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Chesterton Foot\Cycle Bridge

Option Study Report

November 2013

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Chesterton Foot\Cycle Bridge Option Study Report

Cambridgeshire County Council

November 2013

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SKANSKA

Table of contents

Chapter Page

SKANSKA

Appendices

Tables

Figures

Executive Summary

A number of potential development opportunities are being considered within the city of Cambridge, including Cambridge East, Cambridge Science Park Interchange and the Chisholm Trail. The latter could provide a relatively direct premier cycling route between the south and the north of the city. The Chisholm Trail route proposes a link between the Abbey and Chesterton districts, where there are few crossings over the River Cam. Consequently Cambridgeshire County Council commissioned Cambridgeshire Highways to develop a feasibility study to research delivery options for a foot and cycle bridge over the River Cam in the vicinity of the existing rail bridge.

This report considers the site and surrounding areas and the effects a bridge development may have upon it. The report also discusses the following issues with regard to a potential new crossing:

- The likely nature and volume of users
- Site constraints
- A “do nothing” option
- Bridge location and routes to it, both in construction and use
- Bridge options including different materials, shapes and connections to existing paths
- Cost estimates, programmes and risk

The study concludes with a discussion on the implications of a new crossing and a preferred option in terms of potential location, form, costs and risks for its construction. Recommendations are made on the early actions required to take the related construction project forward.

There is evidence to suggest that a new foot/cycle bridge may be of benefit in this location, with an estimated 3,000 daily trips expected upon it. A reduction in journey distances up to 1 mile, which represents a time saving of approximately 20 minutes for pedestrians and 5 to 7 minutes for cyclists, is anticipated. It could relieve pressures on nearby existing infrastructure, improve community links and provide opportunities for residents to use sustainable modes of travel, particularly with respect to anticipated growth from nearby planned developments.

A new 4.0m minimum clear width structure with a steel through girder main span, a straight stringer beam south approach ramp and a curved box beam north approach ramp is the recommended option. The bridge would be positioned in an area up to 60m to the east of the nearby railway bridge, but not attached to it, rest on piled foundations and cost about £4.4 million to design and construct inclusive of likely risk. This takes account of the views of the local community, requirements of current design standards, available space, the location of other nearby river crossings, user desire lines, third party implications, aesthetics, safety and future maintenance.

It is further recommended that particular areas of work are instigated early in the design process to help minimise and quantify the risks to the project. There are the usual construction risks, but there are also other potential risks from funding, planning, acquiring necessary rights, public consultation, procurement and third parties.

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1.0 Introduction

A number of potential development opportunities are being considered within the city of Cambridge, including Cambridge East, Cambridge Science Park Interchange and the Chisholm Trail are being considered. The latter could provide a relatively direct premier cycling route between the south and the north of the city. The Chisholm Trail route proposes a link between the Abbey and Chesterton districts, where there are few crossings over the River Cam. Consequently Cambridgeshire County Council commissioned Cambridgeshire Highways to develop a feasibility study to research delivery options for a foot and cycle bridge over the River Cam in the vicinity of the existing railway crossing near Chesterton (OS Grid Reference TL 474 601).

The bridge could be an important piece of infrastructure to link communities, and improve facilities and opportunities for local and outlying residents to use sustainable modes of travel. The closest river crossing is Green Dragon Footbridge, at a position 800m south west of the existing railway bridge. There is the A14 River Cam Bridge about 1.8km to the north east, but this has no provision for pedestrians or cyclists. The next pedestrian crossing to the north east is at Bait’s Bite, a further 500m away.

A new bridge in this location could be a significant benefit for access to the proposed Cambridge Science Park Interchange (CSPI), residents to the south of the River Cam and along the corridor of the railway. The bridge could also form a key part of the proposed Chisholm Trail, which is part of the overall cycling strategy within the city. This report mainly examines the feasibility and construction of the bridge and links to existing paths, but also gives some consideration to future links with the proposed the Chisholm Trail.

The report considers the existing site and surrounding area and the effects a bridge development may have on it. It also discusses the following issues with regard to a potential new crossing:

- The likely nature and volume of users
- Site constraints
- A “do nothing” option
- Bridge location and routes to it, both in construction and use
- Bridge options, including different materials, shapes and connections to existing paths.
- Cost estimates, programmes and risk

The study concludes with a discussion of the implications of a new crossing and a preferred option for it in terms of potential location, form, costs and risks for its construction. Recommendations are made on the early actions required to take the related construction project forward.

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2.0 The Site

2.1 The Existing Site

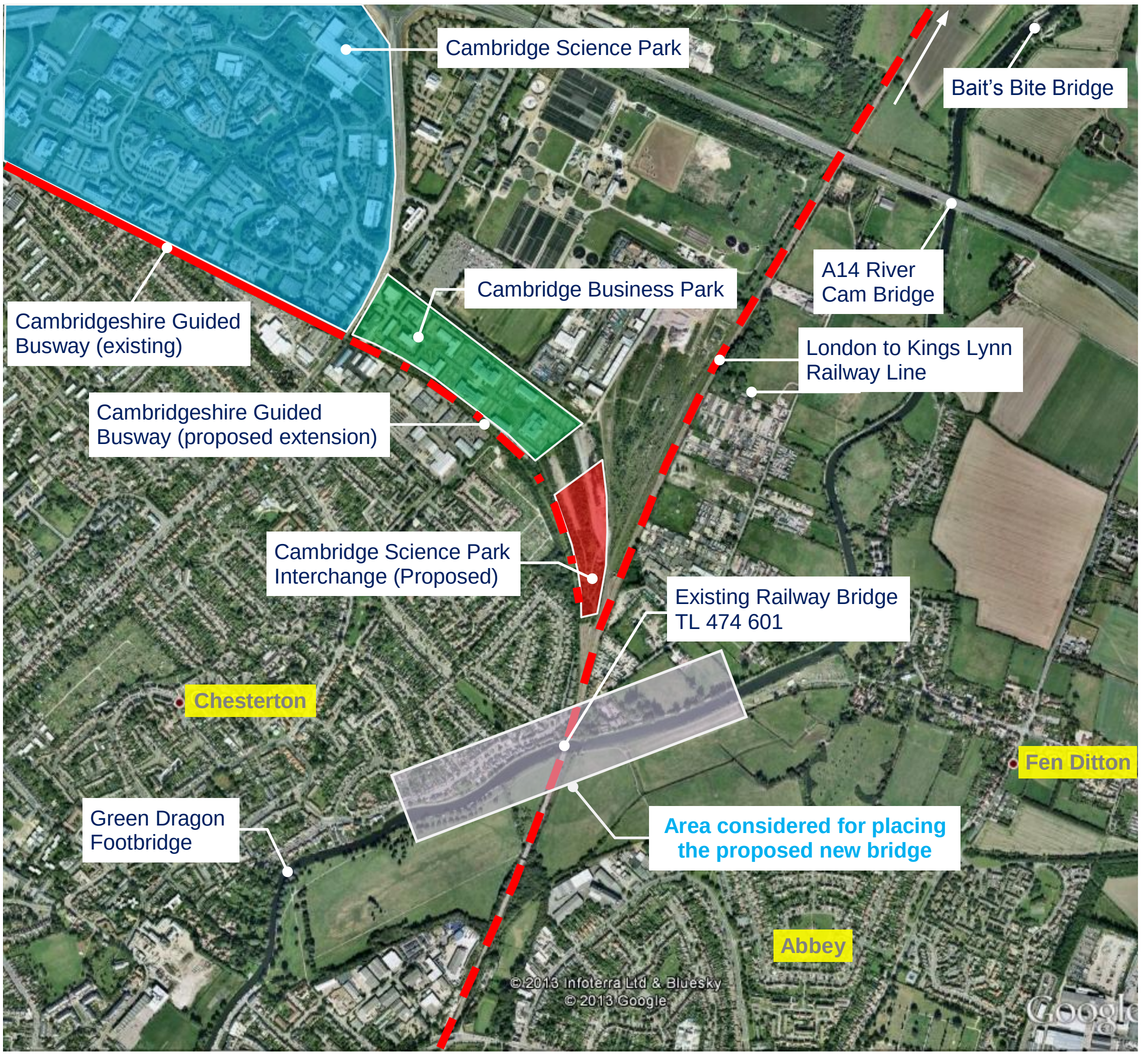

Figure 1 Aerial view of the surrounding area

The site for discussion is centred around a large existing sky blue and dark green coloured steel truss railway bridge located at OS Grid Reference TL 474 601. The potential location for the new bridge investigated in this study has been contained within a rectangular area approximately 500m along the river either side of the existing railway bridge. The closest crossing is Green Dragon Footbridge, at a position 800m south west of the railway bridge. There is the A14 bridge over the river about 1.8km to the north east, but this has no provision for pedestrians or cyclists. The next pedestrian crossing to the north east is at Bait's Bite, a further 500m away.

The railway bridge is bounded by the Chesterton residential area to the north west, and farms and private properties to the north east. There is an operational railway level crossing on Fen Road, approximately 85m north east of the railway bridge. The proposed Cambridge Science Park Interchange (CSPI), when built, will be just 250m to the north. A towpath, which is also used as a foot/cycle path, runs along the north bank of the river and is accessible from Fen Road.

To the south, the railway bridge is bounded by two large open green spaces, Stourbridge Common (south west) and Ditton Meadows (south east). A foot and cycle path runs along the south bank of the river leading from Newmarket Road to Abbey and Fen Ditton. However, the section towards Fen Ditton High Street is currently unsurfaced.

Other site details that place constraints on the options are included in Chapter 3.0.

2.2 Development Plans

The proposed bridge link is associated with other wider development plans which include the following:

- Cambridge East[1]

Cambridge East – the land north of Newmarket Road has been identified in the adopted 2013 Cambridge Local Plan and the South Cambridgeshire Local Plan as a location for a residential development of approximately 1,500 – 2,000 homes. There is the potential that this may be extended to adjacent areas at a later date.

- Chisholm Trail[2]

The 'Chisholm Trail' is a proposal for a premier cycling route running north to south, and is part of Cambridgeshire County Council's programme associated with Cambridge's Cycling Town status. The aim of the overall programme is to encourage continued growth in cycling as a means of travel for journeys within Cambridge and out to its necklace villages, by providing high quality infrastructure. The route would provide links between Addenbrooke's Hospital, south of Cambridge City centre, and the Science Park, north of Cambridge City centre, as well as enhancing links to schools, colleges, places of work, residential areas and open spaces throughout the city. In order for the land to be maximised to its full potential, the cycleway would also link communities, improving their access through the city. The new bridge would be a key part of the Chisholm Trail between Cambridge Rail Station and Cambridge Science Park.

The potential for a cycle route through the heart of Cambridge, adjacent to the existing railway line, was first proposed by the Cambridge Cycling Campaign in a series of articles in their Newsletter between April 1998 and April 1999. The articles are available on the Cambridge Cycling Campaign website at the following addresses:

- The Chisholm Trail Article 15, Newsletter 17 April 1998
  http://www.camcycle.org.uk/newsletters/17/article15.html
- An Economic Case for Better Cycleways Article 14, Newsletter 18, June 1998
  http://www.camcycle.org.uk/newsletters/18/article14.html
- The Chisholm Trail: The Outer Reaches Article 12, Newsletter 23, April 1999
  http://www.camcycle.org.uk/newsletters/23/article12.html

The proposals are for a route that follows the existing railway as closely as possible, either to the east or to the west, through Cambridge. According to Cambridgeshire County Council, it is expected that the route would be constructed over the next 5 to 10 years and would likely be built in discrete sections.

- Cambridge Science Park Interchange (CSPI)[3]

The Cambridge Railway Station located on Station Road is extremely busy and can be difficult to access by road during peak periods due to high volumes of traffic, narrow roads, limited parking facilities and its single entry location. Access to the station by walking or cycling is popular amongst the local population. It has been proposed by Cambridgeshire County Council to build a second railway station in the suburb of Chesterton approximately 3.4km north east of the existing railway station. The new station will be located at Chesterton Sidings, adjacent to the Cambridge Business Park and within walking distance of the Cambridge Science Park.

[1] *Cambridge Local Plan – Towards 2031, South Cambridgeshire Local Plan, Cambridge City Council/South Cambridgeshire District Council, January 2013*
[2] *Cambridge Cycling Campaign; Chisholm Trail Cycleway Option Assessment Report, Atkins, September 2009*
[3] *Cambridgeshire County Council Cambridge Science Park Interchange Planning Application*
http://planapps2.cambridgeshire.gov.uk/DCWebPages/AcolNetCGI.gov?ACTION=UNWRAP&RIPNAME=Root.PgeResultDetail&TheSystemkey=87379

The development includes the erection of a station building with passenger waiting facilities, toilets, ticket office, retail space, amenity space, rail staff accommodation and facilities. The development also includes two main line platforms and a bay platform with a footbridge (with lifts) providing access over the main lines and operational sidings from the station building to the platforms. External works include car (450 spaces) and cycle (1,000 spaces) parking and hard and soft landscaping. Vehicular access from Cowley Road and new pedestrian and cycle links to the surrounding area will also be constructed. The development will be linked to The Busway (which currently terminates at Milton Road/ Cambridge Science Park) by a short length of new busway. It is expected that the new station will relieve the operational pressure of the current central station by providing an alternative with better access and parking facilities, especially for cyclists. It is currently targeted that the interchange would be operational from December 2015.

2.3 Usage Assessment

This report has looked to establish the potential demand for a new combined foot/cycle bridge in the area by undertaking an assessment of journey to work data, traffic counts and national rail travel survey data with regards to the proposed interchange. The Technical Note is available within Appendix B detailing the methodology used.

The provision of a new foot/cycle bridge in the vicinity of the existing rail bridge would reduce journey distances by up to 1 mile, which represents a time saving of approximately 20 minutes for pedestrians and 5 to 7 minutes for cyclists.

The estimated numbers of trips across a new Chesterton Bridge link are shown in Table-1 below:

Component	One Way Total	Two Way Total
Existing Journeys to Work	165 – 590	330 – 1,180
Existing education, leisure, social and pleasure trips	500 – 1,800	1,000 – 3,600
Total Trips	**665 – 2,390**	**1,330 – 4,750**
Trips to CSPI	135	270
Total Trips with CSPI	**800 - 2,500**	**1,600 – 5,000**

Table-1 Estimated trips across new Chesterton foot/cycle bridge

Overall, the demand identified in Table-1 above shows that a range between 1,330 – 4,750 pedestrians and cyclists could use the new Chesterton Bridge depending on the proportion of ‘non walking/cycling trips’ that choose to change their trip mode and transfer to using the new pedestrian/cycle bridge. The demand range would be increased with the construction of the proposed interchange.

A value that falls within the middle of this range is considered most likely, at approximately 3,000 trips.

The provision of the Cambridge Science Park Interchange would increase demand by approximately 10% to 3,300 trips.

Green Dragon Footbridge, the only other nearby river crossing, currently carries approximately 3,500 crossings per day and has been the subject of many pedestrian and cyclist conflict debates. This is due largely to the bridge being narrow, having steep approach ramps, a tight gated entrance at its south end and it running straight on to other busy path areas to the south and a road to the north. It is expected that the construction of the proposed new bridge would reduce crossings on Green Dragon Footbridge significantly.

3.0 Constraints

There are a large number of constraints for the various locations and features of a new crossing within the considered area. This section of the report divides them into groups, through the use of sub-sections, as determined by their respective origins. Whilst all of the below could affect the choices for location, form, function, detailing and construction of any new bridge, the railway based constraints are likely to have the greatest effects. Greater detail of these should be acquired at an early stage of the project.

3.1 The Railway / Railway Bridge

Work immediately adjacent to a railway will impose various conditions upon the design, specifically:

- Any new permanent structure within 4.5m of the nearest rail would need to be designed for railway impact loading.
- Construction work carried out within 3.0m of the Overhead Line Equipment (OLE) would need special arrangements with Network Rail.
- Any excavation or vibration within 6m of railway infrastructure may require design approval by Network Rail. There could be structural implications to consider for the existing Network Rail bridge and embankments from adjacent footings or any attachments for a new bridge.
- Any permanent and temporary works that lie within the clearance envelopes of the railway would need to involve Network Rail as an additional Technical Approval Authority. This could lead to further design requirements.
- Changes to the originally desired choices for form, details, drainage or lighting due to further Network Rail requirements.

In addition, it raises potential concerns for the general public and railway operator. In particular, the railway operator may wish to address their own safety and security concerns. This may lead to a requirement to enclose any new structure that is close to the existing railway bridge.

Certain construction operations, such as craneage or piling, close to the railway will require track possessions. The associated costs could be significant and lead-in times will be at Network Rail's discretion and are expected to be 18 to 24 months on this line. Available working time windows within any track possession will be restricted and generally short. It may be that use of particular construction plant and methods, such as the smaller bored cased piling rigs, could limit the numbers of possessions required.

Future maintenance to any bridge immediately adjacent to the existing railway bridge may also result in track possession working and attract the associated costs and long lead-in periods.

The position of existing railway infrastructure on the north side also has implications:

- The level crossing on Fen Road is relatively busy and is closed to road, pedestrian and cyclist traffic for an average of 22m 45s per hour[4]. This would increase to 28m 23s per hour once Cambridge Science Park Interchange is built. In addition, Fen Road leading east from the level crossing is approximately 5.5m wide and has no verge on either side that would provide a safe off-carriageway location where passing pedestrians or cyclists could wait..
- The presence of existing OLE, signals, cables and buildings prevent the passage of a path immediately alongside the west of the railway, as can be seen in Figure 2 below. Consequently a path in this vicinity would require considerable land purchase from the adjacent private properties, possibly including parts of a private car park, beyond the railway land.

[4] *Cambridgeshire County Council Cambridge Science Park Interchange Planning Application – Transport Assessment* http://planapps2.cambridgeshire.gov.uk/DOCSOnline/6466_52.pdf

Figure 2 View from Fen Road level crossing looking south, showing OLE and buildings on west side

3.2 Land Ownership

Land ownership is shown on drawing no. 5123834/BR/LO/001 in Appendix C.

3.3 Design Criteria

3.3.1 Bridge Geometry

There are various geometrical requirements for foot/cycle bridges in current design standards:

- In terms of the required width, the requirements of LTN 1/12[5] are found to be more onerous than those in BD 29/04[6]. LTN 1/12 states that the preferred minimum effective width for an unsegregated cycle track is 3.0m. Additional 500mm horizontal clearances to vertical features above 600mm high, such as parapets, are also required. This leads to an overall minimum clear width of 4.0m for an unsegregated foot/cycle path on the bridge. Segregation would increase the minimum width further. It would be considered unwise to opt for less than the minimum width on a bridge that could link into a major cycling route in the future.
- Generally gradients on any footbridge ramp should be no steeper than 1 in 20. In addition, 2m long landings with a maximum rise of 2.5m between them shall be provided on any straight or spiral ramps. There are some provisions to increase the slope to a maximum of 1 in 12 if additional landings are introduced, provided that the rise between landings does not exceed 650mm.
- For spiral and curved ramps, the minimum inside radius of walkway, measured 900mm from the edge of the walkway surface on the inside of the curve, shall be 5.5m.

[5] *LTN 1/12 Shared Use Routes for Pedestrians and Cyclists, Local Transport Notes, Department for Transport*
[6] *BD 29/04 Design Criteria for Footbridges, Part 8, Section 2, Volume 2, Design Manual for Roads and Bridges, Department for Transport*

- In addition to the approach ramps, stairs need to be provided at convenient locations if the ramped access leads to a significant detour for pedestrians.

There are numerous options and associated design requirements for segregation, but they can be considered at a later stage in any design process. Thought also needs to be given as to how any new bridge could tie into existing or new paths at the bases of its approach ramps.

The current position of the river, existing tow paths and adjacent land boundaries and regions suggests placing a main span support between the tow path and the river on the south side and to the north of the tow path on the north side. This leads to a main span length of approximately 40m if it is placed square across the river.

3.3.2 Parapets

Parapets of 1.40m minimum height are required on a combined pedestrian and cycle bridge.

3.3.3 Drainage

Provision for the drainage of water from the footbridge should be made through adequate falls and suitable detailing. Statutory undertakers' plans suggest that the connection of any bridge drainage into highway drains is unlikely to be permitted as the highway drains then outfall into the river. This would probably be of concern to the highway drainage owner and the Environment Agency in the event that the route would be salted in future. It is likely that any drainage system would have to drain into new soakaways away from Network Rail assets. Alternatively the provision of open flooring could be considered.

3.3.4 Lighting

The bridge would be located in an area where public lighting is not currently provided. Hence appropriate lighting is recommended to assist in improvements to the personal security of users.

Local residential properties will drive a requirement to minimise light pollution.

3.3.5 Foundations

There is currently no soils information and thus it is essential to commission a full ground investigation including with boreholes. Given the proximity of the river and the very poor ground conditions encountered in the top strata during the construction of other nearby bridges, it is considered that the soil will be of very low strength. Hence piled foundations are expected.

The area of Common that runs along the base of the railway embankment to the south east of the existing railway bridge was noted to be quite boggy during site visits.

3.3.6 Technical Approval Procedures

The permanent design and potentially some elements of temporary works design will require Technical Approval to BD2/12[7] or the equivalent Network Rail procedures.

3.4 Community Engagement

A drop-in session was held in Chesterton, Cambridge, on 19th July 2013 to provide residents and local groups the opportunity to give feedback on the potential new crossing. An estimated 70 people attended attended and there were 40 responses. The responses suggested:

1. There is public support for a bridge at Chesterton, though a small number of residents had concerns over the visual aspect of a bridge and the potential impact on the local environment.
2. There is a preference for a bridge to be located to the east of the railway line. Given the location of the drop-in session this is not unexpected, as local feeling was to develop the bridge away from local housing.

[7] *BD2/12 Technical Approval of Highway Structures*

3. No clear preference was indicated for the type of bridge span, but it was suggested:
    - A steel bridge was preferred over other materials.
    - It should be wide enough for two-way traffic and pedestrians.
    - Access for the bridge should be from the tow path on the north side
    - The colour should closely match the rail bridge in order to reduce the visual impact.
4. The paths on the south of the river may benefit from being widened to support extra cycle traffic.

The Friends of Stourbridge and Coldham's Common were represented at the drop-in event and were concerned that a bridge in this location could negatively affect these areas.

During a visit to the area, it was noted that there were signs of antisocial behaviour in and around a concrete pill box, located to the north east of the existing railway bridge, with drug and alcohol materials apparent. This needs to be considered as part of the overall proposals.

3.5 Construction Access and Site Location

Existing features for potential construction access routes are shown on drawing reference 5123834/BR/SC/001 in Appendix C. All access routes considered will require permission from the land owners.

Any access from the north side of the river may involve either travelling along the river itself or the north towpath. The only potential access routes to the bridge area on the north side of the river are:

- Route A – from some parking bays to the east of the closed former Penny Ferry public house and then east along the north towpath, provided that this area is not redeveloped soon.
- Route B – through a narrow alleyway, approximately 4m wide, from Fen Road and then east along the north towpath. The exact land boundaries to this alleyway are difficult to establish, but it is thought likely that only narrow construction plant and vehicles will be able to pass through it.
- Route C – through the northwest corner of the Hayling House plot. This would involve a temporary land licence for access through an area inside the property's boundaries.

There are four potential access routes across Ditton Meadows, all of which include a considerable haulage distance across it:

- Route D – from Newmarket Road along a narrow strip of land, some of which is heavily wooded, to the west side of Coldham's Brook. A temporary crossing would have to be built across the brook and the disused Cambridge to Mildenhall branch railway line. The residents near to the Leper Chapel of St Mary Magdalene are very sensitive to any changes to this area.
- Route E – through the yards of one of the industrial properties between Beadle Industrial Estate and Ronald Rolph Court, on the north side of Ditton Walk. A temporary crossing would have to be built across a small watercourse on Ditton Meadows and/or the disused Cambridge to Mildenhall branch railway line.
- Route F – along a narrow alleyway from the north of a footpath which starts where Ditton Walk and Wadloes Road meet. However, it is again thought likely that only very narrow construction plant and vehicles will be able to pass through it. A temporary crossing would have to be built across a small watercourse on Ditton Meadows.
- Route G – along a steep and twisting unsurfaced vehicular route from the end of Fen Ditton High Street that is currently used for transporting boats during regattas. Two temporary crossings would have to be built across small watercourses on Ditton Meadows.

There are also two potential access routes across Stourbridge Common, again involving a considerable haulage distance across the Common:

- Route H – along Mercers Row to its east end and through the recycling depot yard at the end of it. A temporary crossing would have to be built across a small watercourse on Stourbridge Common.
- Route I – from the north end of Oyster Row. A temporary crossing would have to be built across a small watercourse on Stourbridge Common.

All existing approach paths on both sides of the river and the Common itself are of unknown load carrying capability for construction vehicles, but they are all likely to be inadequate for at least the larger plant. So there is a choice to be made between using and maintaining existing paths or building a new access route.

There is only about 2.7m headroom above the north towpath and 3.0m headroom above the river, as measured from normal water retention level, at the position of the existing railway bridge. There is the timber “Railway Jetty” structure, which would be too narrow and of negligible load carrying capability for construction plant, which runs underneath the south end of the railway bridge. No other current foot, cycle or vehicular route exists under the south end of the railway bridge. Construction of another structure for access purposes would be expensive and may result in even less headroom. Furthermore, it would reduce the available width for navigation in this busy stretch of river. Consequently it is thought that the access route would probably be placed on the same side of the existing railway bridge as the new bridge.

3.6 Visual Impact

Stourbridge Common and Ditton Meadows form part of a green wedge which penetrates to the heart of Cambridge, giving a pleasant setting. They form a more rural parkland area than other parts of the Central Conservation Area in Cambridge, as they are well screened by low buildings at the edge. A backcloth of trees also surrounds the open commons to the south, softening and at times hiding the built-up areas beyond. Mature trees criss-cross the commons and willows follow the river on its north side.

The Common and Meadows are bounded by the River Cam, residential areas and a disused railway line. The operational Cambridge to Ely railway line splits Stourbridge Common and Ditton Meadows and crosses the river with a large industrial-style steel truss railway bridge. This existing bridge and the overgrown vegetation on its approach embankments are a significant detractor from the surrounding tranquil parkland and river scene, as can be seen in Figure 3 below. Hence it is felt that any new river crossing should have a low visual profile and sit within the visual envelope of the existing railway bridge, so as to not further affect the setting of this area significantly. A landmark type structure will not achieve this.

Figure 3 View across Ditton Meadows towards the existing railway bridge (from the south east)

3.7 Utilities

Enquiries have been made regarding the likely presence of any services in the vicinity of the proposed bridge. Based on the information received from the relevant statutory undertakers, the following services have been identified within a zone of approximately 250m diameter, centred on the railway bridge:

- BT underground plant
- Virgin Media plant
- Anglian Water foul sewer and surface sewer
- UK Power Network underground plant
- National Grid low pressure gas main

Most of the utilities run along Fen Road and further towards the residential streets to the north. Therefore, no significant constraints are envisaged for most of them, but this should be verified by further investigations early on in the design process. The one exception is the presence of a surface water sewer, which runs underground across where a ramp would have to run for an option with a new bridge attached or close to the west side of the existing railway bridge.

Known utilities are shown in Drawing No. 5123834/BR/LP/001 in Appendix C.

3.8 Heritage, Ecology, Environment & Other Third Parties

There is a concrete pill box and associated blast wall located approximately 40m to the north east of the centre of the existing railway bridge in an area of existing trees. Consultation with Cambridge City Council has determined that the pill box is one of a series built along the river bank during the Second World War. However, it is not a Listed structure. Site visits have confirmed that there is insufficient space to fit an approach ramp between the railway and either the blast wall or pill box. Nevertheless, whilst the pill box would not be able to be incorporated as part of the bridge structure, it is possible it could remain within the footprint of the ramp, perhaps as a feature.

An initial ecological investigation[8] has identified that the area of interest for the proposed bridge falls within the River Cam County Wildlife Site, Ditton Meadows City Wildlife Site (along the south river bank) and Stourbridge Common Local Nature Reserve (south west corner). Mitigation measures are often required for working within designated sites. Wildlife that could potentially be affected includes nesting birds, bats, great crested newts, badgers, otters and water voles. Further surveys will be necessary to confirm the presence of the species on site. For full details refer to Appendix D.

The proposed site is within the Riverside and Stourbridge Common Area of the Central Conservation Area in Cambridge. There are a large number of trees within this area and any removal or pruning will require agreement with Cambridge City Council, albeit it is currently thought that none of them are subject to Tree Preservation Orders. In particular, there is the line of mature willows along the north side of the north towpath.

The area of interest for the proposed bridge also falls within a flood plain and passes over a main river. Hence Environment Agency consent for the works will be required. The Environment Agency's exact requirements are not clear at this stage, but it is thought likely that it will include requirements to mitigate any effects from a new bridge on river flow or flood storage. This is likely to result in any approach ramps having to be of an open construction. This stretch of the River Cam is regulated by Baits Bite Lock approximately 2.5km downstream and Jesus Lock approximately 2.5km upstream, which reduces its risk of flooding.

The Conservators of the River Cam are responsible for navigation. This particular stretch of watercourse carries a lot of narrow boats and rowing boats and is within the racing stretch for most river events. Any works affecting navigation, either permanently or during construction, will require their consent and a Navigation Order. As such, it is thought that the soffit of the main span of any new bridge will not be permitted to be lower than the soffit of the adjacent railway bridge. In addition, historic experience has suggested that any construction approach paths to the bridge may have restrictions in terms of materials and construction methods. Checks will need to be made to understand if any adjacent moorings will be affected by the new bridge during its construction.

3.9 Planning Requirements

The new foot/cycle bridge will require planning permission. It is currently estimated that the planning application will take roughly 7 months to prepare and that a further 4 months will be required for its determination, as experienced on other recent projects. However, these timescales represent a current best estimate and could vary considerably. In particular, the determination could extend to two or three times the above period.

3.10 Health and Safety

The Construction Design and Management (CDM) Regulations apply and the various duty holders (client, CDM co-ordinator, designers and contractors) will have to fulfil their obligations. In particular in the early stages, the client shall appoint competent persons, ensure appropriate management arrangements and resources and provide pre-construction information. Designers shall eliminate hazards and reduce risks, both as far as is reasonably practicable, during their design and provide information about remaining risks.

[8] *Ecological Constraints Memo, Chesterton, Atkins, September 2013*

4.0 Bridge Location

Six possible bridge locations have been considered, as shown on drawing reference 5123834/BR/LP/001 in Appendix C. Options further to the west have not been investigated as they are considered too close to the nearby Green Dragon Footbridge, thus offering little time-saving to the user as an alternative route. Options further to the east have not been investigated as they are considered too far from the user desire line, thus probably reducing the potential use:

- Location 1: Standing alone between 60m and 250m to the west of the existing railway bridge
- Location 2: Standing alone up to 60m to the west of the existing railway bridge
- Location 3: Attached to the west elevation of the existing railway bridge
- Location 4: Attached to the east elevation of the existing railway bridge
- Location 5: Standing alone up to 60m to the east of the existing railway bridge
- Location 6: Standing alone between 60m and 135m to the east of the existing railway bridge

Locations 3 and 4 would result in numerous additional design and construction criteria from Network Rail, some of which might alter the desired choices for form, details, operation and maintenance. Consideration would have to be given to the effects on the existing railway bridge, its foundations and embankments. These criteria are likely to complicate, prolong and add risks to the design and construction processes. There will also be additional costs and programme constraints associated with these options, resulting from issues such as the need to enclose the bridge, additional possession working and restrictions on methods of working. Furthermore, future maintenance of bridges at these locations may result in increased possession working and whole life costs. These associated costs and lead-in times could be prohibitive and indefinable. Consequently it is felt that neither of Locations 3 and 4 would be cost effective options and they have not been considered any further. Locations 2 and 5 will result in reduced railway-related requirements and possession working from Network Rail and locations 1 and 6 will largely preclude them altogether.

Of the remaining options, Locations 1, 2 and 6 would all place any north approach ramp along the north towpath region. This will be within view of neighbouring properties, block the accesses behind them properties and is likely to lead to objections.. Location 5 will largely avoid this issue but will place the north approach ramp in the triangular area of woodland to the north east of the existing railway bridge, which is of slightly awkward shape. The land at locations 1, 2 and 6 is wide enough to accommodate a new ramp without any private land purchase, but location 6 would result in some re-positioning of the towpath, albeit it would still then be no closer to the river than at other locations. All of these locations would result in the removal of a large length of the existing line of willow trees. Location 2 will limit the choice of main span positions, as the north ramp length will be limited, and may also result in moving one of the ramp support foundations so that it fits around an existing surface water sewer.

The construction of the south approach ramp for options 2 and 5 may be restricted by the adjacent “Railway Jetty” structure. In addition, the area at the base of the railway embankment on the south east corner of the existing railway bridge is boggy, making it a less desirable area in which to land a bridge.

Location 1 would be considerably closer to the nearby Green Dragon Footbridge and would divert pedestrians and cyclists further from the desire line for the crossing than the other options. Locations 1 and 6 would also be a considerable distance from the existing railway bridge, which would tend to affect the setting of this area on the south approach more adversely than options closer to it.

It has been assumed that all ramps would also have stairs from their top down to the towpath, as this could lessen the desire line distance for pedestrian users of the bridge. It will probably not be possible to fit stairs to the north ramp for Location 2, but this is not considered significant as they would not shorten the desire line distance.

All locations would lead to considerable construction access difficulties, as the existing paths on either side of the river are narrow and unlikely to be capable of taking the loads from construction vehicles. Alternative paths may have to be provided during construction, should the existing paths be closed. While all potential bridge locations and associated construction access routes would need to be considered, this is not thought to be a key factor in influencing the choice of bridge location.

In summary:

- A bridge attached to or close to the existing railway bridge attracts complexities, costs and maintenance issues from Network Rail. Hence it is unlikely to be cost effective
- Ramps at some locations would be visually intrusive to property owners to the north
- A bridge at a location too far from the existing railway bridge would either be close to other nearby bridges or too far from the desire line for the crossing to be used. It would also affect the setting of this area on the south approach more adversely than options closer to the railway bridge

Hence Location 5 is considered the most suitable bridge location.

5.0 Bridge Options

This section of the report considers the potential materials available for the various elements of a new bridge and the construction forms available for both the main span and the ramps. Thought is then given to the longer term maintenance and durability aspects of any new structure.

At this stage it has been assumed that the support for the main span is most likely to be positioned to the north of the towpath on both sides of the river. This is because there is space to fit it between the existing towpath and the river on its south side, but not on its north. Re-aligning the north towpath would worsen cyclist visibility. Hence, the square distance between these two supports would be approximately 40m. It has also been assumed that a 4.0m minimum clear width foot/cycleway, 1.4m high steel parapets and an appropriate lighting system, possibly low level bridge mounted or studs, is present on all options and that colours will be chosen to match the existing railway bridge.

It is likely that the existing ground conditions will be poor. This will affect the routeing of heavy plant to site, the foundations and the construction of various elements. At this stage it has been assumed that a new haul route will be constructed from the industrial properties on the north side of Ditton Walk across Ditton Meadows, including a crossing of one small watercourse and the disused railway line, to the new bridge location (as per Route E). This is currently thought likely to be the shortest available route of suitable width and height for all construction vehicles from the surrounding area to the bridge. It also runs close to the desire line for the Newmarket Road to Cambridge Science Park part of the proposed Chisholm Trail. This leads to the potential for sections of the haul route to be re-used in the base of a new foot/cycle path, should it be built. Given the likelihood of poor ground, it has also been assumed that all foundations for any new bridge and its ramps will be piled, probably to considerable depth in the case of the main span.

Launch installation of the main span has been discounted due to construction practicalities. Any back span used as counterweight will be more difficult to manoeuvre if it is curved and will need to be continuous with the main span. This will greatly limit the choices available for ramp options. Alternatively, a temporary pier will need to be erected in the river, which is unlikely to be acceptable in terms of navigation. Jacking installation of the main span has also been rejected as this is thought unlikely to be acceptable for navigation reasons. Both of these options are also thought likely to cost more than a craneage option. In the case of craneage for the main span, it has been assumed that deep crane pads will have to be built.

There are various options available for the fabrication of the main span in terms of the sizes of sections and place of construction. This could vary from a “kit built” type structure, which is delivered in a series of small parts and connected together on site, through to a single element main span, which is entirely pre-fabricated off site. Smaller, lighter vehicles could be used to transport the small parts of a “kit built” type structure than those utilised for the transport of a single main span element. These smaller vehicles could fit through narrower roads with tighter bends on approach to the Common areas and could then use a narrower haul route of lesser load carrying capability across the Common than vehicles used for transporting a single entire main span element. However, a wider, heavier duty haul route would still eventually be required for the passage of the crane required to lift the fully assembled main span. A crane is thought more likely for the main span assembly than extensive scaffolding in the watercourse because of the resulting restrictions on navigation from the latter.

Pre-fabrication of elements off site would lead to better quality controls, reduce time on site and reduce any environmental impacts. Hence it is thought likely that the element sizes used on the main span would be maximised to what is practical in terms of transporting on a normal road network. This may later need to be tailored to fit around any local dimensional constraints resulting from the access routes chosen to site.

5.1 Construction Materials

There are various potential materials available for the construction of the main elements of a new bridge. However, it is important to recognise that some can be rejected swiftly for the following reasons:

- While it has been described as environmentally friendly, timber has relatively poor durability, especially if water is not carefully managed. This would result in increased maintenance and earlier replacement for any timber elements. In addition, timber is not structurally efficient and so any spans would tend to be very deep.
- Steel and carbon fibre composites are an emerging technology and require high quality workmanship during their construction by a specialist contractor. As they are relatively untested they are not thought to be a suitable material choice for a new bridge with a 40m main span.

This leaves concrete and steel. Concrete elements would be heavy when compared to steel alternatives, which would lead to increased haulage requirements for materials, larger foundations and increased craneage requirements, all with increased costs and environmental implications. With the exception of weathering steel, steel is more susceptible to earlier deterioration than concrete, through its vulnerability to corrosion and would require regular maintenance painting. Choosing weathering steel would enforce a rusty brown colour and lead to maintenance difficulties in the removal of graffiti. Graffiti would adhere more strongly to the porous surface of weathering steel and its removal would result in loss of the protective rust coating.

Hence it is felt that the most appropriate choice would be to use painted steel deck elements and supports with concrete foundations. The exception would be the potential use of concrete supports at the ends of the main span if economic and at the abutments, where all elements are close to ground level. There would also be reduced maintenance associated with the use of stainless steel in any fixings or parapet wires.

5.2 Main Span Options

The following section provides information on three main span options with relatively low visual profiles to blend into the existing environment sympathetically. Further details are shown on drawing reference 5123834/BR/FS/001 in Appendix C. Pictures of existing similar bridges are shown in Appendix E.

5.2.1 Main Span Option 1 – Steel Truss

A truss option has a superstructure consisting of interconnected straight members, forming triangular units. A proposed truss bridge at this site would have an overall construction depth of approximately 3.75m, with about 0.3m below the foot/cycleway running surface. The parapets would sit within the truss construction.

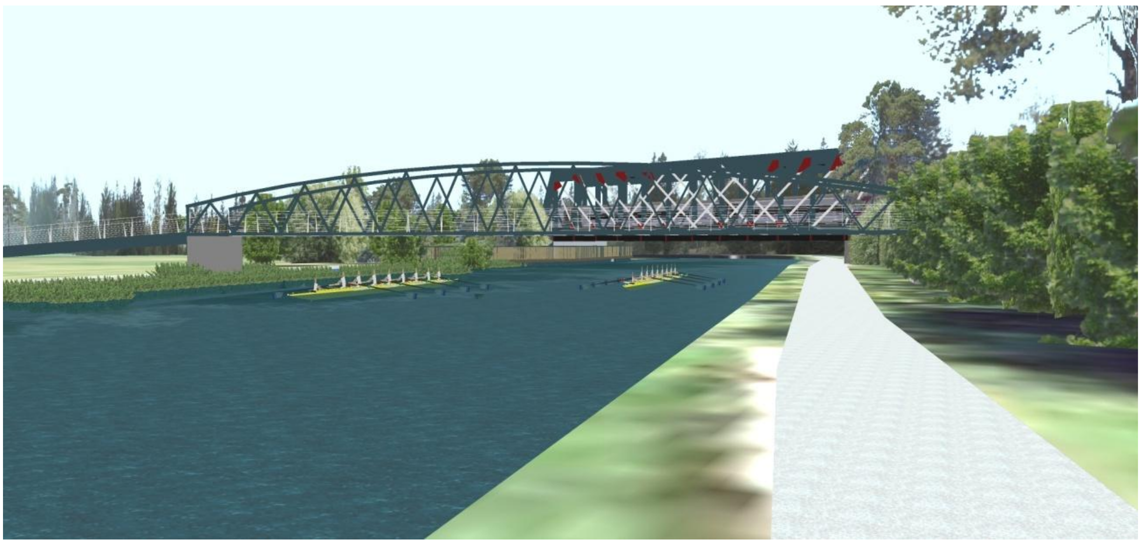

Figure 4 Computer illustration of the proposed foot/cycle bridge main span in truss form with the existing railway bridge in the background

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5.2.2 Main Span Option 2 – Deck on Steel Beam / Box Girder

A deck on steel beam or box girder option comprises either a reinforced concrete deck slab on multiple I-girders or a steel deck plate as part of an overall steel box. This option would have a deck depth of approximately 1.75m below the foot/cycleway running surface and parapets sitting on top of it.

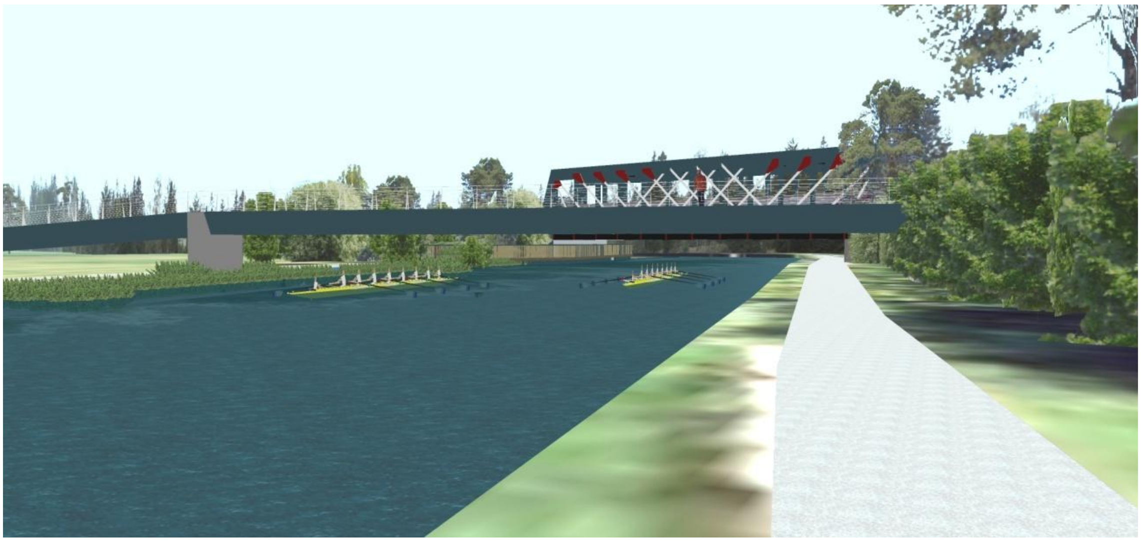

Figure 5 Computer illustration of the proposed foot/cycle bridge main span in box-girder form with the existing railway bridge in the background

5.2.3 Main Span Option 3 – Half Through Girder

A half through girder option is one where the foot/cycleway running surface sits well down inside a pair of 1.5m deep main load carrying members (typically deep and stocky I-girders). The girders thus comprise part of the parapets, with the rest made up by longitudinal rails. As with the truss option, only about 0.3m of deck construction would sit below the foot/cycleway running surface. At this stage it is thought that this option would require dampers to reduce vibration during periods of high usage.

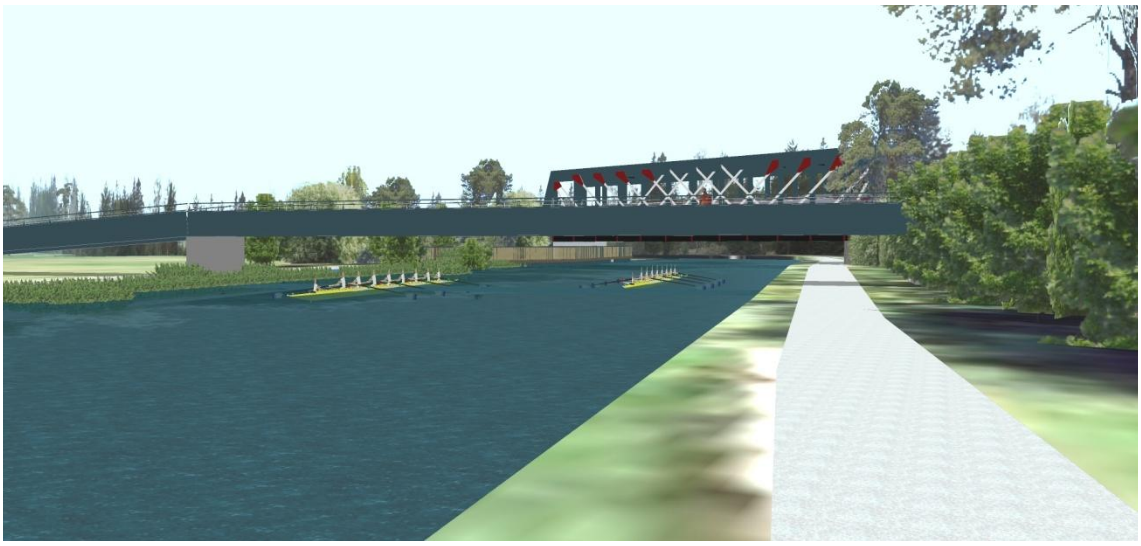

Figure 6 Computer illustration of the proposed foot/cycle bridge main span in half-through girder form with the existing railway bridge in the background

5.3 Ramp Options

The following text provides information on three primary ramp shape options, all constructed in steel for the same reasons discussed in Section 5.1. Only the three structural forms used for the main span have been considered as these will blend most successfully with the main span and the surrounding environment. Further details of the ramp options are shown on drawing reference 5123834/BR/FS/001 in Appendix C.

The ramps have been assumed to tie into existing paths at this stage, but their positioning and shape has also been chosen to link easily to the Chisholm Trail. Parapets will match those on the main span where possible and stairs will be placed at the high end of each approach ramp if they offer a significant saving in travel distance to pedestrians. It has also been assumed that the end span should terminate approximately 0.5m above ground level to keep any steelwork off the ground, ease future access to it and prolong the onset of paint deterioration and corrosion. The interface between pedestrians and cyclists at the base of all ramp options has the potential to cause conflict. This should be considered further through safety audit.

The north ramp will probably be placed in the triangular area of woodland to the northeast of the existing railway bridge to satisfy local residents and reduce the effects on the line of willow trees. The shape of this area will preclude a straight north ramp.

There is the potential to detail the ramp supports, or “piers”, to soften and improve their appearance.

5.3.1 Approach Ramp Option 1 – Straight Ramp

A straight ramp would comprise a series of continuous spans of approximately 15m to 20m with a 1 in 20 slope and one landing. It could take the form of all three main span construction options – the truss, beam or box girder and through girder. With the exception of the truss, which may appear imposing, the most appropriate choice would be to match the form, including the parapets, to that of the main span.

5.3.2 Approach Ramp Option 2 – Zigzag

A zigzag ramp would comprise a series of straight spans of approximately 15m to 20m with a 1 in 20 slope and two or more landings where the ramp turns back on itself. It could take the form of all three main span construction options – the truss, beam or box girder and through girder. With the exception of the truss, which may appear imposing, the most appropriate choice would be to match the form, including the parapets, to that of the main span. However, the tight turns of a zigzag ramp would be difficult for cyclists to negotiate, potentially even forcing them to dismount, decrease user visibility and increase the potential for pedestrian and cyclist conflicts. Hence this option is not considered suitable.

5.3.3 Approach Ramp Option 3 – Spiral/Curved

A spiral or curved ramp would comprise a series of curved continuous spans of approximately 15m to 20m with a 1 in 20 slope and one landing. It could only take the form of a box girder below the deck as a result of the twisting effects.

5.4 Maintenance and Durability

Given the proposed bridge location, access for future maintenance and inspection will be difficult. In particular:

- Access to areas in close proximity to Network Rail land may be subject to restrictions on methods of working or railway possession requirements
- Access to the main span soffit will require a boat or pontoons, which will have navigation restrictions
- Access to the approach ramp soffits will either require tower scaffolds or mobile elevated working platforms, which will not be desirable on the parkland

Consequently all such maintenance and inspection activities will be costly and, therefore, the design should minimise future maintenance. Acquiring maintenance access wayleaves may also ease such activities.

Appropriate routeing of rainwater, positive drainage with easy rodding accesses and stainless steel anti-vandal fixings would reduce unwanted corrosion on sensitive elements below. In addition, deck continuity should be utilised to minimise the number of bridge joints and bearings, which often combine to be main areas of early deterioration on bridges. Longer life paint systems and anti-graffiti measures would also reduce the frequency of maintenance painting, and low level lighting would ease future maintenance access. Whilst weathering steel may remove the need for maintenance painting it could lead to difficulties in graffiti removal, which is considered a likely requirement in the proposed location for a new bridge.

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6.0 Cost Estimates, Programmes and Risks

6.1 Cost Estimates

The following options have been considered:

- Option 1 – steel truss main span with curved box beam north approach ramp and straight stringer beam south approach ramp
- Option 2 – deck on I beams/box main span with curved box beam north approach ramp and straight stringer beam south approach ramp
- Option 3 – half through girder main span with curved box beam north approach ramp and straight stringer beam south approach ramp
- Option 4 – do nothing

The estimated costs are as follows:

- Option 1 - £3.9 million with additional risk of £0.4m (likely) or £0.8m (worst case)
- Option 2 - £4.4 million with additional risk of £0.4m (likely) or £0.8m (worst case)
- Option 3 - £3.9 million with additional risk of £0.5m (likely) or £0.9m (worst case)
- Option 4 – no cost

If the straight stringer beam south ramp was replaced with a curved box beam ramp, the costs would increase by approximately £275,000.

It has been assumed that the bridge could be built in 2016, with historic rates adjusted by construction inflation at 3% per year. A detailed breakdown of the costs and other assumptions made is provided in Appendix F.

In terms of risks, allowance has been made for the effects of high winds/ and looding, unforeseen ground conditions, difficulties in achieving railway track possessions and other normal risk items. Greater detail on the assumptions for these risks is again given in Appendix F. There are also non-construction related risks, which include:

- Land availability
- Funding
- Political approval
- Obtaining planning permission
- Public consultation
- Procurement issues
- Third party issues

It is difficult to predict time spans for delays for any of these non-construction related risks. However, it could reasonably be expected that the predicted costs would increase by a figure in the order of 3% per year’s delay to reflect construction inflation.

Whole life costing, including the costs associated with future maintenance, has not been considered at this stage. However, it was previously recognised in this report that there would be increased whole life costs for any new structure attached or near to the existing railway bridge, as resulting from Network Rail liaison and possession working.

6.2 Programme

All options are expected to take approximately 35 weeks to construct, with Option 2 expected to take slightly longer than the others as a result of the additional piling associated with the additional weight of steelwork.

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An outline programme from the start of consultation to the end of construction is included in Appendix G. Whilst this is an outline programme, planning periods and timescales to agree railway possessions cannot be accurately predicted at this stage. This is because the four month period shown for planning determination could easily be two or three times longer and possession notice periods are at Network Rail's discretion. Programme extension resulting from either of these factors would extend the time to the bridge opening date by the same amount.

There may be scope for time savings through sharing possessions with other Cambridgeshire County Council schemes, such as the Cambridge Science Park Interchange and Ely Southern Bypass. Liaison across the projects should be continued to achieve these savings if the programmes align suitably.

7.0 Discussion

7.1 The Need for a New Crossing

A new bridge in this location would appear likely to attract considerable usage, predicted at over 3,000 crossings per day. It would also ease congestion on the nearby Green Dragon Footbridge and encourage changes in transport modes. If there are further residential developments in future and a new bridge is not built then there will probably be more vehicular and cyclist traffic on existing roads, thus increasing the potential for congestion and accidents.

A “do nothing” option would leave users with the existing route between Abbey and Chesterton, which adds considerable time to their commute. The existing surrounding infrastructure, some of which is dimensionally substandard, will continue to be heavily used and an ongoing source of pedestrian and cyclist conflicts. It is likely that these difficulties will be further emphasised should some of the other planned city developments, particularly Cambridge East, the Chisholm Trail and Cambridge Science Park Interchange, come to fruition. In addition, some of the current funding may not be available at a later date.

7.2 General Bridge Details

As discussed earlier in this report, the most appropriate location for a river crossing would seem to be standing alone up to 60m east of the existing railway bridge. In addition, there is the requirement for a 4.0m minimum clear width with minimum 1.4m high parapets. The main span and ramps would have steel decks and supports, painted in colours to match the existing railway bridge, with piled foundations. Lighting would be appropriate to the environment and drainage would be to new soakaways.

There are tight space restrictions for the north approach ramp within the land to the north east of the existing railway crossing. This will lead to a requirement to push the ramp up to the boundaries of this area, thus placing one end of it near to the railway. There are potential maintenance implications, such as the need for additional possessions, for any part of the structure built near to the railway. In addition, there are extra construction costs, complications and programme constraints for these areas. However, at the moment these cannot entirely be quantified. There are also potential issues with regard to softer ground and working near the existing “Railway Jetty” structure on the south east corner of the existing railway bridge.

So there would appear to be two favoured options for the main span position (dependent upon which way around the north ramp is built):

1. Built skew to the river at a limited distance away from the existing railway bridge
2. Built square across the river at about 50m away from the existing railway bridge

Further information is required in order to decide which of these two options is the most suitable.

7.3 Construction Access

The preferred location of a bridge would require access to be from the east side of the existing railway bridge as the larger plant and bridge sections would not be able to fit underneath the railway bridge when travelling from the west. With reference to drawing 5123834/BR/SC/001, access routes A, B, H and I have thus not been considered any further. The issues associated with the five potential access routes on the east side are summarised in Table 2 below:

Route	Access from	Additional requirements	Comments
C	Fen Road (through Hayling House plot)	• Likely purchase of land from property owner	• Shortest haul route
D	Newmarket Road	• Large amounts of vegetation clearance • 1 no. temporary crossing over watercourse/disused railway	• Long haul route • Boggy ground • Passes area sensitive to residents

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E	North of Ditton Walk between the Beadle Industrial Estate and Ronald Rolph Court	• 1 no. temporary crossing over disused railway • 1 no. temporary crossing over watercourse • Permission from land owner	• Area may be subject to future redevelopment
F	Alleyway from footpath off Ditton Walk/Wadloes Road	• 2 no. temporary crossings over watercourses	• Not wide enough for construction vehicles
G	Fen Ditton High Street	• 2 no. temporary crossings over watercourses	• Long haul route with tight turns/ steep slopes at Fen Ditton end

Table-2 Summary of construction access options from the east side

Routes D and F can be largely discounted as they will probably be unacceptable to local residents and not wide enough for construction vehicles respectively. It is thought unlikely that Route C will be a preferable option as it would involve access through a private property during construction. Route G would seem a long and expensive option. However, a part alternative within it could be to float sections along the river, provided that appropriate navigation restrictions were agreeable to the Conservators of the River Cam.

Route E is thus currently thought likely to be the shortest suitable route to a new bridge and there are several potential access roads or routes as part of the option, some of which also appear wide enough for the larger construction vehicles. It also runs close to the desire line for the Newmarket Road to Cambridge Science Park part of the proposed Chisholm Trail. This leads to the potential for sections of the haul route to be re-used in the base of a new foot/cycle path, should it be built. Given no negotiations over accessed land have taken place it would be inappropriate to choose any particular road or route for Route E at this stage. Further careful consideration should be given to this.

As previously discussed, it is thought that the various sections of the structure would be erected by crane. However, if there are no suitable access routes from the north side there would also be a requirement to carry some plant and sections across the river from the south side.

7.4 Aesthetics

In terms of aesthetics, while it may be expected to look similar to the existing railway bridge, a new truss bridge is likely to appear as a clashing mix of various diagonal steel members which will not align exactly from any angle. It would also have the greatest height of all of the options, making it appear more prominently on the approach.

The deck on I beams/box will result in a fairly narrow band appearing in front of the existing bridge, and the half through girder an even narrower band, which may almost entirely fit within the deck depth of the existing railway bridge on approach view. The through girder may appear a rather plain solid face, but this could be softened through detailing to mimic the railway bridge if desired.

Both the truss and through girder options will result in a change in deck soffit level when moving from the main span to the ramps. This could look disjointed, but the appearance could be eased by the larger main span supports and the use of “cheek walls”, which could extend upwards from the supports at this region to cover the point of change in profile.

Long sweeping curved ramps will look nicer to the eye than the other options, as realised by the local community, but this will probably be precluded on the north side due to tight land restrictions. This is particularly prevalent for the deck on I beams or box option for the main span, with its associated longer ramps.

It may be that opportunity could be taken to investigate aesthetics more closely, through techniques such as architectural photorealism.

7.5 Safety

Cyclists will have a preference for straight ramps or wide bends as tight turns will be difficult to negotiate even force them to dismount if too tight.

There is the potential for pedestrian and cyclist conflicts at the base of any ramp option and this should be given further consideration through safety audit. In particular, visibility, bend radius, segregation and fitting into any existing or new approach paths should be investigated.

7.6 Risks

The construction risks considered to the works are typical to most construction projects and more certainty of the implications and likelihood of some of them could be gained through increased input in the early stages of the project. This could be through early liaison with third parties and ground investigation works.

However, there are other risks prior to works on site that also need resolution. Any issues developed through funding, planning, public consultation, or even enquiry, or procurement issues will also require resolution.

7.7 Cost/Programme Estimates

The main span options can be summarised as seen below in Table 3:

Option	Cost	Construction Programme
1 – steel truss main span with curved box beam north ramp and straight stringer beam south ramp	£3.9 million plus risk of £0.4m (likely) or £0.8m (worst case)	35 weeks
2 – deck on I beams/box main span with curved box beam north ramp and straight stringer beam south ramp	£4.4 million plus risk of £0.4m (likely) or £0.8m (worst case)	35 weeks
3 – half through girder main span with curved box beam north ramp and straight stringer beam south ramp	£3.9 million plus risk of £0.5m (likely) or £0.9m (worst case)	35 weeks

Table -3 Comparison of main span options

The major differences in costs result from increased piling and steelwork costs in some options. This is particularly applicable to option 2, where the increased deck depth of the main span results in longer approach ramps and may result in a slightly longer construction programme.

7.8 Favoured Main Span/Ramps Option

It is suggested that the best location for a new bridge is standing alone in an area up to 60m to the east of the existing railway bridge. This is because of the complexities, costs and maintenance issues associated with a bridge attached to or close to the existing railway bridge, consideration of visual intrusiveness to property owners to the north and user desire lines.

It is considered that the most aesthetically pleasing main span option would be a through girder. This generates the narrowest band of structure on elevation, making it least visible in the surrounding environment. Curved approach ramps would look nicer to the eye than other options and may be required to fit within the existing land available. However, curved ramps would also be significantly more expensive than straight ones, as they would need to be of box beam construction, and the curves would need to be large enough to maintain cyclist ride comfort. Consequently the best option for a new bridge is considered to be a through girder main span with a straight stringer beam south approach ramp and curved box beam north approach ramp.

The cost of the recommended main span/ramps option is about £4.4 million, with a worst case construction risk of a further £400,000.

7.9 Innovation

Despite the desired low visual profile of any new bridge, there is still the potential to improve the aesthetic appearance of it. Hence it may be useful to gain the views of an architect with regard to overall form and appearance. The below items have already been identified as potential areas for further consideration:

- Adding details on to the main span or approach ramps to reflect an existing feature, such as the parkland, navigable river, railway, pill box or an ecological feature
- Utilising landscaping to blend the new bridge into the surrounding environment or reflect an existing feature, such as the parkland, navigable river, railway, pill box or an ecological feature
- Alternative bridge support shapes and blending them into the main span and approach ramps
- Close attention to details or alternative shapes, such as spirals, on any stairs
- Features such as viewing areas incorporated into the ramps

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8.0 Conclusions

Assessment of the likely usage and other benefits suggests that a new foot/cycle bridge would be a valuable future asset at this location, with an estimated 3,000 daily trips expected upon it. A reduction in journey distances up to 1 mile, which represents a time saving of approximately 20 minutes for pedestrians and 5 to 7 minutes for cyclists, is anticipated. It could relieve pressures on nearby surrounding infrastructure, improve community links and provide opportunities for local and outlying residents to use sustainable modes of travel, particularly with respect to anticipated growth from nearby planned developments.

The recommended location for the river crossing is considered to be in an area up to 60m east of the existing railway bridge, but not attached to it. The new bridge would carry a 4.0m minimum clear width foot/cycle path. This takes account of the views of the local community, requirements of current design standards, available space, the location of other nearby river crossings, user desire lines, third party implications, aesthetics, safety and future maintenance.

Construction access is going to be a significant difficulty for any option, with the best route currently thought to be from the area north of Ditton Walk between the Beadle Industrial Estate and Ronald Rolph Court. This route would also run close to the desire line for the Newmarket Road to Cambridge Science Park part of the proposed Chisholm Trail, leading to the potential for sections of the haul route to be re-used in the base of a new foot/cyclepath. Given no negotiations over accessed land have taken place it would be inappropriate to choose any specific road or route at this stage. Pre-fabrication should also be utilised to maximise the lengths of sections to what can be transported practically along the highway network and approach roads.

The option for a new bridge currently considered most suitable is a steel through girder main span with a straight stringer beam south ramp and curved box beam north ramp. It is thought likely the main span and ramps would have steel decks and supports and piled foundations. This takes account of aesthetics, safety, risks and cost. The cost of this option is likely to be about £4.4 million inclusive of likely risk. There is a worst case construction risk of a further £400,000.

Pedestrian and cyclist interfaces are a potential safety concern in any option, particularly at the base of the ramps.

The usual construction risks, including weather and unknown ground conditions, apply but there are also other potential risks from funding, planning, acquiring necessary rights, public consultation, procurement and third parties.

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9.0 Recommendations

A new river crossing could be built in an area up to 60m east of the existing railway bridge at a likely cost of £4.4 million inclusive of likely risk.

A suitable option for the river crossing is likely to be a 4.0m minimum clear width steel through girder main span with a curved box beam north ramp and straight stringer beam south ramp, all resting on steel supports and piled foundations. This option would seem to represent the best value for money and fit the environment most appropriately.

The following items should be instigated early in the design of the associated project to help minimise and quantify the risks to the project:

- Further visualisation of the various options and consideration of innovative deck/support details and landscaping to improve the appearance of the new structure
- Ground investigation works
- Trial pits to confirm utility locations
- Topographical survey
- Ecological enabling works (i.e. tree clearance)
- Safety audit of pedestrian/cyclist interfaces at the base of the ramps
- Confirmation of land ownership and acquiring rights
- Statutory planning processes
- Determination of funding and procurement options
- Liaison with third parties, such as Network Rail, utility owners, Environment Agency, Cam Conservators, local residents and action groups
- Studies into linkage to the Chisholm Trail

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Appendices

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Appendix A Cambridge Cycle Routes

Appendix B Transport Assessment Report

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Appendix C Drawings

Drawing No	Drawing Title
5123834/BR/LO/001	Land ownership
5123834/BR/SC/001	Site location and access
5123834/BR/FS/001	Main span and ramp options
5123834/BR/LP/001	Bridge locations

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Appendix D Ecological Constraints Report

Appendix E Other Main Span Examples

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Steel Truss

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Deck on Steel Beam / Box Girder

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Through Girder

Appendix F Cost Estimates for Bridge Options

Detailed cost breakdowns are included on the following sheets. Note that assumptions have been made in these estimates and on potential risks as below. For reference, "preliminaries" typically refers to the following costs:

- Site compound buildings facilities set up, maintenance and removal
- Main contractor's staff and plant/equipment
- Third party consents
- River and pedestrian traffic management
- Craneage – site preparation and contract lift
- Reinstatement after works, such as repairs to the Commons grassland or paths

Assumptions in Cost Estimates

- The construction work will be awarded through competitive tendering.
- A haul route will be constructed from the area north of Ditton Walk between the Beadle Industrial Estate and Ronald Rolph Court, and plant/elements will be carried across the river by boat to the north side. Consequently pontoons, a manned safety boat and a manned working boat will be present for about 80% of the works.
- The required land will be available for the new bridge construction. A nominal figure of £50,000 has been assumed for land related matters.
- Any necessary planning permissions will be granted.
- A typical compound, and associated cabins, for the size of works will be utilised.
- Piling underneath any crane foundations will not be required.
- The main span will run for 40 metres square across the river.
- A nominal figure of £55,000 has been allowed for ground investigation.
- 14 no. piles per main support, 6 no. piles per ramp support and 4 no. piles per abutment.
- Any requirements for dealing with protected species will have minimal cost impact and be established and dealt with in advance.
- There will be no requirements for dealing with current utilities.
- £75,000 will cover all dealings with third parties (ie. highway departments, parks, Environment Agency, Cam Conservators, Network Rail).
- There are no major changes as a result of Departures from Standard or user safety audits.
- A site manager, foreman and security guard will be present for 100% of normal shifts throughout the works, an engineer and chain man for 67% and a QS and office manager for 50%.
- 8% overheads and profit.
- Design costs at 10% of construction costs.
- Supervision costs of £150,000.

Risks Assumed

- Aborting lifting operations due to unpredicted changes in wind conditions
- Aborting lifting operations due to unpredicted non-availability of track possessions
- Unforeseen physical conditions, such as poor ground
- A 2 week time risk allowance for normal contractor's time related risks

- A 2 week time risk allowance and damage to the compound from flooding
- A 5% to 10% financial risk allowance for miscellaneous small contractor’s risk items
- A 2.5% to 5% financial risk allowance for miscellaneous small employer’s risk items

Appendix G Indicative Outline Programme for Bridge Planning, Design and Construction

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