NetworkRail

System Operator

Wrexham - Bidston – Congested Infrastructure Report

Advanced Timetable Team

On the side of passengers and freight users

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References				
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1.	Analytical Assurance Operational Policy (contained in IMS)	Assurance Policy	03/08/2022	Issue 2
2.				

Abbreviations	
Acronym	**Meaning**
AB	Absolute Block
ATT	Advanced Timetable Team
CTP	Concept Train Plan
DfT	Department for Transport
FOC	Freight Operating Company
HAW	Heavy Axle Weight
IMS	Integrated Management System
Jn	Junction
NR	Network Rail
SRT	Sectional Running Time
TfW	Transport for Wales
TOC	Train Operating Company
TPH	Trains Per Hour
TPR	Timetable Planning Rules

Contents

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Part A: Executive Summary

The Borderlands Line that connects Wrexham to Bidston has been declared congested infrastructure by Network Rail. This because it has not been possible to accommodate the increase in passenger service from an hourly service in each direction to two services per hour in each direction alongside freight services.

The aim of the analysis was to identify the following.

- Constraints which prevent the aspirational service specification
- Interventions required to facilitate the service specification
  Whether the interventions can support current future growth aspirations

As part of this analysis the following three phases have been examined.

- Phase 1 - Two passenger services per hour (one calling at all stations and one limited-stop) in addition to an hourly freight opportunity
- Phase 2 - Two passenger services per hour (both call at all stations) in addition to an hourly freight opportunity
- Phase 3 - Future Aspirations – Four passenger services per hour (calling at all stations) in addition to an hourly freight opportunity into Padeswood Cement Works

As part of this analysis these are the key findings.

- Without infrastructure upgrades including enhanced signalling, capacity has not been found for all services based on the current published TPRs
- Enhancements to the siding entrance at Penyffordd for the Padeswood Cement Works will be essential to prevent freight movements blocking the Down Main line for 40 minutes
- Additional intermediate signals need to be added throughout the area to break the long block sections into shorter sections between Bidston Dee Jn to Wrexham Exchange Jn
- Two passenger and one freight service can be accommodated with the provision of shorter signalling block sections, but the trade-off will be that the passenger service will not arrive on an even 30-minute intervals to their destination

- In order to accommodate four passenger paths per hour alongside an hourly freight opportunity a signalling enhancement will be needed which can support, at a minimum, a planning headway of 7-minutes.

The options table below outlines the infrastructure or signalling changes required to accommodate each phase

Infrastructure	Phase 1	Phase 2	Phase 3
New entrance at Padeswood Cement Works with cross over	✓✓	✓✓	✓✓
Insert intermediate block signals	✓✓	✓✓	×
Re-signalling to allow 7-minute headway	+	+	✓✓

Table 1. Infrastructure options

Key:

✓✓ *= Essential*

\+ *= Nice to have / beneficial*

× *= Not beneficial*

Infrastructure interventions such as the addition of Intermediate Block Signals and an upgraded entrance to Padeswood Cement Works for freight services would be necessary to accommodate freight paths without disruption to the regular 2 tph passenger timetable. Three intervention phases have been created to help alleviate the congested infrastructure.

Part B: Introduction

B.01 Background

The current level of service on the Wrexham-Bidston line of route, as it has been for many years, is one passenger train per hour (tph), operated by Transport for Wales Rail Limited (TfW) as well as various freight services.

As part of the Wales & Borders Rail Service Contract which commenced in 2018, a commitment was made to run additional services operated by new and refreshed rolling stock across the Wales & Borders network. These commitments included a 2tph service between Wrexham and Bidston from December 2021. The Rail Service Contract was let by TfW Authority on behalf of the Welsh Government under an agency agreement with the Department for Transport (DfT), and as such the Network Rail (NR) involvement was via Competitive Dialogue which is different from a typical DfT franchise.

As part of the Competitive Dialogue process, the NR Capacity Analysis team carried out some high-level analysis of any new services proposed by bidders. This analysis was based on a 2-hour weekday morning window and provided just an outline view of network capacity. All bidders were also advised that any proposals were still subject to the standard industry timetable bidding processes despite the analysis. Relating specifically to additional services on Wrexham-Bidston, the clashes with freight paths were identified as being a potential risk to delivering the proposed passenger services.

Further analysis was undertaken in June 2020 by Network Rail to understand feasibility of the uplift proposed by TfW. This was based on Wednesdays only, used the Class 230 timing load and found that it was only possible to run an even-interval 2tph service at certain periods of the day when no freight services were operating. It was not possible to run a regular pattern in conjunction with the freight trains and challenges accommodating specific freight services and TfW's aspirations were highlighted as part of this work.

For the December 2021 (Dec 21) timetable, TfW Rail submitted an access proposal to operate an increased service of 2tph, with the second service proposed to run as a semi-fast service. However, the bid from TfW was based on their use of slower Class 153s rolling stock and sectional running times (SRTs), but now intend to resource Class 230s.

It was noted that between completion of the advance work and the Dec 21 bid submission, additional Cement freight flows had been introduced into the timetable via the Rolling Spot Bid process.

For the May 22 timetable, TfW again submitted an access proposal to operate the increased 2tph service, vice 1tph, on the Wrexham-Bidston route, based on their use of Class 153 rolling stock and SRTs.

Through the validation work and liaison with passenger and freight operators on the December 21 and May 22 timetables, it also became apparent that the Train Planning Rules (TPRs) did not fully reflect the geography on the line of route and that more detailed rules were required to accurately plan the increased services and properly understand available capacity. There were also queries regarding the utilisation of the existing freight paths included within the timetable.

Congested infrastructure was declared for the line on August 1st, 2022. This triggered a 12-month window within which Network Rail must produce an enhancement plan. The first step towards this is for Network Rail Advanced Timetable team to produce and publish a report looking at the line's capacity on the Network Rail website by January 31st, 2023.

B.02 Aims and Objectives

Following the declaration, Network Rail have 6 months to carry out capacity analysis. Under regulation 27 of the Railway Regulations Act this must include:

- Characteristics of the infrastructure
- Operating procedures; and
- Characteristics of the train services.

To that extent, this analysis will provide answers to the following:

- What constraint(s) is preventing the aspirational service specification
- What intervention(s) are required in order to facilitate the service specification
- Does the intervention support current future growth expectations
    - If not, identification of both the constraint and possible interventions will be provided

In addition to the above, the Advanced Timetable Team (ATT) will also provide commentary on expected performance, this will be a high-level view based on the analysis required to answer the above.

Part C: Findings

We analysed three individual phases in ATTUne to identify constraints and possible interventions in the timetable, Phase 1 is based on the bid TfW submitted that led to congested infrastructure being declared.

- Phase 1 - Two passenger services per hour (one calling at all stations and one limited-stop) in addition to an hourly freight opportunity
- Phase 2 - Two passenger services per hour (both call at all stations) in addition to an hourly freight opportunity
- Phase 3 - Future Aspirations – Four passenger services per hour (calling at all stations) in addition to an hourly freight opportunity

C.01 Initial Constraints

Two key constraints have been identified which apply to all three phases. The first is the minimum time-interval enforced between services by the current signalling (the “headway”) and the second is the capacity-consuming access to Padeswood Cement Works.

The signalling system on the line is a mixture of semaphore and colour-light signals that are generally arranged in line with absolute block principles that only allows one train in a block section at one time. Each end of the block section is defined as a timing point in the timetable. The second train can only be timed to enter the block section after the first train has arrived at the end of the block section (the “AB” time) plus an allowance for the signaller to replace and clear the necessary signals and the second train to receive an unrestricted approach to the block section. Since the “AB” time is the transit time of the first train, minimum headway between services is largely dependent on the speed of the first train, which affects how long it takes to clear the block section.

The headways below are based on TfW's Class 230s with a 30 second stop at stations. (With the value in brackets indicating the minimum headway following an all-stations passenger train):

- Bidston West Jn to Dee Marsh Signal Box planned to AB+2 (24.5 minutes)
- Penyffordd to Dee Marsh Signal Box planned to AB+2 (15.5 minutes)
- Wexham Exchange Jn to Penyffordd planned to AB+2 (19.5 minutes)
    - When Penyffordd box is switched out Absolute Block to apply between Wrexham Exchange Junction (CN51/75 signals) and Dee Marsh Junction (DM3/23 signals) (When signal box is closed it takes 30.5 minutes)
- Wrexham Central to Wrexham Exchange planned to one train in section

Access into and exiting Padeswood Cement Works currently takes 40 minutes for freight services to manoeuvre into the Cement Works and consequently they block the Down Main line for that period. The proposed introduction of a new connection at the north or the upgrade to the current entrance of the Cement Works will reduce the 40-minute move considerably freeing up capacity on the line.

Option B – North Entrance

Source

Transport for Wales
BORDERLANDS STAGE B Padeswood Depot - Freight Options Report
Document Reference: 10049646-ARC-RP-ZZ-20001 Revision Number: P02
Issue Date: MAY 2022

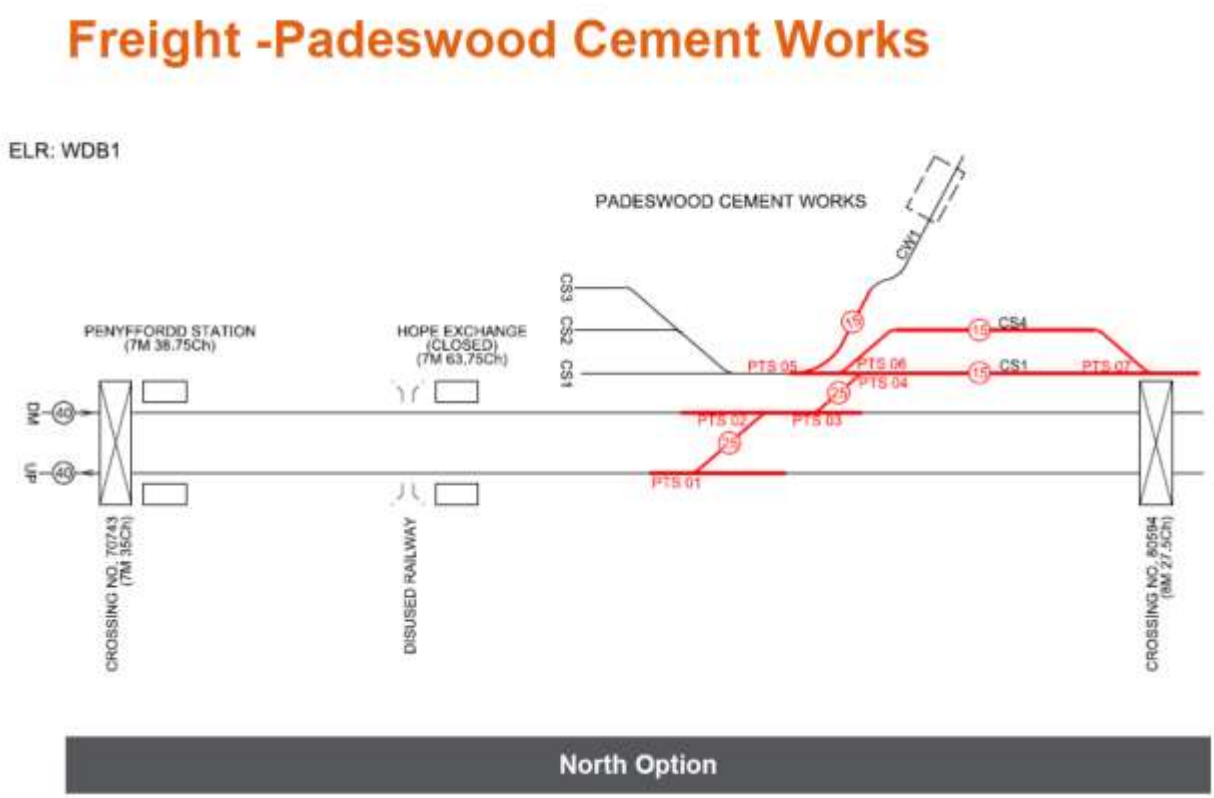


Fig 1. Source: Transport for Wales Borderlands Stage B Padeswood Depot – Freight Options Report Padeswood option B.

C.02 Phase 1

Additional Absolute Block sections are required to reduce headways to allow 2 passenger and 1 freight service to operate in each hour.

As shown by the blue circle on the train graph in Figure 2, when a skip stopping passenger service is introduced in an even-interval pattern alongside the current passenger and freight service a headway constraint is created because the second service needs to occupy the Penyffordd – Wrexham block section before the preceding train has left the block.

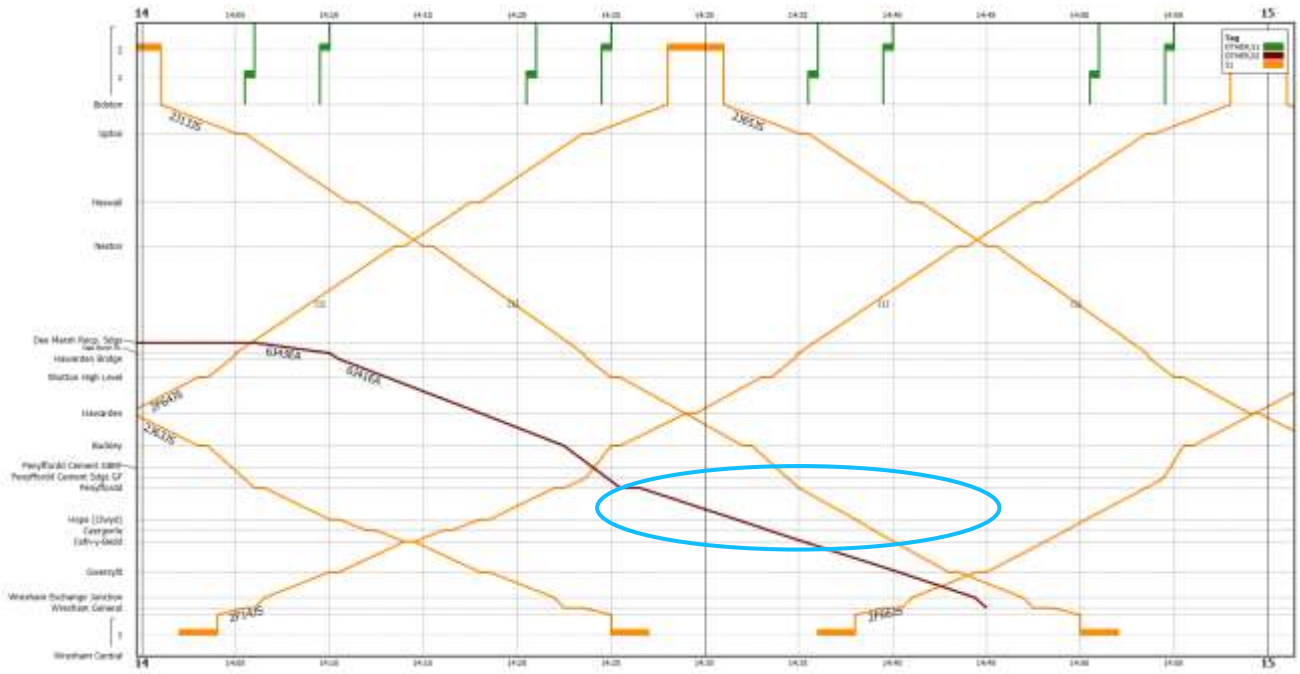


Fig 2. Freight headway vs passenger skip stopping service.

Time is displayed on the X axis; Location is displayed on the Y axis of the graph.

To help alleviate the headway constraint additional block sections are required to break the Absolute Blocks down, to allow the following train to enter earlier than the current TPRs state. Below are recommendations on where the additional signalling should be placed along with the resulting reduced minimum headway in brackets, assuming the train in front stops at all stations. The headways below are based on TfW's Class 230s with a 30 second stop at stations. (With the value in brackets indicating the minimum headway following an all-stations passenger train):

- Bidston West Jn to Neston planned to AB+2 (16½ minutes)
- Neston to Dee Marsh Jn planned to AB+2 (10 minutes)
- Dee Marsh Jn to Buckley timed at AB+2 (10 minutes)
- Buckley to Penyffordd timed to AB+2 (3 minutes)

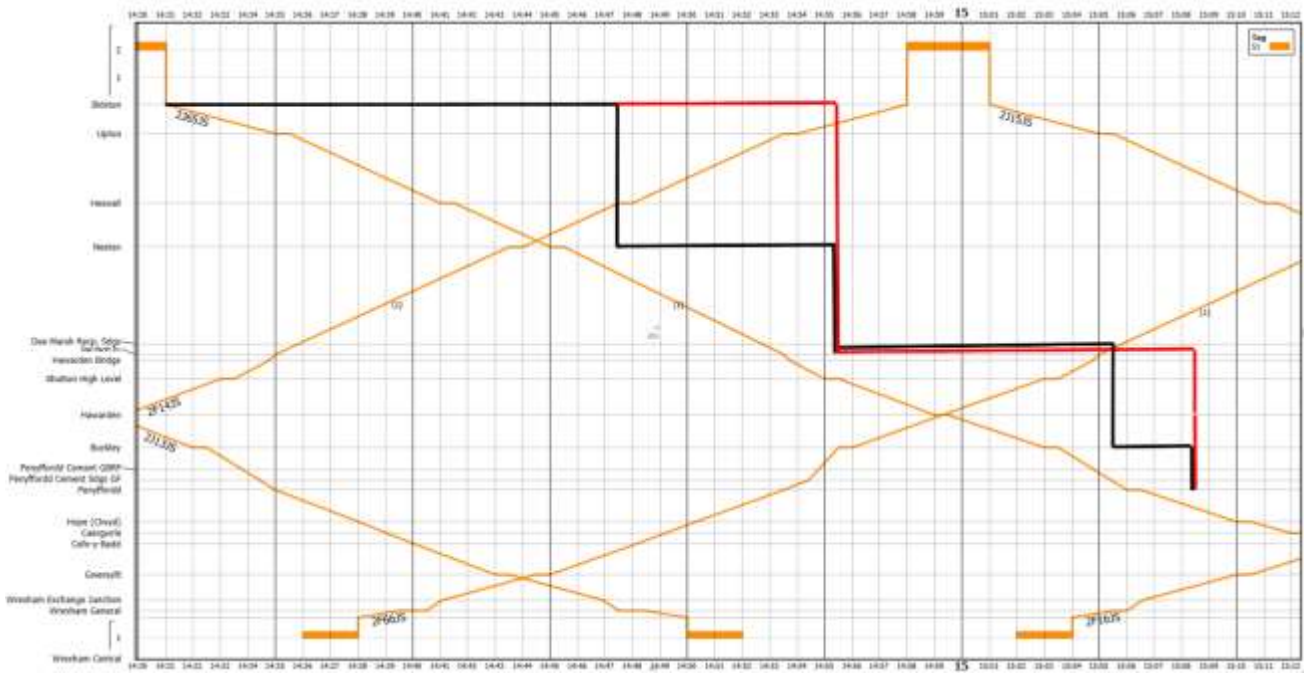


Fig 3. Absolute Block Section Reference.

The graph illustrates in figure 3 the current Absolute Block sections in red and the new proposed sections in black, showing when the first service can enter dependent on the timing load of the first train, which affects how long it takes to clear the block section.

As shown in the blue circle in figure 4, the additional blocks mean trains can enter sections earlier creating space for freight allowing for 2 tph and a freight, to keep this even interval between services will need a signalling system capable of reducing the Absolute Block sections.

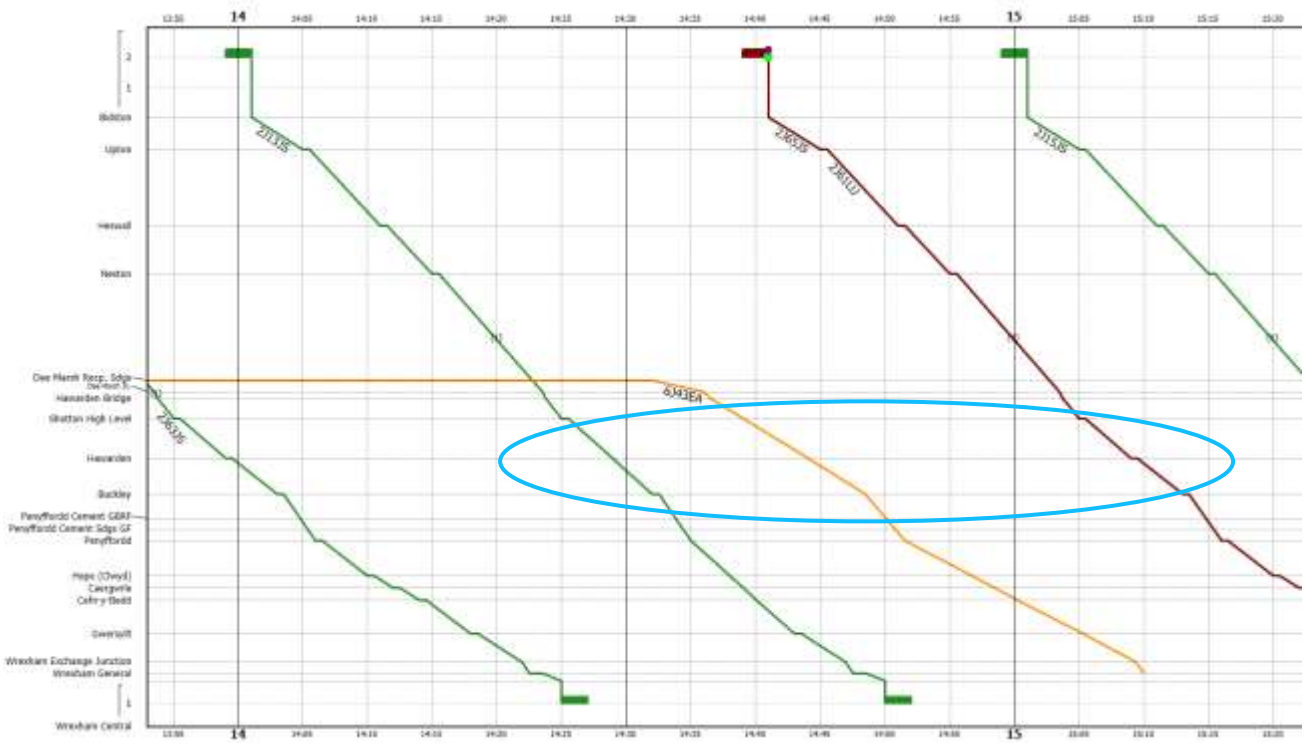


Fig 4. 2tph and freight opportunity

This would allow 2 passenger and 1 freight to operate in a 30-minute interval.

C.03 Phase 2

As per Phase 1, there is a headway constraint when the second passenger service stopping at all stations is introduced instead of a skip-stopping service.

As shown by the blue circle in Figure 5, when an all-stations passenger service is introduced in an even-interval pattern alongside the current passenger and freight service a headway constraint is created.

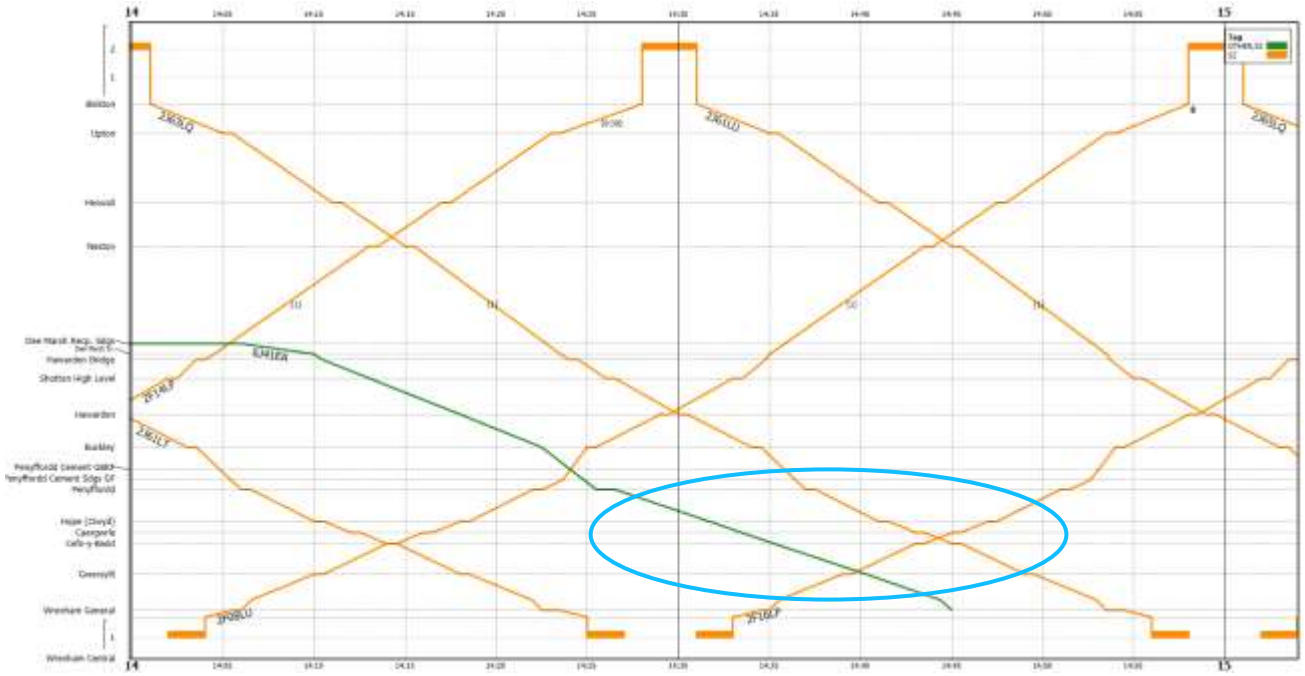


Fig 5. Freight headway vs passenger full stopping service.

As shown in the blue circle we have found that the same result was found in phase 2 as phase 1 where additional block sections are needed to allow for 2 tph and an hourly freight opportunity.

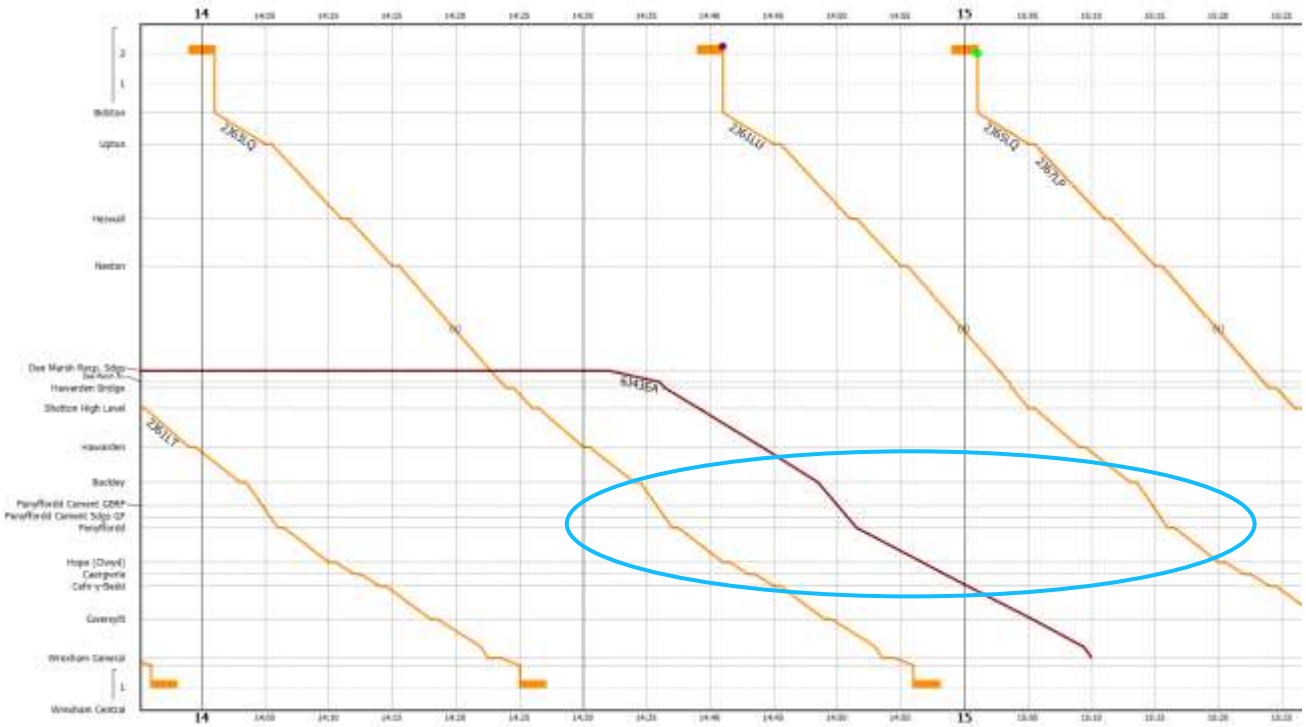


Fig 6. Two full stopping tph and freight opportunity

C.04 Phase 3

As shown in the blue circle in figure 7, to accommodate four passenger paths per hour alongside an hourly freight opportunity a signalling enhancement will be needed which can support, at a minimum, a planning headway of 7-minutes.

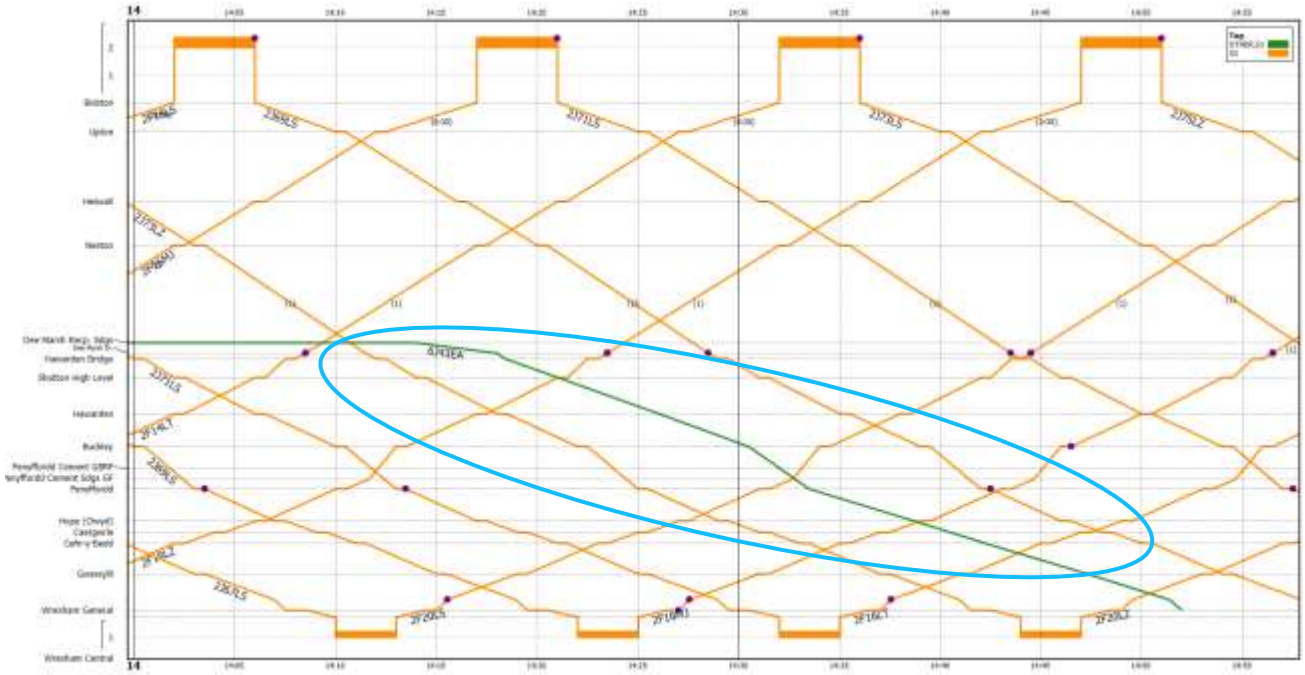


Fig 7. Illustration of 4tph full stopping passenger service vs freight.

To accommodate future aspirations of 4tph it is recommended re-signalling takes place along the route which can support, at a minimum, a planning headway of 7 minutes and one of Padeswood Cement Works north or south entrance enhancements take place to stop the 40-minute freight manoeuvre blocking the Down Main Line.

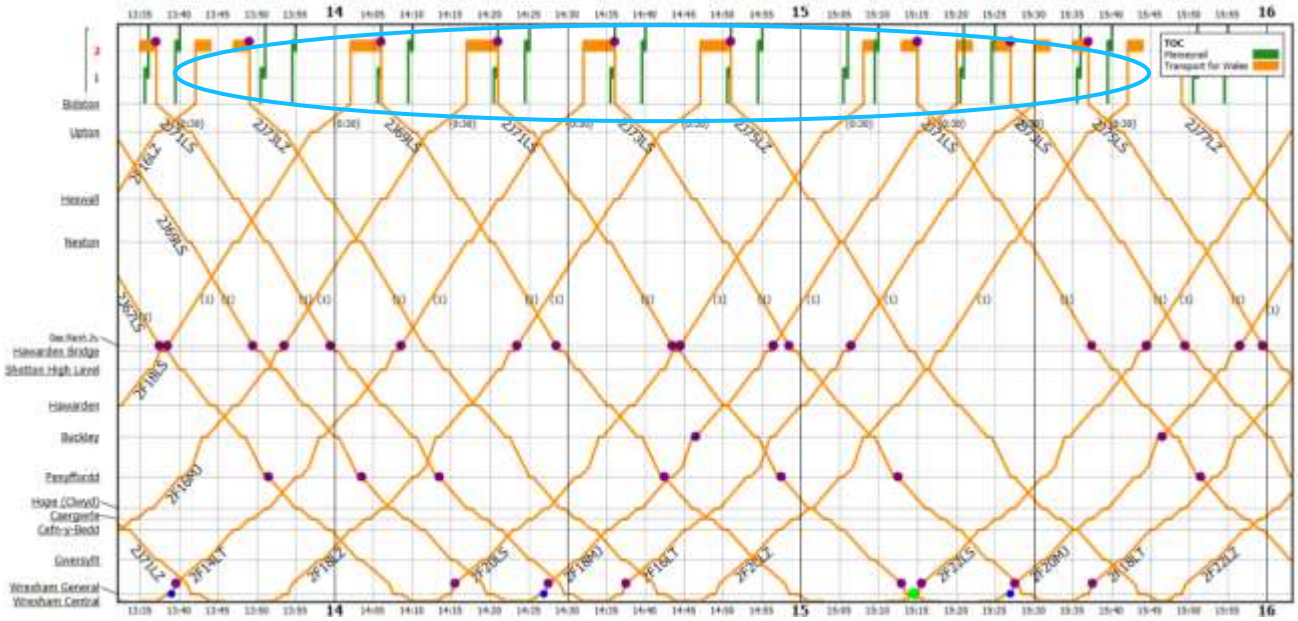


Fig 8. TfW 4tph interacting with Merseyrail at Bidston

The West Kirby Merseyrail service runs a standard repeating pattern calling at Bidston, the future aspiration to run 4tph on the Borderlands Line may require Merseyrail services to be retimed to accommodate the increase of services, there is an ambition by TfW and Merseyrail to have a direct service between Wrexham and Liverpool via Bidston, however that aspiration it is not part of the scope of this work to test the feasibility of this.

There is a risk to performance as the turnaround times would have to be compressed to fit additional services at Wrexham and Bidston in the 4tph phase 3 scenario. It is likely that further inventions at either the Bidston or Wrexham end of the route would be required to permit longer turnrounds whilst retaining compatibility with the Merseyrail services.

C.05 Further Considerations

Further points of interest in the analysis are:

The requirement to operate freight services during the operating day for passenger services is caused by the constraints on the routes of those services outside the Wrexham – Bidston line and the need to be able to practically crew those services.

Part D: Conclusions and Recommendations

Through analysis on the 3 phases to accommodate the 2 tph and freight the recommendations below have been reached.

Given the constraints of the infrastructure at Padeswood Cement Works we conclude that without intervention of upgrading the entrance none of the phases analysed will be feasible to operate.

- Enhancements to Padeswood Cement Works entrance will be essential to alleviate freight movements not blocking the Down Main line for 40 minutes.

The signalling arrangement is also a key constraint as it limits the number of services which can operate across the route.

- We recommend additional intermediate signals need to be added throughout the area to break the Absolute Block sections down to reduce the minimum headway.

Through analysis we recommend that to deliver the 2tph and a freight the network will need an intervention of an updated signalling system to reduce headways and Padeswood Cement Works entrance upgrade to reduce the time it takes for the freight to manoeuvre into the cement sidings freeing up capacity for passenger services.

Based on the constraints noted by freight operators on the pathing of their services, both in terms of crewing and their practical loading / unloading times at each end of the journey it is assumed that these services need to remain on this line of route during the operating day of the passenger services. If this assumption is altered, it would have a material effect on the conclusions of this report.

Infrastructure options table below outlines the infrastructure or signalling changes required to accommodate each phase.

Infrastructure	Phase 1	Phase 2	Phase 3
New entrance at Padeswood Cement Works with cross over	✓✓	✓✓	✓✓
Insert intermediate block signals	✓✓	✓✓	×
Re-signalling to allow 7-minute headway	+	+	✓✓

Table 1. Infrastructure options

Key:

✓✓ *= Essential*

\+ *= Nice to have / beneficial*

× *= Not beneficial*

Part E: Assumptions

E.01 Timing Load Assumptions

Timing loads for passenger and freight will be from existing sectional running times from December 2022 BPlan database.

Timing Loads have been considered in accordance with the Load Books that is a document that contains the different height, weight and traction types of trains that use the network, HAW restrictions have been considered where applicable.

E.01.01 Additional Services

The speed and characteristics of the additional 2tph added in phase 3 where four passenger services are operated per hour have been assumed to be equivalent to the paths in the May ’22 timetable.

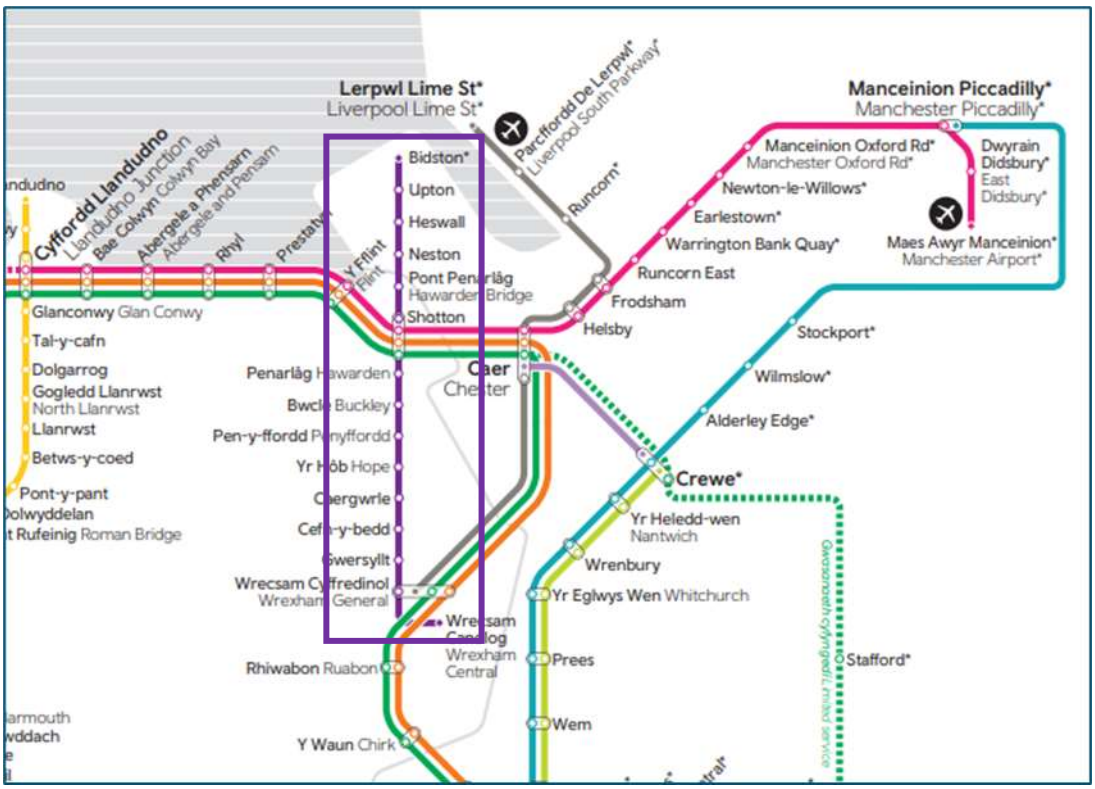
E.02 Timetable Scope

The timetable has been assessed over a 24-hour weekday period to account for the variety of freight paths which operate across the day.

E.03 Geographic Scope

The geographic scope of the Wrexham to Bidston Line is shown below. The line runs from Wrexham Central in the south to Bidston in the north. The interfacing Merseyrail services at

Bidston are not indicated on this diagram.



Source – https://tfw.wales/ways-to-travel/rail/where-to-go/rail-network-map

E.04 Engineering Access Statement

Engineering Access Statement 2023 V4, section 3007.1, 3007.2 & 3007.3 will be considered in this analysis for the Wales route.

E.05 Source Timetable

Electronic files supplied by TfW were used as the base timetable for the Class 230 services overlain with freight and other operators from the May 2022 production timetable.

E.06 Infrastructure

The assumed infrastructure for this analysis will be the base infrastructure being used for May 2023.

Part F: Methodology

The following process was undertaken to deliver the agreed aims and objectives:

- Set up ATTUne – 3 Concept Train Plans (CTPs) were constructed
  - Phase 1 - Two passenger services per hour (one calling at all stations and one limited-stop) in addition to an hourly freight opportunity
  - Phase 2 - Two passenger services per hour (both call at all stations) in addition to an hourly freight opportunity
  - Phase 3 - Future Aspirations – Four passenger services per hour (calling at all stations) in addition to an hourly freight opportunity
- Constraints and possible interventions for each CTP were identified
- The CTP was updated to include interventions
  - If the service specification cannot be accommodated due to additional constraints, step 2 was repeated
  - Step 2 was then repeated with future aspired service level whilst identifying interventions, results from previous analysis have been drawn upon.