NORTHAMPTON GATEWAY
STRATEGIC RAIL FREIGHT INTERCHANGE

RAIL STATEMENT OF COMMON GROUND BETWEEN THE APPLICANT AND NETWORK RAIL

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The Northampton Gateway Rail Freight Interchange Order 201X

RAIL STATEMENT OF COMMON GROUND BETWEEN
THE APPLICANT AND NETWORK RAIL | 6 NOVEMBER 2018

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ROXHILL

STATEMENT OF COMMON GROUND IN RESPECT OF THE PROPOSED NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE

Parties

1. This statement is agreed between:

- Roxhill (Junction 15) Limited ("Roxhill"); and
- Network Rail.

Scope

2. This statement deals with the following matters in respect of the proposed development of a strategic rail freight interchange (**SRFI**) known as Northampton Gateway (**NG**):

a) The support in principle of Network Rail for the growth in rail freight.
b) The extent and nature of the engagement to date between Roxhill and Network Rail
c) The technical work that Roxhill and Network Rail agreed be undertaken in order to inform an agreed statement
d) The conclusions of the technical work in relation to:
    i. the acceptability in principle of the physical infrastructure and its connection to the Northampton Loop Line; and
    ii. the capacity of the strategic rail network to accommodate the train paths required by the proposed development as it develops.
e) The further steps to be taken if the DCO is approved in order to deliver the rail infrastructure.

3. Attached at Appendix 1 to this statement is an explanation of how train paths are allocated which has been agreed between the parties and which it is thought might be helpful for the Examining Authority.

4. This statement deals with agreement between the parties on the basis of the proposals put forward by Roxhill, being a stand-alone scheme and not in conjunction with the proposals being advanced to the west of the Northampton Loop Line, known as Rail Central. Nothing in this statement can be applied, or be taken to have any relevance to, a scenario involving the Roxhill scheme being developed at the same time as, or in conjunction with, Rail Central.

i Background Documents

5. The following documents have informed this statement. Where indicated with an asterix the documents accompany this statement. Where indicated with a hashtag the documents were submitted with the application:

- Network Rail Freight Market Study 2013
- National Policy Statement for National Networks 2014
- Department for Transport Rail Freight Strategy 2016
- Network Rail Freight Network Study August 2016
- Department for Transport High Level Output Statement July 2017

- Network Rail Northampton Loop Capacity Report September 2017 *
- Victa Railfreight West Coast Main Line Capacity Report 2017 (Document 6.7)#
- GB Railfreight Capacity Report for Northampton Gateway 2018 (Document 6.7)#
- Network Rail Freight and National; Passenger Operators Strategic Plan February 2018 (Extract)
- Northampton Gateway SRFI – Feasibility Report Completed GRIP 2 Report*
- Northampton Gateway Freight Timing Report (the Railsys report)*
- GBRF Sample Northampton Gateway Services (Down trains) and GBRF Sample Northampton Gateway Services (Up trains) Reports and Northampton Gateway Chart
- Railway Plans
    - General Arrangement NGW-BWB-RGN-XX-DR-C-00110-P6
    - Long Sections NGW-BWB-RGN-XX-DR-C-00111-P4 and 112-P4
    - Cross Sections NGW-BWB-RGN-XX-DR-C-00113-P4
- Bridge Plans
    - General Arrangement NGW-BWB-RGN-XX-DR-C-00110-P6 – Doc 2.9A (APP-061)#
    - Long Sections NGW-BWB-RGN-XX-DR-C-00111-P4 and 112-P4 – Doc 2.9B & C (APP-062 &APP-063)#
    - Cross Sections NGW-BWB-RGN-XX-DR-C-00113-P4- Doc 2.9D (APP-64)#

ii Network Rail support for Rail Freight

6. The National Policy Statement for Networks (NPSNN) confirms that the unconstrained rail freight forecasts produced by Network Rail are considered robust and are accepted for planning purposes (para 2.49). The NPSNN also confirms that the Network Rail forecasts demonstrate the need for an expanded network of large SRFI's across the regions to accommodate the long-term growth in rail freight (para 2.50).

7. Network Rail agrees with the need for additional SRFI to encourage and facilitate a greater modal shift from road to rail. This will assist the economy by alleviating road congestion enabling the logistics industry to be more efficient and productive. Modal shift also assists the UK in meeting its carbon reduction targets making economic growth more sustainable.

8. Network Rail has heavily invested in enhancing the freight capability of the UK rail network to facilitate intermodal freight growth by rail. Network Rail is required by the Secretary of State for Transport (in his High Level Output Statement July 2017) to have regard for growth of the rail freight sector and Network Rail views the intermodal market as one of the key sectors which is driving rail freight growth and resultant modal shift from road to rail. This is in accordance with the Freight Network Study produced by Network Rail in 2016 and the Freight and National Passenger Operators Route Strategic Plan published by Network Rail in 2018 (the 2018 Strategic Plan).

9. The 2018 Strategic Plan is a five year plan for Control Period 6 – which is 1 April 2019 to 31 March 2024. It is subject to consultation and approval by the Office of Rail and Road during 2018 with the final plan being due for approval in October 2018.

10. The 2018 Strategic Plan *"sets out the first stage of a longer- term vision to facilitate significant rail freight growth over the next fifteen years"* (Foreword, page 3). The plan sets out a route strategic plan for all routes. The relevant route for the purposes of NG is LNW (London North West). This area basically covers the extent of the West Coast Main Line. The route plan states that Network Rail plans to *"Facilitate new terminal developments at Daventry, Northampton, West Midlands and Parkside"* (page 121).

11. Network Rail is therefore supportive in principle of the development of additional SRFI provision at Northampton.

iii Engagement between Roxhill and Network Rail

12. Discussions between Network Rail and Roxhill commenced at the time of early development of the scheme, in 2016. Following initial discussions it was agreed that various work streams be undertaken, some directly by Roxhill and some by Network Rail, funded by Roxhill.

13. During the process Roxhill and Network Rail have entered into three Basic Asset Protection Agreements (BAPA), one relating to the rail terminal and its connections to the Northampton Loop Line (recently expanded to include the funding of pathing and capacity work), another relating to the Roade Bypass overbridge (where the new Roade Bypass spans the West Coast Main Line) and a third relating to the production of the report referred to in paragraph 5 above titled Network Rail Northampton Loop Capacity Report September 2017.

14. Technical engagement to GRIP 2 level in relation to rail connections has focused on the following areas:

a. positioning of the terminal relative to the Northampton Loop Line and West Coast Main Line as part of the Strategic Freight Network;
b. specification of the terminal connections to the main line;
c. capability of the terminal to handle the projected volume of rail traffic; and
d. the ability of the rail network to accommodate the projected quantum of freight train paths associated with the terminal

15. This technical engagement has included consideration of the main line connections, and the track layout servicing the intermodal and rapid rail freight terminals, and the connections to the rail connected warehouses. Network Rail appointed a Sponsor to oversee the development of the SRFI and its connection to the national rail network. The dialogue with Network Rail's Sponsor and the technical teams supporting her has continued on a regular basis.

16. Engagement between Roxhill and Network Rail has allowed Network Rail to provide a constructive input to the proposals at their critical formative stage.

17. The technical work is described below.

iv Technical Work

18. The detailed design of the Roade bypass overbridge is being developed in conjunction with Network Rail. The designs shown on the Bridge Plans referred to in Paragraph 5 have been developed to the satisfaction of Network Rail. Following development consent from the Secretary of State for Transport Roxhill will be responsible for producing detailed designs for the overbridge, which Network Rail will need to approve in terms of both the design and the implementation methodology. This detailed design approval will be governed by the existing BAPA.

19. During 2016 Roxhill formulated an initial track layout design for the SRFI for consultation with Network Rail. A series of meetings was held with Network Rail's Sponsor and the Network Rail Infrastructure Projects team in 2017. These discussions focussed on the most efficient way of delivering the design and specification of the connections.

20. At a meeting between Roxhill and Network Rail on 10 November 2017 it was agreed that further technical work should be undertaken to enable Network Rail to assess the acceptability of the proposals, being:

   i. permanent way (track) proposals for the main line connections
   ii. signalling proposals for the main line connections from the Northampton Loop; and
   iii. report on the implications of i and ii for the internal layout design
   iv. preliminary concept design work

21. This work has all been completed, and a GRIP 2 Feasibility Study has been completed.

22. Further work has been undertaken by the Applicant on the request of Network Rail to consider and evaluate the speed of connections into and out of the Northampton Gateway terminal from the Northampton Loop line. Until this work has been verified by Network Rail, Network Rail cannot confirm that the connection speeds to the rail network as proposed are viable. The results of this work also have a bearing on Network Rail's assessment of capacity on the network to accommodate the SRFI, as we explain further below.

23. As is usual, post approval, additional work beyond GRIP 2 level will be required to develop the physical design of the connections to the network leading to construction and commissioning and this is referred to in section vi below.

Capacity

24. Various capacity studies have been undertaken, as we describe below. The results of these studies confirm that there is sufficient capacity for the SRFI to operate up to 4 paths per day at the proposed date of commencement of operation of NG. This statement is, however, subject to the following caveats:

(a) that trains can enter and exit the SRFI at a speed of not less than 40 mph (Network Rail is considering the results of work produced by the Applicant regarding connection speeds); and

(b) the origin and destination of each train movement. This information will not be known until the SRFI is operational and therefore whether a path from the SRFI can be matched to a path at the origin/destination.

25. Roxhill carried out its own assessments of capacity on the West Coast Main Line between London and Rugby (covering the section of line Northampton Gateway is located on). It has procured capacity reports from its rail consultant, Victa Railfreight, and a freight operating company (GB Railfreight) in September 2017 and February 2018 respectively, both demonstrating that there was capacity on the WCML to accommodate the additional freight paths required to serve Northampton Gateway (Document 6.7)

26. Network Rail also reported on its view of capacity on the Northampton Loop Line. A Basic Services Agreement, concluded between Roxhill and Network Rail in August 2017, required the production of this report, and Network Rail delivered the report in September 2017. Unlike the work carried out on behalf of Roxhill this report confined itself to the Northampton Loop. It confirms that there is sufficient capacity on the Northampton Loop for 4 paths per day at the proposed date of commencement of operation of Northampton Gateway, subject to the caveats referred to at paragraph 24 above.

27. At the request of Network Rail, to assist it in its conclusions on capacity, further work was procured by Roxhill in September 2018 in respect of capacity on the West Coast Main Line to service Northampton Gateway. This work included modelling undertaken by its rail consultant GHD Ltd. to calculate technical running times of typical freight trains on the Northampton Loop contained in the Freight Timing Report, which has been submitted to Network Rail.

28. The Freight Timing Report informed a timetable pathing assessment undertaken by GB Railfreight This work demonstrated that, at the time of the study (Autumn 2018) 4 paths per day could be accommodated at the proposed date of commencement of operation of Northampton Gateway, subject to the caveats referred to at paragraph 24 above.

v Conclusions of Technical Work

29. As set out in paragraph 17 above, the design of the bridge has been progressed to an appropriate level of detail. These details are adequate to confirm that the detailed design and construction can be appropriately dealt with under the BAPA already entered into between Network Rail and Roxhill and the Protective Provisions to be included in the Order, subject to those Protective Provisions being sufficient for NR's requirements.

30. Network Rail is considering the proposed connection speeds of rail freight using the SRFI.

31. Sufficient connection speeds are required to ensure that trains are able to enter and exit the SRFI in a manner which minimises the interaction with other freight and passenger trains using the route. Further, as referred to above, the capacity of the network to accommodate the SRFI depends, in part, on connection speeds being sufficient.

32. As regards network capacity, subject to being satisfied in relation to connection speeds and noting that paths cannot be matched to paths at the origin/destination until the SRFI is operational, based on the assumptions made in the Network Rail Northampton Loop Capacity Report September 2017 and the GB Railfreight report Network Rail believes that the facilities being planned have the capability and capacity to support efficient terminal operations for 4 paths/day. In the longer term the 2016 Freight Network Study recognises the potential for significant growth in the intermodal rail freight sector through to 2043, and this is reflected in the FNPO Strategic Plan.

33. Network Rail continues to work with the rail freight industry, and the Department for Transport, in developing the rail network for both freight and passenger operators. DfT's strategic investment programmes are geared to making the best use of available capacity. The opening of HS2 Phase 1 in 2026 and Phase 2 in 2033 provide opportunities to review the use of capacity on the classic network for both freight and passenger traffic. The extent to which this will release additional capacity is uncertain and the SRFI does not rely on such capacity being released, however, some of the additional long-term capacity growth can be expected to be provided by these developments.

vi Delivery

34. Should development consent for the NG SRFI be granted by the Secretary of State for Transport, a Development Services Agreement will be entered into and the remainder of the GRIP stages will be worked through to GRIP 8. This will be followed by an Implementation Agreement and collaboration to secure the necessary possessions to facilitate the construction and commissioning of the mainline connection. In parallel with the above process Roxhill will be constructing the on-site private rail infrastructure.

vii Protective Provisions and Asset Protection Agreements

33. Protective Provisions will be required to protect Network Rail's operational railway and rights of access sought in relation to the operational railway. Discussions in relation to the Protective Provisions are ongoing and the parties hope to agree the final Protective Provisions before Deadline 2.

34. Any works undertaken or adjacent to Network Rail's property will require appropriate Asset Protection Agreement(s) to be in place beforehand.

35 Discussions in relation to the necessary Implementation Agreement, Agreement for the Bridge over the Roade Bypass, and other agreements, including agreements in relation to the removal of structures belonging to Network Rail that will be made redundant by the DCO, at the Applicant's cost, are ongoing.

Signatures on behalf of both parties

Addleshaw Goddard LLP
on behalf of Network Rail Infrastructure Limited

Eversheds Sutherland (International) LLP
on behalf of Roxhill (Sutton 15) Ltd.

APPENDIX 1 to Statement of Common Ground

HOW DOES THE FREIGHT PATHING PROCESS WORK?

This appendix explains the process involved in the identification and allocation of capacity on the national rail network. It has been prepared in the form of Questions and Answers.

Q1. Who makes decisions regarding the rail timetable?

Network Rail makes the decisions about which mix of services are entered into any timetable.

Its "Objective" (as defined in Part D of the Network Code) is to share capacity on the Network for the safe carriage of passengers and goods in the most efficient and economical manner in the overall interest of current and prospective users and providers of railway services. This is set out in the Network Code Part D*.

Where there is a potential conflict between services, Network Rail will consider a set of Decision Criteria from the Network Code Part D*, deciding which are relevant to the particular circumstances, then apply those it has identified as relevant in order to reach a decision which is fair and not unduly discriminatory as between any individual affected train operators.

Network Rail will decide which of the Decision Criteria are the most important in the circumstances and use them with an appropriate weighting to decide how, and if, competing train paths are accepted into the timetable.

If a train operator disagrees with any of Network Rail's decisions in what goes into a timetable, it can use the industry's appeal procedure to challenge the decision.

**The Network Code is a set of rules incorporated into track access contracts between train operators and Network Rail.*

Q2. How often is the timetable changed?

There is a requirement for the timetable to change twice a year, every year, as defined in the Network Code. This is the time when Network Rail can look at the complete set of passenger and freight requirements and adjust train paths to endeavour to accommodate all requests.

Q3. How are freight paths allocated alongside passenger service paths?

When compiling a timetable, Network Rail must assess all operators' requirements together and not look at freight services after passenger services, or vice versa. Paths are allocated based on an operator's rights*.

Many train operators (both passenger and freight) will have "Firm Rights" in their Track Access Contracts for specific services to be present in any timetable, within certain time-bands, and Network Rail, first and foremost, must satisfy those requirements There are also other classes of rights which dictate in what order bids should be accommodated in the timetable and with what priority. Such a process may need to take into account the Decision Criteria described in Q1.

*"operator rights" are specified in Train Operator Company's (TOC's) and Freight Operator Company's (FOC's) Track Access Contracts. These will vary, with specified arrival and departure time windows, any stops, and other characteristics necessary for Network Rail to process and enter the train paths into a timetable.

Q4. How do freight operating companies apply for paths?

As well as being able to change the timetable it wishes to run twice a year (see Q2), freight operating companies (FOCs) are also able to apply to Network Rail for a freight path at any time.

This ability for freight companies to make a "spot bid" into the timetable exists because FOCs need to be able to quickly respond to spot markets of business that come their way at very short notice. This is a fundamental difference to how passenger operating companies respond to their markets and has been recognised as such in how the Network Code was written and approved.

The difference between these two methods of applying for freight paths is that, when making a "spot bid" during the course of a timetable, the FOC itself must ensure that the application for a freight path does not clash with any other established service.

Q5. Do all paths allocated for freight services get used?

Many freight services, such as container trains to and from our ports, run regularly six days a week, like a timetabled passenger operation.

In some cases, not every path allocated for freight gets used every day. Many freight customers do not know exactly what their requirements are until the middle of the previous week. These requirements can be quite complicated and can lead to differing train plans each week for various customers. To cater for these "moving targets", there are more freight paths in the timetable than run each day.

Q6. What happens to paths that are not used?

As part of passenger and freight operating companies' track access contract with Network Rail, there is a requirement for parties to meet as often as necessary in order to ensure that capacity on the network continues to be shared in the most efficient and economical manner in the overall interest of all users. When necessary, Network Rail or an operator are able to instigate the process of removing any deemed unused paths, on a use it or lose it basis. The rules for this are contained in Part J of the Network Code.

Additionally, since April 2014, a joint Network Rail / Freight Operating Company working group (Capacity Management Review Group) has been in existence to review and suggest amendments to rail freight paths in the timetable based on a "usefulness" and "reasonableness" test.

After discussion and reaching a consensus, freight paths that have not been used for 90 days are either completely removed from the current and future timetables or turned into more useful Strategic Capacity* to help cater for future changes to traffic flows.

This is also a rolling process and the Capacity Management Review Group convenes every three months.

From 9th April 2014 up to the current date, over 5000 freight paths have either been completely removed from the timetable or put into the Strategic Capacity Statement. This system is just one mechanism that strikes the right balance between removal of unused rights and paths and keeping relevant and useful paths for strategic capacity.

There is no corresponding working group for non-freight paths.

*Strategic Capacity is capacity for which there is no immediate requirement but is likely to be needed by freight train operators for short-term requirements or longer-term future aspirations.

Q7. Does a simple analysis of the spare paths in the current timetable show what the capacity of the network is and what paths would be available to new freight services?

There is no simple analysis of a timetable to determine the true capacity of the network. It is often the case that the timetable in question isn't always optimised to best capacity and, by reviewing a timetable, a better fit of trains can be achieved. Examples of how a timetable might be optimised include removing unnecessary time in a schedule following other services; investigating putting faster running trains in front of slower ones and ensuring a timetable has sufficient space in it to cater for new services.

There is a balance to be struck between filling every spare path on any line of route to maximise efficiency, and the need to have "fire breaks" in the timetable, such that there is space to recover from perturbation.

Q8. Is it possible that there could be no spare paths in a current timetable but through a review of the timetable additional freight services could be accommodated?

This is possible and has previously been shown to be the case. Any pathing study is reflective of the current timetable which is subject to change (see Q1 and Q2). Paths that are no longer required are removed from the timetable and those paths that remain are often able to be altered to better use the existing capacity. This, in turn, often releases capacity for new freight services.

The production of new timetables also offers the opportunity for Network Rail to flex train paths to accommodate new services.

Q9. How are timetables reviewed to accommodate new services?

Timetables are not routinely reviewed other than in response to timetable review requests (Q2). Often, a passenger or freight operator will examine the detail of how a particular timetable has been put together and will suggest changes to be made in order for one of its new services to be accommodated. Network Rail will then examine the proposal and accept it or reject it.

There is a team of two people within Network Rail who actively look to incorporate useful Strategic Capacity train paths into the timetable, taking into account the projected growth in freight services from the established Freight Market Study.

Q10. Have there been situations on the network where rail freight services have not been capable of being accommodated?

There has not been a situation whereby a new freight facility has been unable to operate due to a lack of train paths; but then why would you build a freight facility where you couldn't operate any trains?. If paths cannot be accommodated, then a route can be deemed to be congested and Network Rail works to produce a plan to de-congest the route. The West Coast Main Line is not currently deemed to be congested.

A great deal of iterative work often goes into the development of a freight path. For example, if you tried to run a freight service along a busy commuter railway during a busy peak period, this would be highly challenging. Finding a space in the off peak, or in the evening or overnight can be easier. Finding a freight path is a balance of timing and resource utilisation.

Q11. The Government and Network Rail support an increase in rail freight and increases in rail freight are anticipated in the future. Within this context why is there not greater certainty about the ability to accommodate paths from new SRFIs?

Whilst it is possible to look at pathing arrangements for new facilities in relation to the current timetable, as answers to the above questions demonstrate, the timetable is subject to review and is not a fixed position unlike, for example, highway infrastructure.

Network Rail is required to have regard to the needs of all rail users. It recognises that the Intermodal market is one of the key sectors that is driving rail freight growth and the desired modal shift from road to rail.

In the Freight & National Passenger Operators' Route Strategic Plan (February 2018), Network Rail addresses the interests of all rail users and indicates its programme to accommodate them. The plan sets out "the first stage of a longer-term vision to facilitate significant rail growth over the next fifteen years" (Foreword, Page 3).

In respect of the West Coast Main Line, the plan includes a commitment to "facilitate new terminal developments at Daventry [DIRFT III], Northampton, West Midlands and Parkside".

The ability to accommodate growth also depends on the nature, speed and length of the traffic flow. It may for example be possible to get a path to and from a site near Northampton, but not be possible to find a matching path to a busy port such as Felixstowe or Southampton in order that the service can run profitably. This comes back to the iterative development process referred to above.

Network Strategy and Capacity Planning:
Capability & Capacity Analysis

Northampton Loop Capacity

Report

Marika Vince

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Abbreviations	
Acronym	**Meaning**
C&CA	Capability & Capacity Analysis
DIRFT	Daventry International Rail Freight Terminal
TOC	Train Operating Company
TPRs	Timetable Planning Rules, building blocks of the timetable which define the minimum safe margin between trains
WCML	West Coast Main Line
LNW	London North Western

Table of Contents

1. Introduction

This report investigates the underlying available capacity on the Northampton Loop Hillmorton Junction to Hanslope Junction.

For the purposes of this report a modular approach has been used – the analysis assumes no constraints on the West Coast Main Line (WCML) or any other onward route. This gives a maximum number of possible paths on the Northampton Loop. Because of the narrow geographical area, in practice the paths found will need to tie up with paths or spare capacity in the wider area.

This should be viewed as primary examination with more detailed analysis to take place once each schemes' plans have been further developed.

Using the current Timetable Planning Rules (TPRs), the analysis found some paths which could fulfil a proportion of the capacity requirements detailed by multiple schemes, however following anticipated updates to these TPRs the actual capacity available is likely to be less than our analysis found.

Any paths identified would need to follow the Industry Timetable bidding process, this is described in Part D of the Network Code.

The analysis shows without significant infrastructure improvements a choice must be made between maximising freight paths and creation of additional passenger paths,.

High Speed 2 is introducing 10 services of which 8 replicate current InterCity West Coast services. All 8 of these replicated services use the fast lines, therefore the capacity released by HS2 is only available on the Fast lines south of Rugby. It is likely that the services that use the released capacity available on the fast lines will need to cross over onto the slow lines for part of their path. Therefore post the implantation of High Speed 2 the slow line south of rugby are likely to see a higher utilisation than today.

2. Proposed Rail Schemes

The proposed enhancement schemes are at varying early stages of development but each relies on there being a number of additional freight or passenger paths along the corridor.

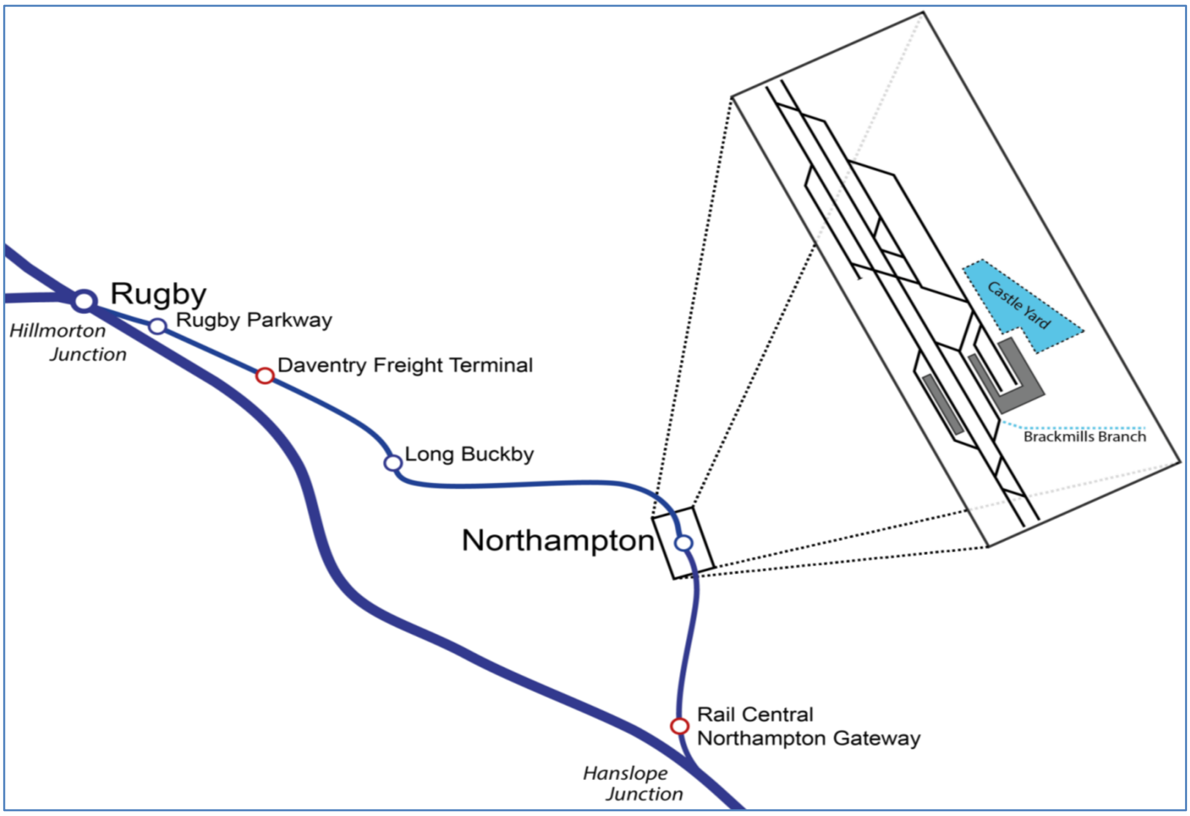
Scheme Requirements Table

Scheme Name	Description	Long term Requirements	Passenger Requirements
DIRFT III	A Strategic Rail Freight Interchange situated between Rugby Parkway and Long Buckby on the Northampton Loop DIRFTI and DIRFTII are operational and consent for DIRFTIII is granted. *Short term requirements* 3 paths by 2021	Up to 20 additional paths per 24 hours in either direction by 2037 (10-12 already running)	-
Re-location of Castle Aggregates Yard	An existing freight yard that is currently situated north of Northampton station	1 path per 24 hours (currently running)	-
Rail Central	Proposed new Strategic Rail Freight Interchange with a primary connection onto the Northampton Loop, with aspirations to also connect with WCML**. *Short term requirements* Up to 4 paths per 24 hours – minimum for SRFI	Up to 16 paths per 24 hours in either direction by 2026	-
Northampton Gateway	Proposed new Strategic Rail Freight Interchange near Hanslope Junction *Short term requirements* Up to 4 paths per 24 hours – minimum for SRFI	Up to 4 paths per 24 hours by 2022 Up to 8 paths (6 south 2 north) per 24 hours by 2026	-
East West Rail	There is an aspiration to run services from East West Rail into Northampton station	-	1 path per hour
Rugby Parkway Station	Proposed new station located on the Northampton Loop south of Rugby station, requiring an additional stop for 2 trains per hour.	-	Additional stop in 2 trains per hour
Total additional trains by 2026		**Up to 45 trains per 24 hour period**	**1 train per hour**

3. Geography

The geographical extent of this report stretches from Hillmorton Junction and Hanslope Junction, both marked in the below diagram.

Diagram of Northamton Loop area



4. Assumptions and Methodology

The following section gives an outline of the assumptions made prior to the analysis being conducted and the methodology followed. During the analysis it became apparent some of the assumptions were not robust and so the results from the study were analysed with this in mind.

4.1. Assumptions

- The working timetable is fully validated and compliant. - The required Engineering Access Statement alterations to the timetable for overnight possessions on the WCML fast line were not included within the WTT. As a result the timetable gives a misleading picture of the availability of paths overnight, this was taken into account during the analysis
- Station workings, association and dwell times in the working timetable are accurate and complete as of the date TPS freeze taken.
- Current Timetable Planning Rules are adequately expressive to enable safe, delay free planning of Northampton station area – Current workings around Northampton do not require the granularity of the TPRs required by this study. As a result the analysis has made assumptions over the workings of trains which do not have TPRs Rules associated with them.

4.2. Methodology

Using TPS, the Network Rail Train Planning System, a freeze of a Wednesday in the December 2016 Working Timetable (WTT) between 00:00:00 and 23:59:59 was taken. The freeze was inspected to identify any available whitespace which was sufficient to allow for a compliant path to be timetabled. For a path to be deemed compliant it had to be compliant with both the 2017 London North Western (LNW) Timetable Planning Rules (TPRs) v4 and the 2017 Engineering Access Statement v4. If a required TPR was not available then advice was sought from the LNW Timetable Production TPR lead as to the best value to assume. The timetable was then separately examined between the hours of 06:00:00 and 19:00:00 to ascertain if the aspirations for passenger trains specified in the aforementioned schemes could be met.

Visual examination of the timetable and infrastructure along with analysis of the platform capacity at Northampton were used to inform commentary on the impact of moving Aggregates Castle Yard site to the branch line.

To assess the impact of an additional stop at Rugby Parkway pathing of 2 minutes was added into relevant trains in the current timetable traversing the Northampton Loop between 06:00:00 and 19:00:00.

5. Findings

Although there is some capacity available across the Northampton loop which could be utilised there is insufficient space and flexibility within the current timetable to adequately accommodate the requirements of all the schemes considered in this report.

The constraint on available paths on the Northampton Loop is caused by a number of different issues:

- The number and complexity of movements around – and at the platforms of – Northampton station, and the number of empty coaching stock moves
- The current TPRs are insufficient to support the number of movements required by the schemes. In order to increase the quantum of trains, as is proposed, more granular TPRs would be required to enable the most efficient use of available capacity. Producing these TPRs is outside of the scope of this study.
- Engineering access and the impact of high maintenance requirements on the West Coast Main Line (WCML) Fast Lines.
- Insufficient infrastructure to support some trains in a more constrained timetable

Each of these areas of concern is dealt with in a separate section within this report

Further work is required to clarify the position north of Rugby and south of Hanslope Junction.

5.1. Overall potential capacity

Maximum Potential Paths (0600-2000)	*Freight*			*Passenger*
	Hanslope Jn – Hillmorton Jn	DIRFT - Hillmorton Jn -	Hanslope Jn - Northampton Station	Hanslope Jn – Hillmorton Jn
Down Line	7	15	28	8
Up Line	3	31	38	13

The table above shows the **number of paths along the Northampton Loop only** between 0600 and 2000. End to end there are 7 paths available in the Down and 3 on the Up, with additional paths available but only for parts of the route.

The passenger paths found represent a trade off with freight paths, so the passenger and freight path totals cannot be combined.

There may be more opportunities for freight paths overnight, but the engineering access for the West Coast Main Line makes these paths potentially irregular or varied.

5.2 Northampton Station

Northampton station consists of 5 platforms and a number of sidings. The station stretches over a large area and includes several junctions and crossovers; currently the area is broken up into only 2 timing points. Increasing the traffic volume through this area would require it to be divided into smaller areas to allow more precise timing of trains.

The constraining factors at Northampton include:

- Reduced line speed through platform 3.
- Lack of through platforms and access to sidings/platforms from both ends
- The number of trains crossing tracks, manoeuvring, attaching and detaching, or waiting for paths onto the West Coast Main Line, congests the station area.

The reduced line speed is one of the biggest constraining factors. This particularly affects freight because the platform is used predominantly for stopping passenger trains. If the line speed could safely be increased to match the main lines this would provide greater flexibility at Northampton. Access to the bay platforms, riverside sidings and connecting the riverside spur to the Down Northampton fast would also provide greater flexibility.

5.3 Engineering Access

Between 2300 and 0600 there are regular section 4 and 5 possessions taken on either the fast or the slow lines between Hanslope and Hilmorton Junctions. During these possessions trains are timetabled through STP (short term planning) to run on either the fast or slow line, depending which is available. As a result the railway is in effect a 2-track railway overnight. Access to the Northampton loop is not always maintained from the north and the south, resulting in additional movements being required to enable access to the current freight facilities at DIRFT.

Combined with the anticipated additional maintenance activities required if the level of freight increases any available paths found overnight are unlikely to be regular and therefore will have to be bid for on an ad-hoc basis through STP and have not been included within this report

5.4 Infrastructure Findings

5.4.1 Northampton Gateway / Rail Central

This analysis found a number of freight paths which could potentially fulfil the quotas specified by either the Northampton Gateway or Rail Central schemes, but would require trade-offs against other schemes, such as the East West Rail paths.

5.4.2 DIRFT III

There were a number of paths that could be utilised by the DIRFT scheme, but not sufficient for the 2037 aspiration. Utilising all these paths would present a significant level of risk to timetable resilience, especially given the substantial limitations of the current TPRs at Northampton.

5.4.3 Castle Aggregates Yard

It is unclear whether the current relocation proposal of the Brackmills site would offer sufficient space to accommodate any necessary freight movements without extending the time they currently spend on the mainlines. This assessment assumes the scheme would include such space.

The main infrastructure requirements of this scheme are:

- Additional infrastructure to enable access to/from the Brackmills Branch line without going via platform 1.
- Sufficient space/provision within the Brackmills site to accommodate freight movements. If not then additional infrastructure within Northampton will be required to enable these movements without taking up capacity or reducing flexibility within the main station area.

For this scheme to be a viable option without reducing station flexibility, access on and off the Brackmills line without using platform 1 would be required. The station workings specifically relating to the empty coaching stock and passenger train attach/detach moves would need to be recast.

5.4.4 East West Rail

Analysis did not find a regular pattern or sufficient paths to provide an hourly service. Factors restricting capacity include:

- Station flexibility and capacity at Northampton
- Need to maintain current freight paths because of constraints on WCML.

5.4.5 Rugby Parkway Station

An additional stop at the proposed Rugby Parkway Station would need to maintain the onward path along the WCML with the same times at both ends of the Northampton Loop. This analysis found that while some of the current paths can accommodate an additional stop those paths do not offer an hourly service and are not regular.

Although the 9 minute attachment allowance at Northampton is restricting platform capacity it is a contractual obligation for the TOC and Network Rail cannot assume that this will change.

6 Conclusion

The analysis reported in this document indicates that in capacity terms, it would be possible for some additional freight paths to run over the loop. However, this study has only analysed capacity on the loop itself, and not the West Coast Main Line on either side. The West Coast Main Line is the busiest mixed use railway in Europe* and detailed studies will be required to ascertain that additional capacity for freight trains is available, particularly north of Rugby.

Additionally, on the loop, there are a number of constraining factors which will need to be resolved to enable additional capacity to be utilised on the Northampton Loop. These factors are:

- The number and complexity of movements around – and at the platforms of – Northampton station, and the number of empty coaching stock moves.
- Insufficient Timetable Planning Rules (TPRs) to support the complex movements in a more constrained timetable.
- Engineering access and the impact of high maintenance requirements on the West Coast Main Line (WCML) Fast Lines.
- Insufficient infrastructure to support some trains in a more constrained timetable.

Future capacity working assumption (post 2026) is that current freight rights will be maintained.

6.4 Recommendations

We have two recommendations resulting from the analysis conducted for this report:

1. Given that capacity on the Northampton Loop isn't the only likely constraint, a wider study should be commissioned looking at the available capacity for additional services on the West Coast Main Line north of the Northampton Loop.

2. If additional capacity can be found on the West Coast Main Line, infrastructure and signalling improvements around Northampton should be analysed to ascertain the value of small infrastructure modifications to the flexibility of the timetable.

Roxhill Developments

Northampton Gateway SRFI

Feasibility Report

July 2018

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Appendices

1. Introduction

Roxhill Developments has prepared a planning application to create a new Strategic Rail Freight Interchange (SRFI) known as 'Northampton Gateway'. The proposed site is located to the southwest of M1 Junction 15, bounded by the M1 to the northeast, the A508 to the east, Collingtree Road to the north and the Northampton Loop of the West Coast Main Line (WCML) to the west (ELR: HNR) between mileposts 61 and 63. The proposed development would include new warehousing and a rail freight terminal accessed via the Northampton Loop railway line.

Roxhill Developments requires Network Rail's support for the proposed connections to the Northampton Loop. This will be demonstrated in the form of a Statement of Common Ground to support the Development Consent Order (DCO) planning application and their acceptance of the GRIP Stage 2 deliverables.

1.1 Purpose of this report

The purpose of this report is to provide a review of the key issues associated with a concept design for the SRFI and their impact upon the existing rail infrastructure.

The report aims to provide sufficient information to allow Network Rail to support the planning application for the development. This is achieved by understanding how the site is proposed to operate in the context of the entry/exit protocols and the way that trains are integrated into the signalling on the Northampton Loop that optimises the site's operation whilst limiting impact on the loop's network operations.

The report will also assess the compatibility between the planned layout and operation of the terminal and the connections to the Northampton Loop.

1.2 Scope and limitations

This report has been prepared by GHD for Roxhill Developments and may only be used and relied on by Roxhill Developments for the purpose agreed between GHD and Roxhill Developments as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Roxhill Developments arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Roxhill Developments and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Engineering Review

2.1 Methodology

GHD has used Roxhill Developments document *Northampton Gateway Functional Requirements Specification V1 03-01-2018* to assess the existing concept design. GHD has then:

- Used RailSys V10 model to establish the optimum locations for connections of the site to the Northampton Loop lines including speed profile for a freight train approaching, braking and stopping using the proposed Reception lines of the site.
- Used the FRS to inform the development of a layout for the Reception Lines and connections to the rail network that will accommodate freight trains of 775m in length. This work has sought to limit the changes required to the proposed internal site layout as prepared for the Northampton Gateway planning application by Roxhill Developments.
- Reviewed existing signalling layout to establish preferred entry and exit points for the loop whilst minimising any alteration to the existing signalling system.
- Assessed main line electrification impact in accordance with the proposed track connections whilst minimising changes to the existing infrastructure. This has assumed the existing electrification system is still in operation.

2.2 Technical Assumptions

To enable the development of this report the following assumptions have been used:

- Infrastructure asset condition and capacity will not prevent the system alterations required to implement the operational solution proposed.
- The route capacity analysis undertaken by Network Rail found the Northampton Loop to have some capacity to accommodate train paths associated with the proposed freight terminal developments on the line.
- RailSys modelling assumed the use a Class 66 operating at a maximum speed of 60mph with a trailing load of 1800 tonnes with the timing load set to 95%.
- Information provided by Network Rail indicates the track category in the proposed vicinity of the SRFI is category 1A and therefore the existing track asset will be in a suitable condition to accommodate any increase in the volume of traffic.
- No major works are to be specified to any structure adjacent to the site.
- The work tasks on or around the Reception lines will be limited to visual inspection, splitting and joining and maintenance.
- The Reception lines do not need to be parallel and straight.
- Standard S&C units are proposed, where possible.

- Only standard S&C units incorporated in the design currently. Should this change in future design development, the product approval process will be followed to determine their acceptability.
- The HV and LV power distribution systems have sufficient capacity to supply the additional load imposed by the changes required by the proposed site. It is noted load assessment will need to be undertaken in the development process to verify this assumption.

Further testing and assessment of these assumptions should be made at later stages in the development of the Northampton Gateway design.

2.3 Run Time Modelling

Run time modelling was undertaken to identify the optimal turnout speed for the northern and southern connections of the proposed Northampton Gateway site and to estimate the time taken for trains to enter the terminal from the running line. This consisted of an unconstrained line speed model in which the unconstrained deceleration profile of a freight train stopping in the Reception Lines was simulated to identify the maximum speed at the entry locations.

Modelling was undertaken using RailSys version 10 and Network Rail's standards for its use (RailSys 2018 standards issued by Network Rail, revision date 31st October 2017).

2.3.1 Unconstrained Line Speed Model

The purpose of this model was to identify the maximum possible junction speeds at the proposed locations of the running line connections at the northern and southern ends of the proposed terminal. Information provided on drawing *4054-R017 P5 Rail Phasing Plan* was used to determine connection locations within the RailSys infrastructure model.

A loop length of 1842m was modelled with a crossover and turnout located at the north and south ends of the loop. Two nominal stopping signals were added for the Up and Down stopping locations.

The maximum permitted line speed applied to the loop line was 75mph (121 km/h); this would give a maximum line speed profile in RailSys for the turnouts and crossovers and allows the train to run at its maximum performance for the infrastructure setup.

A timing load of a Class 4 1800 tonnes with Class 66 traction equipment was used as the test, and an unconstrained run was done for the Up and Down approaches. See figures 1 and 2 in section 2.3.2 below.

2.3.2 Unconstrained Line Speed Model Results

The model predicted that the maximum theoretical speeds that the proposed junction locations would experience were:

- Northern connections (Up direction movement) 25mph
- Southern connections (Down direction movement) 55mph

The approach in the Up direction is constrained by the rising gradient of 1 in 200. The Class 66 has insufficient tractive effort to accelerate the load up the 1:200 gradient from its entry speed to the gradient dictated by the low line speeds through the Northampton station area.

Figure 1 - Up Direction unconstrained

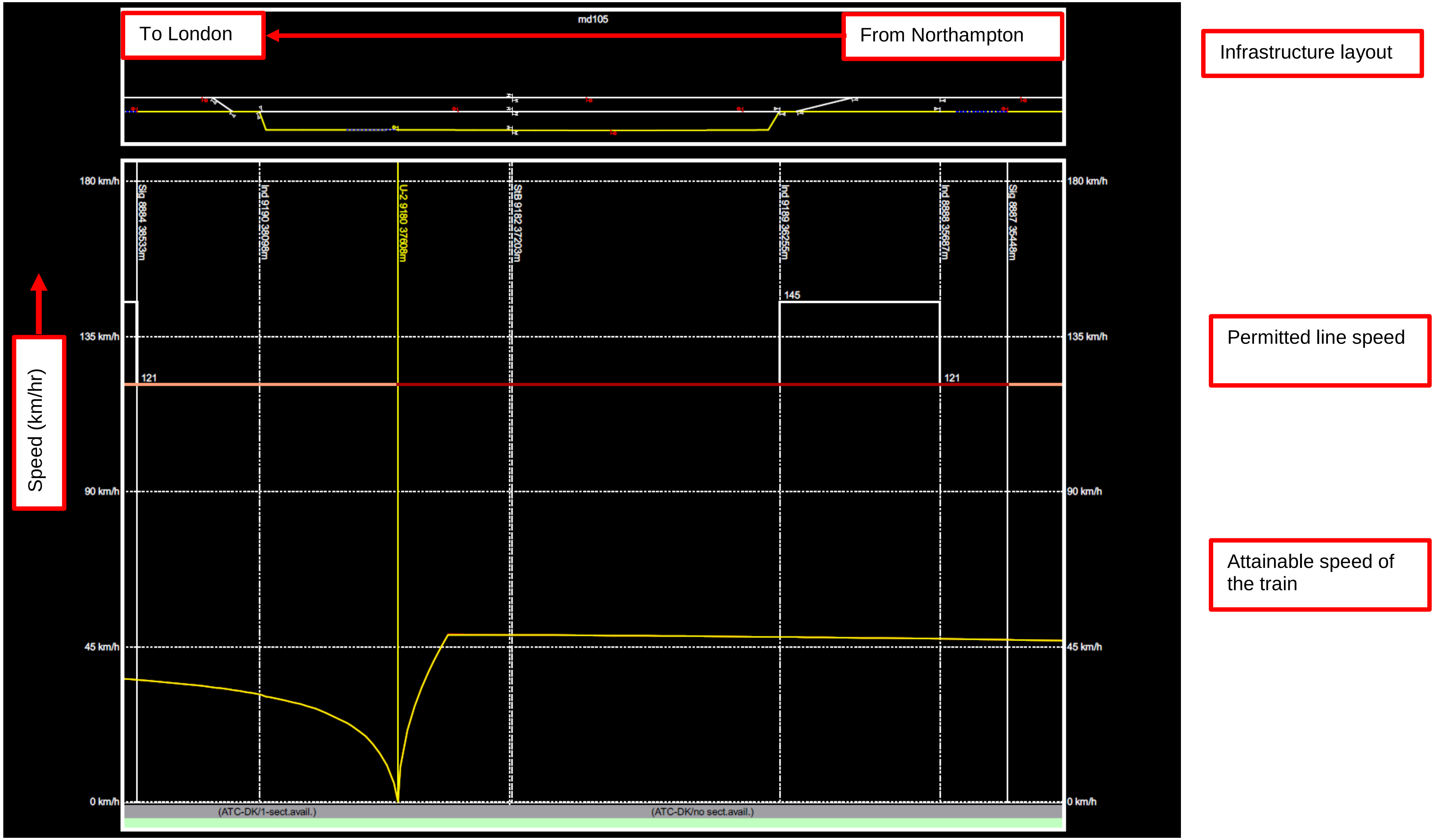
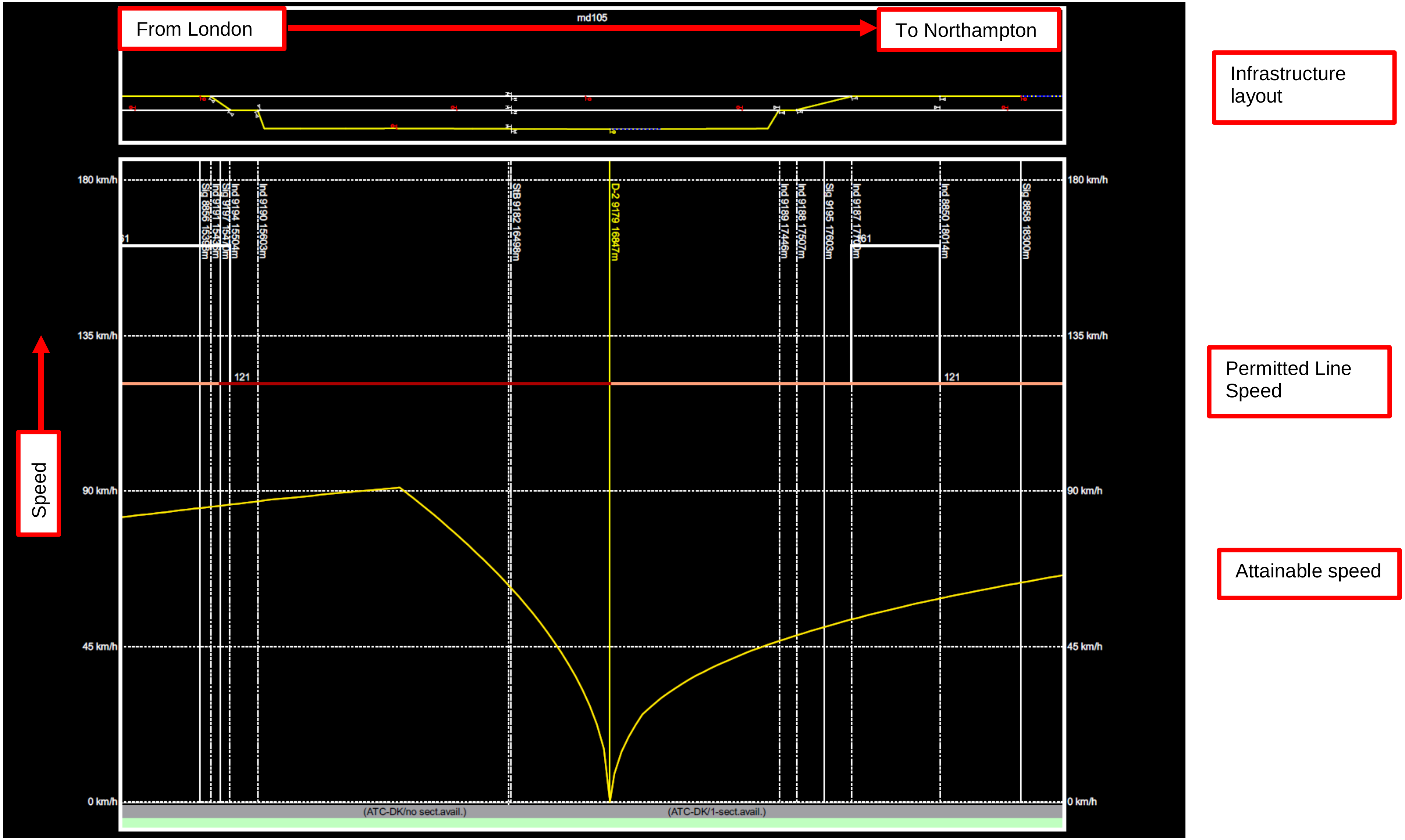


Figure 2 - Down Direction Unconstrained



The approach speed in the Down direction is only constrained by the available stopping distance.

The track design team reviewed the results of the modelling and subsequently used to assist with the development of the permanent way Grip Stage 2 feasibility design.

2.4 Feasibility Design

2.4.1 Track assessment

Following the outcome of the Run Time Modelling, referenced in section 2.3**,** the maximum required speeds of the proposed connections were assessed, however, there are a number of further constraints that influence the location and type of S&C units being used.

The project had a requirement for trains to enter and leave the site from the network at the fastest possible speed and to allow access and egress from both the northbound and southbound connections simultaneously.

Following discussion and review with the client, the design speeds adopted for the terminal connections to the running lines incorporate S&C units capable of at least 40mph at both ends of the facility.

Due to the requirement to achieve reception lines of a length to accommodate 775m trains with compliant signalling overlaps and maximised signal stand backs, subsequent alignment constraints have restricted the terminal alignment at the north end to a design speed of 20mph. To allow for a possible improvement in this speed through future redesign of the internal layout, the mainline connection has utilised an S&C unit with a design speed capable of 40mph.

The proposed S&C connections at the south end will facilitate accessing/egressing the site at 50mph although the sidings operations at this end will be limited to 40mph due to geometry constraints within the terminal and the entry and exit speed will therefore also be constrained to 40mph.

There will be minimal alterations to the existing infrastructure, with the proposal accommodating the existing structures with no works proposed.

Mainline alignments will remain as current.

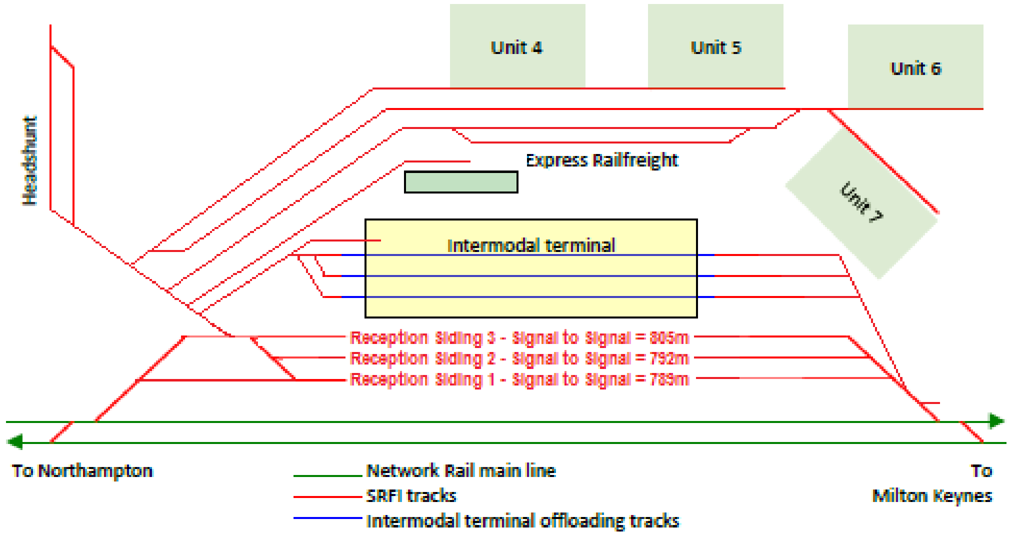
The northern junction and alignment has been designed with 0mm cant. Due to the higher speeds and radii adopted, the southern approach will be canted fit for the 40mph proposed speeds.

The proposed connections to the mainline have demanded changes to the internal S&C connections to the Reception lines and Inter-modal terminal lines. The design now provides Reception line lengths as shown in the diagram below and it is assumed that the development of the terminal layout will facilitate the proposed design of the main line connections..

A head shunt has been provided at the north end of the site to facilitate splitting and joining of trains on the reception lines. It is also accessible from the Inter-modal terminal lines.

A schematic of the proposed mainline connections and reception line layout and lengths is shown below.

Figure 3: Proposed terminal layout and Reception Line lengths



The vertical alignment has been developed with minimal source data, and as such the design levels of the main line connections and the levels within the facility, have replicated those detailed on drawing *NGW-BWB-RGN-01-DR-C-111-S3-P3_Document 2.9B_Railway Plans Long Section Sheet 1 of 2*. Supplementary Ordnance Survey data has been incorporated into the design to allow a high level review of the comparison between existing ground levels and proposed rail levels, however, the accuracy of this data is not sufficient for future design works and a complete topographical survey should be undertaken.

For a technical description of the track proposal see Appendix A.

2.4.2 Signalling Assessment

Running line signalling

The location of S&C to enable entrance and exit to the terminal requires some alteration to the signal positions on the Up and Down Northampton Lines. Two options were identified in the Interim Report.

In reality, more than two options will exist dependent upon the mix of solutions on the Up and Down Northampton lines. For the purposes of demonstrating the feasibility of connecting the SRFI to running lines the solution on the Down Northampton that avoids impacting upon the signal positions on the Down Main has been adopted together with the option on the Up Northampton that minimises signal moves. These alterations are depicted in signalling sketch, *12500857-GHD-SK-T-9001 Rev F01*. A driveability assessment in accordance with Railway Industry Standard: RIS-0713-CCS Iss 1.1 will need to be undertaken in the future development of the scheme together. Final signal positions are subject to further survey, signal sighting, over-run risk assessmentand scheme development.

The proposed alterations depicted on signalling sketch *12500857-GHD-SK-T-9001* are supported by signal spacing calculations using Network Rail's Signal Spacing Module, *SSpaM* *v 6.1*. The output from these is provided in Document No. *12500857-GHD-CA-T-2004* and *12500857-GHD-CA-T-2007* for the Down Northampton and Up Northampton respectively.

At the south end, Signal No. HN5295 will need to be replaced with a new signal approximately 320 m south of the existing signal to form the junction signal into the terminal. The crossover connection to the terminal forms a set of facing points in the overlap. The new signal position is nominally 50m from the toes of the crossover.

Placing HN5295 in this location maintains adequate braking distance from HN5291 signal without incurring further signal moves on the approach to HN5295. This is beneficial as it is understood that Signal HN5293 is on the four track section where any signal moves on the Northampton Lines would require parallel signal moves on the Main lines to avoid misreading risks.

At the north end, signal HN5298 has been maintained in its current position to protect the terminal entry S&C and form the junction signal into the terminal. Maintaining HN5298 in this location results in the facing connection to the terminal from the Up Northampton forming a set of facing points in the overlap of HN5298. The crossover connection is protected by HN5300. This means that when a train is departing the terminal to the north, trains on the Up Northampton will need to be held at HN5300 until the crossing move has cleared the crossover. This will have an impact on the theoretical capacity of the line that may or may not be realised dependent upon the timing of paths for trains leaving the SRFI to the north.

The existing signal spacing on the Up Northampton has a degree of inconsistency which is created by the gradients on the route and physical features such as Hunsbury Tunnel. The signal spacing proposed minimises the impact of the terminal connections on signal spacing but does maintain spacing in excess of 150% braking. Some form of overrun risk assessment will be required at the next stage of scheme development to assess the impact of revised traffic patterns on the over-run risk. Additional train protection may be required to mitigate any increased risk.

The provision of S&C will require a number of signals to be converted from automatic signals with replacement facilities in the form of ‘R’ button functionality to controlled signals with ‘A’ button functionality.

All signal positions will need to be verified through further development work and site survey as part of the future development process.

The Terminal Reception Lines

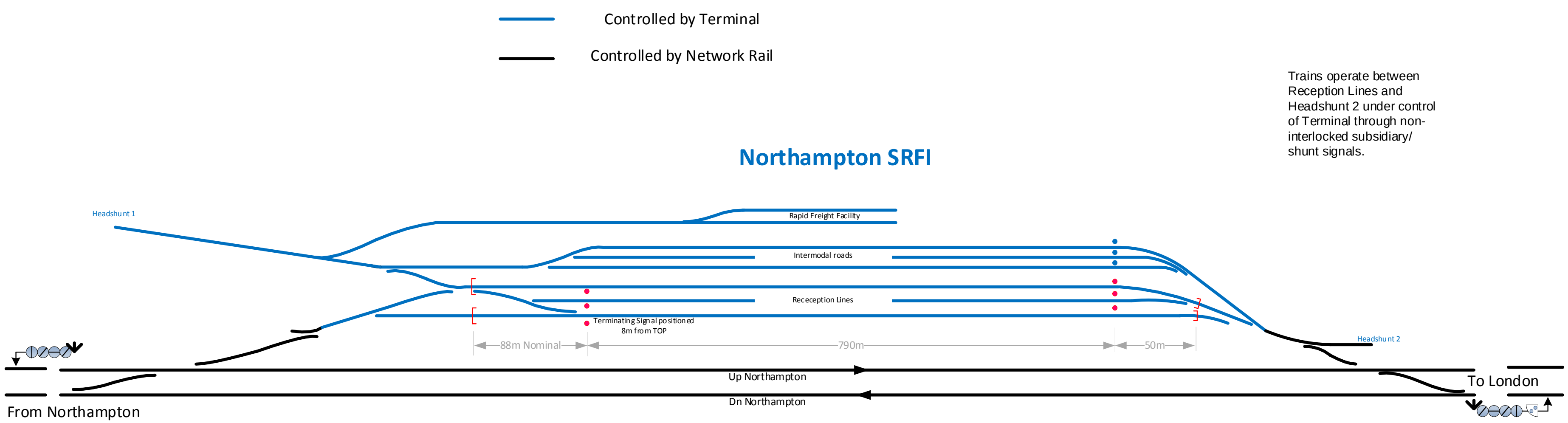
The SRFI terminal is configured with three Reception Lines which will receive trains from the Up and Down Northampton Lines and from which departing trains will re-join the main line network. Three intermodal lines are also provided with direct access to the network at the south end.

It is an operational imperative that trains entering the terminal can do so in the shortest time possible. The maximum entry speed from the south is determined to be 40mph and from the north, 20mph. To utilise the Reception Line at these speeds rather than typical siding speeds of 10mph, and minimise the time taken for an arriving train to access the terminal, the Reception Lines would need to be managed as running lines when trains are arriving, i.e. appropriate distances will need to be maintained from the running edge in respect of positions of safety. Trains will need to be signalled in under full aspect sequences and entry movements terminated by a main red aspect or equivalent.

The terminal needs to be capable of handling 775m trains. The constraints of the site limit the headshunt length to less than 775m standage. This means that trains will need to be split and formed within the Reception Lines with personnel required to work adjacent to the Reception Lines when trains have entered, either from the running lines or other terminal areas. Shunting movements between the north and south headshunts and the Reception Lines will be required.

These two high level operating requirements drive conflicting solutions for command and control of the Reception Lines.

To avoid significant increase to the Network Rail Signaller's workload associated with shunting operations within the SRFI, it is proposed that the control of the Reception Lines will be under the Terminal Controller. Movements in to the Reception Lines from the running lines would require authority from the Terminal Controller who would be responsible for configuring the Reception Line points and ensuring the Reception Lines are clear of Terminal personnel. Early agreement of the acceptance of trains into the terminal would be required to ensure the running line is operated efficiently. The operational procedure to effect this needs to be developed following which the information and system requirements to support the procedure may be developed. The following sketch depicts the possible arrangement of signalling and control.



Northern entry speed restricted to 20 mph by track geometry

Trains signalled in to Terminal under MAR controls from Up Northampton to Stop Signal in Reception Line with Reduced Overlap.

Move slotted by Terminal Controller

Reception Lines equipped with train detection

Reception Lines used to split and form trains

Southern entry speed restricted to 40 mph by track geometry

Trains signalled in to Reception Lines under Flashing Yellow aspect sequence from Down Northampton to Stop Signal in Terminal with Reduced Overlap

Trains signalled into Intermodal Roads on Subsidiary signal

Moves slotted by Terminal Controller

Figure 4: Terminal layout - entrance/exit signalling

Moves into the terminal will require communication and co-ordination between the Terminal Controller and the Network Rail Signaller. The Terminal Controller will configure the Reception Line to receive a train and provide an authority to the Network Rail signaller to set up the signal move from the junction signal into the nominated reception road. The Network Rail signalling system will receive a slot from the Terminal signalling system which will prove that the points are set and detected correctly, the route within the terminal is clear and the red aspect in the terminating signal is lit. Provision of the slot will be indicated to the Network Rail Signaller on the control system at Rugby. Upon receiving the slot, the Network Rail Signaller will set the route up from the junction signal into the Terminal. In order for the appropriate aspect to be displayed on the junction signal, independent slots may need to be provided for each line that a train can enter the terminal from the running line.

Trains arriving form the south will be provided with a flashing yellow aspect sequence as the main line speed is 90mph and the diverging speed is 40mph.

Trains arriving from the south may be signalled directly into the Intermodal Lines. The nature of the Intermodal Lines dictate that this will need to be a shunt class route indicted by a subsidiary signal to the main signal with route indication by stencil route indicator.

Trains approaching from the north will be subject to an aspect sequence where the junction signal is approach released from red as the approach speed is 90mph and the diverging speed is 20mph. This may have an impact on network operations and further assessment of this will be required as part of the option development process and prior to MSRP review in GRIP Stage 3. It is proposed that a subsidiary signal is provided on HN5298 to improve the operational flexibility and enable a light engine to be signalled in to an occupied Reception Line.

Once in the terminal, the points will be normalised for the running lines and the trains will be under the full authority of the Terminal Controller.

Trains departing the terminal will be formed in the Reception Lines. Departing trains will be signalled from the Reception Lines with main aspects. Departure signals will require the Network Rail Signaller to set the connections on to the running lines and provide a release to the Terminal Controller who will then be able to clear the relevant departure signal. As all departure routes from each end have a common exit, a single release will be required for each direction, i.e. departures to the south and to the north. The configuration of S&C in the Reception Lines is likely to result in Reception Line 2 being used mainly as a run-round line. Reception Lines 1 and 3 are likely to be the main Reception/Departure lines.

System alterations

The existing system description and envisaged alterations are based upon analysis of the data received from Network Rail, listed in Appendix H, and discussion with stakeholders such as the Route Asset Manager's representatives.

Existing system description

The existing signalling is controlled via Roade SSI from Rugby SCC through an MCS VDU control system manufactured originally by GE transportation. Communication by serial data transmission to the trackside equipment is via Long Distance Terminals and the telecommunications SDH transmission system. Baseband transmission circuits are provided at the track side from Drop and insert locations. Track side equipment is controlled locally by Trackside Functional Modules. Multiple aspect line side signals provide movement authority with train detection provided by Axle Counters.

The asset condition of the existing systems is not known. It is assumed at this stage that the asset condition will not prevent the system alterations required to implement the operational solution. Further work will need to be undertaken at the next stage of development to ascertain the current asset condition and its potential impact on the scope of work.

Control System

Screen layouts and software/data will need to be altered to reflect the proposed changes in signalling including alterations to the Train Describer System and any ancillary information systems. Initial inspection of the screen layouts suggest there is capacity to accommodate the layout changes however further assessment of the system capacity will be required.

Interlocking

The area affected is controlled by the Roade SSI located in Rugby. Data changes will be required on this interlocking and further assessment of the available capacity is required to determine whether the additional Trackside Functional Modules (TFM) can be accommodated.

Initial estimates of TFM requirements indicate the following:

Option	Line	Existing interlocking capacity	Indicative Scheme requirement	Capacity available?
1	Main		0	
	Northampton	Roade - 44	14*	✓

**Assumes TFM required for each point end*

Other factors may affect the interlocking capacity such as memory capacity, data volume and processing speed. At this stage of development it is assumed that these elements will not constrain capacity further than the TFM count indicates. There is a risk that further design development would require the re-platforming of the SSI.

Line side data links and equipment housing

The provision of the new connections and associated signalling will require additional location cases to be installed. To integrate these into the SSI data transmission alterations will be required to the baseband transmission system.

Signalling power supply

Alterations will also be required to the 650V signalling power supply feeder. Load data has not been available to determine if sufficient capacity exists in the existing Signalling Supply. Detailed loading calculations will need to be undertaken in subsequent design development. In the meantime we have assumed that the transient load of the point operation will require a Point Rectifier and battery to be provided to support the load presented by the new connections. The future development of the configuration of the signalling power supply architecture should consider the extent of change required and the requirements of delay cost assessment.

Trackside equipment

Line side equipment alterations will require to be undertaken in line with asset policy and will include provision of:

- New LED type signals and junction indicators.
- Re-plating of auto signals to controlled signals.
- Conversion of steady yellow aspects to flashing yellow aspects.

- Provision of MkII Hydrive point operating equipment.
- Alteration to the axle counter sectioning. Further scheme development is required to define the changes to sectioning arrangements and its impact on evaluators and communications circuits, however initial analysis undertaken by Network Rail indicates that sufficient capacity should exist in the existing AzLM systems to accommodate the anticipated changes.
- Consideration should be given to the provision of Relocatable Equipment Buildings to house line side equipment at the south and north junctions together with the provision fo vehicular access for maintenance staff.

New signalling equipment will be required to be compliant with BS7671.

Switch heating and DNO Supplies

Switch heating will be required on all switches that are within the signalled route from the running line, i.e. the connections in the running lines and the connections to the Reception Lines. The scope of work included in this study is for the connections to the running lines and crossovers only

Connection cubicle	Switches	Strip Config – Stock Rail	Strip Config Switch Rail	Transformer
South	Crossover NR60 Fv	2 x 5m + 4 x 4m	2 x 5m + 4 x 4m	1 x 10kVA + 1 x 5kVA
	Crossover NR 60 Fv	2 x 5m + 4 x 4m	2 x 5m + 4 x 4m	1 x 10kVA + 1 x 5kVA
	Single lead NR60 Fv	2 x 5m + 4 x 4m	2 x 5m + 4 x 4m	1 x 10kVA + 1 x 5kVA
	Trap end NR60 Cv	2 x 5m + 2 x 4m	2 x 5m + 2 x 4m	10kVA
North	Crossover NR60 Fv	2 x 5m + 4 x 4m	2 x 5m + 4 x 4m	1 x 10kVA + 1 x 5kVA
	Crossover NR 60 Fv	2 x 5m + 4 x 4m	2 x 5m + 4 x 4m	1 x 10kVA + 1 x 5kVA
	Single lead NR60 Ev	2 x 6m + 2 x 5m	2 x 6m + 2 x 5m	10 kVA
	Trap end NR60 Cv	2 x 5m + 2 x 4m	2 x 5m + 2 x 4m	10kVA

The introduction of switch heating will present a significant load that will require a new DNO supply. Configuration of the DNO supply to support the north and south locations will need further development work but should provide a guaranteed DNO supply for the switch heating independent of any supply provided for the terminal. This supply should be located in a position that is accessible by Network Rail maintenance staff. Telecommunications Assessment

Alterations to the telecommunications systems will be required in the following areas:

Line side telephony

Details of the telecommunication assets were not available at the time of writing this report. Further assessment of the llineside telephony requirements will need to be made using the FLAT tool. Pending this assessment it is assumed that sufficient capacity exists in the existing cabling and transmission system to accommodate new SPT telephone circuit for the relocated HN5295 and two Emergency Telephones located in the Reception Lines. It is assumed that the new HN5295 SPT will be tied back into the existing circuit.

It is also assumed that the existing auto signals have SPTs and that these will be maintained when the signals are converted to controlled signals.

Cable route

The main cable route runs adjacent to the Up Northampton and cable route diversions will be required to enable the construction of the terminal connections to the running lines. It is envisaged that the route will contain the following types of cable: signalling power (650v), SSI data cables, FTN and other structured telecoms cabling including fibre optic bearers. Full survey of the cable route and its contents will be required in future stages to determine fully the scope of work of the diversions. Given the length of the diversion it is likely that new cables will need to be run and terminated at suitable connection points.

Voice and Data Links

New voice and data links will be required between Rugby SCC and Terminal Control. Further assessment of the specific needs will need to be undertaken when the Terminal systems are further defined.

Interfacing systems

It assumed that the terminal will be signalled. Work has not been undertaken to define this yet and for the purposes of this report it is assumed that this will be compliant with Network Rail standards and asset policies.

2.4.3 Electrification Assessment

The existing Up and Down Northampton lines were electrified at 25kV in 1965. The contact system was upgraded in recent years under the West Coast Route modification programme and, latterly, the power supply system was upgraded to an Autotransformer system.

The affected works area is located outside the influence of Hunsbury Hill Auto Transformer Station (ATS) which is the nearest major feeder station. The proposed sidings are located next to Milton Cottages Principle supply Point (PSP); however, this is on the down side and should not be affected by the proposed crossover and turnout arrangements.

Should the facility be implemented, there would be some reconfiguration of the OLE required in the area in order to provide overrun protection of the lines and to provide power to the facility reception lines which may be electrified for electrically hauled freight.

The impact of the additional infrastructure on the existing OLE will be reasonably low: the alignment will run within an area of single track cantilevers which may require replacing with double cantilever arrangements to support the additional crossover wire and associated geometry alterations.

One minor risk associated with the infrastructure is the positioning of the new signal associated with the reception connections: although geometric drawings are yet to be produced there is a possibility that this would be situated within a switched overlap (structure RR61/05) proximate to the bare feed arrangement at structure RR6101A. The overlap is switched but with no booster transformer (these were recovered in the power supply upgrade project) not optimal, however, does comply with the requirements of GL/RT1210 clause 3.5.2 Compatibility with position of signals.

2.4.4 Civils Assessment

Earthworks

It is possible that embankment strengthening may be required for areas where the plain line is affected and where the new crossovers and turnouts are positioned. Inspection of the earthwork records provided by Network Rail show that the required crossover and turnout at the north end will be on an existing embankment. The condition of this embankment is stated as low risk from recent inspection and for this reason; it is assumed that no strengthening work will be required. The crossover and turnout at the south end of the site are in a slight cutting and the condition of the cutting is shown as low/average risk from the records provided. No work is therefore proposed to the cutting slopes other than to allow the new route into the terminal.

Benched tie-ins to the existing embankment will be required where the depot access lines diverge from the main line. This will require earthworks to the existing asset to achieve a tie in. Monitoring measures are likely to be required throughout the works.

Civils – Groundworks

The site is low lying and is assumed to have poor sub soil (based on British Geological Society data). Areas on which new track is positioned are likely to need to be treated to provide acceptable ground bearing capacity.

Use of material arising from excavations across the site is likely to construct the bunds that encircle the site. In some locations these will be adjacent to the railway and as such will be subject to asset protection measures.

Track drainage management and realignment/diversion is likely to be required and this work should be integrated with the existing infrastructure.

Piling design for OLE and signal foundations will need to be agreed and all existing services, ducting routes etc. will need to be established, particularly where these are buried.

Under track crossing provision may be required under the railway dependent on how the design is developed and the position of cable ducts etc.

Mainline structures

No works are planned to any structure adjacent to the site. It is assumed that the proposed concept design does not materially affect the volume of timetabled freight on the route therefore the Equivalent Million Gross Tonnes Per Annum (EMGTPA) and associated track category will remain as existing.

Green Bridge

The construction of the ‘green bridge’ may require the operation of cranes and other plant close to the railway and be subject to further Asset Protection measures to satisfy NR’s needs. Construction may also include requirement for use of gabions followed by landscaping.

Ancillary works

Signal bases, OLE bases and LOC bases will be required. These are likely to be formed in-situ or, alternatively, may require to have piled foundations.

2.4.5 Surveys

It is expected that the following site surveys will be undertaken at relevant times through the project life cycle.

- Full topographical survey of the site and the track extending 200m beyond the position of the track interventions in order to confirm alignments and approach speeds by design.
- Full GI of the track bed in the locations of the crossovers and turnouts.
- Embankment GI to access bearing capacity is adequate for new S&C dead loads (Static Actions). Data required for geotechnical designs and earthworks tie in details.
- Undertake California Bearing Ratio testing and localised Cone Penetration Testing at foundation locations to enable design of formation and foundations.
- Environmental / ecological surveys to confirm site status and support Environmental Management Plan preparation.

2.5 Initial Constructability Review

2.5.1 Construction Assumptions

- Facility is to be commissioned in 2022.
- Planning consent commitments are agreed prior to project start
- Next stage of project development is to commence in January 2019.
- Network Rail will deliver the connection works
- The existing asset conditions do not require any remedial works
- Sufficient traction supply will be derived from the running lines
- DNO supply will be derived from the same source as the main facility
- Sufficient and resource and plant will be available when required
- Available access will be available when required
- Existing system capacity for signalling and communications works will be available
- There will be no detrimental impacts from interfacing projects
- Habitat protection measures will be in place where required and an Environmental Management Plan implemented. There are a number ofponds within the site that are assumed to be suitable for amphibians, including Great Crested Newts.
- Main outfalls and drainage infrastructure can be constructed before earthworks, so they are complete prior to the main line connection works.
- It is assumed that the OLE will be operational in the area of the reception roads only and that the shunting will be done by diesel powered shunters.
- ROC has capacity to expand and facilitate this development.

2.5.2 Construction Strategy

Site Compound

A site compound inclusive of layout areas for the S&C fabrication should be established prior to the works commencing, with road access to both extents of the worksite provided. Consideration should be given to establishing site compound adjacent to Up Northampton line by:

- Utilising land to become Northampton Gateway site. This will require bespoke access points to be established, or
- Establishing a compound adjacent to existing access point to facilitate all works at both north and south ends of the site, or
- Alternatively, establishing a primary compound adjacent to the existing access point and acquire, on a temporary basis, additional land to the north of the site as near as feasible to the proposed northern crossover.

Stages of Construction

The development of the project from design development through to asset handback will require additional track access for various activities. These are captured below and detail the potential access requirements to complete the activities.

- **Design Development**

The project team will require site visits to investigate the existing assets and establish whether any previously unidentified issues are present. These works could be undertaken during Rules of the Route (RotR) possessions or under Green Zone working dependent on the nature of the works.

- **Outline Design**

Given the nature of the source data available at the time of the report (OS survey), a full topographical survey will be required to facilitate the design development with an increased level of confidence. In addition to the topographical survey, OLE height and staggers and additional disciplinary site investigations will be required at this stage. Given the requirement for access to the tracks, these works will required a possession, however, given the size of the site, it is envisaged that these works could be undertaken during Rules of the Route possessions.

- **Detailed Design**

In line with Network Rail requirements, a Design Verification Survey (DVS) will be required prior to any construction works. Like the full topographical survey required for the outline design, this survey could be undertaken during Rules of the Route possessions.

- **Enabling Works**

To enable the main works to be undertaken, numerous enabling activities will need to be undertaken. These will include, but not be limited to, UTX construction, cable route diversions and construction, embankment and cutting works, OLE piles, masts and cantilevers installation, reconfiguration of signalling power supplies, installation of lineside signalling equipment, location cabinets and bases and drainage installation in certain areas. Given the proximity to the railway that some of these activities will be undertaken at, it is advised that these works would require possession working. It is envisaged that these works could generally be undertaken during Rules of the Route possessions, though installation of the UTXs may require disruptive possessions.

- **Main Works**

Following on from the close out of the enabling works, the main line connection works will commence. Given the disruption to the existing infrastructure it should be planned to undertake these works in a 54 hour All Lines Blocked (ALB) blockade. It is anticipated that one number 54 hour ALB blockade will be required for the northern connection works and a separate 54 hour ALB blockade will be required for the southern connection works. The blockade will allow for the following activities: the recovery of the existing plain line and track bed, installation of the new formation and bottom ballast, installation of the S&C (clipped out of use), installation of top ballast, tamp, wiring of the crossover, drainage installation, installation of the point operating equipment (POE) and axle counter heads and the signalling testing and commissioning of the through routes.

- **Close out Works**

Following the main construction works, there will be a certain amount of snagging works required before the testing and commissioning of the asset. These will require a combination of Green Zone working and Rules of the Route possessions to complete. At this stage, it is anticipated that the installation of the drainage system, completion of lineside works, signalling recoveries and the wiring of the turnout would all be undertaken under possession. Activities such as the installation of the trap points (and associated plain line), the connection of the signalling equipment associated with the traps and the installation of lineside fencing, could all be completed during Green Zone working.

- **Testing / Commissioning / Handback**

The testing and commissioning of the works will be undertaken following the completion of all stages of construction works and prior to the handback and entry into service. These works are anticipated to include:

Implementation of pre-agreed testing and commissioning activities regarding amendments to controls and signalling control centre, OLE and traction power and inspection and entry into service acceptance.

At this early stage of development, it is considered prudent to allow for a 27 hour possession for the signalling to commission the entrance/exit arrangements, including a wheels free period of 12 hours.

Construction programme

The diagram below indicates the key project phases and influences timescales. The programme has been developed considering the assumptions in section **2.5.1** of this report.

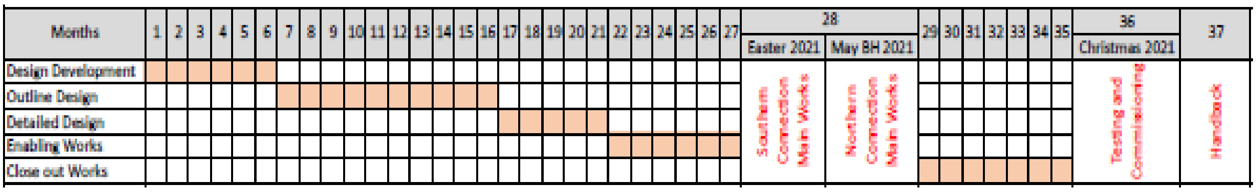


Figure 5:   Indicative construction programme

Indicative Access Requirements

Subject to further scheme development and construction planning, indicative access requirements are:

Work element	Activity	Access
Enabling works	Cable route diversion inc	Rules of the Route
	Installation of UTX's	Disruptive possessions
Track S&C	Undertake S&C installation under possession and lock out of use	2 x 54hr possessions of Up and Down Northampton
Track Turnout	Undertake turnout installation	2 x 36hr possessions of Up and Down Northampton
Track Plain Line	Install all the reception road Track and integrate with control systems and traction power	Not on or near the lineside Segregated worksite
Troughing routes/Service ducts within terminal	Establish as areas become available	Not on or near the line side Segregated worksite
OLE Masts/Signal posts	Erect masts and posts	Rules of the Route
OLE - Wiring up	Wire crossovers and connections; reconfigure existing to suit	Rules of the Route
Loc Bases	Install cabinets as areas become free	Rules of the Route
Positions of Safety / Walkways	Establish as per the design – temporary provision to be made during the works to allow SSOW for RRVs and as risks emerge. All to be complete prior to any usage	Rules of the Route

2.6 HazID Workshop / Systems Safety Report

It is considered that the changes to the main line network will be inter-operable and require authorisation under the Railway Interoperability Regulations (2011). The terminal is not part of the main line network and therefore is not subject to authorisation under the Railway Interoperability Regulations (2011).

Necessary Hazid analysis and risk assessments will be required for the alterations to the main line network and connections/interfaces to the terminal in support of the development of the system definition and Project Authorisation Strategy once the development and delivery roles and timescales are determined.

Initial hazard identification was undertaken at feasibility stage and is recorded in Appendix F.

3. Key Project Risks

3.1 Project Risks

- Network Rail do not approve the design proposals for the terminal connections to the Northampton Loop.
- Additional power supplies are required to feed signalling and line side equipment.

- Additional overhead line traction supply is required to power trains starting from the SRFI sidings.
- Additional signalling alterations are required as a result of signal over-run risk assessment.
- Asset condition is inadequate to implement the works without remedial works.
- Insufficient capacity within the MCS control system at Rugby.
- Planning consent commitments have been agreed prior to start on site.
- Additional signaller's workload cannot be accommodated within current staffing levels and control system provision.
- Required access arrangements are not agreed
- Required plant and personnel are unavailable during available possessions
- Conflicts with interfacing projects

4. Summary and Conclusions

It is an operational imperative that trains entering the terminal can do so in the shortest time possible. From a RailSys simulation, it was found that the optimum approach speeds for main line connections to the terminal would be between 40mph and 50mph. For reasons outlined within the report, the entry and exits speeds adopted are 40mph from the south and 20mph from the north. The proposals are achieved with the alterations to the existing infrastructure minimised where possible.

The location of S&C to enable entrance and exit to the terminal requires some alteration to the signal positions on the Up and Down Northampton Lines. Two options were tested.

- Option 1: minimises signal moves but has the consequence of a potential capacity impact in the down direction whilst trains are exiting the terminal to the north.
- Option 2: resolves the potential capacity impact in the down direction and places the crossover connection at the south in the overlap of the protecting signal. This forms a set of facing points in the overlap.

The terminal is configured with three Reception Lines, each directly connected to the Up and Down Northampton Lines and capable of receiving trains 775m long. The proposed internal layout of the terminal assumes that trains entering the site will need to transfer to various locations on the site, however, the constraints of the site limit the proposed headshunt length to less than 775m standage. This means that trains will need to be split and formed within the Reception Lines which drives conflicting solutions for command and control to meet the operating requirements of both mainline and terminal. The Reception Lines could be controlled by the Network Rail Signaller or by the Terminal Controller.

Of these two scenarios, control of the terminal by the Terminal Controller seems most sensible as it provides full control of activity on the Reception Lines for the differing circumstances of trains arriving/departing and being formed/split. It also obviates the need for the Network Rail Signaller to be signalling movements within the terminal and allows them to focus on signalling the main line network. We recommend that this scenario is taken forward for further development.

The proposals fit around the existing civils structures, the mainline alignments remain as current. Further work will need to be undertaken to:

- Determine, in conjunction with Network Rail, the preferred operational solution to control terminal movements and system changes required to accommodate this;
- Assess the extent of reconfiguration of the OLE required in the area, including quantification of the risk of positioning the new signal within the switched overlap at the south end of the site;
- Confirm, through survey, the impact on the existing cable route and its contents, and
- Assess the signalling and other power supply requirements.

Initial analysis indicates that subject to Network Rail's acceptance of this report's findings and agreement to continue design and construction, and subject to appropriate access being available, the connections to the terminal could be operational in approximately 2 years.

Appendices

Appendix A – Track Technical Proposals

Southern Connection

After discussion with Signalling and Operations disciplines coupled with the constraint of Courtenhall Road Overbridge, it was decided that the Switch Toes of the Southern Connection should be located at a position approximate 229m North of the 61 ¼ milepost (Milepost = 98572m, Switch Toes = 98801m).

Taking into account the braking distances calculated in **section 2.3,** it was determined that the optimum connection speed at this location and for the follow on S&C forming the access to the Reception sidings would be 40mph.

The Southern connection is formed of a FVs 18.5 turnout with continuing turnout radii past the last through bearer position. This will allow a speed of 50mph, but due to the braking profile and the follow on alignment, this should be signalled as a 40mph turnout. This may have the additional benefit of reducing the wear on the asset.

The alignment following on from the mainline connection is driven by the requirement for the connection speeds into the Reception Sidings to be able to accommodate 40mph. This is further impacted by the tight curves required to maximise the standage on the Sidings. The initial turnout Radius is followed by a 354mm Right Hand Curve (RHC), which precedes a straight section. This is followed by a 700m Left Hand Curve (LHC) which ties into the original location of Reception Siding 1 (Eastern). To facilitate these alignment changes 45m transitions have been provided between each change in radii. The alignments require canting to achieve 40mph. The 354m RHC requires 80mm of cant, and the 700m LHC requires between 35mm and 65mm.

Given that the connections to Reception Sidings 2 and 3, will be located on the 700m LHC, it also has to be canted to facilitate the required speed. Applied cant of 60mm or 65mm will enable this. The turnout alignments are continued, with the cant applied, and then transition into the sidings. To enable this curves with no applied cant have been utilised, resulting in the sidings still having a standage of 775m, but not all on a completely straight alignment.

The alignment also provides a straight section of track, from which the connection to the Intermodal Terminal can be located. It has been assumed that these will be a lower speed and CVs 9.25 have been utilised providing a 25mph speed capability, though the speed of movement within the site will be determined in a separate risk based process.. Traps / Headshunt can be located off the inside of the 354m RHC, between the mainline connection and the first S&C unit.

Northern Connection

Although there is a requirement to maximise the entry and exit speed to the terminal (desired minimum speed of 40mph), it is not possibly to achieve this and the required 775m standage within the limits of the site. It is therefore assumed that a blanket speed of 20mph will be adopted for the North end of the sidings.

The mainline connection position has again been determined following discussions with the Operations and Signalling disciplines. Consideration has also been given to minimising the impact on the existing Overhead Line equipment and existing structures. It was therefore decided that the Switch Toes of the Northern Connection should be located at a position approximately 55m North of the 62 ½ milepost (Milepost = 100584m, Switch Toes = 100639m). The mainline connection is an EVs 15 Turnout with a straight alignment following on from the intersection point (IP). Although providing a better alignment, this limits the speed of the turnout to 35mph (this could be adapted to offer the full 40mph connection if required). The benefit of this will be reduced by the 20mph maximum speed imposed within the Sidings.

Due to the reduced speed at the Northern end of the Sidings, the REA alignment is mostly retained with a few small alterations.

All the S&C units are CVs 9 ¼ turnouts with either a straight from the IP or a continuing turnout radii, both options are capable of 25mph. The tightest radii of 201m can be used with 0mm cant and 61mm deficiency and would not require a transition between elements (201m radius connected to a straight would result in a Rate of Change of deficiency of 44.70mm/s at 20mph).

An additional connection has been added to the exit road to allow a direct connection to Reception Siding 3, thus allowing the required signalling overlap, see **section 2.4** for further details. This would require minor amendments to the wing walls of the proposed tunnel.

Reception Lines

On the original design the spacing of the siding lines were set at 1970mm, this would limit the flexibility of the arrangement as no member of staff would be able to walk or work in between sidings. As a part of the development of the Reception Sidings design they have now been set at Running Edge dimensions of 2570mm between Reception Sidings 1 and 2, and 4070mm between Reception Sidings 2 and 3 to allow staff to inspect and split/join trains whilst adjacent lines could be in use.

Headshunt

Although not mandated by the standards, consideration should be given to fitting a continuous check rail on the proposed track section of 201m radii leading in to the headshunt. The length of the headshunt will also need further review.

Vertical Alignment

Given the limitations of the source data available, the vertical design has been developed as described in **section 2.4.1.**

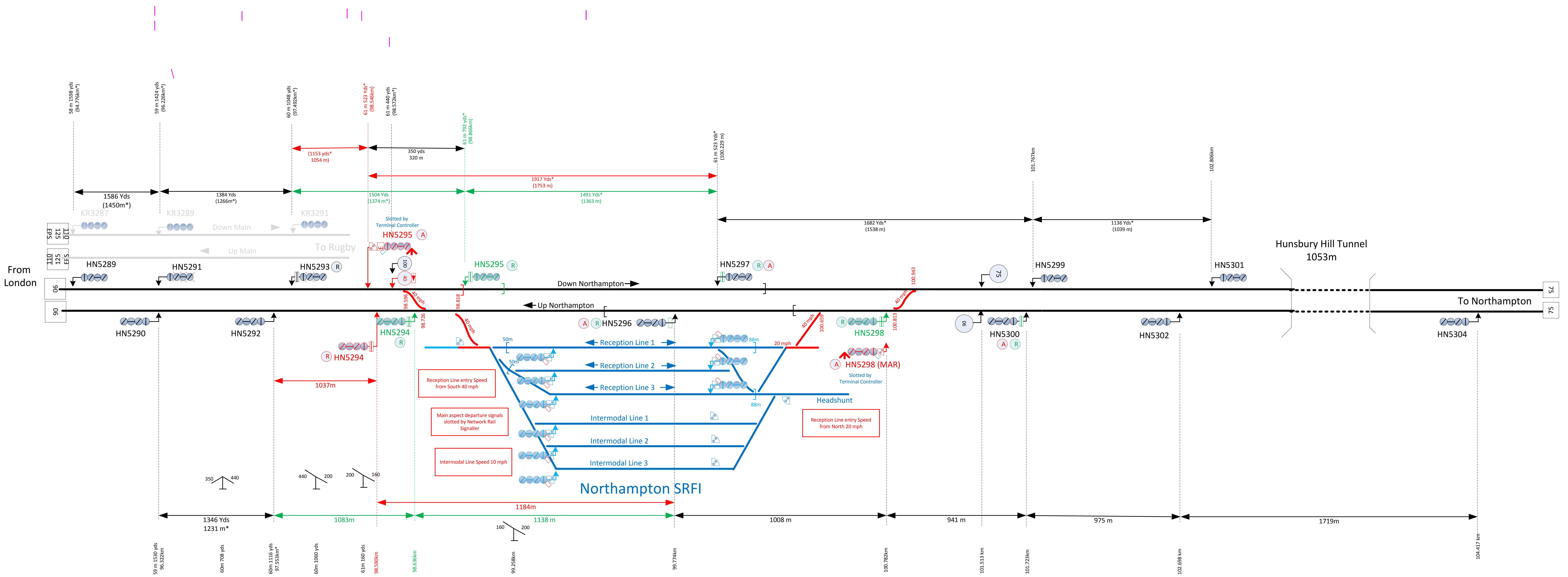
The existing railway as a whole is located on a steep gradient, falling from South to North, at approximately 1:200. Given the easing of these grades in the area of the proposed main line connections, and the reducing of the gradients within the standing areas of the Reception sidings, a stepped vertical profile has been generated resulting is steepening of the gradients in the areas between these two constraints.

The design philosophy has been to replicate the main line design alignment, and proposed siding levels proposed while also placing all S&C units on level grades. Constrainted by these parameters, the vertical profile has resulted in a gradient of approximately 1 in 123 at the South end of the facility and 1 in 100 at the North end. These have been modelled against a Class 4 1800 tonnes with Class 66 and has been proven to meet the demands.

60mm of Cant has been applied to the southern connections of Reception Sidings 1 & 2, and as such a level difference of 60mm has been designed at the respective Intersection points.

Appendix B – Signalling Sketch

12500857-GHD-SK-T-9001 F01 Signalling Sketch Option 1



Signal Id.	Route	Class	Destination	Indication	Comments
HN5295	A	M	Down Northampton	None	
	B	M	Reception Line 1	Pos 4 PLJI	Approach released from Yellow Slotted by Northampton SRFI
	B	S	Reception Line 1	Pos. 4 PLJI	Approach released Slotted by Northampton SRFI
	C	M	Reception Line 2	Pos. 5 PLJI	Approach released from Yellow Slotted by Northampton SRFI
	C	S	Reception Line 2	Pos.5 PLJI	Approach released Slotted by Northampton SRFI
	D	M	Reception Line 3	Pos. 6 PLJI	Approach released from Yellow Slotted by Northampton SRFI
	D	S	Reception Line 3	Pos. 6 PLJI	Approach released Slotted by Northampton SRFI
	E	S	Intermodal Line 1	Stencil RI 1	Approach released Slotted by Northampton SRFI
	F	S	Intermodal Line 2	Stencil RI 2	Approach released Slotted by Northampton SRFI
	G	S	Intermodal Line 3	Stencil RI 3	Approach released Slotted by Northampton SRFI
HN5298	A	M	Reception Line 3	Pos. 1 PLJI	Approach released from Red Slotted by Northampton SRFI
	A	S	Reception Line 3	Pos. 1 PLJI	Approach released Slotted by Northampton SRFI
	B	M	Reception Line 2	Pos. 2 PLJI	Approach released from red Slotted by Northampton SRFI
	B	S	Reception Line 2	Pos.2 PLJI	Approach released Slotted by Northampton SRFI
	C	M	Reception Line 1	Pos 3 PLJI	Approach released from red Slotted by Northampton SRFI
	C	S	Reception Line 1	Pos. 3 PLJI	Approach released Slotted by Northampton SRFI
	D	M	Down Northampton	None	

Notes

1. Sketch based on signalling Plans:
   RSC-02-0038-01 Rev EP2
   RSC-02-0038-02 Rev FY1
   RSC-02-0038-03 Rev AH3
2. Not to scale
3. *Calculated position or dimension
4. Line speeds taken from Sectional Appendix (Supplement No33 December 2017)

Northampton SRFI
Signalling Sketch

SIZE	FSCM NO	DWG NO	REV
		12500857-GHD-SK-T-9001	F01
SCALE NTS		SHEET 1 OF 1	

Appendix C – Signal Spacing Calculations

12500857-GHD-CA-T-2004-P01-Down Northampton SSpaM v6p01 Option 1

12500857-GHD-CA-T-2007-P01-Up Northampton SSpaM v6p01 Option 1

General Information	Reference	Enter data into white cells
6.1.1 Title Information Inputs		
Spacing Chart Drawing Number		12500857-GHD-CA-T-2004 P01.01
Spacing Chart Drawing Version Number	chart title box	
Signalbox Name	chart title box	Rugby SCC
Line Name	chart title box	Down Northampton
Producer Initials	chart & report	HRK
Checker Initials to signify input data checked	chart & report	PCD
Approver Initials	chart & report	HRK
Direction of Train Travel (enter '<' or '>')		>
System of Distance Measurement 'M' metric or 'I' Imperial		M
Is chart imperial? / conversion factor		FALSE 1
Validated entry for dir of travel		>
Drawing Number	chart title box	12500857-GHD-CA-T-2004 P01.01

Notes:

1. signals must be arranged in EITHER ascending or descending mileage order for calculations to be effectiv
2. the braking aspect sequence TO a RED is determined by the number of aspects entered in the column for the chosen caution signa
3. to prevent a signal from displaying a braking sequence type N in row 29 e.g. at edge of chart where insufficient 'hidden' signals exist to model full brakin
4. this model is capable of modelling up to 6 aspects in a head and in a sequence: G, YY, YY, YY, Y, I
5. the Green aspect is never shown on a SSpaM char
6. Consequently a Stop Board can be modelled by inputting as a 2-aspect signal able to show a red (R/G)
7. Consequently a Distant Board can be modelled as a 2-aspect signal unable to show a red (Y/G
8. A junction signal is depicted by inputting an L or R character in row 33 where the character describes the principle divergenc
9. Junction signalling - ensure turnout speed restrictions are input
   MAR is facilitated by ensuring the turnout speed is entered rather than the principal route. Any YY-Y sequence at the junction sig is depicted but should be ignore
   MAY-FA is not explicitly depicted; spacing from the FlashY position to R is modelled as a 4-aspect, YY to
   MAY-YY aspects are depicted but the performance benefits can not
   MAF and MAF-SD are simple aspect sequences
10. **Where the speed approaching or just after a signal is lower than the actual speed AT the signal this can be used for the braking speed**
    Manually input the required 'braking speed' under the RED signal to which the sequence will apply in the Manual Override section; Row 73 below

CHECK THAT ERRORS HAVE NOT ARISEN see yellow rows below

These cells to be used only where the direction of travel is this way >> and the chart contains the maximum 17 signals. Signals will not be shown on chart

Signals Data — Enter data into white cells. Note only signals 1 to 17 shown on chart. outer two columns of signals are for approach signals where appropriate for the direction of traffic

Signals Data	Braking Chart row or data summary										
6.1.2 Signals Input Data											
Signal chart position (left-most signal is pos 1)	-	Additional caution (if required)	Caution to 1 (if required)	Signal 1 (lowest mileage)	Signal 2	Signal 3	Signal 4	Signal 5	Signal 6	Signal 7	
Input signal Identification number including box prefix	row 2		HN5289	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301		
Input signal mileage as-built (km/miles part)	row 1		94	96	97	98	100	101	102		
Input signal mileage as-built (metres/yds part)	row 1		776	226	429	866	229	767	806		
Input is signal to be displayed on spacing chart (Y or N)				Y	Y	Y	Y	Y	Y		
Input does signal show a red aspect (Y or N)	-		Y	Y	Y	Y	Y	Y	Y		
Input total number of signal aspects (1 to 6)	row 3		4	4	4	4	4	4	4		
Input number of aspects in this sequence (1 to 6)	row 4		4	4	4	4	4	4	4		
Input for junction indicator (N-none, L-left, R-right)	row 4	not used	not used	N	N	N	N	N	N		
Input as-built overlap (metres)	row 11	not used	not used	180	180	180	180	185	182		
Input signalling plan dr'g number (including version)	row 33	not used	not used	RSC-02-0038-01 vEP2	RSC-02-0038-01 vEP2	RSC-27-0038-03 vAH3	RSC-27-0038-03 vAH3	RSC-27-0038-03 vAH3	RSC-27-0038-03 vAH3		
6.1.3 Logic for Display of Data											
Flag =1 when signal display required on chart	6 signals	not used	not used	1	1	1	1	1	1	0	
Best caution aspect possible (0=Red,1=Y,2=YY, 3=2xYY, 4=3xYY)		0	2	2	2	2	2	2	2	0	
Relative position of first caution (<<direction)		not used	not used	2	2	2	2	1	0	0	
Relative position of first caution (>>direction)		not used	not used	1	2	2	2	2	2	2	
No of braking aspects approaching this sig (-ve for >> dir of travel)		not used	not used	-1	-2	-2	-2	-2	-2	0	
6.1.4 Signal Calculations											
Fractional part of km/miles input expressed as metres/yds		0	0	0	0	0	0	0	0	0	
Evaluated km/miles part of signal position	ok	0	94	96	97	98	100	101	102	0	
Evaluated metres/yds part of signal position	ok	0	776	226	429	866	229	767	806	0	
Normalised mileage (in metres)	row 2	0	94776	96226	97429	98866	100229	101767	102806	0	
Normalised mileage blanked if zero (in metres)			94776	96226	97429	98866	100229	101767	102806		
Distance from 1st caution to red (in metres)	row 4	not used	not used	1450	2653	2640	2800	2901	2577	-101767	
6.1.5 Input Data Error Reports											
Change of position sig 1 to sig 2 sign & magnitude (metres)				1203							
Error check for input data omitted in one or more cells	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for out of range input in y/n boxes	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check of signal position (km/miles part)	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check of signal position (metres/yds part)	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for mileage chg different sense as sig 1 to 2	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for 'total aspects' input out of range	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for 'aspects displayed' out of range	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok	
Error check for caution data giving impossible aspect sequence	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok	
Flag=1 if 'v' is omitted from plan No. unless sig ID blank	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok	
Summary error report for all input data	ok										
6.1.6 Signals GK/RT/0075 Clause 2.1.3 c and 2.6.2 assessmen											
Tests for ok, if Y-R distance>=1/3 of YY-R distance (--- for n/a)		not used	not used	---	45.34% - ok	54.43% - ok	48.68% - ok	53.02% - ok	40.32% - ok	---	
Tests for ok, if Y-R distance>=1/3 of YY-R MIN distance (or n/a)		not used	not used	N/A	81.32% - ok	93.05% - ok	82.19% - ok	66.59% - ok	44.99% - ok	N/A	

Manual Override data — Enter data into white cells or leave blank to use auto-calculated values

Manual Override data	Refers to Braking Chart										
6.1.7 Manual Override Input Data											
Signal Identification number	row 2	0	HN5289	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301	0	
Max attainable speed for all trains (mph) @ FIRST CAUTION for *this* signal	row 12	not required	not required								
Max attainable speed for passenger trains (mph) @ FIRST CAUTION for *this* signal	row 13	not required	not required								
Max attainable speed for enhanced trains (mph) @ FIRST CAUTION for *this* signal	row 14	not required	not required								
Max attainable speed for Future #1 (mph) @ FIRST CAUTION for *this* signal	row 15	not required	not required								
Max attainable speed for Future #2 (mph) @ FIRST CAUTION for *this* signal	row 16	not required	not required								
If required*, min signal spacing for all trains (metres)	row 17	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
If required*, min signal spacing for passenger trains (metres)	row 18	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
If required*, min signal spacing for enhanced trains (metres)	row 19	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
If required*, min signal spacing for Future#1 (metres)	row 20	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
If required*, min signal spacing for Future#2 (metres)	row 21	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
* override may be required if compliance with GK/GN 0675 GN31 is not achieved											
Disabled (was braking excess/def)	row 22	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
Disabled (was braking excess/def)	row 23	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
Disabled (was braking excess/def)	row 24	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
Disabled (was braking excess/def)	row 25	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
Disabled (was braking excess/def)	row 26	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	
MSWD for all trains (mph)	row 27	not required	not required								
MSWD for passenger trains (mph)	row 28	not required	not required								
MSWD for enhanced trains (mph)	row 29	not required	not required								
MSWD for Future#1 (mph)	row 30	not required	not required								
MSWD for Future#2 (mph)	row 31	not required	not required								
Signal narrative: any describing feature recorded in this free field should be copied to the Scheme/Signalling plan Design Log											

These cells to be used only where the direction of travel is this way << and the chart contains the maximum 17 signals. Signals will not be shown on chart

Signal 8	Signal 9	Signal 10	Signal 11	Signal 12	Signal 13	Signal 14	Signal 15	Signal 16	Signal 17 (highest mileage)	Caution to 17 (if required)	Additional caution (if required)
										not used	not used
										not used	not used
										not used	not used
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
---	---	---	---	---	---	---	---	---	---	not used	not used
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	not used	not used

0	0	0	0	0	0	0	0	0	0
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled

	Row						
MILEAGE (km AND metres)	1	96+226	97+429	98+866	100+229	101+767	102+806
Signal Identification Number		HN5291	HN5293	HN5295	HN5297	HN5299	HN5301
Signal to Signal (metres)	2	1203	1437	1363	1538	1039	
Signal (figure within circle is number of aspects in main signal head)	3	4	4	4	4	4	4

Direction of travel →

Down Northampton

Braking Aspect Sequence and Signal Spacing Current (metres)	Row	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301
	4	R	.	.	.	.	
		Y	R	.	.	.	.
		YY 2640	Y	R	.	.	.
		.	YY 2800	Y	R	.	.
		.	.	YY 2901	Y	R	.
		.	.	.	YY 2577	Y	R

This chart must be read in association with its Status Report - Input Errors and Excess Braking Assessments.

THIS CHART IS ABLE TO MODEL CONSECUTIVE YY

		Row	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301
Maximum Permissible Speed 'MPS' at the signal (mph)	All Trains	5	90	90	100	100	100	100
	Passenger Trains	6	90	90	100	100	100	100
	Enhanced	7	90	90	100	100	100	100
	Future #1	8	90	90	100	100	100	100
	Future #2	9	90	90	100	100	100	100
Overlap (metres)	Minimum (GK/RT 0064)	10	180	180	180	180	180	180
	As built	11	180	180	180	180	185	182
Speed (mph) at the first caution signal (note 9) MPS, or Maximum Attainable Speed sampled every 16 m	All Trains	12	90	90	90	90	100	100
	Passenger Trains	13	90	90	90	90	100	100
	Enhanced	14	90	90	90	90	100	100
	Future #1	15	90	90	90	90	100	100
	Future #2	16	90	90	90	90	100	100
Minimum Signal Spacing (metres)	All Trains	17	1484	1479	1544	1658	p 2310	2310
	Passenger Trains	18	1484	1479	1544	1657	p 2310	2310
	Enhanced	19	1074	1072	1104	1155	p 1436	1436
	Future #1	20	1074	1072	1104	1155	p 1436	1436
	Future #2	21	1074	1072	1104	1155	p 1436	1436
Signal Spacing Excess (+) (metres) Deficiency (-) (metres) (see note 8)	All Trains	22	(-34)	+1174	+1096	+1142	+592	+268
	Passenger Trains	23	(-34)	+1174	+1096	+1143	+592	+268
	Enhanced	24	+376	+1581	+1536	+1645	+1465	+1141
	Future #1	25	+376	+1581	+1536	+1645	+1465	+1141
	Future #2	26	+376	+1581	+1536	+1645	+1465	+1141
Maximum Speed Without Deficiency at first caution signal (mph) (see note 6)	All Trains	27	85	125	125	125	125	125
	Passenger Trains	28	85	125	125	125	125	125
	Enhanced	29	105	125	125	125	125	125
	Future #1	30	105	125	125	125	125	125
	Future #2	31	105	125	125	125	125	125
Average Gradient		32	391R	364R	LEVEL	228F	164F	160F
Signalling Plan Number		33	RSC-02-0038-01 vEP	RSC-02-0038-01 vEP	RSC-27-0038-03 vAH	RSC-27-0038-03 vAH	RSC-27-0038-03 vAH	RSC-27-0038-03 vAH

Notes:

1. Diverging junction to left or right shown by ↖ or ↙ next to red aspect. Does not imply Junction Indicator on signal
2. Rows 22-26 display deficiencies in brackets to aid recognition.
3. Neither overlap nor sighting distance are included within gradient or signal spacing calculations.
4. Maximum permissible speed is presented for every signal. Changes are indicated by vertical line between values. Position of line does not represent relative position of speed change.
5. Signal spacing prefixed by 'p' indicate specific application of signalling principle GK/RT 0075 clause 2.3.8 invoked when a signal approach demonstrates falling and variable gradients.
6. MSWD Rows 27-31 conservatively show speeds that will always result in adequate braking if adopted, though higher speeds may be possible after more detailed evaluation.
7. Figures are positioned in columns to denote the place of application e.g. at the stop signal - right hand side, at the first caution - left hand side.
8. Speeds prefixed by 'm' are manually determined 'override' values
9. Speeds shown underlined indicate MPS values, otherwise MAS, though no change to application position.

Software version		Full Issue 6.01		Network Rail
		Signature	Rugby SCC	
Produced	HRK		Signal Spacing Model	
Checked	PCD			
Approved	HRK			Drg.No 12500857-GHD-CA-T-2004 P01.01
Original Scale		N/A	Down Northampton	Refers to: GK/RT 0075 issue 1, GK/RT 0064 issue 1
Date Printed		26/07/2018 15:27	96 km 226 m to 102 km 806 m	Version 0

Status report title information	Reference			
6.7.0 Status Report Title Information				
Signalbox name	sig&gen_inputs	Rugby SCC		
Line Name	sig&gen_inputs	Down Northampton		
Drawing Number	sig&gen_inputs	12500857-GHD-CA-T-2004 P01.01		
Version Number	sig&gen_inputs	0		
		initials	signed	date
Producer signature and date	sig&gen_inputs	HRK		
Checker signature and date	sig&gen_inputs	PCD		
Approver Signature and date	sig&gen_inputs	HRK		
Date and time this report printed	sig&gen_inputs	26/07/2018 15:27		

Checksum Report							
6.7.9 Checksum Report							
	Known	**Test**	**Verdict**		**Known**	**Test**	**Verdict**
Star	0	0	OK	>>	####	5945724	OK
Sel	####	12273333	OK	Stat	####	5208983	OK
SeM	####	15317458	OK	All	####	2854691	OK
Sig	####	2549131	OK	Pas	####	2853008	OK
Gra	####	3324484	OK	Enh	####	2850492	OK
Per	####	5665133	OK	Fut1	####	2840700	OK
Att	####	145190349	OK	Fut2	####	2847942	OK
Calc	####	24095366	OK	Over	####	1080498	OK
<<	####	6013876	OK	DATE		30-Apr-12	

Status report for general data	Reference	Displays 'ok' for compliance or provides diagnostic information
6.7.1 Report for Signals and General Inputs Sheet		
Summary of signal and mileage input data	sig&gen_inputs	ok
Manual override inputs	sig&gen_inputs	ok
6.7.2 Report for Gradient Inputs Sheet		
Summary of gradient input data and mileage limits	grad_inputs	ok
6.7.3 Report for Permissible Speed Inputs Sheet		
Summary of speed input data and mileage limits	linespeed_inputs	ok
6.7.7 Report on Attainable Speed Evaluation		
Accuracy of sampling for speed profile calculations	att_speed	Worst case error 0 mph, mean error 0 mph with sampling every 16 metres
6.7.8 GK/RT0064 clause 4.3.2 - speed and ROLs		
Summary of a) overlap min lengths and b) speed changes within approach to signal with ROL	overlaps	ok

Spacing % are rounded DOWN for presentation purposes. Tests are reported on ACTUAL distances

Status report for individual signals — Reference — Displays report: **'ok'; 'FAIL' or 'a' 'b' 'c'** means the described test has not been met (see row label); **'n/a' or '---'** mean not applicable. SAT/DA***** and SPH D220***** gives explanation of compliance requirement. **Note:** #### **or #VALUE! identifies *there is overspill* or that the chart is unable to *make* the required calculation which should be done manually** e.g. an excess reduction comparison with a signal on the edge of the chart. **RGS GI/RT 7006 category simple signals automatically satisfy *assessments**. Underbraked signals are depicted ~~**75%**~~ but will meeet the various overbraking tests.

Status report for individual signals	Reference																	
Signal Identification number	sig&gen_inputs	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
6.7.5.1 Report on GK/RT 0075 & GK/GN 0675 Various Clauses																		
Acceptability to GK/GN 0675 GN31: Signal requires further assessment if its approach includes falling and rising grad's both steeper than 1%	calculations	ok	ok	ok	ok	ok	ok	---	---	---	---	---	---	---	---	---	---	---
Compliance with GK/RT 0075 clause 2.6.1: Ratio of Y-R distance to YY-R distance - result shows "ok" if ratio > 33.33% or "FAIL" if not. 4 aspect areas only.	sig&gen_inputs	---	45.34% - ok	54.43% - ok	48.68% - ok	53.02% - ok	40.32% - ok	---	---	---	---	---	---	---	---	---	---	---
Compliance with GK/RT 0075 clause 2.6.2: Ratio of Y-R distance to YY-R min req distance - result shows "ok" if ratio > 33.33% or "FAIL" if not. 4 aspect areas only.	sig&gen_inputs	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6.7.5.2 Report on GK/RT 0075 - Signal Spacing and GK/GN 0675 GN50																		
All Trains report: Sig Spacing as a % of Minimum SS	calculations	~~97%~~	179%	170%	168%	125% -43%	111%	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
All Trains analysis, 'ok' or clause failed:(a) no more than 50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a ok n/a	a ok n/a	a ok n/a	ok n/a n/a	ok n/a n/a	---	---	---	---	---	---	---	---	---	---	---
All Trains report: Summary of compliance	calculations	UNDER SPACED	SAT/DA	SAT/DA	SAT/DA	ok	ok	---	---	---	---	---	---	---	---	---	---	---
		Risk assessment of the Passenger Train differential is only required when this train is the dominant train type																
Passenger Trains report: Sig Spacing as a % of Minimum SS	calculations	~~97%~~	179%	171%	168%	125% -43%	111%	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Pass Trains analysis, 'ok' or clause failed:(a) no more than 50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a ok n/a	a ok n/a	a ok n/a	ok n/a n/a	ok n/a n/a	---	---	---	---	---	---	---	---	---	---	---
Passenger Trains report: Summary of compliance	calculations	UNDER SPACED	SAT/DA	SAT/DA	SAT/DA	ok	ok	---	---	---	---	---	---	---	---	---	---	---
		Risk assessment of the Enhanced Train differential is only required when this train is the dominant train type																
Enhanced Trains report: Sig Spacing as a % of Minimum SS	calculations	134%	247%	239%	242%	202% -40%	179%	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Enhanced Trains analysis, 'ok' or clause failed:(a) no more than 50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a b n/a	a b n/a	a b n/a	a b n/a	a ok n/a	---	---	---	---	---	---	---	---	---	---	---
Enhanced Trains report: Summary of compliance	calculations	ok	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SAT/DA	---	---	---	---	---	---	---	---	---	---	---
		Risk assessment of the Future#1 Train differential is only required when this train is the dominant train type																
Future #1 report: Sig Spacing as a % of Minimum SS	calculations	134%	247%	239%	242%	202% -40%	179%	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Future#1 analysis, 'ok' or clause failed:(a) no more than 50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a b n/a	a b n/a	a b n/a	a b n/a	a ok n/a	---	---	---	---	---	---	---	---	---	---	---
Future #1 report: Summary of compliance	calculations	ok	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SAT/DA	---	---	---	---	---	---	---	---	---	---	---
		Risk assessment of the Future#2 Train differential is only required when this train is the dominant train type																
Future #2 report: Sig Spacing as a % of Minimum SS	calculations	134%	247%	239%	242%	202% -40%	179%	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Future#2 analysis, 'ok' or clause failed:(a) no more than 50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a b n/a	a b n/a	a b n/a	a b n/a	a ok n/a	---	---	---	---	---	---	---	---	---	---	---
Future #2 report: Summary of compliance	calculations	ok	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SAT/DA	---	---	---	---	---	---	---	---	---	---	---
6.7.6 Report on Software Self-Checks																		
Accuracy of average gradient calculations	calculations	ok	ok	ok	ok	ok	ok	---	---	---	---	---	---	---	---	---	---	---
Report on Overlaps GK/RT 0064																		
Overlap warning (see Overlap tab)	calculations	ok	ok	ok	ok	ok	ok	---	---	---	---	---	---	---	---	---	---	---

General Information	Reference	Enter data into white cells	
6.1.1 Title Information Inputs			
Spacing Chart Drawing Number		12500857-GHD-CA-T-2004 P01.01	
Spacing Chart Drawing Version Number	chart title box		
Signalbox Name	chart title box	Rugby SCC	
Line Name	chart title box	Down Northampton	
Producer Initials	chart & report	HRK	
Checker Initials to signify input data checked	chart & report	PCD	
Approver Initials	chart & report	HRK	
Direction of Train Travel (enter '<' or '>')		>	
System of Distance Measurement 'M' metric or 'I' Imperial		M	
Is chart imperial? / conversion factor		FALSE	1
Validated entry for dir of travel		>	
Drawing Number	chart title box	12500857-GHD-CA-T-2004 P01.01	

Notes:

1. signals must be arranged in EITHER ascending or descending mileage order for calculations to be effective
2. the braking aspect sequence TO a RED is determined by the number of aspects entered in the column for the chosen caution signal
3. to prevent a signal from displaying a braking sequence type N in row 29 e.g. at edge of chart where insufficient 'hidden' signals exist to model full braking
4. this model is capable of modelling up to 6 aspects in a head and in a sequence: G, YY, YY, YY, Y, R
5. the Green aspect is never shown on a SSpaM chart
6. Consequently a Stop Board can be modelled by inputting as a 2-aspect signal able to show a red (R/G)
7. Consequently a Distant Board can be modelled as a 2-aspect signal unable to show a red (Y/G)
8. A junction signal is depicted by inputting an L or R character in row 33 where the character describes the principle divergence
9. Junction signalling - ensure turnout speed restrictions are input
   - MAR is facilitated by ensuring the turnout speed is entered rather than the principal route. Any YY-Y sequence at the junction sig is depicted but should be ignored
   - MAY-FA is not explicitly depicted; spacing from the FlashY position to R is modelled as a 4-aspect, YY to R
   - MAY-YY aspects are depicted but the performance benefits can not
   - MAF and MAF-SD are simple aspect sequences
10. **Where the speed approaching or just after a signal is lower than the actual speed AT the signal this can be used for the braking speed**
   Manually input the required 'braking speed' under the RED signal to which the sequence will apply in the Manual Override section; Row 73 below

CHECK THAT ERRORS HAVE NOT ARISEN see yellow rows below

Signals Data	Braking Chart row or data summary	These cells to be used only where the direction of travel is this way >> and the chart contains the maximum 17 signals. Signals will not be shown on chart Enter data into white cells. Note only signals 1 to 17 shown on chart. outer two columns of signals are for approach signals where appropriate for the direction of traffic								
6.1.2 Signals Input Data										
Signal chart position (left-most signal is pos 1)	-	Additional caution (if required)	Caution to 1 (if required)	Signal 1 (lowest mileage)	Signal 2	Signal 3	Signal 4	Signal 5	Signal 6	Signal 7
Input signal Identification number including box prefix	row 2		HN5289	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301	
Input signal mileage as-built (km/miles part)	row 1		94	96	97	98	100	101	102	
Input signal mileage as-built (metres/yds part)	row 1		776	226	429	546	229	767	806	
Input is signal to be displayed on spacing chart (Y or N)				Y	Y	Y	Y	Y	Y	
Input does signal show a red aspect (Y or N)	-		Y	Y	Y	Y	Y	Y	Y	
Input total number of signal aspects (1 to 6)	row 3		4	4	4	4	4	4	4	
Input number of aspects in this sequence (1 to 6)	row 4		4	4	4	4	4	4	4	
Input for junction indicator (N-none, L-left, R-right)	row 4	not used	not used	N	N	N	N	N	N	
Input as-built overlap (metres)	row 11	not used	not used	180	180	180	180	185	182	
Input signalling plan dr'g number (including version)	row 33	not used	not used	RSC-02-0038-01 vEP2	RSC-02-0038-01 vEP2	RSC-27-0038-03 vAH3	RSC-27-0038-03 vAH3	RSC-27-0038-03 vAH3	RSC-27-0038-03 vAH3	
6.1.3 Logic for Display of Data										
Flag =1 when signal display required on chart	6 signals	not used	not used	1	1	1	1	1	1	0
Best caution aspect possible (0=Red,1=Y,2=YY, 3=2xYY, 4=3xYY)		0	2	2	2	2	2	2	2	0
Relative position of first caution (<<direction)		not used	not used	2	2	2	2	1	0	0
Relative position of first caution (>>direction)		not used	not used	1	2	2	2	2	2	2
No of braking aspects approaching this sig (-ve for >> dir of travel)		not used	not used	-1	-2	-2	-2	-2	-2	0
6.1.4 Signal Calculations										
Fractional part of km/miles input expressed as metres/yds		0	0	0	0	0	0	0	0	0
Evaluated km/miles part of signal position	ok	0	94	96	97	98	100	101	102	0
Evaluated metres/yds part of signal position	ok	0	776	226	429	546	229	767	806	0
Normalised mileage (in metres)	row 2	0	94776	96226	97429	98546	100229	101767	102806	0
Normalised mileage blanked if zero (in metres)			94776	96226	97429	98546	100229	101767	102806	
Distance from 1st caution to red (in metres)	row 4	not used	not used	1450	2653	2320	2800	3221	2577	-101767
6.1.5 Input Data Error Reports										
Change of position sig 1 to sig 2 sign & magnitude (metres)				1203						
Error check for input data omitted in one or more cells	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
Error check for out of range input in y/n boxes	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
Error check of signal position (km/miles part)	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
Error check of signal position (metres/yds part)	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
Error check for mileage chg different sense as sig 1 to 2	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
Error check for 'total aspects' input out of range	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
Error check for 'aspects displayed' out of range	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok
Error check for caution data giving impossible aspect sequence	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok
Flag=1 if 'v' is omitted from plan No. unless sig ID blank	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok
Summary error report for all input data	ok									
6.1.6 Signals GK/RT/0075 Clause 2.1.3 c and 2.6.2 assessment										
Tests for ok, if Y-R distance>=1/3 of YY-R distance (--- for n/a)		not used	not used	---	45.34% - ok	48.15% - ok	60.11% - ok	47.75% - ok	40.32% - ok	---
Tests for ok, if Y-R distance>=1/3 of YY-R MIN distance (or n/a)		not used	not used	N/A	81.32% - ok	73.07% - ok	101.49% - ok	89.63% - ok	44.99% - ok	N/A

Manual Override data	Refers to Braking Chart	Enter data into white cells or leave blank to use auto-calculated values								
6.1.7 Manual Override Input Data										
Signal Identification number	row 2	0	HN5289	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301	0
Max attainable speed for all trains (mph) @ FIRST CAUTION for *this* signal	row 12	not required	not required							
Max attainable speed for passenger trains (mph) @ FIRST CAUTION for *this* signal	row 13	not required	not required							
Max attainable speed for enhanced trains (mph) @ FIRST CAUTION for *this* signal	row 14	not required	not required							
Max attainable speed for Future #1 (mph) @ FIRST CAUTION for *this* signal	row 15	not required	not required							
Max attainable speed for Future #2 (mph) @ FIRST CAUTION for *this* signal	row 16	not required	not required							
If required*, min signal spacing for all trains (metres)	row 17	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for passenger trains (metres)	row 18	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for enhanced trains (metres)	row 19	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for Future#1 (metres)	row 20	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for Future#2 (metres)	row 21	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
* override may be required if compliance with GK/GN 0675 GN31 is not achieved										
Disabled (was braking excess/def)	row 22	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 23	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 24	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 25	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 26	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
MSWD for all trains (mph)	row 27	not required	not required							
MSWD for passenger trains (mph)	row 28	not required	not required							
MSWD for enhanced trains (mph)	row 29	not required	not required							
MSWD for Future#1 (mph)	row 30	not required	not required							
MSWD for Future#2 (mph)	row 31	not required	not required							
Signal narrative: any describing feature recorded in this free field should be copied to the Scheme/Signalling plan Design Log										

These cells to be used only where the direction of travel is this way << and the chart contains the maximum 17 signals. Signals will not be shown on chart

Signal 8	Signal 9	Signal 10	Signal 11	Signal 12	Signal 13	Signal 14	Signal 15	Signal 16	Signal 17 (highest mileage)	Caution to 17 (if required)	Additional caution (if required)
										not used	not used
										not used	not used
										not used	not used
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
---	---	---	---	---	---	---	---	---	---	not used	not used
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	not used	not used

0	0	0	0	0	0	0	0	0	0
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled

	#						
MILEAGE (km AND metres)	1	96+226	97+429	98+546	100+229	101+767	102+806
Signal Identification Number		HN5291	HN5293	HN5295	HN5297	HN5299	HN5301
Signal to Signal (metres)	2	1203	1117	1683	1538	1039	
Signal (figure within circle is number of aspects in main signal head)	3	4	4	4	4	4	4

Direction of travel → Down Northampton

Braking Aspect Sequence and Signal Spacing Current (metres) (4)

HN5291	HN5293	HN5295	HN5297	HN5299	HN5301
R					
Y	R				
YY 2320	Y	R			
	YY 2800	Y	R		
		YY 3221	Y	R	
			YY 2577	Y	R

This chart must be read in association with its Status Report - Input Errors and Excess Braking Assessments.

THIS CHART IS ABLE TO MODEL CONSECUTIVE YY

		#	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301
Maximum Permissible Speed 'MPS' at the signal (mph)	All Trains	5	90	90	90	100	100	100
	Passenger Trains	6	90	90	90	100	100	100
	Enhanced	7	90	90	90	100	100	100
	Future #1	8	90	90	90	100	100	100
	Future #2	9	90	90	90	100	100	100
Overlap (metres)	Minimum (GK/RT 0064)	10	180	180	180	180	180	180
	As built	11	180	180	180	180	185	182
Speed (mph) at the first caution signal (note 9) MPS, or Maximum Attainable Speed sampled every 16 m	All Trains	12	90	90	90	90	90	100
	Passenger Trains	13	90	90	90	90	90	100
	Enhanced	14	90	90	90	90	90	100
	Future #1	15	90	90	90	90	90	100
	Future #2	16	90	90	90	90	90	100
Minimum Signal Spacing (metres)	All Trains	17	1484	1479	1529	1658	p 1716	2310
	Passenger Trains	18	1484	1479	1529	1657	p 1716	2310
	Enhanced	19	1074	1072	1097	1155	p 1180	1436
	Future #1	20	1074	1072	1097	1155	p 1180	1436
	Future #2	21	1074	1072	1097	1155	p 1180	1436
Signal Spacing Excess (+) (metres) Deficiency (-) (metres) (see note 8)	All Trains	22	(-34)	+1174	+791	+1142	+1505	+268
	Passenger Trains	23	(-34)	+1174	+791	+1143	+1505	+268
	Enhanced	24	+376	+1581	+1223	+1645	+2041	+1141
	Future #1	25	+376	+1581	+1223	+1645	+2041	+1141
	Future #2	26	+376	+1581	+1223	+1645	+2041	+1141
Maximum Speed Without Deficiency at first caution signal (mph) (see note 6)	All Trains	27	85	125	125	125	125	125
	Passenger Trains	28	85	125	125	125	125	125
	Enhanced	29	105	125	125	125	125	125
	Future #1	30	105	125	125	125	125	125
	Future #2	31	105	125	125	125	125	125
Average Gradient		32	391R	364R	LEVEL	228F	167F	160F
Signalling Plan Number		33	RSC-02-0038-01 vEP	RSC-02-0038-01 vEP	RSC-27-0038-03 vAH	RSC-27-0038-03 vAH	RSC-27-0038-03 vAH	RSC-27-0038-03 vAH

Notes:

1. Diverging junction to left or right shown by ↖ or ↙ next to red aspect. Does not imply Junction Indicator on signal
2. Rows 22-26 display deficiencies in brackets to aid recognition.
3. Neither overlap nor sighting distance are included within gradient or signal spacing calculations.
4. Maximum permissible speed is presented for every signal. Changes are indicated by vertical line between values. Position of line does not represent relative position of speed change.
5. Signal spacing prefixed by 'p' indicate specific application of signalling principle GK/RT 0075 clause 2.3.8 invoked when a signal approach demonstrates falling and variable gradients.
6. MSWD Rows 27-31 conservatively show speeds that will always result in adequate braking if adopted, though higher speeds may be possible after more detailed evaluation.
7. Figures are positioned in columns to denote the place of application e.g. at the stop signal - right hand side, at the first caution - left hand side.
8. Speeds prefixed by 'm' are manually determined 'override' values
9. Speeds shown underlined indicate MPS values, otherwise MAS, though no change to application position.

Software version	Full Issue 6.01	
	Signature	
Produced	HRK	
Checked	PCD	
Approved	HRK	
Original Scale	N/A	
Date Printed	26/07/2018 15:41	

Rugby SCC

Network Rail

Signal Spacing Model

Down Northampton
96 km 226 m to 102 km 806 m

Drg.No 12500857-GHD-CA-T-2004 P01.01
Refers to: GK/RT 0075 issue 1, GK/RT 0064 issue 1
Version 0

Status report title information	Reference			
6.7.0 Status Report Title Information				
Signalbox name	sig&gen_inputs	Rugby SCC		
Line Name	sig&gen_inputs	Down Northampton		
Drawing Number	sig&gen_inputs	12500857-GHD-CA-T-2004 P01.01		
Version Number	sig&gen_inputs	0		
		initials	signed	date
Producer signature and date	sig&gen_inputs	HRK		
Checker signature and date	sig&gen_inputs	PCD		
Approver Signature and date	sig&gen_inputs	HRK		
Date and time this report printed	sig&gen_inputs	26/07/2018 15:41		

Checksum Report							
6.7.9 Checksum Report							
	Known	Test	Verdict		Known	Test	Verdict
Star	0	0	OK	>>	####	5945724	OK
Sel	####	12273333	OK	Stat	####	5208983	OK
SeM	####	15317458	OK	All	####	2854691	OK
Sig	####	2549131	OK	Pas	####	2853008	OK
Gra	####	3324484	OK	Enh	####	2850492	OK
Per	####	5665133	OK	Fut1	####	2840700	OK
Att	####	145190349	OK	Fut2	####	2847942	OK
Calc	####	24095366	OK	Over	####	1080498	OK
<<	####	6013876	OK	DATE		30-Apr-12	

Status report for general data	Reference	Displays 'ok' for compliance or provides diagnostic information
6.7.1 Report for Signals and General Inputs Sheet		
Summary of signal and mileage input data	sig&gen_inputs	ok
Manual override inputs	sig&gen_inputs	ok
6.7.2 Report for Gradient Inputs Sheet		
Summary of gradient input data and mileage limits	grad_inputs	ok
6.7.3 Report for Permissible Speed Inputs Sheet		
Summary of speed input data and mileage limits	linespeed_inputs	ok
6.7.7 Report on Attainable Speed Evaluation		
Accuracy of sampling for speed profile calculations	att_speed	Worst case error 0 mph, mean error 0 mph with sampling every 16 metres
6.7.8 GK/RT0064 clause 4.3.2 - speed and ROLs		
Summary of a) overlap min lengths and b) speed changes within approach to signal with ROL	overlaps	ok

Spacing % are rounded DOWN for presentation purposes. Tests are reported on ACTUAL distances

Status report for individual signals — Reference

Displays report: **'ok'; 'FAIL' or 'a' 'b' 'c'** means the described test has not been met (see row label); **'n/a' or '---'** mean not applicable. SAT/DA***** and SPH D220***** gives explanation of compliance requirement. **Note:** #### **or #VALUE! identifies *there is overspill* or that the chart is unable to *make* the required calculation which should be done manually** e.g. an excess reduction comparison with a signal on the edge of the chart. **RGS GI/RT 7006 category simple signals automatically satisfy *assessments**. Underbraked signals are depicted ~~75%~~ but will meeet the various overbraking tests.

Status report for individual signals	Reference						
Signal Identification number	sig&gen_inputs	HN5291	HN5293	HN5295	HN5297	HN5299	HN5301
6.7.5.1 Report on GK/RT 0075 & GK/GN 0675 Various Clauses							
Acceptability to GK/GN 0675 GN31: Signal requires further assessment if its approach includes falling and rising grad's both steeper than 1%	calculations	ok	ok	ok	ok	ok	ok
Compliance with GK/RT 0075 clause 2.6.1: Ratio of Y-R distance to YY-R distance - result shows "ok" if ratio > 33.33% or "FAIL" if not. 4 aspect areas only.	sig&gen_inputs	---	45.34% - ok	48.15% - ok	60.11% - ok	47.75% - ok	40.32% - ok
Compliance with GK/RT 0075 clause 2.6.2: Ratio of Y-R distance to YY-R min req distance - result shows "ok" if ratio > 33.33% or "FAIL" if not. 4 aspect areas only.	sig&gen_inputs	---	---	---	---	---	---
6.7.5.2 Report on GK/RT 0075 - Signal Spacing and GK/GN 0675 GN50							
All Trains report: Sig Spacing as a % of Minimum SS	calculations	~~97%~~	179%	151%	168%	187%	111% -76%
All Trains analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a ok n/a	a ok n/a	a ok n/a	a ok n/a	ok n/a n/a
All Trains report: Summary of compliance	calculations	UNDER SPACED	SAT/DA	SAT/DA	SAT/DA	SAT/DA	ok
Risk assessment of the Passenger Train differential is only required when this train is the dominant train type							
Passenger Trains report: Sig Spacing as a % of Minimum SS	calculations	~~97%~~	179%	151%	168%	187%	111% -76%
Pass Trains analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a ok n/a	a ok n/a	a ok n/a	a ok n/a	ok n/a n/a
Passenger Trains report: Summary of compliance	calculations	UNDER SPACED	SAT/DA	SAT/DA	SAT/DA	SAT/DA	ok
Risk assessment of the Enhanced Train differential is only required when this train is the dominant train type							
Enhanced Trains report: Sig Spacing as a % of Minimum SS	calculations	134%	247%	211% -36%	242%	272%	179% -93%
Enhanced Trains analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a b n/a	a b n/a	a b n/a	a b n/a	a ok n/a
Enhanced Trains report: Summary of compliance	calculations	ok	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SAT/DA
Risk assessment of the Future#1 Train differential is only required when this train is the dominant train type							
Future #1 report: Sig Spacing as a % of Minimum SS	calculations	134%	247%	211% -36%	242%	272%	179% -93%
Future#1 analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a b n/a	a b n/a	a b n/a	a b n/a	a ok n/a
Future #1 report: Summary of compliance	calculations	ok	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SAT/DA
Risk assessment of the Future#2 Train differential is only required when this train is the dominant train type							
Future #2 report: Sig Spacing as a % of Minimum SS	calculations	134%	247%	211% -36%	242%	272%	179% -93%
Future#2 analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a b n/a	a b n/a	a b n/a	a b n/a	a ok n/a
Future #2 report: Summary of compliance	calculations	ok	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SAT/DA
6.7.6 Report on Software Self-Checks							
Accuracy of average gradient calculations	calculations	ok	ok	ok	ok	ok	ok
Report on Overlaps GK/RT 0064							
Overlap warning (see Overlap tab)	calculations	ok	ok	ok	ok	ok	ok

Status report for individual signals											
Signal Identification number	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
6.7.5.1 Report on GK/RT 0075 & GK/GN 0675 Various Clauses											
Acceptability to GK/GN 0675 GN31	---	---	---	---	---	---	---	---	---	---	---
Compliance with GK/RT 0075 clause 2.6.1	---	---	---	---	---	---	---	---	---	---	---
Compliance with GK/RT 0075 clause 2.6.2	---	---	---	---	---	---	---	---	---	---	---
6.7.5.2 Report on GK/RT 0075 - Signal Spacing and GK/GN 0675 GN50											
All Trains report: Sig Spacing as a % of Minimum SS	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
All Trains analysis	---	---	---	---	---	---	---	---	---	---	---
All Trains report: Summary of compliance	---	---	---	---	---	---	---	---	---	---	---
Passenger Trains report: Sig Spacing as a % of Minimum SS	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Pass Trains analysis	---	---	---	---	---	---	---	---	---	---	---
Passenger Trains report: Summary of compliance	---	---	---	---	---	---	---	---	---	---	---
Enhanced Trains report: Sig Spacing as a % of Minimum SS	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Enhanced Trains analysis	---	---	---	---	---	---	---	---	---	---	---
Enhanced Trains report: Summary of compliance	---	---	---	---	---	---	---	---	---	---	---
Future #1 report: Sig Spacing as a % of Minimum SS	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Future#1 analysis	---	---	---	---	---	---	---	---	---	---	---
Future #1 report: Summary of compliance	---	---	---	---	---	---	---	---	---	---	---
Future #2 report: Sig Spacing as a % of Minimum SS	not calc	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####
Future#2 analysis	---	---	---	---	---	---	---	---	---	---	---
Future #2 report: Summary of compliance	---	---	---	---	---	---	---	---	---	---	---
6.7.6 Report on Software Self-Checks											
Accuracy of average gradient calculations	---	---	---	---	---	---	---	---	---	---	---
Report on Overlaps GK/RT 0064											
Overlap warning (see Overlap tab)	---	---	---	---	---	---	---	---	---	---	---

General Information	Reference	Enter data into white cells
6.1.1 Title Information Inputs		
Spacing Chart Drawing Number		12500857-GHD-CA-T-2007 P01.01
Spacing Chart Drawing Version Number	chart title box	
Signalbox Name	chart title box	Rugby SCC
Line Name	chart title box	Up Northampton
Producer Initials	chart & report	
Checker Initials to signify input data checked	chart & report	
Approver Initials	chart & report	
Direction of Train Travel (enter '<' or '>')		<
System of Distance Measurement 'M' metric or 'I' Imperial		
Is chart imperial? / conversion factor		FALSE 1
Validated entry for dir of travel		<
Drawing Number	chart title box	12500857-GHD-CA-T-2007 P01.01

Notes:

1. signals must be arranged in EITHER ascending or descending mileage order for calculations to be effectiv
2. the braking aspect sequence TO a RED is determined by the number of aspects entered in the column for the chosen caution signa
3. to prevent a signal from displaying a braking sequence type N in row 29 e.g. at edge of chart where insufficient 'hidden' signals exist to model full brakir
4. this model is capable of modelling up to 6 aspects in a head and in a sequence: G, YY, YY, YY, Y, I
5. the Green aspect is never shown on a SSpaM char
6. Consequently a Stop Board can be modelled by inputting as a 2-aspect signal able to show a red (R/G)
7. Consequently a Distant Board can be modelled as a 2-aspect signal unable to show a red (Y/G
8. A junction signal is depicted by inputting an L or R character in row 33 where the character describes the principle divergenc
9. Junction signalling - ensure turnout speed restrictions are input
   MAR is facilitated by ensuring the turnout speed is entered rather than the principal route. Any YY-Y sequence at the junction sig is depicted but should be ignore
   MAY-FA is not explicitly depicted; spacing from the FlashY position to R is modelled as a 4-aspect, YY to
   MAY-YY aspects are depicted but the performance benefits can not
   MAF and MAF-SD are simple aspect sequences
10. **Where the speed approaching or just after a signal is lower than the actual speed AT the signal this can be used for the braking speed**
   Manually input the required 'braking speed' under the RED signal to which the sequence will apply in the Manual Override section; Row 73 below

CHECK THAT ERRORS HAVE NOT ARISEN see yellow rows below

These cells to be used only where the direction of travel is this way >> and the chart contains the maximum 17 signals. Signals will not be shown on chart

Signals Data	Braking Chart row or data summary	Enter data into white cells. Note only signals 1 to 17 shown on chart. outer two columns of signals are for approach signals where appropriate for the direction of traffic									
6.1.2 Signals Input Data											
Signal chart position (left-most signal is pos 1)	-	Additional caution (if required)	Caution to 1 (if required)	Signal 1 (lowest mileage)	Signal 2	Signal 3	Signal 4	Signal 5	Signal 6	Signal 7	
Input signal Identification number including box prefix	row 2			HN5290	HN5292	HN5294	HN5296	HN5298	HN5300	HN5302	
Input signal mileage as-built (km/miles part)	row 1			96	97	98	99	100	101	102	
Input signal mileage as-built (metres/yds part)	row 1			322	553	590	774	782	723	698	
Input is signal to be displayed on spacing chart (Y or N)				Y	Y	Y	Y	Y	Y	Y	
Input does signal show a red aspect (Y or N)	-			Y	Y	Y	Y	Y	Y	Y	
Input total number of signal aspects (1 to 6)	row 3			4	4	4	4	4	4	4	
Input number of aspects in this sequence (1 to 6)	row 4			4	4	4	4	4	4	4	
Input for junction indicator (N-none, L-left, R-right)	row 4	not used	not used	N	N	N	N	N	N	N	
Input as-built overlap (metres)	row 11	not used	not used	180	180	180	180	182	180	182	
Input signalling plan dr'g number (including version)	row 33	not used	not used	RSC-02-38-01 Ver EP2	RSC-02-38-01 Ver EP2	RSC-02-38-03 Ver AH3	RSC-02-38-03 Ver AH3	RSC-02-38-03 Ver AH3	RSC-02-38-03 Ver AH3	RSC-02-38-03 Ver AH3	RSC-
6.1.3 Logic for Display of Data											
Flag =1 when signal display required on chart	8 signals	not used	not used	1	1	1	1	1	1	1	
Best caution aspect possible (0=Red,1=Y,2=YY, 3=2xYY, 4=3xYY)		0	0	2	2	2	2	2	2	2	
Relative position of first caution (<<direction)		not used	not used	2	2	2	2	2	2	1	
Relative position of first caution (>>direction)		not used	not used	0	1	2	2	2	2	2	
No of braking aspects approaching this sig (-ve for >> dir of travel)		not used	not used	2	2	2	2	2	2	1	
6.1.4 Signal Calculations											
Fractional part of km/miles input expressed as metres/yds		0	0	0	0	0	0	0	0	0	
Evaluated km/miles part of signal position	ok	0	0	96	97	98	99	100	101	102	
Evaluated metres/yds part of signal position	ok	0	0	322	553	590	774	782	723	698	
Normalised mileage (in metres)	row 2	0	0	96322	97553	98590	99774	100782	101723	102698	
Normalised mileage blanked if zero (in metres)				96322	97553	98590	99774	100782	101723	102698	
Distance from 1st caution to red (in metres)	row 4	not used	not used	2268	2221	2192	1949	1916	2694	1719	
6.1.5 Input Data Error Reports											
Change of position sig 1 to sig 2 sign & magnitude (metres)				1231							
Error check for input data omitted in one or more cells	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for out of range input in y/n boxes	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check of signal position (km/miles part)	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check of signal position (metres/yds part)	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for mileage chg different sense as sig 1 to 2	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for 'total aspects' input out of range	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	
Error check for 'aspects displayed' out of range	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok	
Error check for caution data giving impossible aspect sequence	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok	
Flag=1 if 'v' is omitted from plan No. unless sig ID blank	ok	not used	not used	ok	ok	ok	ok	ok	ok	ok	
Summary error report for all input data	ok										
6.1.6 Signals GK/RT/0075 Clause 2.1.3 c and 2.6.2 assessmen											
Tests for ok, if Y-R distance>=1/3 of YY-R distance (--- for n/a)		not used	not used	54.28% - ok	46.69% - ok	54.01% - ok	51.72% - ok	49.11% - ok	36.19% - ok	---	
Tests for ok, if Y-R distance>=1/3 of YY-R MIN distance (or n/a)		not used	not used	79.81% - ok	71.89% - ok	83.89% - ok	88.11% - ok	82.26% - ok	85.23% - ok	N/A	

Manual Override data	Refers to Braking Chart	Enter data into white cells or leave blank to use auto-calculated values								
6.1.7 Manual Override Input Data										
Signal Identification number	row 2	0	0	HN5290	HN5292	HN5294	HN5296	HN5298	HN5300	HN5302
Max attainable speed for all trains (mph) @ FIRST CAUTION for *this* signal	row 12	not required	not required							
Max attainable speed for passenger trains (mph) @ FIRST CAUTION for *this* signal	row 13	not required	not required							
Max attainable speed for enhanced trains (mph) @ FIRST CAUTION for *this* signal	row 14	not required	not required							
Max attainable speed for Future #1 (mph) @ FIRST CAUTION for *this* signal	row 15	not required	not required							
Max attainable speed for Future #2 (mph) @ FIRST CAUTION for *this* signal	row 16	not required	not required							
If required*, min signal spacing for all trains (metres)	row 17	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for passenger trains (metres)	row 18	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for enhanced trains (metres)	row 19	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for Future#1 (metres)	row 20	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
If required*, min signal spacing for Future#2 (metres)	row 21	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
* override may be required if compliance with GK/GN 0675 GN31 is not achieved										
Disabled (was braking excess/def)	row 22	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 23	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 24	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 25	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
Disabled (was braking excess/def)	row 26	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
MSWD for all trains (mph)	row 27	not required	not required							
MSWD for passenger trains (mph)	row 28	not required	not required							
MSWD for enhanced trains (mph)	row 29	not required	not required							
MSWD for Future#1 (mph)	row 30	not required	not required							
MSWD for Future#2 (mph)	row 31	not required	not required							
Signal narrative: any describing feature recorded in this free field should be copied to the Scheme/Signalling plan Design Log										

These cells to be used only where the direction of travel is this way << and the chart contains the maximum 17 signals. Signals will not be shown on chart

Signal 8	Signal 9	Signal 10	Signal 11	Signal 12	Signal 13	Signal 14	Signal 15	Signal 16	Signal 17 (highest mileage)	Caution to 17 (if required)	Additional caution (if required)
HN5304											
104											
417											
Y											
Y											
4											
4											
N										not used	not used
331										not used	not used
02-38-03 Ver AH3										not used	not used
1	0	0	0	0	0	0	0	0	0	not used	not used
2	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	not used	not used
2	2	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	not used	not used
0	0	0	0	0	0	0	0	0	0	0	0
104	0	0	0	0	0	0	0	0	0	0	0
417	0	0	0	0	0	0	0	0	0	0	0
104417	0	0	0	0	0	0	0	0	0	0	0
104417											
no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	no caution	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	not used	not used
---	---	---	---	---	---	---	---	---	---	not used	not used
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	not used	not used

HN5304	0	0	0	0	0	0	0	0	0
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled
disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled	disabled

MILEAGE (km AND metres)		1	96+322	97+553	98+590	99+774	100+782	101+723	102+698	104+417
Signal Identification Number			HN5290	HN5292	HN5294	HN5296	HN5298	HN5300	HN5302	HN5304
Signal to Signal (metres)		2	1231	1037	1184	1008	941	975	1719	

Signal (figure within circle is number of aspects in main signal head) 3

Direction of travel

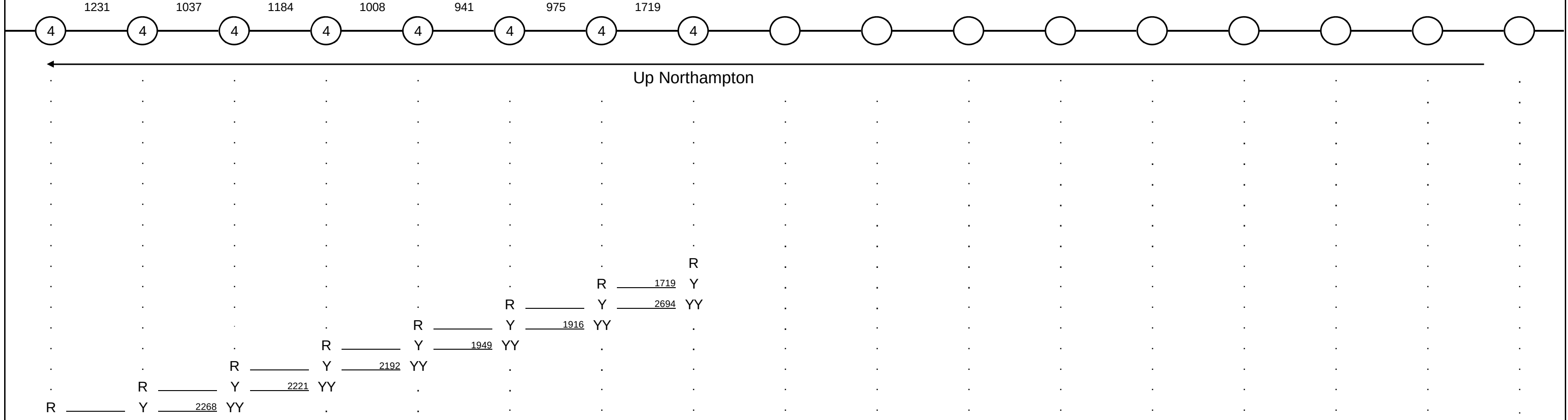
Braking Aspect Sequence 4

and

Signal Spacing Current (metres)

This chart must be read in association with its Status Report - Input Errors and Excess Braking Assessments.

THIS CHART IS ABLE TO MODEL CONSECUTIVE YY



Maximum Permissible Speed 'MPS' at the signal (mph)	All Trains	5	90	90	90	90	90	75	75	75
	Passenger Trains	6	90	90	90	90	90	75	75	75
	Enhanced	7	90	90	90	90	90	75	75	75
	Future #1	8	90	90	90	90	90	75	75	75
	Future #2	9	90	90	90	90	90	75	75	75
Overlap (metres)	Minimum (GK/RT 0064)	10	180	180	180	180	180	180	180	75
	As built	11	180	180	180	180	182	180	182	331
Speed (mph) at the first caution signal (note 9) MPS, or Maximum Attainable Speed sampled every 16 m	All Trains	12	90	90	90	75	75	75	75	75
	Passenger Trains	13	90	90	90	75	75	75	75	75
	Enhanced	14	90	90	90	75	75	75	75	75
	Future #1	15	90	90	90	75	75	75	75	75
	Future #2	16	90	90	90	75	75	75	75	75
Minimum Signal Spacing (metres)	All Trains	17	1542	1442	1411	1144	1144	1144	1144	1258
	Passenger Trains	18	1542	1442	1411	948	948	948	948	1030
	Enhanced	19	1103	1056	1041	734	734	734	734	779
	Future #1	20	1103	1056	1041	734	734	734	734	779
	Future #2	21	1103	1056	1041	734	734	734	734	779
Signal Spacing Excess (+) (metres) Deficiency (-) (metres) (see note 8)	All Trains	22	+726	+779	+781	+805	+772	+1550	+575	(-1258)
	Passenger Trains	23	+726	+779	+781	+1001	+968	+1746	+771	(-1030)
	Enhanced	24	+1165	+1165	+1151	+1216	+1183	+1961	+986	(-779)
	Future #1	25	+1165	+1165	+1151	+1216	+1183	+1961	+986	(-779)
	Future #2	26	+1165	+1165	+1151	+1216	+1183	+1961	+986	(-779)
Maximum Speed Without Deficiency at first caution signal (mph) (see note 6)	All Trains	27	125	125	125	120	120	125	95	#N/A
	Passenger Trains	28	125	125	125	120	120	125	95	#N/A
	Enhanced	29	125	125	125	120	120	125	115	#N/A
	Future #1	30	125	125	125	120	120	125	115	#N/A
	Future #2	31	125	125	125	120	120	125	115	#N/A
Average Gradient		32	LEVEL	229R	170R	160R	160R	160R	160R	LEVEL
Signalling Plan Number		33	RSC-02-38-01 Ver EP	RSC-02-38-01 Ver EP	RSC-02-38-03 Ver AH	RSC-02-38-03 Ver AH	RSC-02-38-03 Ver AH	RSC-02-38-03 Ver AH	RSC-02-38-03 Ver AH	RSC-02-38-03 Ver AH

Notes:
1. Diverging junction to left or right shown by ↙ or ↖ next to red aspect. Does not imply Junction Indicator on signal
2. Rows 22-26 display deficiencies in brackets to aid recognition.
3. Neither overlap nor sighting distance are included within gradient or signal spacing calculations.
4. Maximum permissible speed is presented for every signal. Changes are indicated by vertical line between values. Position of line does not represent relative position of speed change.
5. Signal spacing prefixed by 'p' indicate specific application of signalling principle GK/RT 0075 clause 2.3.8 invoked when a signal approach demonstrates falling and variable gradients.
6. MSWD Rows 27-31 conservatively show speeds that will always result in adequate braking if adopted, though higher speeds may be possible after more detailed evaluation.
7. Figures are positioned in columns to denote the place of application e.g. at the stop signal - left hand side, at the first caution - right hand side.
8. Speeds prefixed by 'm' are manually determined 'override' values
9. Speeds shown underlined indicate MPS values, otherwise MAS, though no change to application position.

Software version	Full Issue 6.01	
	Signature	
Produced	0	
Checked	0	
Approved	0	
Original Scale	N/A	
Date Printed	26/07/2018 15:46	

Rugby SCC

Signal Spacing Model

Up Northampton

96 km 322 m to 104 km 417 m

Network Rail

Drg.No 12500857-GHD-CA-T-2007 P01.01

Refers to: GK/RT 0075 issue 1, GK/RT 0064 issue 1

Version 0

Status report title information	Reference			
6.7.0 Status Report Title Information				
Signalbox name	sig&gen_inputs	Rugby SCC		
Line Name	sig&gen_inputs	Up Northampton		
Drawing Number	sig&gen_inputs	12500857-GHD-CA-T-2007 P01.01		
Version Number	sig&gen_inputs	0		
		initials	signed	date
Producer signature and date	sig&gen_inputs	0		
Checker signature and date	sig&gen_inputs	0		
Approver Signature and date	sig&gen_inputs	0		
Date and time this report printed	sig&gen_inputs	26/07/2018 15:46		

Checksum Report

6.7.9 Checksum Report

	Known	Test	Verdict		Known	Test	Verdict
Star	0	0	OK	>>	####	5945724	OK
Sel	####	12273333	OK	Stat	####	5208983	OK
SeM	####	15317458	OK	All	####	2854691	OK
Sig	####	2549131	OK	Pas	####	2853008	OK
Gra	####	3324484	OK	Enh	####	2850492	OK
Per	####	5665133	OK	Fut1	####	2840700	OK
Att	####	145190349	OK	Fut2	####	2847942	OK
Calc	####	24095366	OK	Over	####	1080498	OK
<<	####	6013876	OK	DATE		30-Apr-12	

Status report for general data	Reference	Displays 'ok' for compliance or provides diagnostic information
6.7.1 Report for Signals and General Inputs Sheet		
Summary of signal and mileage input data	sig&gen_inputs	ok
Manual override inputs	sig&gen_inputs	ok
6.7.2 Report for Gradient Inputs Sheet		
Summary of gradient input data and mileage limits	grad_inputs	ok
6.7.3 Report for Permissible Speed Inputs Sheet		
Summary of speed input data and mileage limits	linespeed_inputs	ok
6.7.7 Report on Attainable Speed Evaluation		
Accuracy of sampling for speed profile calculations	att_speed	Worst case error 0 mph, mean error 0 mph with sampling every 16 metres
6.7.8 GK/RT0064 clause 4.3.2 - speed and ROLs		
Summary of a) overlap min lengths and b) speed changes within approach to signal with ROL	overlaps	ok

Spacing % are rounded DOWN for presentation purposes. Tests are reported on ACTUAL distances

Status report for individual signals

Reference

Displays report: **'ok'; 'FAIL' or 'a' 'b' 'c'** means the described test has not been met (see row label); **'n/a' or '---'** mean not applicable. SAT/DA***** and SPH D220***** gives explanation of compliance requirement. **Note:** #### **or #VALUE! identifies *there is overspill* or that the chart is unable to *make* the required calculation which should be done manually** e.g. an excess reduction comparison with a signal on the edge of the chart. **RGS GI/RT 7006 category simple signals automatically satisfy *assessments**. Underbraked signals are depicted ~~**75%**~~ but will meeet the various overbraking tests.

Signal Identification number	sig&gen_inputs	HN5290	HN5292	HN5294	HN5296	HN5298	HN5300	HN5302	HN5304	no data	no data	no data	no data	no data	no data	no data	no data	no data
6.7.5.1 Report on GK/RT 0075 & GK/GN 0675 Various Clauses																		
Acceptability to GK/GN 0675 GN31: Signal requires further assessment if its approach includes falling and rising grad's both steeper than 1%	calculations	ok	ok	ok	ok	ok	ok	ok	---	---	---	---	---	---	---	---	---	---
Compliance with GK/RT 0075 clause 2.6.1: Ratio of Y-R distance to YY-R distance - result shows "ok" if ratio > 33.33% or "FAIL" if not. 4 aspect areas only.	sig&gen_inputs	54.28% - ok	46.69% - ok	54.01% - ok	51.72% - ok	49.11% - ok	36.19% - ok	---	---	---	---	---	---	---	---	---	---	---
Compliance with GK/RT 0075 clause 2.6.2: Ratio of Y-R distance to YY-R min req distance - result shows "ok" if ratio > 33.33% or "FAIL" if not. 4 aspect areas only.	sig&gen_inputs	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6.7.5.2 Report on GK/RT 0075 - Signal Spacing and GK/GN 0675 GN50																		
All Trains report: Sig Spacing as a % of Minimum SS	calculations	147%	153%	155%	170%	167% -68%	235%	150% #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc
All Trains analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a ok n/a	a ok n/a	a ok n/a	a ok n/a	a b n/a	a ok n/a	ok n/a n/a	---	---	---	---	---	---	---	---	---
All Trains report: Summary of compliance	calculations	ok	SAT/DA	SAT/DA	SAT/DA	SAT/DA	SPH D220 assessment	SAT/DA	ok	---	---	---	---	---	---	---	---	---
		Risk assessment of the Passenger Train differential is only required when this train is the dominant train type																
Passenger Trains report: Sig Spacing as a % of Minimum SS	calculations	147%	153%	155% -50%	205%	202% -82%	284%	181% #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc
Pass Trains analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	ok n/a n/a	a ok n/a	a ok n/a	a b n/a	a b n/a	a b n/a	a ok n/a	ok n/a n/a	---	---	---	---	---	---	---	---	---
Passenger Trains report: Summary of compliance	calculations	ok	SAT/DA	SAT/DA	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SAT/DA	ok	---	---	---	---	---	---	---	---	---
		Risk assessment of the Enhanced Train differential is only required when this train is the dominant train type																
Enhanced Trains report: Sig Spacing as a % of Minimum SS	calculations	205%	210%	210% -55%	265%	261% #####	367%	234% #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc
Enhanced Trains analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	ok n/a n/a	---	---	---	---	---	---	---	---	---
Enhanced Trains report: Summary of compliance	calculations	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	ok	---	---	---	---	---	---	---	---	---
		Risk assessment of the Future#1 Train differential is only required when this train is the dominant train type																
Future #1 report: Sig Spacing as a % of Minimum SS	calculations	205%	210%	210% -55%	265%	261% #####	367%	234% #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc
Future#1 analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	ok n/a n/a	---	---	---	---	---	---	---	---	---
Future #1 report: Summary of compliance	calculations	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	ok	---	---	---	---	---	---	---	---	---
		Risk assessment of the Future#2 Train differential is only required when this train is the dominant train type																
Future #2 report: Sig Spacing as a % of Minimum SS	calculations	205%	210%	210% -55%	265%	261% #####	367%	234% #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc #####	not calc
Future#2 analysis, 'ok' or clause failed:(a) no more than50% excess (b) min spacing 500m or more, no more than 100% excess (c) min spacing below 500m, max spacing 1000m	calculations	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	a b n/a	ok n/a n/a	---	---	---	---	---	---	---	---	---
Future #2 report: Summary of compliance	calculations	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	SPH D220 assessment	ok	---	---	---	---	---	---	---	---	---
6.7.6 Report on Software Self-Checks																		
Accuracy of average gradient calculations	calculations	ok	ok	ok	ok	ok	ok	ok	---	---	---	---	---	---	---	---	---	---
Report on Overlaps GK/RT 0064																		
Overlap warning (see Overlap tab)	calculations	ok	ok	ok	ok	ok	ok	ok	---	---	---	---	---	---	---	---	---	---

Appendix D – Drawings

12500857-GHD-DR-T-7100 – General Arrangement Drawing

Notes

1. This drawing is based on Ordnance Survey data provided by Roxhill and supplemented by Ordnance Survey data provided by emapsite (licence number 0100031673) on 28th September 2017.

2. All dimensions are in metres unless otherwise stated.

3. Drawing is to be read in conjuction with;
   - 12500857-GHD-DR-T-7101-P01-LS Longsection drawing
   - 12500857-GHD-RP-T-1003-P01 Feasibility Report
   - 12500857-GHD-SK-T-9001 P01-03 Signalling Sketch Option 1

4. Discipline impact assessments for; signalling, telecomms, civils, earthworks and OLE are appended to the Concept Design Report.

Legend

- PROPOSED WORKS
- MODIFIED WORKS
- EXISTING SURVEY DATA
- PROPOSED FACILITY DESIGN (Supplied by others)
- PROPOSED FACILITY TRACK DESIGN (Supplied by others)
- PROPOSED EARTH BUND (Supplied by others)
- PROPOSED FOOTPATH (Supplied by others)
- BOUNDARY USED FOR ESTIMATING PURPOSES

Rev	Date	Description of Revisions	Drawn	Chkd	Appr
P03		REVISED FOLLOWING DISCIPLINE REVIEW			
P02	-	INTERNAL ISSUE - FOR REVIEW	-	-	-
P01	08/06/18	ORIGINAL ISSUE - FOR INFORMATION	GKW	DPH	HRK

Status

FEASIBILITY

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Contractor(s)

Project

NORTHAMPTON GATEWAY
STRATEGIC RAIL FREIGHT INTERCHANGE

Drawing Title

NORTHAMPTON SFRI

PERMANENT WAY
GENERAL ARRANGEMENT

Designed	G.K.Warren	Signed	Date
Drawn	G.K.Warren	Signed	Date
Checked	D.P.Harrison	Signed	Date
Approved	H.R.Kane	Signed	Date
Scale(s) 1:1000		ELR & Mileage HNR 61m 40ch - 62m 40ch	

Alternative Reference N/A

Sheet 1 of 1

Drawing Number 12500857-GHD-DR-T-7100-P03_GA

Revision P03

Sheet Size A1+9 594 x 2731

Appendix E – Technical Impact Assessments

Signalling		
Asset	**Impact**	**Indicative Scope of work**
Point operating equipment	8 new point ends will be provided to form the southern and northern connections to the proposed terminal. Assumptions • Trap points controlled by Network Rail	• Provision of 8nr MkII Hydrive systems for switch lengths C to F and associated equipment • Provision of Point Battery for northern connections
Line side signals	Alterations will be required to the line side signalling to provide two new junction signals and conversion of a number of auto signals with replacement facilities to controlled signals with Auto working facilities. The location of the Northern crossover will cause trains being held on the Up Northampton at HN5300 rather than HN5298 when a northbound train is leaving the SRFI. Assumptions • All Reception Line and SRFI signals part of SRFI scope	• Provision of 4 aspect LED junction signal with three position Junction Light Indicator and subsidiary signal with three way stencil indicator. • Provision of 4 aspect LED junction signal with three Position Light Junction Indicator and subsidiary signal. • Replating of 3nr auto signals to controlled signals
Train detection	Modification of the train detection arrangements (Axle Counters) will be required to cater for the new layout. Assumptions • Train detection assumed to be AzLM Axle Counters. • Train detection sections within the Reception Lines are part of SRFI scope. Risks • Creation of additional sections may trigger need for additional evaluator	• Reconfiguration of up to 10nr train detection sections

Line side cabinets	Additional lineside cabinets will be required to house the local control equipment for the junction signals and new point ends. Modification to the power supply feeder will be required to accommodate the new locations.	• Provision of 8nr new locations and • modification to power supply arrangements including provision of point battery at northern connections.
Data links	Modification to the existing baseband transmission system will be required to accommodate the new locations and control equipment (DLMs, TFMs).	• Provision of data link cable to suit modifications. Estimated in order of 3km.
Interlocking	Roade SSI located in Rugby controls the area of running lines affected. Roade interlocking currently accommodates 44 TFMs with a further 14 envisaged as being required by the scheme Data changes will be required on this interlocking and further assessment of the available capacity is required to determine whether the additional Trackside Functional Modules can be accommodated. Reception Line departure signals will require to be released by slot from the Network Rail signaller. Similarly, the Network Rail Signaller will require a slot from the SRFI signaller to release the junction signals on the Up and Down Northampton Lines. Once trains are completely within the Reception Lines the connections to eth running lines will be normalised and trains within the SRFI will be completely under the control of the SRFI Signaller via the SRFI interlocking.	• Interlocking data modifications to cater for new layout and interface to SRFI. Assumptions • Sufficient capacity ion existing interlocking Risks • Re-platforming of SSI may be required if insufficient capacity available in existing interlocking.

Control	The existing signalling is controlled from Rugby SCC through an MCS VDU control system manufactured originally by GE Transportation. Screen layouts and software/data will need to be altered to reflect the proposed changes in signalling including alterations to the Train Describer System and any ancillary information systems. Initial inspection of the screen layouts suggest there is capacity to accommodate the layout changes however further assessment of the system capacity will be required. A remote TD workstation will be required in the SRFI Control centre where the SRFI signaller will interpose Train Descriptions for trains configured and initiated from the SRFI.	
Overhead Line Equipment		
Asset	**Impact**	**Indicative Scope of work**
Overhead wiring (Up to Down Main connections)	Existing electrified network is largely plain line single track cantilevers. In terms of existing network with the introduction of two crossovers, two new crossover tension lengths will be required. This will mean additional anchors and likely masts as well as slight adjustments to existing wires at the points for transition purposes. Section Insulators will separate the electrical sections, thereby reducing isolating procedures. Proposed signalling works would be required to be complete before new OLE is installed as the existing network may create stopping issues.	• 2nr new ½ tension lengths for the new crossovers • 1nr new section Insulator for each crossover. • Potentially 2nr new anchor masts. • Re-registering and droppering for new arrangement. • Approximately 8nr single masts • 400 metres of contact and catenary wire.

Overhead wiring (Up to Reception)	Two turnouts into the proposed facility require 2 no 1/2 tension lengths as the full loop with overlaps is approximately 1600 metres. This loop is not considered part of the national network and will be fenced at either end. Isolating switches at both ends to be operated by client and SIs to be positioned within the fence.	• 2nr ½ tension length with anchors. • Approximately 16nr masts, • 800 metres of contact and catenary wire and • 2nr Section Insulators.
OLE network update	Such a change to the electrified network would require changes to master plans which take approximately 10 weeks to process before commissioning.	Consultation with Network Rail regarding network change.
E & M		
Asset	**Impact**	**Indicative Scope of work**
DNO supplies		
Principal/Functional Supply Points	Principal Supply Point at Roade 61m 10ch. Capacity and loading not known. Assumptions Signalling load can be accommodated on existing feeder. Risk Point battery may be required to support northern connections	• No work.
Switch heating	Switch heating required for southern and northern connections. No existing supply. Assumptions • DNO supplies provided from SRFI development.	• Switch heating cubicle, transformers and associated cabling for: **Southern connections** o 3nr x Fv switches

		o 1nr Cv switch Northern connections Crossover o 2nr x Fv switches Terminal connection and Trap o 1nr x Ev switch o 1nr x Cv switch Further survey and development work required.
Cable route	Local cable routes	• Provision of cable routes local to points for switch heating cabling
Telecomms		
Asset	**Impact**	**Indicative Scope of work**
Line side telephony	1 additional Signal Post Telephone circuit required for new HN5295 signal. 2 'Emergency' Telephones located in Reception Lines Assumptions; • Existing Automatic Signals that are to be converted to controlled have SPTs and associated circuits today • Point Zone telephones not required • Spare capacity in structured cabling/transmission system for additional circuits • Spare capacity on concentrator for additional circuits	• 1nr new SPT and local connection to existing at telecoms stump box. • Connections into existing transmission system.

	• Electrification Phones part of Terminal scope Note: Capacity and condition of concentrator (Nortel Meridian with BT Syntegra front end) stated to be life expired.	
Cable route	Cable route diversions required to enable construction of new connections	• 2nr 6-Way x 150mm Under Track Crossings • 2km of C1/9 surface concrete troughing • Cable quantities subject to survey
Data links	Existing track side signalling data links modified to accommodate revised lineside architecture (locations and TFMs) connected to existing Long Distance Terminals.	• No new LDTs or transmission circuits required
Voice and data links	New diverse voice and data links to be provided between Rugby SCC and Terminal Control by connecting into existing transmission system. Assumptions • Sufficient capacity in existing transmission systems/structured cabling • Concentrator/cabling from Terminal Control to existing transmission network part of Terminal scope.	• SDH system capacity to be assessed at next stage
GSM-R	Further assessment of GSM-R coverage required for Reception Lines. Assumptions • Additional GSM-R base station required.	• 1nr GSM-R Base Transceiver Station and Data Loop to existing data network. • SDH system capacity to be assessed at next stage

Civil Engineering		
Asset	**Impact**	**Indicative Scope of work**
Earthworks	NR Earthwork records show that for the Southern connection there is a soil cutting on the Up Side with no Earthwork on the downside. This being the case the new connection will affect the cutting. The recorded condition of the cutting is low/average risk. NR Earthwork records show that for the Northern connection the railway is on a low soil embankment where the new connection is to be made. This being the case the new connection will affect the embankment. The recorded condition of this embankment is 'low risk'	The design of the formation works to access the site at the South end will take account of the cutting and ensure the required works leave any remaining cutting adjacent to the main line in an acceptable condition. Where the north end connection interfaces with the existing embankment the new work will be suitably 'benched in' to the existing embankment. Suitable site investigation works will be undertaken prior to design to ensure the existing embankment is suitable to have S and c placed upon it.
Lineside Structures	There are no identified conflicts of the freight terminal connections with any existing lineside support structures	No works required
Bridges	The connections from the main line to the freight terminal have been positioned to avoid conflict with any existing bridges	No works required

Appendix F – Feasibility Stage HazID

Northampton SRFI Project Hazard Log

Date: 21/06/2018

Client: Roxhill Developments

														Initial Risk Rating			Residual Risk Rating									
Hazard Ref	RSSB Hazardous Event Code	Hazardous Event Description	Hazard Explanation	Cause	Cause Comments	Component	Safety Function	Consequence	Consequence Comments	Operating Mode	Population at Risk	Origin	CDM	C	L	RR	C	L	RR	Safety Requirement/ CSM REA Risk Acceptance Principles	Cause Control Measures (Design Evidence)	Consequence Control Measures	Risk Control Actions to be Transferred	Hazard Status	Notes	Actions
	HEN-39	Electric shock (MoP)		Trespass/ unauthorised access. Inadequate/ poorly maintained physical security.				Fatality/ serious injury		Normal Degraded Maintenance	MoP	Initial HAZID 17/05/18								Physical security measures in place - to be included in site maintenance and inspection programme. N.B. NR standards apply at sites adjacent to NR assets. Relevant standards/ Codes of Practice: BS 1722, Fence Specifications LPS 1175 Security Ratings.						
	HEN-31	Electric shock (maintenance personnel)		Poorly designed system interfaces				Fatality/ serious injury		Maintenance	Maintainers	Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: OHLE design standards (TBC).						
	HEN-31	Electric shock (maintenance personnel)		Inadequate / outdated processes/ procedures between depot and NR operations. (e.g. isolation diagram out of date).				Fatality/ serious injury		Maintenance	Maintainers	Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: Procedures for working on OHLE to comply with NR/L3/ELP/29987, Working on or About 25kV AC Electrified Lines.						
	HEN-31	Electric shock (maintenance personnel)		lack of training/ certification				Fatality/ serious injury		Maintenance	Maintainers	Initial HAZID 17/05/18								Maintenance personnel working on or near OHLE to be competent. Relevant Standards/ Codes of Practice: NR/L2/CTM/014 Competence and Training in Overhead Line Engineering.					Assumption: SRFI OHLE supplies from adjacent main line.	
	HEN-31	Electric shock (maintenance personnel)		Inadequate OHLE isolation procedures				Fatality/ serious injury		Maintenance	Maintainers	Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: NR/L3/ELP/29987 Working on or About 25kV AC Electrified Lines NR/SP/ELP/27203 Provision of Isolation, Earthing and Indication Facilities Where Local Isolations are Permitted on AC Electrified Lines.						
	HET-13	Damage to NR infrastructure		Specification of existing infrastructure/ track inadequate for increased tonnage				Derailment, falsity/ serious injury, NR/ 3rd party property damage.		Degraded Emergency	Mops Passengers Traincrew	Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: Track over which trains accessing SRFI will comply with NR/L2/TRK/2102, Design and Construction of Track. Configuration of trains (axle weight, speed) accessing SRFI to be taking into consideration when assessing track.						
	HET-13	Collision		Derailment in reception sidings/ train fouling main line.				Derailment, impact of train fouling main line with passing train		Degraded Emergency	Passengers Traincrew	Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: Track within SRFI will comply with NR/L2/TRK/2102, Design and Construction of Track. Configuration of trains (axle weight, speed) accessing SRFI with be taken into consideration when designing SRFI track layout/ specification and specifying maximum train speeds within SRFI.						
	HET-13	Loss of track support/ geometry (land slip)		Earthwork collapse				Derailment		Degraded Emergency	Passengers Traincrew	Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: Earthworks to be designed in accordance with BS 6031, Code of practice for earthworks. Earthworks to be managed in accordance with NR/L2/CIV/086 Management of Earthworks Manual.						
	HET-13	Soil failure leading to loss of kinematic envelope/ track geometry		Earthwork collapse				Impact with collapsed earthwork, derailment		Degraded Emergency	Passengers Traincrew	Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: Earthworks to be designed in accordance with BS 6031, Code of practice for earthworks. Earthworks to be managed in accordance with NR/L2/CIV/086 Management of Earthworks Manual.						
	HET-13	Train exits sidings in de-railed condition		Derailment within sidings, excessive speed, track damage				Derailment		Degraded	Passengers Traincrew	Initial HAZID 17/05/18								Train drivers comply with maximum line speed within and entering/ exiting SRFI. Relevant standards/ Codes of Practice: Track layout and maximum permitted speeds in sidings in accordance with design standards referenced above. Track within SRFI to be inspected and maintained in accordance with NR/L2/TRK/001 Inspection and Maintenance of Permanent Way						
		Train exits sidings in out of gauge condition		Out of spec wagon loading, leaving door open etc.				Impact with lineside installations, property damage		Degraded	MoPs Passengers Traincrew	Initial HAZID 17/05/18								SRFI personnel to be competent in the loading, securing and inspection of wagons. Relevant standards/ Codes of Practice: Wagon loading operations to comply with Railway Group Standard GO/RT3056, Working Manual for Rail Staff Freight Train Operations.						
		Flooding		Inadequate assessment of water flows during design (both directions)				Flooding		Degraded		Initial HAZID 17/05/18								Roxhill to obtain flood risk data for SRFI area from NR. Relevant standards/ Codes of Practice: Food risks to be assessed in accordance with BS 8533:2017 Assessing and managing flood risk in development. Code of practice.						
		Flooding		Inadequate drainage (NR and SRFI)				Flooding		Degraded		Initial HAZID 17/05/18								Roxhill to obtain flood risk data for SRFI area from NR. Relevant standards/ Codes of Practice: SRFI track drainage systems to comply with NR/L2/CIV/140 Model Clauses for Civil Engineering Works Section 5.						
		Flooding		Inadequately maintained drainage (NR and SRFI)				Flooding		Degraded		Initial HAZID 17/05/18								Relevant standards/ Codes of Practice: SRFI track drainage systems to be maintained in accordance with NR/L2/CIV/140 Section 6.						
		Contamination of water courses		Inadequate drainage system protection measures (e.g. interceptors and procedures)				Contamination of water courses. Possible conviction for pollution offence.		Degraded		Initial HAZID 17/05/18								Risk assessment for SRFI site surface water drainage system in accordance with Environment Agency PPG3 required. Recommendations with respect to oil interceptor specification to be implemented in the design.						
		Cross-contamination (NR/ SRFI/ 3rd party land)		Inadequate drainage system protection measures (e.g. interceptors and procedures)				Contamination of NR/ SRFI/ 3rd party drains from spillages etc originating on 'the other side of the fence'. Possible conviction for pollution offence.		Degraded		Initial HAZID 17/05/18								SRFI and NR surface water drainage systems to be physically segregated.						

Northampton SRFI Project Hazard Log

Date: 21/06/2018

Client: Roxhill Developments

Hazard Ref	RSSB Hazardous Event Code	Hazardous Event Description	Hazard Explanation	Cause	Cause Comments	Component	Safety Function	Consequence	Consequence Comments	Operating Mode	Population at Risk	Origin	CDM	Initial Risk Rating C	Initial Risk Rating L	Initial Risk Rating RR	Residual Risk Rating C	Residual Risk Rating L	Residual Risk Rating RR	Safety Requirement/ CSM REA Risk Acceptance Principles	Cause Control Measures (Design Evidence)	Consequence Control Measures	Risk Control Actions to be Transferred	Hazard Status	Notes	Actions
		Propagation of invasive weeds		Unmaintained / Incorrect vegetation/ poorly managed work sites				Damage to structures and harm to wild/ farm animals from toxic invasive species spreading from site		Degraded		Initial HAZID 17/05/18								SRFI site maintenance regime to include identification and removal of potentially harmful invasive species.						
		De-wirement (NR/ SRFI OHLE)		PAN damage				Train movement disruption. Risks associated with working on OHLE.		Degraded		Initial HAZID 17/05/18								Locomotive pantograph inspection and maintenance procedures (TBC).						
		De-wirement (NR/ SRFI OHLE)		OHLE damage/ failure				Train movement disruption. Risks associated with working on OHLE		Degraded		Initial HAZID 17/05/18								SRFI OHLE system design and inspection and maintenance procedures in accordance with relevant standards (TBC)						
	HET-13	Kinematic envelope compromised due to fallen tree etc.		Unmaintained / inappropriate vegetation				Collision/ derailment/ fatality and/ or injuries		Degraded Emergency		Initial HAZID 17/05/18								Vegetation in vicinity of running lines and sidings to be planted and maintained in compliance with NR/L2/OTK/5201 Lineside Vegetation Management Manual.						
		Unmaintained assets		Poorly defined maintenance boundaries/ interfaces				Assets at SRFI/ NR interface potentially not maintained. Increased risk of failure in service.		Degraded		Initial HAZID 17/05/18								Ensure all site assets are included in either NR or SRFI asset registers and inspection and maintenance plans.						
		Misrouted trains (N.B. replicate for train movements inside SRFI)		Excessive signaller workload caused by increased train movements				Collision risk, operational disruption		Degraded		Initial HAZID 17/05/18								Signaller Human Factors assessment required to ensure additional workload associated with routing of freight trains into and out of SRFI not excessive, leading to increased risk of mistakes. Reference RSSB Good Practice Guide on Cognitive and Individual Risk Factors, RS/232.						
		Misrouted trains (N.B. replicate for train movements inside SRFI)		Irregular train patterns/ timetable				Collision risk, operational disruption		Degraded		Initial HAZID 17/05/18								Signaller Human Factors assessment required to ensure additional workload associated with routing of freight trains into and out of SRFI not excessive, leading to increased risk of mistakes. Reference RSSB Good Practice Guide on Cognitive and Individual Risk Factors, RS/232.						
		Misrouted trains (N.B. replicate for train movements inside SRFI)		Poorly designed signalling systems and interface				Collision risk, operational disruption		Degraded		Initial HAZID 17/05/18								Signaller Human Factors assessment required to ensure additional workload associated with routing of freight trains into and out of SRFI not excessive, leading to increased risk of mistakes. Reference RSSB Good Practice Guide on Cognitive and Individual Risk Factors, RS/232.						
	HET-13	Subsidence/ collapse leading to undermining of P-way and other infrastructure		Historical mine works/ mineral extraction sites				Derailment		Degraded Emergency	Passengers Traincrew	Initial HAZID 17/05/18								In the event that mine workings are identified that could impact new lines within SRFI and connecting SRFI to NR main lines, subsidence risks will be managed in accordance with NR/L3/CIV/038 Managing the Potential Effects of Coal Mining Subsidence.						

Hazard Status
Open
Resolved for PDR Design
Resolved for Design
Resolved for Construction
Resolved for Handover
Closed
Transferred
Eliminated
Cancelled

PHL Definition

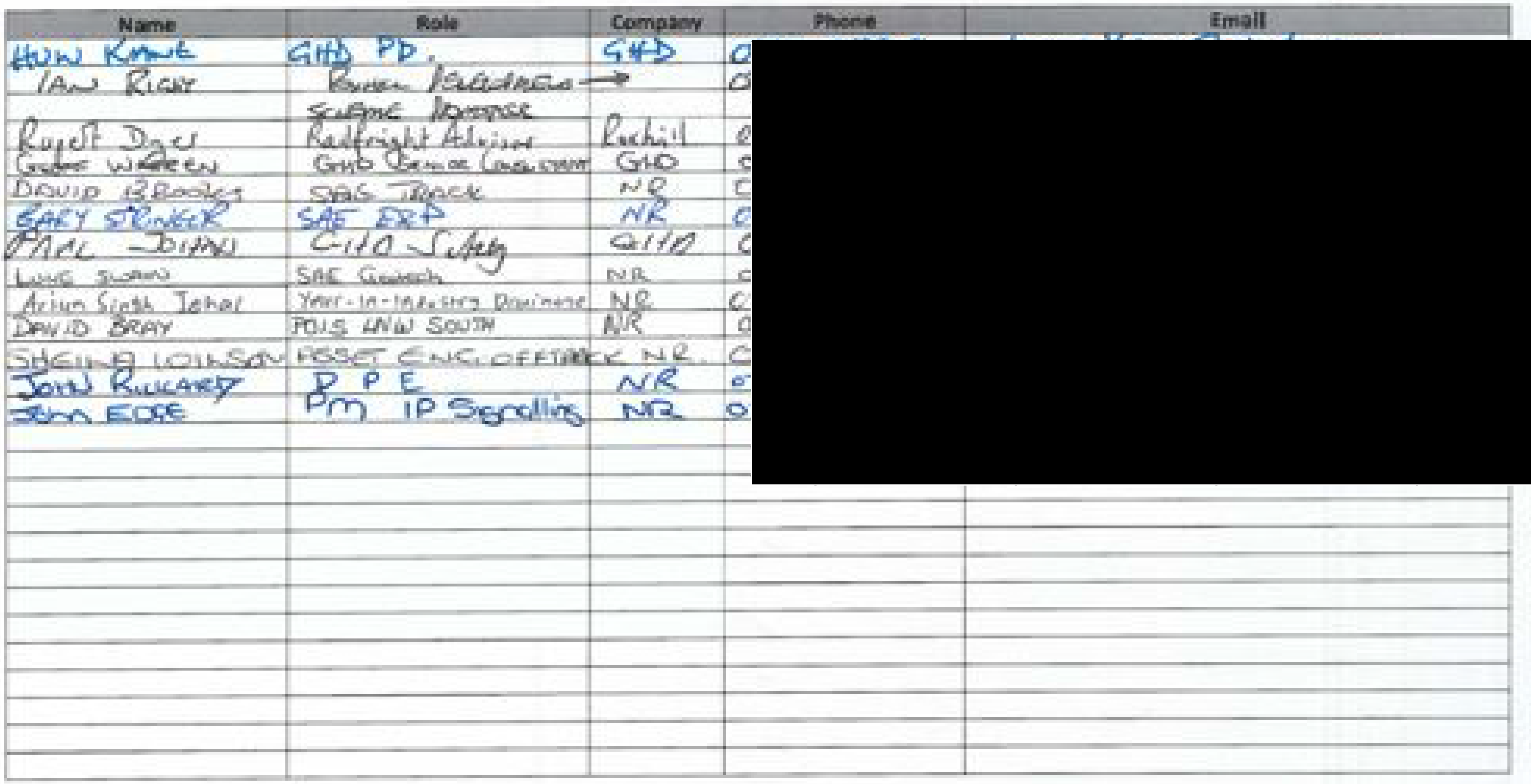
Initial state of all hazards.
Evidence is provided that all safety requirements that can be addressed in the PDR phase are implemented and/or noted as an action for resolution in the CDR design.
To move a hazard to this status, the following criteria needs to be met: o Presentation of an argument that the safety risk associated with the hazard meets the project safety risk criteria. o Evidence is provided and verified that all safety requirements associated with the hazard have been addressed in
To move a hazard to this status, the following criteria needs to be met: o Evidence is provided and verified that all safety requirements associated with the hazard have been addressed in
All safety requirements and other relevant actions have been verified and validated. There remains a residual risk to be “handed-over” to the Client for ongoing management and/or further risk treatment.
All safety requirements and other relevant actions have been verified and validated. There is no requirement to transfer the hazard to the Client for ongoing management or risk treatment.
The hazard has been assessed to fall under the remit of another party (i.e. Client or Interface Contractor) and has been transferred to relevant party for management and closure. Acknowledgment of identified hazards from
The hazard has been eliminated by design, with verification evidence of the corresponding safety requirements (if any) provided throughout design and implementation phase as applicable.
The hazard is either o Deemed ‘Not Credible’ or; o Hazard has a duplicate entry or; o Hazard has been consolidated with another hazard; or o Hazard is deemed to be non-safety related i.e. has been assessed to result in asset damage or system outage/ service perturbations; or o The hazard is not within the scope of delivery of the Project

SAFETY RISK ASSESSMENT MATRIX

Risk Assessment Matrix		CONSEQUENCE				
FREQUENCY		NON-REPORTABLE INJURY	MINOR INJURY	MAJOR INJURY, MULTIPLE MINOR	SINGLE FATALITY, MULTPLE MAJOR	MULTIPLE FATALITIES
		1	2	3	4	5
LESS THAN A YEAR	5	Tolerable	Tolerable	Intolerable	Intolerable	Intolerable
1 YEAR TO 10 YEARS	4	Tolerable	Tolerable	Intolerable	Intolerable	Intolerable
10 YEARS TO 100 YEARS	3	Negligible	Tolerable	Tolerable	Intolerable	Intolerable
100 YEARS TO 1000 YEARS	2	Negligible	Negligible	Tolerable	Tolerable	Tolerable
1000 YEARS OR GREATER	1	Negligible	Negligible	Negligible	Tolerable	Tolerable

WORKSHOP ATTENDANCE
Northampton SRFI HAZID, 17/05/18

Name	Company	Signature			



Name	Role	Company	Phone	Email
Huw Kane	GHD PD.	GHD	[redacted]	
Ian Rigby	Power [illegible] → Scheme Sponsor			
Rupert Dyer	Railfreight Advisor	Rockhill		
Graham Warren	GHD Senior Consultant	GHD		
David Brooks	SBG Track	NR		
Gary Stringer	SAE ERP	NR		
Paul Dixon	GHD Safety	GHD		
Luke Sloan	SAE Growth	NR		
Arjun Singh Johal	Year-in-Industry Dominate	NR		
David Bray	POIS LNW South	NR		
Sheila Lowson	Asset Eng. Offtrack	NR.		
John Rickard	D P E	NR		
John Edge	PM IP Signalling	NR		

Appendix G –Functional Requirements Specification (Roxhill Developments Ltd)

Northampton Gateway

Railway Functional Requirements

Version 2

20th July 2018

Document Control Notice

Document title	Northampton Gateway: Functional Requirements Specification

Revision	Date	Description
V1.0	03/01/2018	Initial Draft
V1.1	04/01/2018	Revision to deal with client comments
V2.0	20/07/2018	Update to reflect outcomes of Feasibility Study

1 Introduction

1.1 Background

Roxhill Development Ltd. has applied for a Development Consent Order (DCO) for the construction of a Strategic Railfreight Interchange (SRFI) adjacent to Junction 15 of the M1 at Collingtree, south of Northampton. The SRFI site lies alongside the Northampton Loop of the West Coast main Line (WCML).

This document identifies the operational capabilities, terminal facilities, and service amenities to be provided at SRFI in order to;

- Provide clarity of Client Requirements
- Guide design development
- Provide a mechanism for change control

This "Functional Requirements Specification" will be updated periodically as new information becomes available or the client modifies the site requirements .

1.2 The Purpose of this Document

Roxhill is the owner of this Functional Requirements Specification (FRS). It has been developed in conjunction with Roxhill's designers and other stakeholders, including Network Rail.

Roxhill has developed designs for the main line connections and network signalled infrastructure to the SRFI to GRIP 2 stage. Further development to GRIP Stage 4 and onwards to full installation and commissioning will carried out in agreement with Network Rail.

Roxhill will develop designs for the internal SRFI rail network and manage full installation and commissioning, as part of the general site development.

This document sets out the functional requirements for the SRFI that shall guide the design and define the required outputs.

Version 1 of this document was issued on 3rd January 2018. Version 2 has been issued following a review of the outcome of the GRIP 2 Feasibility Study, and will guide further design development. Subsequent versions will document later additions and revisions.

This document is intended to provide specific guidance for the depot design team and wider stakeholders, including Network Rail as owner and operator of the national rail network.

This document lays down specific requirements for the design and operation of the SRFI. It is understood that there may be instances where some of these requirements cannot be met in full. Designers and other stakeholders should identify areas where they feel that it is unreasonable to achieve the specification in full. Roxhill will consider varying the requirements where a reasonable case for doing so has been demonstrated.

1.3 Scope

The Northampton Gateway SRFI shall provide an intermodal rail interchange, receiving trains of intermodal containers from UK ports and other railfreight interchanges (RFIs) and also bulk commodities. Facilities will be provided on site for unloading and reloading rail vehicles for reforwarding to other RFIs, and transhipping products to customers on site and into the surrounding area by road.

The SRFI shall perform the following functions:

- Accepting and despatching intermodal trains to and from the WCML
- Accepting and despatching bulk aggregate trains to and from the WCML
- Providing terminal facilities for the loading and unloading of containers
- Providing terminal facilities for the loading and unloading of bulk traffic including (but not limited to) aggregates
- Providing rail connections to on site warehouses with associated bespoke loading and unloading facilities
- Making provision for future facilities for Rapid Railfreight traffic
- Providing associated rail facilities including cripple sidings for wagons requiring repairs and locomotive stabling sidings

This document does not define specific track layouts, which shall be confirmed by the designer. It sets out the facilities and capabilities that should be provided by those designed layouts and associated operational arrangements.

The SRFI plans require construction of a new road overbridge across the WCML to the north of Roade. The works for this overbridge do not form part of this FRS, and are the subject of separate agreements with Network Rail.

1.4 Location and Context

The SRFI site is situated 6 kilometres to the south of Northampton town centre, and adjacent to Junction 15 of the M1. It lies alongside the Northampton Loop line of the West Coast Main Line (Engineer's Line Reference HNR). All rail works for the SRFI are expected to be between the 60 and 63 mileposts.

The SRFI is linked to the A508 Northampton to Old Stratford trunk road.

The site is approximately 1,800 metres long and 1,000 metres wide, with a total land area of approximately 190 hectares.

Roxhill has produced indicative plans of the layout of the site. These do not set out the precise track layout to be adopted, but illustrate the facilities that shall be provided and the intended land use.

Figure 1: Northampton Gateway illustrative master plan

1.5 Target volumes

It is intended that the following numbers of trains shall use the site on a daily basis;

Figure 2: Northampton Gateway forecast train volumes

Northampton Gateway - Forecast rail traffic levels								
Train Type	Number of trains per 24 hours in each direction 2021		Number of trains per 24 hours in each direction 2026		Number of trains per 24 hours in each direction 2033		Number of trains per 24 hours in each direction 2043	
	Low forecast	High forecast	Low forecast	High forecast	Low forecast	High forecast	Low forecast	High forecast
75 mph intermodal freight Towards Wembley	2	3	4	6	6	8	9	10
75 mph intermodal freight Towards Crewe	0	0	0	1	1	2	2	4
Class 6 60 mph bulk freight Towards Wembley	0	0	0	0	0	0	0	0
Class 6 60 mph bulk freight Towards Crewe *	1	1	1	1	1	2	1	2
Event year	SRFI Opens		HS2 Phase 1 opens London - Birmingham		HS2 Phase 2b opens London - M'chester/Leeds		NR Long term planning horizon	

Notes:

1. These are indicative estimates only, and do not distinguish loaded, part loaded or empty services, or origin and destination
2. * One Class 6 bulk freight path runs in the same times as one path already present in the WTT between Mountsorrel (Leics) and Northampton Castle Yard (which Northampton Gateway replaces)

2 Glossary

The following terms are used in this report. The associated definitions are listed below.

DCO	Development Consent Order: A consent by a Minister for a Nationally Significant Infrastructure Project
FRS	Functional Requirements Specification: this document
NSIP	Nationally Significant Infrastructure Project: as defined by the Planning Act 2008
OLE	Overhead Line Equipment: wiring to provide traction current to electric locomotives and multiple units
RFI	Rail Freight Interchange: a terminal where goods can be transferred between rail, road, ground storage and warehouses
ROC	Regional Operations Centre: Network Rail facility that provides overall management of all operations on the WCML
SCC	Signal Control Centre: Network Rail facility that controls all train movements and signalling on the Northampton Loop
SRFI	Strategic Rail Freight Interchange: A Rail Freight Interchange that meets the requirements laid down by the Department for Transport to qualify as an NSIP

3 Applicable railway standards

The requirements of the Railway Group Standards and Railway Industry Standards shall be incorporated into the designs for all works connected to the national rail network or forming part of the infrastructure connecting to it. These standards shall also apply where appropriate to all internal rail works.

4 Functional Requirements

4.1 Location

The depot shall be located on private land to the east of, and adjacent to, the Northampton Loop (ELR HNR) between mileposts 60 and 63.

4.2 Site Characteristics

The SRFI shall be capable of being accessed by rail from both the south (towards Milton Keynes) and north (towards Northampton) by trains moving inwards and outwards.

The sidings (but not running lines comprising the main line connections) within the site shall be level throughout where possible. The maximum railway gradient permitted within the sidings shall be 0.2% (1 in 500) in line with Railway Group Standards. Any proposal to exceed this requirement shall be supported by risk-based evaluation of the impacts and mitigations to be adopted.

The SRFI shall be capable of rail operation 24 hours per day, 365 days a year.

All parts of the rail network within the SRFI (except the main line connecting tracks) shall be lit in compliance with Railway Group Standards.

25 kV AC overhead electrification shall be provided on the lines within the site specified in this FRS. Staging of the installation and commissioning of all or parts of the OLE coverage shall be considered where appropriate. OLE traction power supply and isolation arrangements shall remain the responsibility of Network Rail at all times. OLE maintenance arrangements shall be defined during development of the scheme up to GRIP Stage 4.

The SRFI rail facilities shall be available at the time that the main site opens. Phased introduction of the full rail facilities in line with the growth of traffic shall be permitted.

All infrastructure on site shall be designed to accommodate the following requirements;

- Structure gauge profile for all structures shall be a minimum of W12, with the ability to run a GC gauge shunting locomotive throughout the internal SRFI tracks.
- It shall be possible for a main line diesel locomotive (by default a Class 66) to access all tracks within the SRFI, including those to rail connected warehouses, the Intermodal Terminal, the bulk terminal and the Rapid Railfreight Terminal
- Maximum train length of trains using the SRFI shall be 775 metres

4.3 Access Arrangements

The connections to the SRFI shall be provided in a way that minimises the impact on main line operational capacity on the Northampton Loop.

Connections the Northampton Loop shall be provided to the north and the south. The connections shall be to and from the up and down lines.

The design speed capability of the connecting tracks shall be in line with the maximum speed that can be physically achieved by trains running into and out of the SRFI sidings. As an initial position the permissible speed of the south connections shall be 40 mph, and the north connections 20 mph. Consideration shall be given during design development to GRIP Stage 4 to increase the speed capability of the northern connection to a maximum speed of 40 mph. The speed of the Reception Sidings shall match the permissible speed of the connections.

The connections shall comprise single leads with follow on main line crossovers. Passive provision shall be made for the installation of double (parallel) connections at an unspecified date in the future.

Trains shall enter and exit the SRFI sidings using main aspect signals, and run to full stop signals within the SRFI Reception Sidings on each route. Consideration shall be given to using flashing aspects for movements into the SRFI to maximise arrival speeds and optimise main line capacity.

Where feasible subsidiary signals shall also be provided at the entry signals to allow a locomotive to enter an occupied Reception Siding

The signalling shall be configured to allow a maximum of two trains to follow successively into or out of the site, subject to network path availability.

4.4 SRFI reception sidings

Three Reception Sidings shall be provided within the SRFI site. Each Reception Siding shall be equipped with train detection to Network Rail standards and its occupancy shall be visible to Network Rail's signallers.

The maximum railway gradient permitted within the Reception Sidings shall be 0.2% (1 in 500) in line with Railway Group Standards. Any proposal to exceed this requirement shall be supported by risk-based evaluation of the impacts and mitigations to be adopted.

Each Reception Siding shall be at least 775 metres long. Where practicable Reception Lines shall be straight. Spacing between Reception Line tracks shall be at least 3 metres (centre to centre) to permit staff to work between trains for shunting, examination and preparation purposes.

All Reception Sidings shall provide direct access for main line arrival and departure movements in both directions.

All Reception Sidings shall be lit in accordance with the requirements of Railway Group Standards

All Reception Sidings shall be electrified.

4.5 Intermodal Terminal

An Intermodal Terminal shall be provided, where trains of containers can be unloaded and reloaded. The Intermodal Terminal shall comprise three tracks, each of 775 metres length. The Intermodal Terminal tracks shall be straight and level. The maximum railway gradient permitted within the Intermodal Terminal shall be 0.2% (1 in 500).

The container handling within the Intermodal Terminal shall be provided by either reach stackers or gantry cranes. All track designs shall permit gantry cranes to be used, and space shall be left for the provision of crane rails between the Intermodal Terminal tracks and Reception Sidings.

The Intermodal Terminal shall be parallel to the Reception Sidings. It shall be capable of being accessed directly from the south (Milton Keynes) connections to the main line. Direct access to the north connections shall be provided if possible.

The Intermodal Terminal shall not be provided with overhead wiring. Consideration shall be given to providing overhead wires to either end of the terminal tracks, terminating at a point clear of the unloading area, to allow electric locomotives to be attached to container trains within the terminal and depart from it.

4.6 Headshunt

A single track headshunt shall be provided to permit movements from the north of the Reception Sidings to the Intermodal Terminal, Rapid Railfreight Terminal, and rail connected warehouses. The headshunt shall be as long as possible, and shall be at least 600 metres long. The headshunt does not need to be straight.

The headshunt shall be capable of being accessed to and from each of the Reception Sidings, and all of the Intermodal Terminal tracks, the rail connected warehouses and the Bulk and Rapid Railfreight terminals.

Consideration shall be given to whether the connections to the above facilities should be controlled by the local signalling system, or operated by handpoints. Where frequent movements are anticipated preference should be given to operation by signalling, provided a suitable economic case can be developed.

The headshunt shall have a run round loop provided at the buffer stop end to facilitate shunting movements. Connections to the run round may be by handpoint.

The headshunt shall be electrified.

The headshunt shall be level throughout where possible. The maximum railway gradient permitted within the headshunt shall be 0.2% (1 in 500) in line with Railway Group Standards. Any proposal to exceed this requirement shall be supported by risk-based evaluation of the impacts and mitigations to be adopted.

4.7 Rapid Railfreight Terminal

Passive provision shall be made for a Rapid Railfreight Terminal, which shall be able to be constructed without impacting on the operation of the rest of the SRFI facilities. This shall comprise a 200-metre long platform track. This track shall be straight, and provided with overhead electrification. An electrified run round loop shall be provided. Connections to the run round may be by handpoint.

The Rapid Railfreight terminal track shall be level throughout where possible. The maximum railway gradient permitted within the Rapid Railfreight Terminal shall be 0.2% (1 in 500) in line with Railway Group Standards.

Consideration shall be given to providing direct access between the Rapid Railfreight Terminal and the north connections to the Northampton loop, so that a train can arrive from or depart directly to the Northampton Loop in the Northampton direction.

4.8 Rail connected warehouses

Provision has been made within the overall site for a number of rail-connected warehouses. These shall be served exclusively from connections from the headshunt. It shall be possible to service any one or a combination of the rail connected warehouses with a train of a minimum length of 400 metres, which can be split and rejoined in the Reception Sidings where appropriate.

The layout of the warehouses and their connections shall be determined later once specific client requirements are known. For the present time each warehouse shall be shown as being served by an independent double ended siding off a core service line offering access to all warehouses.

The maximum railway gradient permitted within the rail connected warehouses shall be 0.2% (1 in 500). The tracks leading to the rail connected warehouses shall not be provided with overhead electrification.

4.9 Bulk Terminal

A bulk terminal shall be provided within the site, primarily for the handling of aggregates. The bulk terminal shall be connected to the Headshunt. It is not necessary for the Bulk terminal to be accessible to the main lines other than by shunt move via the Reception Sidings.

The maximum length of the Bulk Terminal siding shall be 266 metres. The Bulk Terminal track shall be level throughout where possible. The maximum railway gradient permitted within the Rapid Railfreight Terminal shall be 0.2% (1 in 500) in line with Railway Group Standards.

The Bulk Terminal shall not be provided with overhead electrification.

4.10 Other siding facilities

One cripple siding of at least 100 metres length shall be provided for the storage and repair of wagons unable to proceed from the SRFI. The cripple siding shall be capable of being protected from rail movements by locking of the points providing access to it.

The cripple siding shall be provided with road access capable of accepting at least a 12 metre articulated lorry, and shall be provided with access to either side of the track. Hardstanding shall be provided to at least one side of the siding to provide the ability to loft wagons with a mobile road crane.

Consideration shall be given to providing two cripple sidings where space permits.

The maximum railway gradient permitted within the cripple sidings shall be 0.2% (1 in 500). The track leading to the cripple siding shall not be provided with overhead electrification.

Two locomotive holding sidings shall be provided, each of at least 60 metres length, to hold a minimum of two main line locomotives each. It shall be possible to locate a road tanker alongside the locomotive holding sidings to allow diesel locomotives to be refuelled on site.

The locomotive holding sidings shall be located so that it is possible to access them from the Reception Sidings even if all there are fully occupied with traffic.

The locomotive holding sidings shall be provided with overhead electrification.

It may be that the SRFI will be provided with its own motive power in the form of a diesel shunter. The SRFI layout shall be designed to permit this locomotive to be of GC gauge. Internal locomotives shall not be permitted to run on Network Rail infrastructure.

Other than on lines to the Reception Sidings there shall be no requirements for cant in turnout routes or track within the depot.

The maximum design speed in depots and sidings shall be 20 mph.

Curvature of turnouts and plain line shall be at maximum possible radii to prevent excessive wear and maintenance.

Safe trackside walking routes shall be provided for staff and equipment.

All S&C units shall be provided with safe staff access routes. As far as is practicable maintainable equipment shall able to be worked on from a position of safety.

4.11 Signalling

Depot signalling for all SRFI lines shall be controlled from one SRFI control room located within the site. The control room shall manage all movements including those of trains into the Reception Sidings from the main line. The signalling control room will be operated by SRFI terminal staff, and will interface directly with Network Rail's Regional Operations Centre (ROC) and Signalling Control centre (SCC), located at Rugby, for movements onto and off the Northampton Loop.

All signalling between the Reception Sidings and other parts of the SRFI shall be under the control of the depot, undertaken by depot staff. Signalling of the Reception Sidings shall be under the control of the depot control centre, with appropriate slotting to the SCC at Rugby. Signalling of the exit signals protecting the Network Rail running line shall be under the control (by slotting or direct switching) of the Network Rail SCC at Rugby.

The Intermodal and Rapid Railfreight terminal connections shall be controlled by signalling from the local control panel, where a suitable economic case can be developed. Signalling of the Intermodal Terminal sidings shall be under the control of the depot, with appropriate slotting to the Network Rail ROC at Rugby for direct movements into the terminal from the main line.

Access to the rail connected warehouses and Bulk Terminal shall be controlled by depot signalling where this can be justified in terms of the cost of equipment provision.

Appendix H - Received Network Rail Documents

Discipline	Information	Document Name
General	Marlin Maps	Maps from HNR 56m 20ch - 64m 00ch. 31 Drawings
	Five Mile Diagrams	HNR 56m 00ch to 61m 00ch HNR 61m 00ch to 65m 00ch LEC 52m 00ch to 57m 00ch LEC 57m 00ch to 62m 00ch
	Buried Services	Network Rail requests 156111 parts 1 to 4
	GPR Records	LEC1 1200 to HNR 1100 GPR traces (17 traces in total) LEC1 2200 TO HNR 2100 GPR traces (17 traces in total)
Civils	Structures	Structures list from CARRS Structures Examination Records
Signalling	Existing Signalling Plans	RSC-02-0038-03_AH3 RSC-02-0038-1 of 3_EP2 RSC-02-0038-2_FY1
	Existing Location Area Plans	RSC_27_0038_1_3-BA1 RSC-27-0038-03_AH3 RSC-27-0038-2OF3_MY2
	Existing Signalling Power Supply	RSC_11_0038_COVER-NULL RSC_30_0037_COVER-AF1 RSC-30-0037-A01_WM3 RSC-30-0037-W01_WM1 RSC-30-0037-W02_JT2 RSC-30-0038-W01_UR2 RSC-30-0038-W02_FX1 RSC-30-0038-W03_GF2 RSC-30-0038-W04_GF2 RSC-30-0038-W05_GS2 RSC-30-0038-W06_GS2
OLE	Existing Records	results results (1)
	Sectioning Diagram	IDU-LNW-AN-ISO-issue 59 (2)
Track	LEC1 & HNR INM (existing assets)	WCC3004 HNR TU_Tool WCC3004A HNR TU_Tool WCC3004B LEC1 TU_Tool
	Ellipse Data	WCC3004_20171214_1208_Assets WCC3004A_20171215_1133_Assets
	TSR & PSR Sites	LNWS3817WN Sectional Appendix MD101 Diagram 20 and MD105 Diagram 1
Telecommunications	GSMR System details	33-34. GSM-R system details FTN System details Northampton Gateways
M & E	DNO supply data	northampton route
Miscellaneous	ARMS report	HNR Data (10 files) ARMS LEC1 Data (7 files)

	Hazard Directory	038. Hazard Directory

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signatur[redacted]	Date
F01	GKW	J Blake	[redacted]	[redacted] Kane	[redacted]	25/07/18

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Roxhill Developments

Northampton Gateway SRFI

Freight Timing Report

12500857-GHD-RP-T-1014 Rev F01

September 2018

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Figure index

1. Introduction

The Northampton Strategic Rail Freight Interchange (SRFI) is proposed to handle 775 m freight trains by connection to the national Network on the Northampton Loop of the West Coast Main Line. Roxhill Developments Ltd. have engaged with Network Rail to develop proposals that are compatible with Network Rail's business and national freight strategies for the rail industry. The collaboration aims to result in Network Rail being able to support a Statement of Common Ground that evidences that the proposal is technically feasible and operable. The operability of the proposal is dependent upon sufficient network capacity being available to support the initial traffic levels envisaged.

1.1 Scope and Limitations

This report provides technical running time data for diesel and electrically hauled freight trains of 775 m length entering and leaving the SRFI that will inform the consideration of network availability and capacity.

As many of the intermodal trains that operate over the network today are less than 775 m, the study has also calculated run time data for a train consisting of 32 wagons. This is referred to as the base line and provides some quantification of running time for intermodal traffic that is typical on the network today. This train is not used to inform the planning values.

This report has been prepared by GHD for Roxhill Developments and may only be used and relied on by Roxhill Developments for the purpose agreed between GHD and Roxhill Developments as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Roxhill Developments arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD within this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Roxhill Developments and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.2 Remit

The remit for the modelling work is set out below:

FROM/TO THE SOUTH:

a. How long each train takes from Hanslope Junction to the Northampton Loop point work that takes you into Gateway Reception Lines.

b. How long each train takes from reaching that point work for the back of the train to clear the Northampton Loop.

c. How long each train takes from departing the Gateway Reception Lines to reaching the Northampton Loop point work.

d. How long each train takes from the Northampton Loop point work to reach Hanslope Junction.

FROM/TO THE NORTH:

e. How long each train takes from Northampton Station to the northern entrance point work, off the Northampton Loop, that takes you into Gateway Reception Lines.

f. How long each train takes from reaching that point work for the back of the train to clear the Northampton Loop.

g. How long each train takes from departing the Gateway Reception Lines, northwards, to reaching the Northampton Loop point work.

h. How long each train takes from that Northampton Loop point work to reach Northampton Station.

Reference: Email dated 12/07/18 from Ian Kapur, GB Railfreight Ltd.

2. Methodology

The technical running times have been generated using a RailSys simulation that models the operation of both a Class 66 diesel and a Class 92 electric train each with an 1800 tonnes trailing load with a nominal length of 775 m over an infrastructure definition of the connection arrangements proposed in the GRIP 2 Study for the scheme.

A base line train has also been modelled to replicate a typical intermodal freight train currently operating. This has been set up with an 1800 tonnes trailing load with a nominal length of 669 m.

The running time was calculated using the detailed train calculation in line with Railsys standards, 2018.

Following the generation of technical running times from the RailSys simulation, planning values were defined using the national methodology of timetable planning rules for use in a pathing analysis exercise conducted by GB Railfreight.

2.1 RailSys Infrastructure Definition

The RailSys infrastructure definition was taken from the existing signalling plans modified by the proposed signalling and rail layout contained within the GRIP 2 Feasibility Study accepted by Network Rail. For the purpose of the exercise, the depot was configured with one reception line. See Figure 1 below

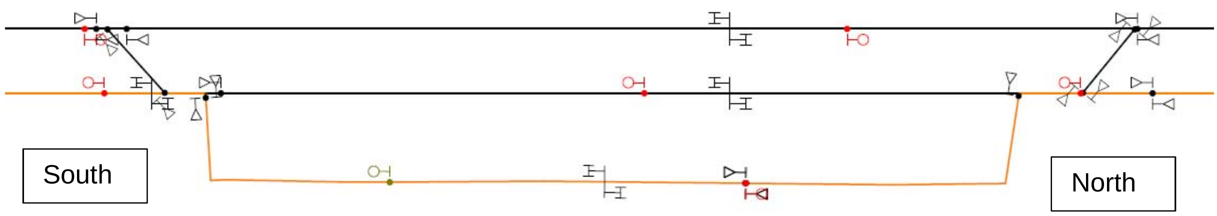

Figure 1 RailSys Layout

The definition of the infrastructure used in the modelling is listed below running South to North

1. Infrastructure model limits are Hanslope Junction to Northampton Station.
2. The South Crossovers are located between the Down and Up Northampton Lines between 98.596 Km and 98.726 Km with a speed of 64 Kmph
3. The South Entrance is located at 98.818 Km and Northern Entrance at 100.642 Km
4. The Northern Crossovers are located between the Up and Down Northampton Lines between 100.784 Km and 100.902 Km with a speed of 64 Kmph
5. Two stopping signals were added at 99.233 Km (Southern) and 100.028 Km (Northern)
6. A timing node was added at 99.777 km to capture the clearance point for the Gateway entrance point work. This was for a Freight Train approaching form the South. A distance of 865 meters was then applied; this included the length of the Freight Train and an allowance for the rear of the train reaching the clearance point of the SRFI connection.
7. A timing node was added at 99.683 km to capture the clearance point for the Gateway entrance point work. This was for a Freight Train approaching form the North. A distance

of 865 meters was then applied; this included the length of the Freight Train and an allowance for the rear of the train reaching the clearance point of the SRFI connection.

8. The bidirectional speeds in the depot were set as follows; between 98.818 Km and 100.028 Km 64 kmph and between 100.028 Km and 100.642 Km 32 Kmph.

2.2 Train data

The detailed train data within the RailSys Rolling stock library was used for each train as follows to calculate the technical running times.

2.2.1 Class 66

Total length of train	770m
Trailing Load	1800.50t
Total mass of train	1928.072t
Number of Wagons	37
Wagon Length	20.24m
Wagon Tare Weight	20t
Wagon Load Weight	28.650t
Wagon Total Weight	48.650t
Acceleration	Loco set to 95% of tractive effort
Deceleration	As per Network Rail RailSys Standard

2.2.2 Class 92

Total length of train	769m
Trailing Load	1800.50t
Total mass of train	1926.040t
Number of Wagons	37
Wagon Length	20.24m
Wagon Tare Weight	20t
Wagon Load Weight	28.650t
Wagon Total Weight	48.650t
Acceleration	Loco set to 95% of tractive effort
Deceleration	As per Network Rail RailSys Standard

The trailing load has been split evenly across the 37 wagons. This takes into account the weight of the wagon and the load.

For the base line comparison, a nominal train length of 32 wagons has been used to replicate a typical current freight train. The trailing load has been split evenly across the 32 wagons.

2.2.3 Base Line Class 66

Total length of train	669m
Trailing Load	1800t
Total mass of train	1928.022t
Number of Wagons	32
Wagon Length	20.24m
Wagon Weight	20t
Wagon Load Weight	36.250t
Wagon Total Weight	56.250t
Acceleration	Loco set to 95% of tractive effort
Deceleration	As per Network Rail RailSys Standard

2.2.4 Base Line Class 92

Total length of train	667m
Trailing Load	1800t
Total mass of train	1928.022t
Number of Wagons	32
Wagon Length	20.24m
Wagon Weight	20t
Wagon Load Weight	36.250t
Wagon Total Weight	56.250t
Acceleration	Loco set to 95% of tractive effort
Deceleration	As per Network Rail RailSys Standard

3. RailSys Results

3.1 Timing Runs

Table 1 and Table 2 show the RailSys timing runs for the up and down scenarios with a stop in the depot. The Freight Trains were modelled at permitted line speed for this type of freight, allowing the Freights to be modelled “at line speed” at Hanslope Junction and passing through Northampton station. The data for these tables has been obtained from the fahre++ file from a simulated run.

3.1.1 Hanslope to Northampton Timing Runs

	Class 66 1800	Class 92 1800
Hanslope Junction	00:00:00	00:00:00
Set of Points Cross Over Down to Up	00:05:03	00:04:11
Set of Points Cross Over Down to Up	00:05:11	00:04:19
Set of Points Gateway South Entrance	00:05:17	00:04:25
865 Meter Marker for Point Clearance	00:06:12	00:05:20
Stop at Signal	00:06:52	00:05:59
Departure Time	00:07:52	00:06:59
Set of Points Gateway North Entrance	00:09:28	00:08:37
Set of Points Cross Over Up to Down	00:09:44	00:08:53
Set of Points Cross Over Up to Down	00:09:57	00:09:05
Northampton Station T-2	00:14:58	00:13:28

3.1.2 Northampton to Hanslope Timing Runs

	Class 66 1800	Class 92 1800
Northampton Station T-99	00:00:00	00:00:00
Set of Points Gateway North Entrance	00:07:59	00:06:07
865 Meter Marker for Point Clearance	00:09:37	00:07:44
Stop as Signal	00:10:48	00:08:55
Departure Time	00:11:48	00:09:55
Set of Points Gateway South Entrance	00:13:07	00:11:15
Hanslope Junction Timing Point	00:20:46	00:16:42

The times from the timing, runs above have been converted into the requested timings as per the email dated 12/07/2018. These are given in the section below.

3.1.3 Results From/To the South

The figure below shows the applied timing locations for the From/To the South results

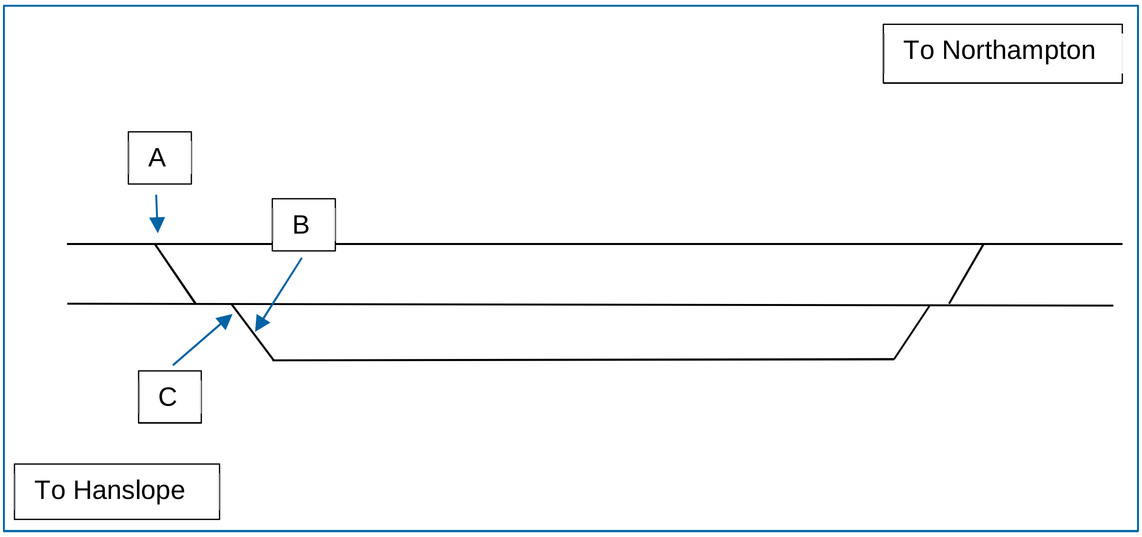

Figure 2 Results Locations From/To the South Timing Locations

	Class 66	Class 92
A) How long each train takes from Hanslope Junction to the Northampton Loop point work that takes you into Gateway Reception Lines. *(Shown as A, Time taken for the front of the train to reach this point, departing from Hanslope Junction)*	00:05:03	00:04:11
B) How long each train takes from reaching that point work for the back of the train to clear the Northampton Loop.*(Shown as B, Time taken for the back of the train to clear all sets of points, Cross Over and turnout, into Gateway)*	00:01:09	00:01:09
C) How long each train takes from departing the Gateway Reception Lines to reaching the Northampton Loop point work.*(Shown as C, Time taken for the front of a departing train in the Up direction to reach the turnout onto the main line)*	00:01:19	00:01:20
D) How long each train takes from the Northampton Loop point work to reach Hanslope Junction.*(Time taken from Point C for the front of* train to reach *Hanslope Junction)*	00:07:39	00:05:27

3.1.4 Results From/To the North

The figure below shows the applied timing locations for the From/To the North results

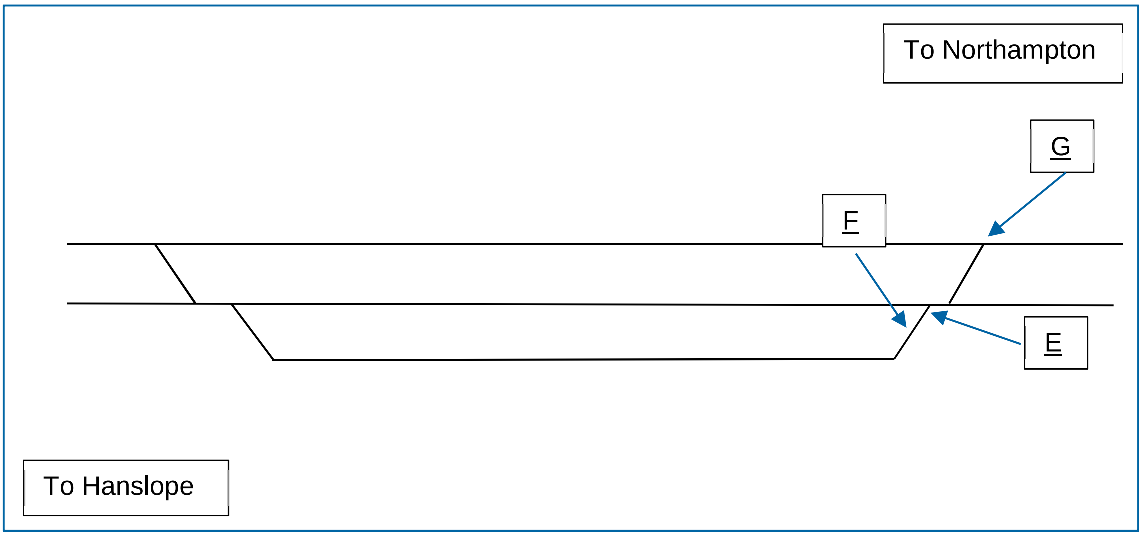

Figure 3 Results Location From/To the North Timing Locations

	Class 66	Class 92
E) How long each train takes from Northampton Station to the northern entrance point work, off the Northampton Loop, that takes you into Gateway Reception Lines.*(Shown as E the time taken for the front of the train reach the turnout into the Gateway)*	00:07:59	00:06:07
F) How long each train takes from reaching that point work for the back of the train to clear the Northampton Loop. *(Shown as F, Time taken for the back of the train to clear turnout into Gateway)*	00:01:38	00:01:37
G) How long each train takes from departing the Gateway Reception Lines, northwards, to reaching the Northampton Loop point work.*(Shown as G, Time taken for front of the departing train to reach the Down Line points on the northern crossover)*	00:02:05	00:02:06
H) How long each train takes from that Northampton Loop point work to reach Northampton Station. *(Time taken for the front of the train to reach Northampton station from the northern Cross over)*	00:05:01	00:04:23

The result for the class 66 shows it out performs the class 92 over the lower speed profile when departing the depot, when checking the detailed output from RailSys this is correct as the class 66 out performs the class 92 at lower speed from a standing start.

Overall the clearance times for the point work in the depot are similar between the Class 66 and Class 92, however in the runtimes to and from the depot the Class 92 out performs the Class 66 as expected.

3.2 Influencing Factors

There are two influencing factors due to the depots location that have an impact on the RailSys run times

1. The gradients approaching the site have an impact on the performance: freight Trains approaching from Hanslope Junction are constrained by the 1 in 300 and 1 in 320 gradients to point 97.204 Km. On the approach from Northampton, the constraint is the 1 in 200 gradient. (See Figure 2)
2. The line speed of 32 kmph within the depot has an impact on Freight services entering from the North and stopping at 99.233 Km. This is because the Freight service cannot realise the increase in line speed to 64 kmph at 100.028 due to the time taken for the rear of the train to clear the 32 Kmph restricted section.

3.3 RailSys Gradient Profile and Speed Graphs

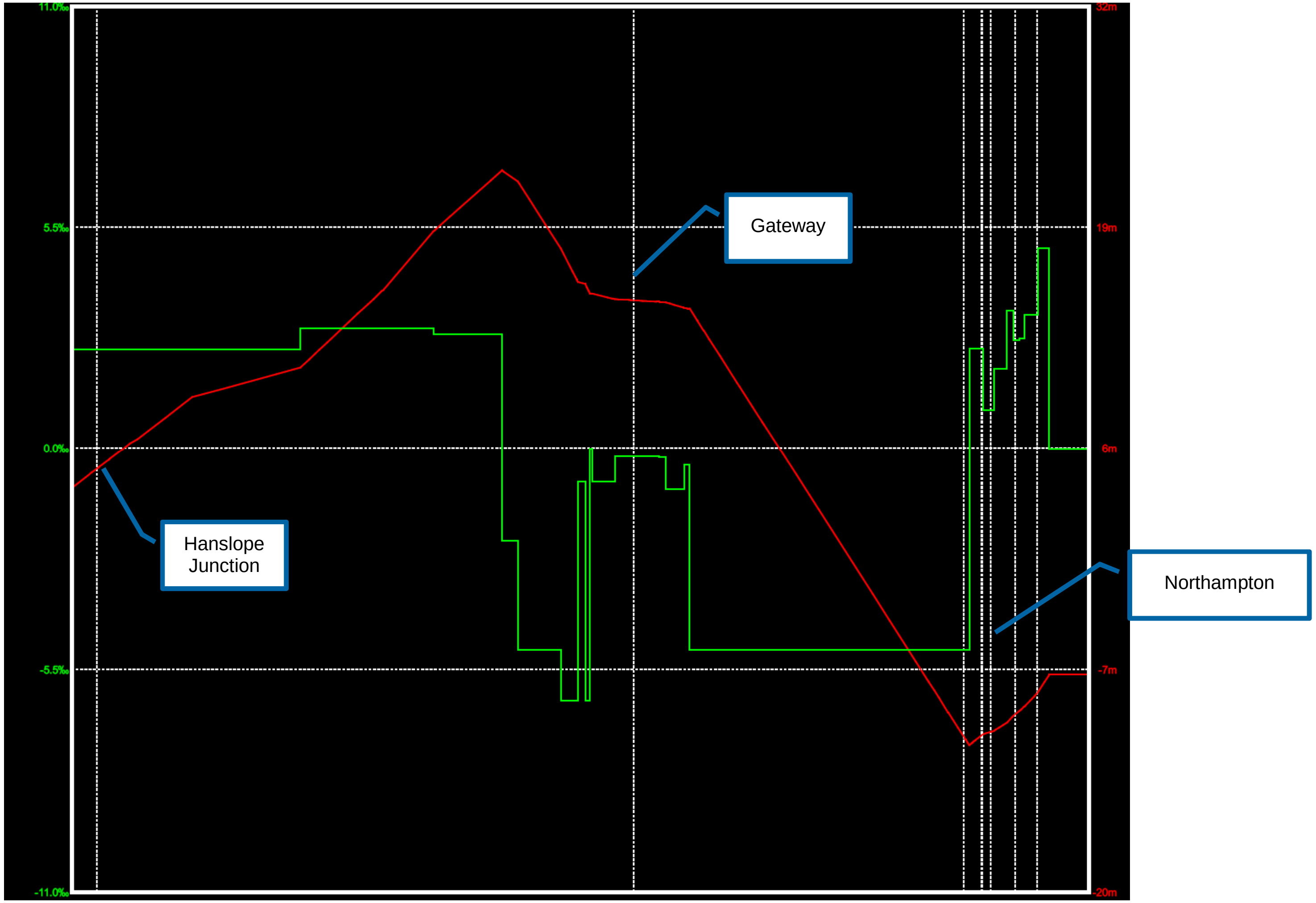

Figure 4 Hanslope Junction to Northampton Gradient Profile

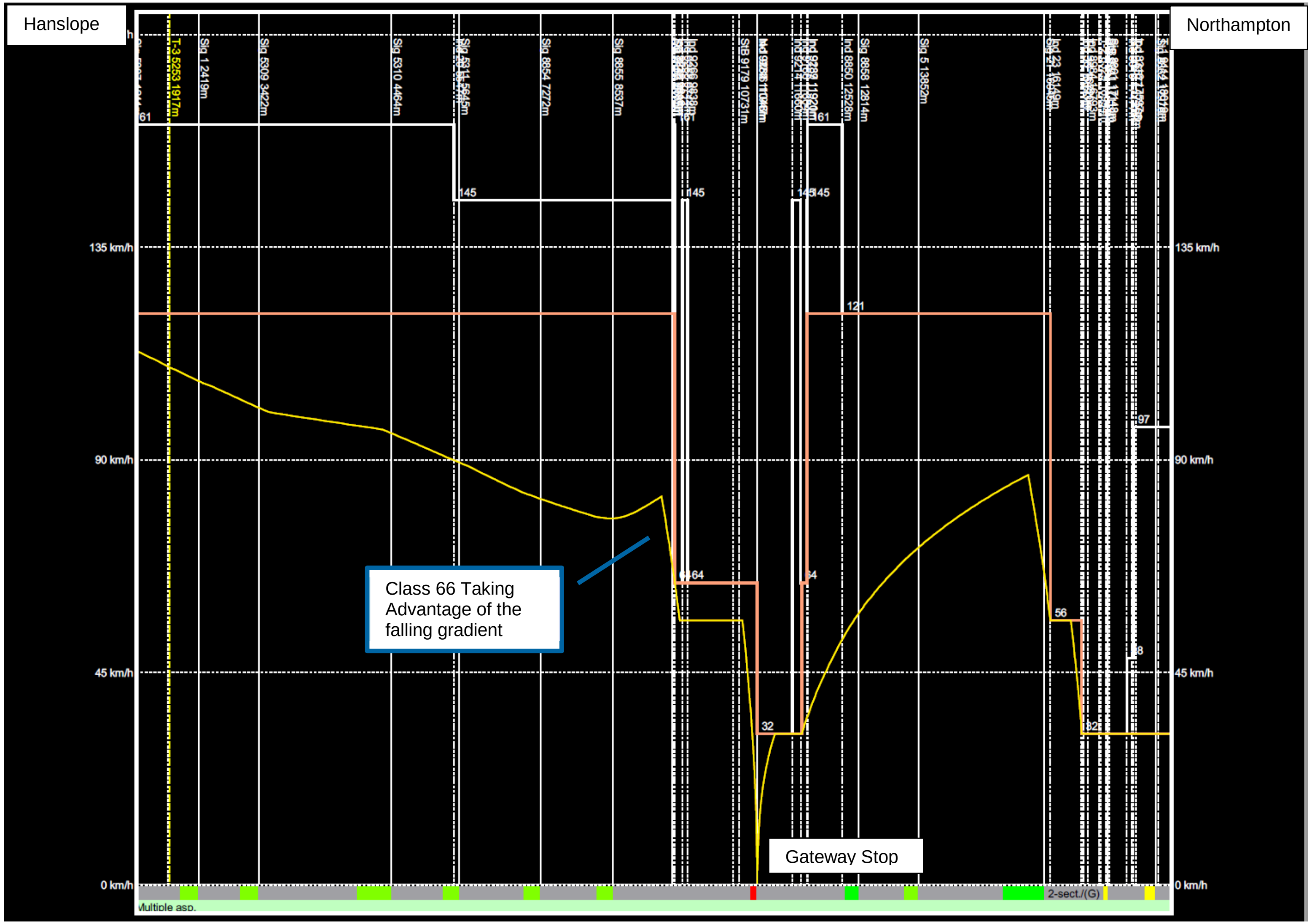

Figure 5 Hanslope Junction to Northampton Class 66 1800T

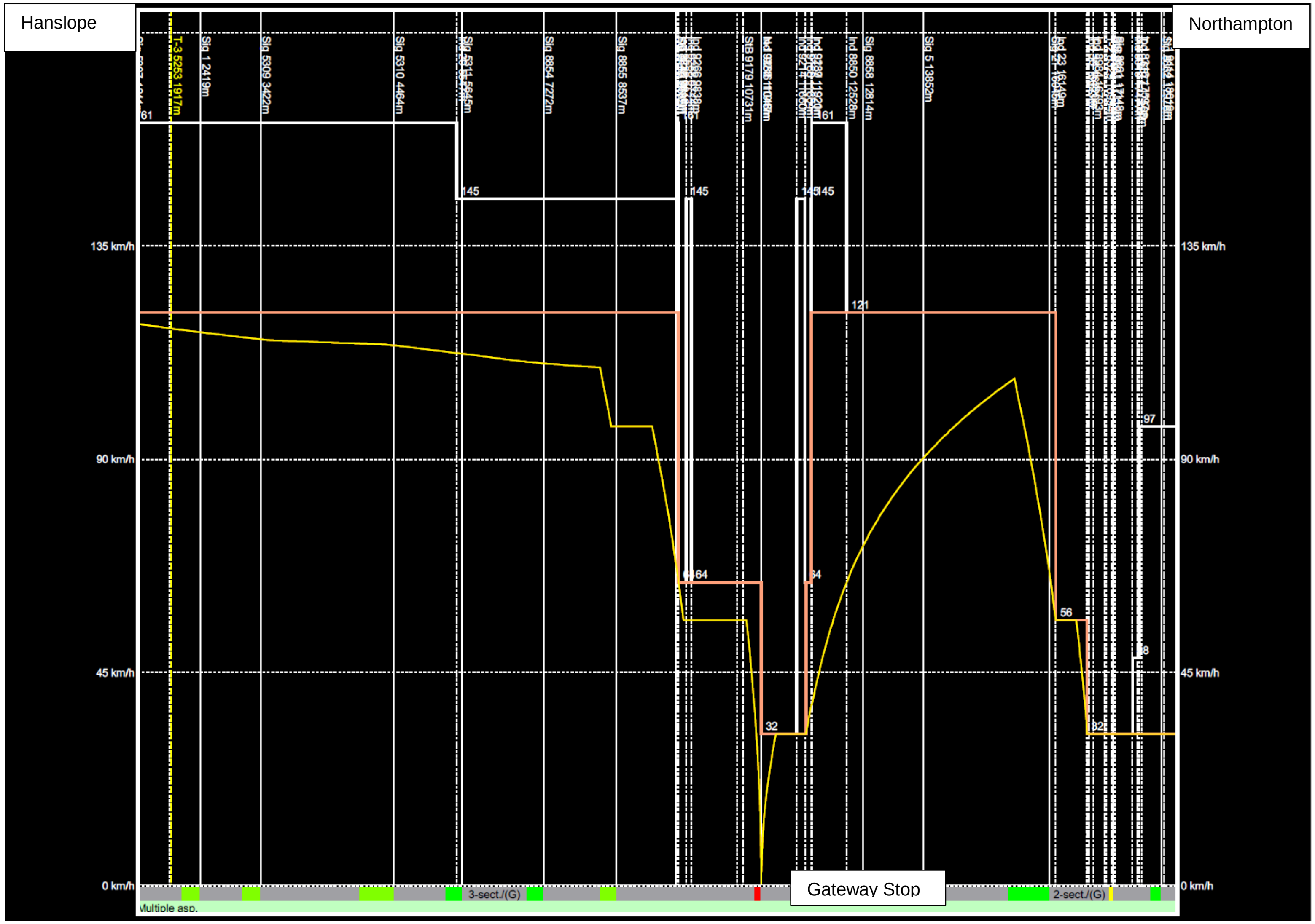

Figure 6 Hanslope Junction to Northampton Class 92 1800T

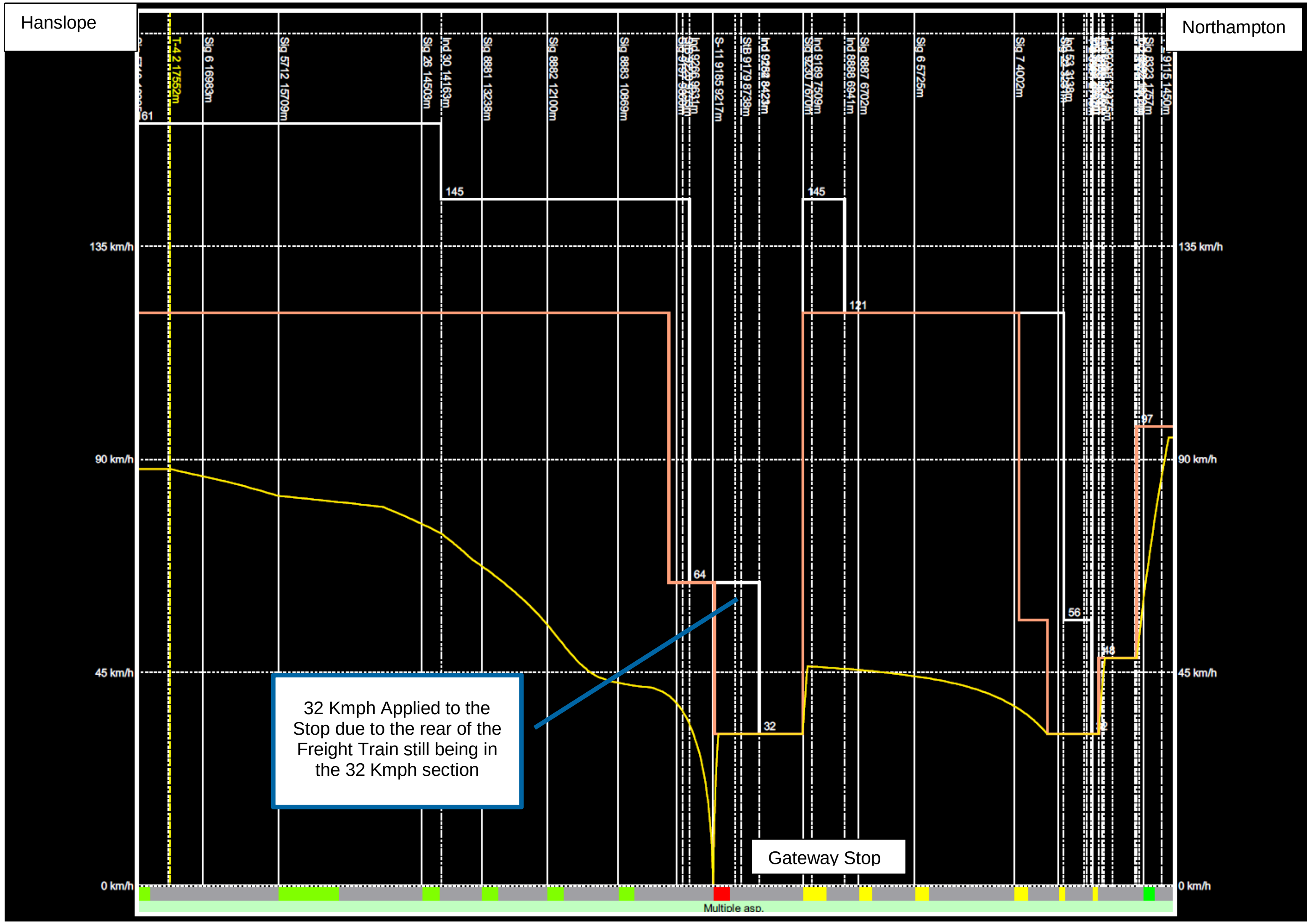

Figure 7 Northampton to Hanslope Junction Class 66 1800T

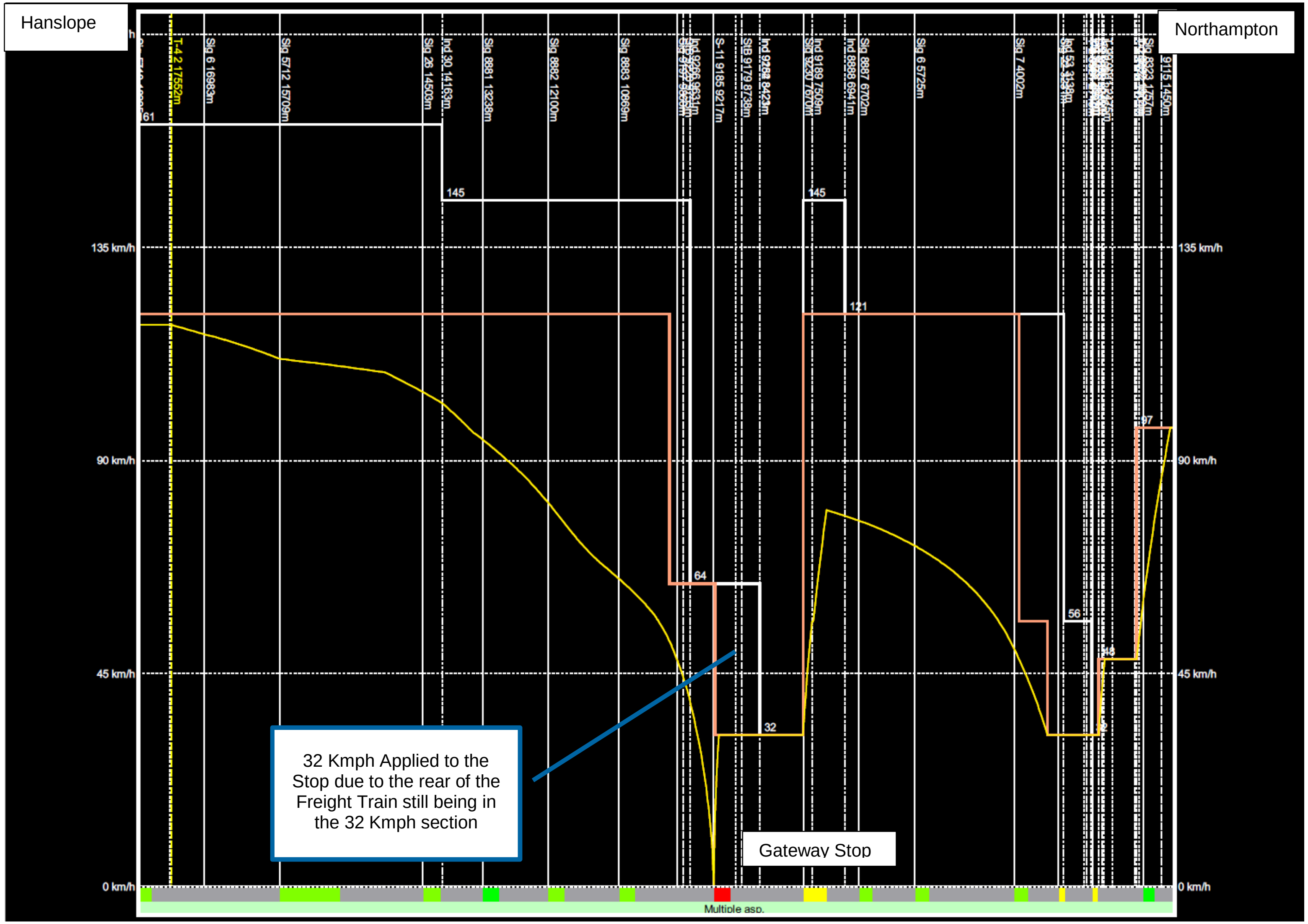

Figure 8 Northampton to Hanslope Junction Class 92 1800T

3.3.1 Hanslope Junction to Northampton Commentary

On the approach to the Gateway the Class 66 is out performed by the Class 92 this is due to the rising gradient from Hanslope Junction see figure 2. There is some recovery on the approach for the 66 when it reaches the falling gradient shown by the increase in the speed see figure 3 for the speed distance graph. On the exit from the depot the Class 66 is out performed by the Class 92 as would be expected.

3.3.2 Northampton to Hanslope Commentary

With the approach to the depot from Northampton as expected the Class 92 out performs the class 66, due to the gradient. The line speed in the depot is constrained by the 34 Kmph section of track on the Northern entrance and time taken for the rear of the train to clear this section. The time distance graph shows this constraint see figure 5 and 6. On the exit from the depot, the Class 66 is out performed by the Class 92 as would be expected.

4. Base Line Comparison

The tables below show the base line comparison using a train with 32 Wagons with a nominal train length of 669 meters. This represents a typical train currently operational on the network. This was set up with a trailing load of 1800 Tons.

In all the comparisons there is a difference in the run time modelled in Railsys as the 669meter freight train load is quicker.

4.1.1 Hanslope to Northampton Timing Runs Class 66

	Class 66 37 Wagons	Class 66 32 Wagons	Comparison
Hanslope Junction	00:00:00	00:00:00	
Set of Points Cross Over Down to Up	00:05:03	00:04:43	00:00:20
Set of Points Cross Over Down to Up	00:05:11	00:04:51	00:00:20
Set of Points Gateway South Entrance	00:05:17	00:04:57	00:00:20
865 Meter Marker for Point Clearance	00:06:12	00:05:53	00:00:19
Stop at Signal	00:06:52	00:06:32	00:00:20
Departure Time	00:07:52	00:07:32	00:00:20
Set of Points Gateway North Entrance	00:09:28	00:09:08	00:00:20
Set of Points Cross Over Up to Down	00:09:44	00:09:24	00:00:20
Set of Points Cross Over Up to Down	00:09:57	00:09:35	00:00:22
Northampton Station T-2	00:14:58	00:14:29	00:00:29

4.1.2 Hanslope to Northampton Timing Run Class 92

	Class 92 37 Wagons	Class 92 32 Wagons	Comparison
Hanslope Junction	00:00:00	00:00:00	
Set of Points Cross Over Down to Up	00:04:11	00:04:07	00:00:04
Set of Points Cross Over Down to Up	00:04:19	00:04:15	00:00:04
Set of Points Gateway South Entrance	00:04:25	00:04:21	00:00:04
865 Meter Marker for Point Clearance	00:05:20	00:05:16	00:00:04
Stop at Signal	00:05:59	00:05:56	00:00:03
Departure Time	00:06:59	00:06:56	00:00:03
Set of Points Gateway North Entrance	00:08:37	00:08:33	00:00:04
Set of Points Cross Over Up to Down	00:08:53	00:08:48	00:00:05
Set of Points Cross Over Up to Down	00:09:05	00:08:59	00:00:06
Northampton Station T-2	00:13:28	00:13:15	00:00:13

4.1.3 Northampton to Hanslope Timing Runs Class 66

	Class 66 37 Wagons	Class 66 32 Wagons	Comparison
Northampton Station T-99	00:00:00	00:00:00	
Set of Points Gateway North Entrance	00:07:59	00:07:53	00:00:06
865 Meter Marker for Point Clearance	00:09:37	00:09:31	00:00:06
Stop as Signal	00:10:48	00:10:41	00:00:07
Departure Time	00:11:48	00:11:41	00:00:07
Set of Points Gateway South Entrance	00:13:07	00:13:00	00:00:07
Hanslope Junction Timing Point	00:20:46	00:20:33	00:00:13

4.1.4 Northampton to Hanslope Timing Runs Class 92

	Class 66 37 Wagons	Class 66 32 Wagons	Comparison
Northampton Station T-99	00:00:00	00:00:00	
Set of Points Gateway North Entrance	00:06:07	00:05:58	00:00:09
865 Meter Marker for Point Clearance	00:07:44	00:07:36	00:00:08
Stop as Signal	00:08:55	00:08:46	00:00:09
Departure Time	00:09:55	00:09:46	00:00:09
Set of Points Gateway South Entrance	00:11:15	00:11:06	00:00:09
Hanslope Junction Timing Point	00:16:42	00:16:30	00:00:12

5. Planning Values

Based on the technical running times in Section 3 above,the following planning values were determined for use in a pathing analysis to be conducted by GB Railfreight.

Section Description	Technical Running Time		Planning values (Minutes)	
Entry from the south	Class 66	Class 92	Class 66	Class 92
Hanslope Junction > Gateway South Crossover	5 m 03 secs	4 m 11 secs	5 ½	4 ½
Gateway South Crossover > Clearance point of the South Junction	1 m 09 secs	1 m 09 secs	1 ½	1 ½
Clearance point of South Junction > Reception Line Stop	0 m 40 secs	0 m 39 secs	1 ½	1 ½
Exit to the south				
Reception Line Start > South Junction	1 m 19 secs	1 m 20 secs	2	2
South Junction > Hanslope Junction	7 m 39 secs	5 m 27 secs	8	6
Entry from the North				
Northampton > North Junction	7 m 59 secs	6 m 07 secs	8 ½	6 ½
North Junction > Clearance point of North Junction	1 m 38 secs	1 m 37 secs	2	2
Clearance point of North Junction > Reception Line Stop	1 m 11 secs	1 m 11 secs	1 ½	1 ½
Exit to the North				
Reception Line start > North Junction	2 m 05 secs	2 m 06 secs	2 ½	2 ½
North Junction to Northampton	5 m 01 secs	4 m 23 secs	5 ½	5

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
P01.4	Julian Ockford	J Blake	Draft	H Kane	Draft	31/07/2018
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Northampton Gateway RailSys Model Analytical Assurance Statement

Document Control	
RailSys Model Name	Northhampton RailSys Model Detailed
Project	Northampton Gateway Technical Run Times
Modeller	Julian Ockford, Gutteridge Haskins & Davey Limited
Assured By	Gavin Dowland, 03/09/2018
Capability Analysis Project Manager Approval	Andrew Robinson, 07/09/2018
Last Edited	07/09/2018

Assurance Statement

This document confirms that the Northampton Gateway model has been checked in line with the RailSys Quality Assurance Guidelines and the 2018 RailSys Standards. It is suitable to be used for the analysis indicated in the table below. The model is not assured for any other use.

	TRT Calculation	Technical Margin Calculation	Timetable modelling	Performance modelling
Inputs	**Assured**	Not Assured	Not Assured	Not Assured
Outputs	**Assured**	Not Assured	Not Assured	Not Assured

Note: The model does not assume any sort of approach control entering the Northampton Gateway proposed infrastructure from either the North or South. Given that this is likely to be Approach on Yellow (MAY) this is not a problem when it comes to technical calculation of the run times utilised in the outputs of this model as the freight train is assumed to be approaching a red signal in the yard. However, it is advisable that for any future developments of this model, that an approach control method is assumed, especially when considering junction margins and any further modelling that this may use.

The analysis from a RailSys model cannot be used by Network Rail without an accompanying (up-to-date) RailSys Assurance document confirming its use for the analysis performed.

Documentation

Network Rail were provided with locations of the freight facility in the remit for assurance purposes.

All other information was obtained from the Sectional Appendix (speed & station locations) and Network Rail's 5 Mile Diagrams (gradients).

RailSys Model use

This model is only suitable for the calculation of technical run times on the following routes:

Northampton Station to Hanslope Junction in both directions.

Assurance Activity

The model was assured against the RailSys Standards 2018 and confirms with those standards, given the information provided and the outputs required from this stage of modelling work.

It is advised that further modelling, including inputting of release contacts and approach controls are required to calculate Technical Margins including headway and junction margins will need to be done to calculate these values accurately and in line with the standards.