Network Strategy and Planning: Capability Analysis
MetroWest Phase 1 Addendum Report

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Stakeholders

Name of stakeholder	Company / Business
James Willcock	Phase One Project Manager, West of England councils.
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1. EXECUTIVE SUMMARY

The MetroWest Phase One project is the first step in a scheme that will radically alter the passenger connections in Bristol and the surrounding areas. It focuses on the increased frequency of services on the Severn Beach line and Bath corridor, and reopening of the Portishead line to passenger trains.

This report details the continuation of previous work conducted by Capability Analysis, Economic Analysis and Halcrow. It focuses on the analysis of two service specification scenarios on the background of Crossrail/IEP Iteration 5 timetable. Both options are assessed for their operational feasibility and infrastructure requirements, with a focus on providing inputs to the investment case for the proposals.

Some minor infrastructure changes above the core proposals are required to construct either timetable. However given these interventions, a relatively even pattern can be constructed for both options. Both options require a theoretical minimum of six units to achieve a viable timetable. The structure of the Crossrail and IEP timetable dictates the operational working of the services. This, together with short turnarounds at the terminal locations, may have an impact on the performance of MetroWest and other services.

It is recommended that both service specification options are taken forward as potential outputs for the scheme and the associated infrastructure progressed to GRIP 3, where further analysis of their connectional benefits, unit requirement and operational strategy will be conducted.

2. INTRODUCTION & OBJECTIVES

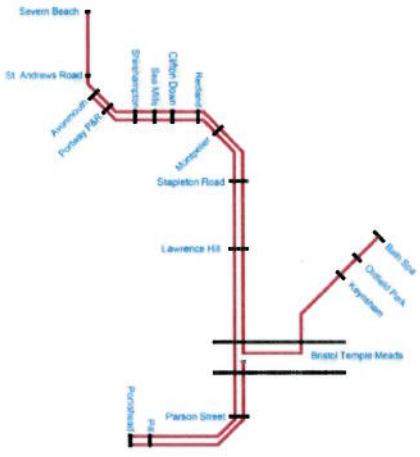
Chronologically, this report details the work that this team has untaken since the issue of the MetroWest Interim Report Final Issue v1, where an introduction to the background and objectives of the MetroWest scheme can be found. The purposes of this particular iteration are:

- to determine whether a suitable MetroWest phase 1 service level can be delivered given the latest timetable and infrastructure assumptions.
- to analyse the timetable structure of the proposed service level options.
- to compare the operational suitability of these timetables, with regard to service regularity, journey times, required unit numbers and connectivity.
- to feed these indicative timetables into the business case studies to be conducted by the Economic Analysis team.
- to inform of any potential infrastructure changes necessary to deliver the required service level.

The assumptions for this analysis can be found in Appendix A

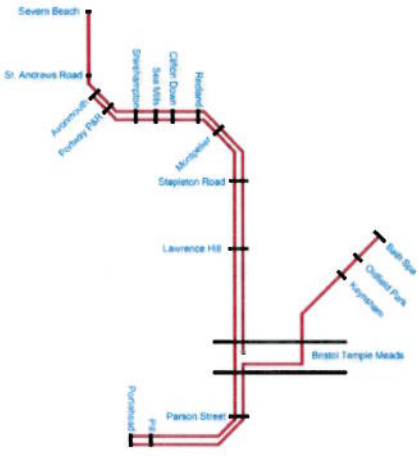
The train service specifications tested are defined as Option 5b and Option 6b; the details of the scenarios are as follows:

Option 5b



•Portishead – Avonmouth : 1 tph
•Severn Beach - Bath : 1tph
•Portishead – Bristol Temple Meads : 1 tph

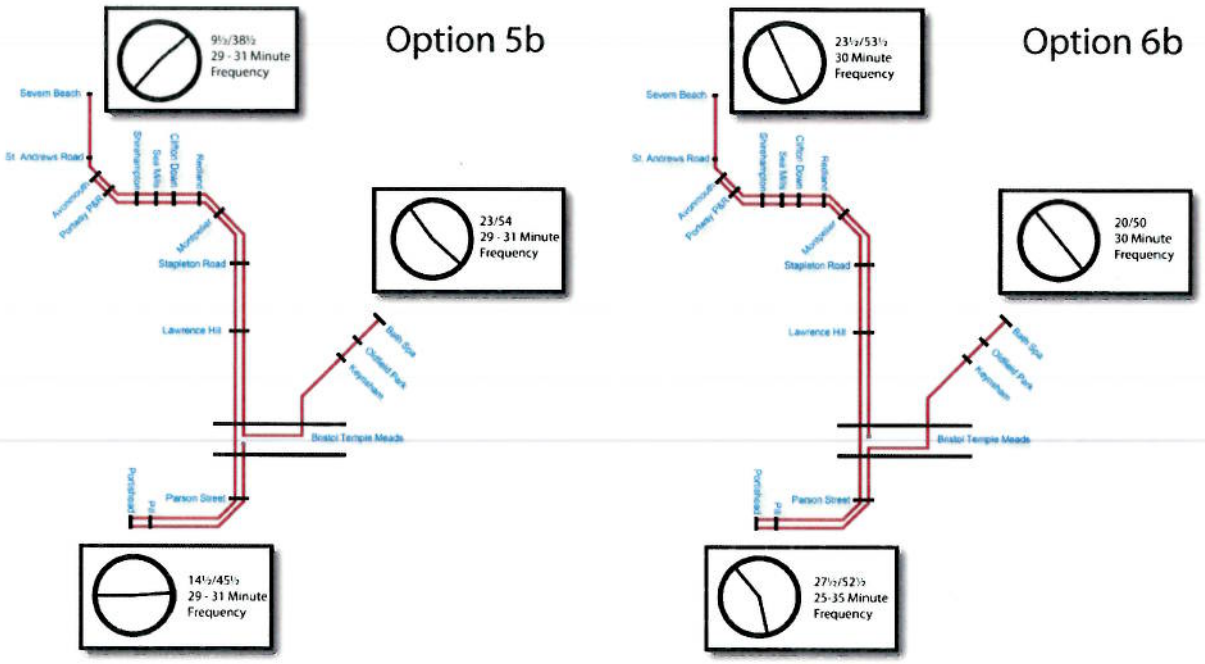
Option 6b



•Portishead – Avonmouth : 1 tph
•Severn Beach - Portishead : 1tph
•Severn Beach - Bristol Temple Meads : 1tph

3. PROJECT FINDINGS

The diagrams below are a visual representation of the timetable findings of both options:

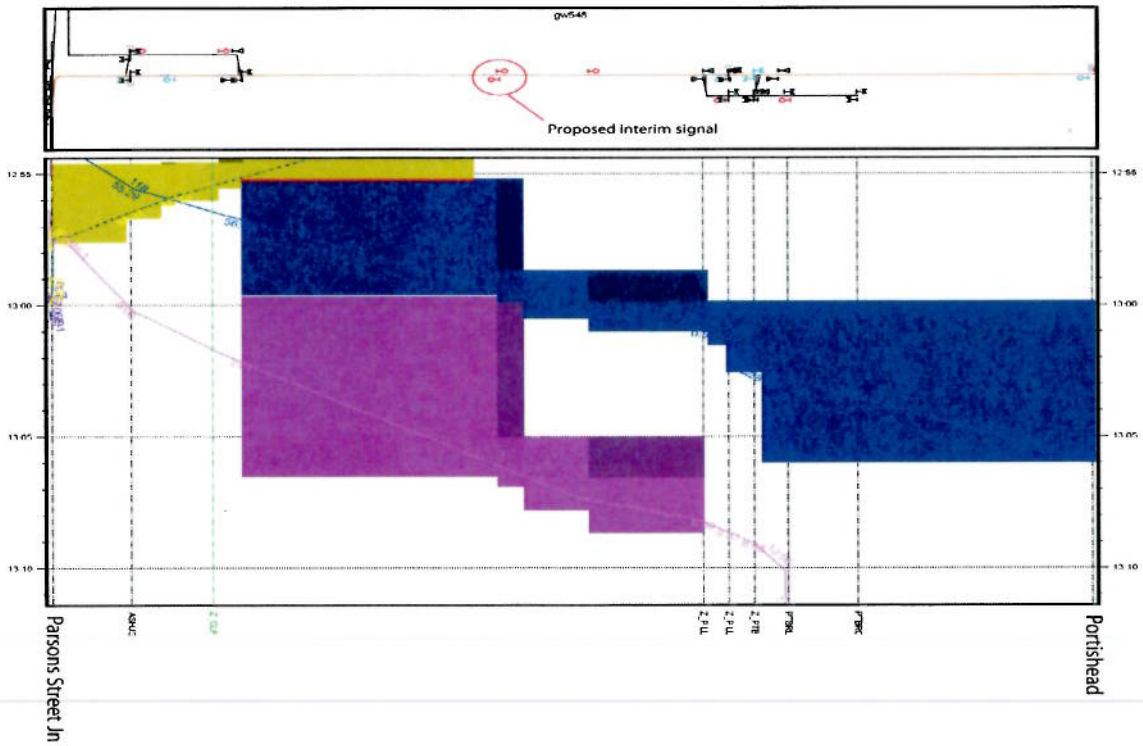


They demonstrate primarily that in both scenarios it has been possible to produce a test timetable that meets the required service specification. Due to the connectivity of the services there are some necessary compromises on regularity of services.

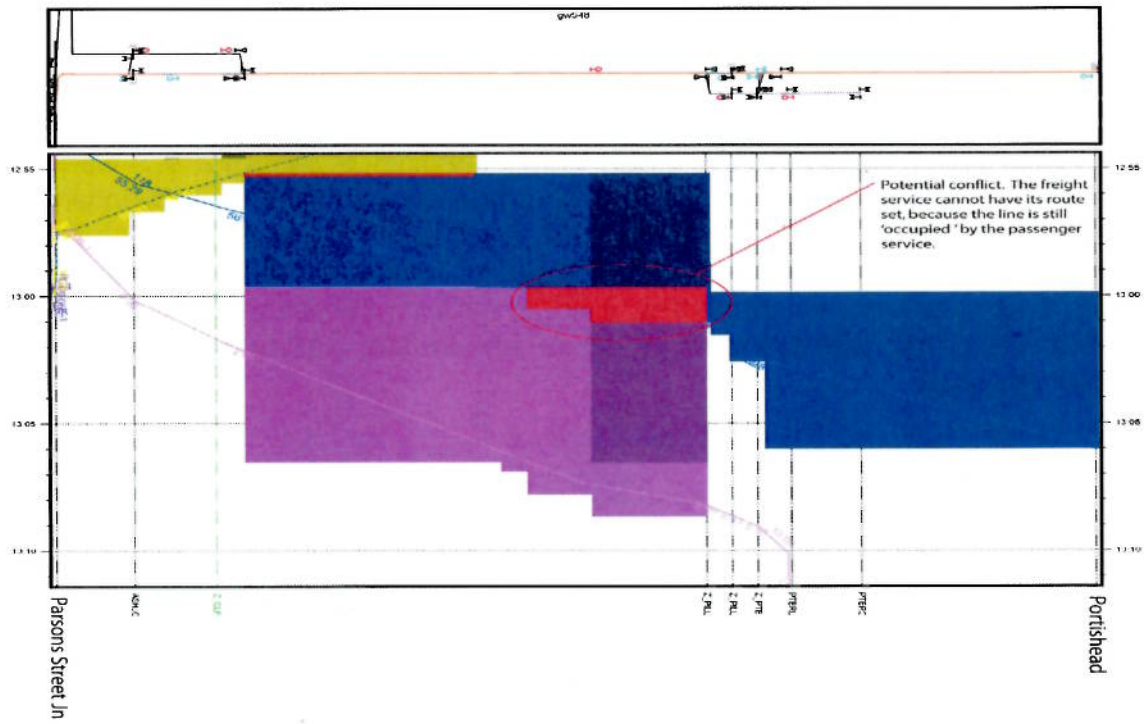
The following infrastructure findings are common to both indicative timetable scenarios.

Portishead Branch intermediate signal

The addition of an intermediate signal on the Portishead Branch has been assumed for this work. The diagram overleaf demonstrates the requirement for this signal.



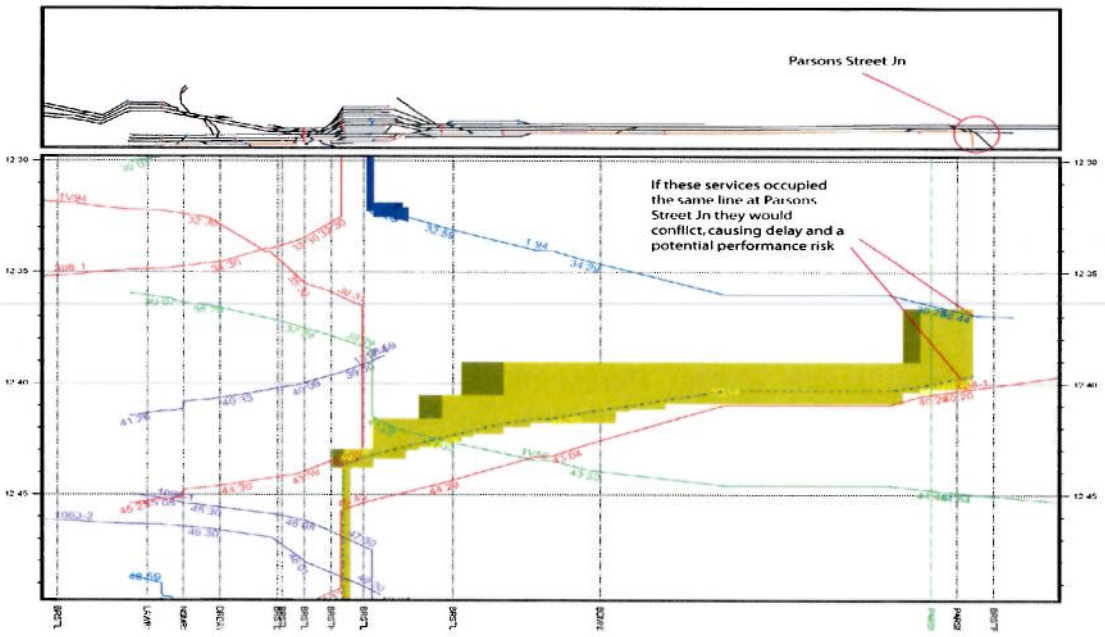
This shows a train graph of the Portishead line with a freight service (lilac) immediately following a passenger train (blue). The blue and lilac boxes surrounding the services represent the required block occupation, as calculated by Railsys. If the intermediate signal is not present, the block occupation of the passenger service increases. This is shown in the diagram below.



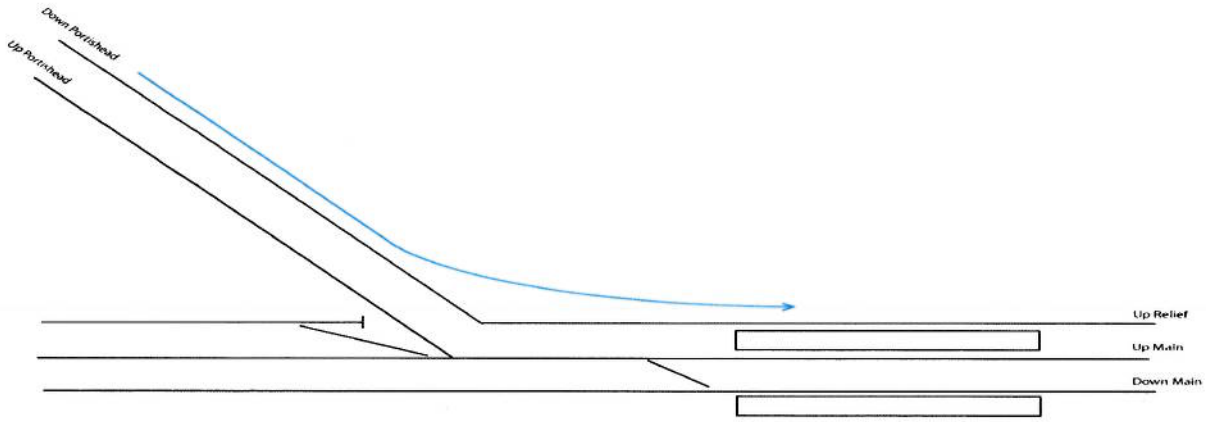
The conflict is marked and labelled on the diagram overleaf, and demonstrates that the passenger and freight service specification is not achievable without an additional signal.

Doubling of Parson St junction

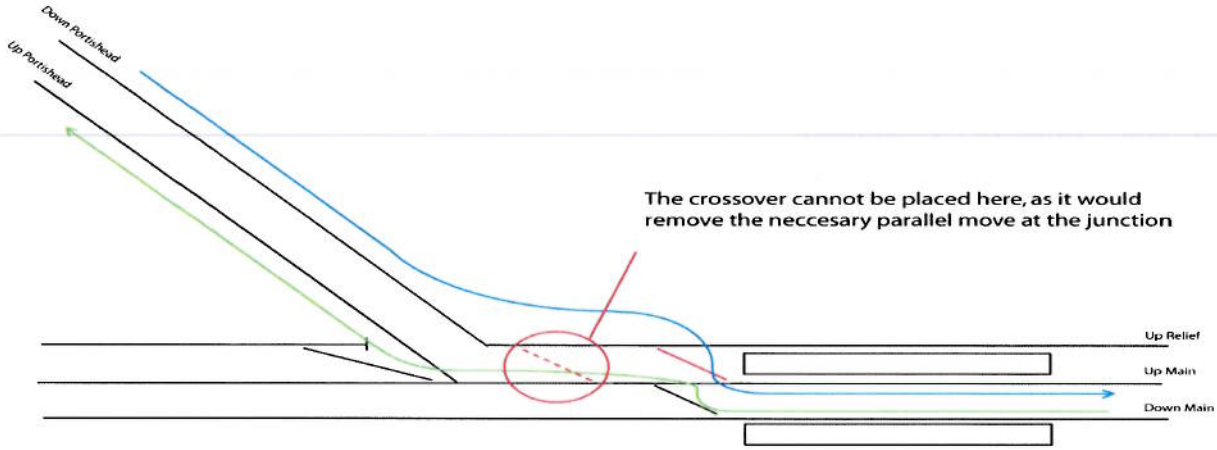
The work conducted has also demonstrated the need to provide a double junction at Parson Street Jn. This will allow a parallel move for services entering and exiting the Portishead branch, which is essential for achieving a regular pattern of MetroWest services.



The diagram above shows a train graph where services cross at Parson Street Jn, making use of a double junction. The yellow box shows the line occupation of a down Portishead train. The marked blue line is an up Portishead Metro service in a parallel move with the down Portishead train. If it were to remain a single lead junction, these services would conflict. It would then be necessary to retime at least one of these trains, which would result in an uneven calling pattern for these Portishead services.



It should be noted that on the layout provided a service leaving the Portishead line must run on the up relief line through Parsons Street.



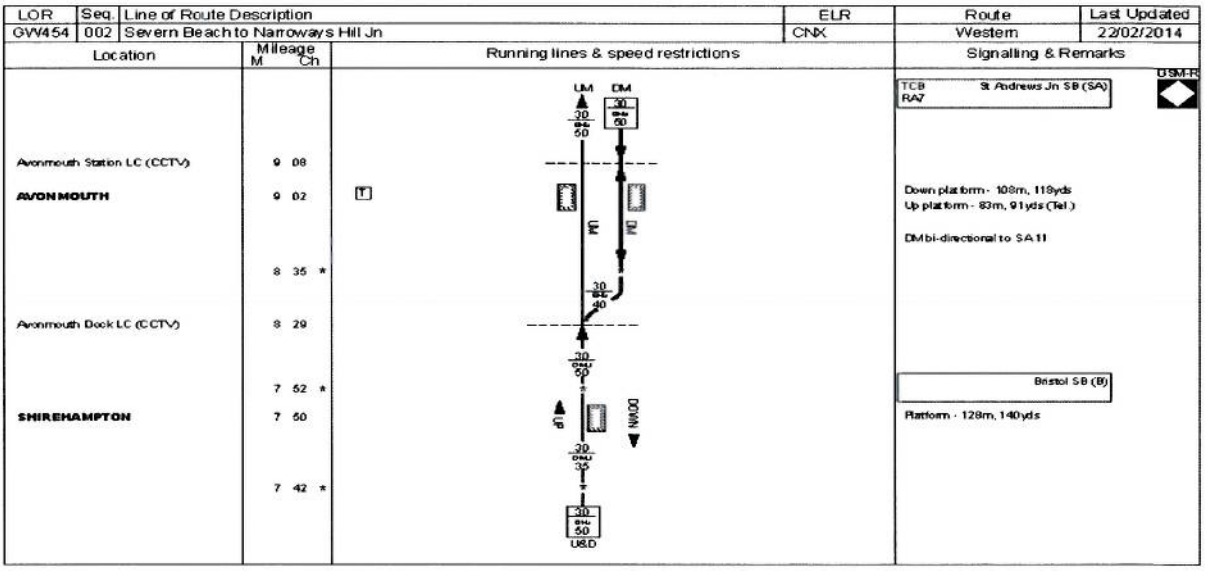
If the layout enabled services to diverge to the Up Main as shown above (whilst maintaining a parallel move with an Up Portishead service) it would provide greater timetable and operational flexibility for both freight and passenger services. This in turn mitigates the performance risk of perturbed services.

Signalling enhancements at Avonmouth (6b) or North of Avonmouth (5b)

At present the capability of Avonmouth station is:

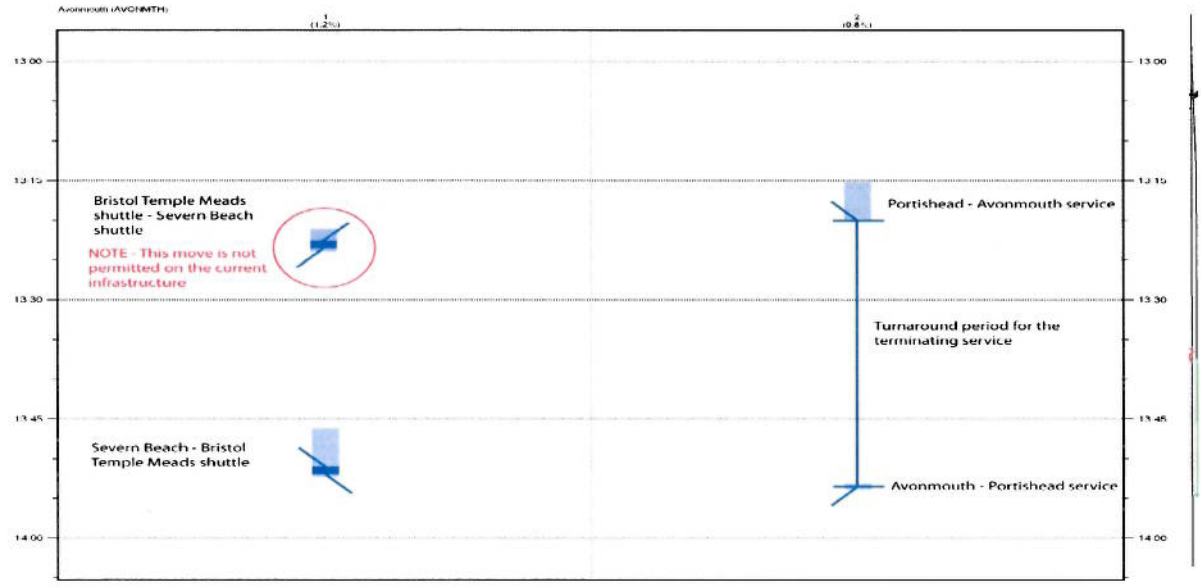
- 1 up Severn Beach line
- 1 bi-directional line/Down Severn beach line

This is shown in the diagram below.



This situation does not allow for a Down Severn Beach service to pass a train that is turning around at Avonmouth.

This diagram shows a platform graph of Avonmouth station. The blue markers represent the MetroWest services. It demonstrates that it is necessary to permit bi-directional running on the up Severn Beach line, in order to achieve a uniform service pattern in Option 6b.



A further advantage of two bidirectional lines is that it allows better access for passengers to Avonmouth station, as it would be possible to depart all up Bristol

services from platform 2. This means that it would not be necessary to cross the level crossing to board the train. This would require extra unit miles to achieve, but would not affect unit numbers.

Given the construction of the timetable, Option 5b timetable does not require the services to cross at Avonmouth, which removes the immediate requirement for signalling enhancements at this location. However, Option 5b has a long service dwell at Severn Beach, which blocks the ability of freight services to enter and leave the LPG freight terminal for a significant proportion of the hour. Here signalling enhancements north of Avonmouth would enable these moves to be performed independently.

It is recommended that the potential for signalling enhancements at either Avonmouth or north of Avonmouth are explored in order to make the best use of capacity for freight and passenger services in this area.

Commentary on Bristol East jn

As stated in the assumptions, these timetable scenarios have been developed using the current Bristol East Jn. Should Bristol East Junction be enhanced (assumed as per option version 5.4.2), the improved layout would allow:

- More efficient usage of Bristol Temple Meads platform capacity
- Potential journey time, service regularity benefits
- Improved performance of the MetroWest scheme and in the wider Bristol area

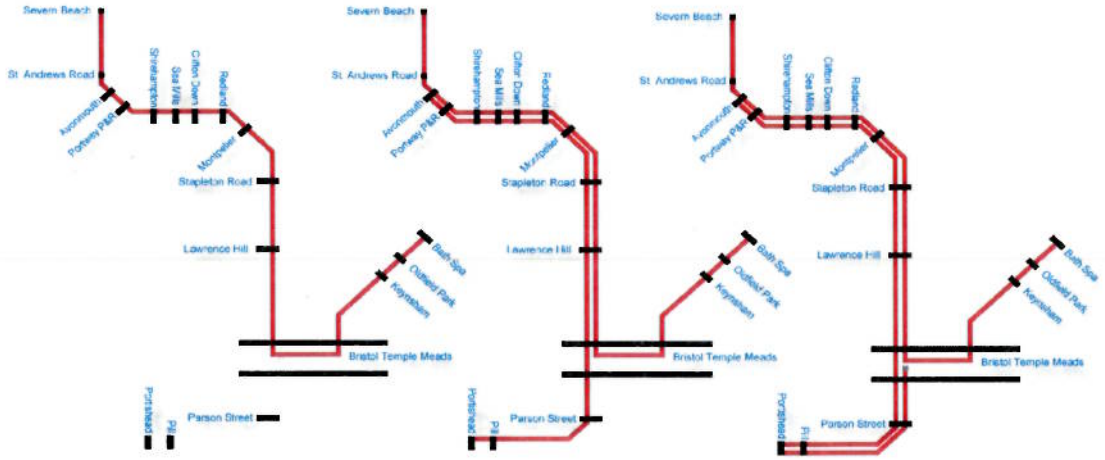
Commentary on rolling stock

All the timetabling work conducted for this report has assumed Class 150 rolling stock for the MetroWest trains. All SRTs, whether previously available or calculated, are for Class 150. There is a proposal to make Class 165 units available for use as MetroWest services. Given the superior acceleration/braking characteristics of Class 165s, this work is valid in both cases.

Timetable comparisons

Given the connective nature of the MetroWest service specification, the development of both scenarios has been a process of 'fixing' a MetroWest service on one route and cascading the broad effect of this to the rest of the area. An example of how this has been achieved is shown overleaf:

Option 5b

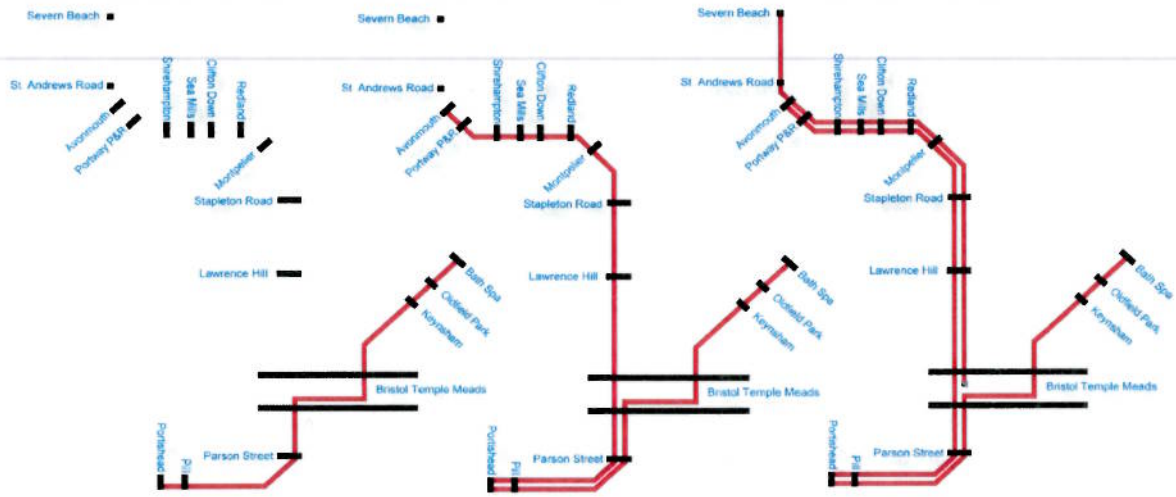


1. Bath - Severn Beach service fixed in both directions, in order to create an even pattern for interim Bath corridor stations

2. Avonmouth - Portishead services can now be fixed in both directions, to ensure an even pattern.

3. Portishead shuttle services can now be added in both directions. The available paths result in the segregation of service groups

Option 6b



1. Bath - Portishead service fixed in both directions, in order to create an even pattern for interim Bath corridor stations

2. Avonmouth - Portishead services can now be fixed in both directions, to ensure an even pattern. Due to the journey time disparity between the Portishead and Severn beach branches, this is necessarily in the opposing half hour from its counterpart in Option 5b

3. Severn beach shuttle services can now be fixed in both directions. Again, to ensure an even pattern, the available paths result in the requirement for service interworking

Furthermore, the different service specifications have resulted in the direction interaction of different services in both cases. This drives a requirement to manipulate the paths in different ways, in order to achieve a balanced timetable.

These two factors have resulted in a number of differences between the two scenarios, which are detailed below:

Portbury dock freight traffic

The proposed reinstatement of passenger services to the Portishead line results in the need to examine the capability of this route to accommodate mixed traffic. The

capacity for one standard path freight train per hour in each direction has been assumed, as agreed with Peter Willey, Senior Freight Manager for Network Rail (Western route).

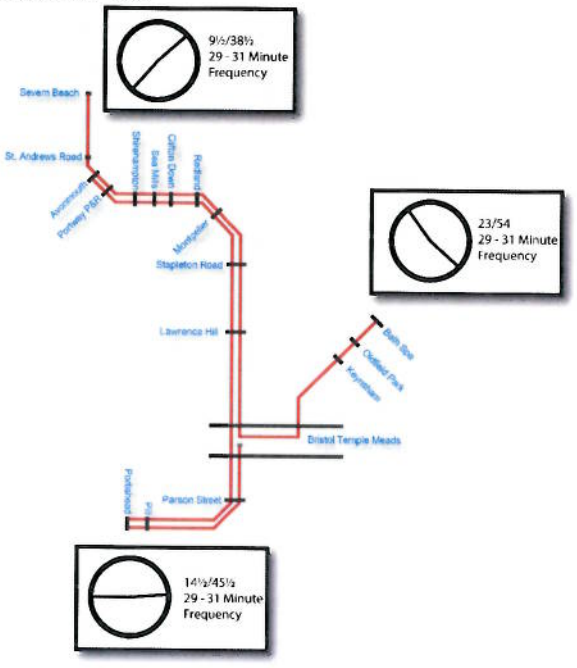
It is possible to accommodate this assumption with both MetroWest scenarios. Both options would require any regulation of freight services to take place away from the Portishead line (assumed to take place either within the Port itself or on both the up and down through lines at Bristol Temple Meads or in the wider area).

It should be noted we have calculated new preliminary SRTs (Sectional running times) for the freight services based on the TRTs (theoretical running times) produced by Railsys. Network Rail Operational Planning 'own' the SRTs and as such the update and/or acceptance of these calculated SRTs for both freight and passenger services, will be required at a later GRIP stage.

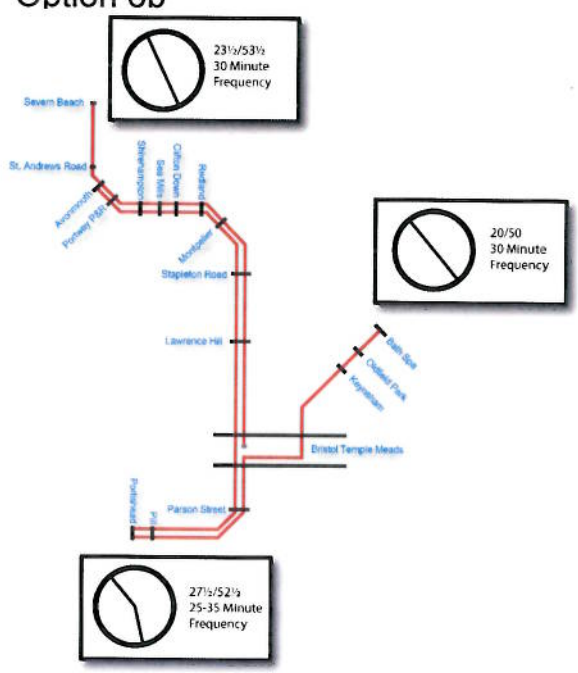
Regularity of pattern

It has been possible to manipulate both timetables to achieve an acceptable clockface pattern on departures from origin stations to Bristol Temple Meads, as shown below

Option 5b



Option 6b



Unit usage

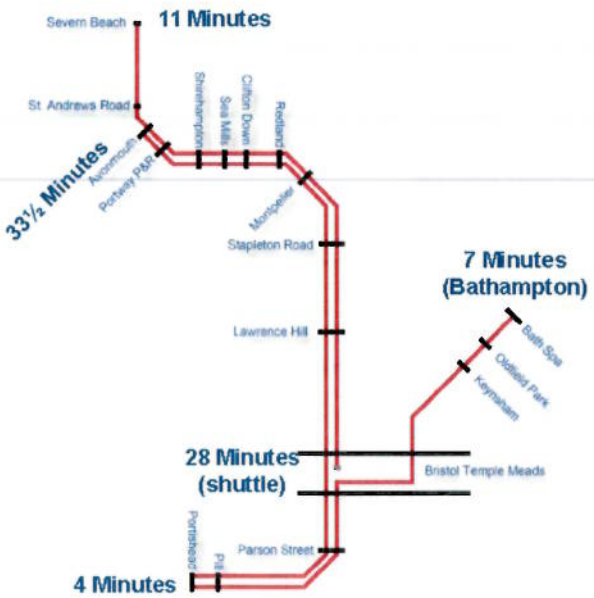
In order to achieve an economy of units whilst fitting within the structure of other services in the area, the requirements of the two service specifications drive different operational strategies. This is due to the fixed nature of each specification scenario and journey time difference on all branches.

Turnaround time at outer locations

The fixed nature of these timetables has resulted in the following turnaround times.

Option 5b

Option 6b



It should be noted that, given the segregation of services in option 5b, the short turnarounds at both Avonmouth and Portishead are a critical factor in terms of unit numbers.

The above diagram also shows the length of the turnarounds at Severn Beach and Avonmouth are inverted in both options. This drives the necessary signalling intervention at Avonmouth, as discussed in the 'Signalling enhancements at Avonmouth (6b) or North of Avonmouth (5b)' section above.

Journey times

Option 5b

	To Bristol	From Bristol
Bath Spa	17	16.5
Avonmouth	33/31	26/26½
Portishead	17½/18½	16½/16½

Option 6b

	To Bristol	From Bristol
Bath Spa	17	16.5
Avonmouth	30/35½	25½/27½
Portishead	17/15½	16½/16½

The journey times overleaf have been calculated. The differences between the two scenarios are again due to the formation of uniform timetables around the surrounding services.

Unit numbers

These two scenarios, operated in different ways, have resulted in the following minimum unit numbers:

	Option 5b	*Option 6b*
Required unit numbers	6	6

These unit numbers are intrinsically linked to the journey, dwell and turnaround times of all MetroWest services and as a result are only indicative of the theoretical minimum number of units needed to timetable the proposed service levels. Due to the (relatively) short turnarounds and dwell times at Temple Meads it can be deduced that both scenarios involve using six units extremely efficiently, which may not be achievable in the course of normal operations. Furthermore, because recovery opportunities are limited in both scenarios, there are performance risks with minimum unit number operation.

The table below demonstrates the operational risks of operating this. It shows the estimated efficiency of the units on the various routes. In this case the estimated efficiency is calculated as the percentage of time the units are in use plus minimum turnaround allowances.

		Unit Efficiency	
	Service Pattern	**6 total units**	**7 total units**
Option 5b	Portishead – Avonmouth	94.2%	62.8%
	Severn Beach – Bath Spa	77.2%	57.9%
	Portishead – Temple Meads	75.8%	37.9%
Option 6b	Bath Spa – Portishead - Avonmouth	86.5%	69.2%
	Severn Beach – Temple Meads	70.8%	47.2%

As can be seen, the addition of another unit on any route results in significantly lower unit efficiency. This would mitigate the performance risk of perturbed services on that route. It should be noted that this is an indicative measure, as the feasibility of interworking an additional ECS move into the timetable, particularly on the single line sections, would need to be explored.

The differences in interworking of services between the two options mean that there are different performance implications. In Option 5b, which is segregated by service, any primary delay will likely be similarly segregated. This will be of particular importance on the Avonmouth – Portishead route, as there are short turnarounds at both ends. Conversely, any delay experienced by the metro services in Option 6b will potentially spread across the connected service groups. This is potentially mitigated by the longer turnaround at Avonmouth, which will provide recovery time for delayed services.

Robustness – Unit usage

The impact of the structure of the timetable on performance can be deduced from these two scenarios. The fact that the connectivity of units vary between scenarios demonstrates that the decision on service specification will have performance, capability and timetable implications. Factors that may mitigate these risks are:

- Enhanced Bristol East Jn – To allow greater flexibility to the timetable, potential recovery opportunities and journey time benefits.
- Further timetable development which will take place as the proposals progress through the GRIP stages, in particular with regards to other services in the area. This will provide a more accurate view on how the timetable will be formed in the future. Better integration of MetroWest services into the timetable will reduce the performance risks.

- The use of Class 165 units would potentially provide some performance benefits, however this cannot be quantified with the present analysis.

4. CONCLUSIONS & RECOMMENDATIONS

The following infrastructure interventions are necessary to deliver the required MetroWest service level in both scenarios:

- Parson Street Junction doubling
- Intermediate signal on the Portishead branch
- Signalling adjustments, at Avonmouth for Option 6b and north of Avonmouth of Option 5b
- Bathampton turnback siding

The enhancement of Bristol East Jn is desirable for the development of this project, due to the increased number of moves across Bristol Temple Meads Eastern throat under MetroWest. Delivery of this scheme would have performance, timetabling and operational benefits for both the MetroWest project and the wider Bristol area.

The nature of the service level in the wider Bristol area and the required connectivity of the MetroWest service drive whether the services are segregated by route or interconnected. Both options have potential performance benefits and drawbacks.

It is recommended that the ability of the project to procure Class 165 units for MetroWest services be explored as thoroughly as possible. Whilst it is not anticipated that this rolling stock will provide journey time benefits, it has the potential to mitigate performance risk inherent in the scheme.

Further timetable development is recommended as the project progresses through the GRIP stages in order to continue to ensure that the required outputs can be delivered in a timetable context.

APPENDIX A. SERVICE SPECIFICATION

Core Timetable Train Service Specification				
Ref.	**Origin**	**Destination**	**Calling Pattern**	**Timing Load**
IE1	London Paddington	Taunton / Weston-Super-Mare	Bristol Parkway, Nailsea & Backwell, Yatton, (Western Milton or Worle), Highbridge & Burnham, Bridgewater	2x5-car Class 800 5-car Class 800
IE2	London Paddington	Bristol Temple Meads	Bristol Parkway	2x5-car Class 800 5-car Class 800
IE3	London Paddington	Bristol Temple Meads	Reading, Didcot Parkway, Swindon, Chippenham, Bath Spa	9-car Class 801
IE4	London Paddington	Bristol Temple Meads	Reading, Didcot Parkway, Swindon, Chippenham, Bath Spa	9-car Class 801
IE5	London Paddington	Carmarthen / Swansea	Didcot Parkway, Bristol Parkway, Newport, Cardiff Central, Bridgend, Port Talbot Parkway, Neath	9-car Class 801
IE6	London Paddington	Swansea / Cardiff Central	Reading, Swindon, Bristol Parkway, Newport, Cardiff Central, Bridgend, Port Talbot Parkway, Neath	9-car Class 801
XC1	Newcastle (North)	Plymouth (South-West)	...Bham, Cheltenham, Bristol Parkway, Bristol Temple Meads, Taunton...	5-car Class 221
XC2	Manchester Piccadilly (North)	Bristol Temple Meads / Paignton (South-West)	...Bham, Cheltenham, Bristol Parkway, Bristol Temple Meads, Western-Super-Mare	5-car Class 221

Core Timetable Train Service Specification				
Ref.	**Origin**	**Destination**	**Calling Pattern**	**Timing Load**
			(1tpD), Taunton...	
LOC1	London Waterloo	Bristol Temple Meads	...Bath Spa, Keynsham **(4tpd)**	3-car Class 159
LOC2	Portsmouth Harbour	Cardiff Central	...Bradford-on-Avon, Bath Spa, Bristol Temple Meads, Filton Abbey Wood, Newport	3-car Class 158
LOC3a	Taunton / Weston-Super-Mare	Cardiff Central / Yate/Gloucester*	...Nailsea & Backwell, Bristol Temple Meads, Filton Abbey Wood, Patchway, Severn Tunnel Jn, Newport, Cardiff Central, Filton Abbey Wood, Patchway	2-car Class 150
LOC3b	Weston-Super-Mare	Cardiff Central / Bristol Parkway*	...Nailsea & Backwell, Parson Street, Bedminster, Bristol Temple Meads, Filton Abbey Wood, Patchway...	3-car Class 158
LOC4a	Westbury (South)	Gloucester	...Bradford-on-Avon, Avon Cliff, Freshford, Bath Spa, Oldfield Park, Keynsham, Bristol Temple Meads, Filton Abbey Wood, Bristol Parkway, Yate...**(0.5tph)**	3-car Class 158
LOC4b	Westbury (South)	Great Malvern	...Bradford-on-Avon, Avoncliff, Freshford, Bath Spa, Oldfield Park, Keynsham,Bristol Temple Meads, Filton Abbey Wood, Bristol Parkway, Yate... **(0.5tph)**	3-car Class 158

Core Timetable Train Service Specification				
Ref.	**Origin**	**Destination**	**Calling Pattern**	**Timing Load**
BM1	Severn Beach	Bristol Temple Meads^	All Stations	4-car Class 150
BM2	Avonmouth	Bristol Temple Meads^	All Stations	4-car Class 150
BM3	Bath Spa	Bristol Temple Meads^	All Stations	4-car Class 150
BM4	Portishead	Bristol Temple Meads^	Pill Only	4-car Class 150
BM5	Portishead	Bristol Temple Meads^	Pill Only	4-car Class 150
FR1	Portbury	Severn Tunnel Jn	1tph each way off peak 1tph one way peak	Class 6 GLW:2000tn from Portbury Class 4 TARE to Portbury