



# **RYR 121 – MELTON NOTTINGHAM CONNECTIVITY**

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**Annex D**

**Capacity Analysis**



## TECHNICAL NOTE

<b>DATE:</b>	30 June 2021	<b>CONFIDENTIALITY:</b>	Confidential
<b>SUBJECT:</b>	Potential capacity for additional train services between Melton and Nottingham		
<b>PROJECT:</b>	Melton – Nottingham RYR SOBC	<b>AUTHOR:</b>	LG
<b>CHECKED:</b>	DW	<b>APPROVED:</b>	JC

## INTRODUCTION & BACKGROUND

As part of the Restoring Your Railways Ideas Fund, Melton Borough Council (scheme promoter) and Charnwood Borough Council (joint funder) have commissioned a Strategic Outline Business Case (SOBC) to identify potential new transport links between Melton Mowbray and Nottingham. A number of feasible timetable solutions to improve connectivity have been identified, either a direct connection via Syston, or with a change at Leicester.

As of today, public transport connectivity between Melton and Nottingham is poor. This lack of connectivity, combined with an ageing population and a skills gap is restricting growth for businesses in Melton Mowbray which require additional labour and access to wider consumer markets to grow further. It is anticipated that enhanced connectivity will offer businesses stronger connections to a wider labour pool and make Melton better connected for essential inward investment.

Alongside this, Melton has significant housing growth plans which will play a critical role in strengthening and deepening the housing market and economic geographies of Leicester, Nottingham and the wider Midlands Engine development area. Enhanced connectivity between Nottingham and Melton will provide improved access to both employment and leisure opportunities for residents of both districts.

To provide better connectivity between Melton and Nottingham, a longlist of ITSS proposals was identified at a stakeholder workshop on 19<sup>th</sup> February 2021. A sift process was then used in order to shortlist the options that were under consideration. The sift process incorporated a desktop review of constraints within the study area and took into account the ability of each option to:

- meet the project's stated strategic objective to improve connectivity between Melton Mowbray and Nottingham;
- deliver improved journey times, and/or a direct journey between the two locations;
- be affordable in terms of likely capital costs;
- be commercially attractive for a train operator to run;
- be operationally deliverable, and not import undue train performance risks taking into account known infrastructure capability and capacity.

The options that were brought forward for timetable analysis after the conclusion of the sift process were as follows:

- Option 3 – Baseline plus extension of the Birmingham New Street to Leicester service through to Peterborough
- Option 4 – Baseline plus an extra TPH between Nottingham and Melton calling at all stations
- Option 5 – Baseline plus an extra TPH between Nottingham and Melton calling at limited stations



- Option 9 – Baseline plus an extra TPH between Nottingham and Peterborough calling at limited stations
- Option 10 – Baseline plus an extra TPH between Nottingham and Cambridge calling at limited stations

The options that were discounted after the conclusion of the sift process were:

- Option 1 – Baseline (Extension of Crewe – Stoke – Derby through to Newark)
- Option 2 – Baseline plus an extra TPH between Leicester and Melton
- Option 6 – Baseline plus an extension of the Lincoln – Nottingham – Leicester service through to Melton
- Option 7 – Baseline plus an additional TPH between Melton and Mansfield/Worksop, travelling via Langley Mill and Ilkeston
- Option 8 – Baseline plus an additional TPH between Melton and Stoke (travelling via Derby)

Full details of the sift process including the scores associated with each option and the reasons for options being discounted are included in the Options Assessment Report.

It should be noted that there may be other competing strategic priorities for the capacity that has been identified as part of this work. Therefore, further stakeholder engagement will be required as the project develops.

## SCOPE

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This capacity study will assess the four ITSS options listed above in order to determine whether the current infrastructure within the study area could provide sufficient capacity to support the additional train services. The assessment will be performed using the ATTUne timetabling software. Once each ITSS option has been assessed, conclusions will be drawn regarding its viability, and the level of infrastructure interventions which would be required to achieve viability.

The *Restoring Your Railway (Beeching) Ideas Fund Strategic Outline Business Case Guidance (May 2021)* states that: *detailed and costly modelling is not needed at this stage of the project*, and therefore this timetable study will aim to produce high level evidence to support the SOBC assumptions and strategic narrative. The objective when looking at each timetable option will be to find a viable, conflict-free, hourly path for any additional/extended services, without creating additional conflicts on other services. Existing conflicts on existing passenger/freight trains within the base timetable will not be mitigated.

In terms of geographical scope, the study will focus on several LOR's:

- LN3201 – from Leicester to Trent South Junction
- LN3204 – from Trent South Junction to Nottingham
- LN3615 – from Helpston Junction to Syston South Junction and North Junction
- LN101 – from Peterborough to Helpston Junction

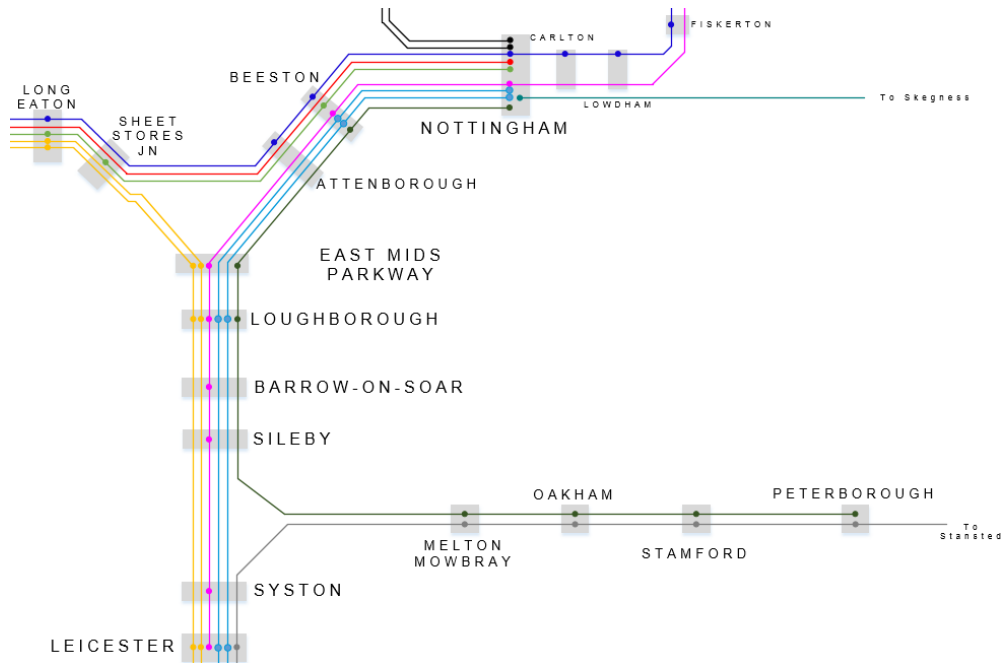


Figure 1 - Schematic of the study area

## DATA INPUTS

The following data sources have been used as inputs during this timetable study:

- May 2021 Network Rail timetable database
- Timetable Planning Rules – These are rules regulating the standard timings between stations and junctions together with other matters enabling trains to be scheduled into the working timetable for the various parts of the main rail network. Two sets of timetable planning rules were utilised in this assessment:
  - East Midlands – 2021 Timetable – Version 4.1
  - London North Eastern – 2021 Timetable – Version 4.1
- 2021 default Network Rail geography which holds the planning information for the UK rail network

## ASSUMPTIONS

Aligned with the availability of existing information a series of assumptions were made prior to the commencement of this study. They are as follows:

- The study will cover a 6 hour period (10:00am – 4:00pm) on a typical Wednesday using the May '21 timetable. The decision to study this period was made because if a service is not viable in an off peak hour, it is unlikely to be viable in a peak hour. Additionally, train service specifications in peak hours may differ to those in non peak hours in order to cater for different demand profiles.
- The type of rolling stock used for additional services between Nottingham and Melton Mowbray/Peterborough is a class 170 DMU timed at 100mph. Sectional running times for this service are already in the NR geography database. If there is a desire to run longer trains then the



platform lengths at each stopping station will need to be consulted. A train that exceeds the maximum platform length in any of the locations would not be viable.

- There is no limit on the number of extra rolling stock units available to support the additional services.

## RESULTS

### Option 3 – Baseline plus extension of the Birmingham New Street to Leicester service through to Peterborough

Given that this option centres around an extension of an existing service, the hourly services were fixed in their current paths between Birmingham and Leicester, before an attempt was made to path the trains beyond Leicester to Peterborough.

In the eastbound direction (Birmingham – Peterborough) it is very difficult to find a path through the Leicester – Syston East Junction section of the route without introducing conflicts with other passenger services. Leicester and the sections of track to the north and south of the station are highly congested areas that do not offer a lot of flexibility for train movements. The conflicts to the north occur because of the single line constraint at Syston South Junction, and the fact that the eastbound passenger service is required to make two crossing moves to move from the fast line onto this single line section. This means that it has to cross the path of traffic heading southbound towards Leicester. Examples of two such conflicts can be seen in Figure 2 and Figure 3 below. The required margin at Syston South Junction is 4 minutes, and there is not an hourly path for the eastbound service that is able to both maintain that junction margin whilst maintaining its arrival time at Leicester.

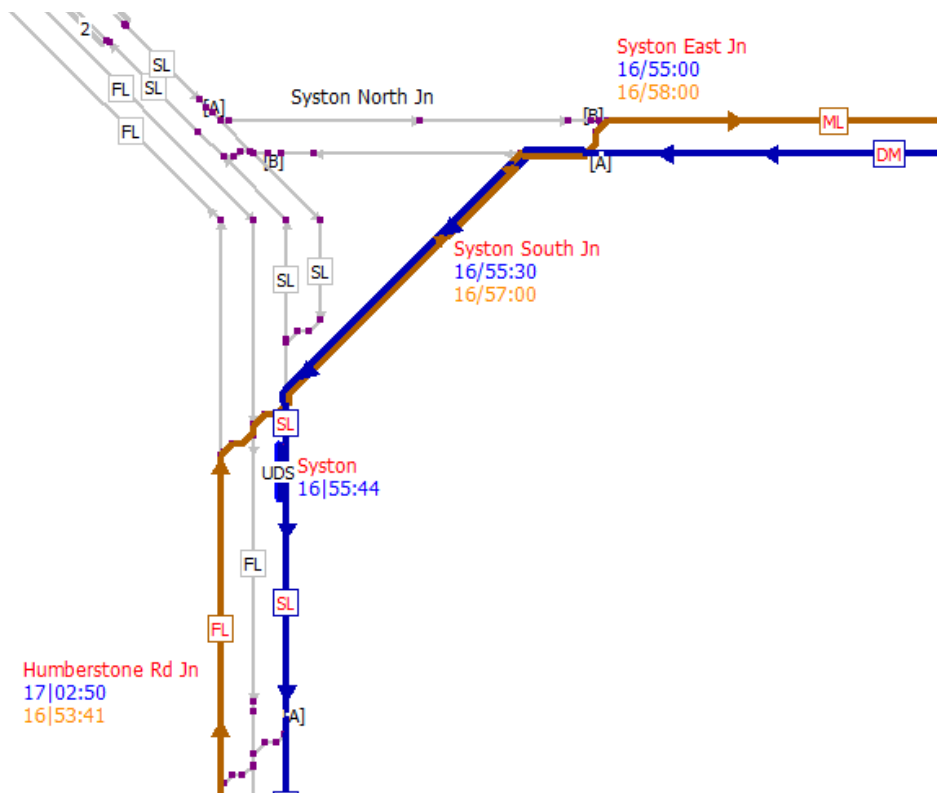


Figure 2 - Eastbound passenger service (gold) and a westbound freight service (blue) producing a conflict on the single line. This is a common occurrence when trying to extend trains beyond Leicester to Peterborough

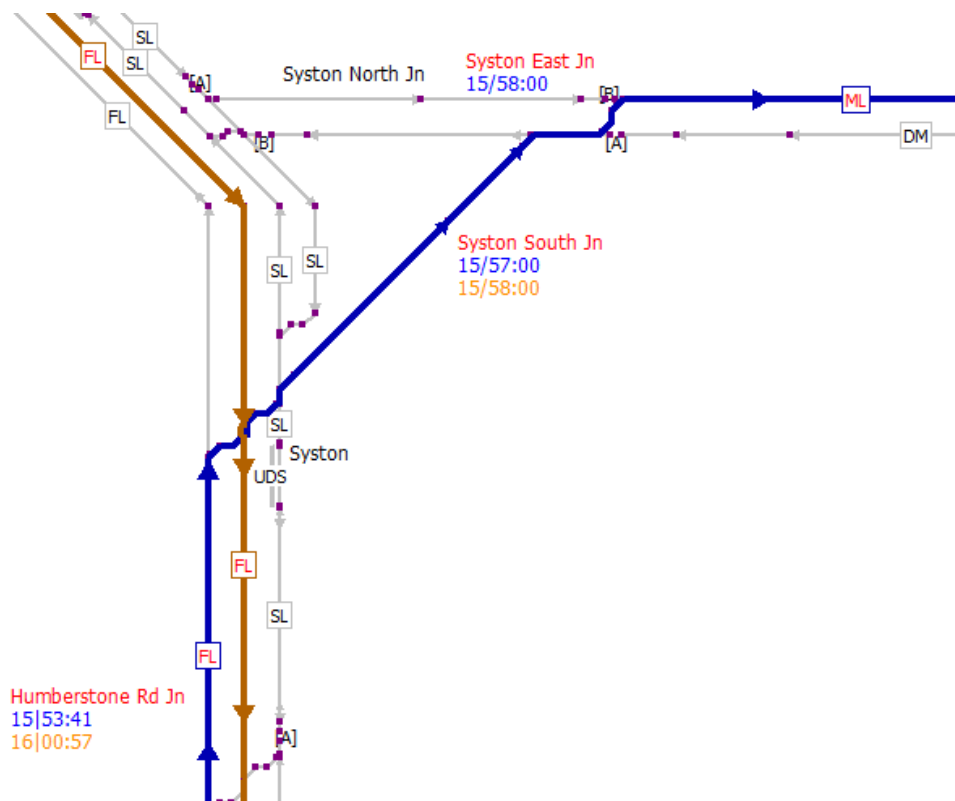


Figure 3 - Eastbound passenger service (blue) crossing the path of a southbound passenger service (gold) in order to get to the single line at Siston South Junction. This is another common occurrence when extending the Leicester trains to Peterborough

Once the train has passed through the section of route shown in Figure 3 above, it becomes much less complex to find an hourly path for an additional service. This is due to the fact that there is little traffic between Siston East Junction and Peterborough, and therefore not much pathing time would be needed in order to provide compliance.

The section north of Leicester is still signalled by Absolute Block signals which limits the number of trains that can run. Also, as well as regular stone trains from Mountsorrell quarries towards East Anglia, there are frequent intermodal trains between Felixstowe and the midlands, and this traffic is expected to grow over the next few years. Network Rail have looked at re-signalling the line to provide more capacity but the current state of these plans is unknown. That said, we have found suitable paths in this timetable between Siston and Peterborough for additional passenger services.

In the westbound direction (travelling from Peterborough to Birmingham) it is possible to find hourly paths for the trains between Peterborough and Siston East Junction, but the section of route between Siston South Junction and Leicester is where conflicts begin to arise. There are hourly headway conflicts with the Grimsby/Lincoln – Leicester services, and resolving this would require the Grimsby/Lincoln – Leicester services to depart approximately 3 minutes earlier, which opens up additional conflicts with other trains. An example of the hourly headway conflict with the Grimsby/Lincoln – Leicester service (2L64) is shown in Figure 4 and Figure 5 below.

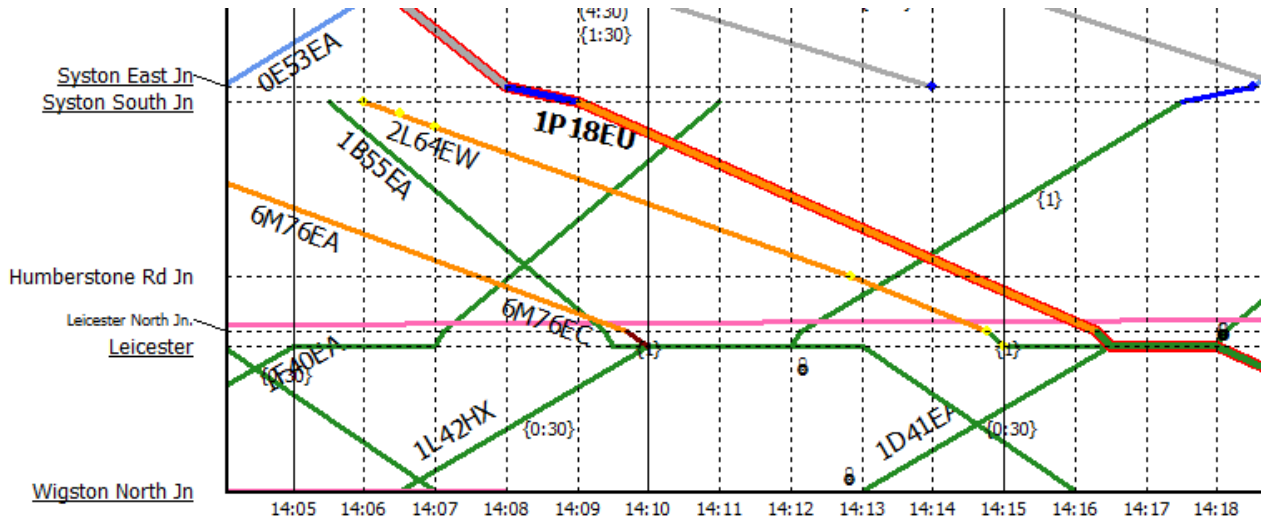


Figure 4 - Train graph showing the extended service (1P18) approaching Leicester and the associated headway conflicts with the train ahead of it (2L64)

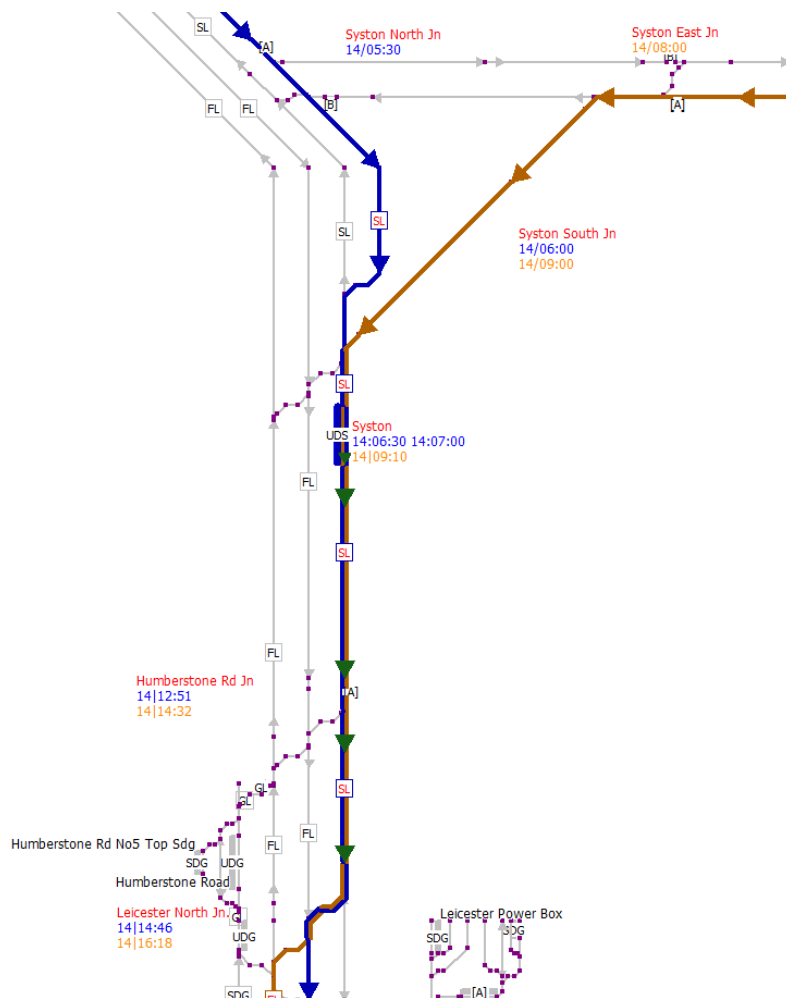


Figure 5 - Schematic showing the hourly conflict between the extended service (gold) and the Lincoln/Grimsby - Leicester service. The required headway in this area is 5 minutes, and currently there is only 2.5 minutes headway between the two services

All of the issues identified in this section are caused by congestion on the approaches to Leicester station, as well as congestion within the station itself. Infrastructure interventions that could be potentially help to resolve these issues (and other potential service increases) are:





- Providing 4 tracks between Wigston and Leicester
- Providing 4 tracks between Leicester and Syston
- Double-tracking the curve between Syston South Junction and Syston East Junction.

This area has already been identified by Network Rail for action within the Leicester Area Strategic Advice produced by Network Rail in 2021<sup>1</sup>.

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<sup>1</sup> <https://www.networkrail.co.uk/wp-content/uploads/2021/02/Leicester-Area-Strategic-Advice-2021.pdf>

## Option 4 – Baseline plus an additional TPH between Nottingham & Melton Mowbray (All stations)

The route between Nottingham and Melton Mowbray can be broken down into three parts:

- Nottingham – Trent East Junction
- Trent South Junction – Syston North Junction
- Syston East Junction – Melton Mowbray

In the southbound direction (travelling from Nottingham to Melton Mowbray), it was relatively simple to find conflict-free hourly paths for the additional service. The most critical area is the heavily congested section of the route between Nottingham and Trent East Junction. There was only one viable path through this area, and in some hours of the day this required freight services to be held on the goods line at Beeston South Junction for approximately 25 minutes in order to allow the new passenger service to pass through ahead of it. This constraint is not found for options 5 or 9, and it is not expected that a delay of this kind would be acceptable to stakeholders. An example of this can be seen in Figure 6 below.

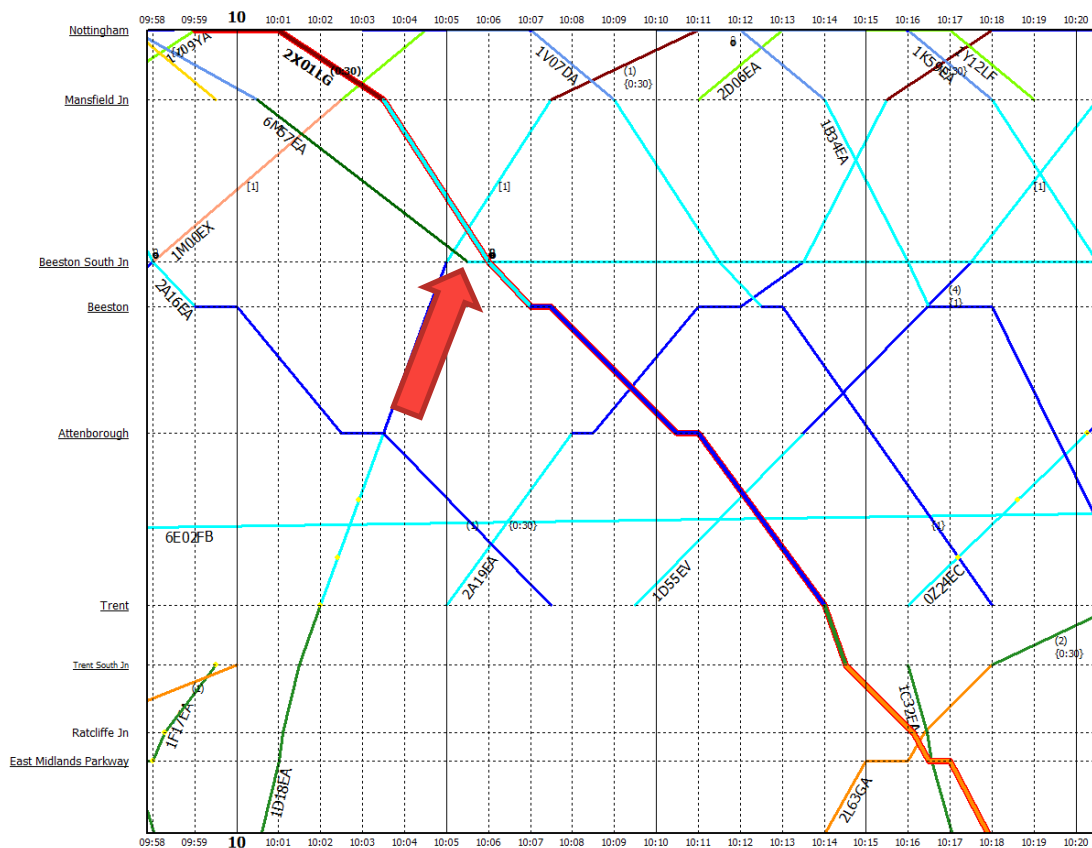


Figure 6: 6M57 is held at Beeston South until 2X01LG (highlighted) has passed.

In order to have the additional service call at all stations on the journey to Melton Mowbray, it is essential to run the trains on the slow lines through East Midlands Parkway, Loughborough and onwards. If the train were to run on the fast lines through these locations, it would not be able to call at Barrow-on-Soar as there is no crossover from the fast to the slow lines in advance of that location, and it does not have platforms on the fast lines. The slow lines are not as congested as the fast lines, so finding a path through this area that

links with the Nottingham – Trent East Junction path is relatively simple. The only issue with travelling on the slow lines is that there is currently no Up Slow line platform at Loughborough station. That means passenger trains in both directions have to use the Down Slow platform limiting capacity. Given that this is a critical station on the route, a new platform would need to be provided in order for the additional passenger service to be viable.

In some hours, freight services travelling on the slow lines cause conflicts with the new passenger service, and a small amount of pathing time was added to the passenger service in order to address this. An example of a typical path through this section of route is shown below in Figure 7. The orange lines denote trains travelling on the slow lines, and the green lines denote trains travelling on the fast lines.

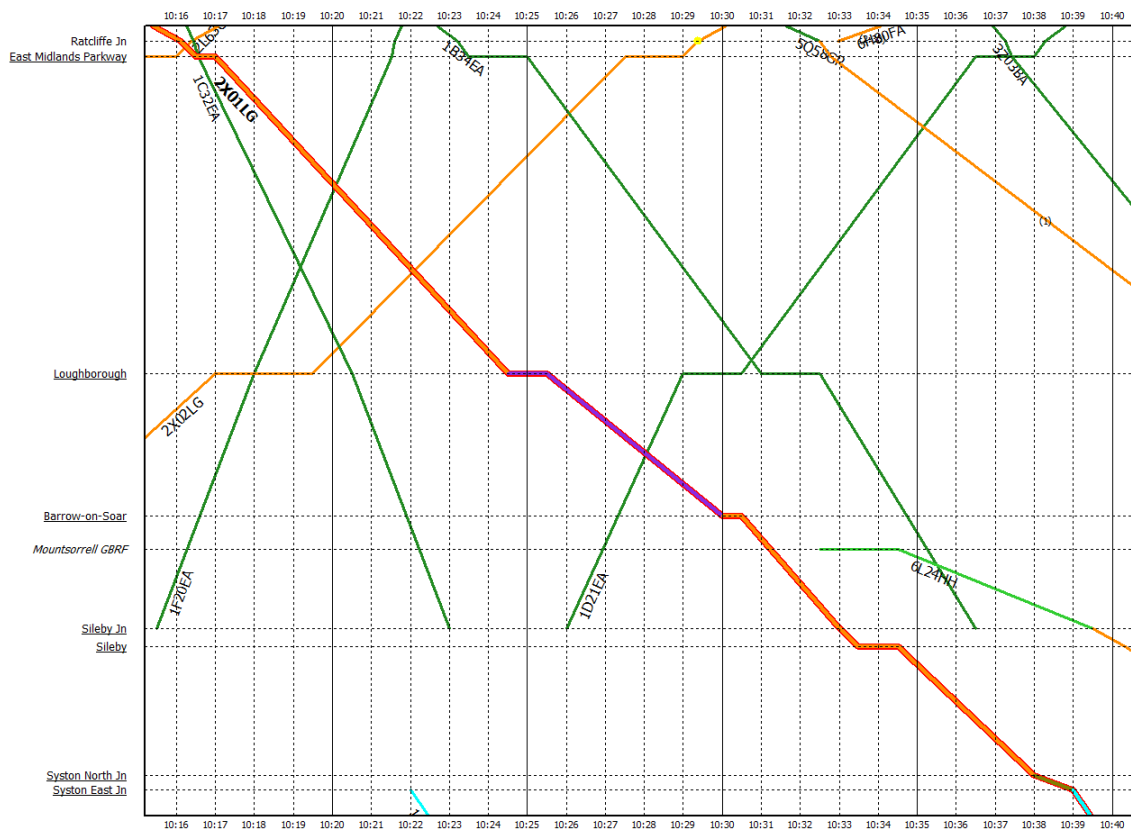
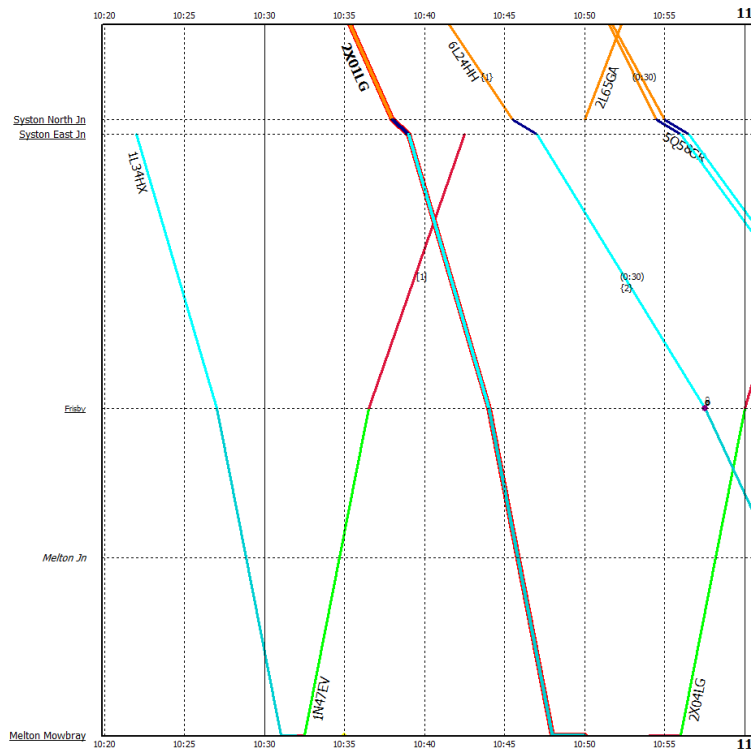


Figure 7 - The highlighted train (thick line) is an example of a new hourly southbound path between East Midlands Parkway and Syston North Junction

As described above, the route from Syston East Junction to Melton Mowbray is much less congested than the other areas, so finding a path through this section is less complex. In some hours, pathing time was inserted into the passenger service from Syston East Junction in order to maintain compliant headways with freight services travelling towards Melton Mowbray. An example of a typical path through this location can be seen in Figure 8 below.



*Figure 8 - The highlighted train (thick line) is an example of a new hourly southbound path between Syston North Junction and Melton Mowbray*

It is slightly more difficult to path the additional train in the northbound direction (travelling from Melton Mowbray – Nottingham). Similarly to the southbound direction, the section of route between Melton Mowbray and Syston East Junction in the down direction is relatively traffic free, making it easy to path the additional service between these locations. A typical path between Melton Mowbray and Syston East Junction is shown in Figure 9 below.

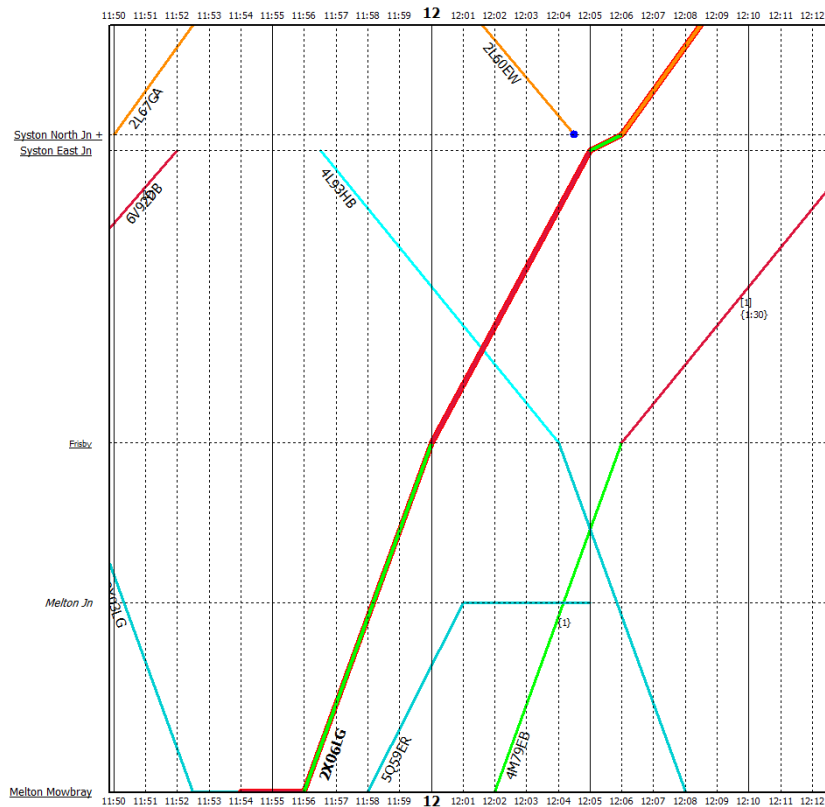


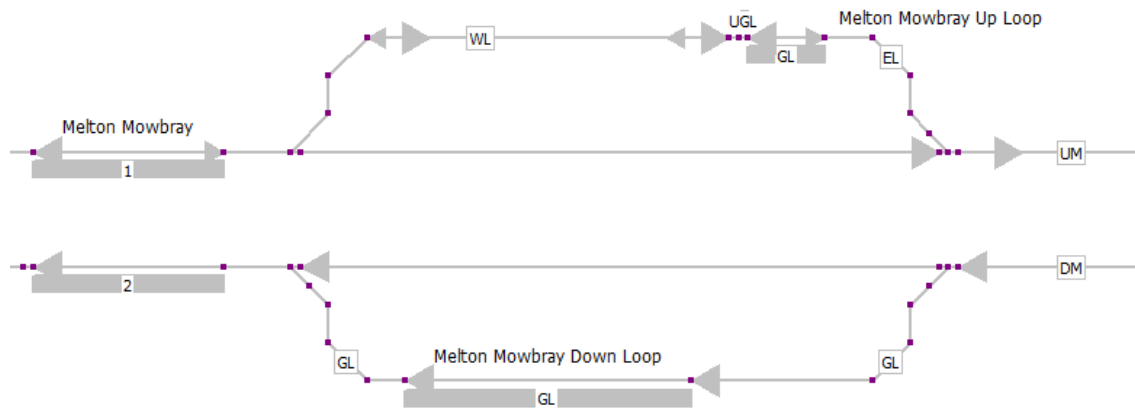
Figure 9 - The highlighted train (thick line) is an example of a new hourly northbound path between Melton Mowbray and Syston North Junction

In the northbound direction significant conflicts occur in every hourly path at Syston North Junction between the new additional service and the Lincoln – Leicester service. The required junction margin at Syston North Junction is five minutes, and in order to achieve this margin a significant amount of pathing/extra dwell time (approximately 7 minutes) would need to be added to the new passenger service.

Junction Margins		
First Movement	Second Movement	Margin
Up Slow to Up Slow	Down North Curve to Down Slow	5
Down North Curve to Down Slow	Up Slow to Up Slow	5
Movements at Syston South Jn		
First Movement	Second Movement	Margin
Up Slow to Up & Down Slow or Up Fast	Down Fast to Down Slow	4
Down Fast or Up and Down Slow to Down Slow	Up Slow to Up & Down Slow or Up Fast	5
Down Fast or Up and Down Slow to Syston East Jn	Up Slow to Up & Down Slow or Up Fast	5
Syston East Jn to Up & Down Slow or Up Fast	Down Fast or Up & Down Slow to Down Slow	5

Figure 10 - Timetable Planning Rules for Syston North Junction

The addition of this pathing/dwell time would mean that the turnrounds in Platform 1 at Melton could not be achieved, and the train would have to run empty into Melton Mowbray Up loop before beginning its return path to Nottingham. An extra crossover could be installed to the east of the Melton platforms to allow the train to run from the up loop into platform 2. This would necessitate the use of an additional rolling stock resource to support the operation of this new service.



*Figure 11 - Current Layout at Melton Mowbray Station, Along With The Loops*

The headway values are the result of the short length of track between Syston East and Syston North and the fact that this has no signal. The route is set from the signal east of Syston East and locked out so the five minutes is dictated by that. In the past Network Rail have looked at moving Syston East Junction further east to increase the length of both sides of the triangle there as this would be useful to recess freight trains and provide an additional signals to reduce junction margins in the area.

A typical path between Syston East Junction and East Midlands Parkway is shown in Figure 12 below, along with the associated hourly junction margin conflict with train 2L60 at Syston North Junction.

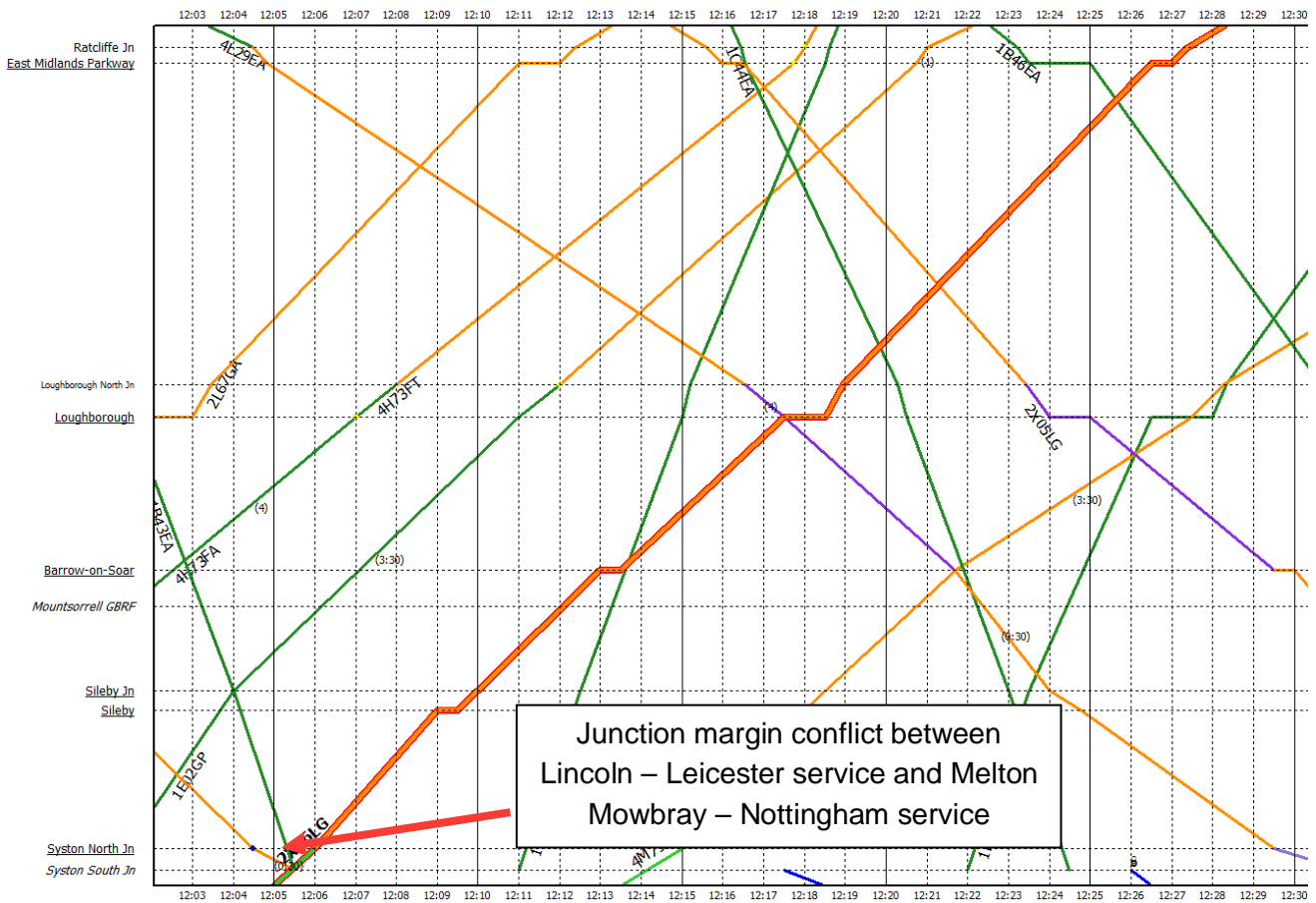


Figure 12 - The highlighted train (thick line) is an example of a new hourly northbound path between Syston North Junction and East Midlands Parkway

Once again, the section of route in which it is the hardest to find a path is the heavily congested area from Trent East Junction to Nottingham, and therefore the train must be fixed in this area before working backwards along the train’s path. A small amount of pathing time is required in most of the hourly paths in order to maintain a compliant headway between the new service and the London St. Pancras to Nottingham train (1D31 on the graph below) which follows it. A typical path from Trent East Junction – Nottingham is shown in Figure 13 below.

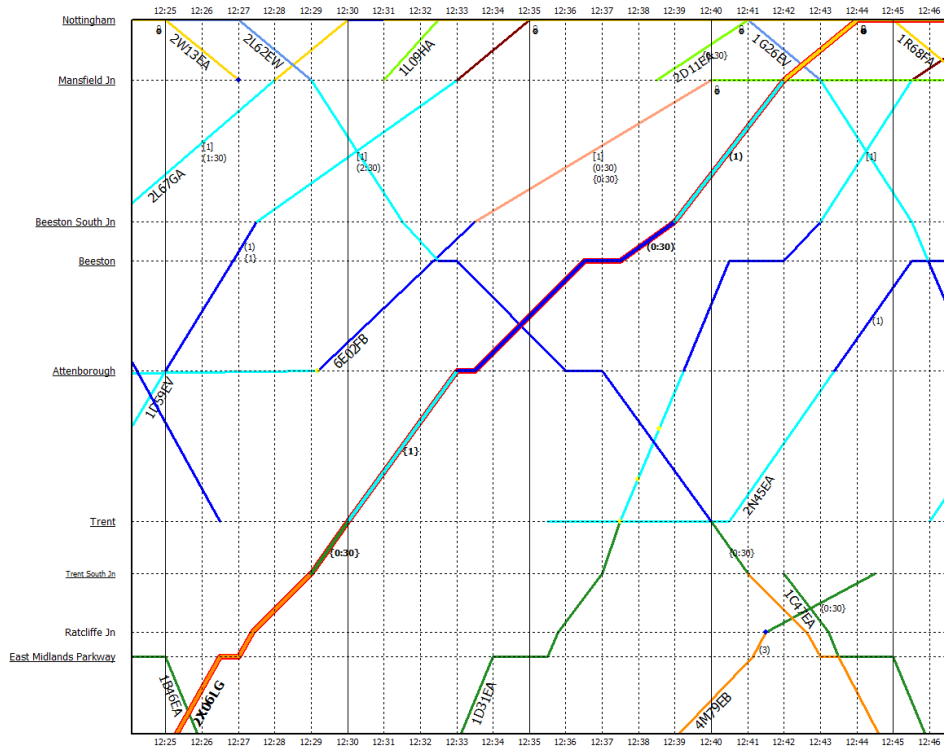


Figure 13 - The highlighted train (thick line) is an example of a new hourly northbound path between East Midlands Parkway & Nottingham

At the Nottingham end of the route, the additional services require (approximately) 17 minute turnrounds. Nottingham is a heavily congested station, and as such it is possible to turn the train round in the platforms in some hourly paths, but not in others. Where we have not been able to identify opportunities for trains to turnround in platforms, options such as turning trains round in Nottingham sidings could be explored. An alternative could be the provision of an extra platform at Nottingham station, which would provide enough capacity for the additional service to have an hourly turnround within the station. Multiple units of rolling stock would be required to operate the services outlined in option 4.



## Option 5 – Baseline plus an additional TPH between Nottingham & Melton Mowbray (Limited stations)

This option is a slight variation of option 4, in which the additional train is not required to call at every station on the route. Instead, the additional train will only call at Beeston, East Midlands Parkway and Loughborough. This cuts out stops at Attenborough, Sileby & Barrow-on-Soar – meaning that the train does not necessarily need to run on the slow lines between East Midlands Parkway and Sileby Junction although this would mean additional crossing moves with Up Fast line services and increased performance risk.

In the up direction (running from Nottingham – Melton Mowbray), it was once again possible to achieve an hourly conflict-free path between the two locations. In the first part of the route, the train remains in the same path out of Nottingham as was used in option 4. The removal of the Attenborough stop does not cause any additional headway conflicts. The typical hourly path for this section of route is shown in Figure 14.

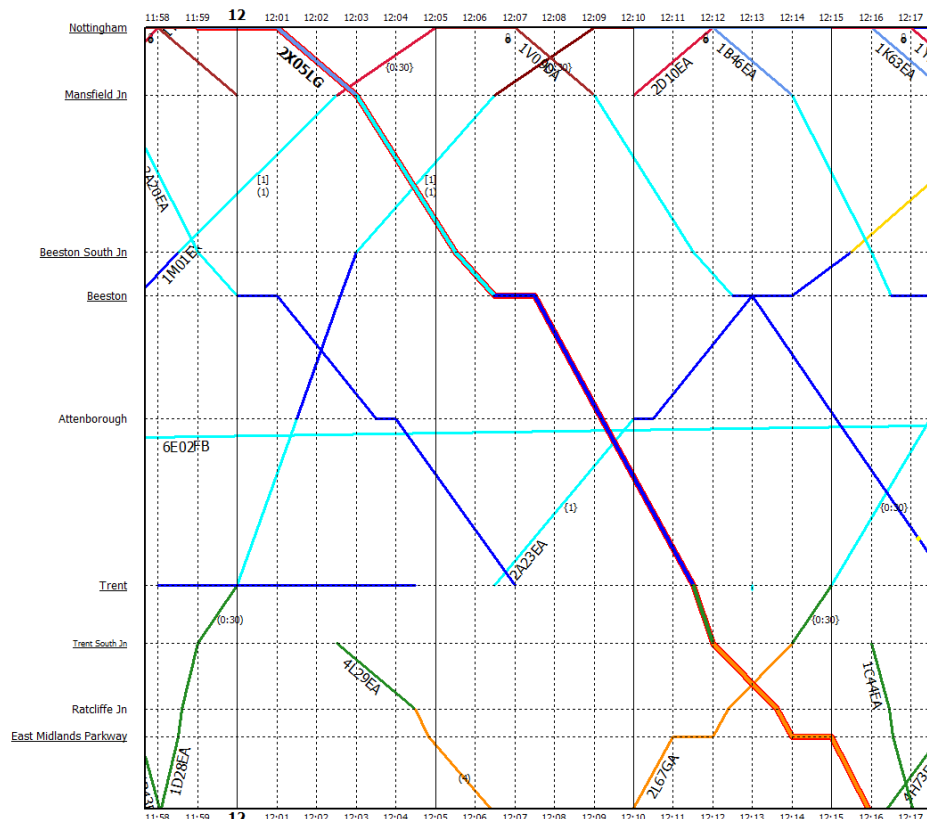


Figure 14 - The highlighted train is an example of a new hourly southbound path between Nottingham & East Midlands Parkway

Even though it is theoretically possible for this train to run on the fast lines between East Midlands Parkway and Sileby Junction, it quickly becomes apparent that that is not possible in reality, when the train graph in Figure 15 is taken into account. The green lines in the train graph represent trains travelling on the fast lines, and the orange lines represent slow line trains. If the new service were moved onto the fast lines, this would lead to a conflict between it and the Sheffield to London St. Pancras service. Therefore, it was necessary to keep the new service pathed on the slow lines as demonstrated in option 4. As previously explained, this would require a new fourth platform to be constructed at Loughborough on the up slow line to allow the train to stop there.

In some of the hourly paths (such as the one shown in Figure 15 below), a small amount of pathing time was inserted into the new service in order to avoid headway conflicts with freight trains that were also using the slow lines to travel through to Melton.

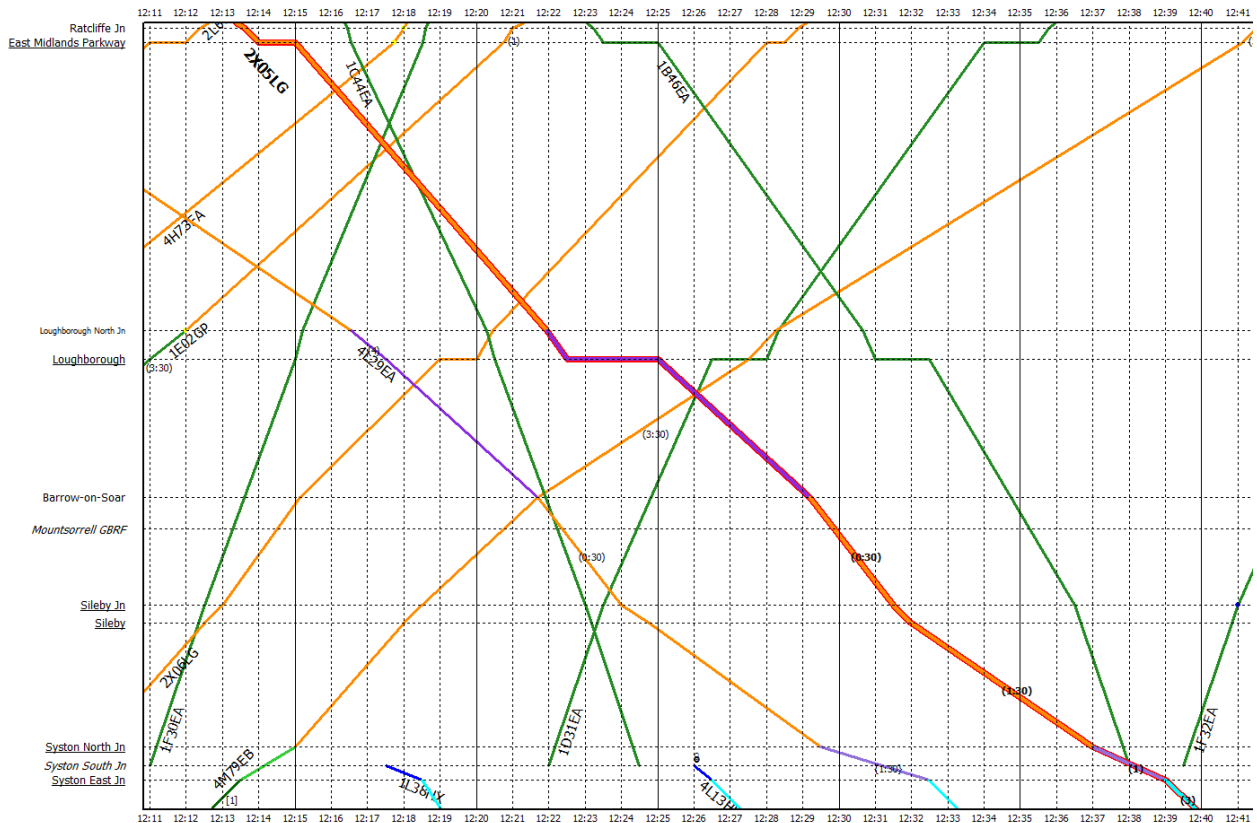


Figure 15 - The highlighted train is an example of a new hourly southbound path between East Midlands Parkway and Syston North Junction

The section of route between Syston East Junction and Melton Mowbray is by far the least congested, and as such it is relatively simple to find a path for the additional train in that area. In some hours (like the one shown in Figure 16 below), a small amount of pathing time is required in order to ensure that headway conflicts do not occur between the new passenger train and the preceding freight service.

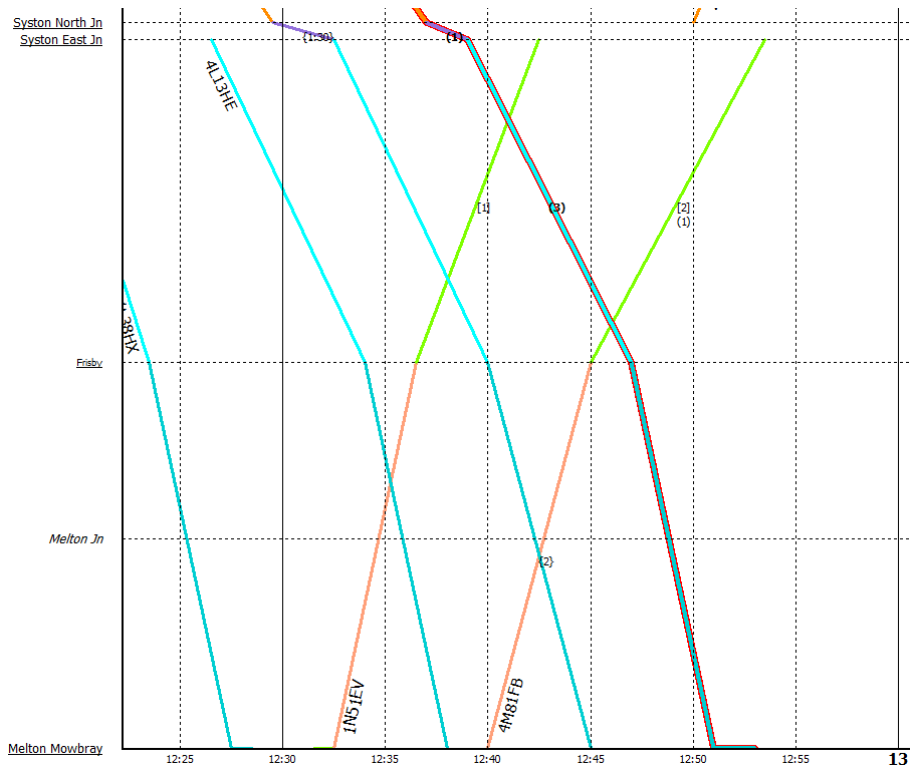


Figure 16 - The highlighted train is an example of a new hourly southbound path between Syston North Junction and Melton Mowbray

In the down direction (running from Melton Mowbray to Nottingham) it is also possible to achieve an hourly conflict-free path between the two locations. The removal of the stops at Sileby, Barrow-on-Soar and Attenborough allow several minutes to be cut from the overall journey time, and this allows the train to avoid the junction margin conflict at Syston East Junction that was a feature of option 4.

From Melton Mowbray to Syston East Junction, a few minutes of pathing time was often required to avoid headway conflicts with freight trains travelling through the area. An example of this can be seen in Figure 17 below.

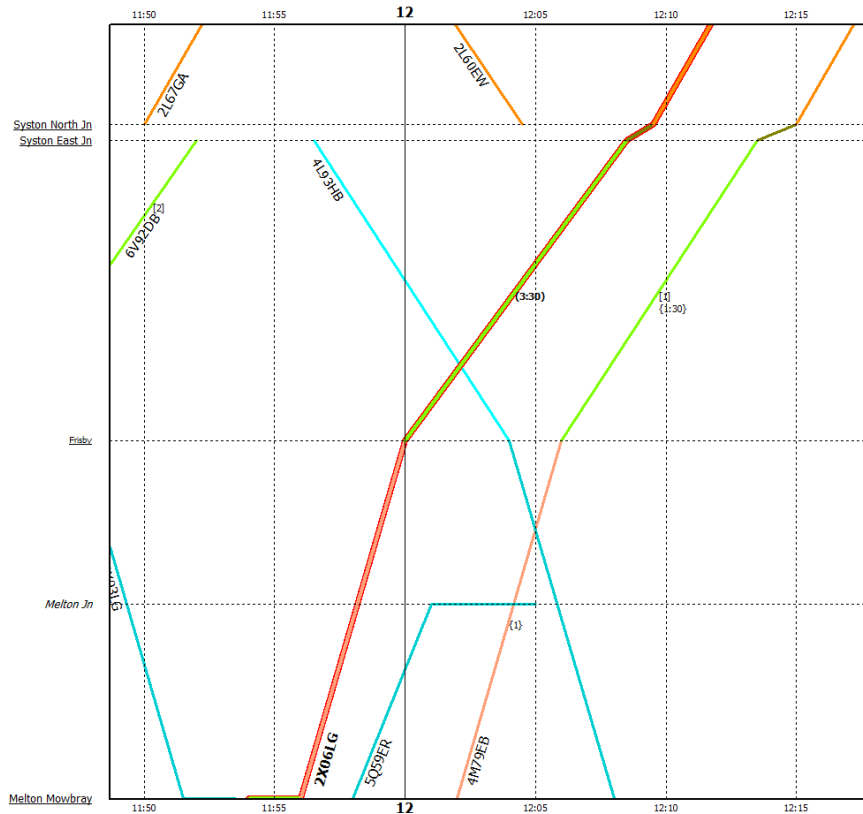


Figure 17 - The highlighted train is an example of a new hourly northbound path between Melton Mowbray and Syston North Junction

In the middle section of the route between Syston East Junction and East Midlands Parkway, it was possible to use the slow lines in every hourly path with no pathing time required. It was also possible to use the fast lines, but in some hours this required a little more manipulation of surrounding passenger and freight services. An example of a typical hourly slow line path is shown in Figure 18 below.

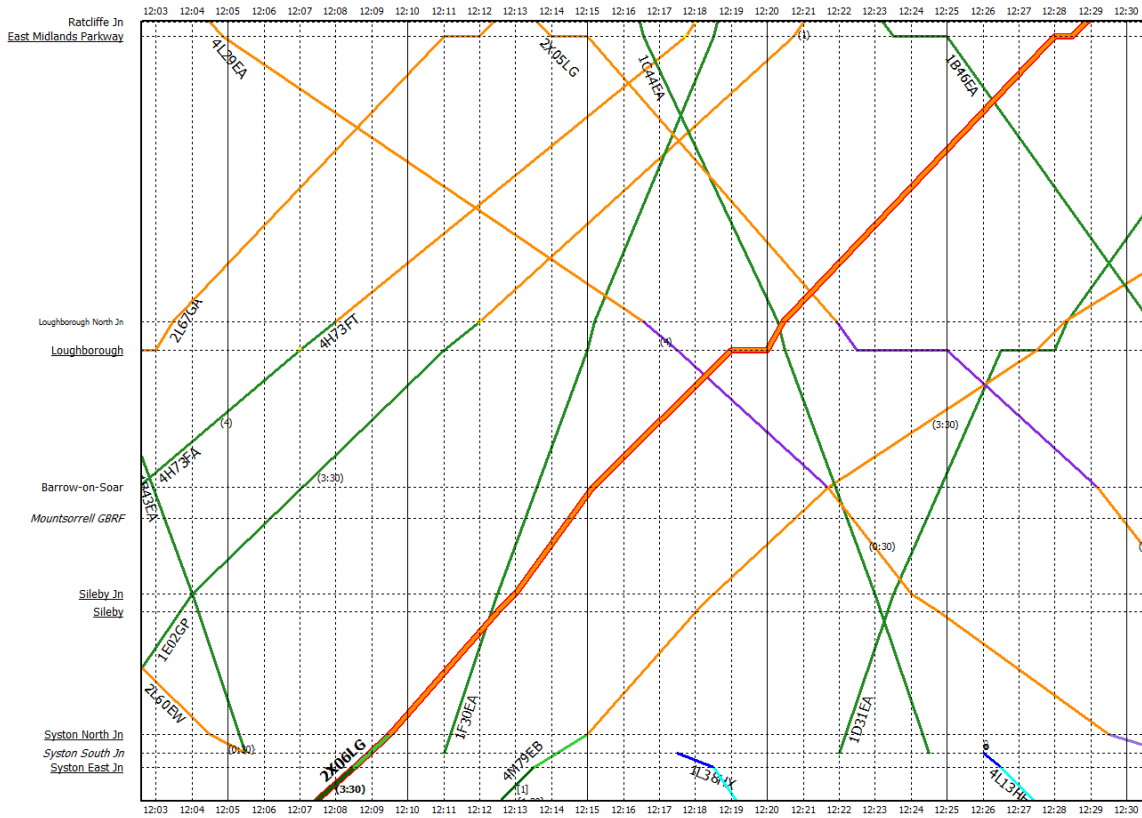


Figure 18 - The highlighted train is an example of a new hourly northbound path between Syston North Junction & East Midlands Parkway

The train graph shown in Figure 19 below shows that when approaching Nottingham, the train remains in the same path that was identified during option 4. The approach to Nottingham represents the most congested part of the route, so the train was fixed in this location first before working backwards along the rest of the route.

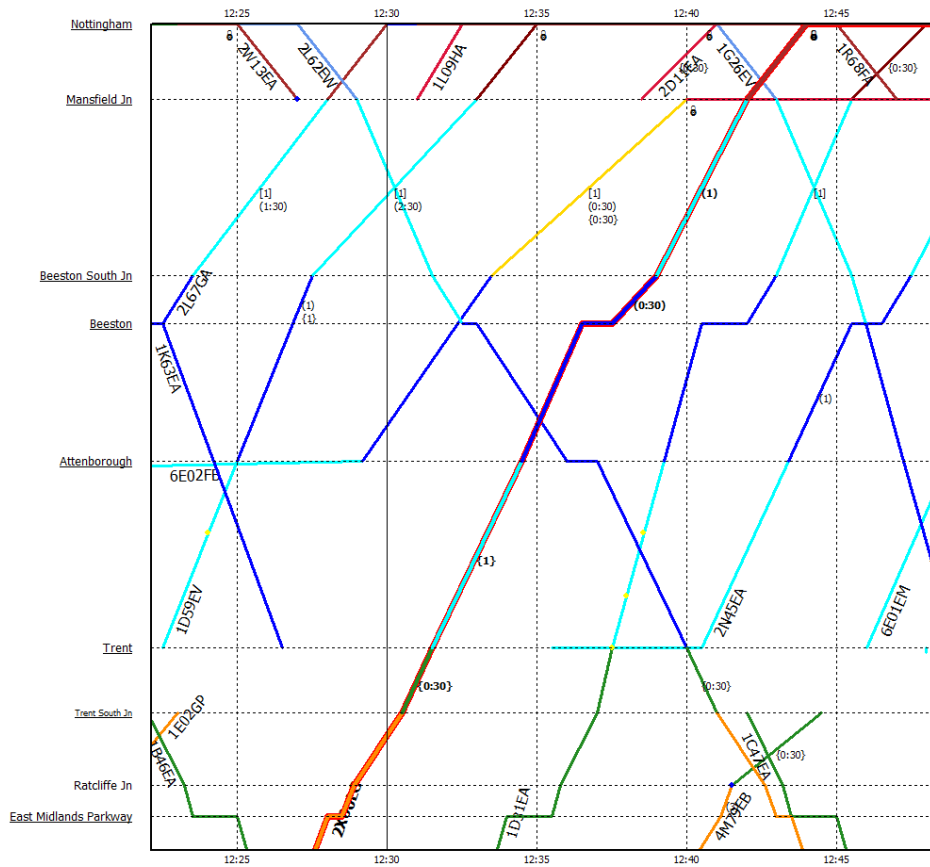


Figure 19 - The highlighted train is an example of a new hourly northbound path between East Midlands Parkway and Nottingham

At the Nottingham end of the route, the additional services have approximately 17 minute turnrounds. As previously mentioned, there is not enough capacity within Nottingham station for the services to have conflict-free, hourly turnrounds. Where we have not been able to identify opportunities for trains to turnround in platforms, options such as turning trains round in Nottingham sidings could be explored. An alternative could be the provision of an extra platform at Nottingham station, which would provide enough capacity for the additional service to have an hourly turnround within the station. The average turnround time at Melton Mowbray station is approximately 7.5 minutes. Multiple units of rolling stock will be required to operate these services.

## Option 9 – Baseline plus an additional TPH between Nottingham & Peterborough (Limited stations) *Preferred option*

This option builds on option 5, allowing the additional passenger service to travel through Melton Mowbray and terminate at Peterborough instead. When developing this option, the viable paths already outlined between Nottingham and Melton in option 5 were fixed and then extended to Peterborough. As such, this part of the report will only focus on the section of route between Melton Mowbray and Peterborough. Whilst on this route, the service will stop at two intermediate locations – Oakham and Stamford.

In the westbound direction (travelling from Peterborough to Melton Mowbray) it was possible to achieve a conflict-free hourly path. The main conflicts that did have to be resolved were caused by freight services preceding the additional passenger service. These conflicts were alleviated by placing the freight services in the loops at Oakham and Melton Mowbray and allowing the passenger service to pass through ahead of them. An example of this can be seen in Figure 20 below with 6M60EJ being recessed in Melton Mowbray Down Loop. There were also some hourly paths where a minimal amount of pathing time was inserted into the passenger service in order to maintain compliant headways on the exit from Peterborough.

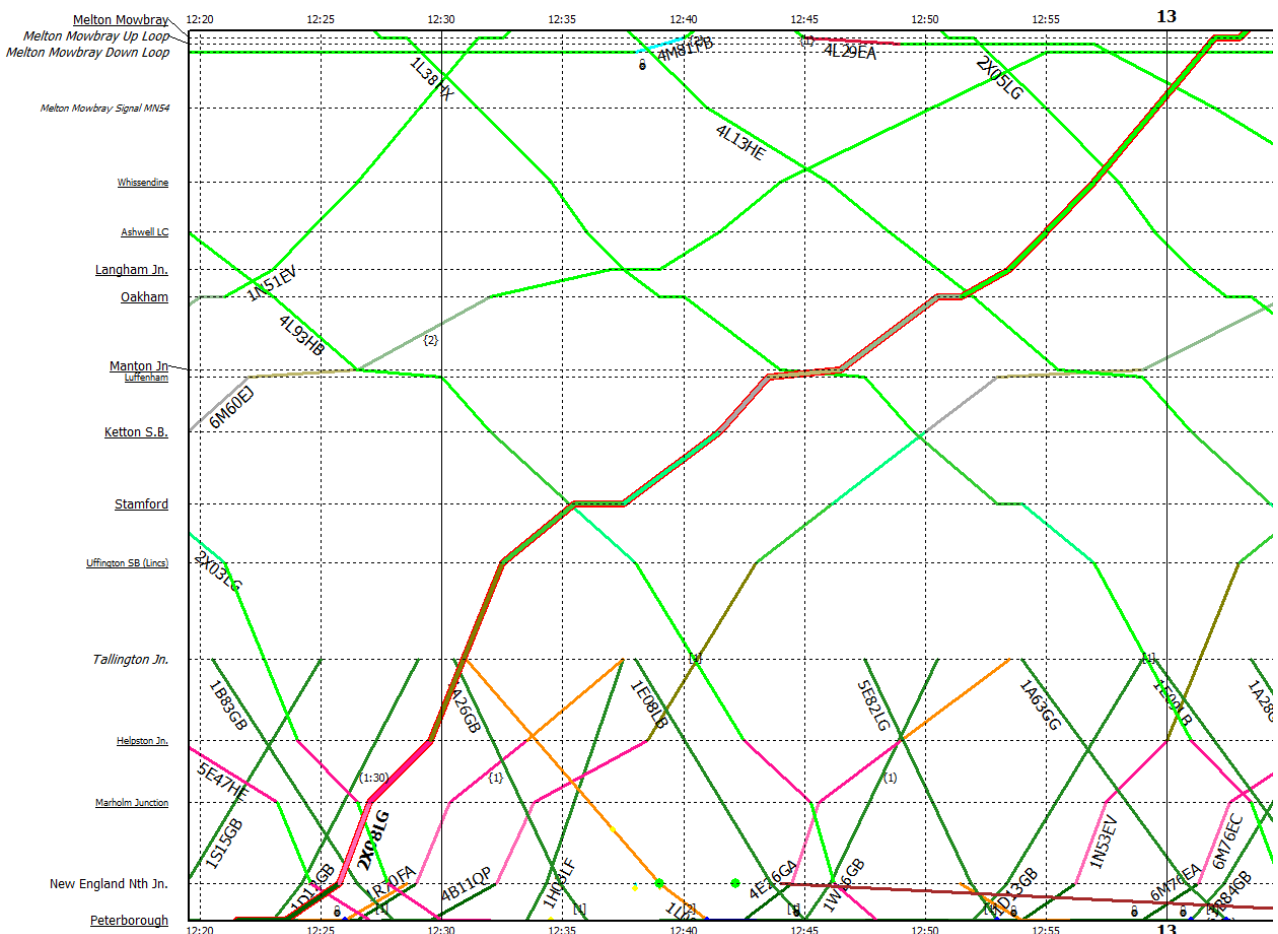


Figure 20 - Example of an hourly westbound train path between Peterborough and Melton Mowbray

It was much easier to path trains in the eastbound direction (travelling from Melton Mowbray to Peterborough) than the westbound direction. Two paths during the study period required the addition of 2-3 minutes of pathing time was required in order to avoid headway conflicts with freight services around the Oakham area. An example of a typical hourly path can be seen in Figure 21 below.

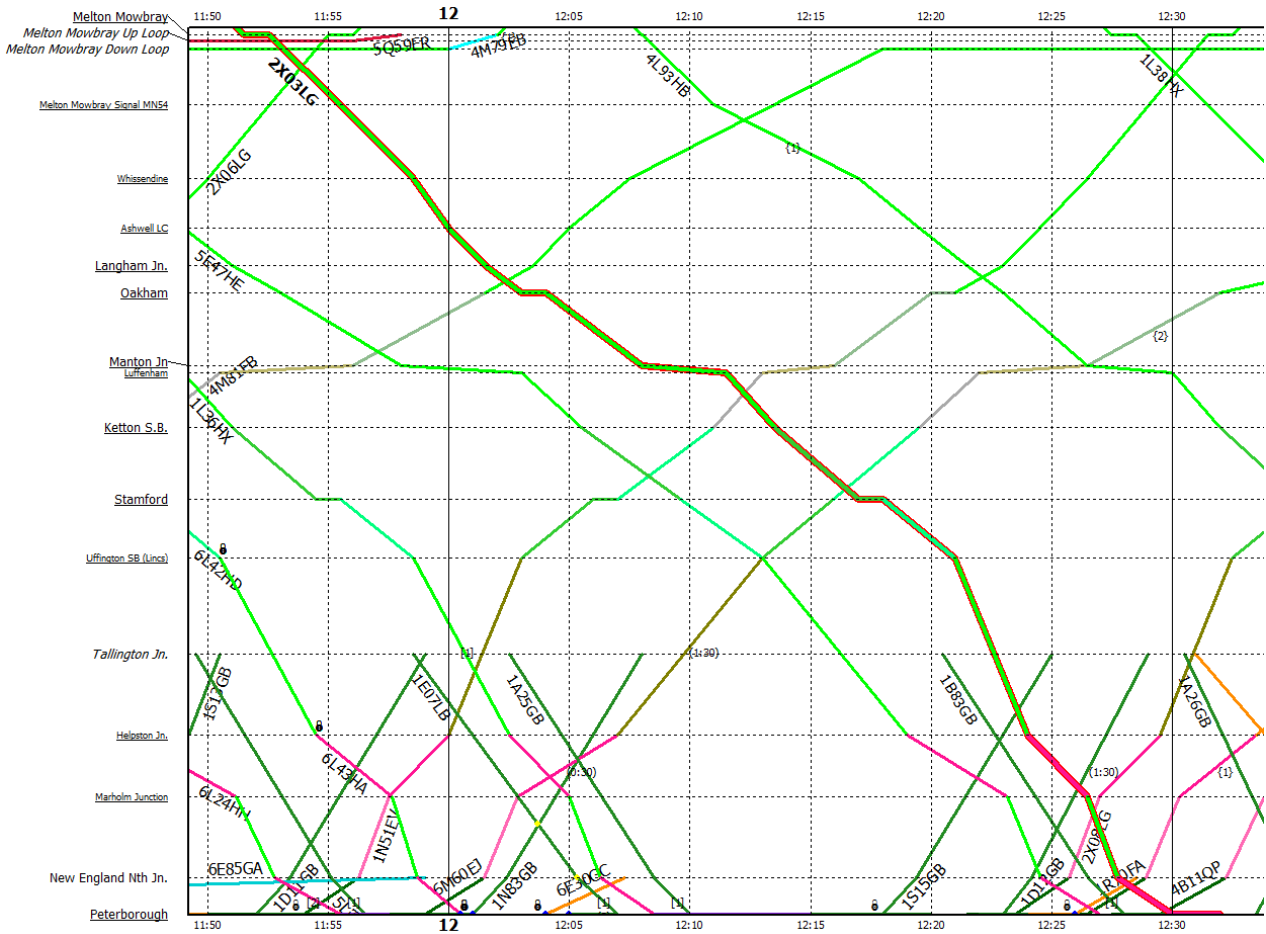


Figure 21 - Example of an hourly eastbound train path between Peterborough and Melton Mowbray

The service in the eastbound direction arrives into platform 5 at Peterborough just after the westbound service has departed, meaning that a turnround in one platform would require the train to dwell there for approximately 45 minutes. This is not feasible as it leads to conflicts with other services. Instead, the train will need to dwell for enough time for passengers to alight and then depart to Nene Sidings just south of the station. In advance of its scheduled departure time from Platform 5, the train will return from the sidings in order to allow passengers to board, and then depart in the scheduled path. Multiple rolling stock units would be required to support the operation of Nottingham – Peterborough services.



## Option 10 – Baseline plus an additional TPH between Nottingham & Cambridge (Limited stations)

This option builds on option 9, allowing the additional passenger service to travel through Peterborough and terminate at Cambridge instead. When analysing this option, the viable paths that have already been outlined between Nottingham and Peterborough in option 9 were fixed and then extended through to Cambridge. As such, this part of the report will only focus on the section of route between Peterborough and Cambridge. Whilst on this route, the service will stop at two intermediate locations – March and Ely.

In the southbound direction, it was not possible to find a conflict-free hourly path between Peterborough and Cambridge. In some hours this was due to headway conflicts between Peterborough and Ely with various freight services that were travelling through area towards Ipswich/Felixstowe. Because these freight services are travelling at lower speeds than the newly inserted passenger service, the passenger train catches up with freight trains in this section of the route. Freight trains can use the sidings close to March station to allow passenger trains to overtake them, but this did not alleviate all of the conflicts that were brought about due to the introduction of the passenger service. Examples of the conflicts with freight services can be seen in figure 22 below.

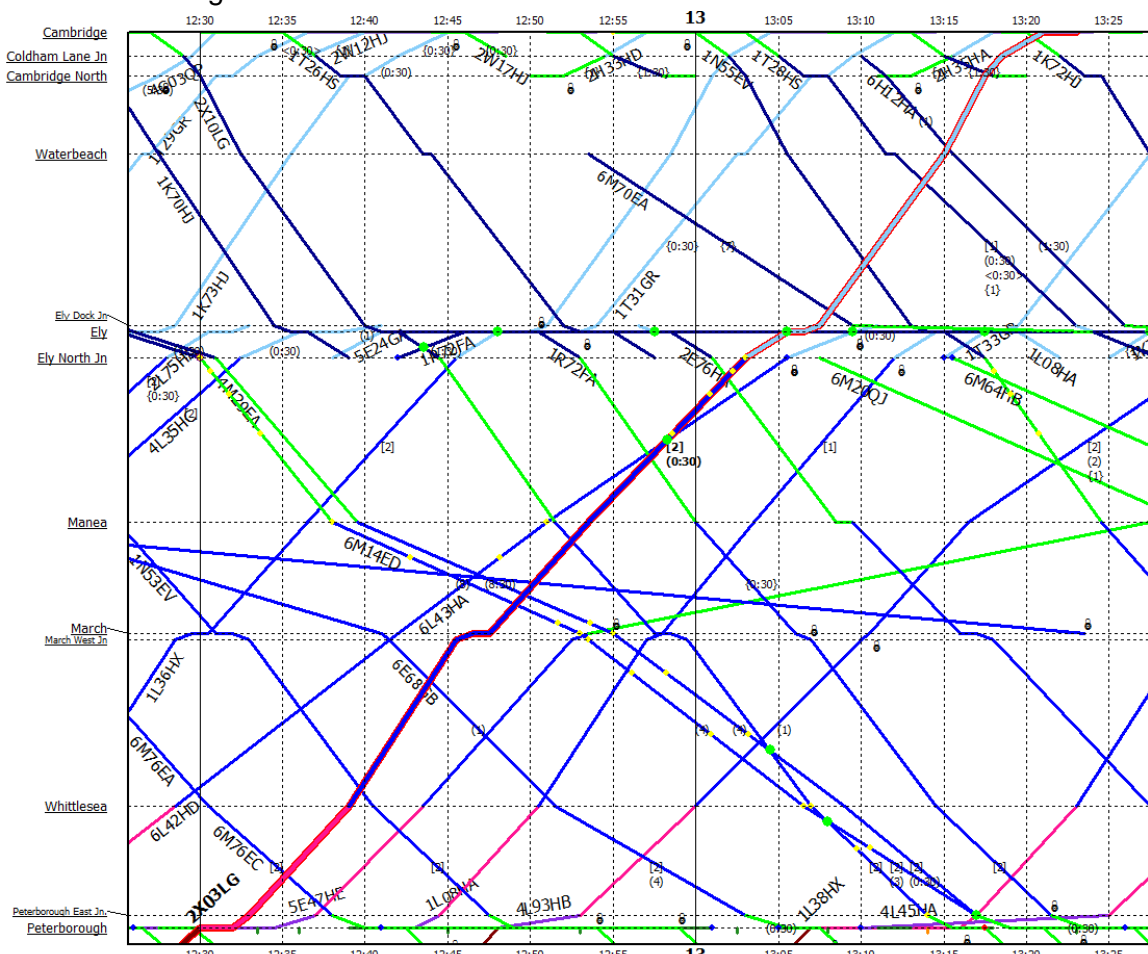


Figure 22 - Example of an hourly southbound train path between Peterborough and Cambridge. There are many conflicts with freight services throughout this section of route

There were also some hours in which the introduction of the passenger train led to unresolvable headway conflicts at Cambridge North station with another passenger service that was heading from Cambridge to London Liverpool Street.

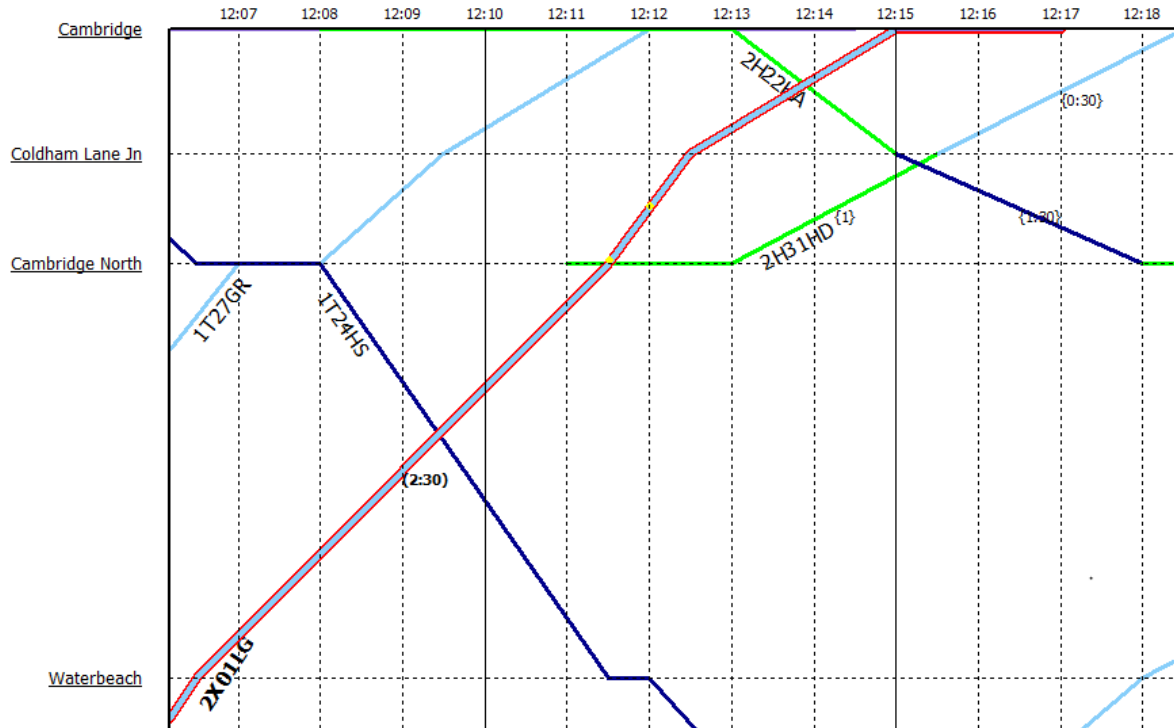


Figure 23 - Example of a headway conflict between a southbound Nottingham - Cambridge service and a Cambridge North - London Liverpool St Service

Although it was possible to find some hourly paths in the southbound direction, this required many adjustments to the timings of freight services and was not something that could be replicated in each hour.

Although it was slightly simpler to find a path for the passenger train in the northbound direction between Cambridge and Peterborough, it still was not possible to find an hourly conflict free path. Again, the main conflicts were headway conflicts with freight services on the route between Ely and Peterborough, and there were also several junction margin conflicts at Ely which it was impossible to avoid. An example of a typical hourly path between Cambridge and Peterborough in the northbound direction can be seen in figure 24 below.

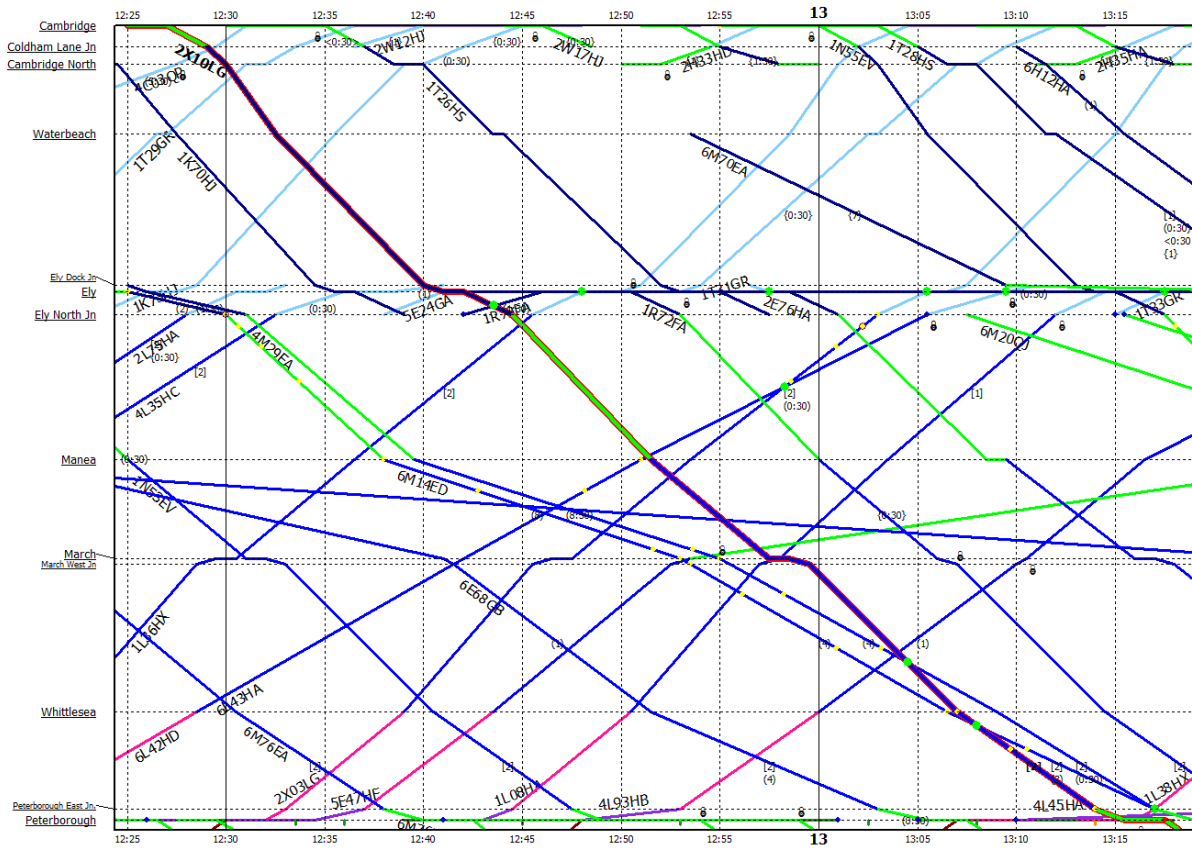


Figure 24 - Example of an hourly northbound train path between Cambridge and Peterborough. There are many conflicts with freight services throughout this section of route

Given that it was not possible to find viable hourly paths between Peterborough and Cambridge, the possibility of extending the passenger service through to Stansted Airport was not explored in this technical note.

## CONCLUSIONS

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The development of option 3 demonstrated that it was incredibly difficult to find paths for eastbound and westbound services to the north of Leicester. Based on the current infrastructure layout and the path that the Birmingham New Street – Leicester service currently sits in, there is no feasible hourly path to and from Peterborough via Melton. There are a series of infrastructure interventions that could potentially help to resolve these issues, including four-tracking the areas immediately north and south of Leicester, and double-tracking on the curve between Syston South Junction & Syston East Junction.

In option 4, it was possible to path a conflict-free hourly service from Nottingham to Melton calling at all stations. Due to the fact the train would need to run on the slow line through Loughborough, an extra platform would need to be installed at the station. In the Melton to Nottingham direction there were regular hourly junction margin conflicts with the Lincoln – Leicester services at Syston East Junction which were difficult to resolve. To resolve them, pathing time could be added to the new service, but this would likely extend the turnround time at Melton, meaning that more units would be required and terminating trains would have to move into the Melton loop before coming back to the station to meet their scheduled departure times. Movements such as this could reduce the opportunity for freight trains to use the loops at Melton. Interventions such as double-tracking could also be explored on the curve Syston East Junction. At Nottingham, hourly conflict free turnrounds cannot be achieved in the platforms. Therefore, trains running into the sidings and back out again should be explored. Also, the addition of an eighth platform could be considered.

Option 5 represents a variation of option 4, stopping at only three intermediate stations (Beeston, East Midlands Parkway and Loughborough) as opposed to six (Beeston, Attenborough, East Midlands Parkway, Loughborough, Barrow-on-Soar, Sileby). It is possible to path a conflict-free hourly service in both directions on the slow lines. Again, this would necessitate an extra platform at Loughborough on the up slow line. This option leads to (on average) a 17 minute turnround at Nottingham, and a 7.5 minute turnround at Melton in platform 1. Once again at Nottingham, hourly conflict free turnrounds cannot be achieved in the platforms. Therefore, trains running into the sidings and back out again should be explored. Also, the addition of an eighth platform could be considered.

Option 9 represents an extension to option 5, in which the hourly service would terminate at Peterborough rather than Melton. It is possible to path a conflict-free hourly service between Nottingham and Peterborough in both directions. This option will also require an extra platform at Loughborough on the up slow line. This option leads to an average turnround length of 17 minutes at Nottingham, and 45 minute turnrounds at Peterborough (arriving and departing from platform 5). The train would not be able to dwell in platform 5 for the entire 45 minutes. Instead, it would have to depart to the sidings and return in advance of its scheduled departure from Peterborough. Running trains into the sidings at Nottingham or the addition of an extra platform will need to be explored, as the current layout does not facilitate hourly conflict-free turnrounds. The length of the turnrounds means that multiple units of rolling stock would be needed to operate these additional services.

Option 10 represents an extension of option 9, in which the hourly service would terminate at Cambridge rather than Peterborough. It was not possible to path a conflict free hourly service in either direction when analysing this option. Making this option viable would likely require an introduction of extra track between



Peterborough and Ely, as well as additional freight loops in which freight trains could be recessed if necessary.

A summary table of the main findings has been included in table 1.