

Version 3
19 December 2005

**CONSULTATION ON CAPACITY STUDY FOR EAST COAST MAIN LINE
December 2005**



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Report on Capacity Analysis Study on the East Coast Main Line

1.0 Introduction

In a letter of 9 August 2005 from Chris Bolt to John Armitt, Network Rail was required under Condition 15 of its network licence to provide information on certain tasks set out below by Friday 23 December 2005.

The letter stated that the analysis was required to focus on:

1. The extent to which Network Rail can satisfy the requirements of all applicants.
2. Whether and to the extent to which the introduction of the proposed new services would require the variation of existing paths or restructuring of the timetable, or could only be achieved if existing access rights were changed.
3. The likely performance effects of changes to the timetable.
4. Differences in the use of capacity in peak / off peak times.
5. Operational issues such as train splitting and different types of rolling stock (and other signaling issues) which have become apparent from the operators' applications.
6. The effect of any additional passenger services on existing freight capability and on the potential for freight growth (taking into account known development proposals).
7. The implications for the proposed Leeds Horseshoe project.

1.1 Assumptions and approach

A number of further clarifications have taken place during meetings between ORR and Network Rail and the resulting assumptions are listed below:

- For the purposes of carrying out this study it is assumed that there will be no change to the West Anglia Great Northern quantum or calling patterns.(2/12)
- Performance modeling will not be undertaken as part of the workstream but will follow during the timetable construction process. (21/10)
- For capacity factors the same base information that timetable planners used to create the RotP will be used. (27/10)
- The analysis will not take into account the ECML resilient timetable review. (27/10)
- The analysis will be based upon the December 2005 timetable. (27/10)
- The analysis will not consider alternative destinations in order to increase capacity; however it may consider alternative routes where possible. (27/10)

- The analysis will not consider platform Y at Kings Cross as it is unlikely to be available in December 2006.

In order to deliver requirements 1/2/4/6, Network Rail has used the theory of constraints model focusing on key bottlenecks.

This analysis focuses on the ability to accommodate the actual requirements made in each of the track access applications. In some cases some minor variations to these requirements have been considered in order to maximize capacity. Recasting the timetable has also been considered. Section 4 explains this analysis in more detail

Concerning the performance effects in requirement 3, these are dealt with in Section 5 of the report.

With regard to requirement 5, a view was sought from the various operations and safety professionals involved and the issues are decided using professional judgment. This is also dealt with in more detail in Section 5.

With regard to requirement 7 this is dealt with in the section considering the constraint dealing with Hare Park section 4.2.2.

1.2 Service proposals

The applicants have asked to operate the following services

GNER

A proposal for 10 additional contingent rights between Kings Cross and Leeds – Mondays – Fridays.

Firm rights for two additional services between Kings Cross and Leeds (for which GNER currently has contingent rights) and the retiming of an existing service (this is the current 1850 departure from Kings Cross to Leeds requested to be retimed to depart at 1833).

Grand Central Railways

Firm rights to operate on 2 routes:

Sunderland – Kings Cross

Stopping at: Sunderland, Hartlepool. Eaglescliffe, Northallerton, Thirsk, York, London Kings Cross.

Bradford Interchange – Kings Cross

Stopping at: Bradford Interchange, Halifax, Brighouse, Wakefield Kirkgate, Pontefract Monkhill, Doncaster, London Kings Cross.

4 paths a day on each route in each direction Mondays – Saturdays and 3 paths on Sundays .

Hull Trains

The continuation of a sixth firm right to one Monday – Friday path each way between Hull and Kings Cross.

Departure times:

08:00 – 08:20 from Hull

12:00 – 12:20 from Kings Cross

Amendment of existing departure time slot from Kings Cross from 08:23 – 08:43 to 07:20 – 07:40.

Continuation of a fifth firm right to a Saturday path each way between Hull and Kings Cross. Not considered as part of this analysis. The approach was to make the weekday service work first and if successful to then focus on the weekend requirements.

Additional contingent right to one Sunday path each way between Hull and Kings Cross. Not considered as part of this analysis. The approach was to make the weekday service work first and if successful to then focus on the weekend requirements.

2.0 Theory of Constraints

2.1 Theory of Constraints - what is it?

The Theory of Constraints (ThOC) is a management and improvement tool originally developed by Eliyahu M. Goldratt and introduced in his book, *The Goal*. It is based on the fact that, like a chain with its weakest link, in any complex system at any point in time, there is most often only one aspect of that system that is limiting its ability to achieve more of its goal. For that system to attain any significant improvement that constraint must be identified and the whole system must be managed with it in mind.

The use of analytical tools that give power to the ThOC are based on rigorous, but easily understood, cause-and-effect logic. These tools provide the ability to support the development of breakthrough solutions through the premise that in the real world, all systemic conflicts that inhibit action are the result of unexamined assumptions that can be identified and corrected for delivery of real benefits in terms of capacity throughput, production increases or cost savings.

The ThOC, taken as a whole, provides an integrated problem-solving methodology that addresses not only the construction of solutions, but also the need for communication and collaboration that successful implementation

requires. ThOC has been used in a significant number of industry sectors including accounting, aerospace, automotive, consulting, defence, education, healthcare, lumber, manufacturing, metals and mining, semiconductors, steel, technology, telecommunications and textiles. The ThOC was initially applied to solve problems of bottlenecks, scheduling, and inventory reduction.

The generic solution has broad applicability. No matter what an organization's offering is – products and/or services – the methods for most effectively and efficiently managing processes and resources are basically the same. To use another powerful analogy: just as *the strength of a chain is dictated by its weakest link*, the performance of any value-chain is dictated by its constraint. Recognising this, the resulting steps to maximising the performance of a system are:

1. To identify the system's constraints. Of necessity this includes prioritisation so that just the ones that really limit system progress toward the goal are identified.
2. To decide how to exploit the system's constraints.
3. To subordinate everything else to the above decision in Step 2. Since the constraints are keeping us from moving toward our goal, we apply all appropriate resources to assist in breaking them. Constraints are not acts of God. In practically all cases their limiting impact can be reduced or eliminated.
4. To elevate the system's constraints. If we continue to work toward breaking a constraint at some point the constraint will no longer be a constraint. The constraint will be broken.
5. If the constraint is broken, return to Step 1. When that happens, there will be another constraint, somewhere else in the system which is limiting progress to the goal.

Most individuals will readily see the use for the Theory of Constraints in the improvement of production scheduling or in improving manufacturing. Limiting its application to this is would be incorrect. Although it is true that the Theory of Constraints provides us with simple examples in the manufacturing environment, ThOC is applicable to any process in any organisation. This includes universities, hospitals, service providers of all varieties, government, manufacturing and, of course, the rail industry.

Network Rail has worked with Ashridge Consulting in order to gain a deeper understanding of the ThOC, and to establish a pragmatic approach to applying the ThOC to capacity constraints on the rail infrastructure.

2.2 Its application to railway operations planning

The railway, or parts of it, can be viewed as a system with a number of bottlenecks, capacity restrictions or constraints. Traditionally these constraints were junctions, but constraints need not necessarily be junctions. The railway lends itself to the ThOC because it is limited to two dimensions which limits the number of variables involved. The constraints can be physical infrastructure constraints or commercially induced constraints. Examples of physical constraints include the Welwyn Viaduct where the railway layout reduces from four tracks to two, the single line section between Gretna and Annan and indeed any single line. An example of a commercial or business decision constraint is where two services use the same piece of infrastructure and we make the decision that one of the service groups will remain unaltered – thus constraining planning options for the other.

In railway operations planning it is not always clear which is the constraint, as there are often a number of pinchpoints or bottlenecks that appear to be constraints. Therefore we need to model each of the possible constraints to establish which is the most severely constrained and thus the constraint that determines the capacity of the whole system.

We have developed a method of representing the constraint on a capacity graph (which can be used to calculate the Capacity Utilisation Index). In simple terms this can be described as follows. A graph plots each half hour of the day on the X axis against the minimum headway on the Y axis. We are then able to plot the number of trains operating in each half hour and adjust the value if they require more than minimum headway (ie. are slower than the fastest train that operates over that constraint). This produces a curve. There is a correlation between this curve and railway performance measures. See the performance section for more detail (section 5).

When adding proposed services to a constraint we can identify if they breach 100% capacity and therefore either reject them or consider retiming something else out of the time band in question. We can also identify where they breach the current curve and would have an adverse impact on performance. The extent of this effect is a matter of professional judgment informed by empirical evidence.

It is necessary for a proposed service to be able to be accommodated at each of the potential constraints. We can therefore construct a table showing the proposed services at each constraint and stating whether it can successfully path through the constraint. Only if it can pass through each constraint is the service viable.

In order to present at the correct time at each constraint and therefore maximise throughput, it will usually be necessary to use pathing time. In the case of a flexible application such as Grand Central's this will also influence the best timings to develop. In the theory this is the practice of supporting a constraint. This pathing time extends journey time. It is therefore necessary to check that the

application of pathing time to present correctly at all constraints does not extend journey times to unrealistic levels. If this were to be the case we would again say the service was not viable.

Once all of these tests have been successfully passed the service is declared viable and outline paths can then be produced in order to sense check the assumptions that have been made. If there are two or more viable services proposed then the decision would have to be made on other grounds e.g. economic, safety etc.

We have explained this methodology to each of the applicants. We have had constructive feedback from each of them. We believe that we have found a way of incorporating all issues raised into the methodology. We have received written comments supporting the ThOC in general from each of the operators concerned.

3.0 The Process

Network Rail and ORR have held a series of regular managerial and technical meetings to work through this process. The use of ThOC to solve this problem is a new solution and it was recognised that all parties would need to work closely to ensure completion of the analysis.

In addition to the regular progress meetings, workshop sessions have been held with the ORR and each of the operators to demonstrate the methodology and the emerging issues. These sessions were well received. Each of the applicants has received briefings on the approach taken and has been given an opportunity to raise concerns regarding the approach. No major issues were raised and other issues and suggestions have been addressed and recorded in the minutes of the meetings held.

Network Rail believes that none of the three operators has fundamental concerns about the use of the methodology. However, it is clearly important that each operator is happy that their aspirations are being treated in a fair and robust manner. Network Rail wrote to each of the operators on 30 November 2005 asking for their comments on the process.

Grand Central in a letter dated 09/12/05 made a number of detailed comments. Following clarification sought by Network Rail, Grand Central have confirmed that whilst they have no objections about the methodology being used, they are concerned that Network Rail is not proposing a recast for the December 2006 timetable. This issue is considered in some detail in Section 4.3.2.

As stated in the introduction, this report seeks to inform decisions about the use of capacity on the East Coast Main Line (ECML). Once these decisions have been made by the ORR, the findings of this report will be used as a blueprint to develop a revised timetable for the ECML. The revised timetable will be fully performance modeled prior to implementation.

It is intended that this will be managed using a series of workshops with ORR and operators and the usual processes in accordance with part D of the Network Code.

The process the analysis has followed is:

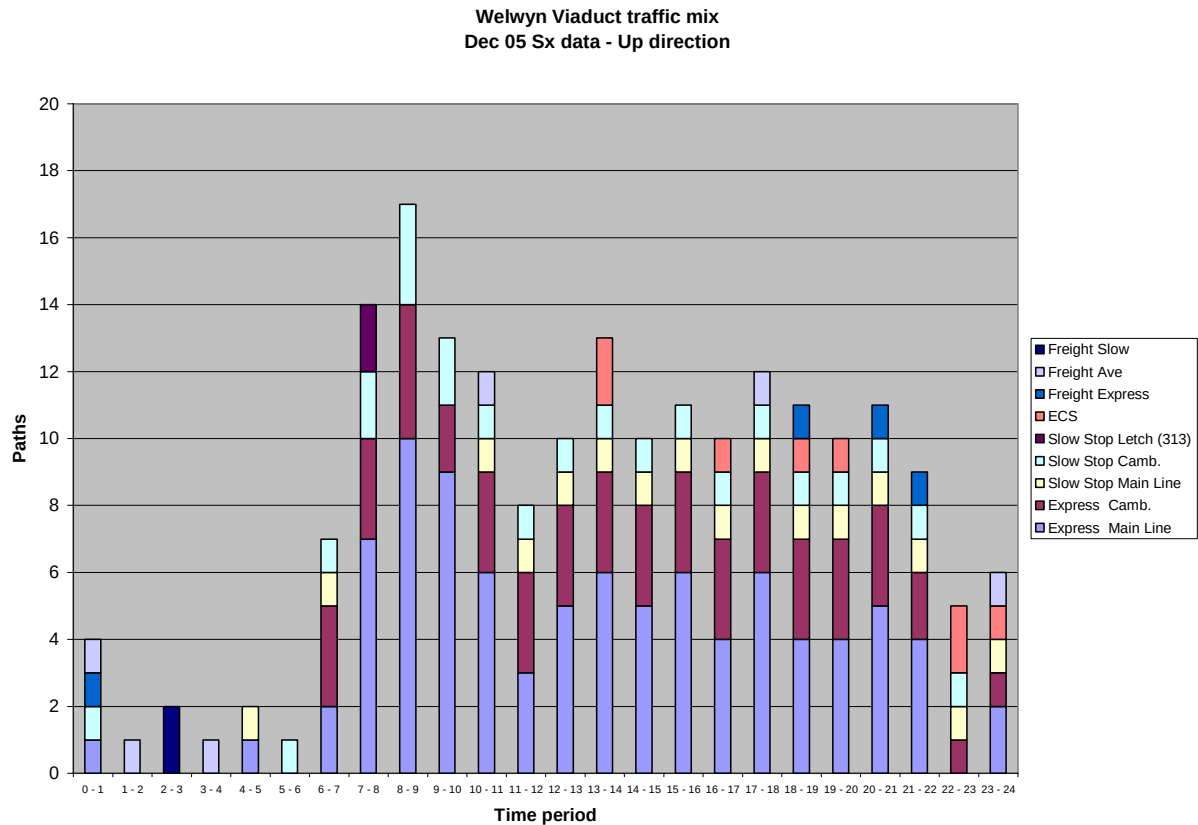
- Identify constraints (Section 4.1)
- Obtain an understanding of each constraint and its likely interaction (using graphical analysis) with the services requested (Section 4.2)
- Match the requested services with the specific constraints (Section 4.3)
- Make viability decisions and summarise as Red, Amber, Green (Section 4.4)

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4.0 The Analysis

Before describing in detail the methodology adopted, it is useful to set the scene by describing Network Rail's initial thoughts on capacity management.

At the beginning of this study, Network Rail produced the following chart of the different types of traffic using the two track section at Welwyn. It can be seen from the chart that there is a mixture of stopping and non-stop passenger services and a mixture of freight traffic. The number of services also varies throughout the day and there is a clear peak of 17 trains in the hour of 0800 to 0900. It can be seen, however that even during this peak hour it does not reach the theoretical maximum of 20 trains per hour (i.e. 60 divided by the headway across the viaduct of 3 minutes). Looking at this graph could give the impression that even in the peak hour there is the potential for an additional 3 trains and during the rest of the day there is plenty of spare capacity.



This approach considerably over-estimates the amount of capacity potentially available. In order to understand how capacity is used at a particular constraint it is important to look at the factors that contribute to capacity use. It is perhaps instructive to compare the 'size' and 'shape' of the curve in the graph above with the one reproduced in section 4.2.6 which takes into account the Hitchin effect.

Network Rail also established that half hour periods were a much more useful division of time than hourly. By reducing the time period of each band the amount of 'smoothing' of the capacity curve is reduced. The 'rougher' half hour curves produce a great deal more information about the potential availability of capacity and thus make it easier to identify opportunities.

A further important point is that the law of diminishing returns applies to the calculation of capacity usage. For example, although it could be argued that the calculation of capacity usage factors on an individual basis for every freight timing load on the ECML would produce a more accurate result, it is clear that the use of a number of generic freight factors produces a result to a level of accuracy appropriate to draw accurate conclusions. A basic objective of the analysis has therefore been to make the amount of time spent on a particular aspect proportional to its importance.

4.1 The selection of potential constraints

The starting point of the analysis was the selection of the potential constraints to be considered. A draft list of locations to be studied was produced using Network Rail's detailed working knowledge of the East Coast Main Line. One approach has been to discuss potential issues with the Network Rail Timing Specialists who have a timetabling responsibility for the area of interest. Commonly they have been asked 'which location / locations are likely to prove problematic?'. One of the tenets of the ThOC is that the over-riding constraints will be widely recognized. The locations selected for analysis have been discussed with each of their operators and they have each indicated their agreement. It is reassuring in this respect that the locations studied to date feature prominently in the responses of consultees to the applications.

One of the key benefits of the adopted methodology is that it uses an incremental approach. The initial stage of the process is to model the current use of capacity at each selected constraint. Understanding how much capacity is used and in what way is fundamental to understanding whether additional services could be accommodated and what changes to current services might be required. As each constraint is initially looked at in isolation it is not important which constraint is looked at first. The methodology is also flexible enough to cope with the inadvertent exclusion of an important constraint. Since each constraint is eventually linked together to check the validity of through paths, any newly identified constraints can be looked at and included in the model.

The locations that have been analysed as potential constraints are as follows :-

- Platform occupancy at Kings Cross Station
- Welwyn Viaduct (including the impact of Hitchin junction)
- The 2 tracks section south of Peterborough
- The 2 track section between Loversall Carr and Stoke
- Newark Flat Crossing
- Hare Park Junction to South Kirby
- Sunderland Station

In addition capacity at Micklefield has been looked at in detail as a subset of the Hare Park to South Kirby study.

Capacity at the Welwyn Viaduct was the first location to be studied as this location is widely quoted as the key constraint to additional London paths on the ECML.

4.2. Techniques used to model capacity at the locations listed having regard to the varying characteristics of the constraint in question.

The various locational constraints may be categorised as follows:

Running line with limited geographical scope

- Welwyn Viaduct (plus Hitchin)
- Newark Flat Crossing
- Hare Park to South Kirby
- Micklefield.

Running line with extended geographical scope

- Loversall Carr to Stoke
- 2 track section south of Peterborough (extended to demonstrate pathing opportunities to Welwyn).

Through station with current regular pattern service

- Sunderland.

Terminal station with multiple platform choices

- London Kings Cross.

All locations have been looked at for SX using the current December 2005 database as the starting point.

All locations identified as 'running lines' have been looked at for the Up direction (i.e. towards London) except where down traffic has an influence over up movements (e.g. at Hitchin Junction). (Note at Micklefield the Down direction is the direction of travel towards London). This direction has been looked at first due to the fact that if a service cannot get to London there will be little point looking at the viability of a service coming back.

It will be noted that there are a number of locations that are not included in the list above. One of the most notable is a location to cover the proposed Bradford legs of Grand Central's proposals. A later section in this report lists the future work that is possible. This will only be required if paths can be found on the main part of the ECML.

The methodology used operates as a series of tests. In order for the proposed service to be viable it must be viable at every constraint. Therefore, if a proposed service is not viable (and cannot be made viable) at just one constraint

there is little benefit to be gained from extensive work elsewhere i.e. if you cannot get a path across Welwyn there is no point looking at other locations. If a service is viable at each constraint then further work is necessary in order to assess if a slot at each constraint can be made into a viable service.

Whilst every possible permutation of possible service has not been considered (there are theoretically an infinite number of these) Network Rail believes that it has done sufficient work to reach conclusions about the viability of each of the proposals.

The next section describes the modeling of each location and details the conclusions that can be drawn about current and future use of capacity. The first location of a particular group also includes a detailed explanation of the technique employed. It should be noted that although many of the techniques have been specifically developed for this study, Network Rail has discussed them at length both internally and with the operators concerned. Indeed the feedback received from the operators has played a key part in their development. Each technique is based on the use of robust data. The current Rules of the Plan are a key source of information (on the basis that any timetable produced in future will use current Rules of the Plan values as a basis for construction).

It should also be noted that the following have been used as the initial starting point for looking at the impact of each of the operators' aspirations:

- Base position = Dec 2005 SX Timetable without the Hull Trains 6th path.
- GNER = additional Leeds half hourly services as indicated by GNER using the base stopping pattern supplied by them. This information was used to produce skeleton 'clean' paths to provide indicative times at the various constraints.
- Grand Central (GCR)= outline paths developed and supplied by Vossloh. It is obviously recognized that these paths were produced assuming HST timings and were unable to take into account all freight paths and some Hull Trains changes. However, they do provide a good starting point for the analysis and a framework for developing possible alternatives. This approach has been discussed with Grand Central and agreed as an acceptable way forward.
- Hull Trains – this is their 6th path as included in the December 2005 timetable.

In order to aid the understanding of what is, by definition, a complex situation the locations are presented in a geographical order working North to South and not in the order in which they were developed or in the categories described above.

4.2.1 Sunderland Station

Type: Through Stations with current regular pattern service

Sunderland was identified as an important area for study due to its combination of a regular metro service (operated by NEXUS), hourly services to Middlesbrough operated by Northern and regular freight services.

The regular interval metro service is being introduced in the new December 2005 timetable and has taken a great deal of work to achieve, involving the removal of some Northern services. From NEXUS' response to the consultation process it is clear to Network Rail that 'protection' of this new pattern of service is a key concern.

However GCR have advised Network Rail on a number of occasions that NEXUS are supportive of Grand Central's aspirations and have indicated a willingness to make necessary changes to accommodate GCR's aspirations (see Nexus comments - Section 6).

In assessing Grand Central's aspiration to operate Inter city services from Sunderland it is key to understand the impact that this will have on NEXUS' services.

Sunderland has 2 long platforms both subdivided (platforms 1 and 2 serving southbound services, platforms 3 and 4 serving northbound services).

Current passenger use is as follows:

Platf 1 Northern services towards Middlesbrough
Platf 2 Metro services towards Park Lane / South Hylton
Platf 3 Metro services towards Newcastle
Platf 4 Northern services towards Newcastle.

GCR have proposed the operation of 5 car 222 sets. A comparison of their length with that of the platforms at Sunderland demonstrates that GCR's proposed rolling stock would need either platforms 1 and 2 combined or platforms 3 and 4 combined.

It is noted that in the December 2005 timetable the metro services for both directions are timed to be at Sunderland at the same time. It is clear that GCR services cannot therefore be accommodated through a simple re-platforming exercise.

Base assumptions:

Any impact on metro services should be confined if possible to those operating to South Hylton / Park Lane. The proximity of these locations to Sunderland make it more likely that any impact can be absorbed in the turnrounds and secondly that any impact is not allowed to spread further 'through the system'. It is noted that this is one of NEXUS' concerns.

To keep the impact of Grand Central to a minimum, GCR services should be planned to be at Sunderland station (as far as possible) when Northern services and freight services are not.

Finally, Network Rail's starting position was that in order to maximize use of capacity GCR should be planned to be at Sunderland for an absolute minimum amount of time. It was considered that the most robust assumption to make at this point was that GCR services would arrive and then reverse to stable at either the nearby sidings (these are believed to be currently too short) or Ryehope sidings a mile to the south of Sunderland. By keeping GCR's operations to the south of the station it was felt that the risk of causing planned / unplanned 'knock on' effects to metro services would be kept to an absolute minimum.

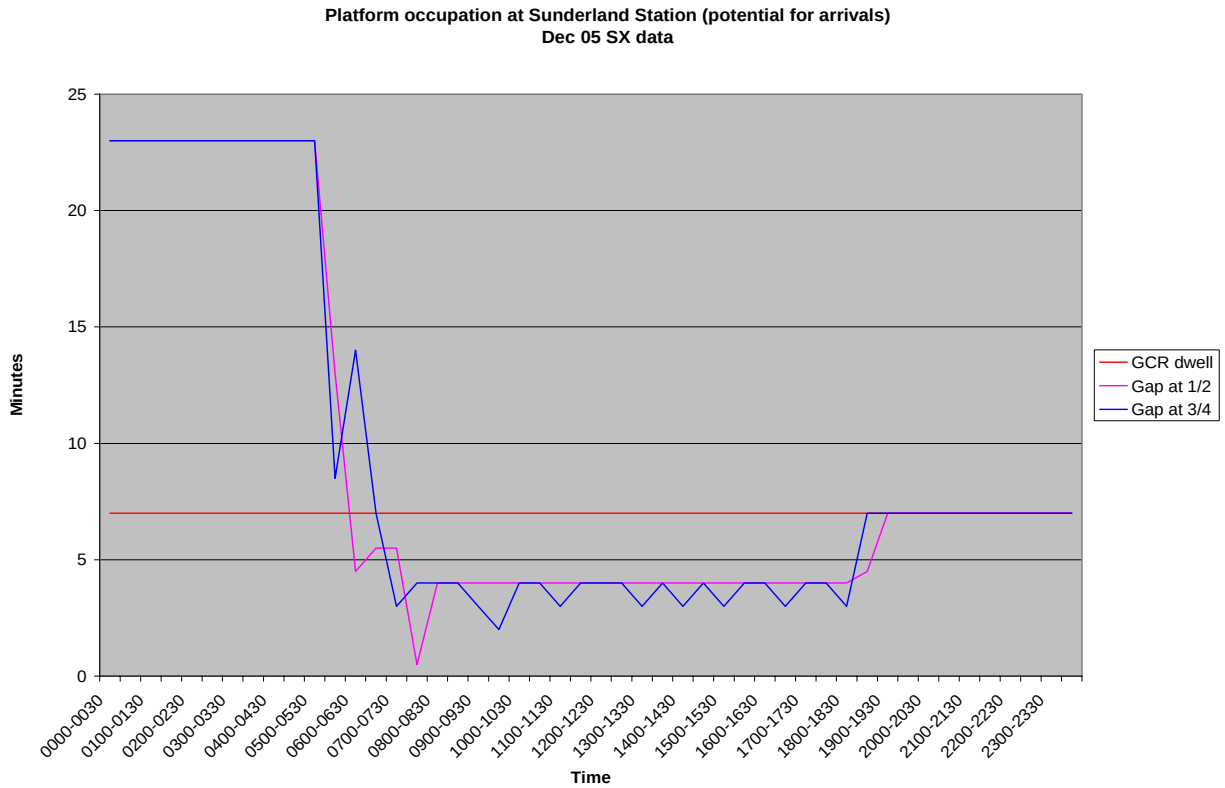
The minimum reversal time is 7 minutes (note the ROTP gives no specific value for Sunderland, there is no general value for 222 units; this issue has been discussed with the custodian of the Rules of the Plan at Leeds Train Planning Centre and he has indicated that 7 minutes is the minimum Network Rail could reasonably accept; 7 minutes is the value given for HSTs).

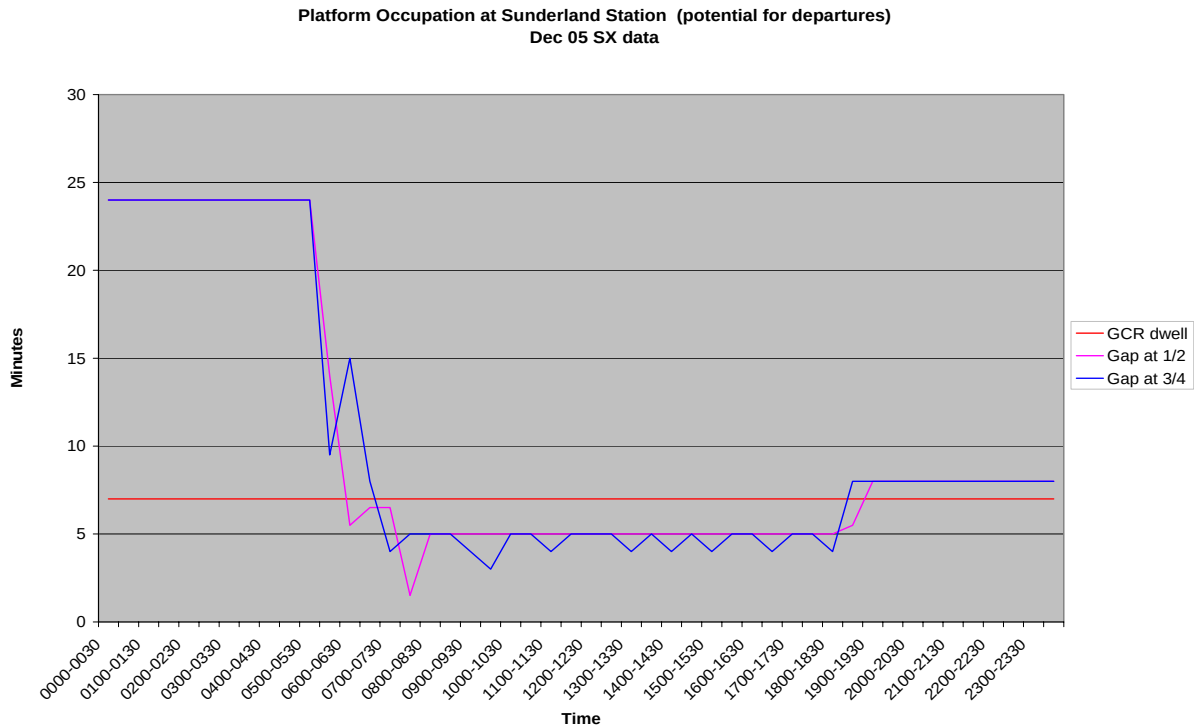
Methodology and analysis

These base assumptions have been used to derive the following methodology:

1. Using platform occupation reports for Sunderland, the gaps between services have been noted. These have been put into half hour timebands (as described earlier, this has found to be the most appropriate time period for the analysis).
2. The identified gaps have been sorted to identify the largest gap in each time period. As noted earlier, the minimum disruption will be achieved at Sunderland by planning GCR services into the biggest available gap. This in practice will be that formed by successive metro services (the presence of a freight or Northern service obviously leads to a reduced gap).
3. The usable gap for a GCR service is then calculated by deducting the relevant margins from the largest gap. This is a reduction of 6 minutes for GCR departures and 7 minutes for GCR arrivals.

- The resulting useable gaps were then plotted with the minimum GCR time at Sunderland to produce the following graphs.





It can be seen that between approximately 0630 and 1830 GCR services cannot be accommodated at Sunderland station without some impact on the metro services.

5. The impact on the metro services was calculated by looking at how much time would need to be inserted into the 'second' metro service at Sunderland to create sufficient gap for a GCR.

This was calculated as 3 minutes for a GCR arrival and 2 minutes for a GCR departure.

As stated previously these time insertions would be to metro trains terminating at South Hylton and Park Lane and would probably take the form of an extended dwell at a station in advance of Sunderland.

Finding 1 – Therefore it is possible to accommodate Grand Central services at Sunderland provided Nexus (Tyne and Wear Metro) agrees to retiming its services which will result in moving away from a standard hour timetable

Alternative 1 - When these findings were discussed with Ian Yeowart (Managing Director of Grand Central) on 07/11/05, Ian indicated that one

of GCR's aspirations was to stand at Sunderland for a length of time (20 minutes) following arrival so as to provide a visible presence. Ian suggested that this could be achieved through the re-platforming of relevant trains.

A second exercise was therefore undertaken to establish the impact of this approach.

The methodology adopted again worked on the principle that it would be the South Hylton / Park Lane terminating trains that should be affected first.

A typical hour was looked at and the impact on each and every train that would need to be re-platformed was calculated if GCR was using platforms 1 and 2 at that time.

Since the Northern and freight services use standard paths these could also be included in the analysis.

Through this quick and simple exercise it was therefore possible to calculate the impact of GCR standing at Sunderland for any length of time at any point during the core part of the day. It also meant that potential arrival and departure opportunities could be looked at.

Calculated potential impact on other operators

The value shown against each service is the retiming that would be required if a GCR service was platformed at Sunderland at the same time. Due to the importance of these calculations they have been checked with the relevant Network Rail Area Timing Specialist for their accuracy.

Tyne & Wear Metro services to Park Lane / South Hylton (4 minute minimum turnround)

Time shown is the departure time from Sunderland

Xx10	5 minutes later (has 16 minute turnround at South Hylton)
Xx 22	4.5 minutes later (has 7 minute turnround at Park Lane so this would be breached).
Xx34	6.5 minutes later (has 28 minute turnround at South Hylton)
Xx46	5.5 minutes later (has 9 minute turnround at Park Lane, however the train in the opposite direction has a 2 minute dwell which could be reduced by half a minute meaning that this turnround would be at the minimum).
Xx59	5 minutes later (has 9 minute turnround at Park Lane).

Tyne & Wear Metro services towards Newcastle Time shown is departure time from Sunderland

Xx 11	Not affected.
Xx22	Not affected.
Xx35	1 minute later.
Xx47	Dwell at Sunderland reduced by 0.5 minute later.
Xx59	Not affected.

Northern Rail services towards Newcastle

Time shown is departure time from Sunderland

Xx 30 Would be 2 minutes later.

Northern Rail services towards Middlesbrough

Time shown is time at Sunderland

Xx48.5 to xx50.5. Would become xx54 to xx55.5,
i.e. 5 minutes later departure from Sunderland. Network Rail
believes that this would lead to a breach of Northern Rail's
Track Access Agreement.

Finding 2 – It is possible to accommodate services standing at Sunderland in this way provided Nexus and Northern agree. Network Rail does not consider this to be effective use of available capacity.

Finding 3 – Freight would have greatly reduced opportunities for paths through Sunderland.

As noted, some work has also been undertaken on the pathing opportunities that this presents for Grand Central. However, due to the impact at Sunderland itself this work has not been developed.

It is clear from the findings that the approach in Alternative 1 would lead to a much greater impact on current services. In some cases it is clear that contractual rights would be broken and turnrounds breached. In sharing these findings with Grand Central they accepted the principle that their services should cause the least amount of disruption to existing services.

Alternative 2 - A number of suggestions have been made about how in practice any impact could be avoided altogether (e.g. the continuation of GCR services onto stabling at Monkwearmouth) thus avoiding the need for the reversal penalty. However, this would only be potentially possible with certain exact GCR timings and does not meet the criteria of avoiding as far as possible transmitting risk onto the wider metro network.

Finding 4 – With respect to Alternative 2 above the analysis leads to a likely conclusion that there will be a significant impact on capacity and performance.

Grand Central has indicated their agreement to this approach.

4.2.2 Hare Park to South Kirby junction

Type: Running line with limited geographical scope

This location is obviously specific to GNER's aspirations to operate additional services from Leeds calling at Wakefield Westgate.

This location is widely recognized as a potential constraint due to its mixture of long distance fast services (operated by Midland Mainline, GNER and VXC), local stopping services between Leeds and Doncaster and Leeds and Sheffield (operated by Northern) and a mixture of freight traffic which includes trains accessing to and from the Crofton branch.

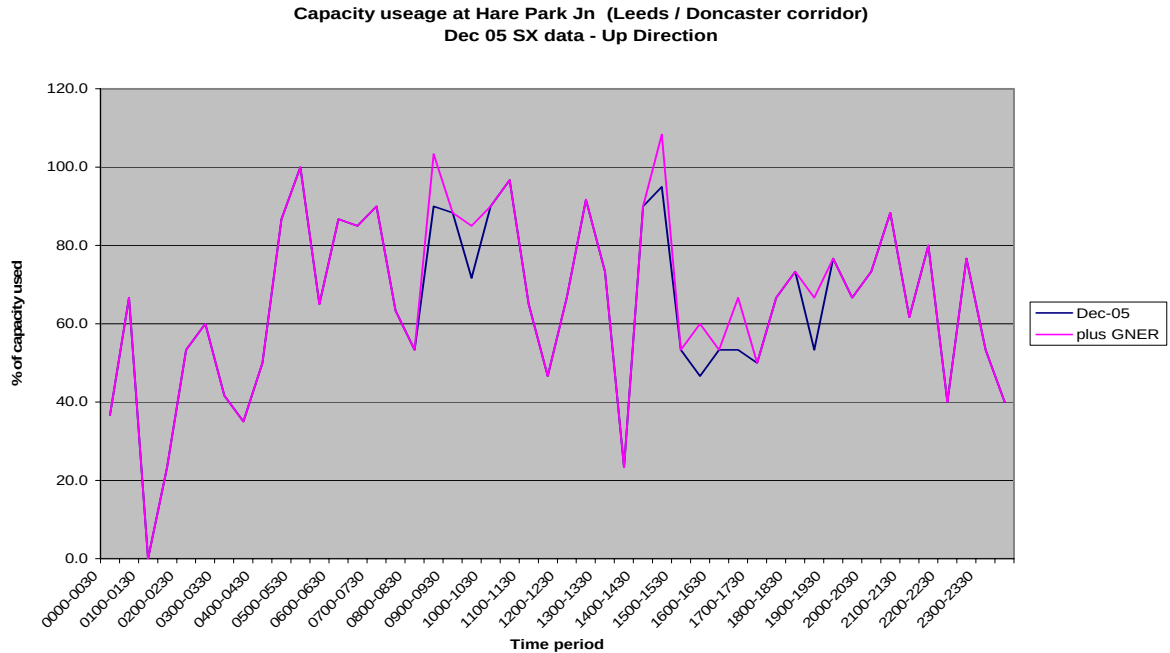
It is noted that this location has been specifically referred to by a number of consultees.

Methodology and analysis

The methodology for this type of location is as follows:

1. Identification of traffic volumes and types at the relevant location through a combination of junction reports / Train plan graphs.
2. Calculation of a capacity factor for each train type. As explained earlier this takes into account headway, relevant junction margins, and journey times (a combination of SRTS and stopping patterns). Where relevant, evidence of 'flighting' or its potential has been identified and taken into account.
3. Separate factors are also calculated where crossing down services impact on up services - in this case down moves made onto the Crofton branch. These are calculated through reference to the appropriate junction margins. Any benefit to be gained from parallel moves is then factored in. For a more detailed explanation on this please see the later section on the Hitchin effect (4.2.6).
4. The identified train types are then put into a spreadsheet which is divided into half hour time periods. Multiplication of the number of trains by the relevant factor produces a capacity usage for that time band.
5. Division by 30 (number of minutes) then multiplication by 100 to produce a percentage.

The graph illustrating the current usage of capacity as well as the impact of the GNER proposals is as shown below.



It can be clearly seen that for two of GNER's proposed services, the 0840 and 1440 departures from Leeds, the usage would be above 100% (i.e. another train would have to be removed, significantly retimed, or its occupancy reduced – through for example the missing of stops – in order for the GNER services to stand any chance of being accommodated).

Since GNER has indicated that their target departure times from Leeds should be in the range of xx30 to xx40, nothing would be gained through timing the GNER services earlier.

As mentioned earlier, even for time bands where 100% is not breached there is no guarantee that a usable path can be found (since the available gaps might consist of a large number of odd minutes that cannot be combined into sufficient white space due to the requirements of the existing services). In any event, the higher the percentage, the less likely it is for a usable path to be found.

It can be seen [of the other proposed GNER services] that the 0940 departure from Leeds presents the biggest concern.

Finding 5 – It is not possible to find paths for 2 of the GNER services at all. Network Rail believes that it would materially adversely affect performance on this section of the route to provide capacity for any of the remaining GNER services that have been applied for.

Finding 6 – In order to achieve the desired level of service to Leeds in the GNER proposal an alternative route would have to be used. This indicates a

requirement to route via Micklefield which could raise issues regarding future electrification.

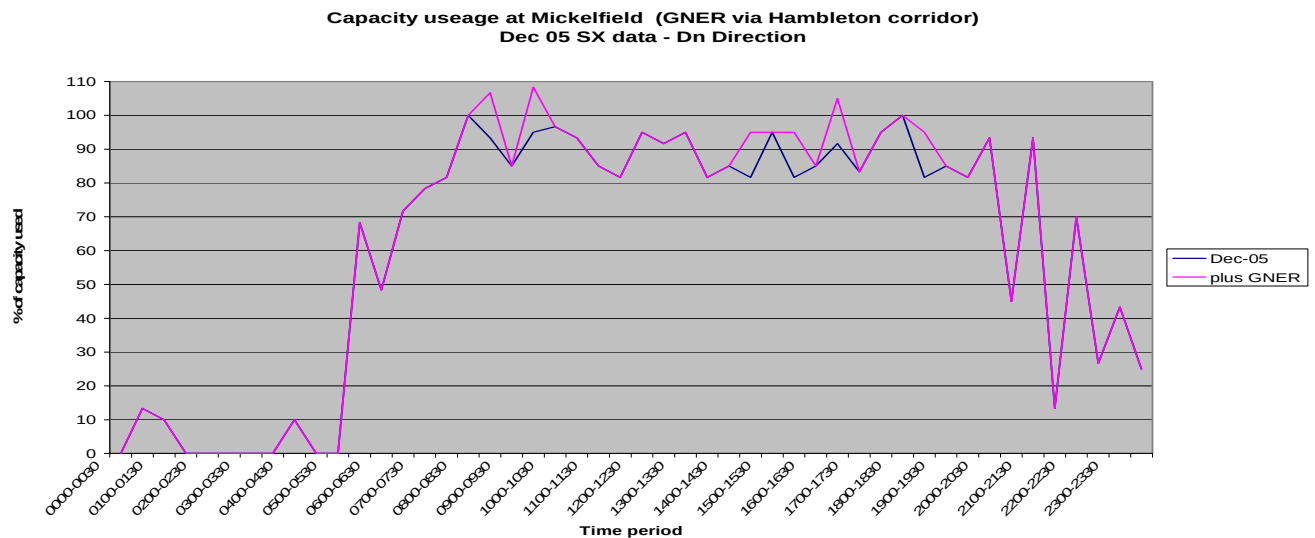
GNER, after being shown these results, asked Network Rail to look at the impact of instead routing their services via Hambleton or via Askern. Although, these are currently non-electrified routes, GNER's draft diagrams for 2007 show the 0840 as being an HST.

The route via Askern was immediately rejected as being impractical due to its increased journey time (even if a 'clean' path could be found an 0840 departure would arrive at Doncaster at the same time as the 0905 departure from Leeds). This makes consideration of the route impractical from a commercial viewpoint.

The route via Hambleton was looked at in detail, however, since a clean journey time would be approximately the same as via the traditional Wakefield Westgate route. It was also thought a beneficial exercise due to the current consideration of the 'electric horseshoe'.

The location chosen on this route was Micklefield. The route has a mixture of stopping services operated by Northern, semi-fast services operated by Transpennine and fast services operated by VXC. There is little freight. Micklefield was chosen because it is here that the lines to York and Selby split. Services coming from York have an impact on capacity from Leeds due to the conflicting junction move at Micklefield.

Using the methodology described above the following graph was produced:



It can be seen that the route is already heavily used and that it would not be possible to route the 0840 (for example) by this route.

This analysis should not be taken as evidence that the electric horseshoe would not deliver its objectives. This is because part of the electric horseshoe proposal involves potential changes to stopping patterns. This approach would obviously lead to a change in the amount of capacity being used.

Finding 7 – It may be possible to path services via Micklefield but it will require significant change in current services and possibly access rights.

These results have been shared with GNER and they have accepted that there would be no benefit to be gained from looking at alternative routes between Leeds and Doncaster.

It is clear from this analysis that the routes between Leeds and Doncaster are very heavily used. It is clear that there will be a number of significant challenges to be overcome if GNER's proposals are to be viable.

Finally, it needs to be noted that when the analysis for this route section was undertaken in mid November, a major freight recast of Anglo-Scottish coal was still taking place for December 2005. It is clear from recent analysis of the database that a number of coal trains in the Hare Park area have been subsequently retimed. Now that the recast has been completed, there would therefore be benefit in repeating the analysis. It is clear, though, that this route section continues to be heavily used and as such continues to pose significant issues for GNER's aspirations.

4.2.3 Two track section south of Doncaster (Loversall Carr to Stoke)

Type: Running line with extended geographical scope.

This route section is characterized by GNER (with variable stopping patterns) and Hull Trains 125 mph intercity services with a substantial number of day time freights. This equates into a series of gaps between the intercity services few of which are wide enough to accommodate the slower freight trains. Freight trains are accommodated through them 'hopping' from loop to loop. In addition a number of 'east-west' passenger services use the route at various points. In particular, Newark Flat Crossing is a key node where Nottingham – Lincoln trains cross the ECML. Newark Flat Crossing has been looked at in detail as a separate study and is dealt with in 4.2.4.

Methodology and analysis

This type of constraint has so far proved very difficult to model using the methodology adopted for constraints with a limited geographical scope. This is due to the 'partial' use of capacity on the route section made by freight trains moving between loops. In consequence a satisfactory method of graphically expressing capacity usage on this route section has not yet been found.

Instead a more traditional method of analysis has been adopted:

1. Analysis of available 'gaps' in the December 2005 timetable using Trainplan graphs.
2. Identification of issues that prevent their use.

Due to the methodology adopted for this route section, this analysis was left until the analysis for the more geographically specific constraints had been completed. The possibilities that that analysis had identified were then used as the basis of considering which 'gaps' should be looked at. Since this formed the start of the linking process, the specific output is included in the consideration of the train by train analysis in.

In general terms, however, there are significant issues associated with identifying available spare capacity on this route section. The main reasons for this problem are as follows:

1. Variable GNER stopping pattern.
2. Freight requirements.

As indicated above, movements across Newark Flat Crossing also play a critical part in determining usable 'spare' capacity on the ECML.

4.2.4 Newark Flat Crossing

Type: running line with limited geographical scope.

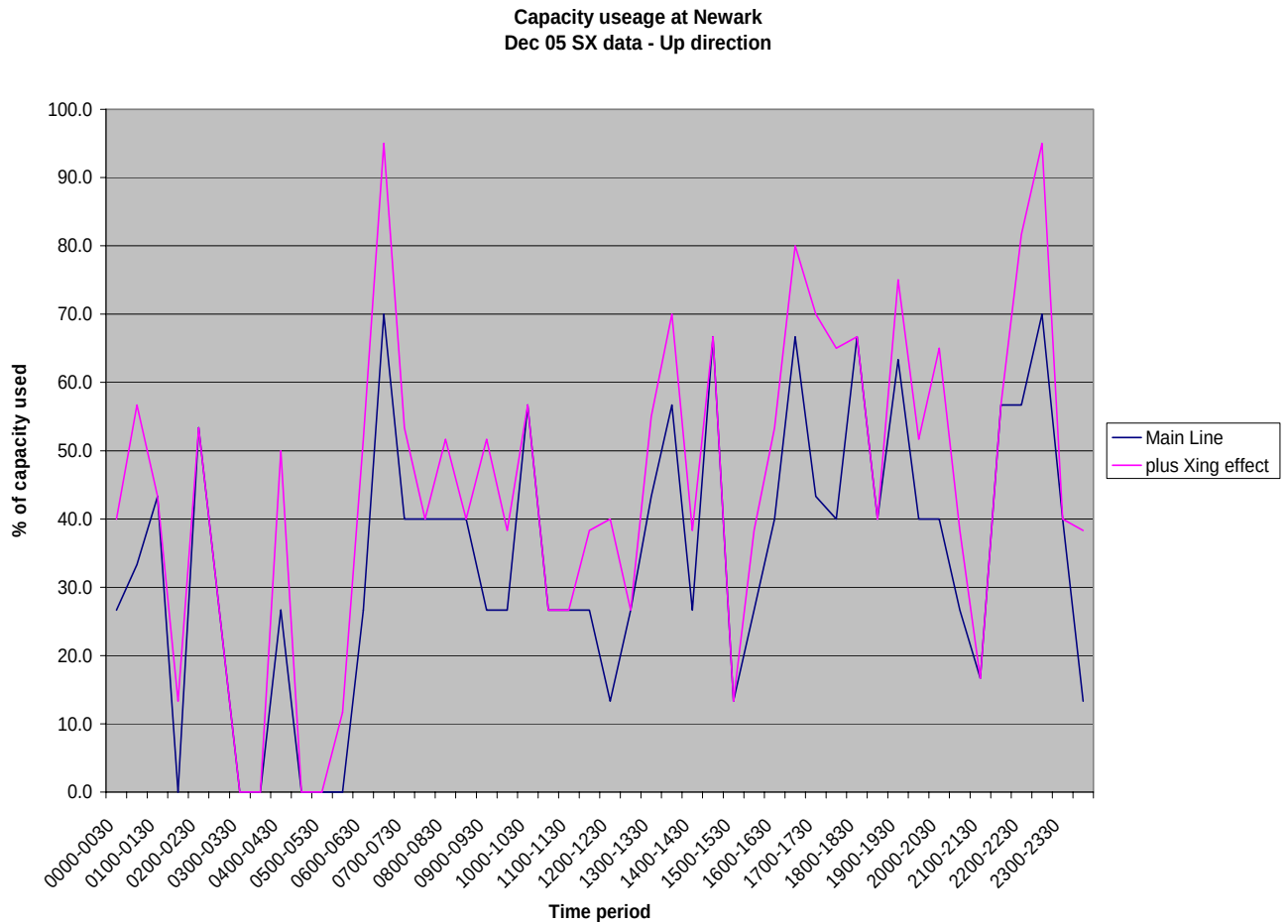
This location has been identified as a key location for analysis because the east-west (Lincoln – Nottingham) movements at this junction have a major bearing on the availability of north-south paths on the East Coast Main Line (and for that matter the other way round).

It is noted that Central Trains has expressed particular concern about this issue.

Methodology and analysis

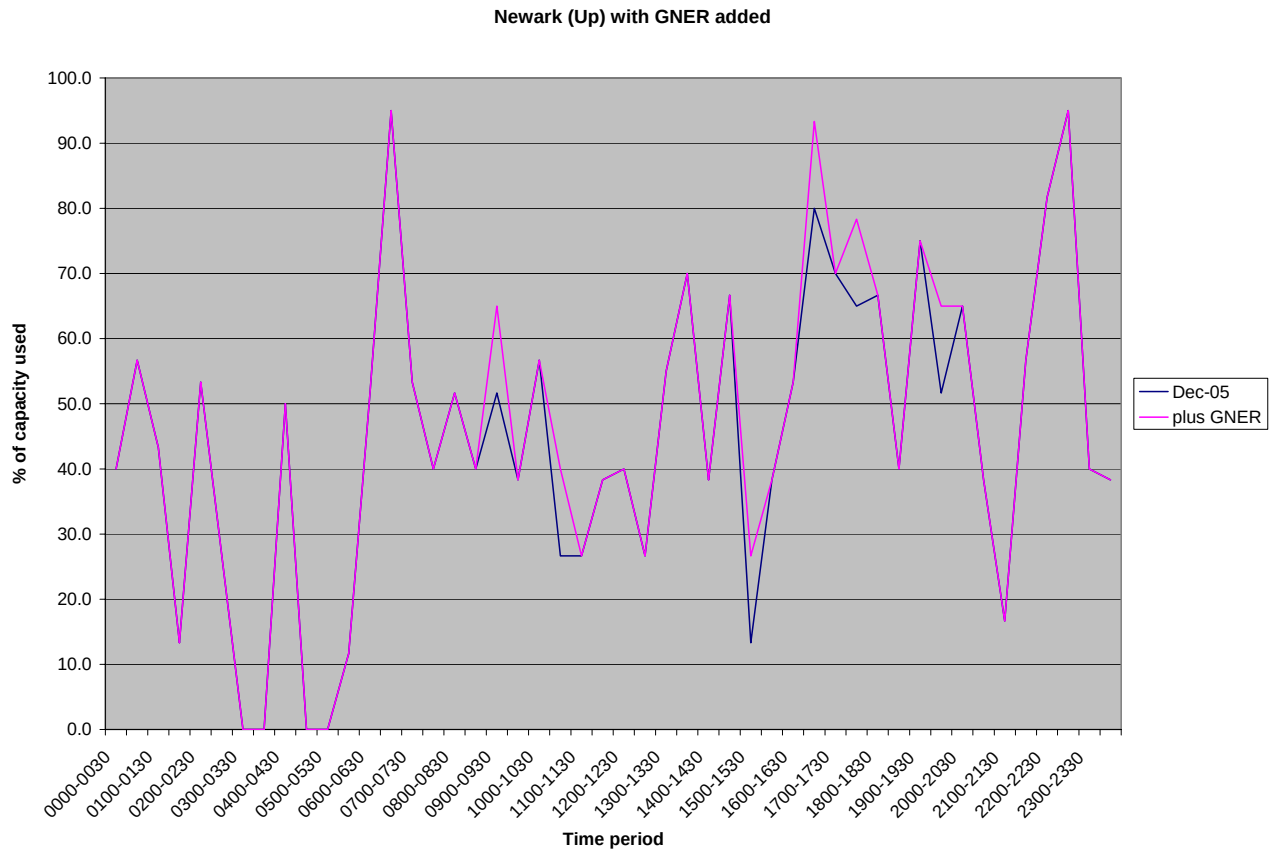
This location has initially been looked at in isolation using the methodology described above. It is worth noting that the junction margins associated with the east – west moves vary according to whether the ECML services stop or not at Newark North Gate. In order to keep the analysis simple, factors were used which represented the most likely combination of possibilities.

The resulting capacity chart produced is shown below:

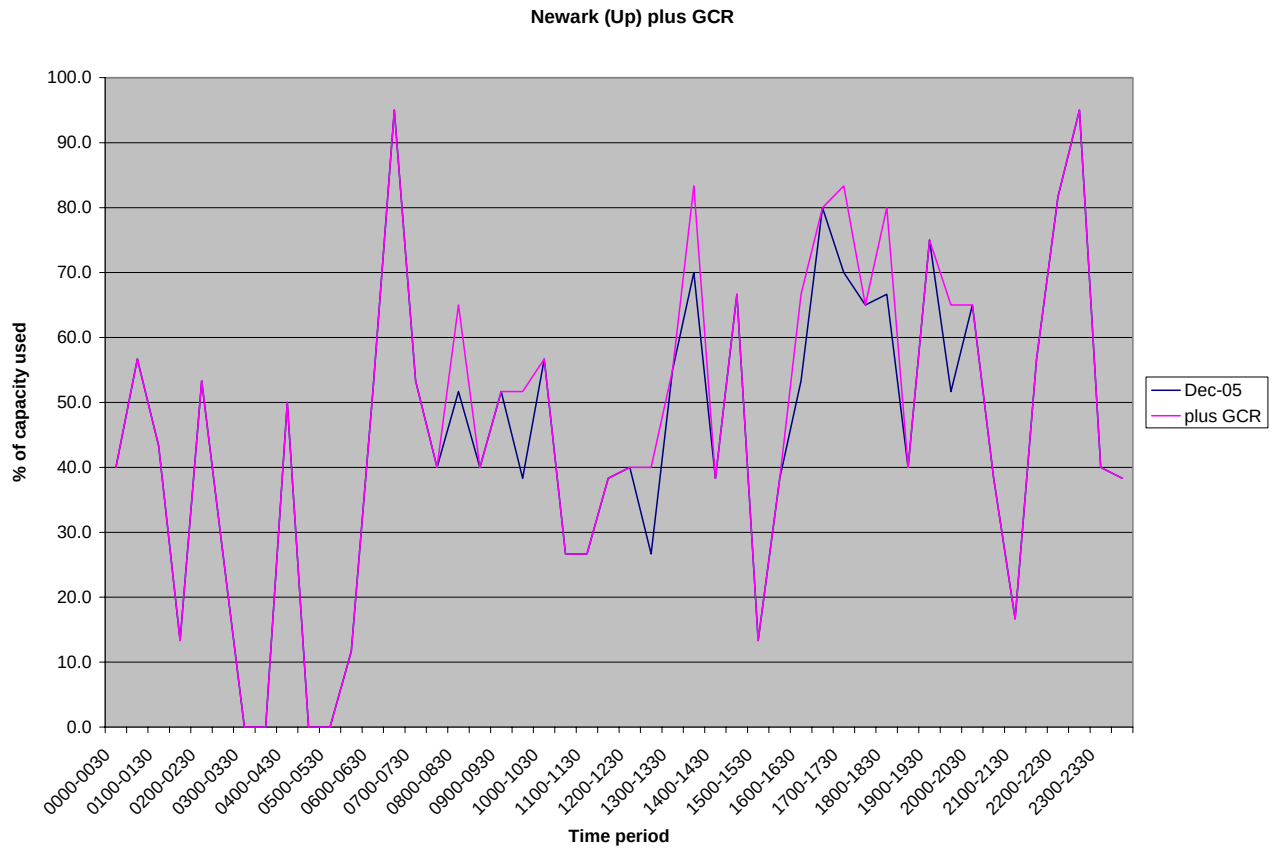


It can be seen that crossing movements at Newark Flat Crossing have a significant (and variable impact) on available ECML capacity.

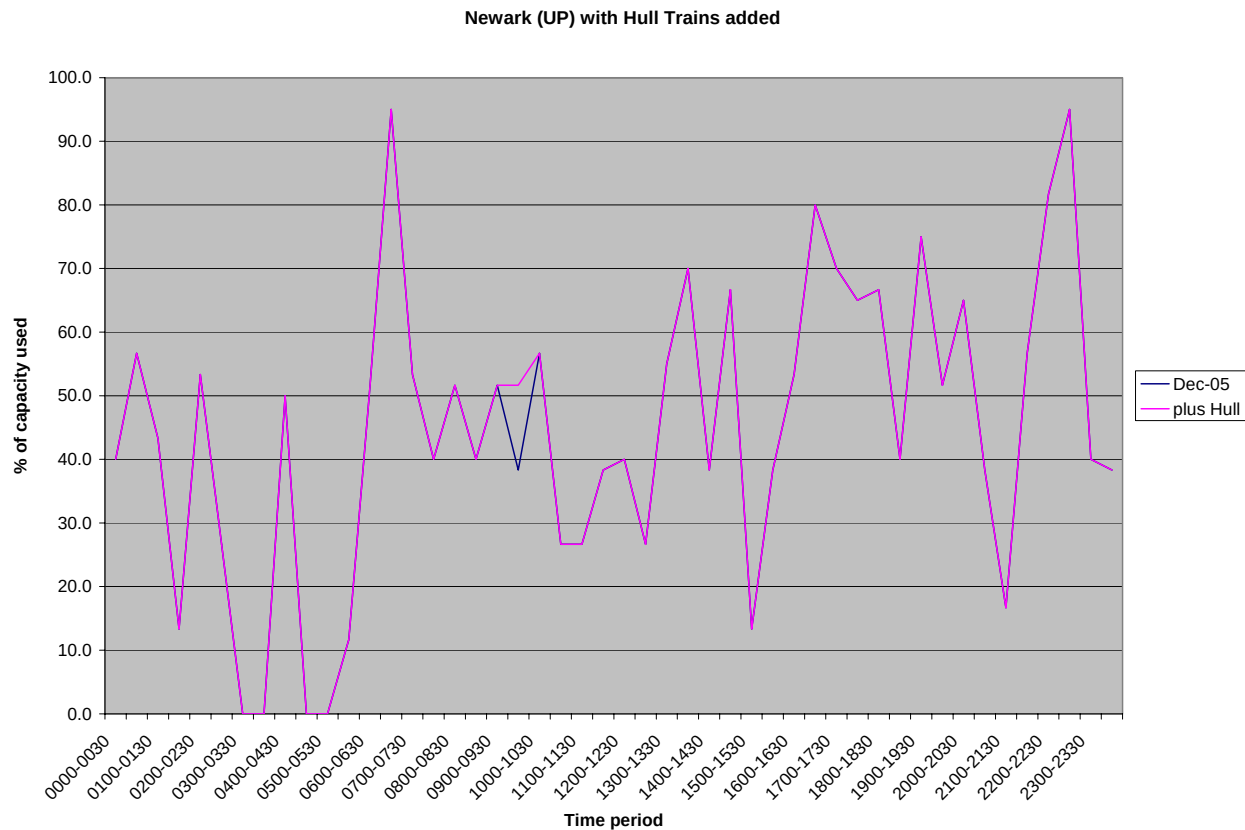
The next stage was to look at the potential effect on capacity of introducing the 3 operators' services. These are covered in the series of charts presented below:



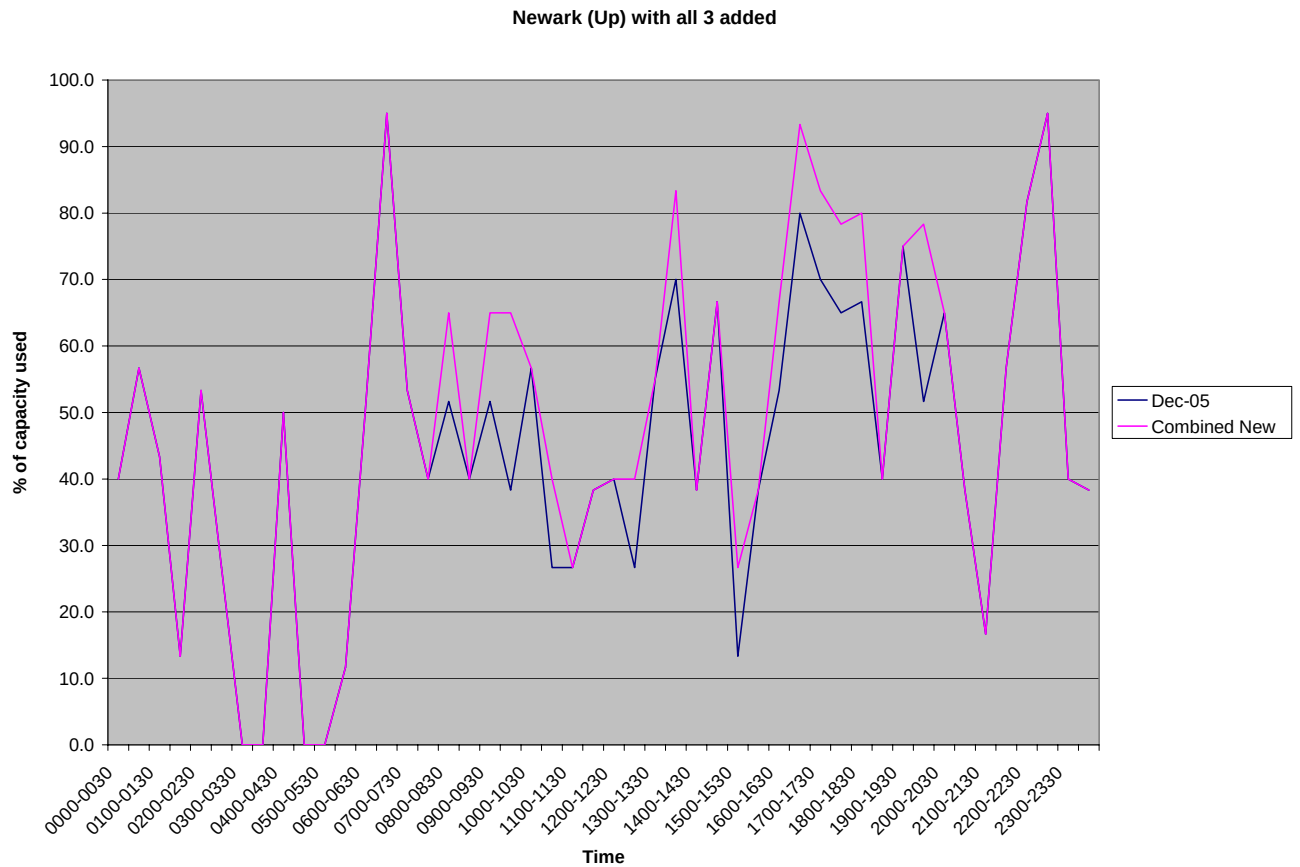
It can be seen that the 1540 and 1640 departures from Leeds produce high capacity usage (almost equivalent to that of the morning peak).



Once again there are a number of potential Grand Central services that would appear to be more problematic than others.



This chart shows the 6th path included in the December 2005 timetable. Finally, the following chart shows the impact if all operators' aspirations were considered:



It can be seen that this would present a general increase in capacity usage throughout the day. The period from 1600 to 1900 would in particular see a high capacity usage.

Movements across Newark Flat Crossing were also taken into account during consideration of the Loversall Carr section to Stoke section as a whole. It should be noted that a number of opportunities that have been looked at as part of this analysis have had to be rejected on the basis of the impact that use of main line capacity would have had on Central's Nottingham to Lincoln services.

Finding 8 – Capacity at Newark Flat Crossing is not constrained in its purest sense. However Network Rail does not believe it would be prudent to accommodate all of the applicants' services because of the adverse effect the loss of current flexibility would have on performance. Constraints other than Newark Flat Crossing have a more significant effect on the applicants' services and as such it is excluded from the analysis at this stage.

4.2.5 Two Track section south of Peterborough

Type: Running line with extended geographical scope.

The 2 track section south of Peterborough, from Fletton to near Huntingdon, could have been looked at from a limited view point. However, it was felt that analysis using the extended methodology would start to provide a useful indication of usable paths across Welwyn.

This analysis has therefore looked at Fletton to Woolmer Green.

This section is characterised by a mixture of long distance high speed services, more local passenger services and a reasonable high number of freight paths that need to be accommodated. WAGN services are also obviously present from Peterborough southwards and are a mixture of fast and slow stopping services.

Again since this work was undertaken as part of the 'linking' process the specific issues will be referred to as part of the train by train analysis.

In general terms the mixture of fast and slow traffic once again makes it difficult to identify usable paths.

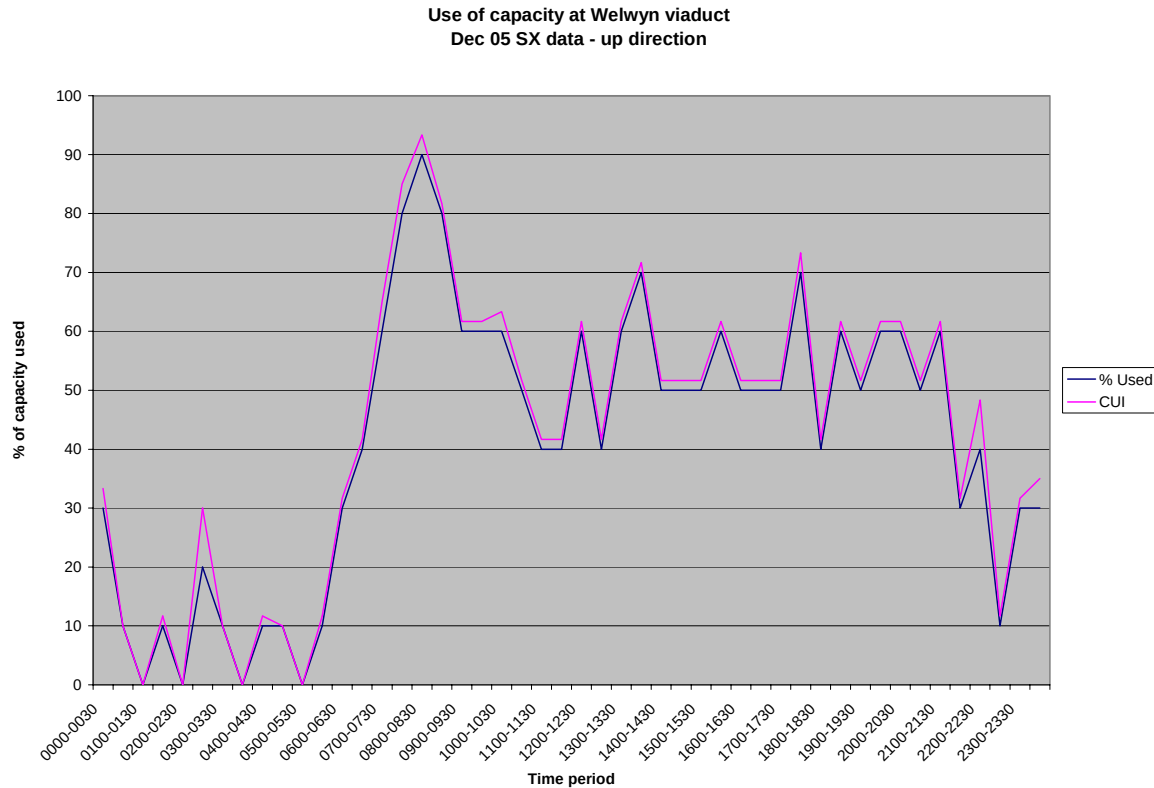
4.2.6 Welwyn Viaduct (including the Hitchin effect)

Type: Running line with limited geographical scope.

This was the first constraint to be looked at. The 2 track section at Welwyn was initially looked at by itself (i.e. from Woolmer Green to Digswell). The reason for it being an obvious constraint is that it is a short 2 track section between 4 track sections. There is a station at Welwyn North. There is a mixture of fast line non-stop trains, Welwyn North stoppers and freight (of various speeds).

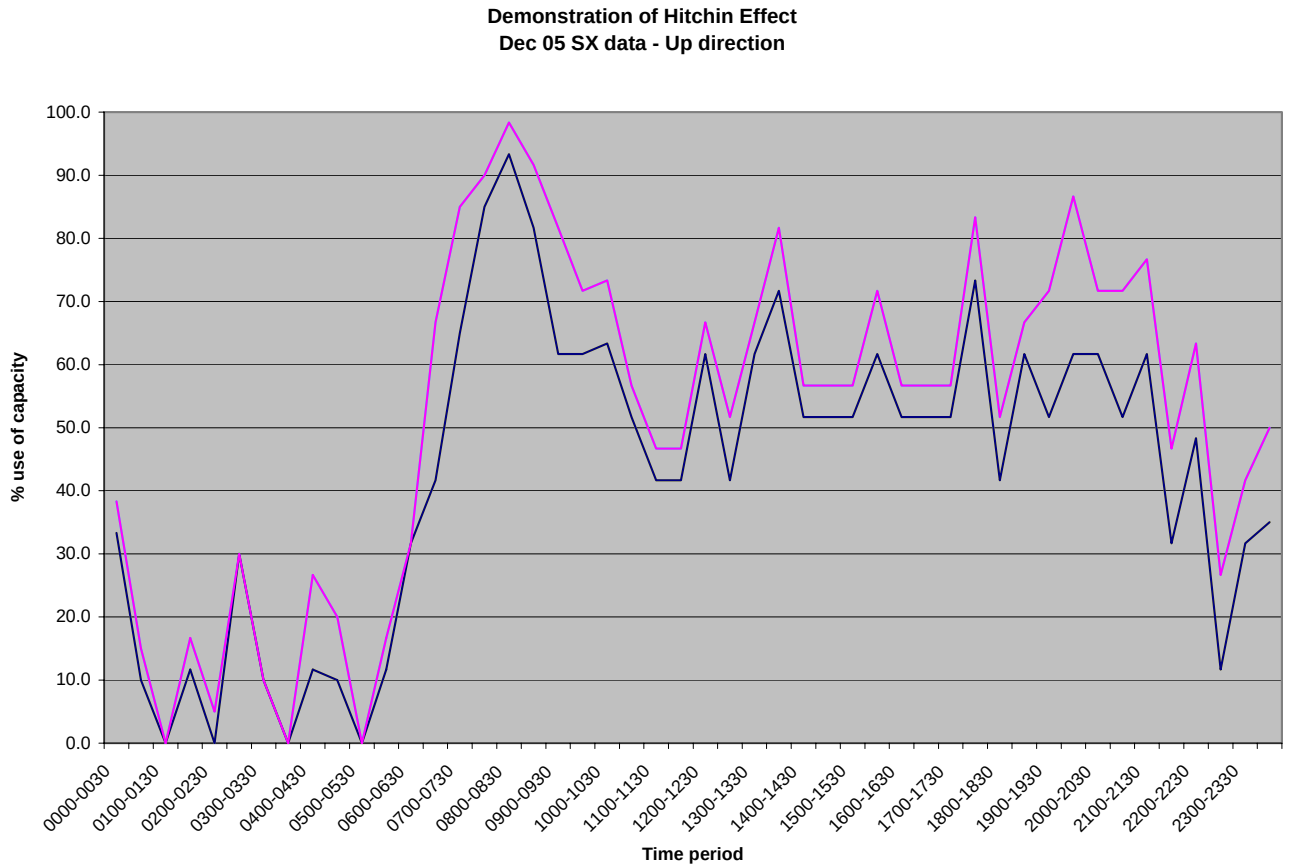
The factors were calculated using the relevant headway, the junction margins (off the slows and Woolmer and for access back onto the slows at Digswell) relevant SRTs (particularly for the stopping services and freight).

The graph shown below was produced early in the process and shows that consideration of use of capacity cannot consider the number of trains alone. Given that 10% spare capacity is required as a minimum to operate an additional 125 path, it can be seen that already there is no chance of operating an additional service in the last half hour which gives an arrival at Kings Cross before 0900 and very little chance of one before that. The morning peak hour at Welwyn is therefore full.



However, the information presented above overstates the theoretical available capacity at Welwyn (i.e. the space above the pink line). This is because available capacity at a constraint is also dependent on how 'free flowing' the resources that feed it are. In the case of Welwyn, the proximity of Cambridge branch junction at Hitchin has an obvious impact on the availability of paths across Welwyn. This is because a down movement onto the branch has a time penalty before there can be another up movement. Hitchin is therefore a 'gate' resource for Welwyn and its impact needs to be taken into account. The impact of parallel moves should also be taken into account, since a down move onto the branch will not result in the loss of an up path off it.

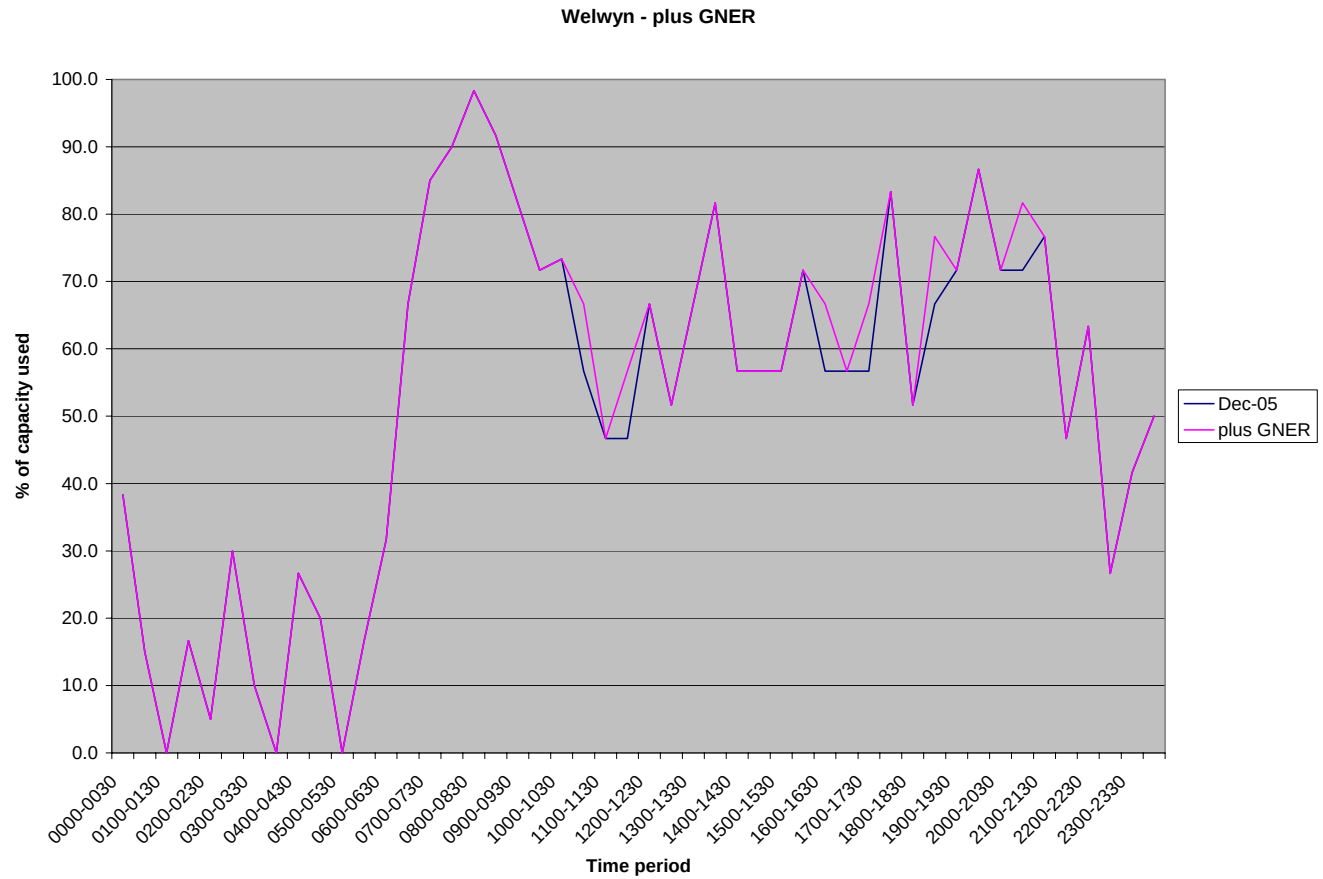
The graph below shows the additional impact of the 'Hitchin effect':

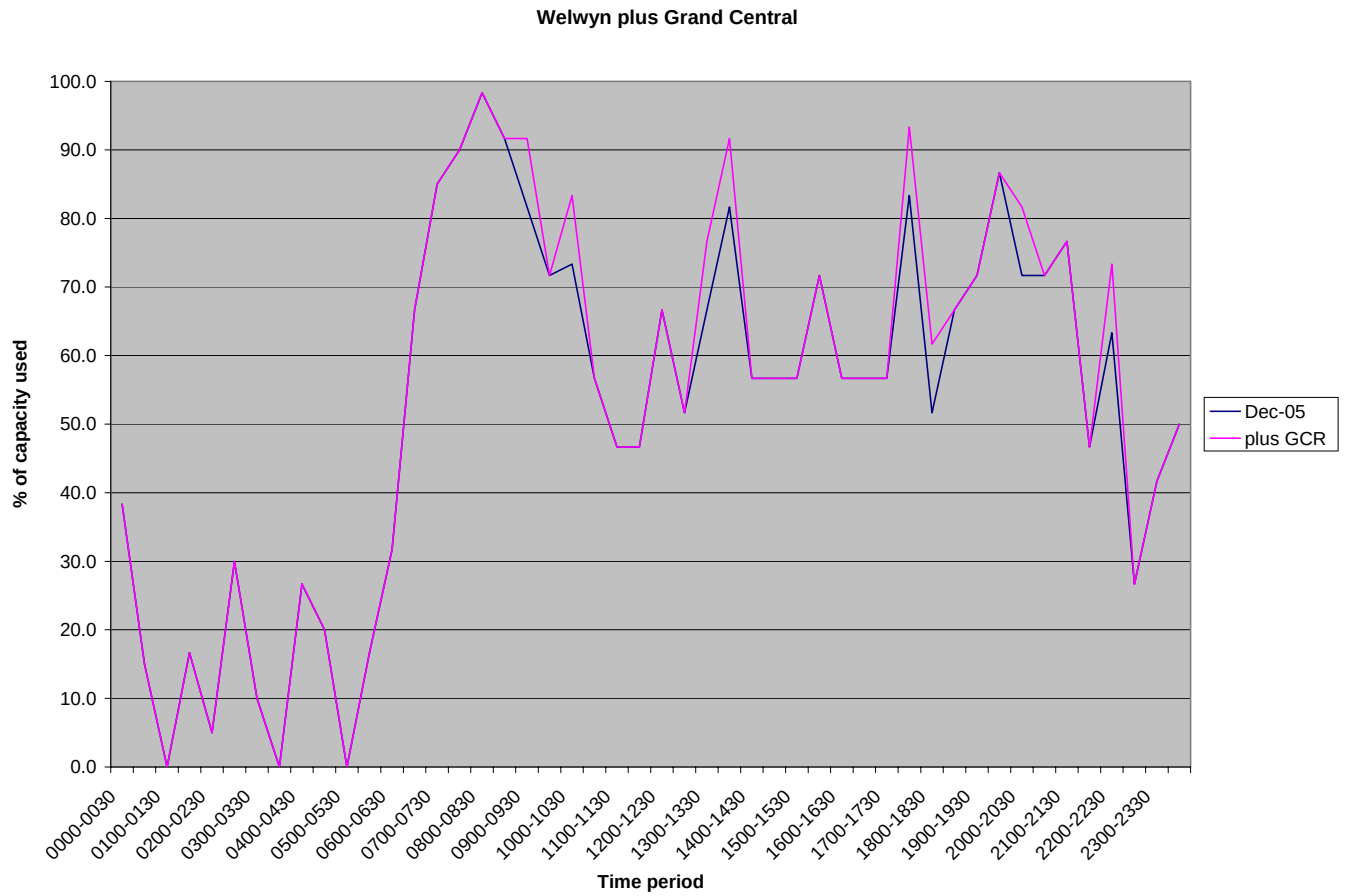


It can be seen that the 'Hitchin effect' further reduces the theoretical spare capacity at Welwyn. Its impact (i.e. the difference between the pink and blue lines) is particularly apparent in the late afternoon / early evening. This is due to there being fewer instances of parallel moves.

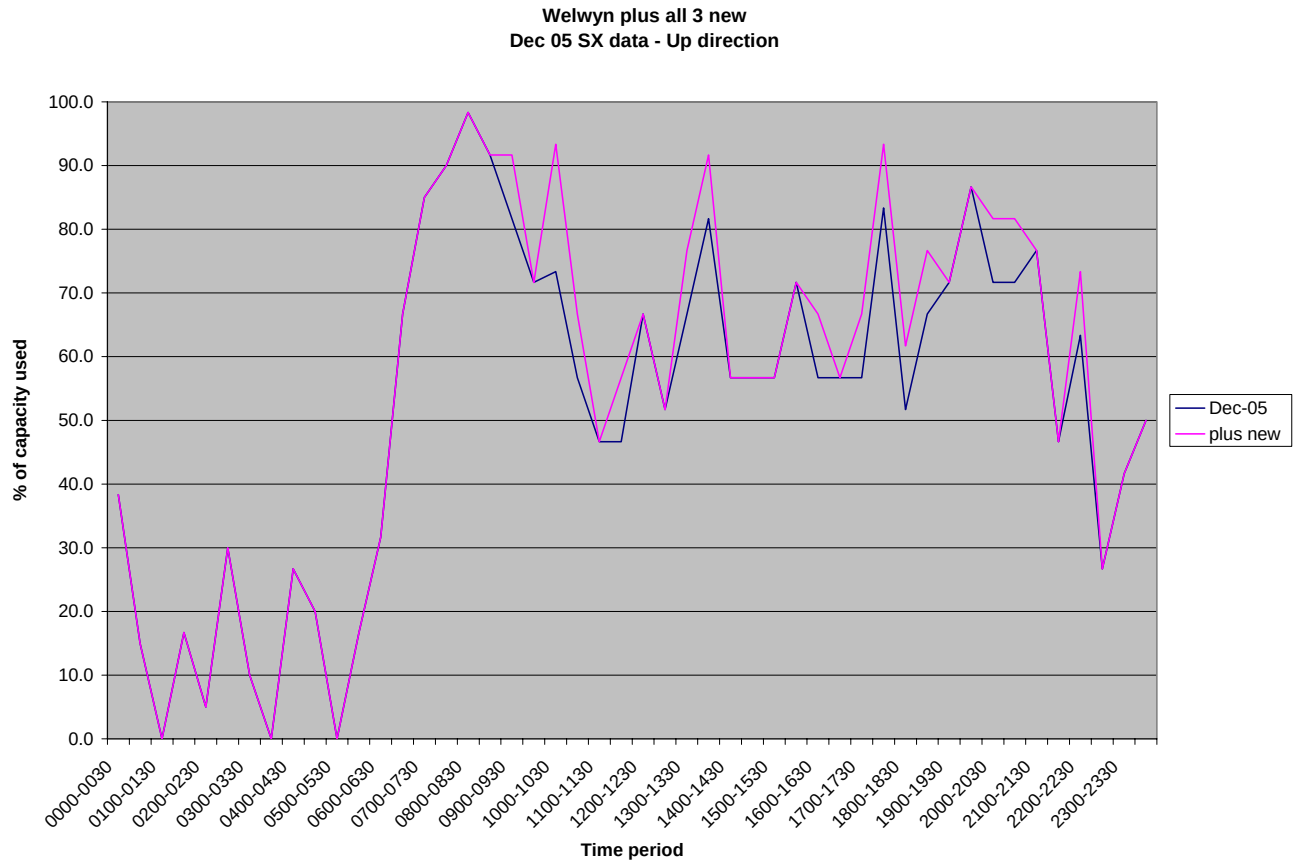
The chart shows that there is only limited spare capacity at Welwyn. There is no spare capacity in the morning peak and it can be seen that even in the traditional off-peak the use of capacity is still very high.

As previously, individual charts have been produced for the potential use of capacity by each of the three operators together with one for all aspirations combined. These are presented below:





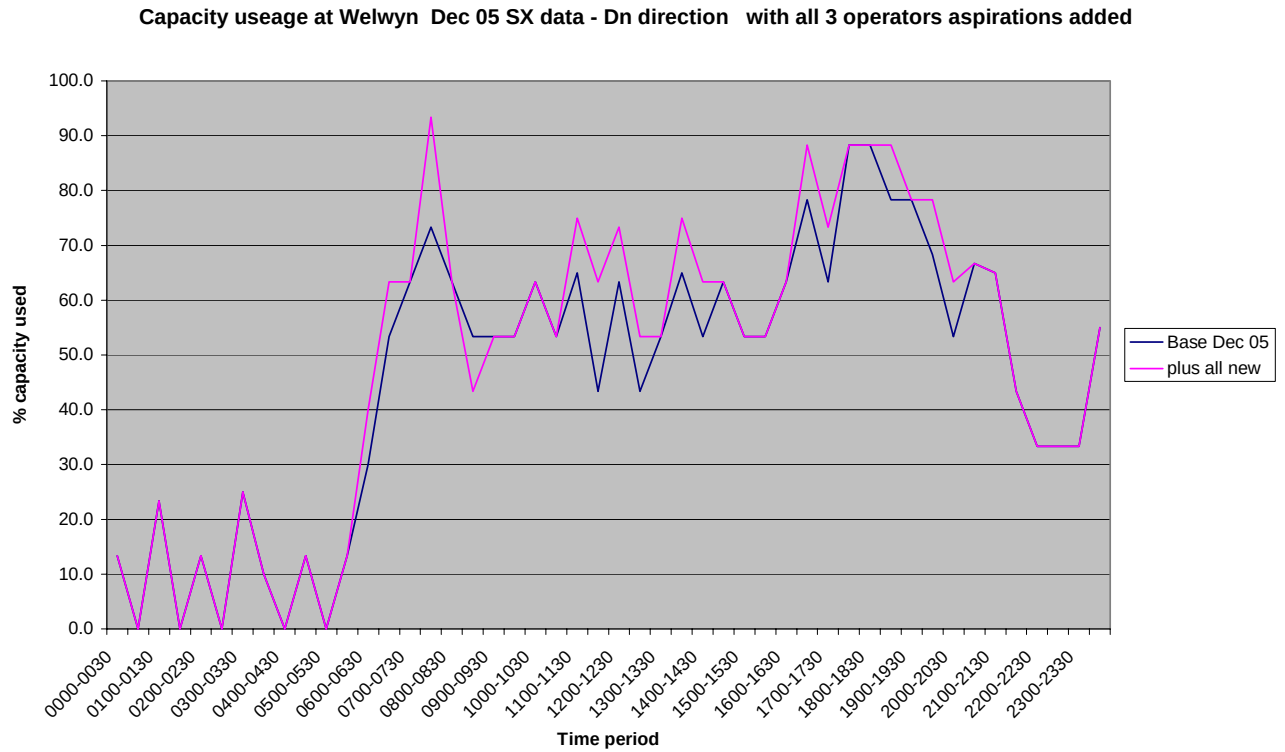




It can be seen that there is theoretical spare capacity at Welwyn for all aspirations. However, it has to be considered how wise it would be to operate a constraint which is operating close to capacity for extended periods of time. Therefore, the key issue at Welwyn is the potential impact on performance.

Initial work has been undertaken for Welwyn in the down direction and the graph showing the impact of all aspirations is reproduced below. It is clear that as with the up direction there is theoretical spare capacity at this location. However, once again the use of capacity at this constraint is very high.

Finding 9 – Network Rail would only consider an additional morning shoulder peak path per day (currently occupied by the Hull Trains 6th path), a further off peak path per day and an evening shoulder peak path over Welwyn Viaduct in Control Period 2. Network Rail would prefer to implement these additional paths one timetable change at a time in order to monitor the effect on performance and react to any adverse trend. Network Rail would need to reconsider this finding in the light of detailed performance modeling and experience of running the services. Also these paths must be viable at each constraint before this is possible.



Performance

The increased performance risk from operating all of the applicants' services together would be excessive and Network Rail would not wish to permit this.

4.2.7 Kings Cross Station

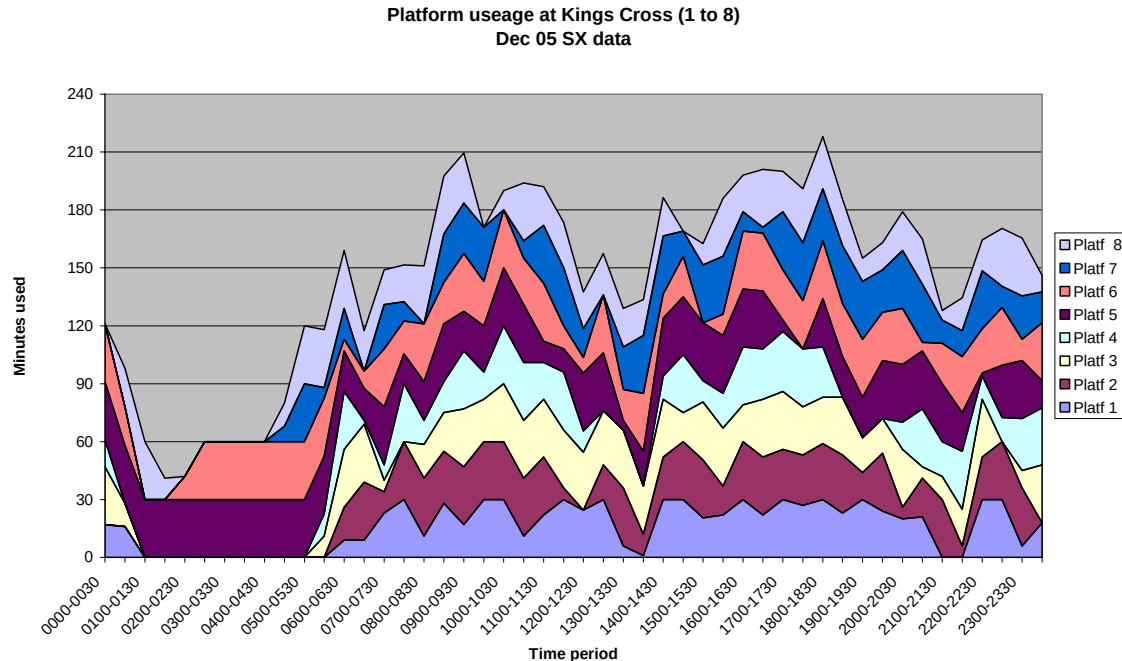
Type 2 Terminal station with multiple platform choices

The analysis of Kings Cross Station with its multiple platform opportunities (8 main line platforms and 3 suburban platforms) has posed its own unique problems. Two key problems to be solved were turnrounds and the relationships between theoretical and usable capacity.

Turnrounds

This issue concerns the use of minimum turnrounds in the Rules of the Plan versus actual turnrounds. Since GNER in particular currently stand trains at Kings Cross in excess of minimum turnrounds, use of these values would overestimate available capacity given current practice.. When this approach was tried the resulting graph showed that the situation at Kings Cross was considerably better than is generally felt to be the case. It was therefore decided to look at real occupancy (as planned for December 2005 timetable). Obviously, the analysis needs to consider any benefit to be gained from moving towards greater adherence to minimum turn rounds.

The graph shown below represents an indication of capacity at Kings Cross. It can be seen that total available capacity for each 30 minute band is shown as 240 minutes (i.e. 8 x 30). Platforms 9 to 11 have not been included in the analysis at this stage. This is in order to keep the analysis as simple as possible. It is assumed that WAGN services in the main train shed represent overspill from 9 to 11 or those that cannot be accommodated due to their length i.e. the basic assumption is that 9 to 11 is full. However, at the train by train analysis stage the potential gaps in 9 to 11 have been examined (with a view to either moving suitable WAGN services out of the main train shed or indeed accommodating Hull Trains or Grand Central services). The graph was shown by noting from the December 2005 platforming plan for how many minutes in each 30 minute time band each platform was occupied. The appropriate reoccupation factors were included where trains departed.



It can be seen from the above chart that as might be expected, Kings Cross is heavily used particularly in the morning and evening peaks.

Theoretical and usable capacity

The second problem is one of identifying whether theoretical spare capacity can be converted into usable capacity. This is a particular problem due to the length of the minimum turnrounds at Kings Cross, i.e. a significant gap needs to be found. As part of this the potential to create more space by re-platforming needs to be considered.

In order to address this issue a fairly straight forward (but robust) method has been developed. This methodology is based on the principle that since each and every arrival will be followed by a departure, only arrivals at Kings Cross need to be looked at.

The analysis was undertaken as follows:

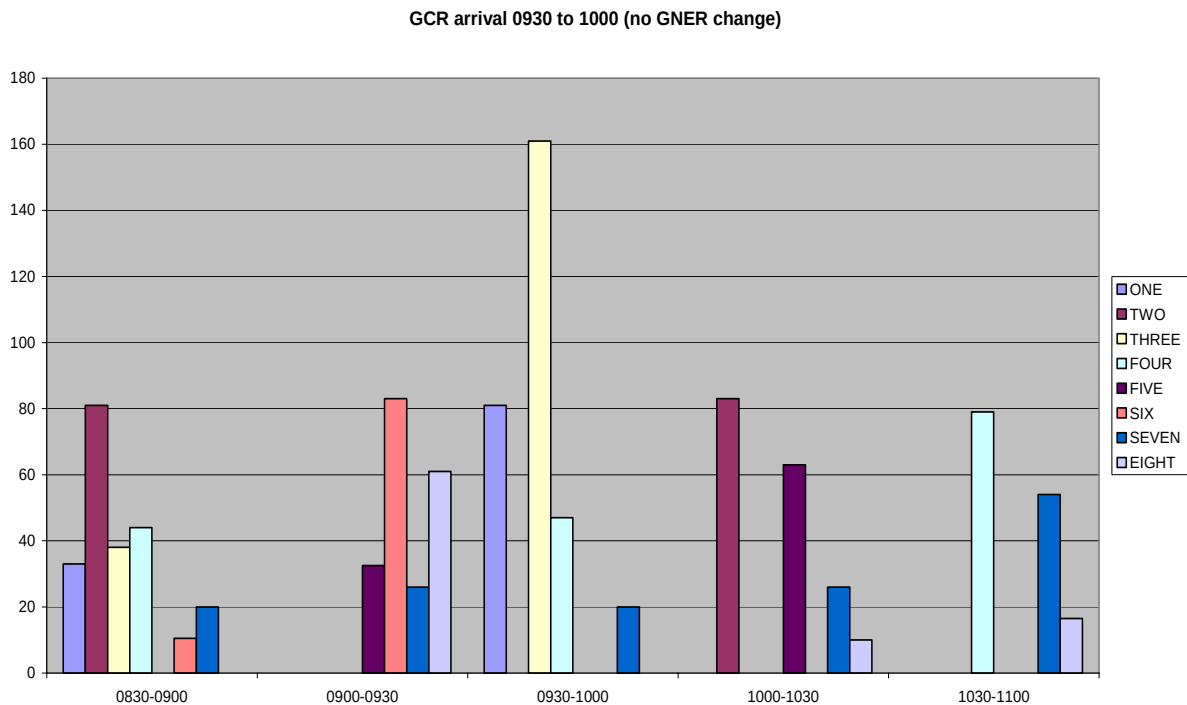
- 1) The December 2005 Kings Cross plan was used to record occupancy of platforms 1 to 8 throughout the day. This was done by recording the total number of minutes occupancy at a platform against the half hour band in which it arrived.
- 2) This can then be used to produce a visual representation of platform occupancy for a given target arrival time together with the time periods before and after it. This provides the following information:
 - Platforms that have trains arriving in the given half hour.

- Trains that are already in that platform (from a previous arrival). Long dwells are readily apparent.
 - The potential for re-platforming (in simple terms moving the 'coloured blocks around').
- 3) In the case of GNER, their proposed 2007 diagrams have been used to update the base data and examine the possibility of accommodating their services.

The dwell times used are as per the Rules of the Plan (in the case of GCR, discussion with the Advance Timetable Specialist at Birmingham TPC suggests that the values for Hull Trains should be the ones adopted). In searching for usable gaps the reoccupation penalty also needs to be taken into account and again these are as per Rules of the Plan.

This approach has meant that each of the operators' proposals can be considered in isolation as well as together.

The following graph, which was produced to investigate a potential GCR arrival before 1000, illustrates the methodology:



It can be seen that the situation for each platform is as follows:

Platform 1	Occupied.
Platform 2	Unavailable due to dwell of arrived train in 0930 to 0900 band (and arrival of train in 1000 to 1030 band).
Platform 3	Occupied (note that this is a long dwell but it can be seen that reducing it would be of no benefit for a 0930 to 1000 arrival).
Platform 4	Occupied.
Platform 5	Unavailable due to dwell of arrived train in 0930 to 0900 band (and arrival of train in 1000 to 1030 band).
Platform 6	Unavailable due to dwell of arrived train in 0930 to 0900 band.
Platform 7	Occupied (although this is a relatively short dwell the platform is also occupied in the surrounding time bands).
Platform 8	Unavailable due to dwell of arrived train in 0930 to 0900 band.

Platforms 9 to 11 have also been confirmed as full.

There is therefore no potential for platforming a new 0930 to 1000 arrival at Kings Cross.

The analysis has been carried out for each of the operators' aspirations. Hull Trains 6th path is obviously included in the December 2005 plan, but its presence has been considered throughout the analysis.

It is noted that WAGN have raised concerns about the availability of platform capacity at Kings Cross.

Finding 10 - The results of the analysis show that this is an extremely valid concern and the following conclusions can be made.

- Up to 0800 there is capacity available.
- There is no spare capacity between approx 0800 and 1000.
- Between 1000 and 1130 limited capacity is available but the gaps are limited and may not link up with available gaps at the other constraints.
- Between 1130 and 1600 more capacity is available so there is more chance of a platform being available for a new service.
- There is no spare capacity between approx 1600 and 1800.
- Between 1800 and 1900 extremely limited capacity is available but the gaps are very limited and may not link up with available gaps at the other constraints.
- Between 1900 and 2000 there is limited capacity which may not link up with available gaps through other constraints.
- From 2000 there is capacity available.

It is clear from the analysis that platforming at Kings Cross is the major constraint on the route. Any proposal must identify available platform space for it to be viable.

Alternative 3 - It should also be remembered that although long dwells have

been mentioned as an issue at Kings Cross, insisting on adherence to minimum dwells will not necessary free up a great deal of capacity due to the fact that:

- During congested hours trains are already at minimum dwells.
- Reductions in dwells need to tie into workable diagrams.
- Any increase in Empty Coaching Stock (ecs) moves to Bounds Green to free up platform space needs to be looked at carefully. An increase in moves will increase pressure on Kings Cross Throat and may mean arrivals may not be able to get into the station to make use of a newly created gap.

Finding 11 – Any gain in moving GNER trains to Bounds Green to free up platform capacity would create conflicts with incoming services and would be unlikely to result in any net gain in capacity.

Each of the operators aspirations for platforming at Kings Cross has been looked at as follows:

GNER

GNER has submitted proposed new diagrams for 2007. These have been used as a comprehensive analysis of the issues posed by the lack of sufficient platform capacity at Kings Cross. The results are summarised below:-

- 1) 0840 ex Leeds (arrives KX 1050 +) diagrammed with 1235 ex KX to Leeds
 - Cannot stand at Kings Cross. Therefore 2 additional empty moves to / from Bounds Green are required. (RED)
 - 0840 either :- Platf 3 (requires 1A13 / 1N07 split with 2 more ecs moves)
 - Platf 4 (replacing Hull Trains – 6th path)
 - Platf 5 (but requires later arrival at 1110)
 - Platf 8 (requires re-platforming of WAGN to 9)
 - 1235 more straight forward with Platforms 1, 2, 7 all available.
- 2) 0940 ex Leeds (arrives KX 1200 approx) diagrammed with 1335 to Leeds
 - Cannot stand at Kings Cross except for following possibility:-
1A21 (1222) to 1D34 (1305) replatformed from 4 to 1. Hull 6th path no longer departs from 4.
1200 to 1335 in Platform 4 .
Hull 6th path arrives in 4 and departs from Platform 2.
A consequence of this, however, would be to impose two ecs moves on Hull Trains rather than GNER. (RED)
 - 0940 either: Platf 2
Platf 3
Platf 4 (instead of Hull 6th path)
 - 1335 Platforms 1 or 4.
- 3) 1440 ex Leeds (arr KX 1700 ish) linked with 1D44 1750 return to Leeds. At present this is worked from ecs ex Bounds Green. Platform 2 1710 to 1750.
 - 1440 ex Leeds would need to arrive at 1710 ish to work. (AMBER)
- 4) 1540 ex Leeds arr KX 1800 ish (links to 1D46 dep KX 1833)
Currently 1A37 (1813) to 1D46 (1850).
In 2007 plan 1A37 will link with 1Dxx 1903 dep to KX.
 - Cannot identify a platform for 1800 ish arrival. it needs to be much later (1825 when Platform 4 becomes available) but then would not

be able to form retimed 1833 departure from KX. This therefore defeats the object of making this alteration. (RED)

- 1A37 and 1Dxx can be platformed on 6 – 1P73/1C11 being replatformed on 5 to allow this (looks possible).
- 5) 1640 ex Leeds arr KX 1900 ish. (links to 1dxx 2005 dep to Leeds)
- Platform 5 available (GREEN)
- 6) 1840 ex Leeds (2100 arr) then to Bounds Green
- Platform 3 available (GREEN)

It is clear that 4 out of the 6 proposed new arrivals from Leeds have issues associated with them. The analysis suggests an increase in the movements of empty stock between Bounds Green and Kings Cross, as there is insufficient capacity for GNER arrivals to stand at Kings Cross awaiting their diagrammed departure. This increase will obviously place much greater pressure on the capacity of the approaches into Kings Cross.

Finding 12 - In summary the GNER plan as presented cannot be accommodated at Kings Cross.

GCR

Finding 13 - Grand Central Railways

Based on the arrival times for the paths submitted by Vossloh:

- 3 cannot be platformed (0946, 1751 and 1820 arrivals)
- 3 can possibly be platformed with some replatforming / slightly different arrival times (1048, 1346 and 2051 arrivals)
- 2 look to be more straight forward (1418 and 2230 arrivals) and the viability of these services rests on their interaction at other constraints.

The GCR departures from Kings Cross have not been considered due to the apparent difficulty of producing workable GCR diagrams. This issue is dealt with in some detail in section 4.3.2.

Finding 14 - Hull Trains

Their 6th path is already platformed at Kings Cross and is therefore viable.

4.2.8 The linking of constraints

As discussed earlier, the use of the ThOC identifies whether services are viable at the most constrained part of the network. If they are not viable then a viable service cannot be planned and there is little point in doing additional work. One of the strengths of the theory is that it facilitates the rapid elimination of large numbers of options. More time can then be spent on developing options that have a chance of succeeding.

The next step in the process was to start to link some of the constraints described above. Although, it is recognized that there are a number of potential locations that have not yet been considered, it was felt that starting to link the constraints at this stage would provide useful information on what might be deliverable services.

The process was carried out on an individual train level and involved the comparison of the 'rough' new path that had been developed (to provide the anticipated time at each of the identified constraints) with the December 2005 SX timetable.

Where a clear 'gap' existed through the constraint, the services that formed the gap were identified. Where a gap did not exist at the time required, options for either changing the time of the 'new' train or the existing paths causing the issue (i.e through the application of pathing time) were considered.

Spot validation was then used between the constraints to identify whether there was likely to be problems with the emerging rough paths. These spot checks concentrated on locations where there was likely to be the most problems. Once again potential issues were explored and possible solutions considered. The amount of time spent on each train and on each route section varied according to the particular issues identified. Where major issues were identified, the number of possible solutions explored was limited to those that were believed to have a reasonable chance of succeeding.

Where the solution involved the inclusion of pathing time in the 'new service'; new times were then re-calculated for each of the constraints and rechecked. This process was then repeated until it was felt that the key issues determining the viability of each path had been identified.

4.3 Commentary on detailed service proposals

This section uses the results of the analysis described above to examine each of the operators' aspirations on a train by train basis. Once again this work has currently only been undertaken for Up services.

4.3.1 GNER

Summary of train by train issues **GNER Leeds Half Hourlys**

The impact of the following constraints has been considered :-

1. Hare Park / South Kirby
2. Loversall Carr to Stoke
- 3a. Hitchin (including consideration of Peterborough (excl) to Woolmer Green)
3. Welwyn (including consideration as far as Alexandra Palace)
4. Kings Cross Platform availability.

Summary of key findings for each of the 6 trains as follows:

0840 dep

Issues with freight at Hare Park but there appears to be scope for a solution. (it also clashes with a second freight path but as this is an MO Q path this has not been considered further).

Catches local stopper at Doncaster but should be solvable with use of pathing time. (Amber)

Clashes with Hull Trains 6th path (1A92 0812 from Hull) for much of route. This might be solvable with a change in stopping patterns for the two trains – but obviously requires input from Hull Trains / GNER. (GREEN)

Needs to be slightly earlier at Welwyn (again changes to stopping pattern could be solution). (AMBER)

Unable to stand at Kings Cross to form return working. (RED)

0940 dep

Issue with Freightliner's 0857 Leeds to Felixstowe (4L85) at Hare Park. Although this train stands at some time at Doncaster, it causes issues with other paths. An acceptable solution at Hare Park would create difficulties requiring other solutions elsewhere. This issue is therefore currently considered to be very problematic, and therefore the service does not appear viable. (RED)

Loversall Carr to Stoke: Issue with EWS' 0844 Normanton to Willesden (4M90). There appears to be scope for a solution that just about works. (AMBER)

Appears satisfactory from Peterborough (excl) to Alexandra Palace – i.e. through Hitchin and across Welwyn. (GREEN)
Unable to stand at Kings Cross to form return working and it is therefore not viable. (RED)

1440 dep

Issue with EWS' 1112 Seaforth to Tinsley (6E14) at Hare Park. No solution identified at present. (RED)
Issue with GNER stopping pattern as train is caught up by 1E14 at Stoke pathing time could possibly offer a solution). (AMBER)
Needs to be later at Hitchin due to Down movement onto branch (1C29).
Clashes with WAGN local (2P59) which is fast line from Potters Bar. GNER could run after 2P59 (which would fit with Hitchin issue anyway) but takes path of WAGN empty (3R01). (AMBER)
Lack of platform availability would mean later arrival at Kings Cross. (AMBER)

1540 dep

Pathing time required approaching Doncaster as too close behind local stopper (2B21). GNER require pathing time but this would further exacerbate issue with 1A46. (AMBER)

1A46 too close behind at Loversall Carr but different stopping patterns means further back at Stoke. (AMBER)

Major issue with freight from Fletton to Huntingdon. This is with EWS' 1340 West Burton to Colnbrook (6V25). (RED)

We have looked at a number of alternatives for 6V25 but each time it conflicts with local WAGN stoppers.

This appears to be a path across Welwyn to Alexandra Palace.

Cannot identify a platform at Kings Cross. (RED)

1640 dep

Close behind 4D54 at Adwick Jn but should be solvable with pathing time. (AMBER)

Sufficient gap from Loversall Carr to Stoke. (GREEN)

Direct clash with 1P73 at Hitchin (GNER would need to be 4 minutes earlier) – requiring further consideration for a solution.

Issue with 4M75 across Welwyn – requiring further consideration for a solution. (RED)

Platform available at Kings Cross. (GREEN)

1840 dep

Close behind 6E66 at Adwick Jn. But 6E66 FOC has a long stand at Healey Mills so may be solvable. (AMBER)

Currently significant issue with 7L84 between Loversall Carr and Stoke. (RED)
Ok at Hitchin (and from Peterborough to the 2 track at Welwyn).

There is a large gap following 1E21 / 2P63 but GNER too close in front of 1P75. Either GNER will need to be 2 minutes earlier or 1P75 needs 2 minutes pathing. (AMBER)

Platform available at Kings Cross. (GREEN)

4.3.2 Grand Central

It has already been identified that the paths produced by Vossloh on behalf of Grand Central are in the majority of cases not viable. This is principally due to combination of lack of platform availability at Kings Cross, freight paths and Hull Trains paths. In addition, Grand Central's proposals now assume 222s rather than HSTs.

However, we have undertaken a train by train analysis for specific issues for consistent treatment of the applicants' proposals.

0540 Sunderland to London Kings Cross (arrives at 0946)

Platform available at Sunderland. (GREEN)

No apparent issues between Loversall Carr and Stoke. (GREEN)

Peterborough to Woolmer Green - clashes with EWS' 0544 Peterborough to Bow Depot (6L69 at Hitchin at 0920). Both planned to be on the slow line at the same time. (RED)

Path available across Welwyn.

No platform available at Kings Cross. (RED)

1035 Sunderland to London Kings Cross (arrives at 1418)

Sunderland.

Loversall Carr to Stoke : clashes with Freightliner's 0857 Leeds to Felixstowe (4L85). (RED)

Looks to be a path between Peterborough and Woolmer Green.

Woolmer Green to Alexandra Palace : issue with GNER's 1205 from Leeds (1A25) due to different placing of allowances, so should be solvable. (GREEN)

Platform available at Kings Cross. (GREEN)

1358 Sunderland to London Kings Cross (arrives at 1820)

No platform at Sunderland. (RED)

Loversall Carr to Stoke: clashes with Hull Trains 1533 Hull to Kings Cross (1A95). (RED)

Looks to be a path between Peterborough and Woolmer Green.

Path available across Welwyn. (GREEN)
No platform available at Kings Cross. (RED)

1836 Sunderland to London Kings Cross (arrives at 2230)

Sunderland (AMBER)

Loversall Carr to Stoke : clashes with Freightliner's 1544 Wilton to Felixstowe (4L79). (RED)

Looks to be a path between Peterborough and Woolmer Green.

Path available across Welwyn. (GREEN)

Platform available at Kings Cross. (GREEN)

0721 Bradford Interchange to London Kings Cross (arrives at 1048)

Bradford not assessed.

Same path as Hull Train's 6th path (0812 from Hull). (GREEN)

Platform might be available at Kings Cross. (AMBER)

1022 Bradford Interchange to London Kings Cross (arrives at 1346)

Bradford not assessed.

No apparent issues between Loversall Carr and Stoke. (GREEN)

Looks to be a path between Peterborough and Woolmer Green.

Path available across Welwyn. (GREEN)

Platform might be available at Kings Cross. (AMBER)

1422 Bradford Interchange to London Kings Cross (arrives at 1751)

Bradford not assessed.

No apparent issues between Loversall Carr and Stoke. (GREEN)

Peterborough to Woolmer Green : clashes with EWS' 1340 West Burton to Colnbrook (6V25). (RED)

Issue with a WAGN empty between Woolmer Green and Alexandra Palace (3C15).

No platform available at Kings Cross. (RED)

1722 Bradford Interchange at London Kings Cross (arrives at 2050)

Bradford not assessed.

Loversall Carr to Stoke : clashes with EWS' 1739 Doncaster to Whitemoor (7L84). (RED)

Although there is a path across Welwyn itself, there is an issue with down traffic at Hitchin crossing onto the Cambridge Branch. (AMBER)

Path available across Welwyn.

Platform might be available at Kings Cross. (AMBER)

4.4 Other general issues with GCR proposal

4.4.1 Grand Central resources

A key issue for consideration is also the number of units that Grand Central would have available to operate their proposed new services.

Grand Central have indicated that they envisage using 4 sets of 5 car 222s (with a 5th unit as a standby to allow for maintenance rotation and to cover breakdowns etc. This assumption was confirmed by Grand Central).

It is clear looking at the timetable submitted to the ORR by GCR how this would be envisaged to work. This is demonstrated below:

Timetable supplied by GCR to ORR

Origin	Time	Destination	Time	Potential diagram	Minutes before next working
Kings Cross	0745	Bradford	1045	(1)	30
Kings Cross	1045	Bradford	1345	(2)	90
Kings Cross	1445	Bradford	1745	(1)	30
Kings Cross	1845	Bradford	2145	(2)	Last working
Bradford	0715	Kings Cross	1015	(2)	30
Bradford	1115	Kings Cross	1415	(1)	30
Bradford	1515	Kings Cross	1815	(2)	30
Bradford	1815	Kings Cross	2115	(1)	Last working
Kings Cross	0600	Sunderland	0930	(3)	30
Kings Cross	1000	Sunderland	1330	(4)	30
Kings Cross	1400	Sunderland	1730	(3)	30
Kings Cross	1800	Sunderland	2130	(4)	Last working
Sunderland	0600	Kings Cross	0930	(4)	30
Sunderland	1000	Kings Cross	1330	(3)	30
Sunderland	1400	Kings Cross	1730	(4)	30

Sunderland	1800	Kings Cross	2130	(3)	Last working
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It can be seen that a 30 minute turnround is assumed for all but one movement. Using the base assumption that 222 turnrounds at Kings Cross should be the same for Grand Central as those for Hull trains (30 minutes during off peak times and 20 minutes during peak times) it can be seen that there are therefore minimum turnrounds for off-peak trains. As demonstrated previously, the peak trains could not be accommodated at Kings Cross. If these base timings were developed for HST traction (Grand Central's initial preference) then they would all be substandard (if it is assumed that they should be similar to GNER's turnround of 40 minutes for West Yorkshire services and 45 minutes for Newcastle services).

Additionally, it can be seen that this timetable assumes a three hour journey time between Bradford Interchange and London and a 3 and a half hour journey time between Sunderland and Kings Cross. It should be noted that these are the base journey times between these locations (i.e. no pathing time to take into account the presence of other services on the network has been allowed for).

Repeating the exercise for the timings supplied by Vossloh (which do take into account the presence of other operators' services on the network) clearly illustrates the danger of developing resource assumptions in isolation.

Timetable supplied by Vossloh to Network Rail

Origin	Time	Destination	Time	Potential diagram	Journey time
Kings Cross	0727	Bradford	1053.5	(1)	3 hrs 26.5
Kings Cross	1127	Bradford	1453.5	(2)	3 hrs 26.5
Kings Cross	1619	Bradford	1944.5	(3)	3 hrs 25.5
Kings Cross	1933	Bradford	22251	(1)	3 hrs 18
Bradford	0721	Kings Cross	1048	(2)	3 hrs 27
Bradford	1022	Kings Cross	1346	(3)	3 hrs 24
Bradford	1422	Kings Cross	1751	(1)	3 hrs 29
Bradford	1722	Kings Cross	2050	(2)	3 hrs 28
Kings Cross	0549	Sunderland	0944	(4)	3 hrs 55

Kings Cross	1109	Sunderland	1446	(5)	3 hrs 37
Kings Cross	1411	Sunderland	1921	?odd trip (6)	5 hrs 10
Kings Cross	1648	Sunderland	2056	(4)	4 hrs 12
Sunderland	0540	Kings Cross	0946	(5)	4 hrs 6
Sunderland	1035	Kings Cross	1418	(4)	3 hrs 43
Sunderland	1358	Kings Cross	1830	? odd trip (7)	4 hrs 22
Sunderland	1836	Kings Cross	2230	(5)	3 hrs 54

It can be seen that the above timetable would be expensive in units (and by implication train crew). No unit would be able to achieve 4 trips in a day. The majority would be limited to 3 trips and some services would only achieve 1 or 2 trips per day.

It can be seen that most journey times are 30 minutes greater than those predicted by GCR. It can be seen through analysis of Vossloh's timings that this additional pathing time is not just restricted to the ECML itself.

Network Rail believes that it is unreasonable to assume that Grand Central would receive train paths that have no pathing time included.

Network Rail believes that Grand Central have underestimated the level of resource needed to deliver the type of service they have requested. Network Rail believes that Grand Central will either have to allow for additional units or scale back their aspirations.

4.4.2 Grand Central's request for a recast of the ECML timetable for December 2006.

In their letter of 9 December 2005, GCR argue strongly that Network Rail should recast the timetable of the East Coast Main Line. Given the assumptions set out at the beginning of this report and existing contractual commitments, Network Rail does not believe that a recast solution would provide greater access opportunities.

One of the key features of the East Coast Main Line timetable is GNER's non-standard stopping pattern. This is often cited as a primary factor in the lack of available capacity for new traffic. Indeed, during the work undertaken for this capacity analysis this issue presented one of the key challenges for the identification of new paths between Loversall Carr and Stoke.

- It is clear that the adoption by GNER of a standard pattern service would make the identification of new opportunities considerably easier. However, given the analysis, Network Rail believes that a GNER standard pattern service would not in itself free up capacity to meet any of the applicants' requirements. It is possible that a re-cast which changed the current WAGN quantum and/or calling patterns could allow for such capacity. However, this has been put outwith the scope of this analysis and its agreed assumptions. A re-cast would also be limited in scope by existing contractual commitments to other operators.

4.4.3 Hull Trains

The Hull Trains 6th path is already in the December 2005 timetable. As noted in the GNER commentary it conflicts with the proposed 0840 departure ex Leeds. It also conflicts with the GCR 0721 departure from Bradford (as developed by Vossloh).

4.4 Chart of constraints versus services

The comments on each of the services requested by the each of the applicants has been distilled into a viable / not viable decision according to the key below.

If a service has all greens, it is viable.

If a service has one or more amber it may be worth further work by Network Rail or other stakeholders to address the issues that may turn the outcome from amber to green.

If a service has one or more reds it is not viable.

The findings can be summarised as follows:

Key

Green	This path has no issues at this constraint.
Amber	There are issues but there is a possible solution.
Red	There are currently issues that do not have an apparent solution.

4.4.1 GNER

Service	Kings Cross	Welwyn	Doncaster	Hare Park
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		Viaduct	South	
8:40 ex Leeds	Amber	Amber	Green * (HT 6 th path)	Amber
9:40	Amber	Green	Amber	Red
14:40	Amber	Amber	Amber	Red
15:40	Red	Red	Amber	Amber
16:40	Green	Red	Green	Amber
18:40	Green	Amber	Red	Amber

4.4.2 Grand Central

Service	Kings Cross	Welwyn Viaduct	Doncaster South	Sunderland
0946 arrival	Red	Red	Green	Green
1418 arrival	Green	Green	Red	Red
1820 arrival	Red	Green	Red	Red
2230 arrival	Green	Green	Red	Amber

Service	Kings Cross	Welwyn	Doncaster S	Bradford
1048 arrival	Amber	Green (HT 6 th path)	Green (HT6 th path)	Not assessed
1346 arrival	Amber	Green	Green	Not assessed
1751 arrival	Red	Red	Green	Not assessed
2050 arrival	Amber	Amber	Red	Not assessed

4.4.3 Hull Trains

Service	Kings Cross	Welwyn Viaduct	Doncaster South
0812 (6 th path)	Green (In Dec 2005)	Green (In Dec 2005)	Green (In Dec 2005)

4.5 Other Issues

Further investigation of opportunities for paths

Given that Grand Central have indicated that they have very flexible requirements for paths and that they are a potential new entrant to the market, Network Rail has based further investigation of opportunities for paths on their

requirements in the first instance. Had this shown the existence of additional opportunities further work would have been needed in relation to the other applicants.

In investigating opportunities for paths, Network Rail has used the output from the constraints analysis at Kings Cross as the starting point. This approach, which is in accordance with the ThOC, has been discussed with Grand Central.

Section 4.2.7 demonstrates that (other than the HT 6th path) no additional peak services can be accommodated at Kings Cross. Therefore, only off peak arrivals at Kings Cross have been investigated.

In addition the following Grand Central suggestions have been considered:

- Use of 5 car 222s rather than HSTs. This has been taken forward.
- The potential splitting / joining of Sunderland and Bradford services at Doncaster. As discussed below, this has not been taken forward at this stage.

4.5.1 The splitting and joining of GCR services at Doncaster station.

GCR have suggested that one option would be for their Sunderland and Bradford services to combine at Kings Cross. This would meet the objective of 4 trains a day to London Kings Cross from both Sunderland and Bradford Interchange, but would mean that only 4 paths a day would be required on the very heavily used part of the route south of Doncaster. This would be repeated in the opposite direction with a 10 car 222 from London Kings Cross splitting into Sunderland and Bradford Interchange halves at Doncaster.

Although Network Rail is pleased that Grand Central are considering options that take into account the capacity issues on the ECML, Network Rail has not investigated this suggestion at this stage. This is for the following reasons:

- A key aspect of Grand Central's aspiration is its flexibility. However, this would be compromised if splitting and joining were to be factored into the plan. Clearly, there would need to be very rigid paths both north and south of Doncaster to ensure that the three legs linked together. This will be considerably harder to achieve than independent 'end to end' journeys.
- The analysis has revealed that Kings Cross platform availability is a key constraint for capacity on the East Coast Main Line. With 5 car 222s, Grand Central trains would have the options of platforms 1 to 11 as well as the potential to share a platform in the main train shed with Hull Trains. A 10 car 222 would be limited to the main train shed.

Even if these issues did not present such constraint factors it is clear (without full investigation of platform availability at Doncaster) that even if the Sunderland and

Bradford portions could be timed to arrive at Doncaster close together, there would be increased pressure on platform capacity at the station.

Network Rail has discussed these issues with Grand Central and agreed that for the moment 'end to end' paths should be pursued.

4.5.2 Identification of new GCR paths south of Doncaster

We have conducted the following work to attempt to find paths for Grand Central. This demonstrates that we have genuinely been trying to find paths for new potential entrants to the market. Whilst it shows some promise for future years it does demonstrate how difficult it is to find paths on the ECML.

This section describes potential Grand Central paths between Loversall Carr and London Kings Cross. A further step is required to assess the viability of a path from either Bradford Interchange or Sunderland that is able to link into these.

In developing these potential paths the following base assumptions have been adopted:

- The starting point in development will be availability of platforms at Kings Cross.
- Possible arrival times will then effectively be back timed to provide approximate times through the other constraints.
- These will then be linked together using the linking technique described above.
- If potential gaps cannot be linked together through the constraints (even assuming a limited amount of pathing time), the reason for this will be examined for potential remedial action.
- If necessary other gaps will be explored.
- This process will continue until either the number of paths that GCR have requested is achieved or all reasonable options have been explored.

In addition due to Grand Central's flexibility:

- The peak hours at Kings Cross will be avoided.
- The potential resourcing issue flagged up in section 4.3.2 will be set aside at this stage of investigations. Once the number of potential GCR services has been established then diagramming considerations will be looked at.

Network Rail believes that this approach is the best of way of identifying the implications of developing quantum aspirations of the type proposed by GCR.

Potential GCR Up paths between Loversall Carr and Kings Cross

These are the opportunities that have been identified to date. There is still quite a lot of work required to develop them into viable paths, in particular pathing time in addition to that suggested by the times given is likely to be required. As noted it is also not yet known whether these rough times can be linked to viable paths from either Bradford or Sunderland.

Path	Loversall Carr	Newark	Hitchin	Woolmer Green	Alexandra Palace	Kings Cross
1	0851	0908	1000.5	1010.5	1022	1030 approx
2	0933	0950	1053	1102	1112.5	1120 approx
3	1055	1112	1156.5	1210	1216	1230 approx
4	1133	1150	1254	1258	1309	1320 approx
5	1213	1230	1322.5	1328	1338.5	1350 approx

Current issues for the individual paths are as follows:

Path 1 (1030 arrival)

The work undertaken so far suggests that the earliest that a Grand Central train could arrive at Kings Cross is at approximately 1030. Grand Central have indicated that this would meet their aspirations.

An earlier arrival time of 1010 was investigated. However, this could not be made to work in the Newark area and would ultimately have led to a Central Nottingham – Lincoln service breaking its turnround at Lincoln. This would clearly not have been acceptable.

Loversall Carr to Stoke

Path 1 makes use of the gap between GNER's 0728 Harrogate service (1A15) and its 0600 Edinburgh service (1E02).

The GCR service needs to be at Newark North Gate at 0908 to avoid complications with Central's 0834 Lincoln to Leicester service.

Peterborough to Woolmer Green

Pathing time will be required in this section with the aim to follow WAGN's 0928 Cambridge to Kings Cross (1C71) across Welwyn Viaduct.

Woolmer Green to Alexandra Palace

GCR could make use of the gap between 1C71 and WAGN's 0859 Kings Lynn to Kings Cross (1T57). However, the gap disappears at Finsbury Park with 1C71 stopping there. GCR would therefore have to transfer to the slow line (note – it has not yet been established whether this could be achieved without a consequential impact on the following 1T57 nor how much time the GCR service would lose).

This would result in a slightly later arrival time at Kings Cross than 1030.

A platform at Kings Cross looks to be achievable through the replatforming of some WAGN services.

Path 2 – (1120 arrival)

The issues posed by this path provide another excellent example of the difficulties of identifying viable paths on the ECML.

Initially, the aim was to make use of the gap formed by GNER's 0749 Newcastle to Kings Cross service (1A17) and its 0905 Leeds to Kings Cross service (1A18). The presence of Central services at Newark Flat Crossing would need to be taken into account. Unfortunately, this then creates problems between Woolmer Green and Alexandra Palace as 1A17's stop at Peterborough leads to GCR's potential path clashing with a WAGN service.

Timing the GCR service earlier would make it clash with the path currently used as the Hull Trains 6th path.

The most effective way forward appears to be to use the gap between 1A17 and 1A18 between Loversall Carr and Stoke. GCR would then need to make use of the slow lines to pass over Welwyn behind 1A18. It should be noted that this might be difficult to achieve due to the presence of 4020 (GBRF's West Burton to Mountfield sidings).

Assuming that the above was solvable, the GCR train could share a platform with Hull Trains 6th path (the 0812 from Hull planned in December 2005 to use Platform 4 between 1051 and 1210). This is itself of course subject to the future use of the current Hull Trains 6th path.

Path 3 - (1230 arrival)

Loversall Carr to Stoke

This path would make use of the gap formed by GNER's 1005 from Leeds (1A21) and its 0700 from Glasgow Central (1E05).

Once again the time at Newark North Gate would be dictated by the presence of crossing movements at Newark Flat Crossing.

Woolmer Green to Alexandra Palace

The situation is similar to that for Path One, in that GCR would make use of the gap between two WAGN services (in this case 1C73 and 1T59). Again the gap disappears at Finsbury Park with 1C73 stopping there. GCR would therefore have to transfer to the slow line (note – it has not yet been established whether this could be achieved without a consequential impact on the following 1T59 nor how much time the GCR service would lose).

This would result in a slightly later arrival time at Kings Cross than 1230.

A platform at Kings Cross looks to be achievable.

Path 4 – (1320 arrival)

Loversall Carr to Stoke

This path makes use of the gap formed by GNER's 1040 Leeds to King's Cross service (1A22) and its 1105 Leeds to Kings Cross service (1A23). Again the time at Newark is determined by the presence of a Central service crossing at the Flat Crossing.

Peterborough to Woolmer Green

Pathing time would be required in this section to follow a WAGN service and this would mean the GCR service would cross Welwyn just in front of 1A23.

Woolmer Green to Alexandra Palace

The situation is similar to that of Path One in that this GCR path would make use of the gap between 2 WAGN but would have to transfer onto the slows due to the former service stopping at Finsbury Park. (Again it would need to be established whether this is feasible or not and how much later the GCR train would arrive at Kings Cross).

A platform appears to be available at Kings Cross.

Path 5 – (1350 arrival)

Initially, a path producing a 1410 arrival was looked at. However, this has numerous problems particularly with Freightliner's 0904 Leeds to Felixstowe service (4L85).

An alternative path giving a 1350 arrival was developed.

Although there would not appear to be a platform available in the main train shed at Kings Cross it looks as though a suburban platform could be made available.

Paths 6, 7 and 8

Additional paths between Loversall Carr and Kings Cross are still being looked at. However, it should be noted that at the moment Path 5 appears to be the last feasible additional arrival at Kings Cross prior to the end of the evening peak Beyond those already considered in the train by train analysis earlier. (However, note that GNER's proposed Leeds' services with 1700 and 1800 arrivals at Kings Cross have major issues themselves).

In the early part of the afternoon this is due to the volume of day time freight paths on the ECML. Later in the day the issue is clearly the impossibility of getting a viable path and platform in the evening peak.

It is likely therefore that Path 6's arrival time would be after 1830. Vossloh's work suggests the following target arrival times :-

Path 6	approx 1830
Path 7	approx 2050
Path 8	approx 2230

4.6 Initial conclusions from the timetabling work

It is possible to begin to draw conclusions about capacity on the East Coast Main Line and the services that the applicants have requested without further work. These can be divided into three types:

- Generic conclusions that apply to all aspirations for new paths on the East Coast Main Line.
- Conclusions that apply when an operator's aspirations are considered in isolation.
- Those that apply when the combined aspirations of the three operators are considered.

4.6.1 Generic issues

Each of the constraints identified is operating at or near capacity. It is not possible to find a path that is viable at each constraint for the services that the applicants have requested.

Adjustments can be made to a number of constraints that make the service viable at that constraint but not at each constraint required by a whole service. There is a single exception to this and that is the service that could constitute for example Hull Trains 6th path or GNER 8:40 ex Leeds.

- It is extremely difficult to find viable paths on the southern part of the East Coast Main Line. Four key reasons are:
 - 1) GNER's non-standard stopping pattern.
 - 2) The number of daytime freight paths.
 - 3) The need to allow for movements crossing the East Coast Main Line such as at Newark Flat Crossing and at Hitchin.
 - 4) WAGN's requirements which are rigidly defined in its Track Access Agreement.
- Although there are a number of constraints which determine the availability of capacity, the scarcity of platforms at Kings Cross is the key constraint.

4.6.2 Grand Central in isolation

Although it is believed that services to Kings Cross could be identified for Grand Central on the southern part of the ECML, they will have the following drawbacks:

- They will be subject to a considerable amount of pathing time.
- Only off peak arrivals are possible at Kings Cross.
- Even in the off peak, platform capacity at Kings Cross is very limited. In most cases either a viable down path following the minimum turn round would need to be identified or additional empty movements would need to be identified between the station and a suitable stabling point. As noted earlier, the latter approach would lead to even more competition for paths into and out of Kings Cross (and therefore this may not be possible).
- It is firmly believed that the type of service that could be developed would require significantly more resources than Grand Central have estimated.
- The effect of these services on performance would be detrimental as it would use valuable capacity which is currently used as contingency for operating in perturbed circumstances.

Although the down direction still needs to be considered, it is evident that similar issues to these described above will be encountered.

Although, the northern part of the ECML and routes to Bradford and Sunderland still need to be looked at, it is clear from the comments made by several of the consultees, the views of Network Rail's planning experts and the initial work that has been completed, that similar issues to those described above will be encountered.

It remains to be seen how much of a viable service could be constructed once all the constituent parts were linked together. However from this initial work, Network Rail does not believe that Grand Central's aspirations for December 2006 could be delivered.

4.6.3 GNER in isolation

There are significant issues with the majority of GNER's new paths.

There are a number of clear conflicts with freight services (particularly between Hare Park and South Kirby and between Loversall Carr and Stoke). It is apparent that some of these freight services have specifically made use of the gap produced by the absence of xx40 departures from Leeds during certain parts of the day. Now that GNER wish to fill these gaps, it is not readily apparent how all the freight services can now be accommodated.

GNER's proposed 0840 departure from Leeds clashes directly with Hull Trains 6th path.

GNER's non-standard stopping pattern in some cases cause problems.

There are issues with GNER's proposed 2007 diagrams due to the scarcity of platforms at Kings Cross. A solution involving the greater use of daytime empty movements between Kings Cross and Bounds Green is likely. However, although this may make the station itself work, it is clear that such an approach would place increased pressure on Kings Cross station throat and also reduce the number of potential paths for loaded services, resulting in no net usable capacity gain.

At the moment Network Rail does not believe that GNER's aspirations can be delivered in their entirety.

4.6.4 Hull Trains in isolation

As noted previously, Hull Trains' aspirations are already included in the December 2005 timetable.

4.6.5 The three aspirations considered together

From the work undertaken to date, it is clear to Network Rail that there is no possibility of identifying 14 additional paths in each direction which meet the aspirations of GNER and Grand Central. Although a stated objective has been to keep the 'flexible' Grand Central paths away from the 'rigid' GNER paths, this has proved virtually impossible. The requirement to accommodate freight and the

amount of platform capacity required at Kings Cross to meet just minimum turnrounds, means that services that have been planned apart are still likely to be in competition with each other. As noted above, the issues with GNER's diagrams means that there is likely to be further competition between loaded and empty paths.

Finally, although Hull Trains 6th path is included in the December 2005 timetable it can be seen that in the up direction it directly clashes with one of GNER's aspirations.

5.0 Capacity versus Performance

Where a service through a constraint is not considered viable for performance reasons the following logic has been applied.

5.1 Constraint Capacity Curves

Constraints have a theoretical capacity (they are operating at less than 100% capacity at some times of the day). However it is necessary to consider the operation of the whole day to determine whether using this theoretical capacity poses an acceptable performance risk.

A Constraint Capacity Curve can generally be constructed for the existing operation of a railway constraint as shown throughout this report.

The Constraint Capacity Curve is formed by the interaction of a large number of variables over a long time and generates a PPM figure that is empirical fact. There is a correlation between the area under the curve and performance. The area under the curve can be measured using Capacity Utilisation Index and the performance can be measured using Public Performance Measure or industry delay minutes, or the ratio of primary to reactionary delay. Including additional services (therefore increasing the capacity used) will tend to reduce the performance characteristics of the constraint.

The shape of the curve is important too. We tend to operate at or near capacity in peak times. Off peak times should be allowed to operate at well below full capacity to act as a contingency for incidents. As a general rule, after each peak there should be a trough of at least equal dimensions. This is so that if an incident occurs at the beginning of the peak the whole service which is likely to be on the move or ready to move can get to destination.

Ideally there should be a fire break after this trough. This is so that the service can be re-positioned in time for the next peak operation.

6.0 Additional points for consideration

Version 3
19 December 2005

A number of issues have been raised by industry stakeholders and are detailed below. These issues have either been directly addressed in this report or have provided guidance for the process of evaluating capacity.

**EAST COAST MAIN LINE APPLICATIONS – CONSULTATION
RESPONSES/ISSUES
CAPACITY, PERFORMANCE AND RELATED ISSUES ONLY
RESPONSES TO GRAND CENTRAL APPLICATION**

CAPACITY AND PERFORMANCE	
CENTRAL	
The ECML has a number of critical points where additional services cannot be accommodated without importing substantial performance risk, or where ROTP requirements will need to be substantially infringed to permit the additional access. The most obvious example is the flat crossing at Newark, and the impact that ECML services have on Central's Nottingham – Lincoln services, with pathing time inserted into the latter to accommodate services on the ECML	ThOC is designed to evaluate these critical points. See 4.2.6.1
EWS	
EWS notes with concern that Network Rail states that its high-level timetable evaluation has revealed conflicts with existing freight slots	Agree
FREIGHTLINER	
We are concerned at the potential impact the proposed additional trains might have on our services - particular concerns are the routes between Wakefield and Doncaster (South Kirkby to Hare Park) and Northallerton and Sunderland (with a number of long signalling sections)	See Section on Hare Park constraint See 4.2.5
GNER	
Capacity is unlikely to be available to deliver GNER's franchise commitment for 12 additional Leeds services and GC's aspirations	Agree
Delivery of the third hourly Leeds service depends upon a regular interval timetable, use of the newly electrified route and operating trains through Leeds. GNER does not consider capacity would exist for GC's aspirations as well as the regular interval five GNER trains/hour south of Doncaster	This is largely correct. It is very difficult to find a path while keeping the GNER pattern the same. Particularly with respect to longish turnaround times.
GNER is concerned that a further operator on the ECML will import a performance risk to all existing operators on the route	There is additional performance risk. The issue is a matter

	of judgment in how much extra capacity can be delivered while maintaining performance improvement
HULL TRAINS	
Hull Trains said that it has considerable experience in trying to find paths at the southern end of the ECML. We feel that some of the paths are over ambitious and will be very hard, if not impossible, to achieve	It is indeed very difficult
Hull Trains has attempted on several occasions to secure an additional northbound slot to fill the substantial gap between GNER's through service at 1720 and the next Hull Trains service at 1934 to meet known demand and customer feedback. This has hitherto been rejected by Network Rail on the grounds that overall route performance would be significantly affected	Performance is an issue but so is capacity.
We would also like to understand more of how trains are going to be stabled and accommodated in the London area as this has been a major issue for Hull Trains	Out of scope
Our final concern is over the performance impact. To make this service work, even by flexing, seems to lead to undue forcing of paths	Noted
LTUC	
LTUC has no objection providing it does not prejudice the possibility of both peak and off-peak stopping trains on the KX/Moorgate – Welwyn Garden City and KX/Moorgate – Hertford North routes being increased to regular interval 4 trains/hour medium term and 6 trains/hour longer term	See section 1.2.1
LTUC has no objection providing it does not impact on existing WAGN or GNER services nor prejudice the possibility of an increase in the number of calls at Stevenage to one every two hours to Scotland and one every two hours to Leeds	See section 1.2.1
LTUC has no objection providing no rights are granted which limit existing operators' use of the Hertford loop when the main line via Welwyn is closed	Diversions routes not considered thus far. routes not considered this far.
NEXUS	
As experience has shown, perturbation on the Network Rail network has the ability to impact on the Metro network. To address this a new timetable for December 2005 has been devised removing one Northern service/hour and creating a regular interval Metro service of up to six trains/hour. Nexus is concerned that any rights	a) they do. To operate a Sunderland service GCR would have to obtain a flex in the Sunderland

granted to GC do not: a) impact on its ability to operate a regular interval service; b) result in a loss of operational flexibility in the Sunderland area; c) impact adversely on performance; or d) reduce the robustness of the Metro timetable	Metro service. b) there would indeed be a diminished operational flexibility. c) would increase performance risk slightly d) see c) above
The use of the Sunderland – Pelaw Junction section to reach Tyne Yard for maintenance has the potential to reduce the regularity/robustness of the Metro timetable	See above
NORTHERN	
There are several route sections and bottlenecks which are already near capacity and whilst additional paths may be available on the graph, any late running of GC trains could have a disproportionate effect on our services	Agree
Sunderland – the intended turnaround of 30 minutes would be consumed almost entirely by the ecs moves to/from Ryhope Grange Sidings, leaving no time for a driver's break, re-stocking of catering or a performance buffer. If the down train arrived late it would have no time to go to the sidings, aggravating the situation further	Agree
South of Sunderland there is only capacity for three trains/hour between Dawdon and Hartlepool, two-thirds of which is consumed by Northern's hourly service to Middlesbrough and an hourly freight path, so that on the hours that GC trains ran, the remaining capacity would be used up and any delay between London and Hartlepool or late start from Sunderland would have a serious knock-on effect	Partially agree – See []
All Bradford services reverse at the station and cross the slow-speed two-track Mill Lane Junction where, apart from capacity issues, infrastructure failures are fairly common. Mixed quality of track between there and Dryborough Junction at Halifax, raises the possibility of class 67 speed restrictions, and perturbation is a major risk with any delays to Northern services spreading far afield	Not done Bradford yet
Doncaster station is congested and additional GC services would add significantly to the conflicts with services travelling into and across Doncaster from other directions	Partially agree
SRA	
The Leeds services that GNER is contracted to provide are a better use of capacity since they will increase the	A matter for the Economic analysis

number of trains and provide more seats on one of the fastest growing routes in the country	
We question the operational feasibility and potential performance impact of GC's plan, especially the requirement to join units at Doncaster, a practice which is highly likely to consume capacity at this key ECML node. In developing the ECML Review, the SRA assessed and ruled out splitting and joining services at Doncaster on capacity, performance and safety grounds	Network rail does not believe that splitting and joining should be permitted at Doncaster.
Capacity on the ECML is at a premium – especially south of Doncaster. Because of conflicts with existing services, flexing of GC's requested paths is likely to lead to increased journey times making the service less attractive to potential users	Partially agree
The SRA referred to the paths requested into/from KX during the morning and evening peaks and Network Rail's indication that additional services in the peak may necessitate additional infrastructure	This is correct at the peak o the peak. Other solutions than infrastructure are available. Eg shorter turn round times at KX
Our analysis indicates that there will be specific problems in the hours when Hull Trains already operate as this would require six paths and we believe there would be significant pathing problems for both GNER and freight	Hull Trains 6 th path introduced in December 2006 timetable.
Given the [likely] increase in journey times, it is likely that the turnaround times of 30 minutes will be unachievable. It should be noted that this breaches the current minimum turnaround times at these stations	No proven increased in journey times.
TPE	
TPE's own planning and timetable experts have been unable to construct a timetable in accordance with the Rules of the Plan that avoids any conflict with other existing services. TPE believes this to be a clear indication that there is insufficient capacity to accommodate the rights sought by GC alongside the rights of existing operators	Agree
The route between Mirfield and Heaton Lodge Junction is particularly congested and the slightest delay tends to cause significant knock-on effects. Additional services will exacerbate this problem still further	Probably agree
TPE is particularly concerned over the capacity between Northallerton and York as GC services would be routed over the slow lines at Thirsk, where capacity is already limited by freight trains using these lines. Additional services will reduce operational flexibility and increase the	Probably agree

likelihood of knock-on delays to TPE and freight services	
Platform capacity at York and Doncaster is already limited. TPE is concerned that the addition of GC services calling at or passing through these stations will increase the risk of delay and exacerbate delay in the areas during times of perturbed working	Partially agree
TPE is concerned over the capacity and infrastructure maintenance implications of additional ancillary movements and stabling demands on the network	May be an issue
TPE is concerned the GC proposals will increase the performance risks and present further challenges to minimising the time taken to recover from performance failures	Agree
WAGN	
We believe there is no platform capacity at KX for the 6:00 ex-Sunderland/10:00 return and 14:00 ex-Sunderland/18:00 return, and no paths over the Welwyn viaduct for the 06:00 ex-Sunderland and 18:00 and 18:45 ex-KX	see Section 4
We see the introduction of additional services on the route as posing a real threat to the recent recovery in performance	There is a risk to performance
Half an hour turnaround times present a considerable risk of reactionary delays and breach the current Rules of the Plan at both ends	They do breach Rules of the plan but 30 min turnaround times are not uncommon in other stations receiving long distance trains
There is no mention of contingency planning or arrangements for rescue and recovery, particularly what arrangements would apply for using the Hertford Loop for diversions and the impact on Wagn services	No addressed in analysis
WYPTE	
We are concerned that track and signalling capacity is limited on some sections and would not wish granting rights to GC to compromise clockface operation of regular franchised services	Noted
We are working with the franchised operator to develop local services, particularly along the Calder Valley corridor, including a new station at Low Moor between Bradford and Halifax, and would not want the presence of GC to hinder improvements to franchised services in an area of increasing demand for local travel	Noted
WHITE SPACE	
EWS	

EWS will require from Network Rail an analysis of the effect of these proposals on the white space for freight growth	See section 7.6
OTHER RELATED ISSUES	
CENTRAL	
Flexing of Central's rights may have adverse impacts – especially on rolling stock and crew turnrounds	Not proposing to flex Centrals rights and the
NORTHERN	
Sunderland sub-surface station is fitted with a fire alarm which would almost certainly be set off by two power cars standing for more than the minimum dwell time	Not proposing to stand at Sunderland
TPE	
TPE expressed a number of concerns about the risks of having a small fleet in terms of proposed recovery arrangements, potential non availability of sufficient sets and the reliance that may be placed on other operators' services in such situations	Agree

RESPONSES TO GNER APPLICATION

CENTRAL TRAINS	
Central Trains said that as it had previously pointed out in its consultation response in respect of the application by Grand Central, it was evident that the ECML had a number of critical points where additional services could not be accommodated without importing unacceptable performance risk, or where ROTP requirements might possibly need to be infringed to permit additional access. This might be in addition to any flexing of the firm rights of incumbent operators required to accommodate the proposed new services. It continued by saying that Central had concerns at three specific locations: • Peterborough, and specifically the pathing of services calling on the island platform 4/5; • Grantham: the ability of its Norwich – Liverpool service to traverse the two track section through Stoke Tunnel and for eastbound trains to cross the down ECML line on departure from Grantham; and • Newark Crossing: the impact of additional high-speed services on the ECML upon its Nottingham – Lincoln service.	Refer to GCR answer
EWS	
EWS advised that the ECML is heavily used by freight traffic and is extremely congested. It would therefore need	As above

to give very careful consideration to the GNER proposal to operate a significant number of additional high-speed services until it was in a position to examine: • whether or not the proposal would result in any consequential adverse effects on EWS's own services; • whether the proposal resulted in Network Rail refusing to accept EWS's requests for an additional two services each way per day on the ECML between Lackenby and La Louviere in Belgium, Network Rail having advised that it would not be in a position to reply to EWS's bid until later; and • whether acceptance of the proposal would result in the exhaustion of the remaining "spare" capacity over the ECML which was suitable for throughout freight paths. EWS added that it noted with concern some of the comments in Network Rail's representations of 24 May 2005: • the desire by GNER to form a half-hourly pattern created a further capacity constraint, leaving no capacity for additional traffic, including short term freight traffic; • the previous "high-level" timetabling analysis carried out by Network Rail on earlier proposals assumed that certain capacity enhancements would be available and it was not clear whether enhancements would also be required to accommodate the proposed GNER services; and • the previous "high-level" exercise had highlighted between 50 and 60 existing services that would need to be altered to accommodate the proposed GNER services, and this analysis did not examine the effects of these alterations or the off-route implications for any freight services that were identified as needing to be altered.	
GRAND CENTRAL	
Grand Central re-iterated its view that with a more focused approach by all parties, sufficient capacity could be identified to satisfy almost all operator aspirations. In Grand Central's view when a standard hour timetable is introduced performance improvements will follow, whoever operates the services.	Do not agree
Whilst accepting that all rolling stock conforms to 125 mph operation, it is also clear that HSTs in 2 + 9 formation have difficulty in maintaining running times, and import a performance deterioration to the network. With their new Yield Management System in place, Grand Central believes that GNER should be in a position to "spread the load"	No addressed in analysis

more evenly, and consequently HSTs should be re-configured to their 2 + 8 formation to improve performance across the ECML and therefore increase access opportunities for others.	
Many of the additional services are proposed to operate with electric traction, with increased services in the peak. Network Rail advise that the electrical supply system at the south end of the route is at capacity at these times, so it is unclear as to how the timetable can be achieved, and how any improvements to supply will be funded. A balance may be made with the withdrawal of the "Eurostar" sets but no detail is offered.	As above
With a large fleet of diesels coming off-lease, it would not be too difficult to offer services into Leeds from the east without electrification	Noted
The Leeds horseshoe project pre-supposes that capacity can be found from Micklefield to Leeds. Grand Central has previously been advised by Network Rail that the eastern arrivals at Leeds is at capacity	Not addressed in the analysis
HULL TRAINS	
Hull Trains expressed the view that the electric horseshoe proposals were superfluous and had not been tested in terms of an overall ECML or Midland Main Line strategy. It believed that there was considerable merit in Leeds having a third London service on the M1 corridor, via the MML. Hull Trains wished to see the GNER proposal for three London trains an hour via the ECML tested against the long term aspirations of the North East, Lincolnshire, MML corridor and Humberside but not "piggy backed" by stealth onto another approval.	See Section 7.7
MDS TRANSMODAL pp ALCONBURY DEVELOPMENTS	
MDS Transmodal Limited (MDS) responded on behalf of its client, Alconbury Developments Limited (ADL). It advised that ADL had received planning consent to develop a rail linked distribution park at Alconbury in December 2003, and said that Network Rail would be aware that in September 2003 its parliamentary agents wrote to the Secretary of State confirming that its previous commitment to facilitate 20 freight paths per day to Alconbury (and 20 departing) still remained. This undertaking was critical in the Secretary of State's decision to grant planning permission and a TWA Order as the planning conditions included a stringent cap on the volume of HGVs that could enter the development by road. MDS said that its analysis of track capacity on the ECML led it to believe that [If ORR approved] the additional paths	See Section 7.6

being sought by GNER it would mean that Network Rail could not fulfil its undertakings to the Secretary of State. It was concerned that there was no mention in Network Rail's representations of 24 May 2005 of the impact that GNER's proposals would have on the <u>additional</u> freight capacity which Network Rail had undertaken to provide for the Alconbury development. It appeared to MDS from Network Rail's observations that these had not been taken account of and, indeed, Network Rail would find it difficult to fulfil these undertakings if any additional passenger services were provided on the ECML, whether these were through the new GNER franchise, from Grand Central or Hull Trains. It added that evidence was given by the SRA at the Bathside Bay and Felixstowe South inquiries in 2004 (based upon Network Rail analysis) that an additional 12 freight paths per direction could be made available between Peterborough and Doncaster and no mention was made in Network Rail's representations of the impact on the ECML if either of these high profile port developments was granted consent	
Northern	
Northern is concerned at the additional pressure these services would put on the Doncaster station area, whether they call there or not, and the increased risk of Northern's stopping services between Sheffield/Doncaster and Leeds being routed via Hemsworth loop to allow overtaking, both on a planned and unplanned basis. Northern is also concerned that in its comments about power supplies, Network Rail had not mentioned the route between Loversall Carr junction and Leeds, and seeks assurance that Network Rail does not foresee any such problems as a result of the enhanced frequency.	Agree
RPC East Coast Passenger Panel	
Despite the great improvements following the rebuilding of Leeds station to increase capacity and reliability, it is understood that the rebuilt station is already being used at a level close to its capacity and there is not much opportunity to introduce new services. If that is the case it should be determined whether or not additional services to London are the best use of what capacity remains	WAGN services remain unaltered
Additional access rights should be granted only provided that there is no undue adverse impact on existing services on the route in question or on any connecting line. This is most important on the southern part of the route where there should be no diversion of WAGN trains from the fast	Noted

to the slow lines unless that can be done without any reduction of services or extension of existing journey times	
ORR should also take into account the need in the medium to long term to increase the frequency of both peak and off peak stopping services between Kings Cross/Moorgate to Welwyn Garden City/Hertford North, eventually to six trains per hour and ensure that no restriction is placed on WAGN's use of the Hertford Loop at times when the line via Welwyn was closed. Opportunity should also be taken to reorganise GNER's calling pattern at Stevenage. Present calls for both Leeds and Anglo Scottish services should continue, but additional calls need to be added to ensure the provision of no less than a two hourly service throughout the day, every day of the week on each route.	Noted
The SRA	
The SRA confirmed that it had contracted with GNER to provide the additional services from the PCD 2007 or earlier and that they contributed materially to the £1.3 billion premium that GNER had agreed to pay the SRA over the life of the franchise. In respect of Network Rail's representations of 24 May 2005 the SRA said that it had liaised closely with SAP in developing the specification for the ICEC franchise and that these services were entirely consistent with that specification. Also, Network Rail was closely involved in the evaluation of the franchise bids and conducted an evaluation of GNER's timetable proposals to validate whether they were deliverable. Network Rail said that additional infrastructure (in addition to the Peterborough – Werrington bi-directional signalling and Allington Chord schemes) might be required to enable the additional Leeds services to operate. In the SRA's view, this is not the case for two reasons: • the additional platform at Finsbury Park is only required to facilitate additional primarily commuter peak services, and none of the additional services proposed by GNER operate during the peak; and • the need for Platform Y at King's Cross has been obviated by the simplified fleet that GNER will be operating from December 2005; in particular, the capacity constraining Eurostar sets will no longer be operated. It should be noted that the SRA would not have contracted with GNER for the additional Leeds services if it believed that they would be undeliverable or that additional infrastructure works would be required to ensure their	Noted Network Rail believes that additional infrastructure may well be required to deliver the additional Leeds services

delivery.	
SYLTE	
SYLTE would wish to understand the likely impact on its services that either pass through, terminate at or start from Doncaster and those using the route between South Kirby junction and Leeds, both in terms of journey opportunities and performance	Noted
TPE	
TPE is concerned that GNER's proposed additional services would adversely affect TPE services where they interact at Doncaster and Leeds and wishes to understand more fully the likely impact on its services, principally as network capacity at these locations is already significantly constrained. It is particularly concerned that they would: • have a detrimental effect on operational performance at Leeds and Doncaster where route and platform capacity is limited; and • require Network Rail to flex TPE services beyond current flexing rights and undermine TPE's even interval and standardised timetable and seeks assurance from Network Rail that there would be no material effect on TPE's services or on its contractual rights	Noted
Wagn	
Wagn raised two particular capacity/performance issues: • Capacity – it notes that Network Rail conducted a capacity assessment of the infrastructure on the route in connection with the introduction of a half-hourly Leeds service and concluded that certain enhancements would be necessary. Three of the items - signalling alterations at Peterborough and new platforms at Finsbury Park and King's Cross - are in Wagn's area, and Wagn believes that none of these will have been commissioned by the start date of the proposed new services; • performance – Wagn's performance had seen a marked improvement over the previous few months through management action taken both by Wagn and Network Rail, and the introduction of additional services on to the route at this stage could pose a real threat to this recovery. Of particular concern are the pinch points of Welwyn Viaduct and the throat of King's Cross station	Agree Noted

RESPONSES TO HULL TRAINS APPLICATION

EWS	
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EWS said that it had no comments or objections to raise in respect of the proposed agreement when considered in isolation, but would be concerned if ORR's conclusions on the three applications resulted in an outcome which exhausted all remaining "spare" daytime capacity suitable for freight on the ECML south of Doncaster.	See 7.6
TfL LONDON RAIL	
TfL London Rail advised that it had no objection provided that the proposed changes do not impede the future development of improved suburban services on the Great Northern route	Noted

RESPONSES IN RESPECT OF ALL THREE APPLICATIONS

EUROSTAR (UK) LIMITED	
Eurostar said that it would seem prudent to remind all parties that Eurostar's track access rights from Mitre Bridge Junction to, and on, the West Coast Main Line and ECML are only suspended until the Commencement Date of the Summer 2007 timetable	Noted
HUTCHISON PORTS	
Hutchison Ports (UK), which is in discussions with Network Rail with a view to submitting to ORR an application for a track access option to support its proposed port developments at Felixstowe South and Bathside Bay, questions whether approval of the applications risks hindering its ability to move freight on the ECML and conclude a meaningful track access option. It said that it understands from SAP that timetabling future freight movements beyond Peterborough on the ECML is problematic as the network is constrained on this section	Noted

7.0 Conclusions

These conclusions are structured to answer the seven requirements stated in Section 1 (Introduction) of the report.

7.1 The extent to which Network Rail can satisfy the requirements of all applicants

As detailed in Section 4, there is insufficient capacity to satisfy all the stated requirements of all of the applicants. i.e. 15 extra paths per day.

Furthermore, there is insufficient capacity to satisfy all the stated requirements of GNER and Grand Central Railway. Hull Trains' sixth path can be accommodated or replaced with the GNER 8:40 ex Leeds or a GCR path yet to be defined serving Sunderland or Bradford.

7.2 Whether (and to the extent to which) the introduction of the proposed new services would require the variation of existing paths or restructuring of the timetable, or could only be achieved if existing access rights were changed.

To introduce the applicants' services it would be necessary to alter the access rights of operators whose contracts continue beyond December 2006 (Freight, Eurostar) and do further analysis on the possibilities that could arise by changing the current WAGN quantum and calling patterns. Taken together, these rights effectively set the pattern for the timetable. With this pattern set the analysis shows that any contract compliant re-cast will not deliver an increase in capacity. It is only possible to replace existing Hull Trains or GNER services, whose access rights expire in December 2006, with services from another company for which there is found to be a better economic case.

Hare Park would require a removal of freight services to provide capacity for the extra GNER services to Leeds. The freight operators have contractual rights, which are taken as those expressed in the current Working TimeTable, Network Rail cannot sell additional rights that would conflict with these pre-existing rights.

7.3 The likely performance effects of changes to the timetable

The analysis shows that none of the existing proposals is viable with the exception of the path currently being used as the Hull Trains 6th path. Network Rail will fully model the performance effects of any new service prior to implementation of the new timetable.

7.4 Differences in the use of capacity in peak / off peak times

There are peak hour constraints due to current use of capacity involving the Welwyn Viaduct (section 4.2.6) and Kings Cross (section 4.2.7).

7.5 Operational issues such as train splitting and different types of rolling stock (and other signaling issues) which have become apparent from the operators' applications

As a rule it is considered that splitting and joining represents poor operational practice and a significant performance risk. For these reasons, while there is strictly no safety case objection to this, it is not something we would normally encourage or seek to extend. We comment in section 4.5.1 as regards suggested splitting and joining at Doncaster. As regards different types of rolling stock, GCR's change of proposal stock from HSTs to 222s would enable shorter turnrounds (see section 4.3.2, Grand Central resources).

7.6 The effect of any additional passenger services on existing freight capability and on the potential for freight growth (taking into account known development proposals)

The current operation of the East Coast Main Line during the day is at nearly full capacity in some sections and includes significant freight services. Introducing additional passenger services would fill it to capacity and mean that there effectively would be no capacity for further freight growth. Therefore freight growth that required traversing over the East Coast Main Line would be negatively affected. It is envisaged that it will not be possible to path any additional freight over the East Coast Main Line beyond current 2005 levels.

7.7 The implications for the proposed Leeds Horseshoe project

The analysis shows that the route from Doncaster to Leeds via Hare Park is already filled to capacity. Therefore another route such as the "Electric Horseshoe" is the only feasible way of accommodating the desired capacity growth. The analysis has not looked at the proposals in detail to determine whether the project would definitely make it possible to deliver the extra capacity for the additional half hourly services to Leeds. Given the lack of capacity on the southern end of the ECML, this presents considerable difficulty for the services that would expect to use such as an 'electric horseshoe'.

7.8 Caveats

7.8.1 Down direction

The analysis has not considered the down direction in detail. As the analysis has shown that few services are viable in the up direction, to analyse the down direction would add little value.

7.8.2 Weekend services

Work on weekend services has not taken place in detail. As the weekend timetables are less congested it is probable that capacity is available in pure train service terms. However there is a much higher demand from engineering work at weekends, particularly with the asset condition at present, which cannot be reduced, at least in the short term.

The analysis has been based on the necessity for an operator's service to be viable in its entirety (i.e. for the whole week) for it to be able to be considered for operating at weekends.

7.8.3 The effects on diversionary routes have not been considered.

7.8.4 The effects of the Resilient Timetables Programme (RTP) have not been considered. We believe that the RTP is unlikely to generate more capacity.

8.0 Summary

Network Rail has developed a methodology to determine accurately whether capacity exists and expose all of the issues pertaining to the ability to use any available capacity. Network Rail has used its expertise to explore solutions for each of the issues.

Each of the constraints on the East Coast Main Line is operating at or near capacity. Where the constraints are operating at near capacity, the analysis has considered pathing the services requested through the constraints. In all but one case it is not possible to path through each of the constraints to create a viable service.

Network Rail has also actively explored adjustments to the requested services in an attempt to get them to be viable and has tested these against the methodology. It can thus be concluded that based on the analysis and the given assumptions there is insufficient usable capacity on the East Coast Main Line that meets the service aspirations of the applicants or minor variations of them.