be a significant visual impact.
Environment impacts - Noise	The receptors along the route will already be accustomed to traffic noise. However, is area passes Madingley American War Cemetery which is a highly sensitive receptor and any notable increase in noise should be reported.	The receptors along the route will already be accustomed to traffic noise. However, is area passes Madingley American War Cemetery which is a highly sensitive receptor and any notable increase in noise should be reported.	The receptors along the route will already be accustomed to traffic noise.	The receptors along the route will already be accustomed to traffic noise.	The receptors along the route will already be accustomed to traffic noise.	The receptors along the route will already be accustomed to traffic noise.
Environment impacts - Air Quality	No impact to air quality	No impact to air quality	No impact to air quality	No impact to air quality	No impact to air quality	No impact to air quality
Environment impacts - CO2 emissions	No discernible impact to embedded or operational carbon.	No discernible impact to embedded or operational carbon.	No discernible impact to embedded or operational carbon.	No discernible impact to embedded or operational carbon.	No discernible impact to embedded or operational carbon.	No discernible impact to embedded or operational carbon.
Environment impacts - Biodiversity	Widening of the corridor may remove trees and hence habitats. Also in this area the route passes Madingley Wood SSSI and any land take from the SSSI should be avoided.	Widening of the corridor may remove trees and hence habitats. Also in this area the route passes Madingley Wood SSSI and any land take from the SSSI should be avoided.	Widening of the corridor may remove trees and hence habitats.	Widening of the corridor may remove trees and hence habitats.	Widening of the corridor may remove trees and hence habitats.	Widening of the corridor may remove trees and hence habitats.
Heritage	The route is in proximity of the Cambridge American Cemetery and Memorial with the bus lane constructed in the verge area outside the American Cemetery. There are several (around 5No.) CHER Monuments along the roadside that may be impacted. The Cambridge American Cemetery is a CHER Monument and listed building.	The route is in proximity of the Cambridge American Cemetery and Memorial with the carriageway alignment constructed in the verge area outside the American Cemetery. There will also be a visual impact from the gantries. There are several (around 5No.) CHER Monuments along the roadside that may be impacted. The Cambridge American Cemetery is a CHER Monument and listed building.	There is 1No. CHER monument adjacent to the M11 Junction	There is 1No. CHER monument adjacent to the M11 Junction	There are around 4No. CHER Monuments along the roadside that may be impacted by the route. There are also several listed buildings along the road but it is likely that the setting of these is considered to be diminished already.	There are around 4No. CHER Monuments along the roadside that may be impacted by the route. There are also several listed buildings along the road but it is likely that the setting of these is considered to be diminished already.

C. Journey Time Assessment

Madingley Mulch Roundabout								
Data	Time	From	To	Direction	Average Journey Time (Seconds)			
					Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 0800	A428 Rbt	Cambridge Road	Eastbound	353	538	386	256
	0800 - 0900	A428 Rbt	Cambridge Road	Eastbound	1201	877	1028	200
	0900 - 1000	A428 Rbt	Cambridge Road	Eastbound	757	757	537	121
Average					770	724	650	192
AM (Bus)	0700 - 0800	A428 Rbt	Cambridge Road	Eastbound	152	202	154	142
	0800 - 0900	A428 Rbt	Cambridge Road	Eastbound	349	250	292	131
	0900 - 1000	A428 Rbt	Cambridge Road	Eastbound	284	291	227	133
Average					262	248	224	135
PM (All Vehicles)	1600 - 1700	Cambridge Road	A428 Rbt	Westbound	104	111	104	104
	1700 - 1800	Cambridge Road	A428 Rbt	Westbound	103	107	103	103
	1800 - 1900	Cambridge Road	A428 Rbt	Westbound	105	109	105	105
Average					104	109	104	104
PM (Bus)	1600 - 1700	Cambridge Road	A428 Rbt	Westbound	141	144	116	113
	1700 - 1800	Cambridge Road	A428 Rbt	Westbound	148	143	113	115
	1800 - 1900	Cambridge Road	A428 Rbt	Westbound	150	144	115	114
Average					146	144	115	114

Cambridge Road Junction								
Data	Time	From	To	Direction	Average Journey Time (Seconds)			
					Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 0800	A428 Rbt	M11 Jct 13	Eastbound	509	648	534	389
	0800 - 0900	A428 Rbt	M11 Jct 13	Eastbound	1512	1097	1280	328
	0900 - 1000	A428 Rbt	M11 Jct 13	Eastbound	951	849	690	221
Average					991	865	835	313
AM (Bus)	0700 - 0800	A428 Rbt	M11 Jct 13	Eastbound	206	270	219	225
	0800 - 0900	A428 Rbt	M11 Jct 13	Eastbound	397	307	349	190
	0900 - 1000	A428 Rbt	M11 Jct 13	Eastbound	332	352	287	200
Average					312	310	285	205
PM (All Vehicles)	1600 - 1700	M11 Jct 13	A428 Rbt	Westbound	147	176	147	147
	1700 - 1800	M11 Jct 13	A428 Rbt	Westbound	148	243	147	148
	1800 - 1900	M11 Jct 13	A428 Rbt	Westbound	149	253	150	148
Average					350	336	305	178
PM (Bus)	1600 - 1700	M11 Jct 13	A428 Rbt	Westbound	183	209	158	155
	1700 - 1800	M11 Jct 13	A428 Rbt	Westbound	191	289	155	158
	1800 - 1900	M11 Jct 13	A428 Rbt	Westbound	193	312	158	156
Average					189	270	157	156

M11 Junction 13								
Data	Time	From	To	Direction	Average Journey Time (Seconds)			
					Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 0800	Cambridge Road	P&R	Eastbound	275	181	220	173
	0800 - 0900	Cambridge Road	P&R	Eastbound	495	329	371	213
	0900 - 1000	Cambridge Road	P&R	Eastbound	335	149	225	131
Average					368	220	272	172
AM (Bus)	0700 - 0800	Cambridge Road	P&R	Eastbound	169	118	114	113
	0800 - 0900	Cambridge Road	P&R	Eastbound	206	121	129	103
	0900 - 1000	Cambridge Road	P&R	Eastbound	177	102	103	96
Average					184	114	115	104
PM (All Vehicles)	1600 - 1700	P&R	Cambridge Road	Westbound	84	114	91	89
	1700 - 1800	P&R	Cambridge Road	Westbound	97	281	107	107
	1800 - 1900	P&R	Cambridge Road	Westbound	96	334	102	101
Average					212	218	170	139
PM (Bus)	1600 - 1700	P&R	Cambridge Road	Westbound	83	99	76	76
	1700 - 1800	P&R	Cambridge Road	Westbound	96	226	77	81
	1800 - 1900	P&R	Cambridge Road	Westbound	95	289	77	77
Average					91	205	77	78

Park and Ride + High Cross Junction								
Data	Time	From	To	Direction	Average Journey Time (Seconds)			
					Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 0800	M11 Jct 13	West Cambridge Site	Eastbound	178	135	135	102
	0800 - 0900	M11 Jct 13	West Cambridge Site	Eastbound	248	175	185	153
	0900 - 1000	M11 Jct 13	West Cambridge Site	Eastbound	203	120	137	91
Average					210	143	152	115
AM (Bus)	0700 - 0800	M11 Jct 13	West Cambridge Site	Eastbound	205	121	118	100
	0800 - 0900	M11 Jct 13	West Cambridge Site	Eastbound	251	134	143	113
	0900 - 1000	M11 Jct 13	West Cambridge Site	Eastbound	213	109	113	99
Average					223	121	125	104
PM (All Vehicles)	1600 - 1700	West Cambridge Site	M11 Jct 13	Westbound	115	218	212	221
	1700 - 1800	West Cambridge Site	M11 Jct 13	Westbound	133	366	222	203
	1800 - 1900	West Cambridge Site	M11 Jct 13	Westbound	128	454	173	152
Average					125	346	202	192
PM (Bus)	1600 - 1700	West Cambridge Site	M11 Jct 13	Westbound	130	144	143	157
	1700 - 1800	West Cambridge Site	M11 Jct 13	Westbound	144	220	131	122
	1800 - 1900	West Cambridge Site	M11 Jct 13	Westbound	135	329	114	108
Average					136	231	129	129

Grange Road								
Data	Time	From	To	Direction	Average Journey Time (Seconds)			
					Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 0800	Storeys Way	Lady Margaret Rd	Eastbound	82	72	75	76
	0800 - 0900	Storeys Way	Lady Margaret Rd	Eastbound	112	98	91	107
	0900 - 1000	Storeys Way	Lady Margaret Rd	Eastbound	84	106	96	119
Average					93	92	87	101
AM (Bus)	0700 - 0800	Storeys Way	Lady Margaret Rd	Eastbound	96	71	72	91
	0800 - 0900	Storeys Way	Lady Margaret Rd	Eastbound	123	95	85	119
	0900 - 1000	Storeys Way	Lady Margaret Rd	Eastbound	95	108	93	125
Average					105	91	83	112
PM (All Vehicles)	1600 - 1700	Lady Margaret Rd	Storeys Way	Westbound	83	138	140	141
	1700 - 1800	Lady Margaret Rd	Storeys Way	Westbound	97	179	176	176
	1800 - 1900	Lady Margaret Rd	Storeys Way	Westbound	91	190	143	141
Average					90	169	153	153
PM (Bus)	1600 - 1700	Lady Margaret Rd	Storeys Way	Westbound	106	109	126	108
	1700 - 1800	Lady Margaret Rd	Storeys Way	Westbound	115	128	127	127
	1800 - 1900	Lady Margaret Rd	Storeys Way	Westbound	116	159	126	112
Average					112	132	126	116

Bus Lane Removal								
Data	Time	From	To	Direction	Average Journey Time (Seconds)			
					Option 1 Optimised	Option 7.1	Option 7.2	Option 7A
AM (All Vehicles)	0700 - 0800	West Cambridge	Storeys Way	Eastbound	77	74	74	74
	0800 - 0900	West Cambridge	Storeys Way	Eastbound	124	85	84	98
	0900 - 1000	West Cambridge	Storeys Way	Eastbound	76	76	74	85
Average					92	78	77	86
AM (Bus)	0700 - 0800	West Cambridge	Storeys Way	Eastbound	100	99	99	96
	0800 - 0900	West Cambridge	Storeys Way	Eastbound	126	102	100	105
	0900 - 1000	West Cambridge	Storeys Way	Eastbound	98	98	100	110
Average					108	100	100	104
PM (All Vehicles)	1600 - 1700	Storeys Way	West Cambridge	Westbound	74	118	107	118
	1700 - 1800	Storeys Way	West Cambridge	Westbound	75	144	95	85
	1800 - 1900	Storeys Way	West Cambridge	Westbound	74	249	80	74
Average					74	170	94	92
PM (Bus)	1600 - 1700	Storeys Way	West Cambridge	Westbound	86	249	88	86
	1700 - 1800	Storeys Way	West Cambridge	Westbound	86	151	98	91
	1800 - 1900	Storeys Way	West Cambridge	Westbound	86	116	109	116
Average					86	172	98	98

D. Supporting Reports

Date	Title of Report
June 2014	Madingley Road / A428 Corridor Study - Options Appraisal Report
June 2014	Report to Cambridgeshire County Council - Options Appraisal Report
June 2015	Madingley Road / A428 Cambourne to Cambridge Corridor Study - Interim Report
June 2015	Report to Greater Cambridge City Deal Executive Board – Corridor Study Interim Report
September 2015	A428 Western Corridor Study - Park and Ride Locations
February 2016	Cambourne to Cambridge: Better Bus Journeys - Consultation Report
March 2016	Report to Greater Cambridge City Deal Executive Board - Public Consultation Outcomes and Next Steps
June 2015	Madingley Road / A428 Cambourne to Cambridge Corridor Study - Draft Interim Report
June 2016	A428 study - Phase 2 - Park & Ride site locations
September 2016	Cambourne to Cambridge Better Public Transport Scheme: Strategic Outline Business Case
October 2016	Option Assessment Report for Cambourne to Cambridge Better Public Transport
October 2016	Report to Greater Cambridge City Deal Executive Board – Selection of a Catchment Area for detailed scheme development
April 2017	Cambourne to Cambridge Better Public Transport - Park & Ride Location Study
June 2017	Cambourne to Cambridge Better Public Transport - Options Assessment
July 2017	Cambourne to Cambridge Better Public Transport - Park and Ride Study
July 2017	Report to Greater Cambridge City Deal Executive Board - Further scheme development update
August 2017	Cambridge to Cambourne Busway (A428) – Planning Appraisal
September 2017	Cambourne to Cambridge Better Public Transport – End Stage Report
September 2017	Report to Greater Cambridge City Deal Executive Board – Approach to public consultation informing outline business case development

