

East West Rail – Central Section

Bedford Midland Cost Drivers

Briefing Paper

Date: March 2019

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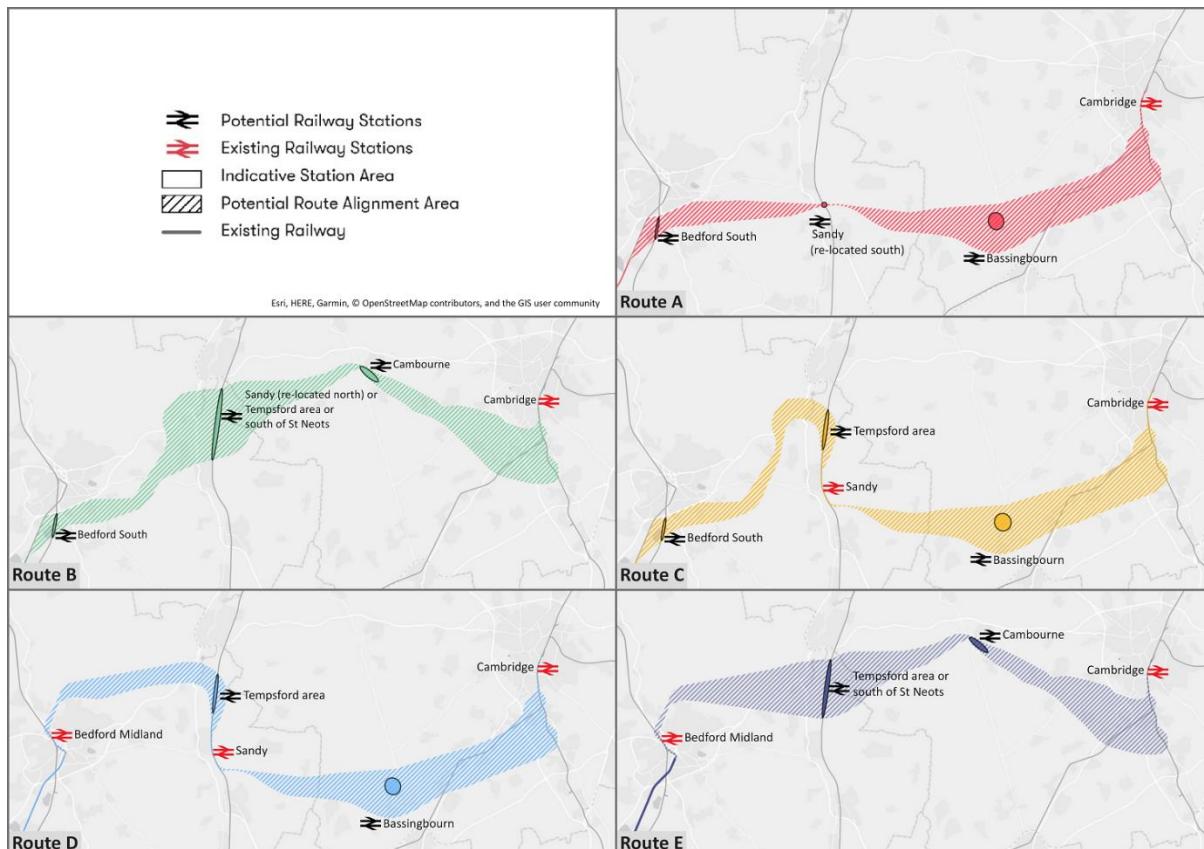
The aim of this briefing paper is to identify key cost drivers between options that serve Bedford Midland Station and options that serve a Bedford South Station.

This summary relates to the routes selected by EWR Co for public consultation, and for the purposes of the paper, Route Options A, D and E have been selected to articulate the differences between a Bedford Midland and a Bedford South option.

- Route A Bedford South option
- Route D Bedford Midland option
- Route E Bedford Midland option

All costs are quoted at 2015 rates and include risk at 40%, which is appropriate for this level of assessment and stage in project development.

This summary generally relies on the development work completed up to the end of September 2018. However, where the current development work is indicating a potential change, these are highlighted.



Consultation Routes

Cost drivers between Bedford Midland route options and Bedford South route options

From the analysis undertaken to date, the key drivers of cost difference between Bedford Midland and Bedford South options are:

1. Route Length
2. Impact on Depots South of Bedford Midland
3. Civils works e.g. viaducts
4. Bedford Midland Station
5. Topography

1. Route Length

When measured between two points of commonality (Lidlington and Cambridge), the two Bedford Midland routes are longer and, by default, this means they require more infrastructure and land.

Route lengths are measured both from Lidlington to the relevant station where EWRCS will interface with ECML (in the Sandy area), and from Lidlington to Cambridge.

The difference in route lengths is:

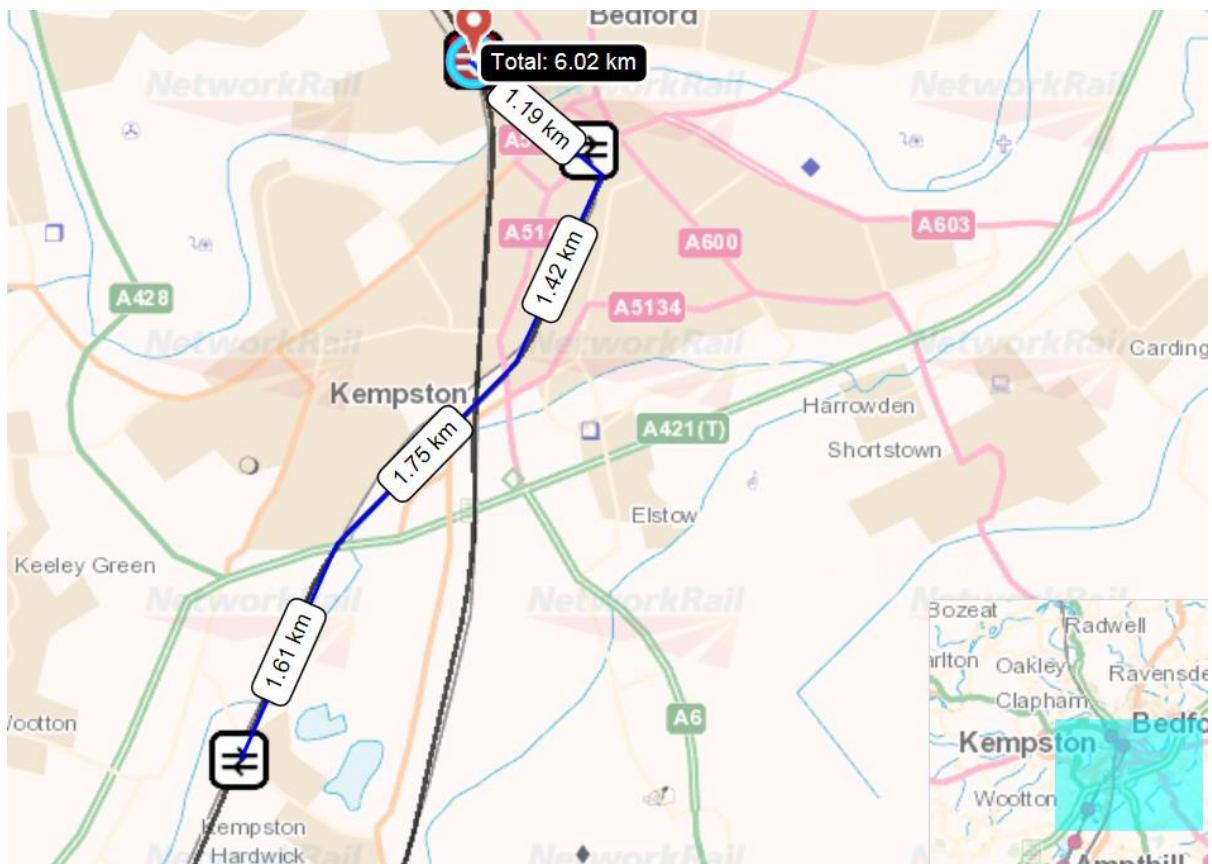
Route Option	Route Length (Lidlington to ECML Station)	Delta (end to end)	Route Length (Lidlington to Cambridge)	Delta (end to end)
A	23.5km		51Km	
D	38km	14.5km	66km	15Km
E	31.5km	8km	60.5Km	9.5Km

It should be noted that the precise route length for each option will vary depending on the final alignment that is chosen. The figures presented here are based on indicative alignments that have been used for the purposes of generating cost estimates. Such indicative alignments are theoretical - they do not represent proposals and are used purely for the current, high level consideration.

Costs – infrastructure on the Marston Vale Line Section

Of the increased length of Bedford Midland options compared to Bedford South options, c6km will be works required to upgrade the existing Marston Vale Line between Kempston Hardwick and Bedford Midland. This upgrade will be required to provide the required train capacity to deliver the Indicative Train Service Specification for EWR services.

This assessment is on-going but indications are that it there would be a cost in the order of magnitude of **c£40-60m**. This cost is not required for Bedford South options as these options do not require this section of infrastructure, as they depart the Marston Vale Line in the area of Kempston Hardwick to go eastwards towards Cambridge.



Kempston Hardwick to Bedford Midland

Costs - infrastructure Bedford to ECML Station Section

For Route D, the additional infrastructure to reach the ECML is c3km with an order of magnitude cost of **c£30m**, plus c6.5km of assumed 6-tracking of the ECML to Sandy Station with an order of magnitude cost of **c£220m**. **Total order of magnitude cost of c£250m**.

For Route E, the additional infrastructure to reach the ECML is c3km with an order of magnitude cost of **c£30m** excluding civils topography costs which are included in section 5.

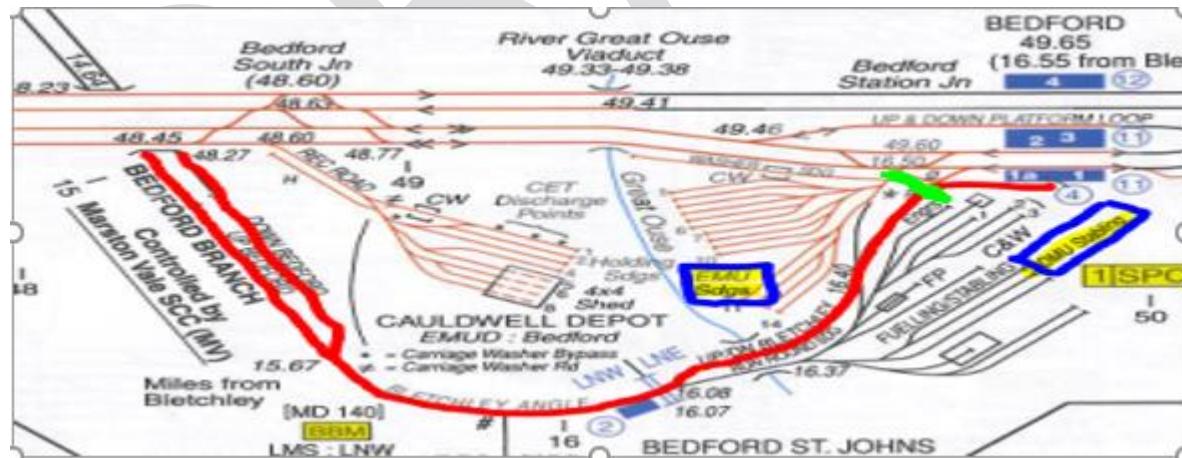
2. Depots to South of Bedford Midland

Additionally, the development work undertaken to date identified that the increased train frequency on the Marston Vale Line, in the area of existing Depot operations to the south of Bedford Midland Station (Jowett sidings and Bedford Maintenance Depot), would import safety and operational constraints that may require mitigating. These issues include a level crossing (length 110m barrier to barrier) which traverses the operational tracks within the depot and train movements between the depot and Jowett sidings. Whilst further investigation is ongoing to identify the appropriate mitigation and technical solution, an allowance of £240m was included to cover a “worst-case scenario” in which a significant proportion of depot operations would require relocation to a new facility. A suitable and acceptable location has not yet been identified.

Current development work is examining solutions to mitigate this in more detail and has included a reassessment of the rail industry risk assessment for level crossings, being carried out to take account of the increased service levels/train movements (from 2tph to a maximum of 12tph in both directions) that would pass over the depot level crossing. It should be noted that the 12tph figure excludes low speed Empty Coach Stock moves over the level crossing.

This indicates that mitigation works (level crossing upgrade and track infrastructure remodelling), rather than wholesale depot relocation, may be practical and acceptable.

This cost (whether for depot relocation or mitigation works) would not be incurred for Bedford South options, as services would diverge from the Marston Vale Line before the area of depot operations.

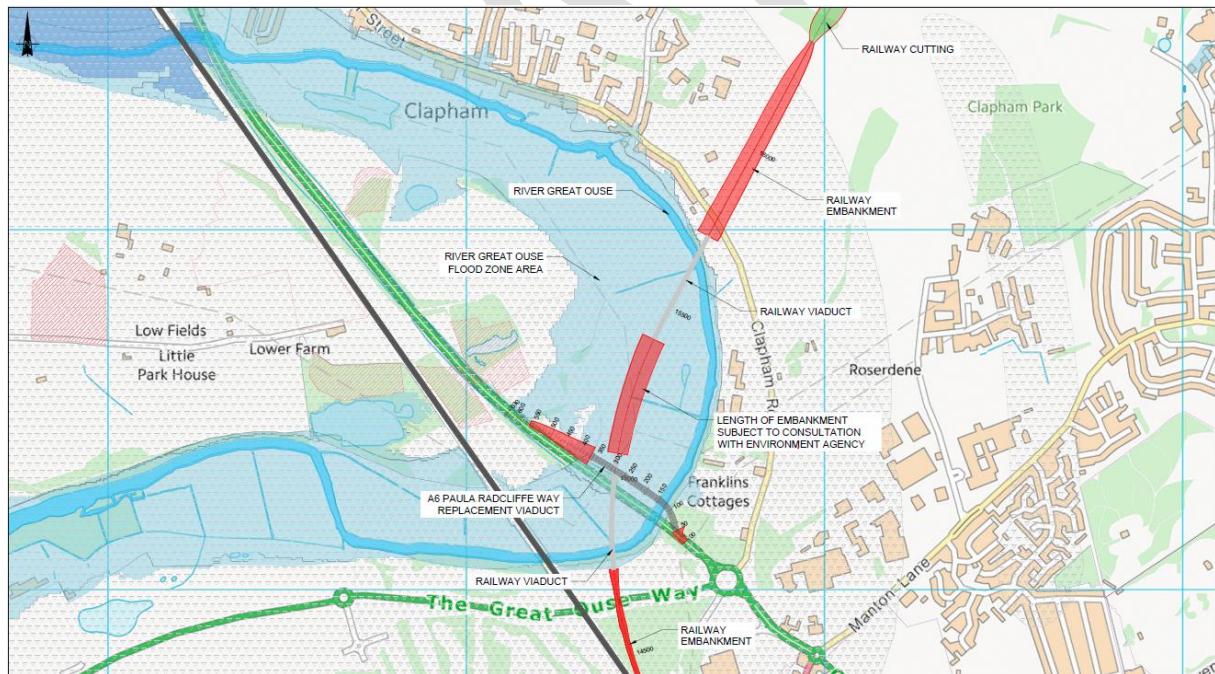


3. Civils items

Development work to date indicates that to accommodate EWR services at Bedford Midland, there would be a requirement for 2 new platforms on the eastern side of the station, with services then continuing north on the Slow Lines to a point c1km north of the station where services need to diverge to the east towards Sandy and Cambridge.

Any route north of Bedford Midland will require two significant viaducts. One new rail viaduct over the Great Ouse River and the flood zone in this area, and the reconstruction of the existing road viaduct (Paula Radcliffe Way) to the north of Bedford Midland station, to enable the new railway to align with the higher ground in this area, rising 18m over a distance of 3km. This would also potentially result in significant disruption to road traffic in and out of central Bedford during the construction period.

Emerging order of magnitude costs for the additional works compared with a Bedford South option that would be required are estimated to be c£25m – 30m for the road viaduct (structure size of 7968m², length 332m) and c£200m -220m for the rail viaduct (structure size of 9600m², length 880m). This is based on a 1:125 gradient.



Potential solution immediately north of Bedford Midland, showing interface with Paula Radcliffe Way.

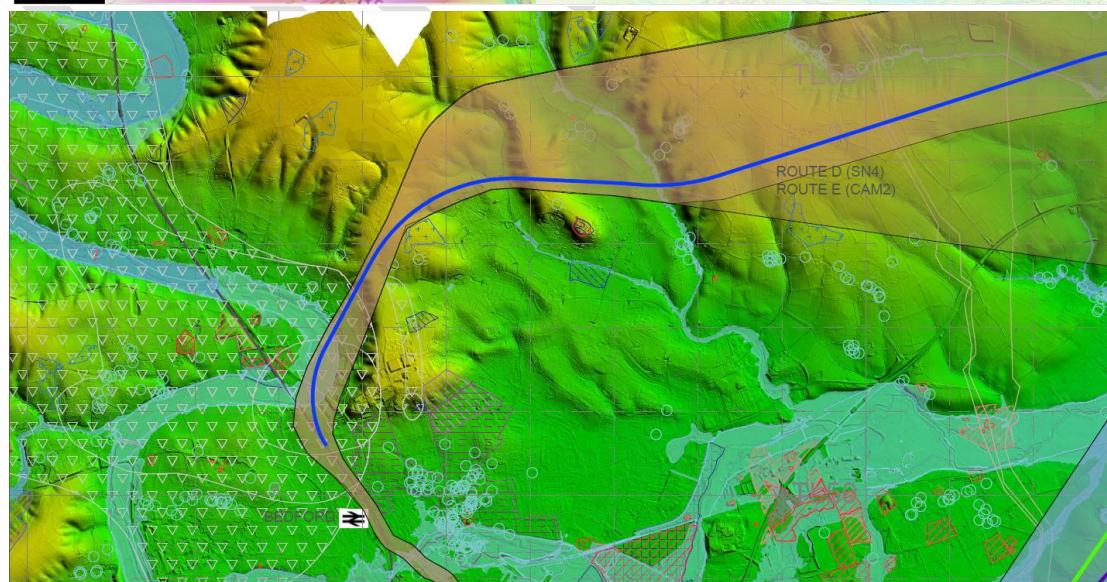
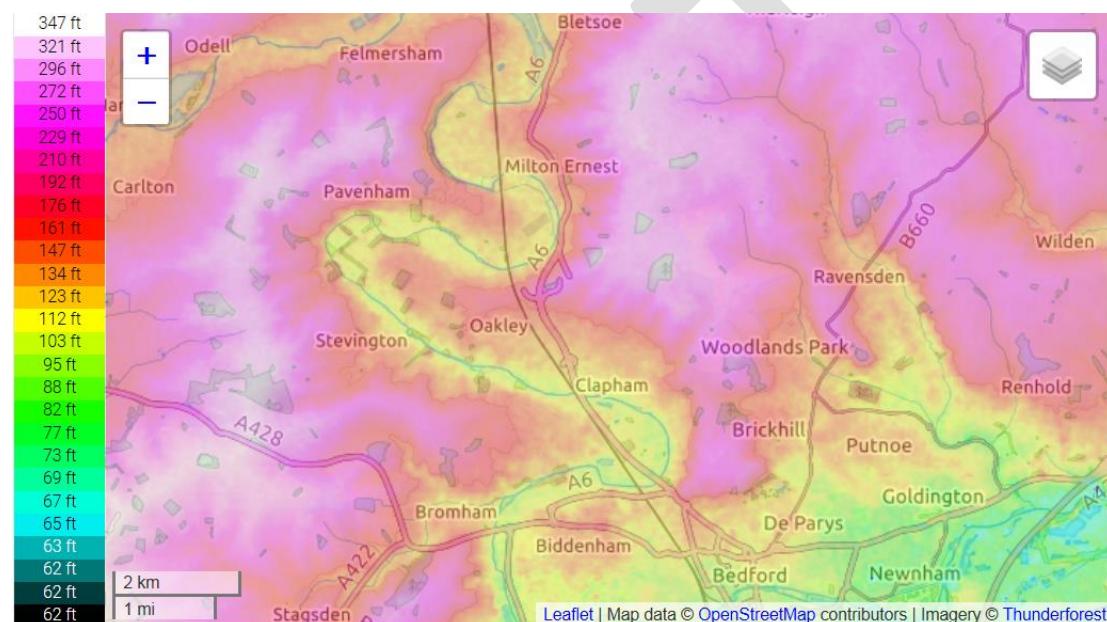
It should be noted that if it were possible to use a 1:80 rail gradient (although this would preclude heavy haul freight services from using the route), it may be possible to avoid the cost/disruption of the road viaduct reconstruction by bringing the railway over the road, however, the viability of this as

a solution currently remains unproven and no order of magnitude cost estimate is currently available. It would also need to be acceptable in terms of the benefit to the freight railway foregone as a result.

The total cost of these interventions is c£225-250m.

Alternatives considered

More northerly points of divergence (for example North of Clapham) were considered but not progressed for immediate evaluation, as they had the effect of increasing route length and journey time without appearing to offer any significant cost benefit, as the topography and local constraints appear no less challenging. This approach is consistent with the objective of this phase of the study, which is to identify a potential alignment which represents the “value opportunity” of a route.



Topographic Mapping – showing higher ground north of Bedford.

4. Bedford Midland Station

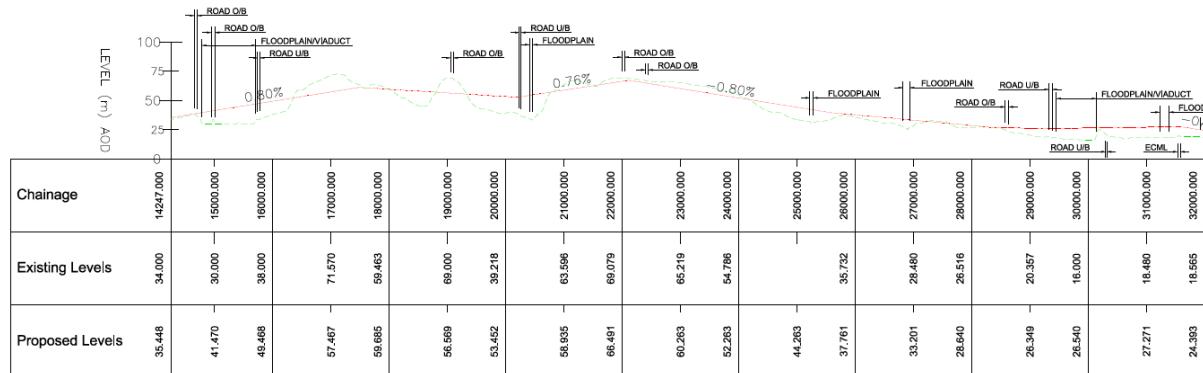
The cost of the station works at Bedford Midland has been assessed previously as c£104m. The cost of the station works for a Bedford South station has been assessed as c£78m. Bedford Midland station costs are, therefore, assessed as **c£26m** higher than a Bedford South option. This reflects the costs of working in the more constrained environment of the existing operational station, the requirement for a multi-storey car park to accommodate the number of cars within a smaller footprint than the current at grade car park, and demolition and reconstruction costs for the station building on the east side, plus the costs of increased disruption to train services when compared to Bedford South options.

Bedford South station in comparison is a new construction in a less constrained location, with an at grade car park assumed.

Cost difference c£26m (based on current order of magnitude estimates)

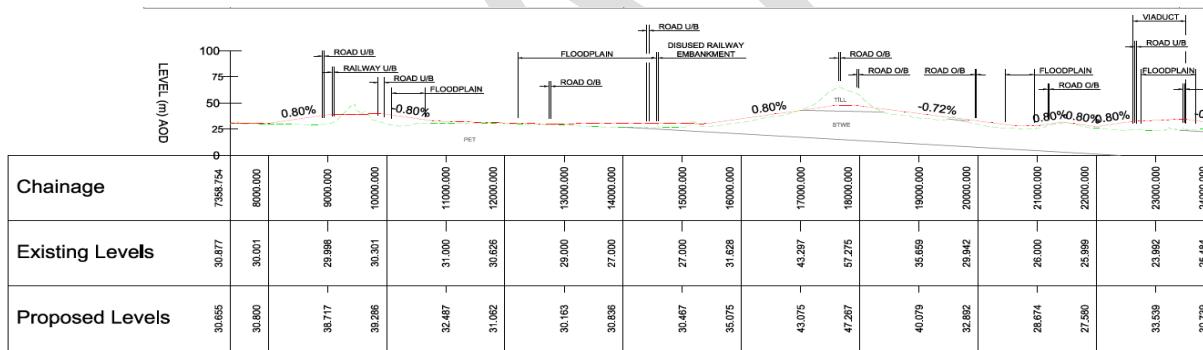
5. Topography

Routes which go north of Bedford Midland encounter more challenging topography with increased cut/fill volumes and hence cost. The Bedford Midland route options have a significant area where fill/cut height changes of up to 14m are not uncommon.



Route D Vertical Profile

In contrast, the route options via Bedford South are flatter with the maximum level fill/cut difference being 9m, but more typically 3-4m.



Route A Vertical Profile

Whilst the existing model only provides end to end volumes, an assessment as to the likely delta between the routes has been made and is in the order of magnitude of £50-100m.

Summary

Infrastructure costs in the section from the Bedford Area, whether a Bedford Midland or a Bedford South route option, are in the order of magnitude as outlined below.

Route A (Bedford to ECML)	= £423m
Route D (Bedford to ECML £704m + BM Depot £240m + MVL £60m + ECML £250m)	= £1254m
Route E (Bedford to ECML £789m + BM Depot £240m + MVL £60m + ECML £30m)	= £1119m

The increase in costs of a Bedford Midland option over a Bedford South option, in this geographic area, is therefore considered to be in the order of **c£800-900m** for route D, and **c£650-750m** for Route E based on the upper limit of the ranges.

As set out previously in this note, this consists of:

Description	Cost £m
1. Route Length – Marston Vale line to Bedford Midland	£40-60m
2. Impact on Depots South of Bedford Midland	£240m
3. Bedford Midland Station delta over Bedford South	£26m
4. Civils works e.g. viaducts	£225-250m
5. Route Length – Bedford midland to ECML	£30-£250m
6. Topography	£50-100m
Order of Magnitude Range	£650-900m

Key Common assumptions

1. All base Journey times in this phase have been assessed using a class 800 rolling stock, operating in diesel mode with a maximum speed of 125mph. A selection of routes have been modelled with 100mph infrastructure to test business case sensitivity.
2. All potential infrastructure solutions have been assessed using a maximum gradient of 1:125 to provide maximum compatibility for potential rolling stock, including freight. Sensitivity analysis on alternative gradients (up to 1:80) has been undertaken to establish if this would offer a significant benefit.
3. A Platform Length requirement base case of 100m has been identified with passive provision made in the design for future increases of up to 260m.
4. Current economic modelling assumes Bedford South/Wixam's would be served by Thameslink services only
5. Patronage forecasts for Bedford South/Wixam's equate to the provision of a 900 space car park, for which provision has been made in current estimates
6. Empty Coaching Stock moves in the Bedford area have been assessed as being in the region of 40+ per day. Sample taken 04/03/19 showed 26 moves from Jowett sidings and 23 moves from Bedford Carriage sidings within the 24hr period.