SLC Rail

East West Rail – Route Update Review

For Bedford Borough Council

V1.2 JANUARY 2024

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The brief

Following the publication by the East West Railway Company (EWR Co) of their Route Update Announcement (and associated supporting documents) in May 2023, SLC Rail has been commissioned by Bedford Borough Council to undertake an evidence review.

The purpose of the review is:

- to determine whether the arguments advanced by EWR Co in favour of their preferred route for the proposed new railway linking Bedford to Cambridge appear valid; and
- to understand how well various alternative route options perform in respect of certain criteria when compared to ERW Co's preferred route option.

In addition, SLC Rail has been asked to test the rationale that underpins EWR Co's proposal to build two additional tracks alongside the existing four Midland Main Line tracks through northern Bedford.

East West Rail Company's route development process

The East West Rail scheme has been developed over a period of many years, during which the leadership of the project has transitioned from the East West Rail Consortium to Network Rail and then to the East West Rail Company. During that time, there has been a slight change in the wording of the scheme objectives but the overall aims of the scheme (i.e. to improve east-west public transport connectivity in the Oxford – Cambridge corridor in order to facilitate continued economic growth) have not changed.

A robust process has been undertaken to determine a preferred route alignment. This started with the consideration of broad route corridors followed by route options within the chosen corridor and then route alignments within the preferred route option.

The decisions on route choices have been guided by published decision making criteria agreed by the Department for Transport.

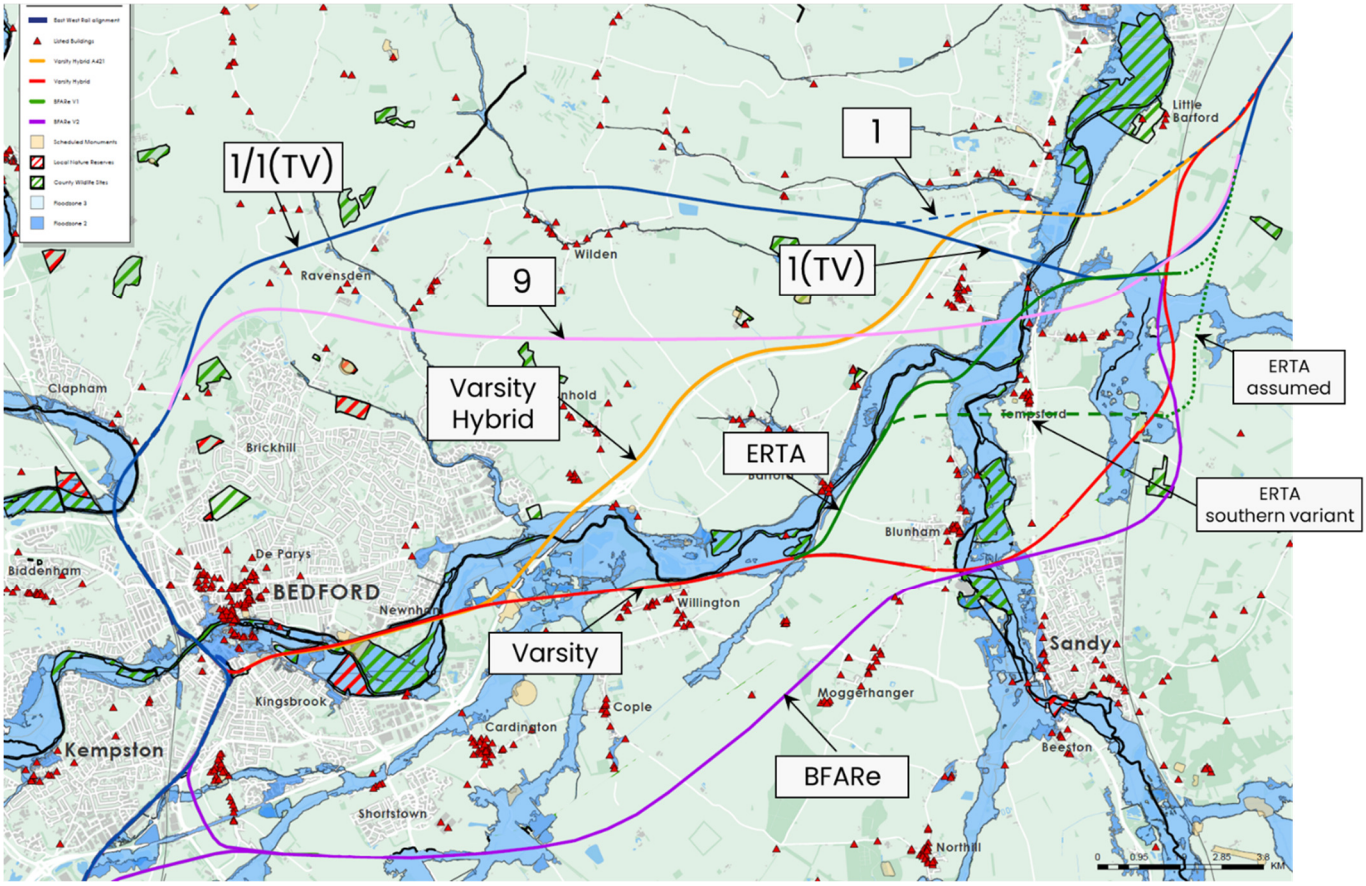
As such, and based on published documents and other supporting evidence, we have found no fault with the decision making that has led to the current preferred route alignment.

Comparison of route alignments

The map below shows the route alignments in question. In the 2023 RUA documentation, EWR Co considers three alternatives to its preferred route alignment. This was done as sense-check in light of comments received from the public and others during the 2021 non-statutory public consultation.

The first alternative is what EWR Co have termed the Varsity route. The second is a variation of the first and is referred to as the Varsity Hybrid route. The third is as proposed by BFARe (Bedford for a Re-consultation).

In addition to the alternatives described in the RUA documents, Bedford Borough Council has requested that we also consider two further alternatives that have been proposed by the English Regional Transport Association (ERTA).



Of the route alignments we have considered, EWR Co's preferred route alignment (Route Alignment 1 (Tempsford Variant)) appears to perform well relative to other route alignments across the various criteria we have been asked to consider. The main exception to this is in respect of the impact on residential properties in the Poets area of Bedford caused by the EWR Co's view that it is necessary to build additional tracks adjacent to the Midland Main Line corridor through north Bedford.

Routes that utilise the former Oxford – Cambridge railway alignment through southern Bedford have impacts on scheduled monuments and on open space that may not be capable of mitigation. Although further work would be required, including engagement with Historic England, to determine whether there is a reasonable prospect of achieving satisfactory mitigation of the impacts, we note that these route alignments carry significant risk of failing to achieve consent. In addition, the alignments interface heavily with Flood Zones. Further, more detailed flood modelling would be required to determine the extent of flooding impacts. This uncertainty compounds the consenting risk associated with these route alignments.

The BFARe route alignment has the lowest impact within the Bedford urban area – although, in common with all of the route alignments considered, it still requires a considerable amount of construction activity within the town to allow services to reliably serve Bedford station. The geometry of the triangular junction at the western end of the proposed route alignment presents some significant challenges. We do not believe that the layout as currently presented by BFARe is feasible due to the tight radii used on the east-north arm of the junction. Slackening of these radii might be possible but with the result that a number of residential properties would need to be acquired and demolished. It is not clear without further development work whether the road and waterway interfaces on the arm of the junction can be accommodated within a viable vertical alignment of the railway. We also note that the east-west arm of the junction will involve a steep gradient to allow the railway to pass over the B530, Midland Main Line and A6. The consequent

elevation of this arm of the junction at the point where it meets the east-north arm is likely to dictate the need for an even steeper gradient on the east-north arm. The remainder of BFARe route alignment appears to be capable of improvement to reduce the extent of impacts but a full alignment design would be necessary to confirm this.

The southern route alignments all have impacts on the train service that can be provided on East West Rail. They all involve a triangular junction south of Bedford that would allow Oxford – Cambridge services to by-pass Bedford Midland, but serve a parkway station in the Kempston Hardwick area instead. Alternatively all services could go into Bedford Midland with reversal as required. In the former case the reduction in frequency of trains serving central Bedford would negatively impact the economic benefits that the town centre will experience as a result of the project, partly offset by increased benefits arising from reduced journey times for some through journeys. In the latter case there would be some journey time extension caused by the reversal move (c.5-6 minutes) compared to northern alignment options.

However, in all options East West Rail represents a sizeable boost to the economy in Bedford worth between £257m and £268m over 60 years on a discounted basis. The difference between options is relatively small in economic terms, with the service capable of being provided on a northern alignment delivering economic benefits between 2% and 4% greater than southern alignment options.

Ultimately, the choice of preferred route alignment (and train service pattern) is finely balanced and depends to a large extent on the relative weight given to the various factors affecting route choice as examined in this report. EWR Co's work to date places considerable weight on economic benefits and the choice of preferred route alignment is sound in this context. However, we believe that a southern route option, such as the one promoted by BFARe, could be feasible if further development work were undertaken to resolve some of the current deficiencies.

4 v 6 tracks north of Bedford Midland

All options for East West Rail services provide for segregated tracks south of Bedford and for additional platforms at the station to accommodate them.

For their preferred alignment, EWR Co has considered two options for immediately north of Bedford station:

- A four-track option in which the EWR tracks merge with the existing Slow Lines just south of Bromham Road Bridge (the A4280), with the junction for Cambridge diverging at Bedford North Junction, 900m further north.
- A six-track option in which new EWR tracks are constructed north of the station, creating a fully segregated railway.

EWR Co has proposed the six-track option because of the difficulty of timetabling EWR trains in amongst existing and prospective traffic on the Midland Main Line. The Route Update material includes timetable and performance modelling by Arup to demonstrate the rationale for this.

The six-track option has remained contentious because of the property demolition in central Bedford required to construct it.

It is clear that a solution with more infrastructure is likely to provide a more resilient solution. However, what EWR Co have not yet been able to do is to demonstrate whether this is necessary as opposed to desirable. The level of performance that East West Rail services need to achieve to avoid causing material

performance reduction elsewhere on the rail network cannot be determined at this stage as the interactions along the wider route are not fully understood.

That said, four tracks could be a workable solution if:

i. Future freight growth can be accommodated by increasing the existing poor utilisation of paths from its current c.27% and by infrastructure changes that are driven by that growth not by East West Rail services.

ii. Platform 5 is constructed so that all EMR services are concentrated on platforms 4 and 5 and do not interact with Thameslink services. This has the added benefit that long distance inter-city services could call at Bedford once more.

iii. An additional platform 0 is constructed so that Thameslink services are able to use four platforms: 0, 1, 2 and 3, offering more capacity than they have at present.

iv. Freight trains make use of platform 3 to be held where necessary in order to fit in with other traffic north and south of Bedford.

v. Compromises and timetable constraints are accepted at other locations on the East West Rail route so that Bedford alone is not forced to accept the main downsides of the construction of the railway.

It is recommended that the East West Rail Company is asked to undertake analysis on this basis.

However, If East West Rail were to take any of the southern routes bypassing Bedford the issue of 4 or 6 tracks would not arise, as there would be no interaction between East West services and those on the Midland Main Line.

SLC Rail

January 2024

1 Methodology

In preparation of this report SLC Rail has reviewed an extensive range of documentation and other items from a variety of sources. These include:

- EWR Co's online document library including:
    - documents and other supporting artefacts published in connection with the 2019 non-statutory consultation
    - the 2020 Preferred Route Option report (which reported EWR Co's preference for Route E, through and to the north/northeast of Bedford)
    - documents and other supporting artefacts published in connection with the 2021 non-statutory consultation
    - material relating to the 2023 Route Update Announcement
    - EWR Co's review of the BFARe proposal for an alternative route to the south of Bedford
- EWR Co's online interactive mapping tool
- DEFRA's online MAGIC mapping system
- The UK Government's online flood maps
- Agricultural Land Classification maps published by DEFRA
- Air Quality Management Area mapping and supporting information published by DEFRA
- Bedford Borough Council's responses to the 2019 and 2021 non-statutory consultations
- Bedford Borough Council's Local Plan 2040 documents and mapping
- Information supplied by BFARe describing their proposed alternative route and the reasons for their objecting to EWR Co's proposals
- Information from ERTA describing their proposed alternative route

In addition to the literature review described above, we have held meetings with BFARe and ERTA at which we have had the opportunity to examine and challenge the proposals put forward by each organisation and the supporting evidence that underpins those proposals. These meetings were arranged by and attended by representatives from Bedford Borough Council.

2 Background to the EWR project

The East West Rail project aims to deliver a new rail route linking Oxford to Cambridge via key urban centres in between. In doing so it aims to:

- Improve public transport links in the corridor;
- Stimulate economic growth, housing and employment through the provision of new, reliable and attractive inter-urban passenger train services; and
- Contribute to improved journey times and inter-regional passenger connectivity by connecting with existing north-south routes and routes beyond Oxford and Cambridge.

The project is being delivered in phases, referred to by ERW Co as "Connection Stages". The first of these delivered a fully upgraded railway between Oxford and Bicester (together with a new section of railway linking to the London - Birmingham Chiltern Main Line) in two stages completed in 2015 and 2016. This allowed Chiltern Railways to commence operation of a new train service linking London Marylebone and Oxford.

The next phase is expected to complete by 2025 and involves the upgrading and reopening of the railway between Bicester and Bletchley. This will facilitate the operation of new train services linking Oxford and Milton Keynes Central. This phase is being delivered by Network Rail under the supervision of EWR Co.

Subsequent phases will see the upgrading of the existing Marston Vale Line (linking Bletchley and Bedford) and the construction of a new railway linking Bedford to Cambridge.

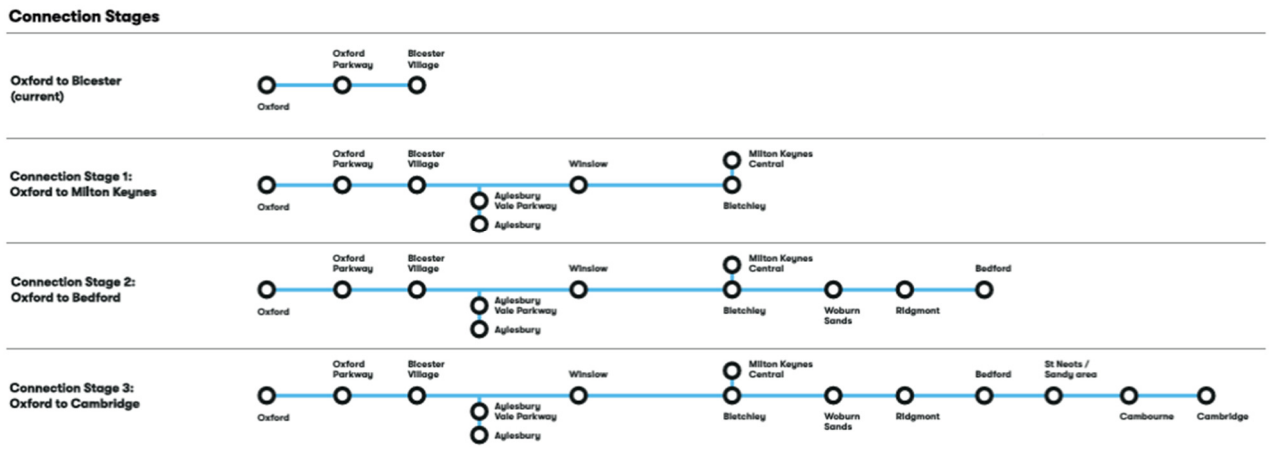


Figure 1: EWR Connection Stages

PART A – REVIEW OF ROUTE UPDATE REPORT

3 Overview of the scheme development process and timeline

3.1 Overview of the process

The publication of a preferred route alignment for the new railway linking Bedford and Cambridge in May 2023 was the culmination of a three-stage route selection process stretching back many years. This process started with the exploration of potential Route Corridors. These corridors each covered a wide area (up to 15 kilometres wide in some instances) through which the railway might run.

Once a preferred Route Corridor was determined, Route Options within that corridor were examined. These were narrower than the Route Corridors but were still several kilometres wide in places.

Following the selection of the preferred Route Option, Route Alignments were developed. The route alignments represent the exact course the railway could take. The process is represented in Figure 2 and each stage is described in more detail below.

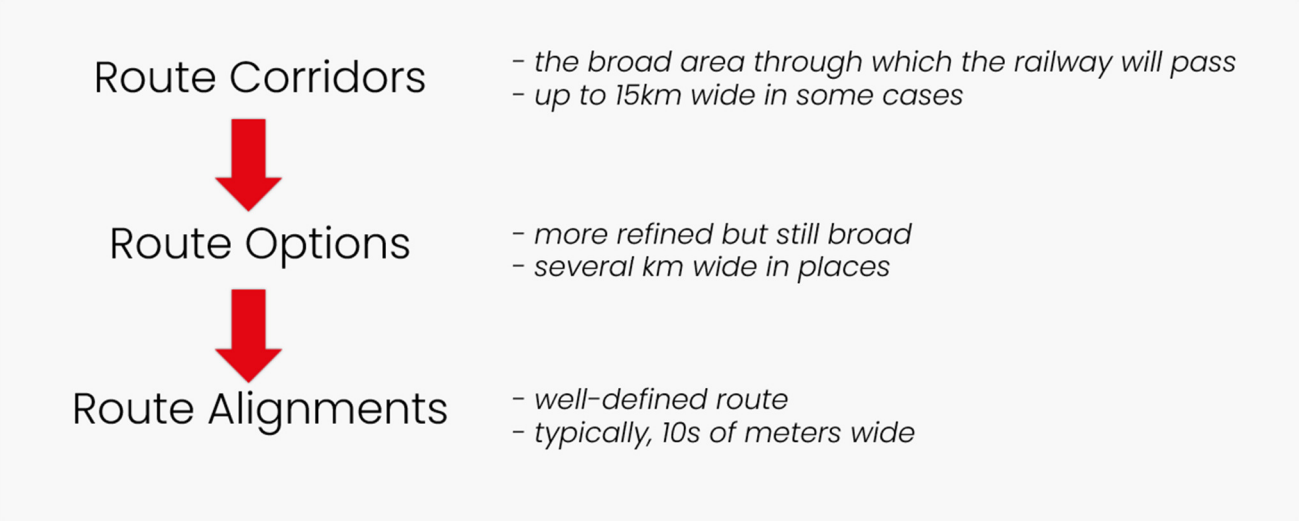


Figure 2: Overview of the key stages of the route selection process

3.2 Early development and selection of the Preferred Route Corridor

In 2014 Network Rail commenced development work on what was then termed the "Central Section" of the East West Rail scheme[1]. This work built on early development of the scheme undertaken prior to 2014 by the

[1] The East West Rail scheme was previously envisaged as a three-stage scheme comprising Western, Central and Eastern sections. The Western Section covered Oxford to Milton Keynes and Bedford, the Central Section Bedford to Cambridge, and the Eastern Section Cambridge to Norwich, Ipswich and the east coast ports. The Eastern Section doesn't form part of the scheme currently being taken forward. However, the East West Main Line Partnership continues to develop proposals and lobby government for funding for the delivery of this section.

East West Rail Consortium[2]. Network Rail identified 20 Route Corridors covering a broad area from Peterborough in the north to St Albans and Harlow in the south. These were appraised against an initial set of objectives that had been developed by the East West Rail Consortium. These objectives are set out below.

The initial objectives developed by the East West Rail Consortium:

- **Improve east-west public transport connectivity;**
- **Increase economic growth, prosperity and employment within the South-East of England through improvements to east-west rail links;**
- **Provide faster, more reliable and additional rail links from the west to Cambridge, Norwich and Ipswich;**
- **Improve journey times and reliability of inter-regional and commuter journeys;**
- **Increase capacity for inter-regional and commuter journeys;**
- **Maintain and enhance capacity for rail freight; and**
- **Contribute to tackling climate change.**

Figure 3 - Initial objectives developed by the EWR Consortium

Following this appraisal five of the 20 Route Corridors were taken forward for further work. These Route Corridors were:

- Corridor C: Bletchley – Stewartby – Bedford – Sandy – Cambridge
- Corridor D: Bletchley – Stewartby – Bedford – Sandy – Hitchin – Cambridge
- Corridor H2: Bletchley – Stewartby – Flitwick – Luton – Stevenage – Hitchin – Cambridge
- Corridor M: Bletchley – Stewartby – Bedford – Hitchin – Cambridge
- Corridor N: Bletchley – Ridgmont – Harlington – Hitchin – Cambridge

Corridors C, D and M encompassed variants passing to the south of and through the centre of Bedford.

Further quantitative analysis of the likely costs and benefits associated with each of the five remaining Route Corridors was undertaken. This analysis was informed by engineering studies. It led to the further narrowing down to just two Route Corridors – Corridor C (via Bedford and Sandy) and Corridor M (via Bedford and Hitchin).

Further analysis indicated that the cost of building a railway in each of the two corridors was likely to be broadly the same, but that Route Corridor C was likely to generate greater benefits, have lower operating costs and result in shorter journey times than Route Corridor M.

As a result, Route Corridor C, linking the Bedford area to Cambridge via a broad corridor through the Sandy area, was selected as the preferred Route Corridor in 2016.

[2] The East West Rail Consortium is now known at the East West Main Line Partnership

3.3 Development of the Route Options

In 2017, EWR Co was established by Secretary of State for Transport with a remit to drive forward the development and delivery of future phases of the East West Rail project. However, between 2017 and 2019 Network Rail continued development work on the route through Bedford Borough on behalf of EWR Co.

Also in 2017, the National Infrastructure Commission published a report titled "PARTNERING FOR PROSPERITY: A new deal for the Cambridge - Milton Keynes - Oxford Arc". This report highlighted a significant shortfall in house building compared to that necessary to allow the area between Oxford and Cambridge to achieve its full economic potential, together with a need to deliver east-west transport infrastructure to support connectivity between housing and jobs. In response to this report, DfT and EWR Co agreed a revised set of strategic objectives for the East West Rail scheme, which are shown below. EWR Co undertook a back-check of the decision to select Route Corridor C against the revised objectives. It concluded that the decision remained appropriate in the revised context.

The revised strategic objectives for the scheme

- **Improve east-west public transport connectivity by providing rail links between key urban areas (current and anticipated) in the Oxford-Cambridge Arc;**
- **Stimulate economic growth, housing and employment through the provision of new, reliable and attractive inter-urban passenger train services in the Oxford-Cambridge Arc;**
- **Meet initial forecast passenger demand;**
- **Consider and plan for future passenger demand, making provision where it is affordable;**
- **Contribute to improved journey times and inter-regional passenger connectivity by connecting with north-south routes and routes beyond Oxford and Cambridge;**
- **Maintain current capacity for rail freight and make appropriate provision for anticipated future growth; and**
- **Provide a sustainable and value for money transport solution to support economic growth in the area.**

Figure 4 - Revised Strategic Objectives for the scheme

In addition to the revised Strategic Objectives, a set of route selection criteria were agreed between DfT, EWR Co and local stakeholders. These route selection criteria are shown below.

Route Selection Criteria

1. **Transport User Benefits – the benefits from improved journey times, lower fares and less road congestion.**
2. **Contribution to enabling housing and economic growth, including best serving areas with developable land**
3. **Capital and operating costs and overall affordability**
4. **Environmental impacts and opportunities**
5. **Short-distance passenger services and connectivity to support commuting into key employment hubs (current and future)**
6. **Rail passenger connectivity to existing main lines**
7. **Long distance passenger services**
8. **Satisfying existing and future freight demand where affordable**
9. **Railway performance and alignment with wider railway strategy and infrastructure**
10. **Safety risk (construction and operation)**
11. **Consistency with plans for the location of settlements**

Figure 5 - Route selection criteria

These criteria are explained in more detail in EWR Co's 2019 Consultation Technical Report, and were used to determine 11 possible Route Options within the chosen corridor. EWR Co's 2019 Consultation Technical Report explains that efforts to determine these 11 Route Options focussed on criteria 1 to 4 on the basis that criteria 5 to 11 were not considered to be material differentiators. In formulating the 11 Route Options, EWR Co sought to address three key questions:

- Where could EWR provide an interchange with the Midland Main Line?
- Where could EWR provide an interchange with the East Coast Main Line?
- What route could EWR take through South Cambridgeshire, including where any potential additional stations might be located?

The 11 Route Options were:

- Route A: Bedford South – Sandy (re-located south) – Cambridge (via Bassingbourn)
- Route B: Bedford South – Sandy (re-located north) / Tempsford area / south of St Neots – Cambourne – Cambridge
- Route C: Bedford South – Tempsford area – Sandy – Cambridge (via Bassingbourn)
- Route D: Bedford Midland – Tempsford area – Sandy – Cambridge (via Bassingbourn)
- Route E: Bedford Midland – Tempsford area / South of St Neots – Cambourne – Cambridge
- Route F: Bedford South – Sandy (re-located north) – Cambridge
- Route G: Bedford Midland – Tempsford area – Cambridge
- Route H: Bedford Midland – Sandy (re-located south) – Cambridge (via Bassingbourn)
- Route J: Bedford Midland – Sandy – Cambridge (via Bassingbourn)

- Route K: Bedford South – Sandy – Cambridge (via Bassingbourn)
- Route L: Bedford Midland – Tempsford area – Cambridge (via Bassingbourn)

All 11 Route Options are described in more detail in the 2019 Consultation Technical Report. Six of the 11 Route Options (Route Option F to K) were rejected on the basis that they performed less well against the route selection criteria than the remaining five (Route Option A to E).

Of the five options that were not rejected, three (Route Options A, B and C) passed to the south of Bedford, connecting to the existing Marston Vale line in the vicinity of Kempston Hardwick. The other two (Route Options D and E) approached Bedford (from Cambridge) from the northeast, followed the Midland Main Line (MML) corridor through the north of Bedford to Bedford station and then continued towards Bletchley via the existing Marston Vale line corridor through southeast Bedford.

3.4 2019 Non-statutory consultation

In 2019 EWR Co conducted a non-statutory public consultation on the five route options for the new railway linking Bedford to Cambridge. The consultation ran from 28 January to 11 March 2019. A range of consultation documents were published with copies available electronically via EWR Co's website and in hard copy.

The public consultation included engagement with potential future prescribed consultees (i.e. those with whom engagement would be mandatory as part of a future statutory consultation), local representatives and a range of other organisations and specialist interest groups. Public exhibitions were held at eight locations across the area potentially affected by the new railway.

EWR Co subsequently reported that the consultation process elicited a total of 6,988 individual pieces of feedback, including letters, emails, completed consultation feedback forms and feedback submitted using EWR Co's standard contact form.

Feedback from the public consultation was used to inform on-going development of the scheme.

3.5 Preferred Route Option (2020)

At the end of January 2020, following consideration of feedback from the 2019 non-statutory consultation and further analysis by EWR Co, it was announced that Route Option E was the preferred Route Option and that this route would be taken forward for further development. **This is the point at which routes passing to the south of Bedford were dropped**, leaving only the route entering Bedford from the Oxford / Bletchley direction via the existing Marston Vale Line, passing through Bedford station, following the Midland Main Line to the north and exiting the town via a route curving to the east in the vicinity of Clapham Green.

The reasons given for the selection of this route over the other four options include:

- Greater transport user benefits:
  - Route E has the greatest number of households within catchment of a proposed station site
  - Route E facilitates better onward rail connectivity because it facilitates direct interchange with services to and from the East Midlands at Bedford station

  - The additional benefits accruing from the greater interchange opportunities at Bedford station (compared to those at a potential Bedford South station) outweigh the disbenefits associated with the journey time penalty incurred by serving Bedford rather than skirting the south side of the town.
  - Serving Cambourne means the route complements other planned transport investments around Cambridge to provide shorter journey times to and from a range of local destinations.
- Supporting wider economic growth:
  - While productivity benefits associated with route through Bedford and routes to the south of Bedford were similar, route serving Bedford station provide better town centre connectivity.
  - Bedford Borough Council's response to the consultation indicated a strong preference for a route via Bedford station on the basis that this could act as a catalyst for growth and regeneration within the town while reinforcing the town's role in the so-called Oxford to Cambridge Arc.
- Supporting the delivery of new homes:
  - Several large sites to the south of Bedford were already allocated for development or had existing consents. These developments were, in part, linked to the proposed new station on the Midland Main Line at Wixams. It was therefore unlikely that routing East West Rail via a new station to the south of the town would unlock significant further new housing.
- Bedford Borough Council noted in its response to the consultation that routing the railway via Bedford station had the potential to generate additional housing in the centre of Bedford as part of the regeneration that could be expected as a result of the railway and could potentially support additional housing to the north of the town that would not be supported by a station to the south of the town.
- Costs and overall affordability:
  - The indicative cost estimates for Route Options A and E were similar (£3.6 billion and £3.7 billion respectively) and were lower than the estimates for Route Options B, C and D (£3.9 billion to £4.3 billion).
  - While the modelled operating costs and revenues were similar for all options, Route Option E was shown to generate the highest net profit in a high growth scenario.
- Environmental impacts and opportunities:
  - Routes via Cambourne (Route Options B and E) would traverse fewer areas where the railway was likely to have adverse impacts on sensitive or irreplaceable environmental features and impacts could therefore be more easily mitigated. (It was, however, noted that the precise impact would depend on the chosen alignment within each route and that careful consideration would be given to potential impacts in the Bedford urban area).
- Other considerations:
  - EWR Co reported that the responses to the 2019 consultation generally reflected a preference for the new railway to serve Bedford station rather than a new station to the south of the town.
  - The consultation responses scored Route Option E highest in four out of five categories (transport user benefits, supporting economic growth, supporting delivery of new homes and environmental impacts and opportunities).

3.6 Midland Main Line six-tracking

The preferred Route Option (Route E) utilises the existing Midland Main Line corridor through the northern part of Bedford over a distance of around 900m. As part of the on-going development of Route Option E during 2019/20, EWR Co undertook work to determine whether the existing 4-track railway on this corridor had sufficient capacity to allow the operation of the proposed level of EWR train services. The conclusion of that work was the existing 4-track layout had insufficient spare capacity to accommodate EWR services alongside anticipated growth in passenger and freight services on the existing railway. This matter is considered in more detail in Part B of this report.

In order to overcome the shortfall in capacity, EWR Co proposed the provision of two additional tracks on the eastern side of the existing railway corridor. To deliver the additional tracks EWR Co's consultants established that it would be necessary to acquire and demolish a significant number of (mostly residential) properties that adjoin the existing MML in the north of Bedford.

3.7 Development of route alignments

Following the announcement of the preferred Route Option, development work was undertaken to develop a number of potential route alignments for the railway within the broad area covered by the route. The process by which the alignments were established is described in detail in Sections 5.4.17 to 5.4.33 of EWR Co's 2021 Consultation Technical Report. In summary, an initial alignment within the area covered by Route Option E was produced. This was refined to form an indicative alignment. A number of factors were then considered to further refine this option and produce a number of Route Alignments. The factors considered included operational requirements, engineering requirements and environmental constraints.

In addition, the opportunity was taken to explore alignments that broadly followed the route of Highways England's (now National Highways') proposed A428 dual carriageway scheme between the Black Cat Interchange and Caxton Gibbet (now under construction). The proposed alignment for this road was published during the 2019 consultation and differed from proposals previously published by Highways England. This, together with the desire to consider a station at Cambourne located to the north of the A428 (in response to stakeholder feedback), resulted in some Route Alignments being partly located beyond (but remaining close to) the limits of Route Option E as originally proposed and consulted on.

A total of nine Route Alignments were developed, incorporating different options for station locations for the interchange with the East Coast Main Line and for the station to serve Cambourne. The station locations were: Tempsford or one of two locations at St Neots South; and Cambourne South or Cambourne North.

In order to compare the Route Alignments, a series of 15 assessment factors were used. These 15 assessment factors closely match the route selection criteria that were used to develop and compare the 11 route options presented in the 2019 consultation. The assessment factors are listed below.

1. **Transport user benefits – the benefits experienced by passengers particularly in terms of journey time savings and modal shift (where people change the mode of transport they use to make a journey)**
2. **Contribution to enabling housing and economic growth – including best serving areas benefitting from land that can be developed**
3. **Capital costs – the upfront costs, including consideration of risk, to implement each option**
4. **Operating costs – the costs incurred in the delivery of the train service**
5. **Overall affordability – the financial implications of the options in terms of costs and incomes, over the whole life of the railway; also encompassing capital and operating costs**
6. **Short distance connectivity – to support commuting travel into key employment hubs (current and future)**
7. **Short distance passenger services – the extent to which EWR facilitates passengers wishing to make short distance local journeys on the EWR network**
8. **Rail passenger connectivity to existing main lines – the ease of interchange**
9. **Long distance passenger services – the extent to which EWR facilitates long distance passenger services beyond Oxford and Cambridge**
10. **Freight demand – satisfying both existing and future demand**
11. **Performance – the ability of the railway to meet or exceed customer expectations in terms of service reliability**
12. **Alignment with wider railway strategy / infrastructure**
13. **Safety risk – both in terms of construction and operation**
14. **Environmental impacts and opportunities**
15. **Consistency with Local Plans**

Figure 6 - Assessment factors used for comparison of the nine Route Alignments

Assessment of the nine options against these factors led to four options being rejected and five being taken forward. The five options that were taken forward were:

- **Alignment 1:** St Neots South Option A to Cambourne North via the A428 Improvement Scheme corridor;
- **Alignment 2:** St Neots South Option A to Cambourne South via the A428 Improvement Scheme corridor;
- **Alignment 6:** St Neots South Option B to Cambourne South;
- **Alignment 8:** Tempsford to Cambourne South; and
- **Alignment 9:** Tempsford to Cambourne North via the A428 Improvement Scheme corridor.

Within Bedford Borough, the five Route Alignments consulted on broadly fall into two groups. Route Alignments 1, 2 and 6 follow an alignment to the north of Roxton, Wilden and Ravensden, while Route Alignments 8 and 9 follow an alignment to the south of these villages. The two groups of Route Alignments come together near Clapham Green and all Route Alignments are identical through the north of Bedford and through Bedford station. The five route options are shown in Figure 7.

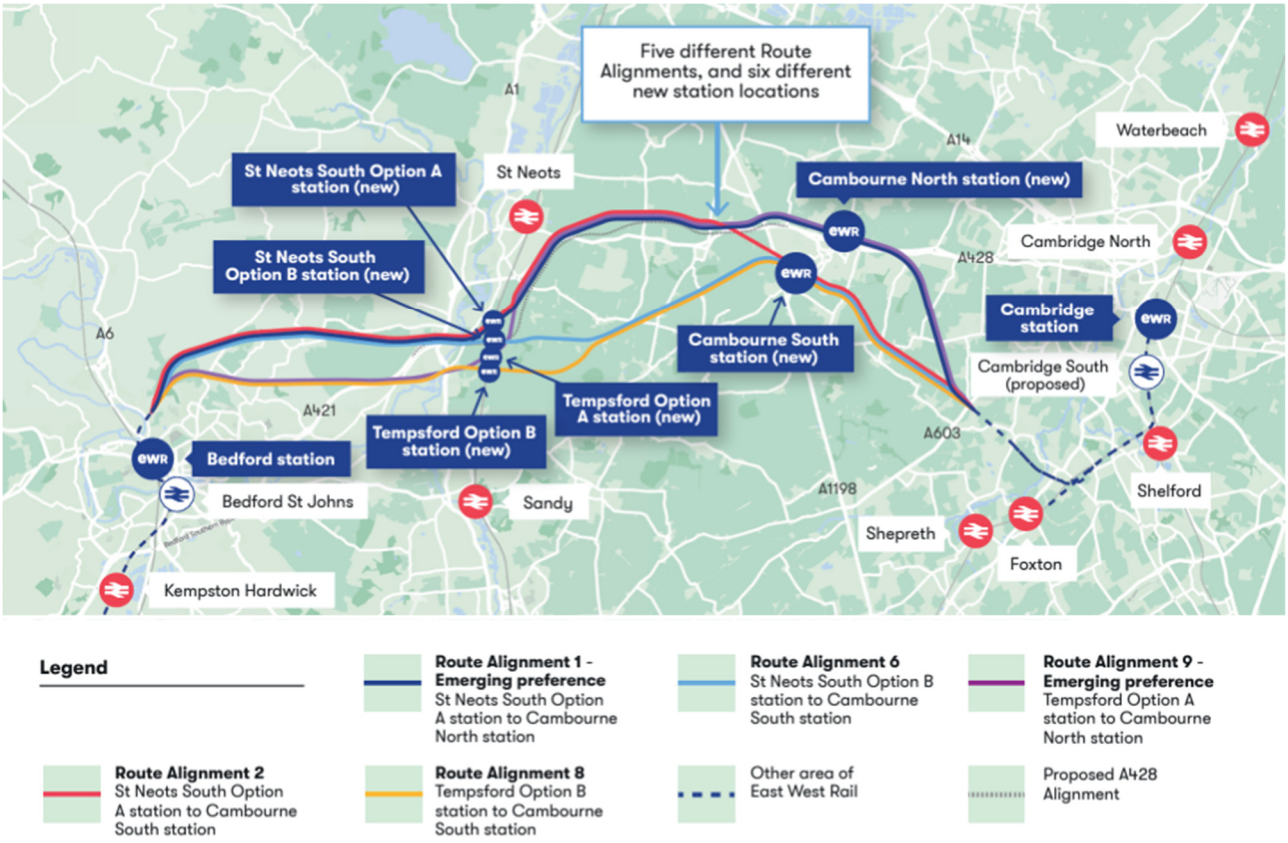


Figure 7: The five route options consulted on in 2021

These five Route Alignments were taken forward to a second non-statutory consultation in 2021.

3.8 2021 non-statutory consultation

A second non-statutory public consultation took place in early 2021. As part of this consultation EWR Co presented and sought views on the five route alignment options (Route Alignments 1, 2, 6, 8 and 9) based on the broad Route Option E that had previously been selected. This consultation also sought views on other elements of the scheme including proposals for upgrading the Bletchley – Bedford Marston Vale Line and potential further upgrades to the infrastructure and stations between Oxford and Bletchley.

In the consultation documents EWR Co declared an emerging preference for Route Alignments 1 and 9. This was primarily based on their performance in respect of assessment factor 2 (contribution to enabling housing and economic growth). EWR Co argued that this is the assessment factor to which the most weight should be attached, given the objectives of the scheme and that the underperformance (compared to other Route Alignments) of the two preferred options against some of the other assessment factors was outweighed by the positive performance against assessment factor 2.

The consultation ran for 10 weeks, from 31st March to 9th June 2021. As with the previous consultation, EWR Co engaged with local interest groups and prospective statutory consultees. The owners of land and property likely to be directly affected by the scheme were engaged with, and information packs were sent to those affected ahead of the start of the consultation.

A range of consultation documents, maps and other supporting materials was published on EWR Co's website and hard copies were made available by request. As a result of on-going restrictions relating to the

Covid-19 pandemic, face-to-face consultation events and meetings were, for the most part, not possible. To overcome this, a virtual consultation room was made accessible from the EWR Co website and a range of online meetings, webinars and live chat sessions were held. These events included sessions targeted as specific groups and events that were open to the general public.

EWR Co reports that a total of 9,775 responses to the consultation were received via email, completion of an online consultation response form, letter or hard copy consultation response form.

3.9 Affordable Connections Project

During 2022 and 2023, with the agreement of the Department for Transport, EWR Co carried out an exercise which they called "the Affordable Connections Project" (ACP). This project focused on:

- the need to reduce the capital cost of the scheme in light of the impact on public finances of the Covid-19 pandemic
- whether the strategic case for the scheme remained valid in light of changes in policy regarding the Oxford – Cambridge area with a shift away from central government leadership to local leadership.

ACP used the "Theory of Change" methodology[3] to explore the outcomes expected of the EWR scheme and the steps necessary to achieve those outcomes. The Project Objectives (comprising Sponsor's Requirements set by DfT and a Programme Wide Output Specification (produced by EWR Co in response to the Sponsor's Requirements)) were relaxed to allow consideration of a broader range of options (including modes other than heavy rail, such as cable car and Hyperloop systems) that might be capable of meeting the majority of strategic needs that the project aimed to fulfil but at a lower cost. The review included the consideration of alternative routes in the Bedford area, including routes passing to the south of the town and routes through the town that utilised the former "Varsity Line" alignment (i.e. the alignment of the former railway that linked Bedford to Cambridge prior to 1968).

An early conclusion of the review was that only heavy rail options were capable of providing the necessary capacity and travel times to expand catchments and unlock growth to a sufficient level.

Having then reviewed numerous heavy rail options (including alternative routes and service patterns), EWR Co concluded that routes to the south of Bedford should not be considered further. This is because, by calling at a station to the south of Bedford, they would serve a catchment with fewer homes and fewer jobs compared to options serving a station in central Bedford. A station south of Bedford would also result a smaller contribution to housing and employment growth.

Having then reviewed numerous heavy rail options (including alternative routes and service patterns), EWR Co further concluded that routes through Bedford via the former Varsity Line alignment should not be

[3] "Theory of Change" is a methodology used to define the outcomes expected from a project or initiative and the steps necessary to reach those outcomes. It is also used as an evaluation tool to determine how projects have performed against their intended outcomes. It is widely used in the voluntary sector and by international NGOs, government agencies and the UN.

considered further. Although such routes would have a lower capital cost, they would have a higher environmental impact than routes through Bedford station and onward via north Bedford.

Routes via the former Varsity Line alignment also performed less well in terms of rail operations. This is because, in order to serve central Bedford and provide connections with services on the Midland Main Line, some trains on the EWR route would have to operate to, from or via Bedford station. This would lengthen some journey times, and the more complex interactions between individual trains (with an increase in conflicting moves) would lead to lower performance (in terms of on-time arrivals) of the service overall.

The lower frequency of EWR trains at Bedford could also hinder regeneration of the area around the station.

A similar conclusion was reached in respect of routes passing further to the south of Bedford. EWR Co arued that this was because, by calling at a station to the south of Bedford, they would serve a catchment with fewer homes and fewer jobs compared to options serving a station in central Bedford. A station south of Bedford would also result a smaller contribution to housing and employment growth.

Having considered a range of alternatives (including the use of modes other than heavy rail), EWR Co's preferred Route Alignment is a variation of Route Alignment 1. The variant is referred to as "Route Alignment 1 Tempsford Variant". It follows the course of Route Alignment 1 except in the area around the A1 and East Coast Main Line, where it deviates from the original Route Alignment 1 to serve a proposed new interchange station at Tempsford, as shown below. The preferred Route Alignment perpetuates the proposed routing through Bedford station and along the Midland Main Line corridor through north Bedford.

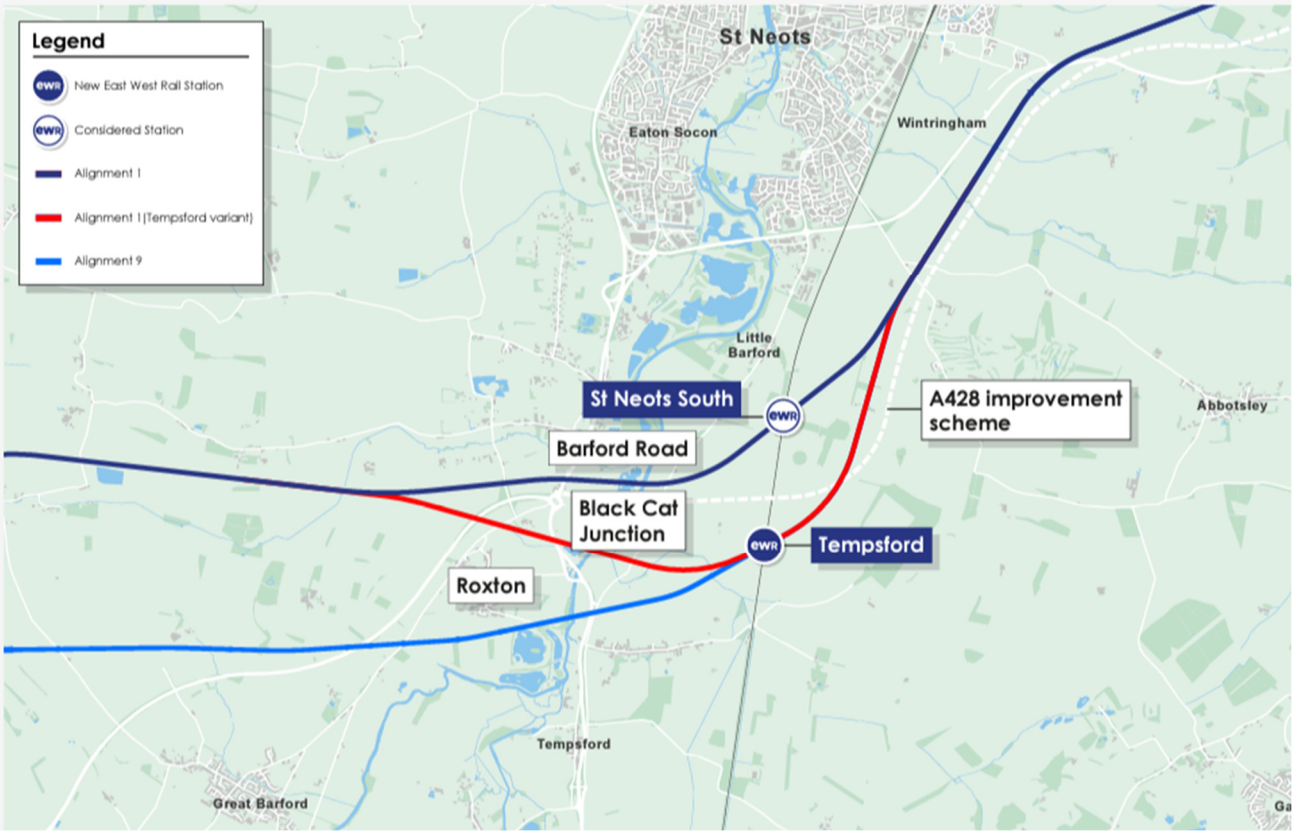


Figure 8: Route Alignments 1, 1 (Tempsford Variant) and 9 in the Tempsford area

In respect of the part of the alignment within Bedford Borough, EWR Co's rationale for the choice of Route Alignment 1 over Route Alignment 9 (the other emerging preference at the time of the 2021 consultation) is that Route Alignment 1 had a lesser impact on the environment and would be cheaper to construct than Route Alignment 9. Route Alignment 9 is also reported to have a greater impact on the village of Roxton, leaving it encircled by transport infrastructure (the A1 and A421 roads and the new railway) thereby restricting access to open countryside to the south.

EWR Co justifies the variation on Route Alignment 1 to serve a new station at Tempsford on the basis that it would be likely to generate more economic growth than a station at St Neots South. There is greater development potential at Tempsford due to:

- More consolidated land ownership (which increases the chances of larger-scale development being promoted and delivered)
- The ability to redevelop the former RAF Tempsford site thereby reusing brownfield land rather than previously undeveloped greenfield land.
- Better accessibility due to the area being less impacted by the severance effects of the new A428 dual carriageway
- Better placemaking opportunities due to the greater separation from St Neots
- The opportunity to enhance biodiversity through the creation of a wetland reserve and additional green spaces, both of which would also contribute to place-making.

The ACP concluded that there remains a compelling case for the project and that only a heavy rail solution was capable of delivering the desired outcomes. It also concluded that the outcomes could be achieved with an alternative train service pattern (to that included with the 2021 consultation), which could lead to a need for less new and upgraded infrastructure, and hence a reduction in the scheme costs. The proposed changes to the train service pattern primarily affect the Bletchley to Bedford section of the route, with fewer trains than previously proposed travelling west from Bedford.

3.10 Route Update Announcement (2023)

In May 2023, EWR Co published a Route Update Announcement (RUA). This summarised the feedback received during the 2021 non-statutory public consultation and the work that has taken place since the consultation, including ACP. The RUA also sets out the EWR Co preferred Route Alignment ("Route 1 Tempsford Variant") and the justification for this preference.

As part of the RUA EWR Co also reported on work done by them in response to feedback from the consultation to re-examine alternative routes between Bedford and the St Neots South / Tempsford area that avoid passing through the north of Bedford and the area to the north / northeast of the town. The routes considered are:

- Two routes utilising the former Bedford – Cambridge railway (the so-called "Varsity Line") alignment through the built-up area of Bedford. These have been referred to by EWR Co as "Varsity Hybrid" and "Varsity Hybrid via A421"
- Two variants of a route proposed by lobby group BFARe, passing to the south of Bedford.

These options are explained and explored further in section 6, below.

3.11 Next Steps

EWR Co currently anticipates undertaking a statutory consultation exercise during the first half of 2024. This will be followed by the submission of an application for a Development Consent Order (DCO), although no timescale for the application is declared in the RUA documentation.

The timeline from early development to Route Update Announcement is shown in Figure 9.

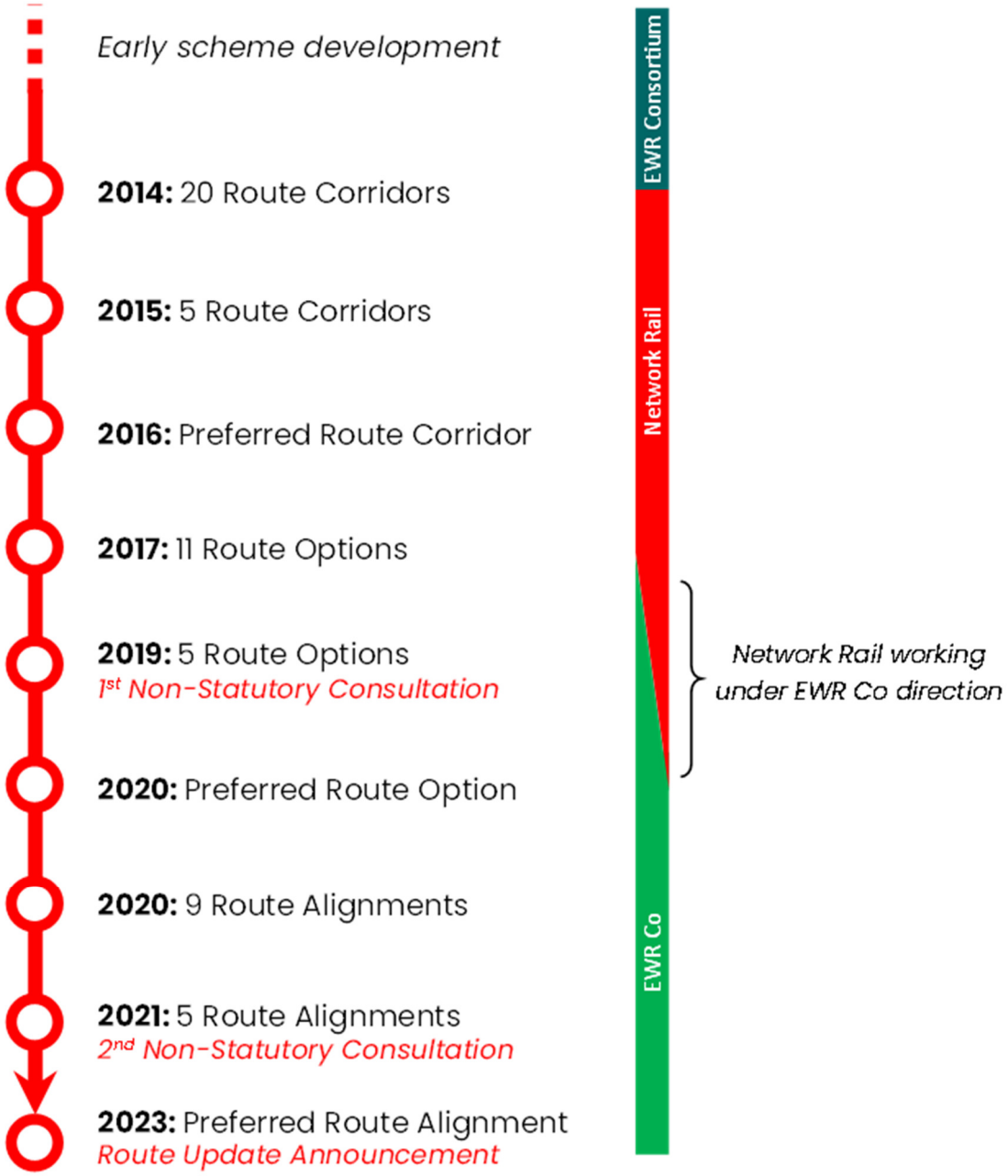


Figure 9: Route selection timeline

4 Was the process of decision-making sound?

The EWR scheme has undergone a phased development. The process started by testing a wide range of options for providing a new railway linking Oxford to Cambridge. At each stage the range of options has been narrowed and greater detail has been introduced to allow remaining options to be refined.

The decision-making processes used by EWR Co (and, prior to 2017, Network Rail) have been well documented. Scheme development has progressed in line with published objectives. Although the emphasis of these objectives has shifted slightly over time, the main themes have remained constant, i.e. to facilitate economic growth by providing better public transport options in the Oxford – Milton Keynes – Bedford – Cambridge corridor, while considering costs and environmental impacts and opportunities. Decision making criteria have been published and these relate well to the objectives of the scheme.

Having reviewed the 2020 decision by EWR Co to select Route Option E and the 2023 decision to prefer a variation of Route Alignment 1, we conclude that the decision-making process appears to have been soundly based.

5 Description of the preferred route alignment

As part of the May 2023 Route Update Announcement, EWR Co stated that its preferred route alignment was a variation of Route Alignment 1, referred to a "Route Alignment 1 Tempsford Variant". This route alignment enters Bedford from the southwest using the existing Marston Vale Line corridor, which it follows (save for a localised realignment in the vicinity of Bedford Hospital) to Bedford station. From Bedford station, the alignment parallels the existing Midland Main Line, with two additional tracks proposed next to the existing four-track railway, before diverging to the northeast in the vicinity of the Fairhill retail park. From here the alignment heads broadly east, passing to the north of Ravensden and Wilden before crossing the A421 road to the north of Roxton. It then crosses the A1 (just to the south of the Black Cat interchange) to reach a proposed new interchange station at Tempsford, where the alignment intersects the East Coast Mail Line.

From the new station at Tempsford, the alignment turns north and closely follows the route of the recently consented A428 Black Cat to Caxton Gibbet dual carriageway to a proposed new station to the north of Cambourne. From here, the alignment turns to the south to reach the Royston – Shepreth railway (known officially as "the Shepreth Branch") which it joins near the village of Harston. At the point where the new railway joins the Shepreth Branch, a localised realignment of the existing railway is proposed to facilitate provision of a grade-separated junction. The final part of the journey is along the existing railway corridor to Cambridge with four-track proposed from Shepreth Branch Junction to Cambridge station.

6 Potential alternative route alignments

In the 2023 RUA documentation EWR Co considers three alternatives to its preferred route alignment. This consideration was undertaken as sense-check in light of comments received from the public and others during the 2021 non-statutory public consultation.

The first alternative is what EWR Co have termed the Varsity route. The second is a variation of the first and is referred to as the Varsity Hybrid route. The third is BFARe's proposed alternative route. Two versions of the BFARe route described in the RUA documentation but the two variants are broadly similar.

In addition to the alternatives described in the RUA documents, Bedford Borough Council has requested that we also consider two further alternatives that have been proposed by the English Regional Transport Association (ERTA).

Each of these five alternatives is described in more detail below and are shown in Figure 10.

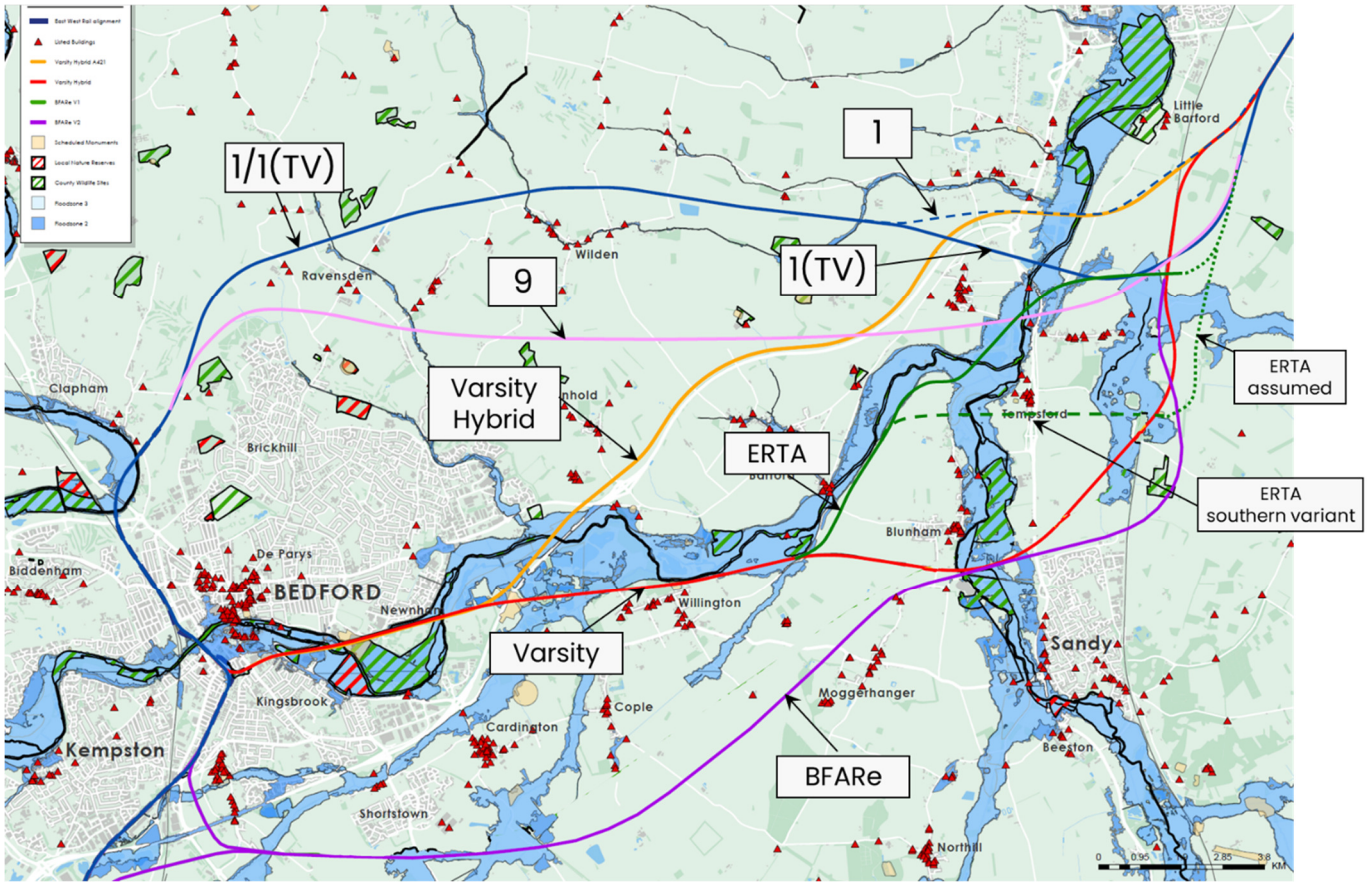


Figure 10: Alternative alignments considered by EWR Co (adapted from map published by EWR Co in connection with the Route Update Announcement)

6.1 EWR Co's "Varsity" route alignment

EWR Co's so-called "Varsity" route follows the alignment of the former Oxford – Cambridge railway from the Marston Vale Line near Bedford St John's to a point immediately to east of the former Blunham station. From

there the route leaves the former railway alignment and heads northeast, crossing the A1 and crossing the East Coast Main Line in the vicinity of the Tempsford Road level crossing.

The route then runs alongside (and to the east of) the East Coast Main Line, passing through the site of Tempsford station proposed in the preferred route alignment (Route Alignment 1 Tempsford Variant) and then joining the alignment of Route Alignment 1 from a point to the south of St Neots, through to Cambridge.

The precise infrastructure layout proposed in the Bedford area, including at Bedford station, is not reported in the RUA documents, although it appears that the proposal includes the realignment of the railway in the St Johns area that was described in the 2021 consultation as Option 1 (which included the relocation of St Johns station to a site close to Bedford Hospital). There is no detail on whether or not this option requires the relocation of Jowett sidings or on the scale or layout of any expansion or redevelopment of Bedford station to facilitate the proposed levels of service.

Our understanding of the train service that EWR Co considered with this infrastructure option is:

- 2 trains per hour (in each direction) between Oxford and Cambridge, not serving Bedford station. It is not clear from the RUA documents whether EWR Co were proposing that these services would serve an alternative station in Bedford (such as a relocated St Johns or a "Bedford South Parkway").
- 2 trains per hour (in each direction) between Bedford and Cambridge.
- 1 train per hour (in each direction) from Bletchley to Bedford (i.e. the existing Marston Vale Line service)

6.2 EWR Co's "Varsity Hybrid" route alignment

The "Varsity Hybrid" alignment is similar to the Varsity route described above but the route turns northeast immediately to the west of the point where the former Oxford – Cambridge railway alignment intersects the A421, and then closely follows the A421 (on its northwest side) towards the Black Cat interchange. Shortly before the Black Cat interchange is reached, the course of Route Alignment 1 is encountered. From this point, the Varsity Hybrid alignment follows Route Alignment 1 to Cambridge via an ECML interchange station at St Neots South.

Our understanding of the proposed train service for this infrastructure option is that it is as described above for the Varsity alignment option.

6.3 The BFARe route alignment

The alignment being promoted by BFARe broadly follows EWR Co's former Route B from the 2019 consultation. Two versions of this route alignment (V1 and V2) were shown in the RUA documentation published by EWR Co. During our meeting with BFARe they confirmed that V2 represents the group's current thinking. We have therefore only considered the V2 alignment.

This alignment diverges from the Marston Vale Line immediately to the Bedford side (northeast) of Kempston Hardwick station. From here the alignment turns to the east, passing through the site recently acquired by Universal Studios for the possible development of a theme park. The railway will then need to climb rapidly to cross above the Midland Main Line and A6. It passes to the south of Elstow and Shortstown before curving to the northeast just beyond Southill Road. The alignment then passes immediately to the west of Moggerhanger and south of Blunham before crossing the A1 and East Coast Main Line immediately north of

Sandy. Once over the ECML, the alignment turns north and runs alongside the ECML towards the proposed Tempsford station. It is not clear from the information provided where the alignments heads after Tempsford but it is reasonable to assume that it then joins one of the EWR Co route alignments towards Cambridge via Tempsford.

The BFARe route has two key differences when compared to Route B. The first of these is that BFARe are proposing a station to serve the Bedford area located at the site of the current Kempston Hardwick station, rather than at the intersection with the Midland Main Line as was proposed for Route B. It is envisaged that the station would be a "parkway" station, drawing its users from a wide catchment area. Although the location of the station would mean there is no direct interchange between EWR services and those operating on the Midland Main Line, Bedford Parkway is located around 1.4km from the proposed Wixams station. BFARe has suggested that a shuttle bus or similar could provide a connection between the new parkway station and Wixams station to facilitate interchange between the two routes.

The second difference is the inclusion of a chord line at the Bedford end of the alignment, allowing trains to access Bedford from the east. This chord line diverges from the main alignment to the south of Elstow and then turns very sharply to the north, passing over the A421 close to where the eastern slip roads to/from Elstow Interchange merge with the main A421 carriageway. The chord then parallels the A5141 before passing beneath the A5134 West End before turning sharply to merge with the Marston Vale Line towards Bedford.

In addition to the infrastructure differences, BFARe have also proposed an alternative Train Service Specification. This specification comprises:

- 2 trains per hour (in each direction) running direct between Oxford and Cambridge serving Bedford South Parkway
- 2 trains per hour (in each direction) between Bedford Midland and Cambridge
- 1 train per hour (in each direction) running between Oxford and Bedford.

The options for train services via southern alignments, including BFARe's, are examined in section 8.3.

6.4 The ERTA route alignment

ERTA has proposed an alignment that uses the former Oxford – Cambridge railway alignment from the Bedford St Johns area and through eastern Bedford. The ERTA alignment follows the former railway to a point immediately east of Barford Road (to the south of Great Barford) from where it turns broadly north-northeast, passing to the east of Great Barford and southeast of Roxton, crossing the A1 just south of the A1/River Great Ouse bridges. At this point the alignment turns east and intersects the East Coast Main Line to the north of Station Road level crossing.

At the Bedford end of the alignment, a 3-way triangular junction is proposed, allowing trains from Cambridge to serve Bedford station or by-pass central Bedford and proceed directly on to the Marston Vale Line, while also providing access to Bedford station from the Oxford direction. The proposal does not include an additional station in the Bedford area, but ERTA accepts EWRCo's proposal to relocate St Johns station closer to Bedford Hospital, and it would be possible to develop a new parkway station in the Kemspton Harwick area.

6.5 The ERTA variant route alignment

ERTA has also presented a variant of their alignment. This variant is identical to the main ERTA route alignment from the Masrton Vale Line to a point just to the north of Blunham Grange, where it turns sharply east, crossing the A1 just south of Church End and intersecting the ECML in the vicinity of the Tempsford Road level crossing.

With both the base and variant options, there is no detail of the onward route beyond the East Coast Main Line. The base option intersects the ECML at approximately the same location as EWR Co's preferred Route Alignment 1 (Tempsford Variant) and it is reasonable to assume that the railway would then proceed along the preferred route alignment to Cambridge via Tempsford. Although the variant option intersects the ECML further to the south, it is reasonable to assume that the alignment would swing to the north, parallel the ECML and then merge with the EWR Co preferred alignment in the general area of Little Barford.

A key feature of both the base and variant options is the inclusion of three chord lines linking the EWR and ECML routes west-north, west-south and east-north. No east-south chord is provided as access from the southern end of the ECML to Cambridge is already catered for by the Shepreth Branch.

ERTA has not proposed a detailed Train Service Specification but proposes that Oxford – Cambridge trains serve Bedford station with a reversal occurring en-route as a result. In addition, it notes that their proposed ECML junction would facilitate:

- operation of services from Biggleswade to Bedford and St Neots to Cambridge
- freight from the northern part of the ECML to access the EWR route towards the west with freight by-passing Bedford station by utilising the southern leg of the triangular junction near St Johns

7 Comparison of the route alignments

7.1 Introduction

Bedford Borough Council has asked us to consider the relative performance of the following alignments against a number of criteria:

- EWR Co's selected Route Alignment (Route Alignment 1 Tempsford Variant)
- EWR Co's Route Alignments 1 and 9
- EWR Co's two "Varsity" alignments (described in the 2023 Route Update Announcement)
- BFARE's proposed alignment to the south of Bedford
- ERTA's proposed alignment via the former Varsity Line

The criteria are:

1. Impact on residential properties
2. Environmental impacts including flooding
3. Carbon impacts
4. Construction costs
5. Operational costs
6. Economic rationale
7. Predicted benefits (including regeneration, GVA and housebuilding)
8. Construction impacts
9. Loss of car parking (both during construction and operation)
10. Air quality and associated health impacts during construction and operation with reference to Bedford's baseline NO_2 levels
11. Local traffic impacts at proposed station locations and proposals for their mitigation
12. Suitability for freight and the impact of it
13. Alignment with development sites identified in the draft 2040 Local Plan

In order to provide a comparative assessment, it is necessary to establish a reference case against which other options can be compared. The choice of reference case does not affect the outcome of the assessment. We have taken Route Alignment 1 (Tempsford Variant) as our reference case. We have assessed whether each of the other route represent a minor improvement, major improvement, minor worsening or major worsening compared to the reference case.

We have limited our assessment of each route to those sections of the route that fall within Bedford Borough. Given the time available for this study and the level of detail available for each of the routes, we have undertaken a qualitative comparative assessment of each of the route against the above factors based on available information.

Set out below is our comparative assessment of each of the alignment options against each of the criteria detailed above.

7.2 Impact on residential properties

EWR Co Route Alignment 1 (Tempsford variant)

In common with other route alignments options that pass through the northern part of Bedford, the impact on residential properties will vary depending on whether or not two additional tracks are to be provided alongside the existing Midland Main Line north of Bedford. EWR Co's stated position in the RUA documents is that the additional tracks are required and therefore 65 residential properties will be directly impacted – 37 are at risk of demolition and a further 28 are likely to lose land within the curtilage of the property (generally garden land or parking areas).

In addition to the direct impacts the railway will, in common with the existing Midland Main Line, be close to numerous residential properties in north Bedford. Modern railway schemes routinely include noise and vibration mitigation measures to reduce impacts on nearby residential properties and other sensitive receptors. These are normally specified as part of the consenting process. The precise details of these measures and the extent to which they are able to mitigate the impacts of the scheme will be subject of detailed modelling at a later stage in the scheme development. It is possible that the mitigation measures provided for the additional EWR tracks could also reduce the existing impacts of the Midland Main Line. It is therefore possible, although not guaranteed, that some properties in north Bedford will experience a slight reduction in exposure to railway-related noise as a result of the scheme.

Beyond north Bedford it is not thought that any further residential properties are directly impacted within Bedford Borough. A number of properties will be indirectly affected by the proposed railway due to their proximity to the alignment. These impacts are likely to be limited to noise and visual impacts. The precise extent of those impacts is not clear at this stage and in many cases may be relatively minor. The greatest risk of impact applies to properties in the south / southeast parts of Clapham, isolated properties in the area north of Ravensden, properties in or close to Wilden; isolated properties between Wilden and Chawston; and properties at the north end of Roxton.

To the east of Bedford Borough, three residential properties to the east of the borough may require demolition and there are several areas where residential properties are at risk of indirect impacts.

EWR Co Route Alignment 1

The impacts on residential property in north Bedford for Route Alignment 1 are identical to those described above for Route Alignment 1 (Tempsford Variant). Route Alignment 1 also impacts a property south of Little Barford that is not impacted by Route Alignment 1 (Tempsford Variant). Impacts to the east of Bedford Borough are the same as for Route Alignment 1 (Tempsford Variant).

The indirect impacts on residential properties of Route Alignment 1 are similar to those of Route Alignment 1 (Tempsford Variant). However, Route Alignment 1 remains to the north of the A421 near Roxton and therefore has a lesser indirect impact on residential properties in Roxton and a greater impact on properties in Chawston.

EWR Co Route Alignment 9

The impacts on residential property in north Bedford for Route Alignment 9 are identical to those described above for Route Alignment 1 (Tempsford Variant). Between the divergence from the Midland Main Line (immediately north of Bedford) and the eastern borders of Bedford Borough, this route alignment does not

directly impact any residential properties (i.e. no residential properties require demolition). Indirect impacts are different to those for Route Alignment 1 (Tempsford Variant). There will be indirect impacts to properties in Clapham, some northern parts of Bedford (notably Woodland Park), Ravensden, isolated properties between Renhold and Wilden and properties in the southern part of Roxton.

Impacts to the east of Bedford Borough are the same as for Route Alignment 1 (Tempsford Variant), except that there will be indirect impacts to residential properties just beyond Bedford Borough, in Tempsford.

EWR Co Varsity alignment

Based on the mapping published by EWR Co the Varsity Alignment appears not to require the demolition of any residential properties in Bedford Borough.

However, there are likely to be indirect impacts on residential properties within Bedford (in the St Leonards area and the southern part of Goldington) and in Willington. Beyond the eastern boundary of Bedford Borough there will be further indirect impacts in the southern part of Blunham and northern parts of Sandy.

The Varsity Route Alignment merges with Route Alignment 1 south of Little Barford. Impacts beyond this point are the same as for Route Alignment 1.

EWR Co Varsity Hybrid alignment

The impacts of the Varsity Hybrid Alignment are the same as those of the Varsity Alignment between the western end of the alignment (near St Johns), through the south of Bedford to the point where the route turns northeast to follow the A421.

From this point to the eastern edge of Bedford Borough there are no direct impacts on residential property. There will be indirect impacts on properties in Roxton and Chawston. In respect of the impacts on Roxton the route is on the opposite side of the A421 and will be less significant than for Route Alignment 1 (Tempsford Variant) and Route Alignment 9.

To the east of Bedford Borough the impacts will be the same as for Route Alignment 1.

BFARe alignment

The BFARe Alignment will require the demolition of residential properties between West End and the Marston Vale Line in southern Bedford (Kempston) as part of the construction of the chord line providing access to Bedford station from the east. Given the stage of development of the BFARe proposal (which, understandably, is at a comparatively lower level of detail), it is not possible to determine precisely the likely number of properties that would be affected. In particular, we note that the proposal as presented includes a sharp radius curve at the north end of the chord line. This curve is likely to have to be eased (i.e. its radius is likely to increase) in order to make the proposal operationally viable. It is likely that properties on West End, St Mary's Close and, potentially, Little Townsend Close would be directly impacted. At this stage, our best estimate is that between 10 and 20 (residential) properties could be affected.

As presently drawn the alignment would also potentially involve demolition of residential properties at the southern end of Elstow. However, we believe that it might be possible to move the alignment slightly further south in this area to avoid these impacts. Also, the alignment appears to directly impact several properties in Chalton (south of Blunham). Again, a localised realignment might be possible in this area to avoid these impacts.

Indirect impacts on residential properties are likely in southern Bedford (where the east-north chord meets the Marston Vale Line), Elstow, Shortstown, Water End, Moggerhanger, Charlton, Blunham and the northern part of Sandy.

To the east of Bedford Borough, we presume the alignment merges with EWR Co's Route Alignment 1 and therefore the impacts (direct and indirect) on residential property would be the same.

ERTA alignment

Although less precisely defined than the other potential Route Alignments described in this report, it appears (from the mapping provided by ERTA) that no residential properties within Bedford Borough are directly impacted by the base version of the alignment. The variant alignment with its more southerly route in the Tempsford area, would require the demolition of several residential properties at Tempsford Church End.

There are indirect impacts on residential properties in Bedford (in the St Leonards area and the southern part of Goldington), in Willington, the eastern side of Great Barford and the southeastern corner of Roxton.

The ERTA alignment is only defined as far as the intersection with East Coast Main Line in the Tempsford area. Assuming the alignment then follows EWR Co Route Alignment 1 (Tempsford Variant), the impacts on residential properties would be the same as for that option to the east of Bedford Borough.

Discussion

Of the Route Alignments considered in this report, three (Varsity, Varsity Hybrid and ERTA) appear not to require any residential property demolitions within Bedford Borough. The BFARe alignment requires residential property demolition, but without further development of the alignment it is not possible to say with any certainty precisely how many properties are affected. It seems likely that further development of this alignment could remove the need for residential property demolitions outside of Bedford but that numerous properties within Bedford would be impacted. Route Alignments 1 (Tempsford variant), 1 and 9 require the greatest number of demolitions due to the proposed additional tracks alongside the Midland Main Line in Bedford.

It is difficult to directly compare the indirect impacts of each alignment, especially given the current level of development of each alignment and its associated mitigation measures. However, it is apparent that Route Alignments 1 (Tempsford Variant), 1 and 9 have more properties within 25m of the railway than the other options due to their proximity to housing in the Midland Main Line corridor through north Bedford. Although ERTA has not specified a train service pattern, the implication is that all trains would serve Bedford Midland where they would reverse. This would result in a higher frequency of trains than other options on the section of line between Bedford St Johns and Bedford station, which passes close to residential properties adjoining the railway on Palgrave Road – but this is a function of the train service pattern rather the route alignment itself.

We therefore assess that the southerly route alignments (Varsity, Varsity Hybrid, BEFARe, ERTA and ERTA Variant) all perform better than the reference case (Route Alignment 1 (Tempsford Variant)). The BFARe alignment performs least well of the southerly alignments because of the need for demolitions near West End (Bedford). Route Alignments 1 and 9 perform the same as the reference case in respect of impact on residential properties.

7.3 Environment (including flooding) and heritage impacts

EWR Co Route Alignment 1 (Tempsford variant)

EWR Co's preferred route alignment has been designed to avoid to some of the more significant environmental features in the area it traverses. However, it passes through two significant areas with respect to flooding risk. The Environment Agency categorises land as being in one of three "Flood Zones". Areas within Flood Zone 1 are deemed to have the lowest risk of flooding (<0.1% annual probability of flooding) while those in Flood Zone 3 have the greatest risk (>1% annual probability of flooding). There are the fewst restrictions on development in Flood Zone 1 while development in Flood Zone 3 is subject to the greatest restrictions.

The first of the areas encountered by Route Alignment 1 (Tempsford Variant) is an area of Flood Zone 3 associated with the River Great Ouse immediately to the north of Bedford near Clapham. In this area, the railway will be climbing and is expected to be constructed on viaduct through the area affected by flood risk, partly in response to flood risk but also because of the need for the railway to cross the river and the adjacent A6.

Flood Zone 3 is also encountered to the east of Roxton and immediately west of the proposed Tempsford station. Again, the railway is expected to be constructed on viaduct in this area to bridge the River Great Ouse, the A1 and the East Coast Main Line.

Although detailed flood modelling will be required to understand the precise flood risk impacts, it is likely that the impacts will be relatively minor due to the elevated nature of the railway in these areas.

This route alignment does not directly impact any areas of ancient woodland within Bedford Borough, although it does pass close to several ancient woodlands, namely Clapham Park Wood, Great Wood and Little Wood (near Wood End), Lady Wood (south of Colesden) and Sir John's Wood (immediately beyond the boundary of Bedford Borough to the east of the East Coast Main Line near Tempsford).

No Sites of Special Scientific Interest within Bedford Borough are impacted by this route alignment. There are no direct impacts on any Local Wildlife Sites or County Wildlife sites within Bedford Borough, although the route alignment does pass relatively close to several such sites, most of which appear to coincide with ancient woodlands, described above.

There are no direct impacts from this route alignment on Scheduled Monuments. However, the route alignment passes close to a number of scheduled monuments and could therefore impact the significance of some or all of these due to changes to their setting. The affected monuments are:

- Palaceyard Wood medieval moated enclosure and associated enclosures, woodland bank and cultivation earthworks (within 750m),
- Bowl barrow known as the "Round Hill" 440m WNW of College Farm (within 100m)
- Tempsford Bridge (within 150m).

Within Bedford Borough, most of the agricultural land crossed by this route alignment is Grade 2 or lower. The exception to this is in the vicinity of Roxton where a short length of the route crosses Grade 1 land.

EWR Co Route Alignment 1

The environmental impacts of this alignment are broadly similar to those of Route Alignment 1 (Tempsford Variant). The only notable difference is that this route alignment is further away from the ancient woodland at Sir John's Wood (near Tempsford). This route alignment also crosses less of Flood Zone 3 in the Tempsford/St Neots area.

There are no direct impacts from this route alignment on Scheduled Monuments. However, the route alignment passes close to a number of scheduled monuments and could therefore impact the significance of some or all of these due to changes to their setting. The affected monuments are:

- Palaceyard Wood medieval moated enclosure and associated enclosures, woodland bank and cultivation earthworks (within 750m),
- Bowl barrow known as the "Round Hill" 440m WNW of College Farm (within 100m)
- Chawston Manor moated site and associated fishpond (within 750m).

Within Bedford Borough the majority of the agricultural land crossed by this route alignment is Grade 2 or lower. The exception to this is in the vicinity of Chawston and the A1 where a Grade 1 land is encountered.

EWR Co Route Alignment 9

In terms of flooding impacts Route Alignment 9 is similar to Route Alignment 1 (Tempsford Variant), although a slightly greater length of the route in the Roxton / Temsford area is within Flood Zone 3. As with Route Alignment 1 (Tempsford Variant), the resulting impacts can only be fully understood following completion of detailed flood modelling work. However, we note that the railway is likely to be elevated in the vicinity of the areas within Flood Zones 2 and 3 and the use of viaducts to bridge the areas of flood zone is likely to minimise potential flooding impacts.

This alignment passes closer to the ancient woodland at Clapham Park Wood than Route Alignment 1 (Tempsford Variant). It also passes close to ancient woodland at Little Early Grove and Great Early Grove and relatively close to Palaceyard Wood (between Green End and Colesden) but is further away from Great Wood, Little Wood and Lady Wood. It is a similar distance from Sir John's Wood.

This alignment passes close to the Scheduled Monument at Birchfield Farm but would not have a direct impact upon it. The alignment does not directly impact any Scheduled Monuments but does pass within close proximity of, and therefore has the potential to affect the setting of, the following Scheduled Monuments:

- Mowsbury Hill: slight univallate hillfort and medieval moated site (within 600m)
- Birchfield Farm moated site and associated fishponds and leats (within 450m)
- Palaceyard Wood medieval moated enclosure and associated enclosures, woodland bank and cultivation earthworks (within 700m)
- Bowl barrow known as the "Round Hill", 450m WNW of College Farm (within 100m).

Route Alignment 9 does not impact any Sites of Special Scientific Interest or Local or County Wildlife Sites.

Within Bedford Borough, the majority of the agricultural land crossed by this route alignment is Grade 2 or lower. The exception to this is in the vicinity of Roxton where a short length of the route crosses Grade 1 land.

EWR Co Varsity route alignment

A large swathe of the part of southern Bedford and the area to the east of the town through which the Varsity Route Alignment passes lies within Flood Zone 3. However, the former railway alignment that this route alignment follows is located on embankment. This has resulted in the majority of the former railway alignment being either classified as Flood Zone 2 or being deemed to be outside the of both Zones 2 and 3. More detailed and precise flood modelling would be required to determine the precise extent of the former railway alignment that is at risk of flooding as it is possible that the high-level modelling undertaken to inform the Environment Agency's flood mapping does not accurately reflect the precise dimensions of the former railway embankment.

The route alignment passes through further areas within Flood Zone 3 near Blunham and again near Tempsford. Both areas are close to intersections with major features (River Great Ouse, the A1 and the East Coast Main Line) and it likely that the railway would need to be elevated through much of the length within Flood Zone 3 in order to facilitate crossing these features.

The Varsity Route Alignment runs through two County Wildlife Sites, the first being around the site of the original Bedford St Johns station, and the second extending from Cardington Road into Priory Park to the east. This second County Wildlife Site includes all of the alignment between Cardington Road and the access road into Priory Park from Barker's Lane (a distance of around 1.4km) and continues alongside the alignment for around a further 900m. The site also extends across the alignment at its eastern end at Allen's Bridge. There is a further County Wildlife Site at Willington that extends across the Varsity Route Alignment.

This alignment does not impact any areas of ancient woodland or Sites of Special Scientific Interest within Bedford Borough.

There are several areas along this alignment that are designated Scheduled Monuments. The first is the site of Newnham Priory, near Barker's Lane in Bedford. The former Oxford – Cambridge railway alignment (which is coincident with this route alignment) runs through the site but is excluded from the scheduling. However, the proximity of the scheduled area to the alignment means that the reinstatement of the railway could have impacts on the scheduled area during the construction phase and could impact the setting of the monument.

To the east of Bedford in the vicinity of the intersection of the route alignment with the A421, there is a series of Scheduled Monuments associated with a neolithic and bronze age mortuary complex. The route alignment passes through the main site immediately to the east of the A421 and passes in close proximity to several smaller sites associated with the main site. The scheduling of the main site excludes the A421 and its embankment but includes the former Oxford – Cambridge railway alignment over a distance of around 500m. This route alignment also passes through the scheduled monument known as "The Docks" moated site and docks at Willington. As such, this route alignment would have a direct impact on these monuments and would impact their setting.

A further Scheduled Monument is encountered beyond the Bedford Borough boundary, near Tempsford and the East Coast Main Line, this being the Biggin Wood moated enclosure.

A notable feature of this route alignment (and others that utilise the former Oxford – Cambridge railway alignment through southern Bedford) is that it passes through Priory Country Park. The park was established in the 1980s, after the former railway had closed. Most of the former railway alignment through the country park is now used as a cycling and walking route. This use continues beyond the eastern boundary of the

country park. As open space benefits from special protections conferred by the Land Acquisition Act 1981, acquisition of the land within the country park and, potentially, also the walking/cycling route beyond the park, for incorporation into the new railway would not be straightforward.

Within Bedford Borough, this alignment crosses agricultural land of Grades 1 to 3. Between Willington and Blunham, the alignment crosses Grade 1 land but over this section, the route alignment follows the former Oxford – Cambridge railway formation, which is not agricultural. Beyond the Bedford Borough boundary, the alignment also traverses a section of Grade 4 land adjacent to and to the east of the East Coast Main Line.

EWR Co Varsity Hybrid alignment

The impacts for this alignment are identical to the Varsity Alignment described above from the Bedford area to shortly before the intersection of the Varsity Alignment and the A421 (where the two route alignments diverge). From the point of divergence the alignment crosses an area of Flood Zone 3 over a distance of around 1.75km.

In this area the alignment is coincident with a large former landfill site.

There are also several discrete areas in very close proximity to the route alignment (and potentially conflicting with it) that are designated Scheduled Monuments. These Scheduled Monuments are associated with the neolithic and bronze age mortuary complex described above (but are each scheduled separately). The route alignment also passes close the following Scheduled Monuments and could impact their setting:

- Howbury ringwork and medieval trackway (within 300m)
- Birchfield Farm moated site and associated fishponds and leats (within 650m)
- Palaceyard Wood medieval moated enclosure and associated enclosures, woodland bank and cultivation earthworks (within 750m),
- Bowl barrow known as the "Round Hill", 440m WNW of College Farm (within 100m)
- Chawston Manor moated site and associated fishpond (within 900m)

Beyond the intersection of the route alignment with the A4280, just beyond this area, the alignment passes relatively close to ancient woodland at Palaceyard Wood. It then passes in close proximity to the Round Hill Scheduled Monument, northwest of Roxton. Shortly after this, the route alignment merges with Route Alignment 1 before crossing a further area of Flood Zone 3 to the east of the A1.

There are no further significant environmental impacts within Bedford Borough.

Within Bedford Borough most of the agricultural land crossed by this route alignment is Grade 2 or lower. The exception to this is in the vicinity of Roxton, Chawston and the A1 where a Grade 1 land is encountered.

BFARe route alignment

The BFARe route alignment passes through a number of areas of Flood Zones 2 and 3. The most significant of these is to the south of Shortstown and Cardington where the alignment lies within Flood Zone 3 over a distance of around 1.6km. There are further interactions with Flood Zone 3 beyond the boundary of Bedford Borough near Sandy and near Tempsford.

At the eastern end of the alignment it crosses the Elstow landfill site, immediately between the Midland Main Line and the A6.

The alignment passes close to ancient woodland at Sheerhatch Wood (southwest of Moggerhanger) and through an area of ancient woodland at Bottom Wood, just beyond the Bedford Borough boundary. Bottom Wood lies within Moggerhanger Park which is a Registered Park.

This alignment passes within 500m of the Manor Farm moated site Scheduled Monument located to the east of Cotton End, near Southill Road and could therefore impact its setting. The alignment also passes close to the Grade II* listed airship sheds at Cardington and, by virtue of impacts on the associated flying field, could be deemed to have an impact on the setting of the sheds. Beyond the Bedford Borough boundary, the alignment comes in close proximity to (and possibly conflicts with) the Scheduled Monument known as Biggin Wood moated enclosure.

Within Bedford Borough, the majority of the agricultural land crossed by this route alignment is Grade 2. Grade 1 land is encountered over a short distance to the east of Bedford Borough, in the vicinity of Moggerhanger and Blunham. Grade 4 land is traversed where the route alignment runs parallel to the East Coast Main Line near Tempsford.

ERTA route alignment and ERTA variant route alignments

The ERTA Route Alignment and the ERTA Variant Route Alignment are identical to the EWR Co Varsity Route Alignment from the Bedford St John's area to the point where the alignment intersects Barford Road. The impacts will therefore be identical to those described above for the Varsity Route Alignment as far as this point. From here, the alignments broadly follows the course of the River Great Ouse and, as a result, is within or very close to the edge of Flood Zones 2 or 3 for most of the route to the East Coast Main Line near Tempsford. As such, the alignment lies within or in very close proximity to Flood Zones 2 and 3 over the majority of its length. The ERTA Variant route alignment is in Flood Zone 3 over slightly less of its length but does encounter further areas of Flood Zone 3 near Church end and in the vicinity of the East Coast Main Line.

The ERTA route alignment passes within 250m of the Tempsford Bridge Scheduled Monument and within 350m of Barford Bridge Scheduled Monument and there is, therefore, a risk that the railway would affect the setting of these monuments.

The ERTA Variant alignment passes close to the Gannocks Castle Scheduled Monument and the proposed intersection and junction with the East Coast Main Line would conflict with the Scheduled Monument at Biggin Wood.

Neither the base nor variant alignments impact any ancient woodland or Sites of Special Scientific Interest within Bedford Borough or the areas immediately beyond the boundary of the borough, although there is potential for the base alignment to come close to or conflict with the ancient woodland at Sir John's Wood, just beyond the borough boundary. This site lies in the area in which the ERTA route is not clearly defined.

Within Bedford Borough the majority of this alignment follows the course of the former Oxford – Cambridge railway. Where it diverges from the former railway, just beyond the borough boundary, the route runs close to the River Great Ouse and crosses a significant stretch of Grade 1 agricultural land between the divergence point and a point north of Blunham. The route beyond the East Coast Main Line is not defined but it is reasonable to assume that it would follow a similar alignment to other southern alignments, alongside the East Coast Main Line, where Grade 3 and 4 land is encountered.

Discussion

Of the routes considered, EWR Co's preferred route alignment, Route Alignment 1 (Tempsford Variant), has the fewest impacts on designated environmental features. Although the route passes relatively close to a number of areas of ancient woodland and a number of Scheduled Monuments, it does not directly impact any of them.

The total length of this route alignment that lies within Flood Zones 2 and 3 is significantly less than the Varsity, Varsity Hybrid, BFARe and ERTA route alignments. As noted above, the true extent of Flood Zones 2 and 3 in the vicinity of the former Oxford – Cambridge railway alignment in southern Bedford may not be as shown on Environment Agency mapping and it is possible that the flood impacts of an operational railway on the former alignment may be capable of mitigation. However, it is likely that re-use of the former railway alignment would involve construction activity within Flood Zone 3, which would require careful planning and is likely to increase construction costs and import programme risk.

Although the BFARe Route Alignment lies within an area of Flood Zone 3 to the south of Shortstown and Cardington, it is possible that the route could be locally realigned to reduce the interactions with Flood Zone 3 in this area. However, the total length of route within Flood Zones 2 and 3 would still be greater than any of EWR Co Route Alignments 1, 1 (Tempsford Variant) and 9.

The ERTA route alignment, as currently proposed, is within Flood Zone 3 for most of its length. Notwithstanding our previous comments regarding the accuracy of Flood Zone mapping in the vicinity of the former railway embankment, it is likely that the scale of required mitigation measures would be prohibitive. Moving the alignment slightly further away from the River Great Ouse over the section between the divergence from the former railway and Tempsford would significantly reduce the length over which the route is within Flood Zone 2 or 3.

The Route Alignments that follow the former Oxford – Cambridge railway alignment have numerous direct interactions with Scheduled Monuments. In the case of the Varsity Route Alignment and the ERTA route alignment, these interactions are limited to locations where the archaeology associated with the monuments is likely to have been impacted by the construction of the original railway. However, these interactions present a considerable risk to the scheme and, even if an agreeable solution can be found (which is by no means guaranteed), will add to scheme costs, complexity and programme. In the case of the Varsity Hybrid Route Alignment, there are also interactions with Scheduled Monuments in locations not affected by the construction of the original railway (close to the divergence from the original railway alignment) and the risk of harm is therefore greater. The BFARe Route Alignment and Route Alignments 1, 1 (Tempsford Variant) and 9 do not interact directly with any Scheduled Monuments within the borough. However, the BFARe alignment passes close to the Grade II* listed Cardington airship hangars and risks harming their setting.

In terms of impacts on the best and most versatile agricultural land, all routes alignments encounter Grade 1 land at some point. The ERTA alignment appears to impact the largest amount of Grade 1 land. The BFARe alignment is located on Grade 3 or Grade 2 land for much of its journey through Bedford Borough. The northern alignments are mostly on Grade 2 land. Alignments that re-use the former Oxford – Cambridge railway alignment impact the least amount of agricultural land.

In terms of environmental impacts, we therefore assess that all of the southerly route alignments (Varsity, Varsity Hybrid, BFARe, ERTA and ERTA Variant) perform less well than the reference case (Route Alignment 1

(Tempsford Variant). Route Alignments 1 and 9 perform the same as the reference case except that Route Alignment 9 performs slightly less well in terms of impacts on heritage assets.

7.4 Carbon impacts

The current level of development of each of the route alignments does not permit a formal carbon assessment to be undertaken. In particular, there is relatively little information available on the Varsity, Varsity Hybrid, BFARe and ERTA Route Alignments, all of which are currently only developed to the stage of an approximate horizontal alignment.

The carbon impact of each Route Alignment will be split between carbon emissions caused by construction activity, embedded carbon and carbon emissions during the operational phase of the railway.

Without a detailed construction methodology it is not possible to determine the relative emissions of each Route Alignment. We have therefore considered the general principles relating to carbon impacts and how these might affect each route alignment.

Within the construction sector there is a gradual move to the use of electric instead of diesel plant. By the time construction of this railway commences it is likely that carbon emissions from construction plant will have been reduced significantly from levels that would be expected with current diesel plant. It must, however, be borne in mind that the carbon impacts of electric plant are dependent on the generating methods used in the production of the electricity that is consumed. The quantum of plant required and over what duration will vary between each of the route alignments but will, in part, depend on the construction programme and methodology.

Earthworks are a significant source of carbon emissions. These principally arise from the quantum of plant movements involved in the construction of earthworks (including the vehicles used to move materials along the course of the alignment, whether for reuse, disposal or import) and from carbon released from soils when disturbed. Disturbed soils are also less able to sequester carbon while stockpiled and in transit. Those route alignments to the north of Bedford (i.e. Route Alignments 1, 1 (Tempsford Variant) and 9) traverse an area that is more undulating than that encountered to the south of the town. It is therefore likely that carbon impacts from earthworks will be higher for the northern route alignments.

The use of concrete is associated with a significant volume of embedded carbon. Concrete is widely used in major infrastructure schemes such as railways in the construction of bridges and viaducts. Therefore, routes with more major structures are likely to have higher levels of embedded carbon. Route Alignments 1, 1 (Tempsford Variant) and 9 all feature several major viaduct structures including the crossing of the River Great Ouse, A6 and other features near Clapham and a viaduct in the region of 3km in length crossing the A1, River Great Ouse, East Cost Main Line and other features to the north of Tempsford. Although detailed proposals do not exist for the other route alignments, it likely each of them will require a large viaduct in the Tempsford area. Other viaducts, bridge structures, culverts and drainage features are likely to be required for these routes where they interact with Flood Zones 2 and 3. It is likely that the BFARe route alignment would entail a large viaduct at the alignment's western end to cross the A6, Midland Main Line and other features.

Materials haulage can be a significant source of carbon impacts on long linear infrastructure schemes. The extent of these impacts will be dependent on the volumes of materials that have to be imported or exported, where those materials are sourced from and the mode used for delivery. Delivery by rail will have a lower

impact than delivery by road but is likely to be impractical for a significant proportion of the materials required. The impact of materials haulage will, obviously, vary according to the volume of materials demanded by each route alignment. At this stage of development and within the time available for this piece of work, it is not possible to determine the relative impacts for each Route Alignment.

Operational carbon impacts will be primarily associated with the operation of trains. The factors affecting the scale of these impacts include the traction type employed (i.e. whether trains are powered by diesel, electricity or an alternative power source), the speed profile of the route, stopping patterns of individual services route lengths and gradients. The operational carbon impacts are likely to be broadly similar for all of the route alignments although marginal differences will arise as a result of differences in the factors described above. A meaningful assessment and comparison of operational carbon impacts will only be possible when (and if) each of the route alignments is developed further.

7.5 Construction costs

Due to the level of development of all of the Route Alignments other than 1, 1 (Tempsford Variant) and 9, it is not possible to produce a detailed comparison of construction costs. However, there are a number of factors that are likely to affect the cost of each route alignment and these are discussed below.

Earthworks

The extent and scale of earthworks will be a significant driver of construction costs. All route alignments require considerable volumes of earthworks. The Varsity, Varsity Hybrid, ERTA, ERTA Variant and BFARe route alignments cross terrain that is generally flatter while Route Alignments 1, 1 (Tempsford Variant) and 9 cross undulating land and, in particular, will require the formation of a sizable cutting or tunnel to the south of Clapham. In the case of Route Alignments 1 and 1 Tempsford Variant, this extends for around 2.5km and has an average depth of around 10m. It is therefore likely that the three northerly options will have the highest earthwork costs with Route Alignments 1 and 1 (Tempsford Variant) being highest.

The Varsity, Varsity Hybrid, ERTA and ERTA Variant route alignments all utilise the alignment of the former Oxford – Cambridge railway over part of their length. The relevant part of the former railway was located on a low embankment. The suitability of this former railway embankment for reuse has not yet been established but it is highly likely that it will require significant remediation, strengthening and widening works to ensure compliance with modern standards and to remedy defects that will have arisen since the former railway closed and maintenance of the embankment ceased.

Structures

The number and scale of structures will be a further significant cost driver. The northerly route alignments incorporate significant viaduct structures in the Clapham area and in the Roxton / Tempsford / Little Barford area. The latter viaduct is associated with the crossing of the A1, River Great Ouse and East Coast Main Line. These are features which all route alignments cross and it is likely that the southerly routes would also require similarly large viaducts to cross these obstacles. The southerly routes are also within or close to flood zones 2 and 3 for more of their length than the northerly routes. This is likely to result in the need for extensive use of flood relief structures (such as culverts) or, potentially, viaducts to allow flood waters to flow beneath the railway. Of the southerly options, the BFARe route alignment is within or adjacent to Flood Zones 2 and 3 for the shortest distance and is therefore likely to have lower structures costs than the other southerly options.

Property acquisition and demolition

The need to acquire and demolish residential and other properties will add to construction costs. Property acquisition and demolition costs will be highest for the northerly route alignments, which require the acquisition of 66 properties (based on EWR Co figures). The BFARe option is also likely to entail the acquisition and demolition of between 10 and 20 properties. The ERTA Variant alignment is likely to require the acquisition and demolition of a small number of properties. The remaining route alignments avoid the need for demolitions with Bedford Borough.

Landfill remediation

The BFARe and Varsity Hybrid route alignments both cross former landfill sites. In order to allow the construction of the railway to be undertaken safely and in order to remove longer term risks to the railway infrastructure (due to settlement of the filled material or as a result of chemicals and/or gases leaching from the site), remediation works will be required. The nature and extent of these works will depend on the nature of the buried materials within each site but could involve the removal of at least part of the landfilled material and disposal at a suitable alternative site. Due to the precautions that must be taken when handling landfill materials and the cost of disposal of those materials, these remediation works could add significant costs to these two route alignments and could also significantly extend the construction programme.

The northerly route alignments run alongside the existing Midland Main Line railway through the north of Bedford. Construction of the proposed additional two tracks (and associated infrastructure) within this corridor will entail major works within close proximity of the existing operational railway over a length of around 900m. The BFARe and Varsity route alignments entail works adjacent to the East Coast Main Line to provide two additional tracks for EWR services over a distance of in excess of 2km. Although not explicitly shown in the material provided by ERTA, we assume that the ERTA and ERTA Variant options will also entail the construction of additional tracks adjacent to the East Coast Main Line over a similar length. All route alignments entail works at Bedford station and on the Marston Vale Line as well as a major bridge crossing of the East Coast Main Line. These elements are therefore not cost differentiators. The BFARe route alignment requires a new bridge over the Midland Main Line south of Bedford, whereas all other route alignments cross the Midland Main Line using the existing Marston Vale Line intersection bridge. This new bridge will involve works in close proximity to the operational railway.

Undertaking major works adjacent to an operational railway places restrictions on the construction methodology and will restrict the times during which some construction activities can take place, including requiring the use of night-time and weekend working for some elements of the work. This will significantly impact the costs associated with this section of the route. Although the Varsity, BFARe, ERTA and ERTA Hybrid route alignments involve works adjacent to an operational railway over a greater length, the corridor in which these works are required is less constrained and offers greater scope to create a degree of separation between the existing and new railways whereas the works adjacent to the Midland Main Line for Route Alignments 1, 1 (Tempsford Variant) and 9 are within a constrained urban environment with pressure to minimise land use so as to avoid unnecessary residential property acquisition and demolition. It is therefore likely that the works adjacent to the East Coast Main Line will be subject to fewer restrictions than those adjacent to the Midland Main Line and the additional costs could be broadly similar for each scenario.

Open space mitigations

The Varsity, Varsity Hybrid, ERTA and ERTA Variant options all involve the re-use of the former railway alignment through Priory Park in Bedford and, to varying extents, beyond the park to the east. Most of the extent of the former railway that would be required for these four route alignments, together with land adjoining it, is now used as public open space. The use of this open space for the railway will necessitate the provision of suitable alternative open space and it is highly likely that the existing walking and cycling route that now utilises the former railway alignment will need to be re-provided. This will add to the scope of works over this section of route and will add further cost and complexity to these route alignments, including the provision of additional or larger bridge structures to accommodate the cycleway.

Scheduled Monument mitigations

The Varsity, Varsity Hybrid, ERTA and ERTA Variant options all have direct and significant impacts on Scheduled Monuments. At this stage, it has not been determined whether it will be possible to mitigate these impacts to the satisfaction of Historic England. Assuming that mitigation is possible, the necessary investigation and mitigation works are likely to be extensive and the presence of the Scheduled Monuments will almost certainly result in restrictions being place on construction methodology in their vicinity. This will add costs to these route alignments.

Summary

Although the preceding paragraphs provide an indication of the presence of factors likely to result in additional costs for each route alignment, it is not yet possible to determine the magnitude of costs associated with each of these factors due to the design immaturity of the majority of the route alignments. It is possible that if design development were progressed for each of the route alignments, further cost drivers may be revealed. It is therefore not possible to draw reliable conclusions about the relative cost of each route alignment at this stage.

7.6 Operational costs

Previous work by EWR Co has highlighted that operational costs are likely to be similar for all route options they have considered and would not be a differentiating factor in the choice between options. We broadly agree with this position. Operating costs are made up of a number of components, some fixed, some variable. Precise operational costs will be heavily dependent on the staffing regime adopted for the service (which is unconnected to the choice of route) and the precise detail of the Train Service Specification and the resultant timetable. Although mileage (and hence fuel consumption and variable track access charges) will vary according to route length, the associated cost differences are not likely to be significant when compared with other operational cost drivers such as rolling stock leasing costs and staffing costs. We therefore assess that, to the extent they are understood at this stage, operational costs are unlikely to be a differentiating factor between the options.

7.7 Economic rationale

One of the primary objectives of the EWR scheme is to stimulate economic growth. It aims to do this by facilitating the construction of new areas of housing, by reducing travel times in the region and by placing more people within reasonable commuting times of high-quality jobs and educational opportunities.

All of the route alignments considered are capable of supporting housing growth in the Tempsford area, where a new station providing interchange with the East Coast Main Line is proposed. Route Alignment 1 and the Varsity Hybrid Alignment would result in the proposed interchange station being located closer to St Neots. EWR Co claim that development in the area close to St Neots is less favoured. However, this assertion is disputed by Bedford Borough Council and the Council is allocating 4,000 new dwellings at Little Barford, which are capable of being served by a station at either of the two locations considered (Tempsford or St Neots South).

All of the route alignments reviewed serve central Bedford. Although the Train Service Specifications for the Varsity, Varsity Hybrid and ERTA route alignments are less well developed, it appears from the information provided that the BFARe, Varsity and Varsity Hybrid options would result in fewer trains serving central Bedford than would be the case with train service proposed for Route Alignments 1 (Tempsford Variant), 1 and 9 and potentially also the ERTA Route Alignment. This lower level of train service reduces the attractiveness of central Bedford as a location for work, leisure and educational activities. Bedford Borough Council has allocated sites for development within central Bedford but these sites are currently considered to be unviable. The provision of an attractive level of (EWR) service to Bedford station is expected to drive up town centre rents which will improve the viability of the allocated sites. It can therefore be seen that lower levels of train service at Bedford station will negatively impact regeneration prospects in the town centre.

The BFARe proposals include the construction of a new "parkway" station to the south of Bedford, on or close to the site of the current Kempston Hardwick station. This station would be more accessible than the town centre station for residents living on the south side of the town and could potentially support redevelopment of the currently derelict industrial sites adjoining the parkway station for employment uses.

Although the new parkway station at Kempston Hardwick is only a feature of the BFARe proposals, all of the route alignments pass through the site of the proposed station and are therefore able to serve a station at this location. Bedford Borough Council, in its 2021 consultation response, advocated the inclusion of a parkway station located slightly further south, at a location referred to as "Stewartby Hardwick". EWR Co is currently considering two options for the future provision of stations on the Marston Vale Line – one that reduces the total number of stations on the route by "consolidating" the stations to a smaller number of better-located sites and one that retains the existing pattern of stations but with EWR services only calling at some of the stations. The consolidation option would place new station at (or close to) the location promoted by Bedford Borough Council at which EWR services are likely to call while the other option would retain a station at the current Kempston Hardwick station site but would necessarily involve EWR services calling at the station.

The BFARe, Varsity and Varsity Hybrid proposals include train services that bypass Bedford station. These services are likely to achieve an end-to-end journey time saving compared to services using the alignment options that serve Bedford station. This saving will increase the attractiveness of longer-distance journeys, which could result in a marginal increase in the economic benefits associated with such journeys. These benefits need to be weighed against the likely reduction in benefits caused by the reduced level of service to Bedford station. A detailed modelling exercise would be needed to provide certainty around the relative benefits of each scenario but we estimate that serving central Bedford (and thereby facilitating more shorter journeys, which will be more attractive to commuters) would deliver marginally greater benefit than that resulting from some longer-distance journeys being slightly faster.

Part B Section 8.3 of this report considers train service options for southern alignments in more detail. However, based on the information available to us regarding each proposal, we assess that those options

where some longer-distance trains bypass Bedford would perform less well than those where all trains serve Bedford. In other words, the Varsity, Varsity Hybrid and BFARe alignments perform less well than the reference case (Route Alignment 1 (Tempsford Variant)) while the remain route alignments perform the same as the reference case.

7.8 Predicted benefits

EWR Co expects the new railway to deliver a range of benefits aimed at growing the UK economy, including:

- Reduced travel times across the Oxford – Cambridge corridor;
- Increased access to employment opportunities as a result of new public transport connections and reduced travel times;
- Opening up of new areas for business growth, making towns and cities between Oxford and Cambridge more attractive to new and growing businesses and relieving pressure on Oxford and Cambridge;
- Providing access between areas of employment and areas with more affordable housing;
- Reducing road congestion;
- Connecting existing rail routes radiating from London, providing new journey opportunities;
- Reducing reliance on road transport, which is less sustainable than rail; and
- Unlocking inward investment

The majority of these benefits are directly related to economic growth (including regeneration and housebuilding) and are considered in the preceding section (7.7).

The anticipated reduction in road traffic has not, to date, been quantified for any of the options. However, the introduction of the proposed new rail services will offer journeys that, for some, will be faster and/or more convenient and it is reasonable to expect modal shift towards rail to occur as a result. The consequent reduction in road traffic (and the likely reduced rate of future road traffic growth) will mean that journeys will be improved for those users that choose not to or are unable to switch to rail. It is likely that road improvements schemes that might otherwise be required in future can be avoided or deferred. The relative degree of improvement offered by the different route options will be a function of the attractiveness of the train services offered and the point-to-point journey times that these services facilitate. More detailed analysis of existing road journeys and anticipated rail journeys will be necessary before any firm conclusions can be reached on the relative performance of each route alignment in respect of facilitating modal shift and reducing road traffic.

Those Route Alignment options that have fewer train services to and from Bedford station (Varsity, Varsity Hybrid and BFARe) are likely to perform less well in terms of connecting existing rail routes radiating from London. As such, these options are likely to provide fewer opportunities to undertake journeys not currently facilitated by rail. However, the magnitude of the relative drop in performance of these options relative to others will depend on the precise service patterns and timings on both the EWR route and on the Midland Main Line at Bedford (services provided by Thameslink and East Midlands Railway).

As previously noted, Part B Section 8.3 of this report considers train service options for southern alignments in more detail.

Given the level of information available at this stage, it is not possible to assess with any certainty the relative performance of each option in respect of benefits not already covered in our consideration of economic rationale in section 7.7.

7.9 Construction impacts

Construction impacts will depend on the detailed construction methodology adopted for the project. EWR Co has not yet published their proposed construction methodology. Equally, the promoters of the alternative route alignments (BFARe and ERTA) have not put forward any details of how their versions of the scheme would be constructed.

It is, however, apparent that all of the route alignments considered will involve extensive construction activity within Bedford, including major works at Bedford and St Johns stations. It is possible, based on information put forward by EWR Co as part of their 2021 non-statutory consultation, that reconstruction of the bridge carrying Kempston Road over the railway might be necessary to facilitate electrification (either as part of the main scheme or separately at a later date) of the railway, although further design development might find alternative solutions that avoid the need for this.

Northerly alignments (1, 1TV & 9) require the construction of an additional span on the east side of Bromham Road bridge if a six-track layout is adopted for the Midland Main Line north of Bedford station. An additional span might also be required for a four-track layout to facilitate the connection between the EWR and Midland Main Line tracks. However, unlike the recent reconstruction of the existing spans of this bridge, this additional span will not be constructed over operational railway and construction should therefore be quicker because work will not be restricted to times when trains are not running.

Northerly alignments require major works through the Poets area. Work in the Poets area will almost certainly include some night-time and weekend working due to the proximity of the works to the operational Midland Main Line railway.

Northerly alignments also involve a new viaduct to carry the railway over the River Great Ouse, Great Ouse Way (A6), Paula Radcliffe Way (A6) and Clapham Road near Clapham. Construction of this viaduct could lead to disruption to road traffic. The extent of disruption will depend on the design of the viaduct and the chosen construction methodology.

The Varsity, Varsity Hybrid and ERTA alignments will require the reconstruction of London Road bridge and the construction of new bridges on Cardington Road and the Priory Park access road. They will also involve major works within Priory Park, which have the potential to significantly impact the northern part of the park due to loss of open space, visual impacts and as a result of construction noise.

The BFARe alignment will require a new bridge to carry West End over the railway and will require several new structures to take the railway over major roads to the south of the town. Each of these will have impacts on the affected roads, including the likely need for road closures for at least part of the construction period.

With all route alignments, where roads and other RoWs are intersected there will be a need for local temporary closures and diversions. These will need to be carefully managed to avoid compound impacts that could arise if multiple routes are closed (or otherwise disrupted) simultaneously.

All route alignments will generate considerable amounts of construction traffic on roads in and around the Borough. This additional traffic will need to be managed through a Traffic Management Plan for the project which we expect would be mandated as part of the DCO process. The use of haul roads within the construction boundaries could help reduce the amount of construction traffic using roads within the borough.

There might be opportunities to use rail haulage to deliver and remove some bulk materials (such as materials required for or generated from earthworks, railway ballast, rails and sleepers). However, it is likely that some of these materials (especially those associated with earthworks) would need to be brought to a temporary railhead close to the works then distributed by road vehicle using either haul roads or the public highway network.

The impact of the construction activity on Bedford's economy will largely depend on whether road closures make travel to and within the town difficult and therefore dissuade people from visiting shopping and leisure facilities in the town. Bedford Borough Council has advised that the closure of Bromham Road bridge for reconstruction works resulted in a reduction in car park utilisation within Bedford town centre. It is therefore reasonable to assume that a further closure of Bromham Road and / or of other roads in the town could result in a similar impact. The impact is likely to be greater if more than one road is closed concurrently.

Although the precise extent and nature of construction impacts will be dependent on construction methodology and on the precise design detail of each potential route alignment, it is likely that, taken as a whole, the construction impacts of each route alignment would be broadly similar. The BFARe route alignment avoids the construction activity in the Poets area of Bedford associated with the northerly options and the works within Priory Park associated with the other southerly options. It does, however, entail significant works in the vicinity of West End but we assess that these works are likely to have marginally less impact than those associated with the other routes . We therefore assess that the BFARe option is likely to perform marginally better than the reference case (Route Alignment 1 (Tempsford Variant)) and the performance of the other route alignments will be broadly the same as the reference case.

7.10 Loss of car parking (both during construction and operation)

All of the route alignments considered include the operation of at least some services to Bedford station. The BFARe and ERTA proposals do not specifically detail how the increase in services to Bedford station would be accommodated. However, it is apparent that the current infrastructure at and to the south of Bedford station is inadequate to reliably support the operation of EWR services in any of the scenarios considered, and notional track layouts for Bedford Midland for southern alignments are included in section 10 below.

We therefore believe that, in order to accommodate EWR services at Bedford station for any of the route alignment scenarios considered, it will be necessary to undertake the works proposed by EWR Co through the Bedford St Johns area to Bedford station. The impact on parking in Bedford to the south of the station will therefore be the same for all route alignment options and will involve the loss of those areas of the Britannia Road / Hospital car park that are situated on land associated with the former Hitchin railway alignment, at least two-thirds of the Ashburnham Road car park and all of the Bedford station "premium" car park. In addition, the current access to the car parking area situated on the former Danfoss site (adjacent to the Britannia Road car park) will be severed and it is likely that the necessary expansion of the station facilities at Bedford will require land take from the station forecourt and part of the main station car park.

Those options which continue north from Bedford station (Route Alignments 1(Tempsford Variant), 1 and 9) will also result in the loss of a significantly larger proportion of the existing main station car park.

EWR Co's 2021 consultation acknowledges the loss of parking and proposes the construction of two multi-storey car parks to compensate for the losses, one to serve the hospital and one to serve the needs of Bedford station and compensate for the loss of spaces within Ashburnham Road car park. The provision of these two car parks would compensate for the lost parking during the operational phase of the project. To

compensate for the temporary loss of parking during the construction of the replacement multi-storey car parks, it may be necessary to provide additional areas of temporary car parking. The exact amount of temporary parking that will be needed will depend on the precise footprint and location of the multi-storey car parks and the amount of adjacent parking land required to facilitate their construction. We note that there is currently vacant land available close to the Britannia Road car park which, together with land within the railway boundary, may be capable of being used for additional short-term parking. There might also be an opportunity to create additional temporary parking for the station within railway land adjacent to the former grain store, south of Ford End Road bridge, but the availability of this land will depend on the final design of the railway alignment in this area and the staging of construction activities.

Regardless of which route alignment is taken forward, it will be necessary for the EWR scheme promoters to develop a parking strategy for the construction stage of the project that takes into account the levels of usage of the affected car parks and the available capacity within other suitable car parks within the town and ensures that an adequate quantum of suitable parking spaces remains available throughout the construction and operational phases of the project. As such, we do not believe that loss of parking is a significant factor in the evaluation of the Route Alignments. However, because of the need to replace more of the existing station car parking and the likely need to find additional temporary parking provision during the construction phase, we have assessed the southerly route alignments as performing marginally better than the reference case (Route Alignment 1 (Tempsford Variant)) and the other northerly route alignments (1 and 9) as perfoming the same as the reference case.

7.11 Air quality and associated health impacts during construction and operation with reference to Bedford's baseline NO_2 levels

Air quality impacts from construction of the new railway will arise primarily from dust from demolition, earth moving and track laying activities and from emissions from plant and vehicles (for example lorries delivering materials to or removing materials from construction sites).

Bedford Borough Council has declared an Air Quality Management Area (AQMA), covering a large part of Bedford Town Centre, in respect of annual mean levels of nitrogen dioxide (NO_2). The main source of NO_2 pollution in the UK is from exhaust emissions from diesel-powered vehicles, especially when slow moving. The extent of the AQMA is shown in Figure 11.

All of the route alignments considered involve works within and adjacent to the Bedford Town Centre AQMA by virtue of the upgrades that are necessary to allow services to call at Bedford station. Works within the AQMA will occur in the vicinity of Bedford St Johns station, where the railway needs to be realigned. Works at Bedford station will be immediately adjacent to the AQMA and could potentially extend into the AQMA depending on the scale of alterations required at the station. The Varsity, Varsity Hybrid, ERTA and ERTA Variant route alignments also briefly cross the AQMA at the point where the alignments pass beneath London Road. The northerly route alignments (1 (Tempsford Variant), 1 and 9) have an additional area of works adjacent to the AQMA along the Midland Main Line corridor through the north of Bedford.

A Code of Construction Practice (CoCP) will be produced for the East West Rail Scheme. This will be included within the DCO application for the scheme. The CoCP should include details of how air quality impacts from construction activities will be mitigated. Common mitigation methods include the use of water spraying to supress dust, the use of battery powered plant and vehicles where practical (and particularly in sensitive areas) and minimising the use of diesel-powered generators to provide temporary power sources for construction activities.

Construction-related air quality impacts from the project will be heavily dependent on the extent to which mitigation measures are employed. If mitigation measures are deployed appropriately and widely across the construction works, it is likely that, post mitigation, construction-related air quality impacts will be broadly similar for all route alignments and that health impacts from construction activity will be negligible in the context of background air quality levels.

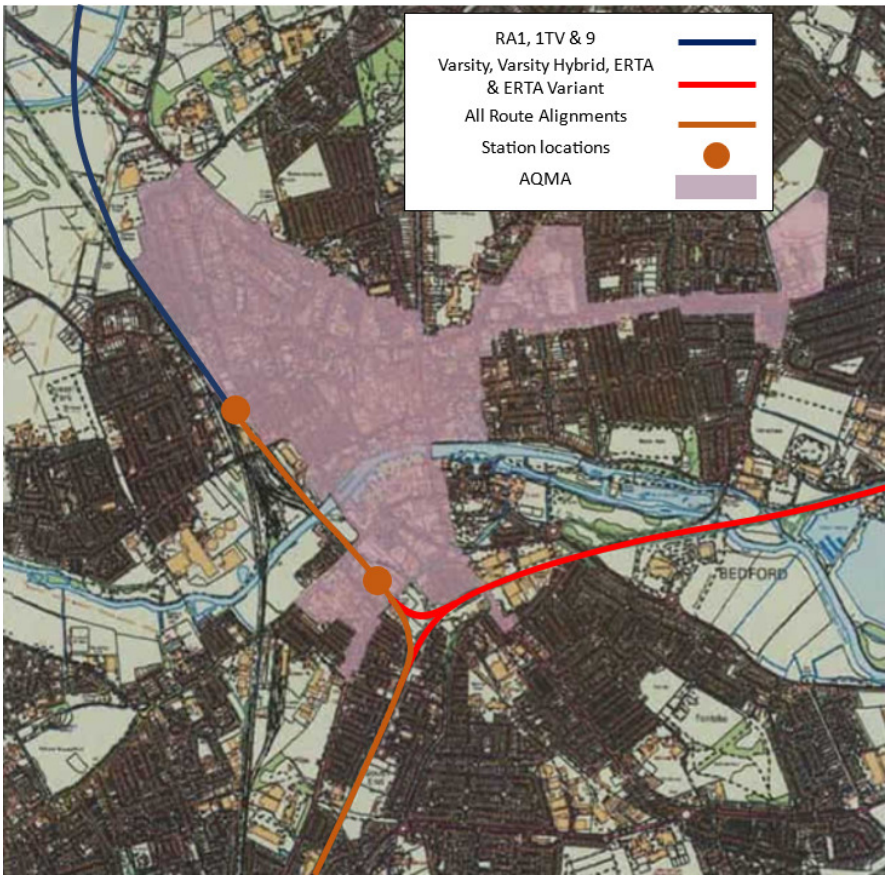


Figure 11: Extract from map showing Bedford Town Centre AQMA with potential Route Alignments and station locations superimposed.

Operational air quality impacts will primarily arise from road vehicles accessing stations and from the movement of trains. Impacts from train movements will depend on the specific rolling stock used on EWR services and, in particular, the energy source used for powering that rolling stock.

EWR Co's stated position is that the scheme will deliver a "net zero carbon railway" and EWR Co is investigating a range of technological solutions for powering trains. This implies the use of conventional electrification or emerging technologies such as battery, hydrogen or hybrid traction power rather than the use of conventional diesel-only traction.

Given current attitudes towards the use of diesel traction, it is increasingly unlikely that further new-build diesel-only rolling stock will be available. If diesel traction is to be used, it is therefore likely that existing vehicles will be re-deployed from elsewhere on the network. The choice of rolling stock in this scenario will depend on the position of the rolling stock market at the time that trains are required for the new railway. This will, in turn, depend on a range of factors including the rate at which electrification schemes progress on the rest of the rail network. The emissions from different classes of diesel rolling stock vary considerably, with more recent builds complying with Stage IIIB emissions regulations while older builds were built to less stringent regulations.

Emissions from diesel trains will also vary according to how the trains are driven. Harder acceleration and braking, as is sometimes required for more demanding timetables (such as those where trains use heavily

trafficked sections of railway and arrival times at key junctions are more critical), will lead to greater emissions. Emissions will also be increased as a result of uphill gradients. Therefore, routes with fewer and less steep gradients will result in lower levels of emissions from diesel trains as will train service patterns that have fewer critical interactions with other services.

However, the number of train movements per day means that exhaust emissions from the railway will be insignificant when compared to exhaust emissions from the far greater number of road vehicle movements within Bedford and the wider borough. The choice of route alignment will not have a material impact on air quality other than at a very localised level.

Air quality impacts from additional road vehicles accessing stations will depend on a number of factors that will determine patterns of station usage. These are discussed in section 7.12 below. Impacts arising from increased road vehicle use can reasonably be expected to reduce over time as more drivers transition to electric vehicles.

In summary, the railway will have air-quality impacts, but these are likely to be low in the context of existing emissions levels from road vehicles and other sources of air-quality impacts within the borough. The choice of station locations and train service patterns are likely to have a greater impact on emissions levels (due to the resultant impact on car movements accessing stations) than the choice of route alignment.

Given the points set out above, we have assessed all route alignments as performing equally in respect of air quality impacts.

7.12 Local traffic impacts at proposed station locations and proposals for their mitigation

Additional trips will be generated by people accessing the new EWR services at existing and new station locations. It is likely that the biggest increases will be seen at Bedford station, where there is the potential for existing congestion issues on roads leading to the station to be exacerbated. However, these additional trips will be offset to some extent by a reduction in car trips to Bedford station as a result of the opening of Wixams station (on the Midland Main Line south of Bedford) and passengers that currently access Thameslink services at Bedford transferring to the new station.

The number of additional car trips to Bedford station that are generated by EWR will be lower for those options that have a reduced level of service at Bedford station. Based on the proposals presented to date, this applies to the Varsity, Varsity Hybrid and BFARe options but we note that alternative service patterns with all trains serving Bedford could potentially be operated using these route alignments, subject to the configuration of Bedford station. This is discussed in section 8.3 below. Where Bedford has a lower (and therefore less attractive) level of service, it is likely that car journeys that would otherwise be made to Bedford station may be displaced to other stations or be replaced by longer journeys as potential rail users use car as the preferred mode for their entire journey.

The service patterns currently proposed for the Varsity and Varsity Hybrid options could result in rail users attempting to drive to a relocated St Johns station if the relocated station is situated at the proposed eastern location (close to the original, pre-1984, St Johns stations) and is served by more EWR trains than Bedford station. If either of these route alignments were taken forward, it is not clear whether the eastern St Johns station would include provision for car parking. If no station parking is included, traffic impacts would be lower, although some rail users may attempt to park in existing (non-rail) car parks or on nearby streets.

A new (or enhanced) station to the south of the town, such as Bedford South Parkway promoted by BFARe or Stewartby Hardwick as suggested by Bedford Borough Council, has the potential to significantly reduce EWR-related car trips into Bedford. For this to happen, the station would need to be provided with adequate parking facilities and be served by at least the same level of EWR train service as would be available at Bedford station. The provision of such a station is not dependent on the choice of route alignment for the Bedford to Cambridge section of the railway.

It must be noted that the volumes and patterns of road traffic associated with the scheme are related to the station location and train service patterns rather than the route alignment. Regardless of which route alignment is taken forward, the train and station operator(s) may choose to adopt pricing strategies (both for travel tickets and car parking) that encourage use of certain stations over others. For example, if the total cost of car parking and train travel to Cambridge from a parkway station south of Bedford is lower than that from Bedford, rail users that use a car to access the station may opt to use the parkway station in preference to the town centre station. Equally, provision for access to stations by modes other than private car will influence mode choice for the journey to the station and therefore affect traffic impacts associated with the new railway.

For the reasons detailed above, we have assessed all route alignments as performing equally in respect of this issue.

7.13 Freight by rail – suitability and impacts

Suitability

Although the primary purpose of the EWR scheme is to provide new passenger services linking homes to jobs, the railway is being designed to be capable of accommodating freight traffic should demand arise. In order to provide a successful mixed traffic railway (i.e. one that carries both passenger and freight traffic), different types of train need to travel at broadly similar average speeds, noting that freight trains do not call at stations and can therefore have a lower maximum speed than passenger trains and still maintain a similar average speed to the passenger services. In situations where freight trains are unable to maintain a similar average speeds to faster passenger trains, situations will occur where a freight train can be caught up by the following passenger train resulting in delays to the passenger train. In these circumstances, passing loops are provided to allow a freight train to pull off of the main running line so that a following train can overtake.

The northerly route alignments (1 (Tempsford Variant), 1 and 9) east from Bedford all incorporate a long rising gradient as the railway towards Cambridge rises to clear the River Great Ouse, A6 and Clapham Road near Clapham and then climbs to cross the higher land north of Clapham Park. EWR Co states that the maximum gradient on the railway will be 1 in 80. This is towards the limit of acceptability for freight traffic and, given the length of railway over which there is a steep rising gradient, freight traffic is likely to experience a loss of speed as it climbs this hill. The type of freight traffic most likely to use EWR is containerised freight, which is lighter than bulk freight (such as aggregate traffic). The impact of the gradient on a container train will be less significant than would be the case for, say, aggregate trains. Detailed modelling is required to determine the precise impacts of the steep gradients, but EWR Co is considering the provision of passing loops if these are found to be necessary and proportionate in the context of anticipated levels of freight traffic.

The southerly route alignments (Varsity, Varsity Hybrid, BFARe, ERTA and ERTA Variant) avoid the higher ground to the north of Bedford and therefore do not incorporate the long, steep gradients that are a feature of the northerly route alignments. However, the BFARe route alignment will incorporate relatively steep gradients at its western end where the main route intersects the B530, Midland Main Line and A6 and, shortly afterwards, merges with the proposed chord line from Bedford (which intersects the B530 and A421 (including slip roads) close to the junction between the two sections of railway). It is not possible to accurately measure the gradients involved without undertaking further design development work but we estimate that gradients might need to be between 1 in 100 and 1 in 150 in order to provide adequate clearance between the new railway and the Midland Main Line.

As noted above, the type of freight traffic most likely to use the EWR route is containerised freight. This type of traffic commonly travels between ports and inland freight terminals. In the case of EWR, the most likely freight journeys would be between the east coast and rail freight terminals located in the Midlands and on the West Coast Main Line, such as those at Daventry and Kegworth. However, the for the northerly route alignments (1 (Tempsford Variant), 1 and 9), the junctions with the rest of the rail network at Bedford and Bletchley do not facilitate east-north movements. As such, it is not likely that the available freight paths over the new section of railway would be sufficiently attractive to freight operators when compared to alternative routes (such as the existing route to the Midlands via Peterborough) to generate regular freight traffic over the route. This is because the necessary change of direction to access northward routes would be difficult to timetable and would require additional staff to facilitate the necessary locomotive run-round manoeuvre (where the locomotive is detached from one end of the train and re-attached to the opposite end) or the use of a second locomotive at the opposite end of the train, all of which would add to operating costs. It should also be noted that Network Rail is planning a major enhancement scheme at Ely (the Ely Area Capacity Enhancement scheme) that will facilitate the operation of additional freight services on the existing freight route between Felixstowe and the Midlands / the North, which will further enhance the attractiveness to freight operators of the existing route via Peterborough.

The southerly route alignments (i.e. the Varsity, Varsity Hybrid, ERTA, ERTA variant or BFARe route alignments all incorporate a triangular junction south of Bedford) and therefore provide a direct route from the east coast ports to the East Midlands via Bedford. This would allow freight (and other) trains to access the Midland Main Line northwards out of Bedford without the need for a change of direction. As such, these route alignments better suited to meeting the needs of freight traffic compared to the northerly route alignments.

When compared to the reference case (i.e. Route Alignment 1 (Tempsford Variant), Route Alignments 1 and 9 are equally suitable for freight traffic, the BFARe route alignment performs better and the remaining southerly route alignments are the best suited to freight.

Impact

The impact of freight traffic using East West Rail needs to be considered in the context of the volumes of freight on the existing railway through Bedford, which currently carries significant amounts of freight traffic. Each day, there are over 100 freight paths (i.e. slots in the timetable that freight trains can utilise) through Bedford station. On a typical day, around 30 of these paths are utilised, although the exact number of paths used varies from day to day depending on demand. All freight traffic through Bedford is currently hauled by diesel locomotives. The dominant traffic through Bedford is aggregates. Aggregates trains are among the heaviest type of rail freight traffic.

EWR Co state they are planning for 2 freight paths per day per direction. This represents an increase in freight train paths through Bedford of less than 4% compared to today.

As noted above, the type of freight traffic most likely to use the EWR route is containerised freight. These trains are lighter than the aggregate trains that currently operate through Bedford and generate less noise and vibration. Noise and vibration are likely to be the two most significant impacts of freight traffic on local residents and the environment. The EWR route will incorporate noise and vibration mitigation measures in the vicinity of sensitive receptors (such as residential properties), with the very high likelihood of conditions being imposed on the consents for the scheme mandating their provision. These measures will extend to the existing Midland Main Line corridor through Bedford if it is upgraded as part of the project. The mitigation measures will take account of the anticipated levels of freight traffic on the EWR route. It is likely that the noise mitigation measures installed for EWR will also reduce noise from existing rail traffic and, as a result, residential properties adjoining the existing rail corridor could see a reduction in rail-related noise compared to today. Away from the existing rail corridor, mitigation measures would be expected to keep noise and vibration impacts on residential properties (and other sensitive receptors) within acceptable limits.

In addition to noise and vibration impacts, the use of diesel locomotives to haul freight trains would result in air quality impacts. Even if the EWR route were to be electrified, freight trains may still utilise diesel haulage if the trains will need to travel over non-electrified sections of track at some point in their journey. The most recent UK order for freight locomotives was for bi-mode locomotives that are capable of utilising overhead electrification where this is available and switch to diesel mode where it is not. It must however be noted that such locomotives represent only a very small part of the total British freight locomotive fleet and, even if the EWR route were electrified, there is no guarantee that they would be used on the route.

For the reasons noted above, air quality impacts from the use of diesel traction will be limited in the context of road vehicle, existing rail freight and other emissions in the Borough, and any such impacts are likely to be negligible other than at a very localised level. When viewed holistically, freight traffic over the EWR route will lead to a reduction in emissions (and hence air quality impacts) compared to those that would arise were the traffic in question to be transported by road.

Our assessment is that the southerly route alignments will be more attractive to freight and will therefore be used by a greater volume of freight. Although the steep gradients of the northerly alignments are likely to lead to greater noise and, in the case if diesel traction is used, a marginal increase in air quality impacts (due to locomotives having to work harder to haul trains up the steeply graded sections of route) this needs to be balanced against the lower volumes of freight traffic likely to use the route. We therefore estimate that total impacts from freight will be slightly greater for the southerly route alignments when compared to the reference case.

7.14 Impact on Local Plan 2040 housing and employment allocations

Bedford Borough Council's Local Plan 2040 sets out planning policy for the borough over the period to 2040. It identifies and allocates sites for the delivery of new homes and employment. Several of the site allocations within Local Plan 2040 conflict with the various route alignments under consideration. The conflicts are shown in Table 1 below, with a red cross indicating a conflict.

Route Alignment 1 (Tempsford Variant) conflicts with site EMP 8 "Land at Roxton, southwest of the Black Cat roundabout", which allocated 17.0 hectares for employment in the form of warehousing and distribution facilities. The construction of EWR on this alignment would impact the viability of this site in the short term and the completed railway will directly impact the amount of land available for employment uses and will restrict layout options for the site. This conflict was recognised by the Council during the examination of Local Plan 2040, and an alternative site identified.

Route Alignments 1 and 9 do not conflict with any Plan 2040 allocated sites.

Table 1: Local Plan 2040 sites impacted by each route alignment

	1(TV)	1	9	Varsity	Varsity Hybrid	BFARe	ERTA	ERTA variant
HOU 5 *Abbey Field, west of Elstow*						X		
HOU 11 *Land at Bedford River Park*				X			X	X
HOU 14 *Kempston Hardwick new settlement*						X		
HOU 17 *Land at College Farm, Shortstown*						X		
EMP 5 *Land at Peartree Farm Elstow*						X		
EMP 6 *Land at Water End and St Neots Road*					X			
EMP 8 *Land at Roxton, SW of Black Cat Roundabout*	X							

The Varsity route alignment passes through site HOU 11 "Land at Bedford River Valley Park", which is allocated for a mix of residential, education, open space and recreational uses including the delivery of a water sports lake and strategic green infrastructure improvements. The impacts will be restricted to a small part of the total site area including the former Oxford – Cambridge railway alignment and (during the EWR construction phase), land surrounding the former railway. While the interface between the railway and the planned development would need to be carefully managed, it does not appear that the two proposals are incompatible.

The Varsity Hybrid route alignment conflicts with site EMP 6 "Land at Water End and St Neots Road", which is allocated for the development of a 30-hectare research campus. The site is bisected by the A421 and were EWR to be developed on the Varsity Hybrid alignment, a strip of the northwestern part of the site, paralleling the A421, would be sterilised, reducing the total developable size of the site. In spite of this, it seems likely that the site would remain suitable for development.

The BFARe route alignment conflicts with four sites. The first of these is HOU 5 "Abbey Field, West of Elstow", which is allocated for housing development. Under BFARe's proposals, the part of the site to the west of Abbey Fields would be bisected by the chord line linking Bedford station to the railway towards Cambridge. Due to the size and nature of the site, delivery of the railway in line with BFARe's proposals would reduce the developable area of the site to the west of Abbey Fields. The presence of the railway would also negatively

impact housing on the remainder of the site due to the proximity of the railway to the new houses. Given that the alignment of the chord line as currently presented by BFARe is not considered to be feasible (due to the extremely tight radius of the curves at each end), the extent of the impact on site HOU 5 cannot yet be fully determined. It should also be noted that the Local Plan Inspector has advised that he is unlikely to agree to the allocation of this site in the Local Plan due to its impact on the setting of Elstow Abbey.

Site EMP 5 "Land at Pear Tree Farm, Elstow", lies immediately to the south of site HOU5 and is also affected by the BFARe alignment proposal. The site is allocated for the development of a 20.4-hectare science park. Under the BFARe proposals, both the chord line to Bedford station and the main Oxford – Cambridge alignment pass through the site. As a consequence, the site would be split into three parts and a significant area would be lost to the railway. It seems unlikely that the site would remain viable for the proposed use if the railway were built in line with BFARe's proposals.

Site HOU 14 "Kempston Hardwick New Settlement" would be impacted by the western end of the BFARe alignment, where the main route diverges from the existing Marston Vale Line. The route alignment crosses the site at the north of the part of the site that is located to the east of the Marston vale Line. As such, it is unlikely to impact the overall viability of the site but will reduce the number of homes that can be provided on the site. It is possible that the (relatively small) part of the site to the north of the BFARe route alignment would not be developable if the railway were built on this alignment because that part of the site would become difficult to access due the presence of the new and existing railways (East West Rail, Marston Vale Line and Midland Main Line) on three sides and the A421 on the fourth side of that part of the site. It should be noted that this route alignment would also have a major impact on the recently proposed Universal Studios theme park on this site.

The BFARe route alignment also passes through site HOU 17 "Land at College Farm, Shortstown" and would divide it into two, roughly equally sized parts. The railway would cause noise and, potentially, vibration impacts to the proposed new housing and would result in a reduction of the amount land available for housing. The likely need for additional land during the construction phase of the EWR project would temporarily further reduce the amount of land available and might result in delays to the housing development, depending on relative timescales for the housing and railway schemes.

The ERTA and ERTA Variant route alignments impact on site HOU 11 "Land at Bedford River Valley Park. The impact on this site would be identical to that described for the Varsity route alignment above. These route alignments impact on no other sites.

We have therefore assessed Route Alignments 1 and 9 as performing marginally better than the reference case and the BFARe alignment as performing worse. The other route alignments perform the same as the reference case.

7.15 Summary of Impacts

Figure 12 summarises the relative impact of each route alignment when compared to the reference case (Route Alignment 1 (Tempsford Variant)). It uses a seven-colour scale to indicate the relative impact of each route alignment in respect of each of the criteria we have been asked to investigate. It must be noted that the scoring of each route alignment and its impacts is relative rather than absolute and, given the level of development of some of the route alignments, has required the use of professional judgement. Further development of the route alignments could result in changes (either positive or negative) to the relative scoring of each route alignment. It must also be noted that not all criteria carry equal weight and the order

in which the criteria are shown is not intended to imply relative importance. There are other criteria that will influence the scheme promoter's choice of route alignment, and these are reflected in the Assessment Factors that have been used by EWR Co in decision making to date.

		RA1(TV) (Ref case)	RA1	RA9	Varsity	Varsity Hybrid	BFARe	ERTA	ERTA Variant
7.2	Residential Properties								
7.3	Environmental Features								
	Flooding								
	Heritage Assets								
	Agricultural Land								
	Open Space								
7.4	Carbon impacts	*(Not possible to assess at this stage)*							
7.5	Construction cost	*(Not possible to assess at this stage)*							
7.6	Operational costs	*Similar for all options*							
7.7	Economic rationale								
7.8	Other benefits	*(Not possible to assess at this stage)*							
7.9	Construction Impacts								
7.10	Car Parking								
7.11	Air Quality (construction)	*Similar for all options*							
	Air Quality (operation)	*Similar for all options*							
7.12	Traffic local to stations	*Similar for all options*							
7.13	Freight suitability								
	Freight Impacts								
7.14	Local Plan 2040 sites								
	Bedford-Cambridge trains per hour*	4	4	4	2	2	2	4	4

* - The level of train service quoted here represents our understanding of the proposals of the relevant route alignment promoter. Each route alignment will be capable of supporting alternative levels of service with consequent impacts on some scheme benefits.

Worse ---	--	-	Neutral	+	++	Better +++

Figure 12: Relative impacts of each route alignment

PART B – RATIONALE FOR 6 TRACKS NORTH OF BEDFORD

8 Infrastructure and Service Patterns

8.1 Current infrastructure constraints

The graphic below illustrates the current track and platform arrangements at Bedford. The interaction with the sidings south of the station has been simplified for this diagram.

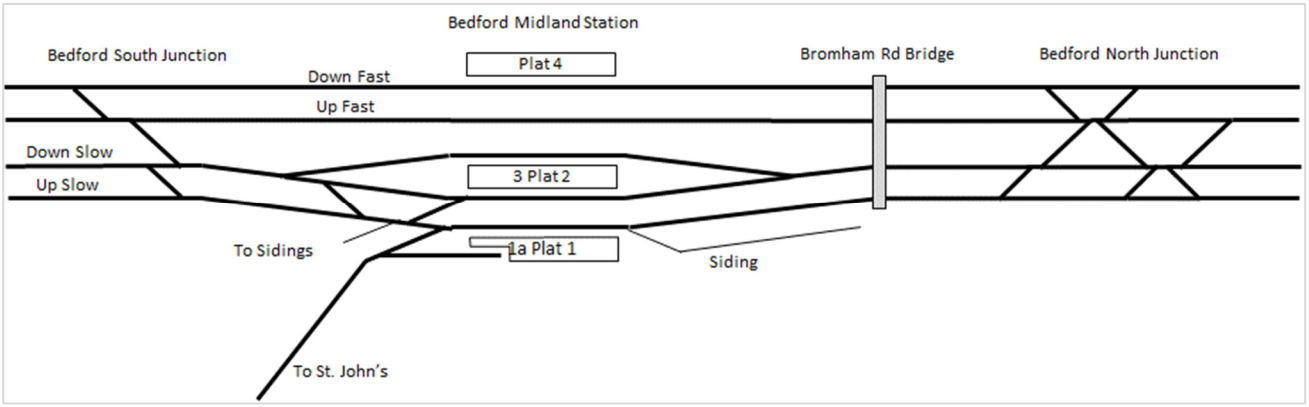


Figure 13 - Current track layout through Bedford

Services are operated through the station area by East Midlands Railway, GTR (Thameslink), London Northwestern (from Bletchley to platform 1a only) and freight operators.

East Midlands Railway (EMR) operates 6 trains per hour (tph) in each direction between London St. Pancras and the East Midlands. In the Down direction (ie northbound) all these services use the Down Fast through platform 4. In the Up Direction (southbound) non-stop trains use the Up Fast. Stopping southbound services approach the Bedford area on the Up Fast, but must then use Bedford North Junction to access platform 1, 2 or 3, before using Bedford South Junction to regain the Up Fast.

GTR operates 4 trains per hour in each direction with some extras in peak hours, all of which terminate or start from Bedford in platforms 1, 2 or 3.

Most, but not all, freight trains use the Slow Lines through the station. The routing of Up freight trains will depend on which platforms are occupied by Thameslink services. Although most use the Up Slow through platform 1, some use Bedford North Junction to access the Down Slow and pass through platform 2 or 3 before regaining the Up Slow at Bedford South Junction (the pointwork for this is off the left of the diagram). The number of freight trains in the timetable varies significantly throughout the day. In some hours there are no trains, and in others one or two each way, and exceptionally three. The amount of freight to be operated in the future is subject to debate, although in December 2023 the Government announced a target to increase rail freight by 75% by 2050.

The Marston Vale service operated by West Midlands Train terminates in the bay at platform 1a.

The other key constraints are defined in the industry's Timetable Planning Rules. These specify the rules that must be used in developing timetables, including the minimum headway (ie the minimum time distance that trains must be timetabled apart), and the time margins that need to be allowed between conflicting moves across junctions and for re-occupation of platforms. The headway through Bedford is 4 minutes, with

the exception that two consecutive non-stop trains can have a 3 minute separation. Conflicting moves through Bedford North Junction must typically be separated by 5 minutes before and 3 minutes afterwards.

8.2 Proposed service pattern

The Route Update Report proposes the service pattern shown in the figure below. Each line represents one train per hour each way. The key change since the previous consultation is a reduction in the number of services proposed on the Marston Vale line between Bedford and Bletchley (previous it had been 4 or 5). The reason for this change is that additional services on this section trigger a level of infrastructure cost an order of magnitude higher than for the service pattern shown below. This is mainly because of the need to remove many more level crossings. Note that EWR Co are still considering two alternative options for the number of stations between Bletchley and Bedford Midland, although the quantum of services is unaffected by this.

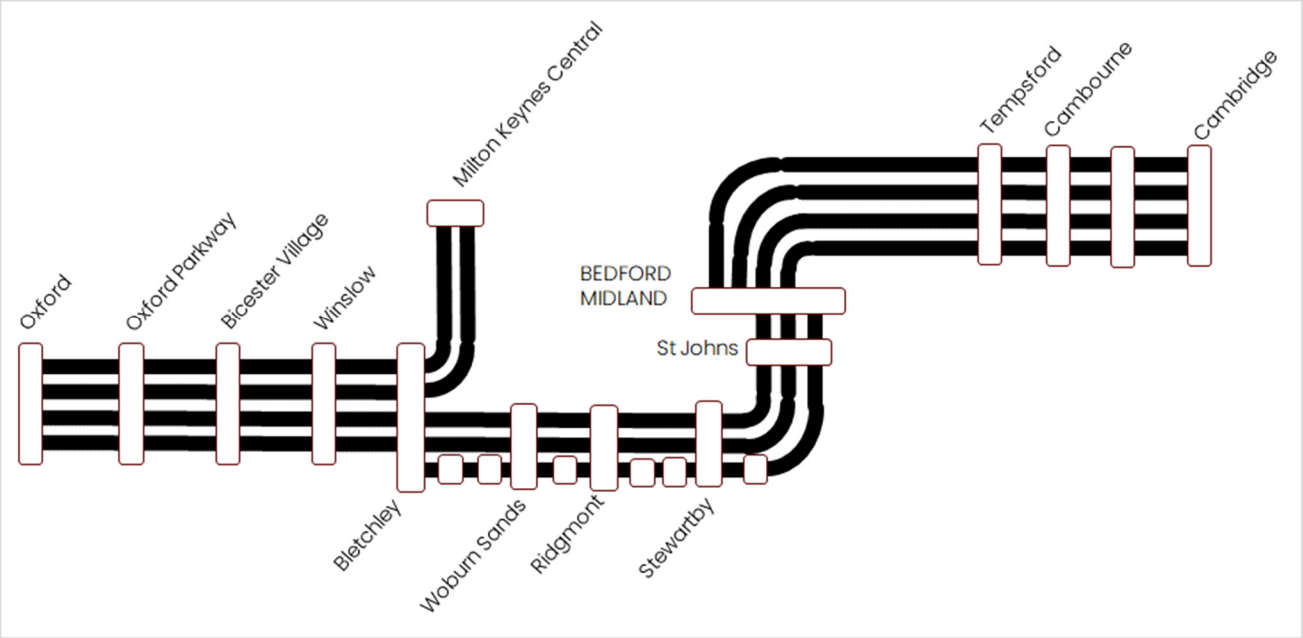


Figure 14 - EWR Co's proposed service pattern (Base Case) – Option 1

8.3 Service pattern options for south of Bedford route alignments

In the context of this report it is also important to consider the potential service patterns for route alignments south of Bedford (ie BFARe, ERTA, ERTA Variant, Varsity or Varsity Hybrid). The service pattern is agnostic as to which of the south alignment options is being considered. This is because they all include:

- A triangle junction south of Bedford to allow services to enter Bedford Midland from both the Bletchley and Cambridge directions, and to bypass it.
- A new parkway station ("Bedford South Parkway", a relocated Bedford St. John's or an upgraded Kempston Hardwick) to enable passengers from a wider catchment around Bedford to access East West Rail.

We present two indicative service options below. South of Bedford Option 2 in the figure below assumes that the Oxford – Cambridge services by-pass Bedford Midland, but serve Bedford South Parkway instead, Bedford Midland is served by two trains per hour from Cambridge and one per hour from Bletchley. This

option has a faster end to end journey time and a requirement for less infrastructure in the central of Bedford. The main disadvantages are that central Bedford does not get the full benefit of East West Rail.

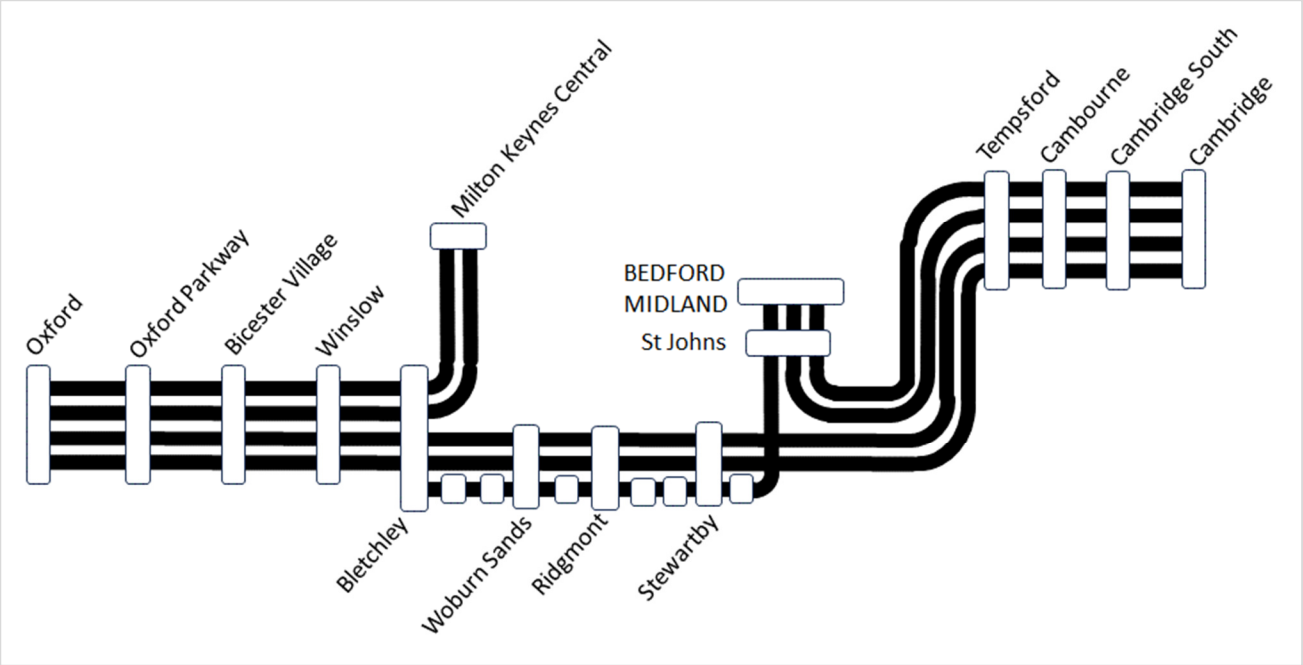


Figure 15 - Service pattern for South of Bedford alignment - Option 2

South of Bedford Option 3 in the figure below takes an alternative approach and routes all traffic into Bedford Midland. Services between Oxford and Cambridge reverse in the station.

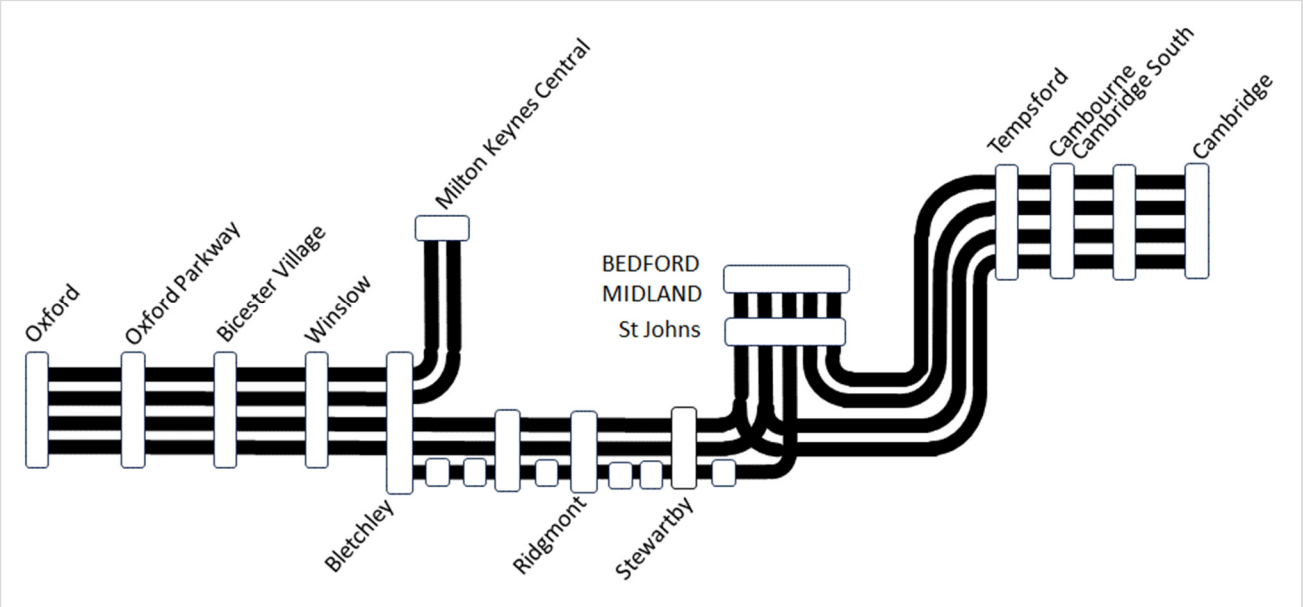


Figure 16 - Service pattern for South of Bedford alignment – Option 3

This option provides stronger benefits for central Bedford, and is also capable of accommodating Bedford South Parkway. There would be some extension of journey time for Oxford – Cambridge services. The journey

time penalty from reversal in service can be assessed using comparator stations. Some examples are shown in the table below.

Reversal Location	Service	Frequency	Time Allowed
Derby	Birmingham – Nottingham	Hourly	4 mins
	Cardiff – Nottingham	Hourly	4 mins
	Crewe - Newark	Hourly	4 mins
Sheffield	Liverpool – Norwich	Hourly	5 mins
Chester	Birmingham International/Cardiff - Holyhead	Hourly	4-5 mins
Hull	Sheffield – Scarborough	Hourly	5-6 mins
Bradford Interchange	Leeds – Manchester Victoria	Hourly	3 mins
	Hull – Halifax	Hourly	3 mins
	Leeds – Chester	Hourly	3 mins
	York – Blackpool North	Hourly	3 mins

Figure 17 - Typical time allowed for reversal at sample stations

It can be seen that the stations with the most parallels to Bedford Midland under South of Bedford Option 3 are Derby (3 x 2 reversals an hour, all timed for 4 minutes) and Bradford Interchange (4 x 2 reversals an hour, all timed for 3 minutes). Such an arrangement is clearly not without precedent.

In times of time impact, therefore, we could reasonably assume a reversal of 4 minutes compared to a station dwell time of 1 minute for a train via the northern alignment – a difference of 3 minutes, plus any additional run time on the route out of Bedford. This is difficult to estimate without a full modelling exercise, but we would expect for example that the north to east chord under both the BFARe and EFTA concepts would be of tight radius and low speed. A working assumption of 5-6 minutes would not seem unreasonable.

8.4 Modelling the economic impacts of service pattern options

In parallel with report, Bedford Borough Council asked Systra to model the three service pattern options described above (and shown in Figure 14, Figure 15 and Figure 16 above). Their report is entitled "East West Rail Routing Options and Station Choice" dated January 2024.

The modelling looked at the wider economic (Gross Value Added – GVA) and labour supply impacts that the opening of East West Rail in full between Oxford and Cambridge would deliver. This was also within the context of hybrid working opening new opportunities for employment and also commuting patterns.

In two areas, labour supply and direct benefits to households, the rise of hybrid working may in fact increase the benefits that East West Rail can bring, through a combination of improved connectivity and increased commuting catchments. The nature of agglomeration benefits may change as a result of new methods of working, but there are both positive and negative impacts, which in combination with the character of the knowledge based economy in the Oxford – Cambridge arc means that the overall level of agglomeration benefits remains comparable to pre pandemic values.

The table below, taken from the Systra report, summarises the total agglomeration and labour supply impacts for each service pattern option in a single year (at 2023 prices) and the a 60 year discounted present value at a 2010 base year in line with DfT TAG guidance.

	Option 1 (EWR Base Case)	Option 2	Option 3
GVA (single year)	£12.70m	£12.28m	£12.55m
Labour supply (single year)	£1.77m	£1.60m	£1.61m
Single year total	**£14.4m**	**£13.9m**	**£14.1m**
60 year discounted present value	**£268.72m**	**£257.57m**	**£262.96m**

Figure 18 - Summary of economic benefits of service pattern options

The key message form the table above is that in all options EWR would represent a sizeable boost to the economy in Bedford worth between £257m and £268m over 60 years. The difference between options is relatively small. Options 2 and 3 both show a reduction in overall benefits compared to EWR Co's base case (Option 1), with Option 2 (which involves the lowest level of train service at Bedford Midland) having the greatest impact with a reduction in benefits of 4%. Option 3 is only worth 2% less than Option 1.

It is notable that Stewartby ("Bedford South Parkway") has a very strong role in supporting East West Rail in the Bedford area, and it provides considerable mitigation in Option 2 when Bedford Midland loses direct services to Oxford, and this station appears critical delivering the benefits of EWR to the Bedford borough as whole.

9 Can a four-track option work?

9.1 EWR Co's position

All options for East West Rail services provide for segregated tracks south of Bedford and for additional platforms at the station to accommodate them.

For the northern alignments, including EWR Co's preferred alignment, two options have been considered immediately north of Bedford station:

- A four-track option in which the EWR tracks merge with the existing Slow Lines just south of Bromham Road Bridge (the A4280), with the junction for Cambridge diverging at Bedford North Junction, 900m further north.
- A six-track option in which new EWR tracks are constructed north of the station, creating a fully segregated railway.

The six-track option has remained contentious because of the property demolition in central Bedford required to construct it. EWR Co published a supplementary paper alongside its Route Update entitled "Why are two additional tracks needed north of Bedford station?". This paper states:

"The preferred option is to build two additional tracks to the existing four Midland Main Line (MML) tracks north of Bedford station. We've explored options to deliver EWR using the existing four tracks. However, after extensive railway capacity and performance modelling, we have concluded that it's not viable to deliver a reliable dedicated service of four EWR trains per hour on the already congested MML."

The table below summarises the arguments advanced by EWR Co in the paper along with the potential counter arguments:

Issue	EWR Co's Argument	Counter Argument
Current levels of congestion	Bedford station area is already congested with train services, even before EWR services are added.	As EWR will have its own dedicated platforms, the issue cannot be about the station area, but the section of the Slow Lines between where the Cambridge Line converges and Bedford North Junction. This section of railway has low utilisation.
Timetabling issues	It would be extremely difficult to introduce EWR services on the existing four tracks and within the existing train timetable.	This depends on how flexible the rail industry is prepared to be with other services and at other locations. It seems inequitable that Bedford should suffer in order to neatly accommodate EWR services at, for example, Oxford and Cambridge.

Issue	EWR Co's Argument	Counter Argument
Constraining future growth	It would constrain future growth of services on the Midland Main Line, including especially for freight.	A high proportion of the freight paths though Bedford in the current timetable are not used on a given day. For example, on a typical weekday in January 2024 there were 78 freight paths in the timetable (both directions, and excluding paths which are alternatives to each other), but only 21 freight trains actually ran (27% utilisation).
Speed restrictions	It would be very difficult to signal and maintain both EWR and existing services effectively within the 4-track section without negative impacts on the speed of trains.	This contention can only be proven one way or the other by detailed modelling and infrastructure design work.
Impact on Wixams station	A 4-track solution would involve Increased use of the existing platforms at Bedford station, exacerbating the performance and growth constraints and threatening the ability to accommodate a new station at Wixams (because the plan for Wixams involves GTR trains standing in Bedford station for longer than they currently do).	The 4-track solution modelled by Arup on behalf of EWR Co has 4 platforms dedicated to GTR services (0 to 3) compared to 2.5 today. This is because the proposal includes the construction of two additional platforms – platform 5 that would enable the removal EMR services completely from platforms 1 to 3 and platform 0.

Figure 19 - EWR Co arguments for 6 tracks and counter arguments

All of EWR Co's arguments are aspects of the same contention: if EWR trains share a section of the existing Midland Main Line it will be very difficult to timetable them and existing services, creating a sub-optimal solution that also does not allow for growth.

9.2 EWR Co's modelling

The evidential support for EWR Co's position comes most recently from modelling work undertaken by Arup entitled: "North of Bedford 4-track Operational Impact Assessment Reference: EWR_PGM-ARU-OP-XX-RP-Z-000003" and dated February 2023. It was included as Appendix 12 of the Economic and Technical Report published alongside the Route Update Announcement in May 2023.

This report compares the 4-track and 6-track options from a timetabling and performance perspective. The diagram below shows the 4-track option Arup used for their modelling, with changes to the current layout shown in red.

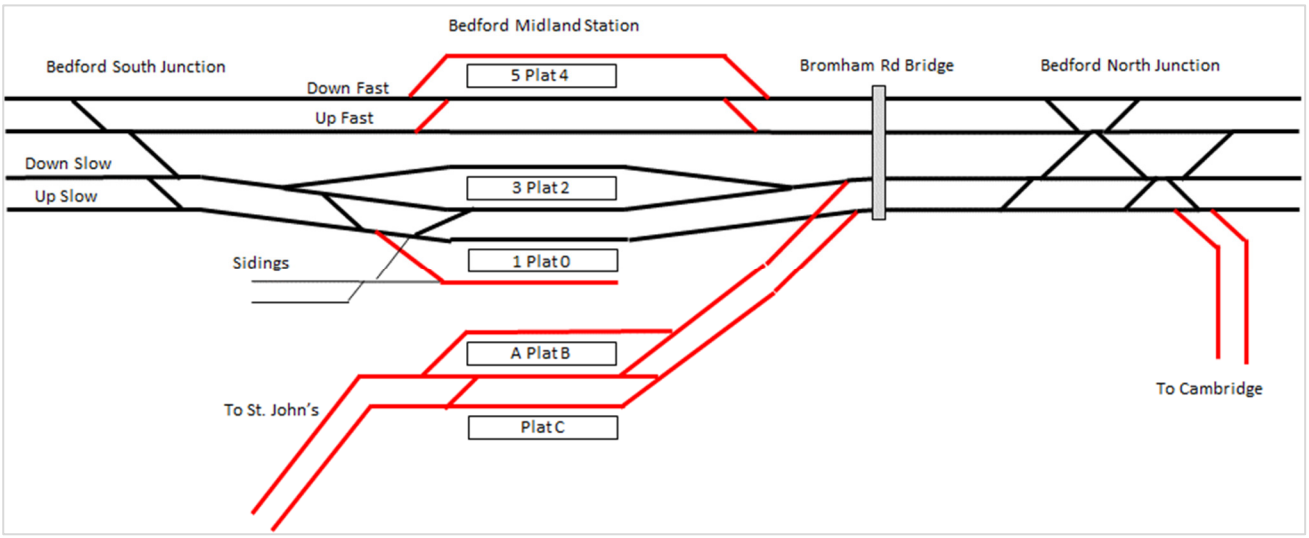


Figure 20 - Four-track option used for EWR Co's modelling

The diagram below shows the 6-track option used by Arup.

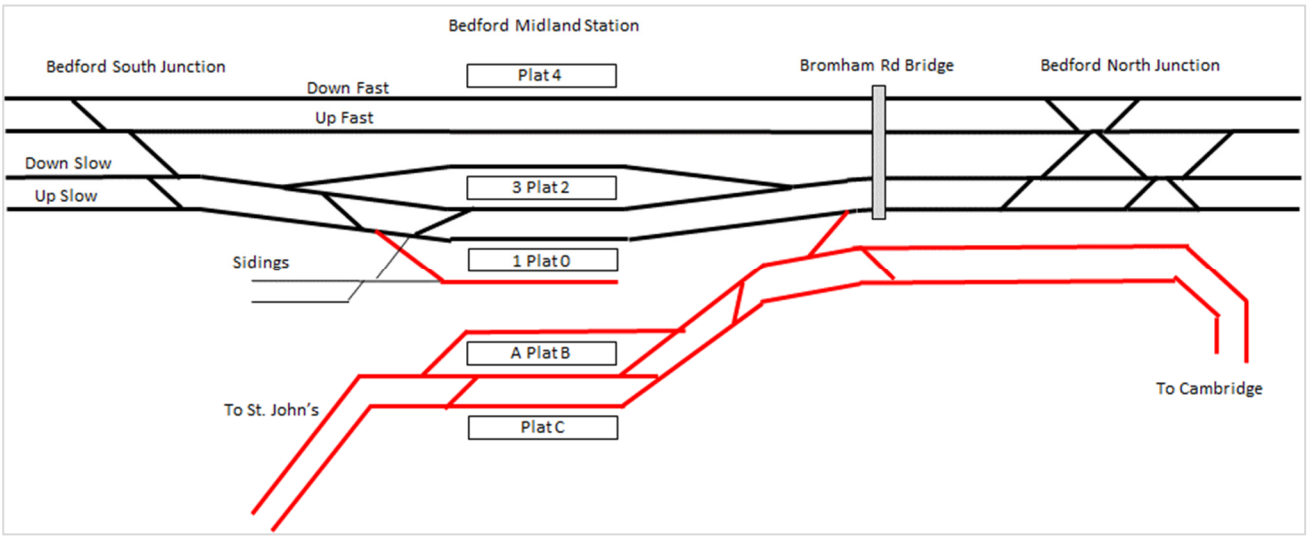


Figure 21 - Six-track option used for EWR Co's modelling

It can be seen that in the 4-track option, Arup have included a couple of key features designed to offset the use of the Slow Lines by EWR services:

- A new platform 5 allows all EMR services to be concentrated in platforms 4 and 5 and removed from the east side of the station.
- A new full-length platform 0. This eases operation of GTR/Thameslink services and replaces a turnback siding that has to be removed from north of platform 1.

In the 6-track option platform 5 is not deemed to be required, although platform 0 is. Note how the operation of East West services is segregated entirely from the Midland Main Line, although the ability to cross from East West Rail infrastructure to the Midland Main Line is retained (for north/west movements only).

9.3 Implications of a four-track option

The Arup report includes the following summary:

"*Whilst there is no direct interaction between Thameslink and EWR services on the four-track design the inclusion of freight services links the structure of the timetables together. To optimise the timetable at Bedford the Thameslink and EWR services need to arrive and depart Bedford at similar times to maximise the number of parallel moves; if the services cannot be coordinated this way there is a sequence of conflicting moves which erodes the available capacity and creates a performance risk. Even with an optimised timetable the number of freight paths is limited to 2 tph in most hours.*

"*There is limited scope to flex the Thameslink timetable due to the crossing moves at flat junctions on the Midland Main Line, Blackfriars Junction and across the Southern network. In addition, freight is tightly pathed between the Thameslink services due to the difference in running times and limited passing locations on the MML This fixes the freight path through Bedford and forms the constraint that EWR must work around.*

"*In terms of performance, due to the number of constraints and interactions Thameslink services have on the existing network it is anticipated that both the Thameslink and freight services will be given regulation priority to minimise overall network disruption. This would leave EWR vulnerable to disruption on the Midland Main Line and potentially spread it along the EWR route to Cambridge, Oxford and the West Coast Main Line.*"

And again: "*It is theoretically possible to timetable a 4tph EWR service around the other services looking at Bedford in isolation on a four-track layout. However, this would constrain the EWR timetable in the middle of the route leading to compromises on performance and journey time.*"

According to Arup there are, therefore, two issues:

- A technical and practical point about the **operation of the Bedford station area** with EWR services.
- A route-wide point about the impact of constraints at Bedford on **timetabling EWR services on a whole route basis**.

9.4 Operational challenges in the Bedford station area

The annotated figure below shows our understanding of the particular challenges found by Arup in the modelling.

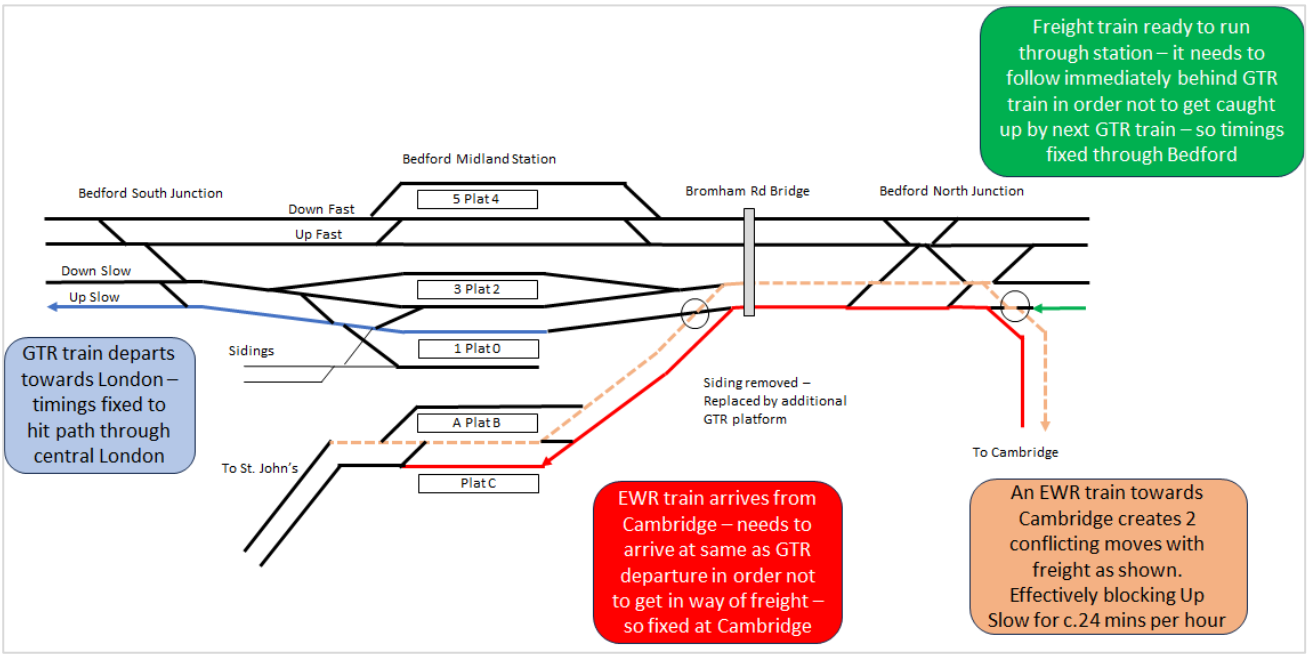


Figure 22 - Why it is potentially difficult to make a four-track option work

On the figure above:

1) The EWR services (buff) essentially need to be timed to coincide with the departure of GTR services (blue) in order to allow enough space for a freight train (green) to be timed between Bedford North Junction and further south on the Thameslink network.

2) In the eastbound direction EWR services (shown in buff) take up 20-25 minutes of each hour on the Up Slow because each of these services perform two conflicting moves (circled). This is likely to constrain the timings of Up direction freight trains.

It would be possible to ameliorate issue 1) if it were possible to hold a freight in the station area, thereby breaking the link between EWR and GTR services. The creation of additional platforms 0 and 5, as shown in Figure 20 should enable platform 3 to be clear for much of the day, as GTR services would still have three platforms to use as now (0, 1 and 2) and Up EMR services calling at the station would use platform 4 rather than 1, 2 or 3 as they currently need to do.

It is recommended that EWR Co is asked to demonstrate whether this option could be made to work.

In addition, whilst the modelling does show some reduction in performance in a 4-track solution compared to a 6-track solution, the Arup report does not include overall figures for performance to allow comparison between options. The following are key points:

- The performance impact of 4-tracks can clearly be mitigated by additional infrastructure elsewhere at Bedford, including platform 0 and platform 5.
- The modelling will always and inevitably show that the six-track alignment provides the most resilient solution for EWR services. Whether this is necessary is a different matter, and as the report notes: "*The level of performance that these services need to achieve to avoid impacting on the wider network cannot be determined at this stage as the interactions along the wider route are not fully understood.*"

10 Alternative Bedford track arrangements for southern alignments

If East West Rail were to take any of the southern routes bypassing Bedford (BFARe, ERTA, Varsity or Varsity Hybrid) the issue of 4 or 6 tracks would not arise. The layout at Bedford would be different depending on whether a service pattern similar to Figure 15 or to Figure 16 were chosen. In Figure 15 - Service pattern for South of Bedford alignment - Option 2) some East West Rail services call at Bedford South Parkway and do not go into Bedford Midland, whereas in Figure 16 - Service pattern for South of Bedford alignment – Option 3) all services call at Bedford Midland and reverse as appropriate.

The figure below shows a notional layout for South of Bedford alignment Option 2. A freight link is provided connecting into the Midland Main Line Up Slow just south of Bromham Road Bridge, but otherwise there is no interaction with existing services. Alternations, such as the construction of a new platform 0 and platform 5 are shown, but would not necessarily be part of the East West proposition.

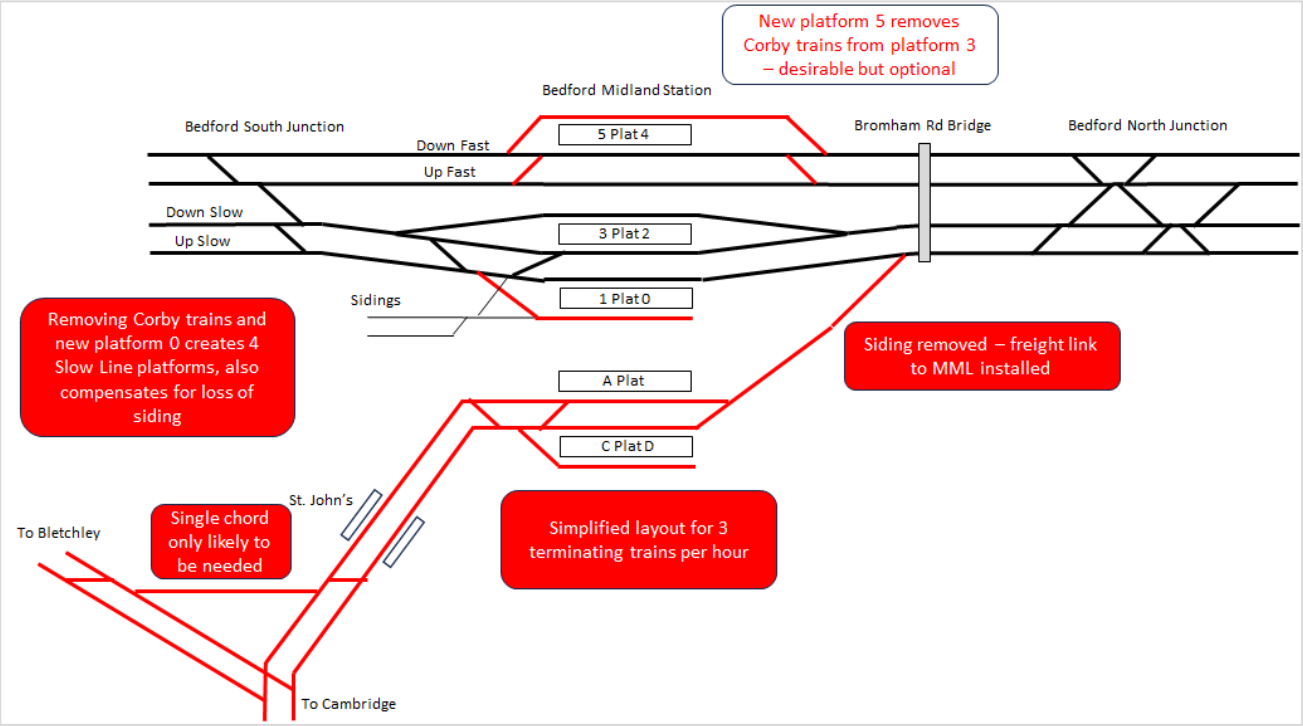


Figure 23 - Alternative Bedford layout for South of Bedford alignment service pattern - Option 2

The figure below shows a notional layout for South of Bedford alignment Option 3. Under this option the footprint of the East West Rail platforms has to be greater in order to accommodate more trains and more reversal moves. However, the interaction with the Midland Main Line is the same as in Option 2.

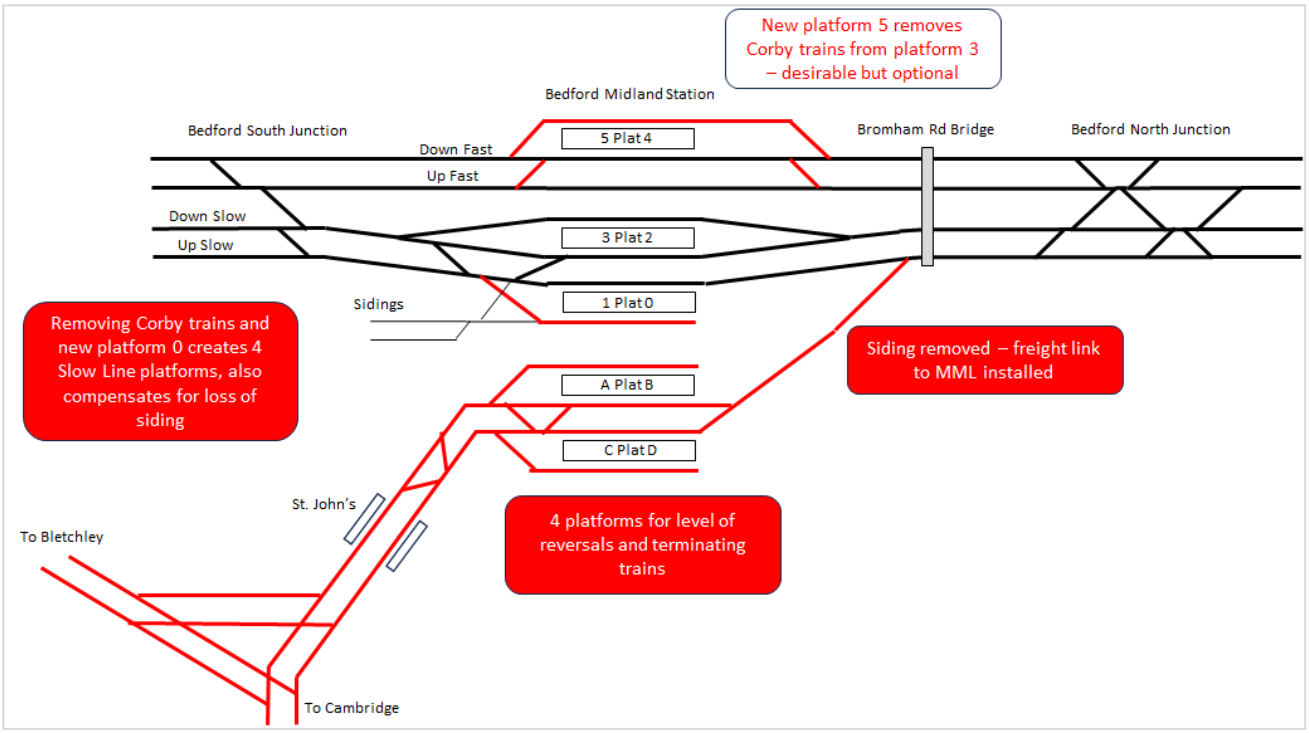


Figure 24 - Alternative Bedford layout for southern alignment service pattern option 3

11 Conclusions on four-tracks through Bedford

It is clear that a solution with more infrastructure is likely to provide a more resilient solution. This applies to the issue of additional tracks north of Bedford Midland station. However, what EWR Co have not yet been able to do is to demonstrate whether this is necessary as opposed to desirable. The level of performance that East West Rail services need to achieve to avoid causing material performance reduction elsewhere on the wider rail network cannot be determined at this stage as the interactions along the wider route are not fully understood.

That said, four tracks appear to be a workable solution if:

vi. Future freight growth can be accommodated by increasing the existing poor utilisation of paths from c.27% and by infrastructure changes that are driven by that growth not by East West Rail services.

vii. Platform 5 is constructed so that all EMR services are concentrated on platforms 4 and 5 and do not interact with Thameslink services. This has the added benefit that long distance inter-city services could call at Bedford once more.

viii. An additional platform 0 is constructed so that Thameslink services are able to use 4 platforms: 0, 1, 2 and 3, offering more capacity than they have at present.

ix. Freight trains make use of platform 3 to be held where necessary in order to fit in with other traffic north and south of Bedford.

x. Compromises and timetable constraints are accepted at other locations on the East West Rail route so that Bedford is not forced to accept the worst downsides of the construction of the railway.

In addition, we have identified indicative layouts for Bedford Midland which would accommodate a southern alignment past Bedford with the reversal of some or all East West Rail services in the station. In these instances the issue of four or six tracks north of the station does not arise.