Peninsula Transport Shadow Sub-National Transport Body

Economic Connectivity Study

Peninsula Transport

Transforming the economic performance of the South West

Quality information

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Preface

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The evidence base and analytical work supporting this report were largely concluded before the end of 2019 and the main findings of the report consequently present movement and economic activity in the Peninsula from that baseline. In the midst of the global COVID-19 pandemic travel patterns and behaviours have changed so that they are unrecognisable from what was considered normal just a few months ago. The Peninsula Transport sub-national transport body (STB) is engaged in responding to the immediate transport needs arising from circumstances driven by COVID-19 and collecting the data which will help inform decision making following the lockdown. On that basis, rather than update the narrative and recast the analysis contained in the main report, this foreword highlights the key areas of work where the time horizon has redefined assumptions.

Funding Context

The report references confirmed Government Major Road Network and Large Local Major development funding up to February 2020 (the September 2019 DfT announcement allocating development funding to three schemes: the Plymouth Major Road Network and Large Local Major schemes and the A38 M5 J22 to Bristol Airport cross border scheme with the Western Gateway STB); however, two further Peninsula schemes the A39 Atlantic Highway and A39 Walton and Ashcott bypass were allocated funding in the Budget of March 2020.

Aviation

The report discusses the operations of the two principal commercial airports in the Peninsula at Exeter and Newquay. The majority of domestic and international flights from the region were provided by Flybe Limited, based at Exeter International Airport. However, the airline went into administration on 5th March and whilst Loganair stepped in shortly afterwards to take on a number of routes, the ongoing uncertainty across the aviation industry inevitably means that the reference point for airborne transport in the Peninsula will have shifted substantially from the situation described in this document. Work associated with the development of the STB's Transport Strategy will revisit the role of air transport in the Peninsula.

Future Demand

The connectivity study deliberately avoids detailed transport and economic forecasting in favour of considering the potential impacts of long term trends in demographics and travel behaviour for life in the Peninsula. One critical observation made is that the greatest challenge for managing future travel demand is expected to be the predicted growth in population. The basic premise is that for a given baseline of travel demand, and excluding other effects and changes in behaviour, an increase in population will result in additional travel demand. The impact of COVID-19 means that the baseline of travel demand will be different to the 2018 / 2019 data generally reported in the connectivity study. Whilst the short term impact due to movement restrictions has been a sharp reduction in all types of travel, evidence from the early stages of transition out of lockdown is already showing increases in demand and the public safety messaging on public transport use is generally expected to result in an increasing reliance on private cars, walking and cycling - at least in the short term. In the longer term it is hard to predict how behaviours will evolve and whether some of the travel responses observed in lockdown will be maintained in some form.

Decarbonisation

A commitment to transitioning to a low carbon transport system is the core of the STB's work to develop a transport strategy and the connectivity study presents an estimate of transport carbon emissions in the Peninsula based on 2018 and 2019 data. The widely reported reduction in transport carbon emissions resulting from COVID-19 travel restrictions will be important additional context for understanding what scale of reductions are achievable for any given intervention as part of national or

STB strategies. Despite the observed global reductions[1], the situation has also reiterated the scale of the challenge, with global CO_2 emissions dropping by 17% at the peak of COVID-19 restrictions, but likely to lead to only a 4% to 7% drop in CO_2 by the end of 2020. This is the scale of reduction needed on a year-by-year basis to reach net-zero emissions by 2050. Significantly, surface transport emissions declined by 43% at the peak of COVID-19 restrictions, the same amount as the drop from industry and power generation combined, which emphasises the importance of surface transport in decarbonisation.

Flexible Lifestyles

One of the trends examined in the report is the increasing flexibility of lifestyles, particularly in relation to the way people undertake work. The study highlights that the proportion of people working from home in the Peninsula is already higher than other regions of the UK and that this is likely to be linked to the popularity of the region as a place to relocate to live. The necessity for a large proportion of the population to work remotely since April of this year has the potential to drive a considerable acceleration in the (already upwards) trend in teleworking. The impacts of this are not fully understood – beyond the likely first order effects of changing commuting patterns - there are gaps in our knowledge of trips made from remote working locations together with potential wider ramifications, such as decisions to relocate away from traditional work places and population centres. For the Peninsula, this could mean higher levels of inward migration from other regions in the UK.

[1] *Nature Climate Change*, 2020 - https://doi.org/10.1038/s41558-020-0797-x

1. Introduction

1.1 Peninsula Transport

Peninsula Transport is the shadow sub-national transport body for the South West Peninsula with a vision of **transforming the economic potential of the South West**. We represent five local authorities and two Local Enterprise Partnership areas, and we are committed to working collaboratively to:

- **Improve the strategic corridor connections between our major urban centres**; and
- **Provide rural mobility solutions to support our rural communities and businesses**.

In July 2019 we submitted our Regional Evidence Base to the Department for Transport setting out the challenges and opportunities for our region, the role of our transport network in connecting people, places and goods and the importance of resilient transport links for supporting the continued growth of our population and economy. The report highlighted some of the unique aspects of the Peninsula, including the exceptional natural environment, rurality, demographics and migration patterns. Also included was a prioritised list of six Major Road Network (MRN) schemes[2] for investment and a further three Large Local Major (LLM) schemes:

In September 2019 the DfT announced development funding for three schemes supported by Peninsula Transport: the Plymouth MRN and LLM schemes and the A38 M5 J22 to Bristol Airport cross border scheme with the Western Gateway STB.

1.2 Purpose and approach of the study

This connectivity study represents the first step in the development of a Peninsula Strategic Transport Strategy. It examines the region's economic geography and the role of transport in enabling intra-regional, inter-regional and international connections. Analytical work has been directed in two ways:

- Using existing data to examine the demographics, transport connectivity and economics of the Peninsula; and
- Considering the future for transport in the Peninsula thematically by extrapolating some key technological and social trends through to a 2050 horizon.

In Part 1 of the report, discussion is therefore focussed on the nature of the region, its unique characteristics and its outlook in terms of the future population. The report then looks at the strategic transport corridors within the region reviewing levels of travel demand and the level of service provided by existing connections.

The sections in Part 2 of the report each provide an examination of the impact of one of five trends expected to impact the ways people connect in the Peninsula: decarbonisation, flexible lifestyles, the world of work, digitalisation and urbanisation. Conclusions and recommendations arising from these sections are provided in Part 3.

[2] The Somerset MRN scheme was subsequently withdrawn leaving five current MRN schemes in the 2020-2025 programme.

1.3 Structure of the report

The remainder of the report is structured as follows:

Part 1

2 – A Growing Region

3 – Connections in the Region Today

Part 2

4 – Carbon and the Environment (Decarbonisation)

5 – How People Live (Flexible Lifestyles)

6 – The Economy and Employment (The World of Work)

7 – The Future of Transport (Digitalisation)

8 – Spatial Planning (Urbanisation)

Part 3

9 – Conclusions and Recommendations

PART 1

2. A Growing Region

Chapter Overview

The South West Peninsula is a unique place which is growing quickly. In this section, we examine where people live, how the population has grown and how unique trends in the Peninsula's demographics point to challenges and opportunities for the future.

2.1 Introduction

The South West Peninsula is a region with unique geographical characteristics, marked by its extensive coastline, varied landscapes and dispersed population. In the past century its population has grown by nearly a million people and population growth is forecast to continue at or above the average rate for the United Kingdom.

Connections within the region are critical for connecting communities who are often located a long distance from the main population centres whilst land connections to other parts of the country rely on a central spine converging around Exeter and then diverging through Somerset to provide links to

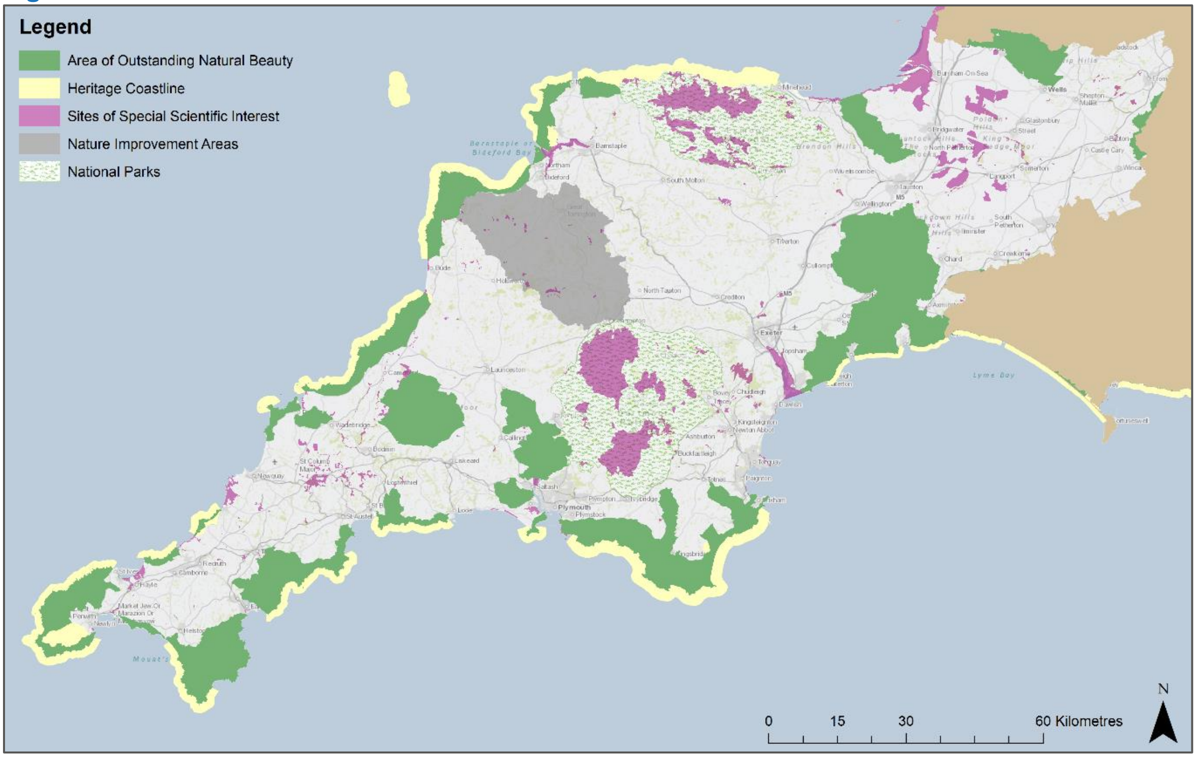
- Bristol, South Wales, the West Midlands and the North of England; and
- London, and the South East and the South Coast.

The challenge for the Peninsula is one of overcoming higher than average journey times to deliver clean, sustainable, economic growth and to ensure communities are well connected to jobs, markets and vital services.

2.2 Unique landscape

The natural environment of the Peninsula is a key asset which continues to attract people to live, work and visit the region. Most of the 1,000-kilometre South West Coast Path is located in the Peninsula and there are also two National Parks, nine Areas of Outstanding Natural Beauty (AONBs), and a number of Nature Improvement Areas (NIA) and Sites of Special Scientific Interest (SSSI). In addition, there are two World Heritage Sites, the Cornwall and West Devon Mining Landscape, and the Jurassic Coast (see Figure 2-1).

Figure 2-1: Peninsula Environment



The Peninsula is made up of five top-tier local authorities:

- Cornwall Council (a county unitary – mainly rural)
- Devon County Council (a two-tier county – mainly rural)
- Plymouth City Council (a city unitary)
- Somerset County Council (a two-tier county – mainly rural); and
- Torbay Council (a unitary covering the conurbation of three towns).

The geographical area of the Peninsula is large, at around 14,000 square kilometres, but the population is widely dispersed with an average of around 165 people per square kilometre compared with an average of around 270 across the United Kingdom. The total population is around 2.3 million and there are three urban areas with a population exceeding 100,000: Exeter, Plymouth and Torbay. There are a large number of small and medium-sized towns (including coastal communities) making an important contribution to economic activity of the region. Figure 2-2 illustrates the location of population centres in the Peninsula with more than 20,000 inhabitants.

The Peninsula's biggest population centres

Clockwise from top left: Plymouth, Exeter and Torbay.

Source: Google Maps

Figure 2-2: Peninsula Population Centres Over 20,000 (2017)

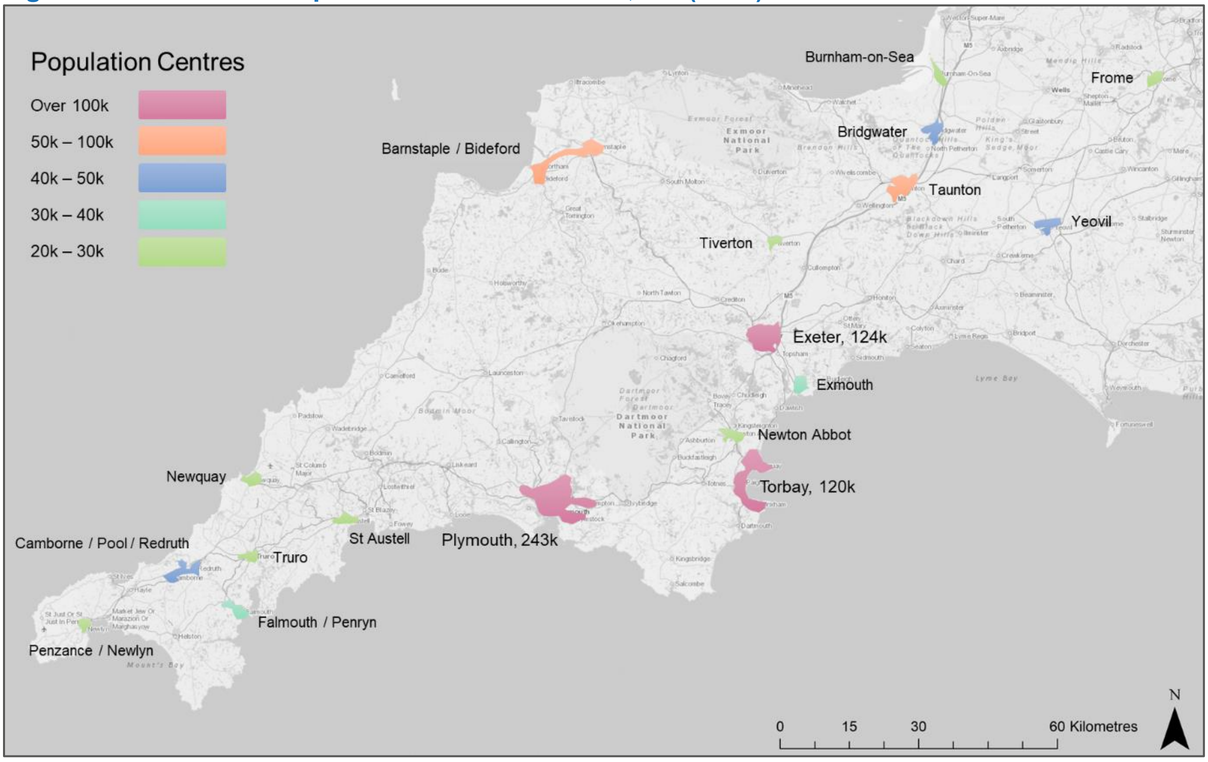
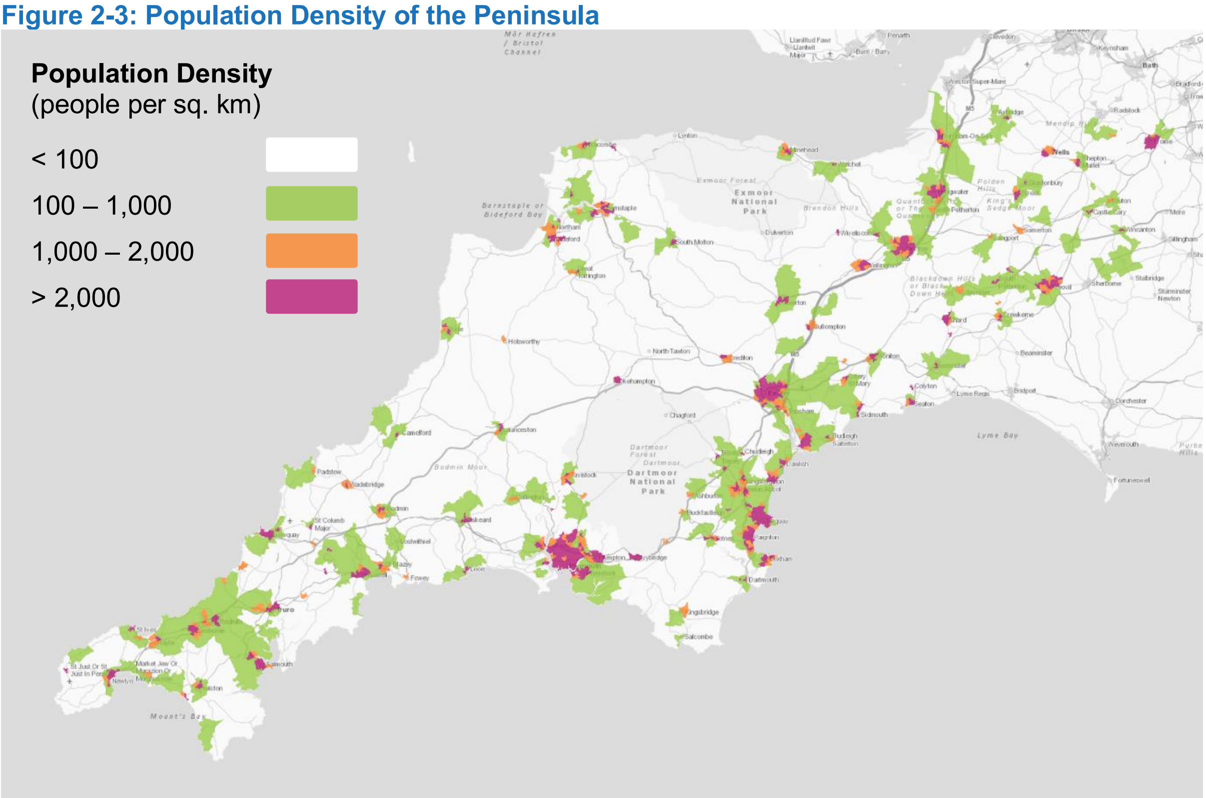


Figure 2-3, which shows population densities across the Peninsula, illustrates that a large proportion of economic activity in the Peninsula is located along the main transport corridors of which the routes along the Peninsula east-west spine are the most critical (see Figure 2-4). This spine runs west through Somerset to Exeter and then on to Plymouth and into Cornwall. It provides connectivity for the largest population centres in the Peninsula (and many of the smaller ones) and connects the Peninsula with Bristol and beyond (South Wales, the West Midlands and the North).

Figure 2-3: Population Density of the Peninsula



Resilience of this spine is extremely important to the Peninsula as there are very limited route alternatives when issues occur. Exeter is a critical gateway with many corridors converging on the city and only a single mainline railway option heading west from Exeter. This railway line runs close to the coast south of Exeter and the major disruption resulting from the damage to the line at Dawlish in 2014 is well documented. The fastest rail times into London for journeys west of Exeter are around five hours from Penzance and three and a quarter hours from Plymouth.

Between Exeter and Bodmin (in central Cornwall) there are two strategic road corridors providing some resilience for road trips into Cornwall, but road access from the rest of the country to the biggest Peninsula urban centres of Exeter, Plymouth and Torbay is principally dependent on the M5 corridor as far north as Taunton and the A38 and A380 routes to the south of Exeter.

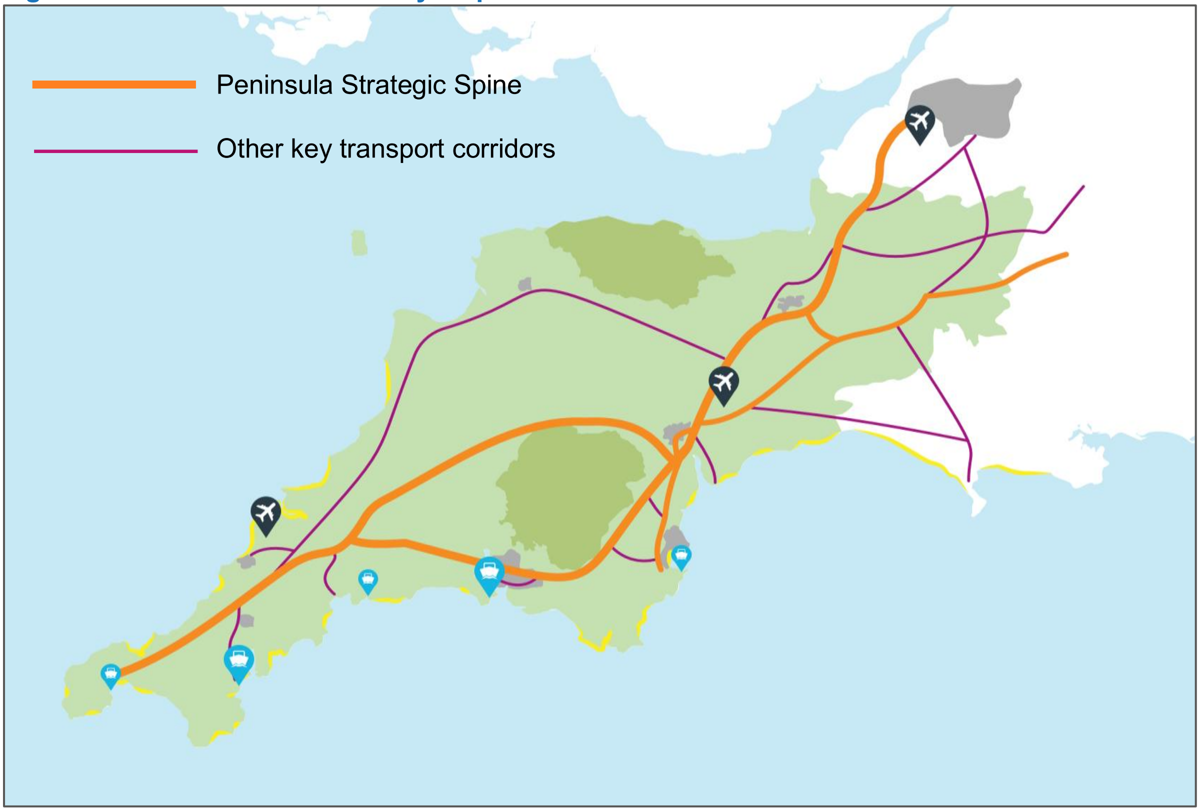
Between Exeter and Taunton there are further strategic road and rail connections east through Somerset towards London, the South East and the South Coast. Two rail routes into London are available, one into London Paddington providing journey options of two and a half hours from Exeter and the other into London Waterloo – generally at lower cost, but also with a much longer journey time.

Similarly, there are two primary road routes towards London and the South East: the M5 / M4 motorway route and the Second Strategic route of A358 / A303 / A30 corridor. The A303 route currently offers a mixed level of service, with both dual carriageway and single carriageway sections and a mixture of grade separated and at-grade junctions.

From the strategic spine route there are further important corridor connections to Peninsula communities, ports and airports. In some cases, both rail branch line and road options are available, but often road is the only transport connection available.

It is self-evident that locations in the western parts of the Peninsula have greater land-based travel times to the rest the Great Britain than the eastern parts and therefore have a greater challenge in terms of competing for access to markets outside of the Peninsula area.

Figure 2-4:Peninsula Connectivity Map

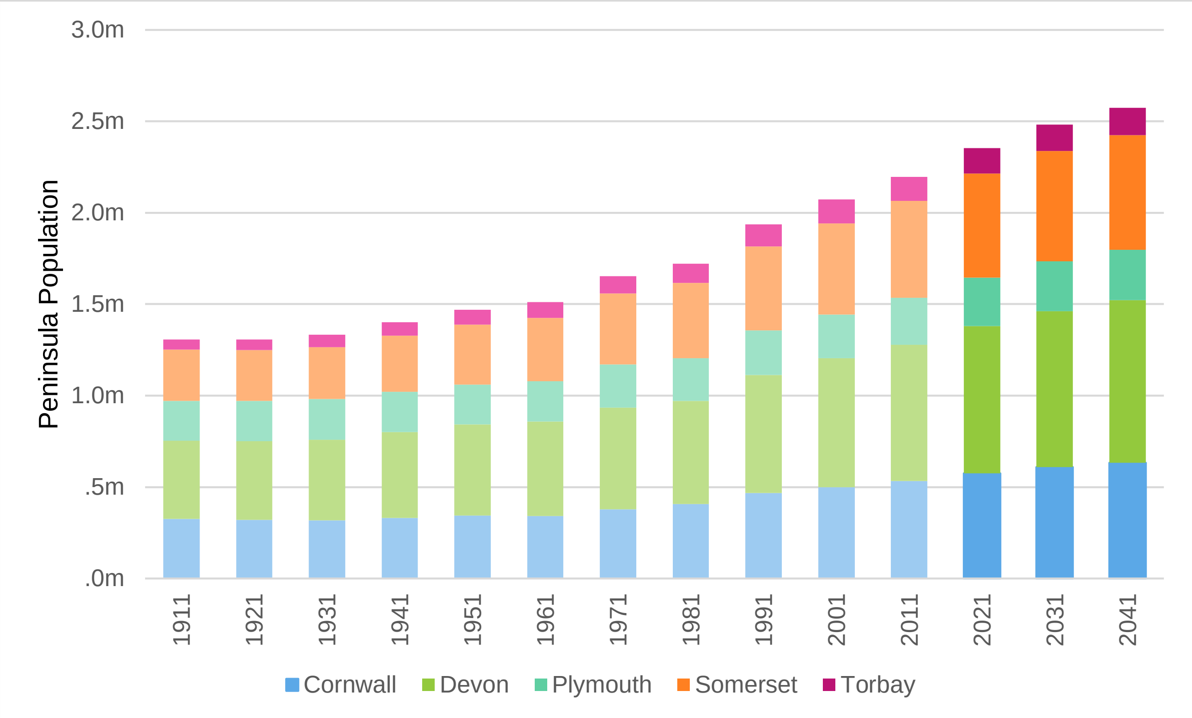


2.3 Growing population

In the past century, the population of the Peninsula has grown by about one million people, from 1.3 million in 1911 to 2.3 million in 2016. In the past 50 years, the population has grown at an average rate of nearly 8% per decade and central forecasts estimate the population will continue to grow, but at a slower rate of just under 5% per decade. In 2041 this means the population is estimated to be 2.6 million (representing 12.8% growth from 2016 to 2041). This rate of growth is slightly above the forecast average of 12.1% for England.

Figure 2-5 presents population forecasts by local authority and shows that each of the five authorities in the Peninsula are expected to increase in population, but that the rural authorities are forecast to grow faster, in the 13-14% range in the period from 2016 – 2041. Torbay is expected to grow about 12% and Plymouth 6% in the period from 2016 – 2041.

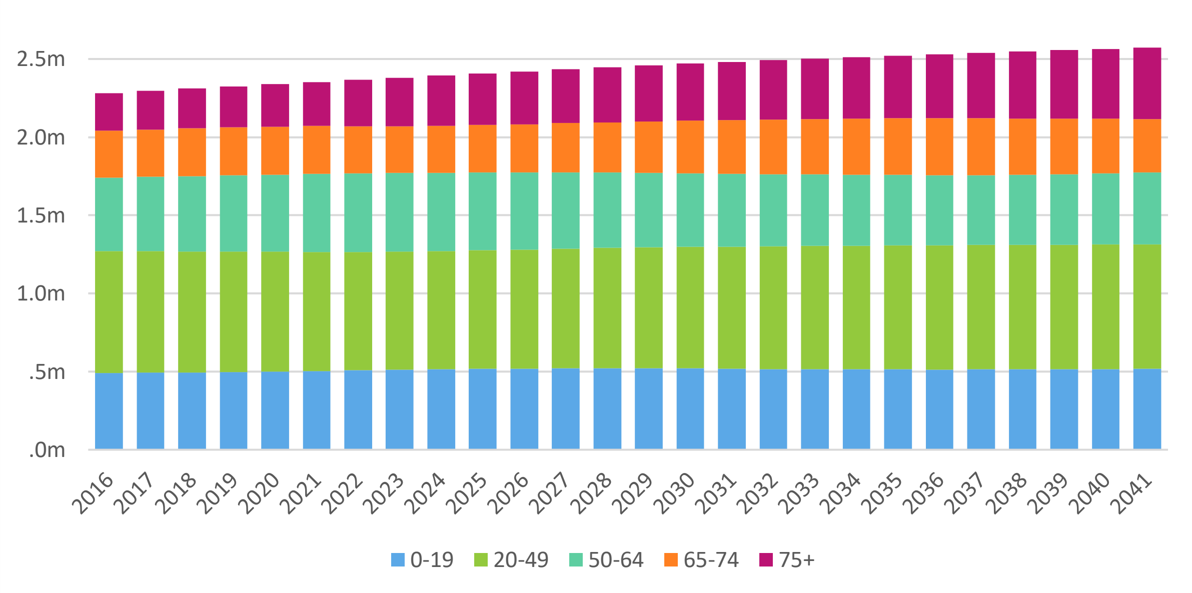
Figure 2-5: Historic and Projected Peninsula Population by Area



Projections also provide some information about the demographics of the future Peninsula population in terms of age groups. Currently, around 24% of the Peninsula population are over 65 (much higher than the average 18% in England) and by 2041 this is forecast to be 31% (see Figure 2-6). The largest contributor to this growth is people over 75, moving from 11% of the total to a predicted 18% in 2041.

Whilst working patterns and retirement ages for the older members of the population are changing rapidly, this forecast therefore presents a distinct challenge for the future productivity of the Peninsula. All age groups are forecast to grow in absolute terms except the 50-64 age group which is forecast to decline slightly.

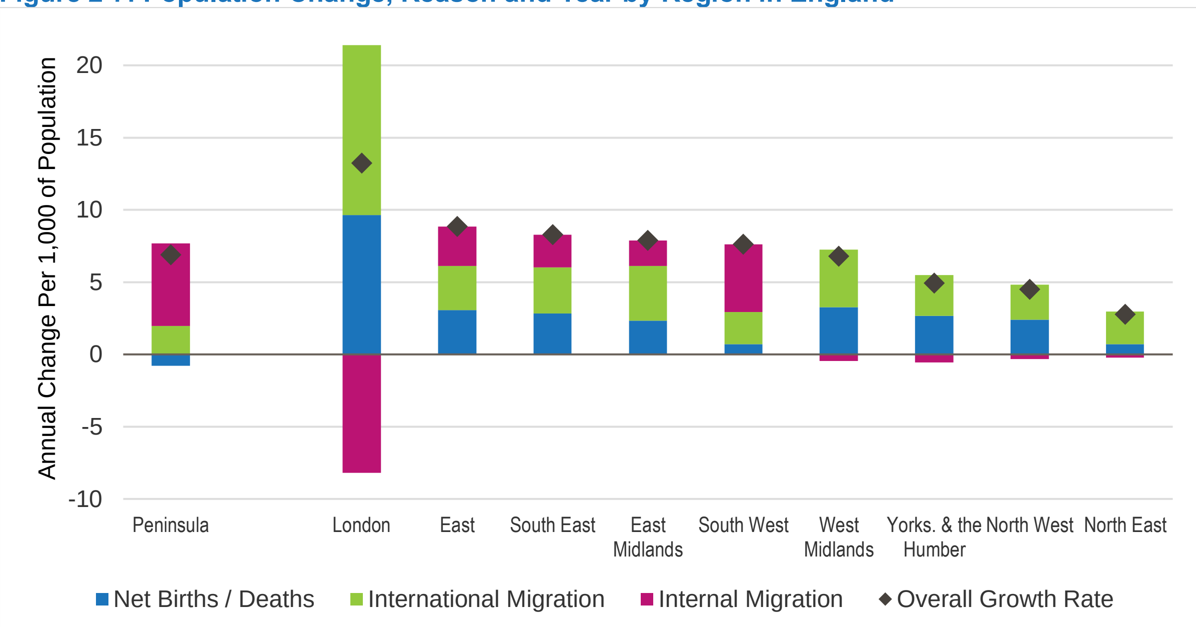
Figure 2-6: Peninsula Population Projection by Age Range



The composition of population growth in the Peninsula is one of its unique characteristics and an understanding of this informs some of the challenges and opportunities for this part of the South West region. Figure 2-7 displays population growth for the Peninsula and regions of England, distinguishing between organic growth (obtained by subtracting death rates from birth rates), international migration (people moving into an area from a country outside of Great Britain) and internal migration (people moving into an area from another region of Great Britain or from Wales / Scotland). The results are an annual average for the five years covering the period from 2011/12 to 2015/16. Only in the Peninsula is organic population growth negative, so that apart from migration the population of the Peninsula would have declined in the period shown. Rates of international migration are generally low in the South West and it is low everywhere in the Peninsula with the exception of Plymouth. However, when it comes to internal migration the South West has a significantly higher rate than any other region (and the Peninsula rate is the leading contributor to this). The key observation from this is that more than any other place in Great Britain, people are choosing to move to the Peninsula to live.

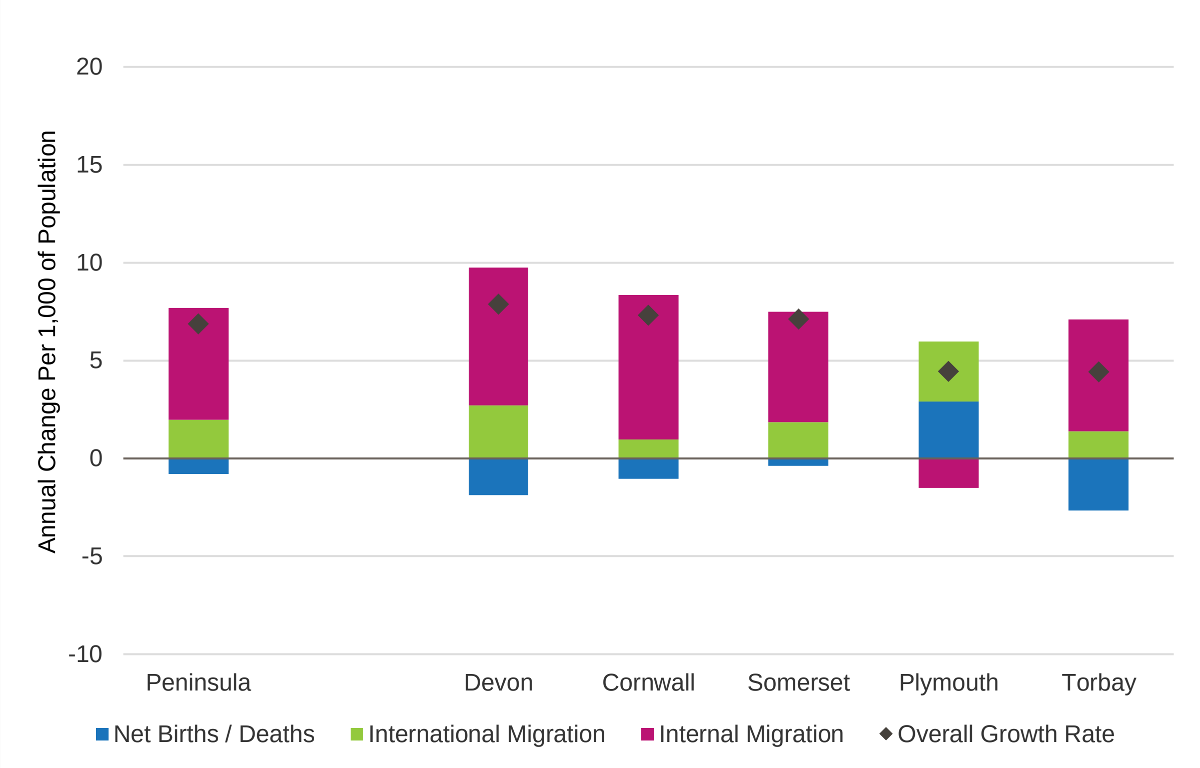
Peninsula Transport sees this an opportunity for the region and part of its role is to ensure connectivity is of a good standard so that people will continue to relocate to live and work from the Peninsula area.

Figure 2-7: Population Change, Reason and Year by Region in England



Breaking the picture down by local authority in the Peninsula shows that the growth pattern is similar across all authorities except Plymouth (see Figure 2-8). Plymouth's growth mix is actually a combination of strong organic growth and international migration, with a slight reduction in the population from internal migration. International migration to Plymouth is perhaps unsurprising given it is the largest city in the region (its migration pattern is similar to other large cities in the UK). It is also the largest population centre in the Peninsula with better developed cultural and linguistic communities for migrants to join.

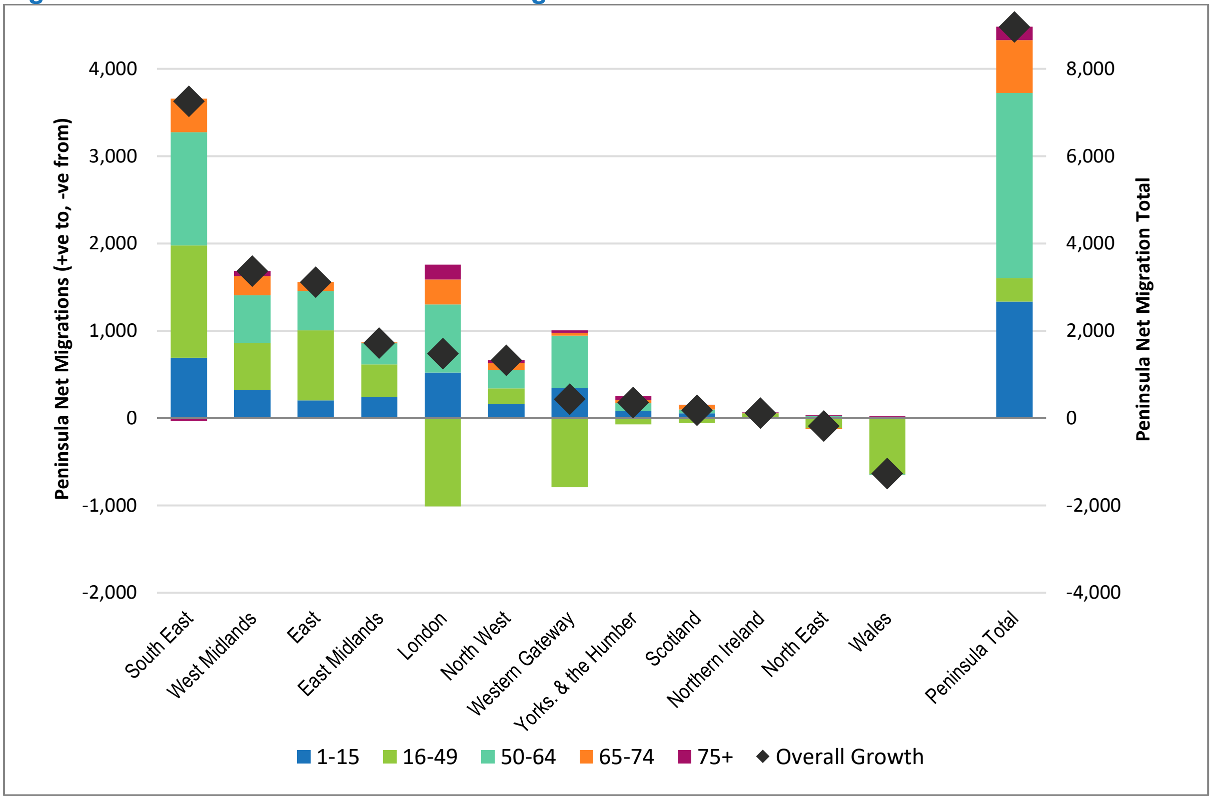
Figure 2-8: Population Change, Reason and Year by Local Authority



Government data also allows for analysis of the origins and destinations of internal migration to / from the Peninsula in 2011. This is shown for regions of the United Kingdom by age group in Figure 2-9. Notable is the fact that net migration is generally into the Peninsula for all age groups with the exception of the 16 – 49 age group where net migration out is substantial to London, the neighbouring Western Gateway region (which includes Bristol) and Wales. The largest contributor to net migration is the 50-64 age group which contrasts with the decline of this age group in the general population forecasts to 2041.

Net migration into the Peninsula was very nearly 9,000 people in 2011, with 3,600 of these from the South East, a further 1,700 from the West Midlands and 1,600 from the East of England. These three regions provided more than three quarters of the growth from internal migration in the Peninsula in 2011, but almost all other areas (with the exception of Wales and the North East of England) contributed to the overall growth.

Figure 2-9: 2011 Peninsula Net Internal Migration



2.4 A growing region - summary

The South West Peninsula is a unique place and its natural environment continues to attract people to live, work and visit the region. It covers a large geographical area with a widely dispersed population, with only three population centres of more than 100,000 inhabitants: Exeter, Plymouth and Torbay.

Much of the economic activity is located along the main transport corridors, with the east-west spine the most critical of these. This backbone of the transport system runs west through Somerset to Exeter and then on providing access to Plymouth and into Cornwall. Resilience of this spine is extremely important to the Peninsula as there are very limited route alternatives when issues occur.

The population of 2.3 million is growing quickly and is expected to reach around 2.6 million by 2041. Growth will be broad based across all the Peninsula authorities and most age groups. Like most of the UK, the Peninsula expects to see an ageing population. However, in the Peninsula, the share of people over 65 is already well above the UK average and is forecast to increase from 24% to 31% by 2041.

The Peninsula has unique drivers of population growth. Overall, growth is expected to be higher than the UK average, despite a birth rate which is below the death rate and consequent decline in the indigenous population. The growth therefore comes principally by migration from other regions of Great Britain (more so than from any other region in England). Net levels of international migration are expected to be low except in the Ocean City of Plymouth.

The impact of forecast population growth in the Peninsula over the next 20 – 30 years will be a key challenge for the transport system. This growth is likely to be the biggest driver of increasing demand for travel in the Peninsula, particularly given the challenge of the large geographical area and dispersed population.

However, population growth provides an opportunity as well, as the Peninsula seeks to attract innovative businesses aligned with the clean growth aspirations of the Local Industrial Strategies for the region.

3. Connections in the Region Today

Chapter Overview

The Peninsula relies on critical infrastructure which forms a strategic transport spine that connects it to the rest of the UK. A network of other routes connect people and places with critical access to jobs, services and markets. The unique character of the Peninsula generates specific challenges, such as serving a geographically dispersed population and managing seasonal peaks in travel demand. The small number of strategic route options means resilience is a key issue for our transport network. In this section, we set out the transport connections across the region, describe how they are used and examine the levels of service that they provide.

3.1 Introduction

This section contains a detailed discussion of the key transport connections in the Peninsula, starting with a review of corridors then moving to more detailed analysis of rail links, road links and the gateways important for travel and trade.

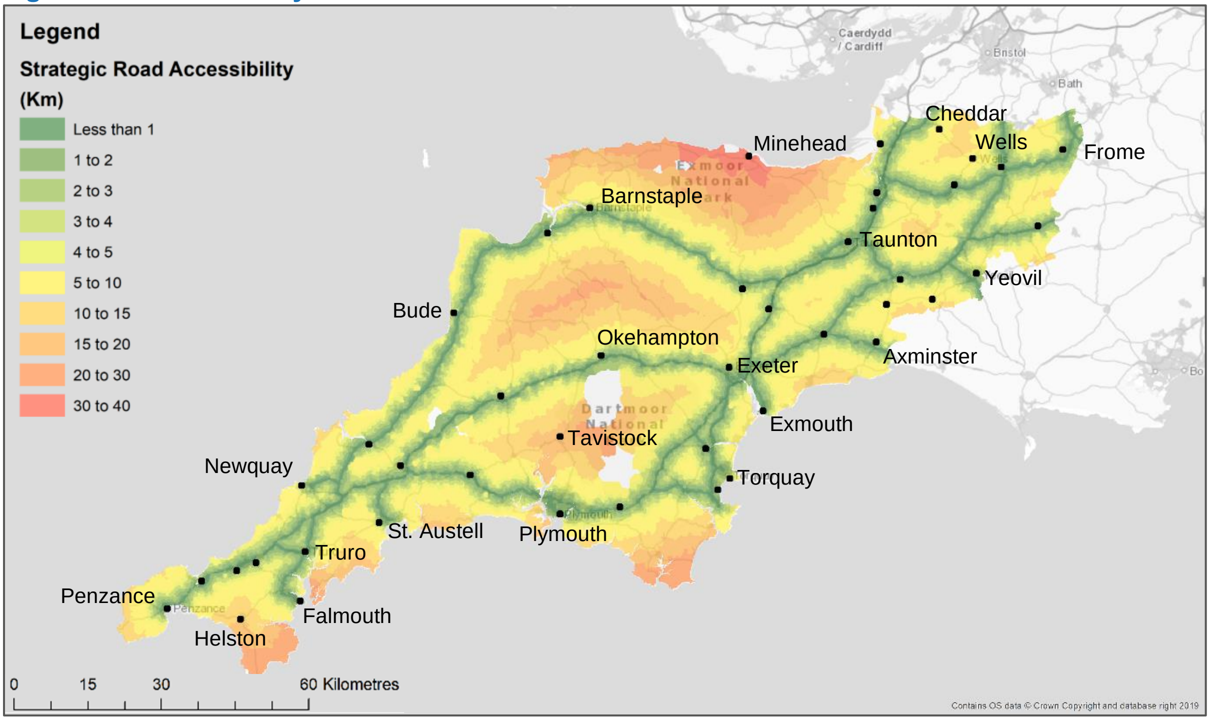
3.2 Network accessibility

An important measure of the quality of the Peninsula's transport network is how easy it is for different people and places to access the strategic network. Accessibility analysis has been undertaken for the Peninsula region to look at access from different places to strategic road and rail connections. This analysis does not assess the level of service provided once a strategic connection is reached, but merely seeks to identify places which are isolated from core transport connections.

Road accessibility

Figure 3-1 illustrates the accessibility of strategic road connections to the population of the Peninsula. For this analysis a strategic road connection was defined as either: the strategic road network (roads managed by Highways England) and the major road network (those roads identified as the next tier of road connections in the Peninsula). Distances are measured through the lower tiers of the road network so that they reflect actual travel distances through the road network to access the more strategic routes.

Figure 3-1: Accessibility to the SRN and MRN Road Network



The analysis highlights that the coverage of the strategic road routes, headed by the east-west spine of the M5, A30 and A38 is reasonably aligned to population centres in the region. There are some notable places where accessibility is worse, predominantly due to a lack of north-south MRN routes. The two largest population centres with poor access to strategic road routes in the Peninsula are:

- Tavistock on the western edge of Dartmoor, with a population of around 13,000[3] rising to nearly 30,000[4] when including the surrounding parishes and communities; and
- Minehead on the coast of West Somerset with a population of around 12,000.

Some other locations are on the periphery of the region and do not have substantial populations:

- The Lizard and Roseland Peninsulas in west Cornwall;
- The South Hams District in Devon;
- Dartmoor National Park;
- Parts of the Torridge District in Devon;
- Exmoor and the West Somerset District;
- Parts of the Mendip District in Somerset.

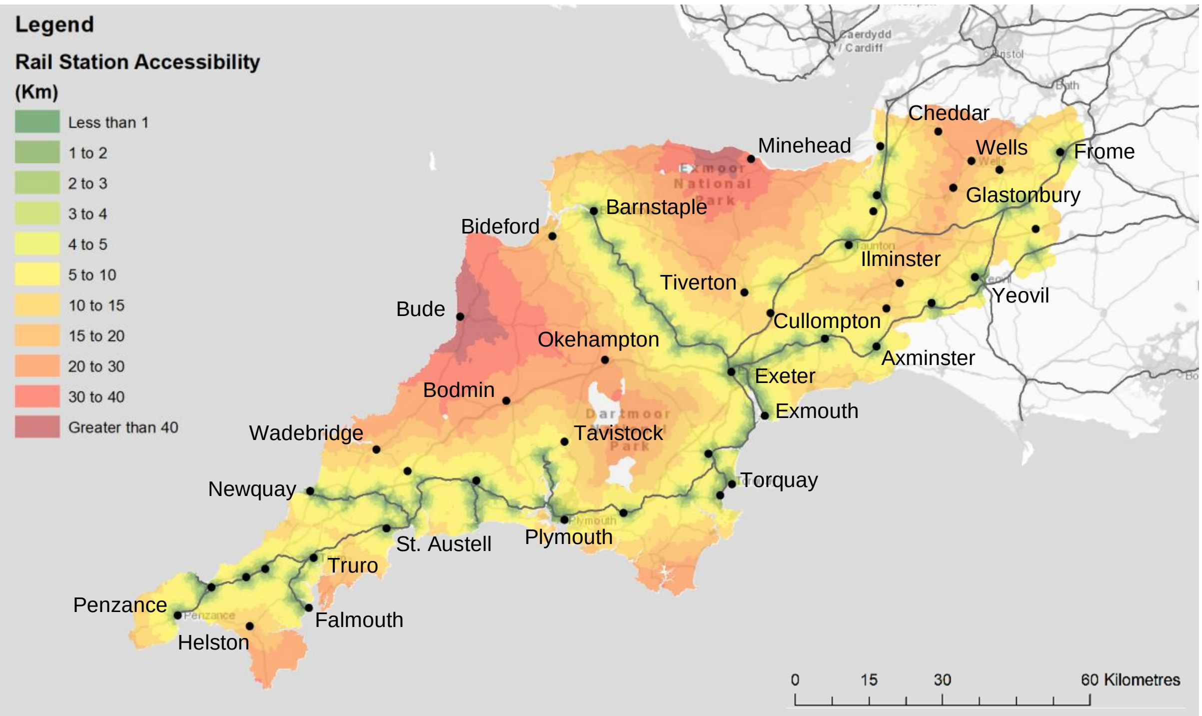
During the consultation on the MRN, Peninsula Transport proposed some additional roads, designated 'Priority Links' which did not meet the criteria set by DfT for the MRN network, but which are considered strategically important for road transport in the region because they are the only transport connection for significant populations in the region. These include the A386 route linking Plymouth in the south to the A30 via Tavistock and the section of the A39 in West Somerset linking Minehead with Bridgwater and the M5.

Rail accessibility

Similar analysis has been undertaken for the rail network in the Peninsula using a measure of the required distance through the road network to access the nearest Peninsula station. This is shown in Figure 3-2 and given the correspondence between the mainline rail network and some of the key road corridors, there are some similarities in the results. However, there are also significant differences as there are wider areas of the Peninsula not served by a rail line.

[3] 2011 Census
[4] Tavistock Community Profile, Devon County Council (https://www.devon.gov.uk/communities/your-community/5943-2)

Figure 3-2: Accessibility to Rail Stations within the Peninsula



The biggest differences with the road accessibility analysis are that North Cornwall is poorly served by rail, but better connected by strategic road route via the A39 Atlantic Highway. However, the Districts of Torridge and North Devon are better served by rail due to the alignment of the Tarka Line which links Exeter with Barnstaple.

The towns of Tavistock and Minehead identified in the road accessibility discussion above, suffer poor rail accessibility as well as neither has a rail station, although Tavistock is located reasonably close to the station at Bere Alston on the Tamar Valley Line providing services (albeit infrequent) into Plymouth.

The accessibility analysis presented is purely distance-based and other aspects of connectivity are considered in later sections.

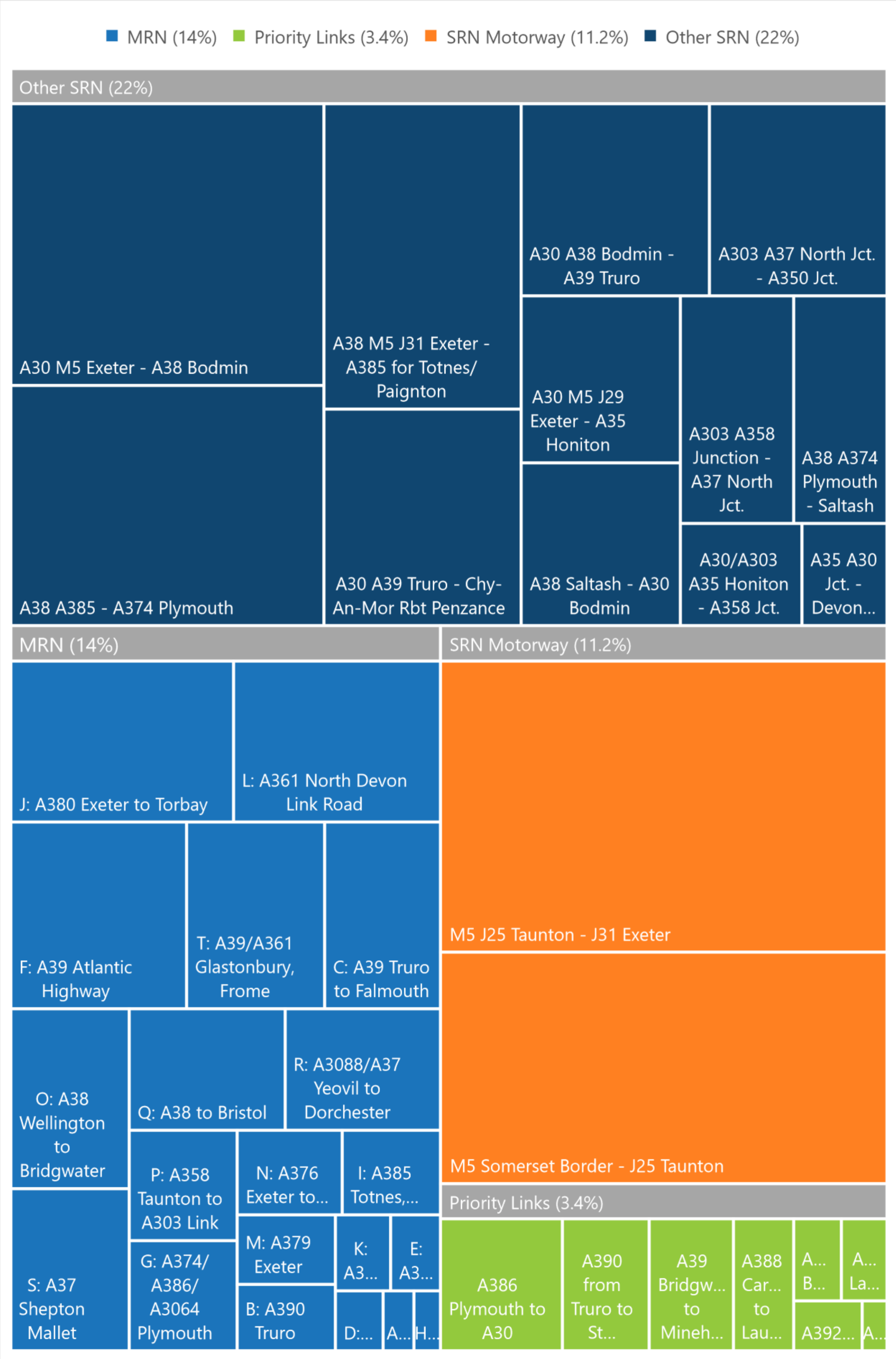
3.3 Strategic travel demand

This section contains a summary of the existing levels of travel demand on strategic road and rail connections within the Peninsula. This highlights the critical nature of the east-west spine through the region, which carries a high proportion of strategic travel demand, with limited alternatives if disruption or incidents occur.

Road corridor demand

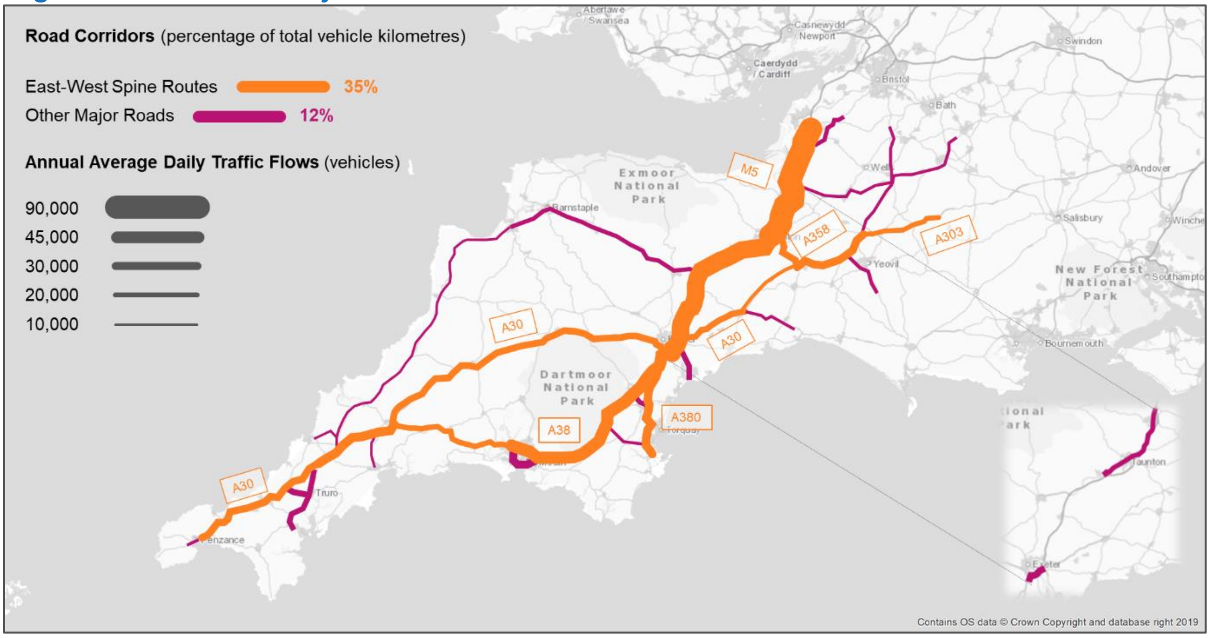
Figure 3-3 illustrates the distribution of traffic across the Peninsula's road network in terms of proportion of vehicle kilometres by corridor. Annually there are 23 billion vehicle kilometres travelled on Peninsula roads and around 47% of these are on the key strategic routes (defined as motorways, 11%, other SRN, 22% and MRN, 14%) even though these represent less than five percent of the total road network, by length.

Figure 3-3: Proportional Distribution of Vehicle Kilometres on Key Peninsula Road Network



An estimated 35% of total vehicle kilometres in the Peninsula travel on the key east-west spine corridors with a further 12% on the remainder of major routes. Figure 3-4 depicts the road corridors which are part of the east-west spine alongside the other major routes and shows the average daily flows for each of the links. This again highlights the critical function of the east-west spine for strategic inter-regional and intra-regional connections, with much higher travel demands across these links than on the other major road corridors in the Peninsula. The lack of alternative strategic routes in the event of incidents or closures is also evident in the figure and highlights the network resilience issues which are an important consideration for the Peninsula.

Figure 3-4: Peninsula Major Road Corridor Flows and Vehicle Kilometres



Source: DfT Major Traffic Counts

As an indication of possible future pressures on the Peninsula road network, Figure 3-5 and Figure 3-6 illustrate the forecast growth in vehicle traffic in the South West by vehicle type and road type respectively. These figures represent percentage growth from 2015 and use the data from the DfT's 2018 Road Traffic Forecast Reference scenario. Looking ahead 30 years, we can only use forecasting tools as a guide. In particular, some assumptions reflect the current situation and priorities for allocating resources, and these may not be the same in the future. For example, over time the levels of public support for bus and rail services and policy commitments such as for rail fares or fuel taxes have all varied. If they vary again in future, this will affect patterns of transport demand and levels of growth. Later in this report, we explore some of the consequences of different assumptions and scenarios for future traffic growth.

Based on the reference case assumptions car and light goods vehicle (LGV) traffic levels are expected to grow considerably. These are, by far, the largest segments of the traffic mix so changes in them will have the largest impacts on carbon emissions. Cars currently make up 79% of all vehicle kilometres on the Peninsula network and LGVs make up 16%. The impact of the growth in the LGV sector is to stagnate growth in heavy goods vehicle (HGV) traffic and buses are forecast to fall below 2015 levels, reflecting the reduced subsidies available in many authorities. Growth is anticipated across the various road types, but this is strongest for motorways and other trunk roads.

Figure 3-5: Forecast Percentage Traffic Growth on South West Roads from 2015 by Vehicle

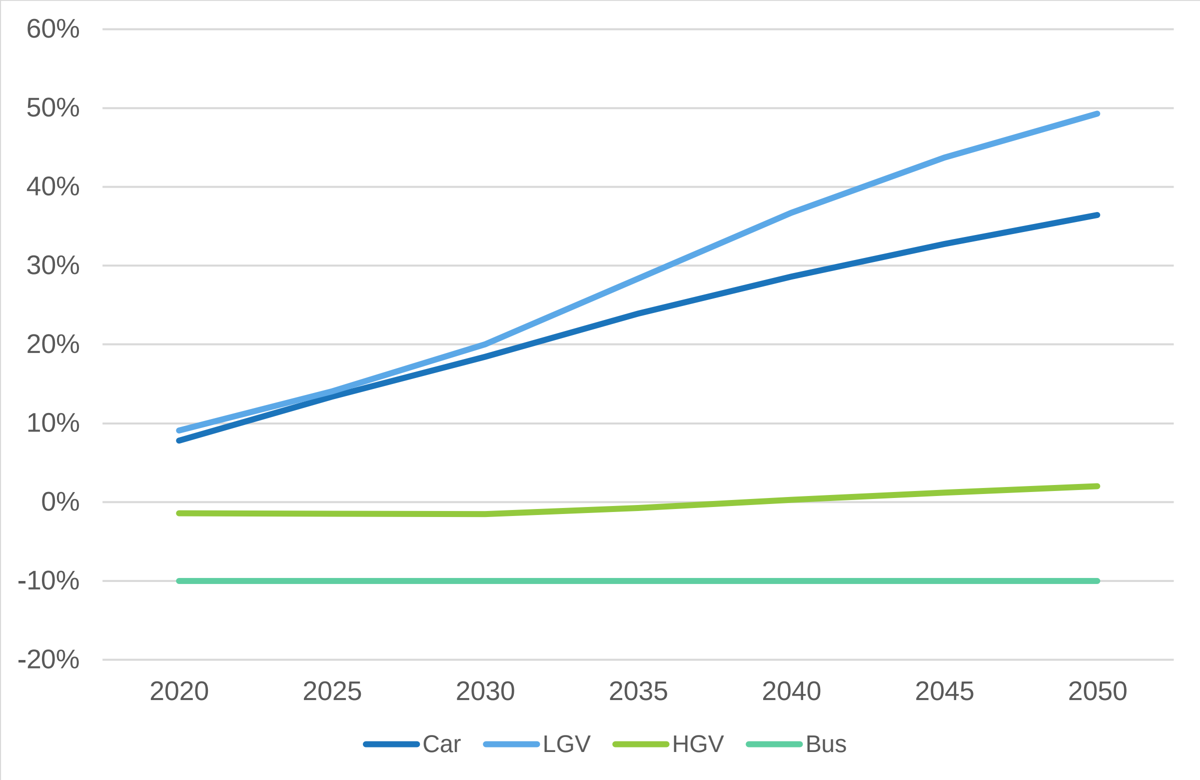
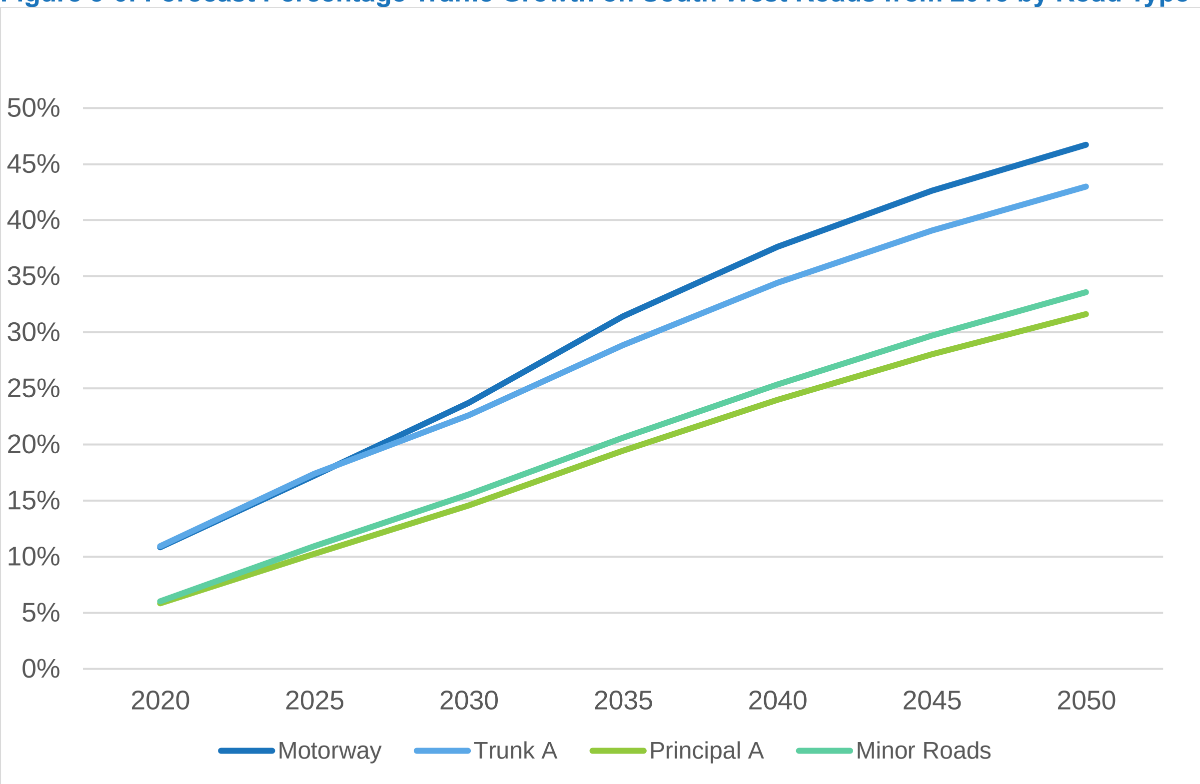


Figure 3-5 shows that between 2020 and 2050 car traffic, measured in vehicle kilometres, is expected to grow by 36%, while LGV traffic is expected to grow by almost 50%. The assumptions in this scenario result in 2050 HGV traffic levels which are only slightly higher than 2015 levels whilst policy assumptions predict steady bus usage from 2020, albeit 10% lower than at 2015 levels.

Figure 3-6: Forecast Percentage Traffic Growth on South West Roads from 2015 by Road Type



Traffic is expected to grow across all road types. The forecasts show sustained higher rates of traffic growth on motorways and trunk roads (growing by between 40% and 50% by 2050), and slower but still substantial growth on principal A roads and minor roads (both growing by between 30% and 35%).

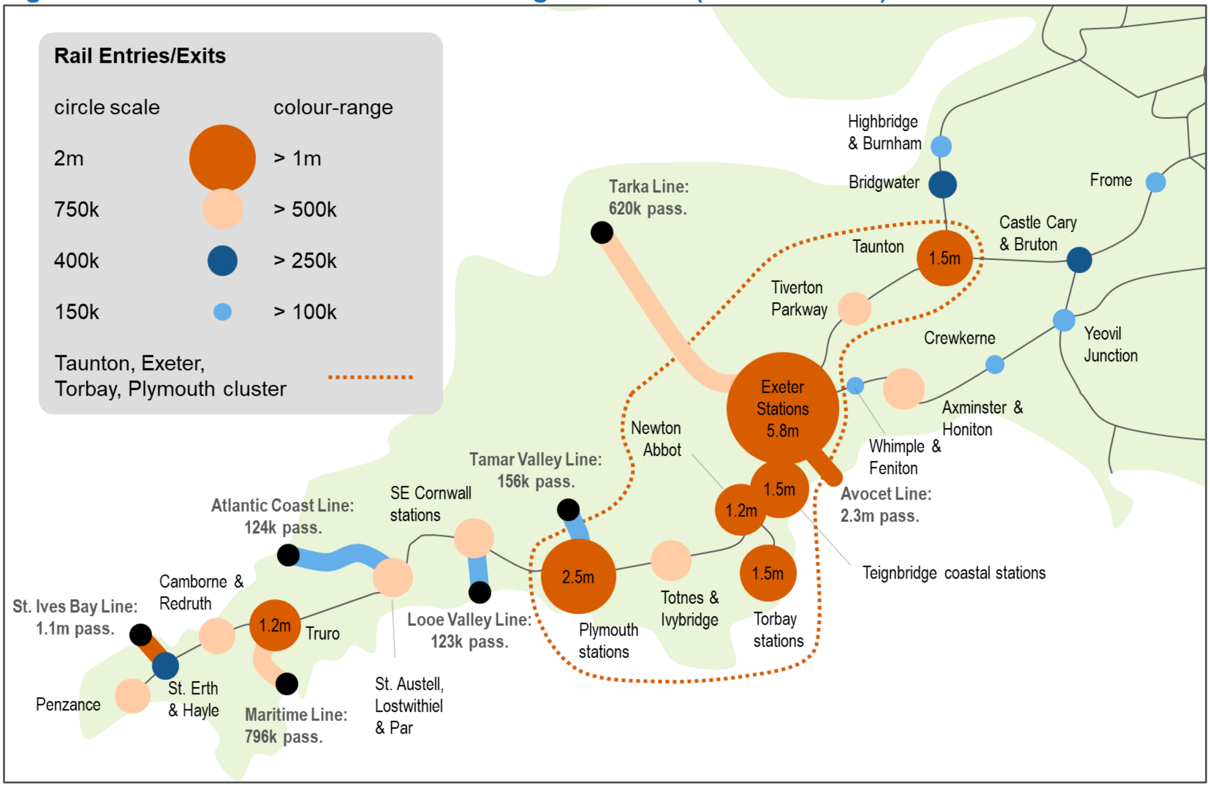
Whilst there are a number of other DfT scenarios with different input assumptions reflecting a range of forecast economic conditions and changes in travel behaviour and technology, it is notable that the scenario for a rapid shift to zero emission vehicles (focussed on cars and LGVs) has even higher levels of forecast growth for cars and LGVs than the reference scenario. This is partly because, after the initial investment in a vehicle, it is cheaper to run a car on electricity than petrol or diesel, so there is a lower marginal cost of taking additional trips.

Rail travel demand

An estimated 18 million rail journeys started or ended in the Peninsula in 2017/18, with a large proportion of these making use of the mainline stations aligned with the east-west spine through the Peninsula from Penzance, through Plymouth, Exeter and Taunton (and including the Riviera Line to Torbay). More than 50 percent of total rail entries / exits in the Peninsula use a station in a cluster covering Taunton to Plymouth and Torbay on the mainline. Figure 3-7 shows the 2017/18 rail passenger demand for stations and clusters of stations in the Peninsula.

The branchline network provides important connections onwards from the mainline, with some branchlines carrying a substantial volume of passengers (for example, the Avocet Line from Exeter to Exmouth has around 2.3 million station entries / exits and the St. Ives Bay Line from St. Erth to St. Ives has more than a million).

Figure 3-7: 2017/18 Peninsula Rail Passenger Demand (Entries / Exits)



Source: Office of Road and Rail

International and inter-regional gateway demand

Within the Peninsula there are a number of ports and airports which are important gateways to other parts of the UK, Europe and other international destinations for both passengers and freight. This section summarises the current levels of demand at the most strategically important of these locations within the Peninsula.

Plymouth Port, Falmouth Harbour and Fowey Harbour are the three largest ports in the Peninsula, but there are also a number of smaller ports and harbours making an important contribution to the economy, including Brixham, Newlyn and Penzance. It should be noted that other ports, particularly Bristol and ports within the South Coast Marine Cluster (including Weymouth, Poole and Bournemouth) are also important gateways for the Peninsula.

The Peninsula is also home to two commercial airports, Exeter International Airport and Cornwall Airport Newquay both providing domestic and international flights. Transport links to major hub airports, particularly those in London, are of high importance as these airports offer a wider range of destinations and choice. Bristol Airport, in the neighbouring Western Gateway region, is a vital gateway and its development and expansion is supported by Peninsula Transport as approximately 25% of its eight million annual passengers originate in the Peninsula. Despite the range of flights on offer from the three South West airports, the South West has the largest surface leakage[5] of passengers from any one region to another in the UK: every year seven million South West and South Wales passengers fly from London airports. Strategic connectivity to facilitate these movements is vital, but we also need to improve the connections to ensure that they can offer connectivity to local business and residents and reduce the need for longer surface access trips to airports outside the region.

Ports

Plymouth is the only port in the Peninsula with an international passenger service which is provided by Brittany Ferries roll-on, roll-off (RORO) services to France and Spain. These vessels can accommodate both cars and HGVs so also cater for some of the freight movements using Plymouth port. RORO ferries carried more than 50 thousand tonnes of freight through Plymouth in 2018. In 2018 there were 450,000 passenger journeys from Plymouth and more of 40% of these originated outside of the region. Freight from Plymouth is a mixture of RORO, dry bulk and liquid bulk with a total of more than 2.4 million tonnes passing through the port in 2018. Fowey also handles a considerable amount of freight, principally China Clay exports, with a total of around 450 thousand tonnes handled in 2018.

Fishing is also an important sector for Peninsula ports with 39 thousand tonnes of fish landed across the ports of Brixham, Newlyn and Plymouth in 2017.

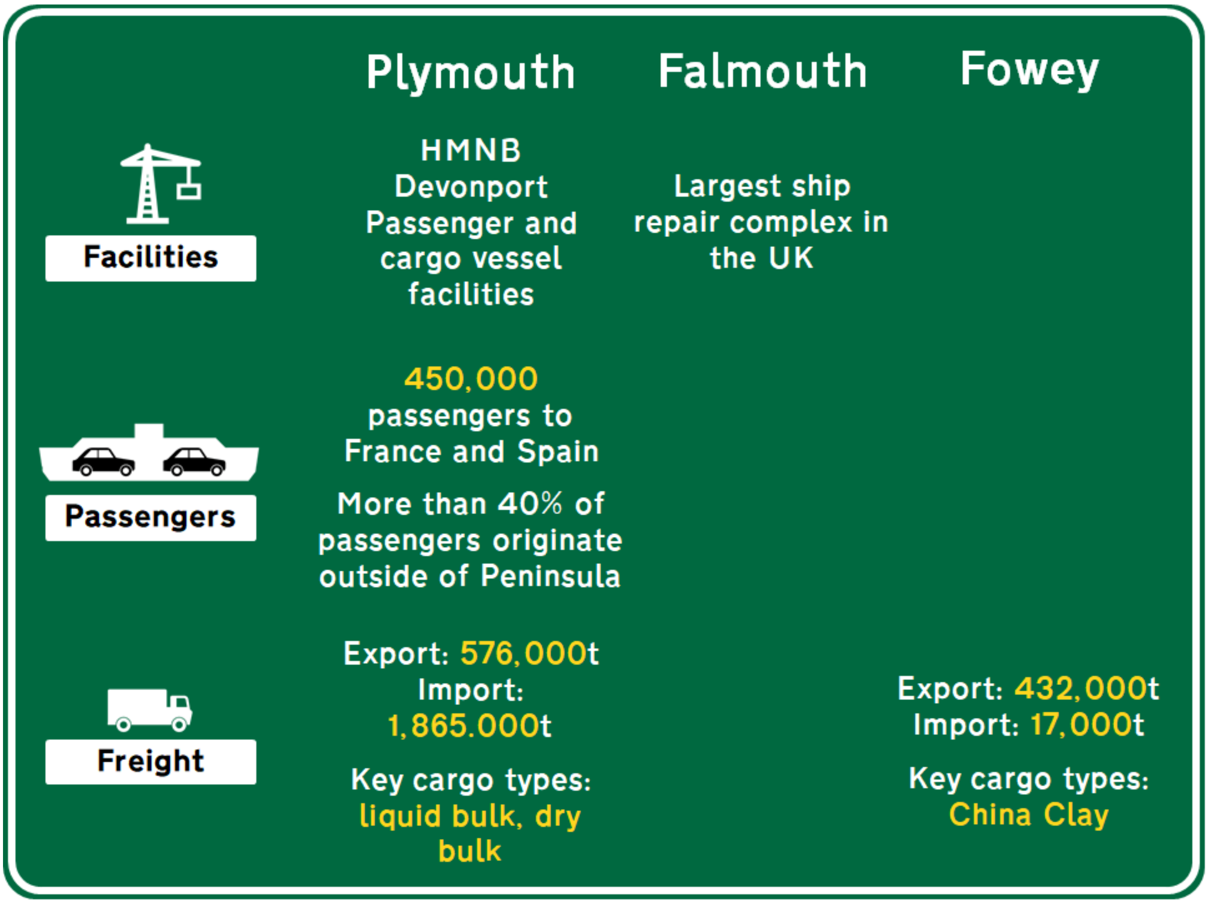
Falmouth Harbour is home to the largest ship repair complex in the UK (it is a centre of excellence for Ministry of Defence work), with three dry docks with capacity for vessels up to 100 thousand tonnes. HMNB Devonport is the largest naval base and dockyard in Western Europe and the port also has berths for passenger vessels, cruise liners and handling facilities for various freight types.

The majority of freight at Fowey Harbour is exports of China Clay mined from the St Austell area and the quay is served by a freight rail line which enables delivery of the China Clay for loading onto vessels.

Figure 3-8 summarises the major passenger and freight movements at Peninsula ports in 2018.

[5] Surface leakage refers to passengers travelling by road / rail to airports outside of the region in order to access air services.

Figure 3-8: Passenger and Freight Demand at Peninsula Ports



Airports

The two Peninsula airports, Exeter International Airport and Cornwall Airport, Newquay, principally serve the regional and international passenger market and very little freight traffic. In 2018 the passenger demand at Exeter, of 931 thousand passengers, was split approximately 50/50 between domestic and international flights. At Cornwall the total demand of 457 thousand passengers was weighted much more towards the domestic market, which partly reflects the importance of its London service and also the fact that some international services are seasonal. The other South West airport at Bristol handles a much larger number of passengers, 8.7 million in 2018, largely weighted towards European destinations.

Whilst freight is not currently a consideration for Exeter and Newquay it is important in other Peninsula locations, particularly between Land's End airport and St. Mary's on the Isles of Scilly, where air links carried around 70 tonnes of freight between the two airports in 2018. Whilst this is a small quantity in regional context it highlights the importance of air links in supporting sea freight provision to the Isles, alongside the 64,000 air passengers carried between the mainland and the Isles.

Figure 3-9 summarises the air passenger traffic from these three South West airports by destination and Figure 3-10 illustrates the key destinations for domestic air passengers from Exeter and Newquay.

Figure 3-9: Domestic and International Passenger Numbers at Peninsula Airports (2018)

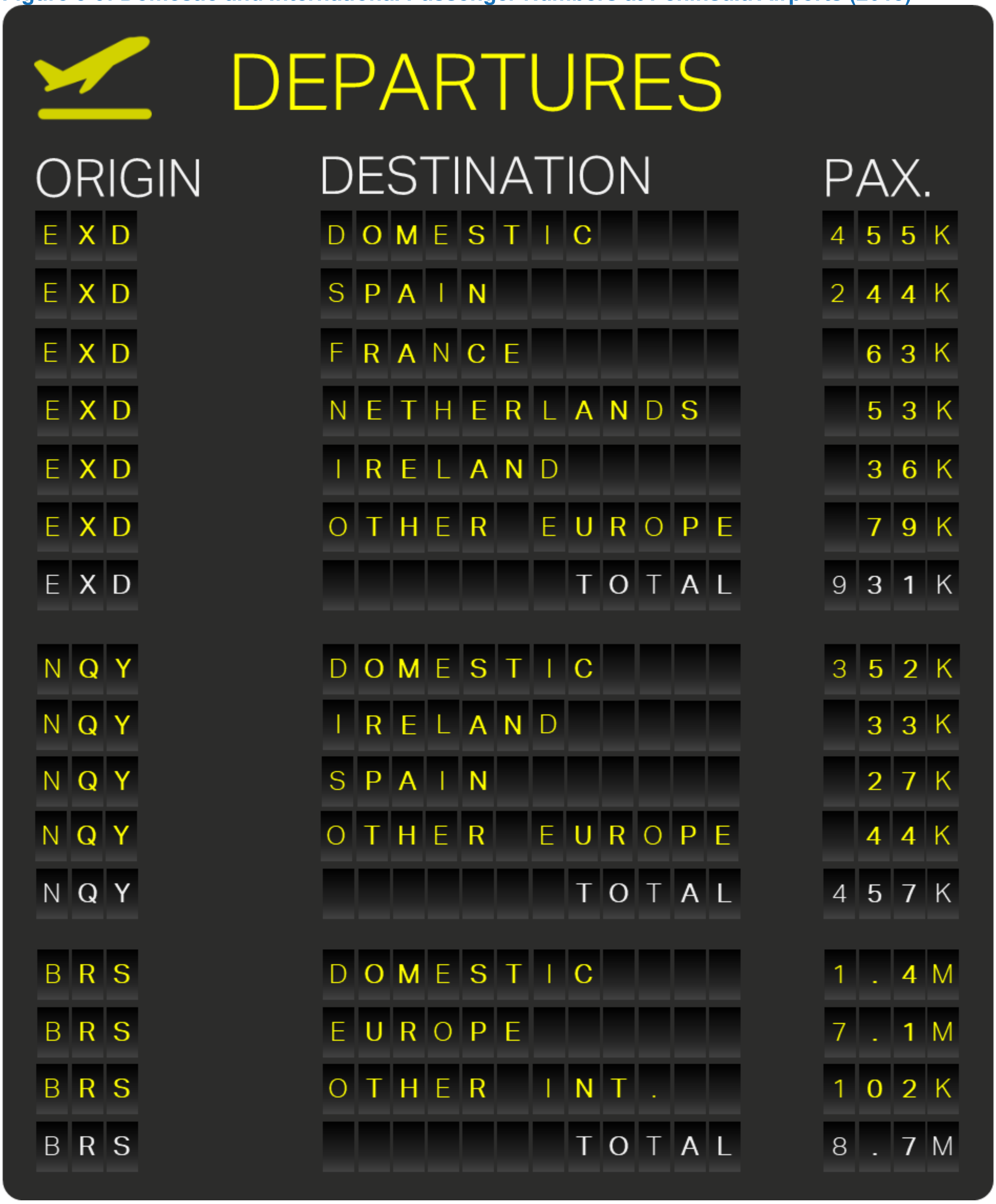


Figure 3-10: 2018 Domestic Flight Routes from Peninsula Airports

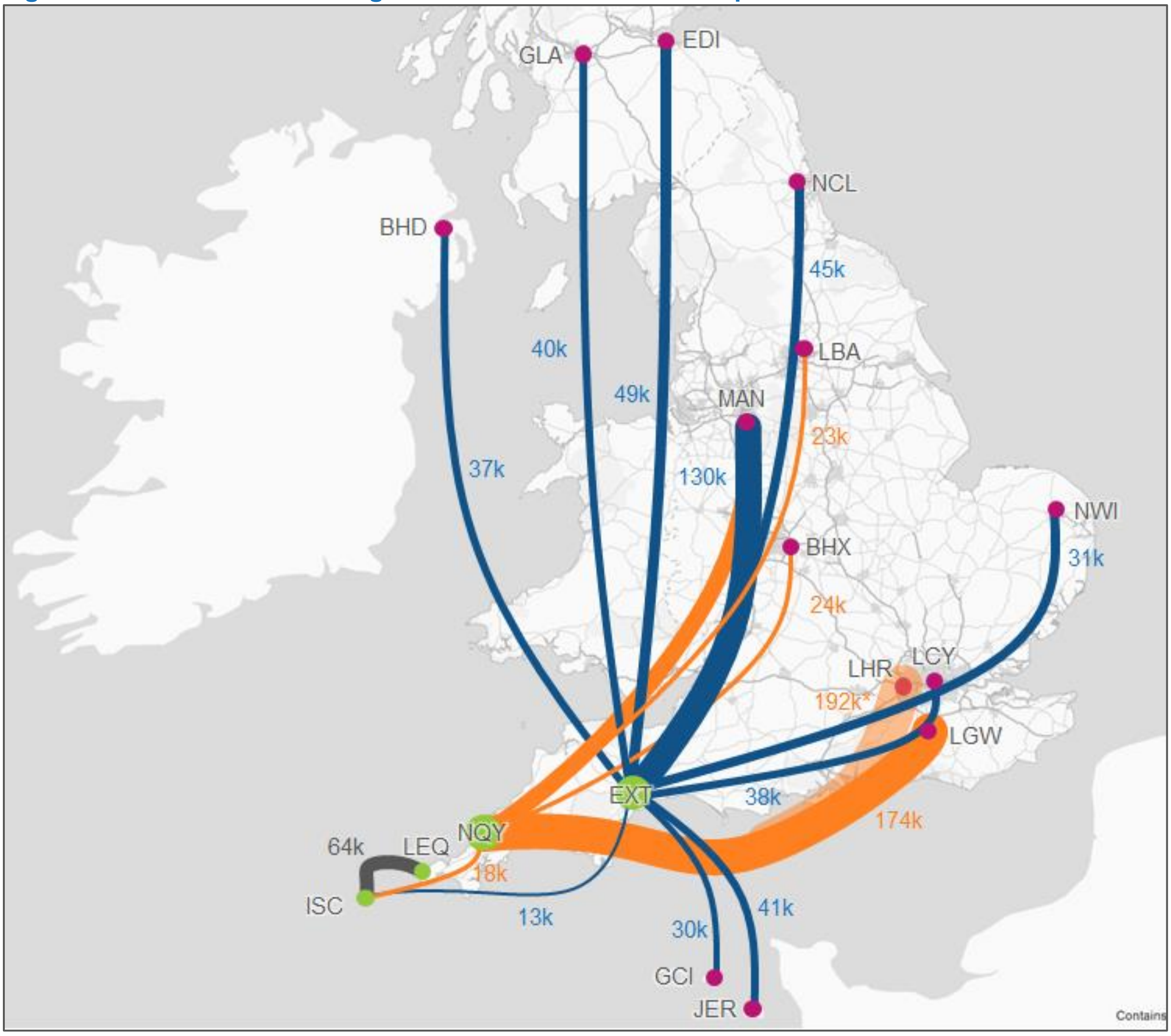


Figure 3-10 highlights the importance of the two Peninsula airports for providing links to other parts of the UK. From Exeter, routes to Manchester and other airports in the north of England and Scotland accounted for 264 thousand passenger movements in 2018. Other domestic routes provide connections to Belfast, Norwich and London City Airport. Exeter also provides services to the Channel Islands and summer services to the Isles of Scilly.

The key domestic route from Newquay is the London service, which had 174 thousand passengers in 2018. This route is covered by a public service obligation and shifted from London Gatwick to London Heathrow in 2019 (however, it will be shifting back to Gatwick from the end of March 2020). Provisional calculations show demand in 2019 have increased to around 190 thousand passengers. The importance of this route is partly due to rail travel times to London: the quickest journey from Truro takes four and a half hours, and so the air route provides a means of getting to the capital before 09:00 as well as facilitating day business trips. Flights are also available to Manchester, Birmingham, Leeds Bradford and the Isles of Scilly (the biggest number of air passengers, 64 thousand, access the Isles from Land's End airport).

Connections to the Republic of Ireland are also provided from both Exeter and Newquay as well as a small range of other short-haul European destinations. To access a wider range of flights, Peninsula residents need either to travel to Bristol Airport or an airport further afield (generally London-based).

Summary

Table 3-1 summarises passenger and freight demand by mode for intra-regional, inter-regional and international movements. There are a number of assumptions underpinning these calculations which mean they should not be relied upon as precise measures of demand, but the figures are presented to provide a reasonable indication of the share of demand across modes and journey types.

Table 3-1: Peninsula Estimates of Annual Passenger and Freight Demand

People / passengers (millions)	Intra-Regional (% of total)	Inter-Regional (% of total)	International (% of total)	Total (% of total)
Road	1,341.8 (99%)	128.1 (93%)	-	1,469.9 (99%)
Rail	9.2 (1%)	8.8 (6%)	-	18.1 (1%)
Port	-	-	0.5 (44%)	0.5 (0%)
Airport		0.8 (1%)	0.6 (56%)	1.4 (0%)
Total	**1,351.1**	**137.7**	**1.0**	**1,489.8**
Freight (millions tonnes)	**Intra-Regional**	**Inter-Regional**	**International**	**Total (% of total)**
Road	163.6	60.9	-	224.5 (94%)
Rail	12.2		-	12.2 (5%)
Port	2.9			2.9 (1%)
Airport	-	-	-	-
Total				**239.6**

The summary of travel demand by road, rail, air and sea in the Peninsula illustrates the current reliance on roads for the majority of passenger movements. Annually, around 1.35 billion trips are made within the Peninsula, of which the vast majority are by car. For inter-regional trips which are generally longer, the rail network makes an important contribution. We estimate that there are around 138 million annual inter-regional passenger movements, of which around 6% are by rail. Regional air travel also plays a role. International journeys from the Peninsula are limited to flights from Exeter and Newquay airports and ferry sailings from Plymouth Port. For air travel the majority of Peninsula trips actually leave the region with perhaps two million passengers using Bristol airport and a further seven million using London airports.

Less is known about freight demand and estimates of tonnage for road and rail are based on average vehicle loadings (for road) and the proportion of road / rail freight from national figures. Around 61 million tonnes of freight are transported by road in and out of the Peninsula, and a further 164 million tonnes are transport within the region annually.

Developing a better understanding of road and rail freight movements, links to gateways and the potential for improving the efficiency of the system are important topics for future work to be undertaken as part of the development of a Peninsula Transport strategy. Alongside these, insight into the requirements for driving behaviours and providing infrastructure investment to achieve modal shift away from private vehicle use are priorities for Peninsula Transport.

3.4 Strategic connectivity

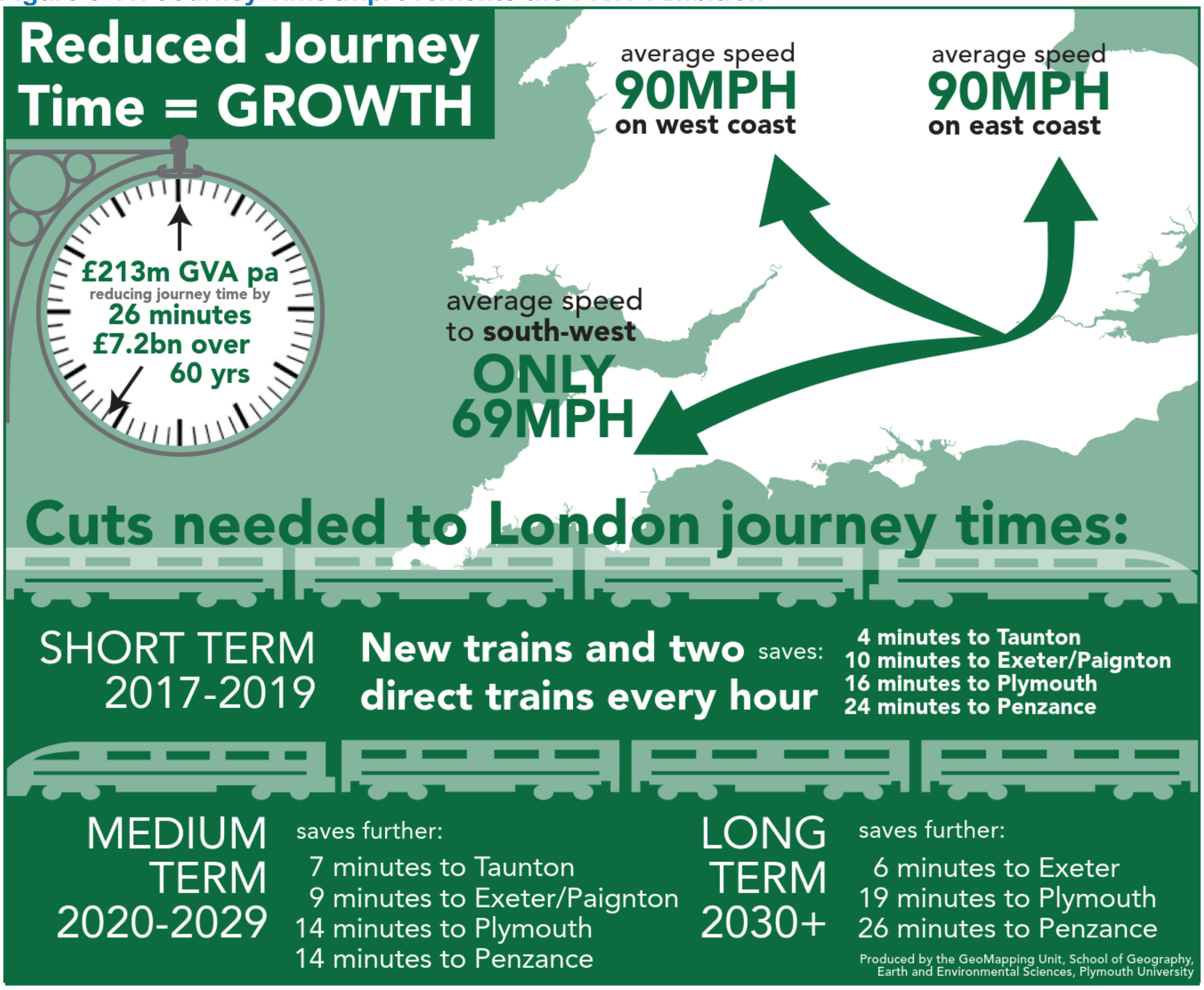
This section discusses the connectivity of strategic corridors, routes and gateways in the Peninsula in terms of various journey time metrics.

Rail connectivity

Passenger rail connections serve an important purpose in the Peninsula, connecting many of our communities and enabling longer journeys to Bristol, London, South Wales, the West Midlands and beyond. Whilst the accessibility mapping provided above highlights there are places in the Peninsula without rail provision, the mainline services are linked, through a number of branch lines to many of the smaller towns and rural areas across the region. Given the geography of the Peninsula, it is no surprise that all but one of the branch lines terminates at the coast.

The Peninsula Rail Task Force (PRTF) report, Closing the Gap[6], set out the principal challenges for rail connectivity in the Peninsula, emphasising the importance of connectivity for the economy and highlighting that the existing rail network is not as good as in other areas. The PRTF has set out short, medium and long-term mainline journey time improvement plans as one of its ambitions (see Figure 3-11) emphasising the £213m of GVA benefits per annum which are achievable if rail journey times from London to Penzance are reduced by 26 minutes.

Figure 3-11: Journey Time Improvements the PRTF Ambition



Source: Closing the gap

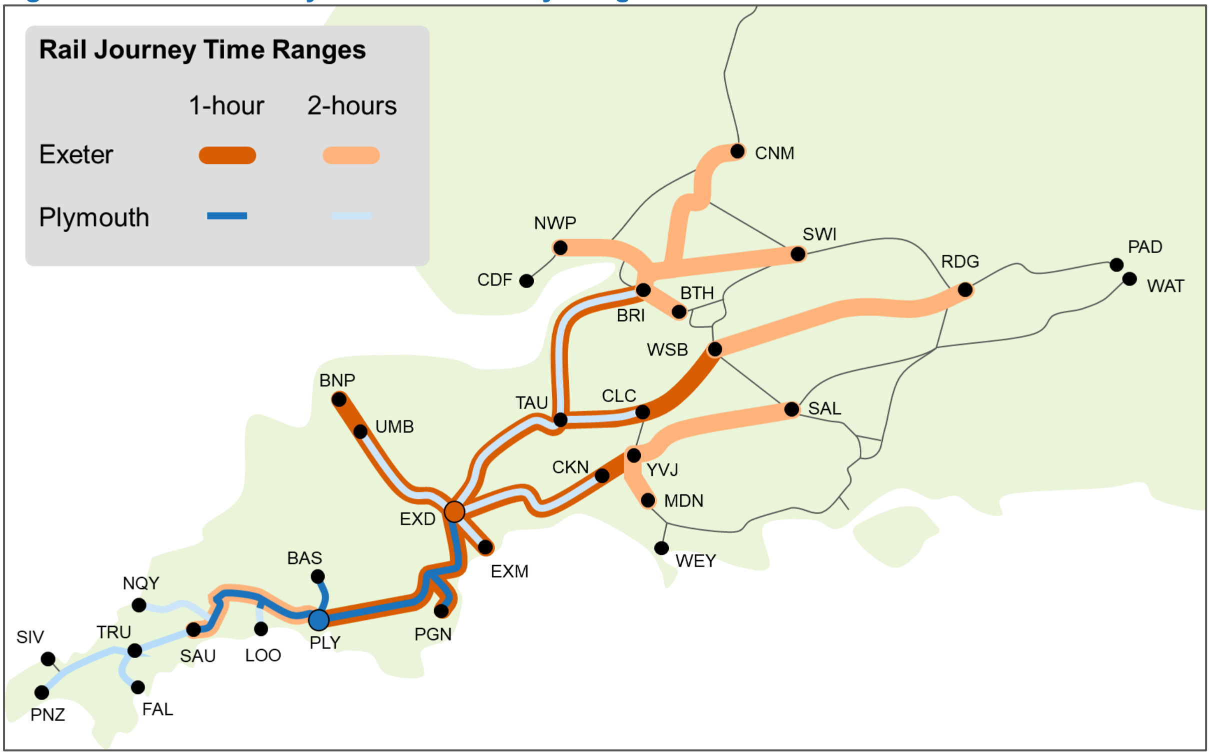
Figure 3-12 displays journey time ranges for rail journeys starting at Exeter and Plymouth. For each location the range of other stations which can be reached within one-hour and two-hours is shown. This highlights the increased speed of rail travel east of Exeter and the wider range of rail routes available. A large range of destinations can be reached within an hour from Exeter, including many within the region: Plymouth, Paignton, Exmouth, Barnstaple, Taunton and Yeovil Junction. On the Cross Country route Bristol Temple Meads can also be reached within an hour and Cheltenham Spa within two. On the route to London Paddington, Westbury can be reached within one hour and Reading within two. The quickest weekday service takes a little over 2 hours to reach London Paddington (129 minutes).

[6] Closing the gap, the South West Peninsula strategic rail blueprint, Peninsula Rail Task Force (November 2016)

Taunton station is well placed for inter-regional rail connections, being a further 25 minutes north and east of Exeter. This means Bristol can be reached in half an hour, Birmingham New Street in just over two hours and London Paddington in under two hours on the fastest services.

All journeys within an hour of Plymouth are restricted to the Peninsula, with St. Austell, Paignton and Exeter defining the range of mainline destinations accessible in this interval. Extending the range to two hours provides access to Penzance at the western end of the main line and also to Bristol Temple Meads.

Figure 3-12: Rail Journey Time Connectivity Ranges



3.5 Corridor performance

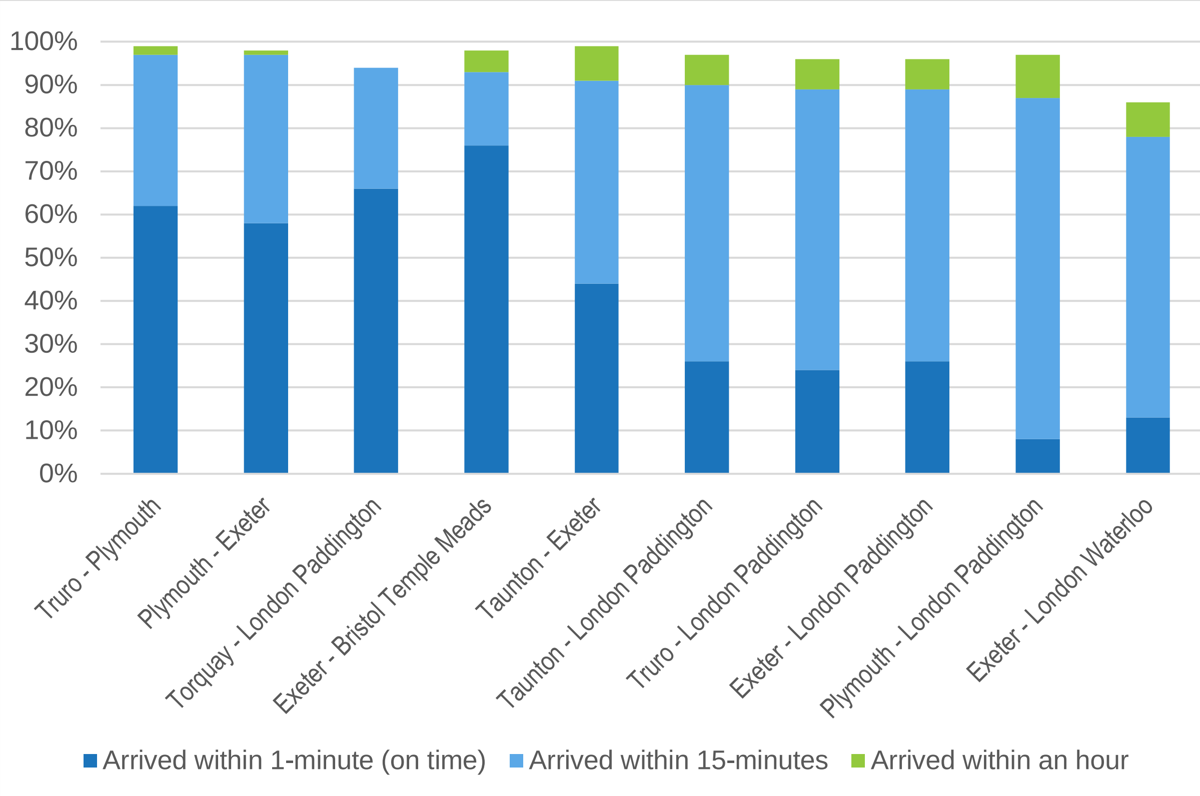
Rail service punctuality

A key measure of performance for rail journeys is service punctuality. This is a driver of passenger satisfaction and without a sufficient level of journey time reliability, services will not give the passenger sufficient confidence to rely on a service. Figure 3-13 presents the punctuality for a selection of key intra-regional and inter-regional journeys important for the Peninsula across 2019. The services chosen are morning peak services for the route and the measures reported are the latest used by train operating companies in Great Britain, which consist of on-time (arrives within one-minute of timetabled arrival), within 15-minutes and within one hour of timetable. Routes are ordered according to the share of trains which are more than 15 minutes late.

The most disrupted morning peak journey from the services selected is Exeter – London Waterloo (nearly 15% of journeys shown were more than an hour late), the only journey shown which uses the West of England line, and which perhaps reflects the characteristics of the line: single track with passing loops, reducing the resilience of the line to timetable disruption.

Access to London Paddington is very important for the Peninsula; however, the reliability of morning peak services on this route is limited with more than 10% of services are delayed by more than 15-minutes for trains from Truro, Plymouth, Exeter and Taunton.

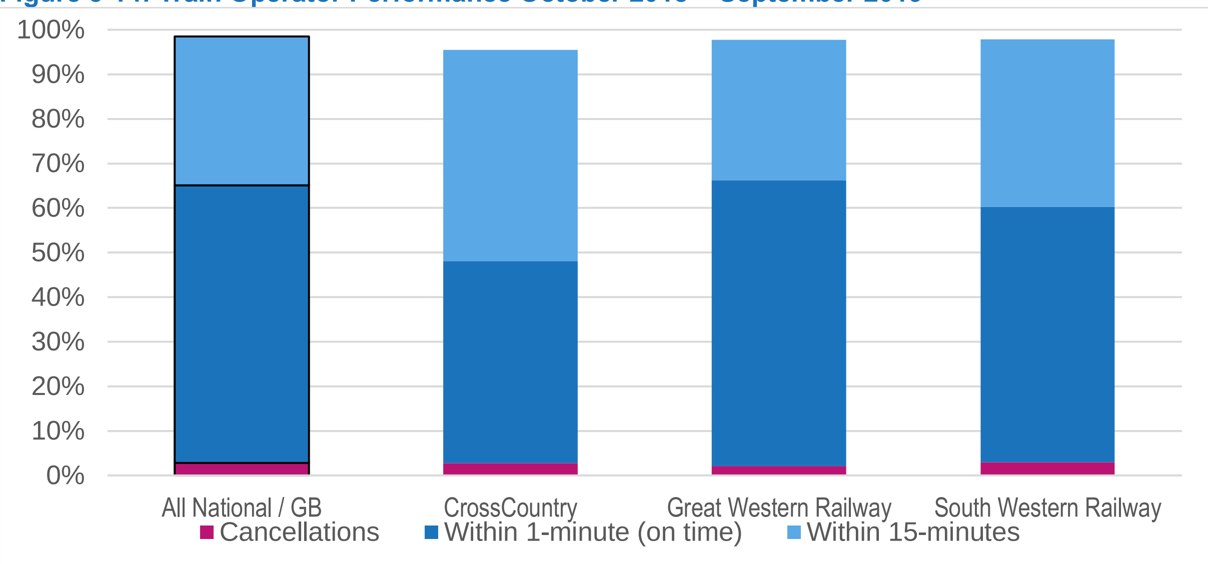
Figure 3-13: Rail Service Punctuality for Selection of Key Peninsula Routes in 2019



Source: National Rail and mytrainjourney.co.uk

Figure 3-14 provides a year's worth of punctuality data for the three operating companies which provide services in the Peninsula, together with the overall punctuality figures for the network. Whilst this provides a good overview of the recent performance of each company, their routes cover many areas outside the Peninsula, and so are not necessarily indicative of train punctuality for journeys starting and / or ending in the region.

Figure 3-14: Train Operator Performance October 2018 – September 2019



Source: ORR Data Portal

Across GB as a whole, 2.8% of trains were cancelled between October 2018 and September 2019, while 62.3% were on time and 33.4% arrived within 15 minutes. The cancellation performance of Great Western was somewhat better than this, although the share of late trains was similar to the GB average. Punctuality was significantly worse on CrossCountry services and somewhat worse on South Western Railway services.

Road corridor level of service

One measure of the level of service provided by road infrastructure is journey time reliability (essentially the road equivalent of the punctuality measure applied to rail journeys). Comprehensive journey time data is available for all roads in the Peninsula and these data have been obtained from the DfT for the 2018 calendar year.

Analysis has been undertaken first at a network level (i.e. looking across all roads within the Peninsula) and then for all of the corridors on the strategic and major road networks. Figure 3-15 shows the performance of the whole Peninsula road network using various measures to show how performance varies by time of day, day of the week and time of year. The analysis has weighted speeds by the vehicle kilometres observed in the journey time data. The measures shown are as follows:

- All weeks: an average of speeds using all available data across the year;
- Average neutral speed: an average of speeds from months considered to represent neutral traffic conditions: April, May, June, September and October (excluding any school holidays and Bank Holidays in these months);
- Average summer holiday: an average of speeds from the school holiday summer holiday period in July and August;
- Lowest observed: the slowest speed observed within the dataset for each hour of the week. This is included for comparison purposes only but in some cases can be used as an example of the impact of a known incident / weather event (e.g. the snow in early March 2018).

Each road corridor is made up of many individual links in the dataset and each hour of the year has only been considered for presentation where at least 90% of the links for a corridor provide a speed value for that hour. Where the speed for an hour is listed as zero this has also been excluded from the presentation. The gaps in any of the data series presented are a result of these two filters applied to the dataset.

The plot shows a consistent pattern of reducing speeds during the day (from an overnight average of around 90 kph to a value a little less than 70 kph) reflecting the higher levels of demand and congestion present on routes during the daytime. Different patterns are observed on Saturdays and Sundays with average day time speeds generally higher on these days than during the week.

Notably speeds during summer holiday periods across the week generally follow the same profile as average weeks, but with a few key differences. The most obvious impacts are seen between Friday and Sunday, with reduced speeds compared to average conditions. However, there is also a corresponding increase in speeds on Monday afternoons. This plot does not present a complete picture as including all roads in the Peninsula dampens the impact of congested conditions / issues on particular corridors.

The slowest observation measure is included to provide an indication of the worst-case for the network as a whole in 2018. The late February early March snows had a severe impact on network operation with average speeds dropping below 40 kph across the network on Thursday 1st March.

Figure 3-16 and Figure 3-17 show plots by direction for two sections of the M5 corridor from J25 Taunton to J31 Exeter and J22 Burnham / Highbridge to J25 Taunton. These two corridor sections are the busiest sections of road in the Peninsula and the most critical road link for maintaining connectivity outside of the region.

During neutral periods of the year the M5 provided a consistent level of service in 2018 with average speeds almost entirely above 100 kph.

However, the impact of increased travel demand in school summer holiday periods is evident, with slower average speeds occurring on Fridays, Saturdays and Sundays. Northbound Friday average speeds are most impacted with average speeds dropping as low as 40 kph. Plots for the remaining Peninsula strategic and major road network corridors are appended in Appendix A.

Figure 3-15: Journey Time Reliability Plot for the Peninsula Road Network in 2018

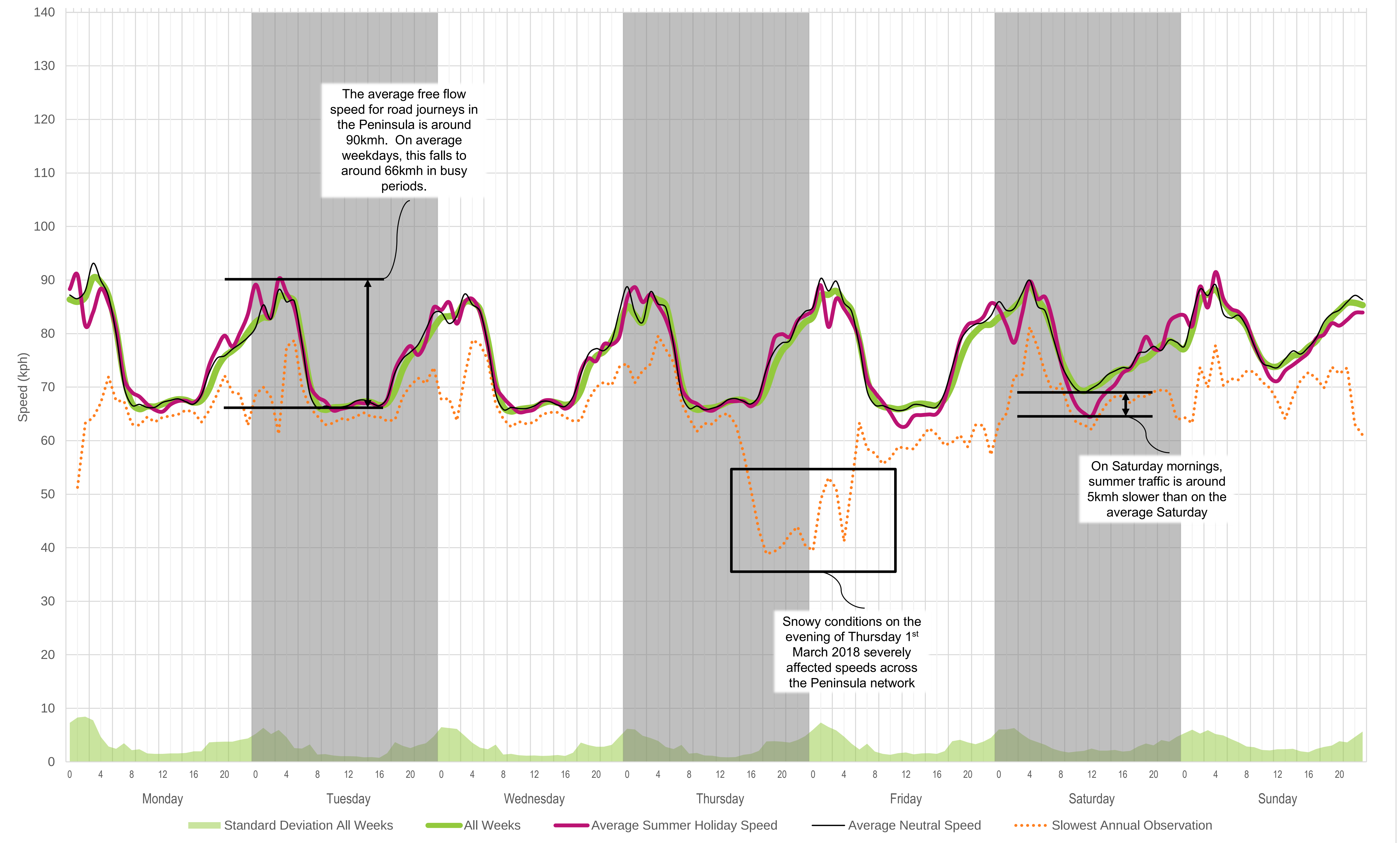
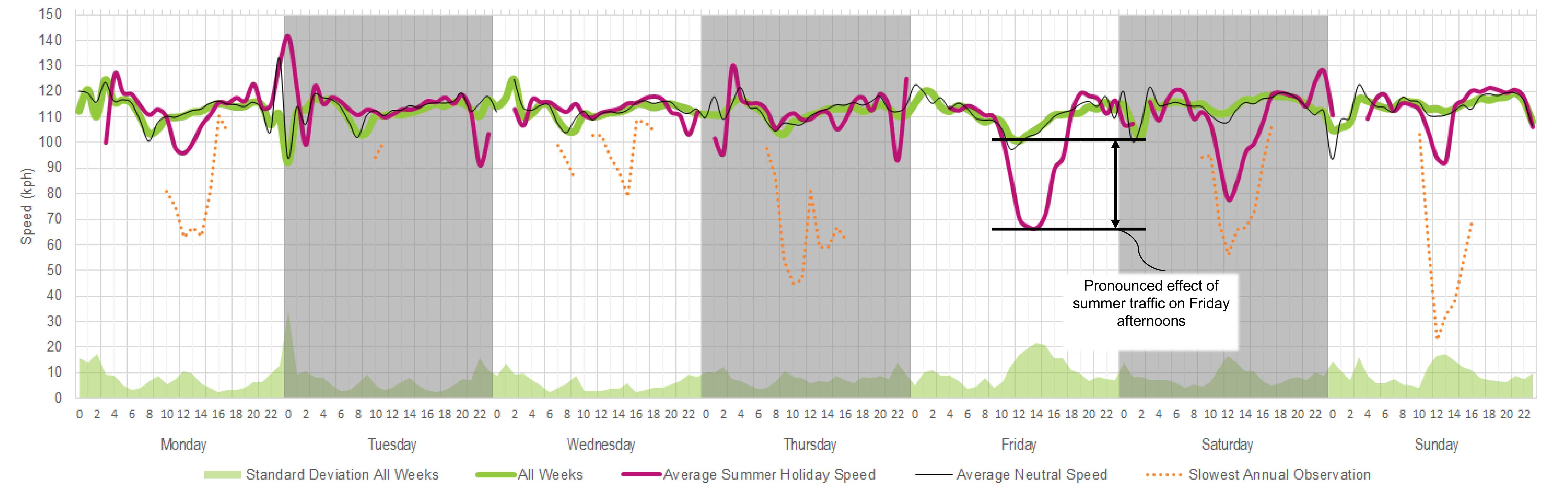


Figure 3-16: Journey Time Reliability Plot for the M5 J25 – J31 (Taunton to Exeter) in 2018 (Top = Northbound, Bottom = Southbound)



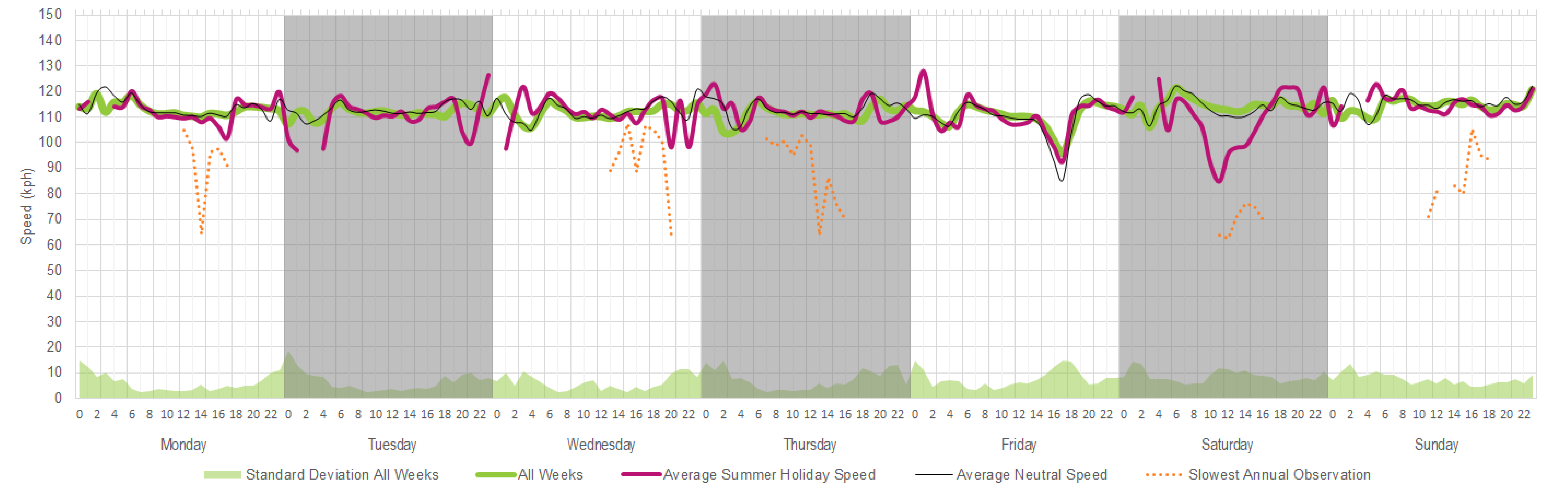
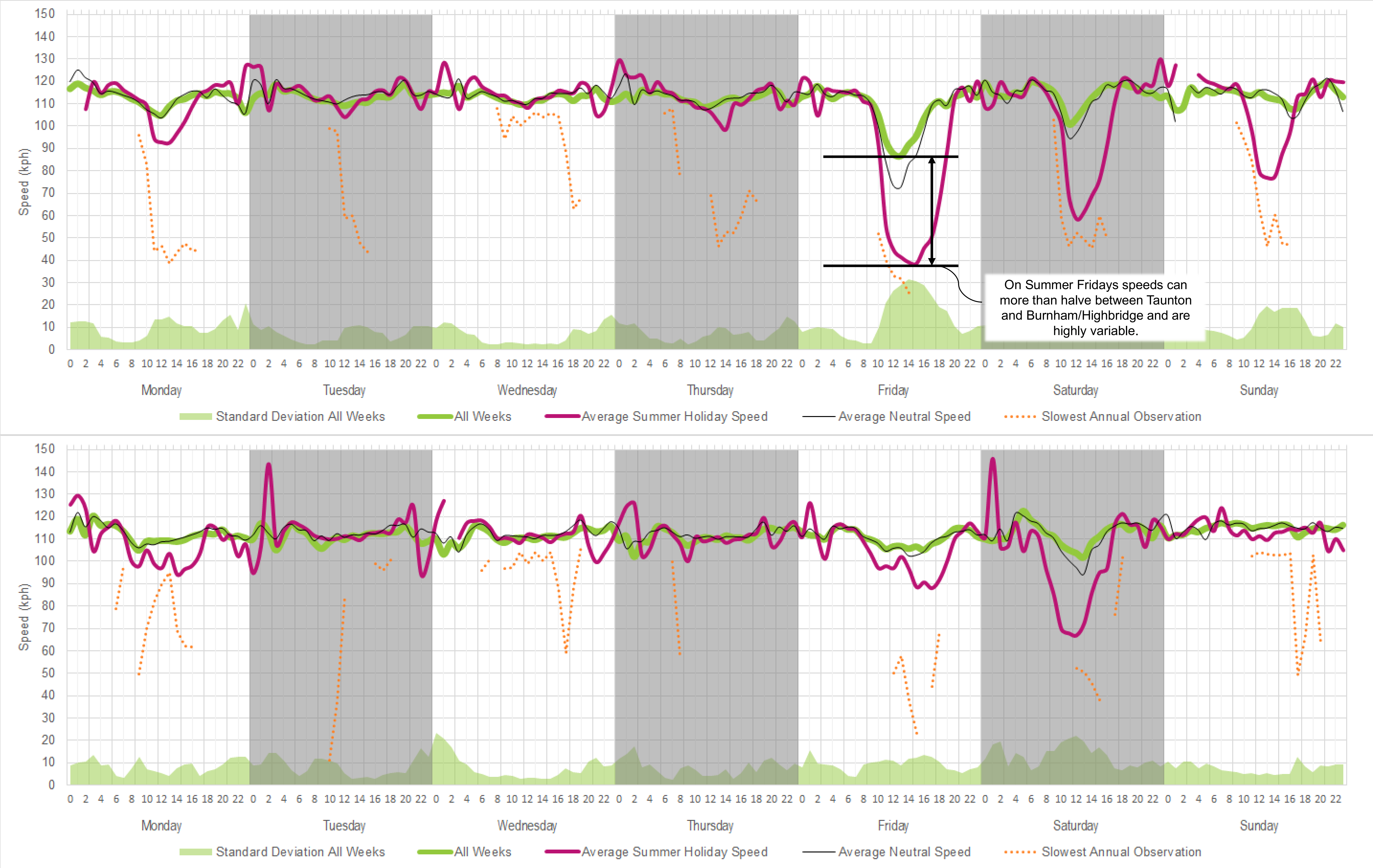


Figure 3-17: Journey Time Reliability Plot for the M5 J22 – J25 (Burnham/Highbridge to Taunton) in 2018 (Top = Northbound, Bottom = Southbound)



3.6 Connections in the region today - summary

Providing accessibility to the strategic network is challenging in a large region like the Peninsula with dispersed smaller settlements. However, most places in the region have reasonable accessibility to the transport network as communities are mostly concentrated along the major routes. Some areas remain remote and some have poor rail accessibility due to the sparsity of the branch line network and single mainline route through the region west of Exeter. Issues of rural accessibility and mobility will continue to be an important focus for Peninsula Transport.

Annually there are 23 billion vehicle kilometres travelled on Peninsula roads with nearly half of these on strategic routes. Forecasts suggest that traffic will grow by around 30% over the next 30 years, with the fastest growth in cars and LGVs and on the primary routes. Without significant changes to travel behaviour or additional infrastructure, levels of congestion will increase, and traffic growth will hamper efforts to reduce transport emissions.

An estimated 18 million rail journeys started or ended in the Peninsula in 2017/18 with the busiest stations in a cluster around Plymouth, Exeter, Torbay and Taunton. Rail provides important connections, particularly for inter-regional journeys, and recent and ongoing improvements to journey times, timetables and rolling stock have the potential to increase the rail share of journeys for mainline routes.

There are a number of important gateways within the Peninsula: the ports of Plymouth, Fowey and Falmouth and the airports at Exeter and Newquay. However, gateways in other parts of the country remain important to Peninsula businesses and residents, particularly Bristol airport and the London airports. Inter-regional air connections cater for small passenger volumes but supplement rail in providing for faster travel on longer journeys. The most important current function of the Peninsula airports at Exeter and Newquay is domestic passenger flights providing lower journey times than the rail and road alternatives to locations outside of the region.

The Peninsula's ports provide a range of facilities including passenger and freight facilities but also major dockyard facilities at Plymouth and Falmouth for ship building and repair. Nevertheless, road transport dominates passenger and freight traffic not just for local journeys, but for interregional ones as well. This reflects the large geographical area the region occupies and the large number of rural and coastal communities where road transport is the only practical alternative.

Reducing rail times to London and other destinations outside of the region is important for improving rail connectivity. The impact of large scale disruption due to the lack of resilience of the network to extreme weather remains an issue, although much has been done to address this in the past five years. Rail reliability on some routes is below average and improving this would also benefit rail connectivity.

Journey time reliability of road connections varies by route, reflecting the wide variety of road standards and in some cases the impact of seasonal traffic demand. The busiest corridor is the M5 and this is critical for inter-regional journeys. Generally, the journey time reliability of the M5 is very good, but around weekends in summer holiday periods average speeds reduce considerably as a result of congestion. Resilience of the strategic and major road network is important because of the links it provides both within the region and to areas beyond. The section of the M5 to the south of J25 at Taunton is critically important because it serves critical links via the M5 as well as the second Strategic Route to the Peninsula via the A303 and A358. Incidents / closures on this section are particularly disruptive and pose risk to the smooth operation of the road network and to the Peninsula economy.

Travellers in Peninsula have few route choices for accessing the rest of the UK and the rest of the world, so the strategic network is crucial. One of the main issues for transport connectivity in the Peninsula is the need to provide reliable and resilient transport corridors for current and future travel demand. Much work has been done to improve the resilience of rail connections following well publicised issues around Dawlish and the Somerset levels. However, the geography of the region and the location of existing rail and road connections means that, without further investment, the region will continue to face resilience issues due to the impacts of climate change and the lack of alternative routes when issues occur.

PART 2

4. Carbon and the Environment

Decarbonisation

Chapter Overview

Peninsula Transport recognises the critical and urgent challenges posed by rising levels of CO_2 in the atmosphere, and all the Peninsula authorities have declared Climate Emergencies. While other sectors of the economy have been successful in reducing CO_2 emissions, transport has struggled. Vehicles are quickly becoming less polluting, but this if almost offset by rising transport demand. So far, this has only led to modest reductions in transport emissions. To meet carbon goals, this needs to change dramatically. In this section we examine the emissions of carbon from the transport sector within the Peninsula and examine how rapid these emissions reductions could be achieved.

4.1 Introduction

All five of the local authorities represented within Peninsula Transport declared Climate Emergencies in 2019[7] and are developing policies and action plans to accelerate the reduction of carbon emissions in their areas. Peninsula Transport has made transitioning to a low carbon transport system the central tenet of its transport strategy development and is investing in understanding the decarbonisation challenge across the surface transport network. This chapter sets out the scale and composition of existing transport carbon emissions in the Peninsula and looks forward to consider possible trajectories for future carbon emissions.

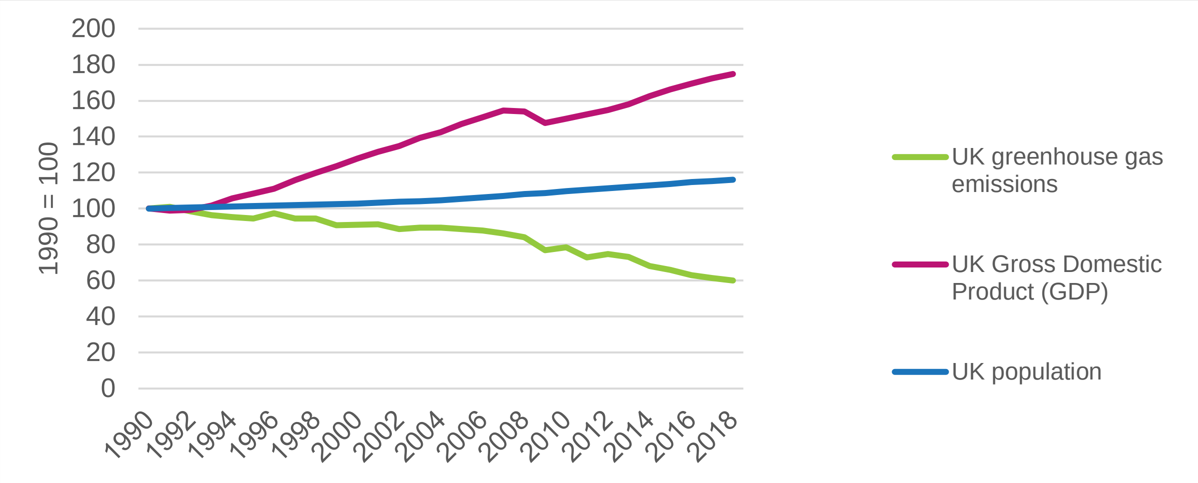
In this chapter, carbon emissions are generally presented in terms of CO_2 emitted or CO_2e which represents the CO_2 equivalent impact for a range of greenhouse gases (GHGs). Often these are measured at source (e.g. from the exhaust of a vehicle); however, sometimes they include elements of the carbon emissions involved in the production of fuel (this is stated in each case). There are a number of other emissions from the transport system which include noise, particulates from exhaust systems, brake systems and road surfaces. As the focus of this chapter is decarbonisation these are not discussed here, and where emissions are referred to they specifically denote carbon emissions.

4.2 UK context

The Committee on Climate Change Annual Progress reports provide a useful overview of UK emissions, targets and the progress being made by each sector of the economy. Figure 4-1 shows indexed GHG emissions across the UK since 1990, compared with GDP and population growth. Between 1990 and 2018 UK carbon emissions fell by around 40% whilst the population increased by 16% and GDP grew by 75%. Reducing transport carbon emissions will be challenging especially in the context of a rising population and growing demand for transport. However, this evidence shows that it can be done in other sectors.

[7] Cornwall: https://www.cornwall.gov.uk/environment-and-planning/climate-emergency/
Devon: https://www.devonclimateemergency.org.uk/devon-climate-declaration/
Plymouth: https://www.plymouth.gov.uk/sites/default/files/PlymouthsClimateEmergencyActionPlan01.pdf
Somerset: https://www.somerset.gov.uk/waste-planning-and-land/climate-emergency/
Torbay: https://www.torbay.gov.uk/council/policies/environmental/climate-change/

Figure 4-1: Indexed UK emissions, GDP and population over time



To-date most of the success in reducing UK emissions has been achieved by the non-transport sectors. The energy sector has made the most substantial progress with emissions falling by nearly 60% from 242 million tonnes in 1990 to 98 million tonnes in 2018. Business emissions have fallen by 40% and residential emissions by 16% in the same period. Transport emissions have remained fairly constant, representing 125 million tonnes in 1990 and 121 million tonnes in 2018, a reduction of only 3% in the period. As a result, transport is now the sector producing the most emissions, 33% of the total, with energy contributing 27% (it contributed more than 40% of the total in 1990). At least some of the reductions in emissions from internal combustion engines in this period has been offset by the trend towards ownership of larger and heavier private vehicles.

The transport sector therefore has a critical role to play in reducing UK emissions further and needs to adopt new policies, take advantage of new technologies and achieve widespread behaviour change in order to ensure a downward trajectory for its emissions profile.

Figure 4-2: UK CO_2 emissions by sector over time

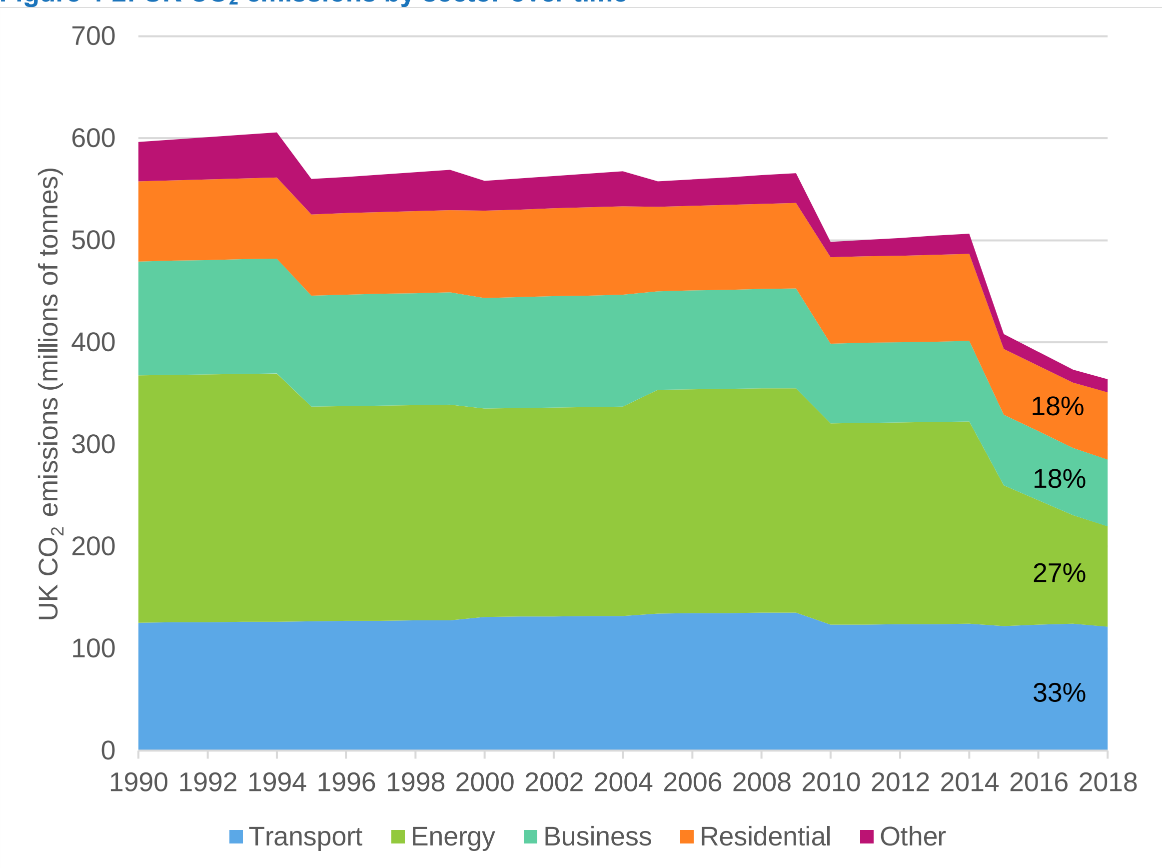


Table 4-1 summarises UK greenhouse gas emissions by transport mode in 2016. Values are presented in millions of tonnes of carbon dioxide equivalent (CO_2e) by source. CO_2e is a term for describing different greenhouse gases in a common unit. The values displayed here therefore include the impacts of other greenhouse gases emitted from the transport system (such as methane and nitrous oxide) represented in terms of their equivalent impact in terms of quantity of CO_2.

Road transport modes are the biggest overall emitters with 69% of total transport emissions in 2016. Cars and LGVs were responsible for 54%, HGVs 12% and buses and coaches just 2%. For reference, in 2016 an estimated 0.22% of total car vehicle kilometres were driven in zero emission vehicles. Air emissions were responsible for 21% of the total in 2016, with the vast majority (20% coming from international flights). Maritime emissions were responsible for 9% of total emissions and rail just 1%.

Table 4-1: UK Transport Emissions by Source (Millions of Tonnes CO_2e)

Road			Rail	Maritime		Aviation	
Cars & LGVs	HGVs	Buses & Coaches	Rail	Domestic Maritime	International Maritime	Domestic Aviation	International Aviation
90.5 (54%)	20.3 (12%)	3.5 (2%)	2.0 (1%)	5.9 (4%)	8.6 (5%)	1.5 (1%)	34.0 (20%)
114.2 (69%)				14.5 (9%)		35.5 (21%)	

4.3 Peninsula emissions

Total road carbon emissions

Peninsula Transport has undertaken calculations of road transport emissions for the Peninsula region derived principally from the 2018 DfT Road Traffic Forecasts[8]. This work has helped understand the scale of the transport decarbonisation challenge for the Peninsula and consider a framework for establishing and monitoring reductions as part of the development of a transport strategy. Figure 4-3 shows Peninsula road emissions from 2016 with two forecast scenarios of emissions to 2050. Table 4-2 summarises the 2050 forecast road emissions alongside equivalent road traffic demand forecasts. Emissions are presented in millions of tonnes of CO_2e by end user, so that as well as direct emissions at source, impacts of emissions associated with production and supply are included, where these occurred in the UK.[9]

In 2016 Peninsula road emissions amounted to an estimated five million tonnes of CO_2e of which 4.03 million were due to cars and LGVs. HGVs emitted 0.85 million tonnes and buses 0.13 million tonnes. Two of the modelled scenarios from the DfT 2018 forecasts were used to consider future road emissions in the Peninsula to 2050.

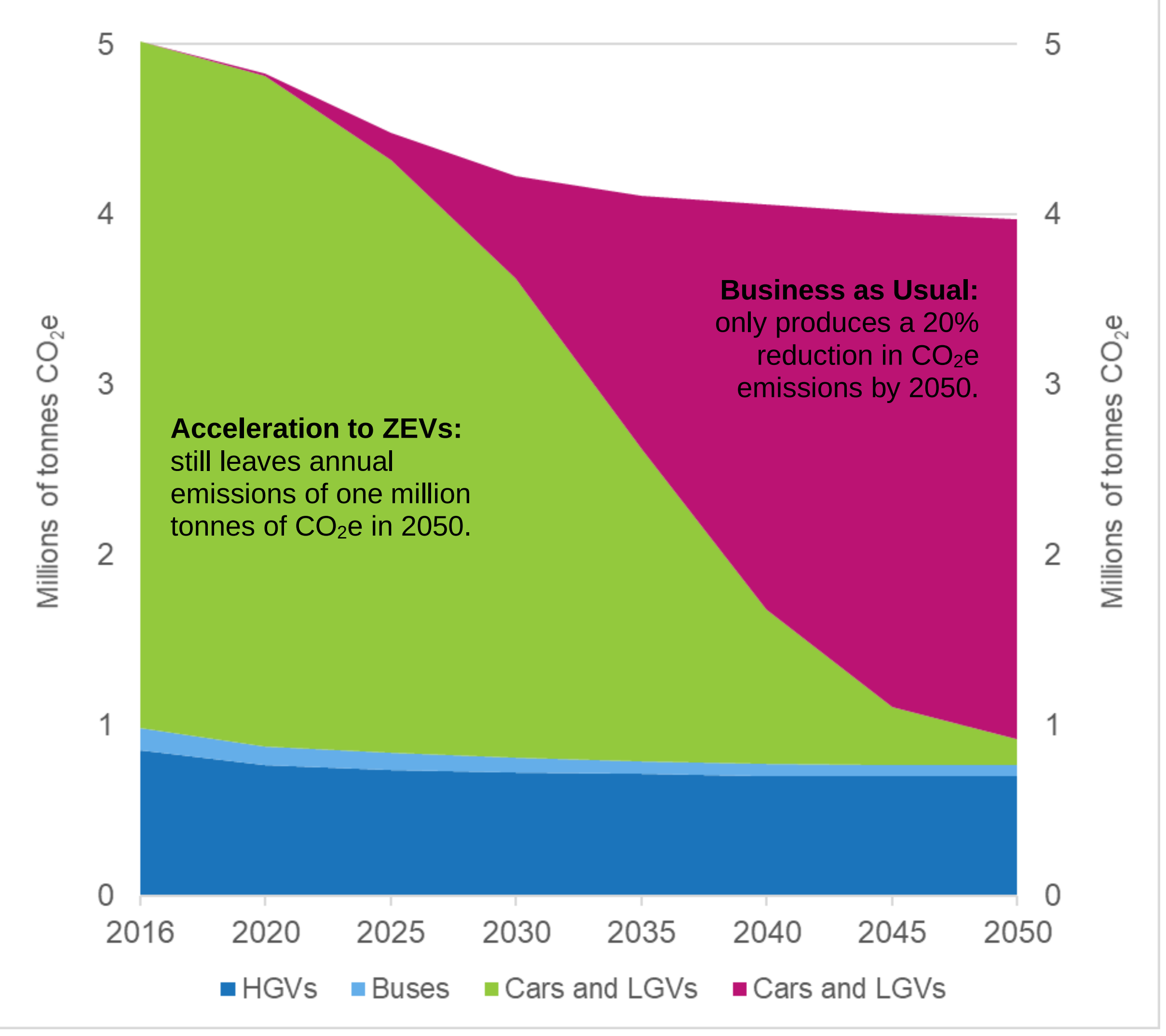
The first of these was the DfT *reference scenario* which includes the assumption that 25% of car and LGV mileage in 2050 will be using zero emission vehicles. The second is the *acceleration to zero emissions scenario* which includes an assumption that by 2040 all cars and LGVs sold in the UK will be zero emission vehicles with the result that 97% of related mileage will be covered by these vehicles in 2050.

[8] Road Traffic Forecasts 2018 present the latest forecasts for traffic demand, congestion and emissions in England and Wales up to the year 2050. These are produced using the Department for Transport's National Transport Model (NTM).
[9] For UK domestic transport, estimates of carbon emissions by source were 125.8m tonnes in 2016, compared with 140.2m tonnes for carbon emissions by end user.

In the reference scenario, the slower progress to zero emission vehicles means that car and LGV emissions are only forecast to fall to 3.21 million tonnes by 2050, with total road emissions of four million tonnes – a reduction of only 20% on current figures.

In the acceleration to zero emissions scenario, car and LGV emissions reduce by a large percentage so that forecast emissions in 2050 are 0.16 million tonnes and total road emissions are 0.92 million tonnes, a reduction of 82% over current figures. This is despite the fact that the assumptions which underpin this scenario predict higher levels of car and LGV vehicle kilometres because of the reduced cost of operating these vehicles compared to those powered by internal combustion engines.

Figure 4-3: Peninsula Road Production Carbon Emissions and Forecasts



For both scenarios the vehicle kilometres travelled and emissions for heavy vehicles are close to identical and reflect the assumptions applied in DfT appraisal guidance at the time of publishing the forecasts. In both scenarios, Peninsula HGV emissions are forecast to reduce to 0.70 million tonnes in 2050 (a reduction of 18%) and buses to 0.06 million tonnes (a reduction of 54%). This means that the emissions from larger vehicles represent more than three quarters of the total forecast road emissions in 2050 under the acceleration to the zero emissions vehicle scenario. A general principle is that zero emission technologies will take longer to be implemented in the larger vehicle fleet due to the increased energy required to operate heavier vehicles. However, there is considerable uncertainty about how and when this technology will become widespread, particularly for larger HGVs operating long distance routes. Both hybrid and zero emission buses are already available on the market suggesting far greater reductions in emissions (compared to the DfT forecasts) may be possible for bus vehicles in the period to 2050 if investments in the vehicle fleet are made.

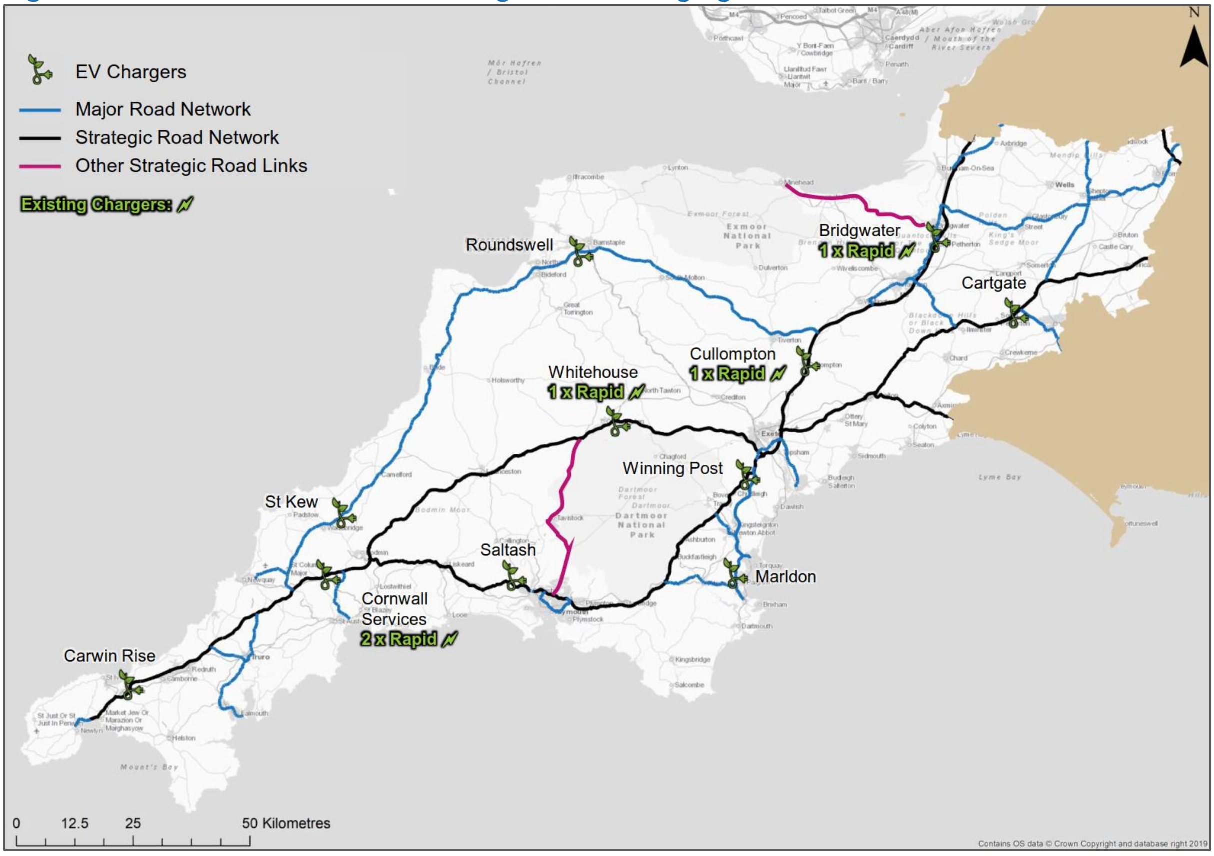
Table 4-2: Peninsula Road Traffic and Emission Forecasts

Traffic (billion vehicle kms) and CO_2e emissions by end user (millions of tonnes)	2016		2050 Reference Scenario		2050 Acceleration to Zero Emission Vehicles Scenario	
	Traffic	Emissions	Traffic (% Δ from 2016)	Emissions	Traffic (% Δ from 2016)	Emissions
Cars & LGVs	20.91	4.03	28.53 (+36%)	3.21	32.19 (+54%)	0.16
HGVs	0.97	0.85	1.00 (+2%)	0.70	1.00 (+2%)	0.70
Buses	0.17	0.13	0.15 (-8%)	0.06	0.1 (-8%)	0.06
Total	**22.05**	**5.02**	**29.68 (+35%)**	**3.97**	**33.34 (+51%)**	**0.92**

Table 4-2 shows that there is a path for overall emissions from cars and LGVs to be almost eliminated by 2050 and potentially before this. The trajectory of emissions from HGVs and buses are less certain and will depend on further developments in technology and infrastructure. The 2050 scenarios for these should therefore be treated with caution and best viewed, not as forecasts, but as setting the scale of the policy challenge posed by existing behaviours and technologies.

To provide an early indication of the scale of the electric vehicle charging network required to facilitate strategic road travel across the network the map shown in Figure 4-4 has been produced. This demonstrates that charging points at just eleven locations within the Peninsula (all existing service stations) would provide coverage of the strategic and major road network so that the driver of a private vehicle on these roads was never more than 50 kilometres from a charging point.

Figure 4-4: Illustrative Peninsula Strategic Road Charging Network



Other transport mode carbon emissions

Nationally, rail emissions represent about 1.7% of road transport emissions. Applying this percentage to the Peninsula produces a rail emissions estimate of around 85,000 tonnes of CO_2e by end user in 2016. However, all current rail operations in the Peninsula rely on diesel power and so it is likely the level of emissions are higher than this figure. Applying some simple adjustments to the national emissions estimates to reflect the lack of electric traction in the Peninsula produces a higher figure of 99,000 tonnes. Both these estimates are based on limited data and so should be treated with caution; however, they represent an indication of the order of magnitude of rail emissions compared to the 22m tonnes of emissions from road transport.

It is more difficult to estimate the aviation and maritime emissions attributable to the Peninsula using published information on transport movements and carbon emissions. A simplistic calculation produced by proportioning the number of passengers using Exeter and Newquay airports for domestic and international flights with the total number of UK passengers produces an estimate of 100,000 tonnes of CO_2e emission by end user for the two Peninsula airports. This figure is broadly comparable with the level of rail emissions, albeit the number of aviation trips departing from the Peninsula is just 5% of the rail total.

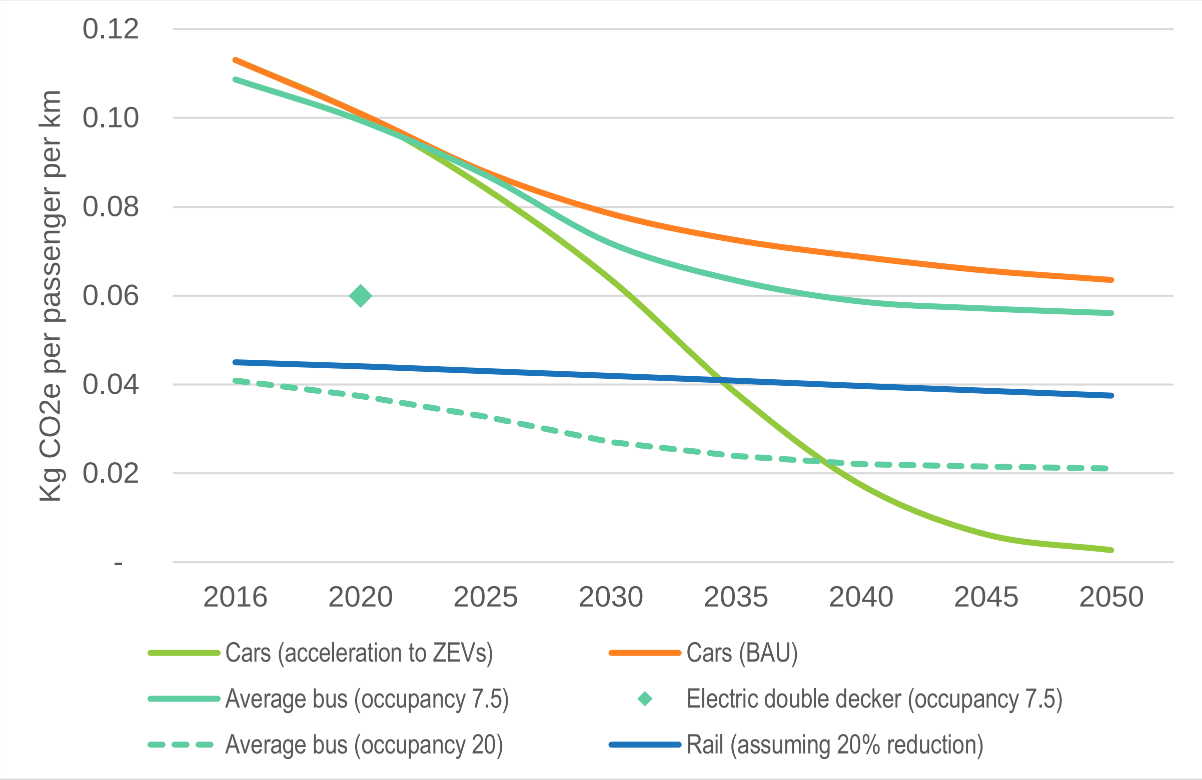
4.4 Per passenger carbon emissions

In order to understand the potential for different modes to contribute to decarbonisation it is important to look at the impact in terms of the movement of people and goods. The currently available data on freight movements by mode is too limited to make this comparison workable, but Peninsula Transport intends to undertake a Freight Study as part of the development of its transport strategy and this will help facilitate future calculations. Available data on passenger movements is more detailed and this section contains a discussion of the current and future emissions per passenger in the Peninsula.

Figure 4-5 provides estimates of emissions per passenger per kilometre for average use cases of transport modes in the Peninsula. The DfT 2018 Road Traffic Forecasts provide the core dataset and the same reference and acceleration to zero emission vehicles scenarios are presented. Data from the 2018 Government Greenhouse Gas Factors for Company Reporting have also been used to inform the bus and rail passenger figures.

Average occupancies for road modes can be derived from the primary data and therefore typically reflect the average figures provided in DfT appraisal guidance, but with some regional variations. For the current situation this means the average car has 1.6 occupants, and the average bus 7.5 occupants (this figure for the Peninsula is lower than the figure of 12.2 typically quoted as a national average).

Figure 4-5: Estimates of Emissions Per Passenger for Peninsula Transport Modes



Of the passenger modes shown, car is the worst per passenger per kilometre with emissions of 0.11 kg of CO_2e in 2016. In the reference case scenario this figure improves by 45% to 0.06 in 2050. Applying the acceleration to zero emission vehicles scenario the improvement is much greater with the average car forecast to be responsible for emissions of only 0.003 kg per passenger per kilometre in 2050. Of note is that increasing the occupancy of the average car in 2016 to four people would reduce its per passenger emission levels to be on a par with that of existing rail services.

A typical bus in the Peninsula does not currently perform much better than a car and reductions of emissions over time to 2050 are slower than those forecast for cars due to the lag in zero emissions technologies applied to heavier vehicles. However, the current figures are averaged on the existing bus fleet which includes a wide range of Euro standard engine technologies and a low average occupancy reflecting the rural nature of much of the Peninsula with a high proportion of services running with small numbers of passengers. Increasing the average occupancy of bus services to 20 people would result in a bus outperforming an average passenger rail service in terms of emissions per passenger per kilometre.

In summary, zero emission technologies provide a means of achieving very substantial levels of emissions reductions for car trips depending on the speed of uptake of vehicles in the fleet and achieving increased vehicle occupancy rates. This takes no account of wider emissions associated with the production of these vehicles, which are not quantified here but are assumed to be substantial.

4.5 Decarbonisation - summary

Transport sector emissions now represent the largest proportion of the UK's emissions profile and the transport sector has made limited progress in reducing emissions over the past thirty years.

In the Peninsula it is estimated that current road emissions are five million tonnes of CO_2e per annum and that these are by far the biggest source of transport emissions in the region. A fast transition to zero emission cars and LGVs would reduce total emissions substantially but requires national policy and market interventions which are not within the direct control of Peninsula Transport or the local highway authorities.

Rail travel already provides a low carbon option for passenger journeys in the Peninsula. Bus travel is not necessarily a low polluting option here because of the need to connect people in rural locations away from major population centres. However, if low emission vehicles are used and high occupancy rates achieved then bus travel can be cleaner than current rail services on a per passenger basis.

Peninsula Transport will have an important role in encouraging behaviour change to reduce the emissions from transport in the Peninsula through the development of its transport strategy. It will also consider how best to develop and plan infrastructure investment so that the transport network is ready for zero emission vehicles and other changes which technology will enable.

Peninsula Transport represents all of the local highway authorities in the region and therefore has direct influence over the strategy for the future operation of local road infrastructure (including the major road network). As road emissions are the biggest contributor to transport emissions in the Peninsula, focussing efforts here will be critical in transitioning towards a zero carbon transport system. Collaboration with Highways England, as managers of the strategic road network, will be important to ensure a co-ordinated approach to the decarbonisation of the highway network.

Through the work of the Peninsula Rail Task Force (PRTF) the STB also has a good understanding of the role rail can play in reducing emissions. Switching trips from car to rail is the biggest opportunity here as rolling stock efficiency improvements will take longer to achieve and require planning and co-ordination with rail operating companies and Network Rail. Opportunities like discrete electrification for parts of the network are being discussed and could also help reduce rail emissions; making use of the bi-mode trains which are part of the Great Western Railway fleet.

Improvements in the efficiency of road vehicles is something largely outside the control of Peninsula Transport; however, the STB does have a role to play in ensuring road infrastructure in the Peninsula is equipped to enable zero emission vehicles to travel within the region. Here the focus will be principally on strategic intra-regional and inter-regional travel and co-ordinating across local authorities to support the development of charging and refuelling infrastructure plans at a local level.

5. How People Live

Flexible Lifestyles

Chapter Overview

Transport demand stems from the size of the population and the activities that people want to undertake. Lifestyles and activity patterns are changing. In the labour market, the gender balance and the occupational mix are shifting, and more people are adopting flexible working practices. Leisure activities are also changing. In this section, we examine how lifestyles in the Peninsula compare to the UK average, how lifestyles are evolving, and what this might mean for the future of transport in the Peninsula.

5.1 Introduction

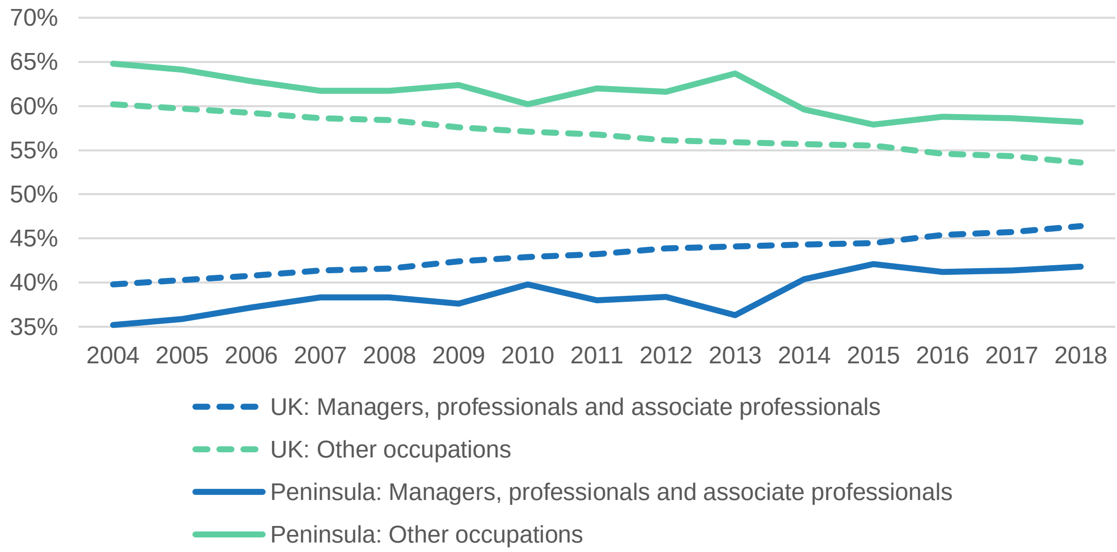
In this section, 'lifestyle' is used as shorthand for a complex set of activities related to work, family, leisure and culture. These are multifaceted and interrelated so it is difficult to distinguish the root causes of changes in lifestyles or to be confident of how they will develop over the coming decades. However, there are some clear recent trends which give us clues about how people might live in the Peninsula in future. This chapter concentrates on activities that drive transport behaviour such as working patterns, shopping and leisure.

5.2 The influence of work

Occupational change

Changes in the economy are causing a steady shift in how people earn their living. Across the UK, there has been a long term shift towards professional / managerial jobs within the service sector. This trend is also clearly seen in the Peninsula, although survey samples are smaller and the data is a little less reliable. Figure 5-1 shows data from the Annual Population Survey which shows how these trends are unfolding. The share of people in managerial, professional and associate professional and technical occupations has steadily grown.

Figure 5-1: Share of employment by occupation



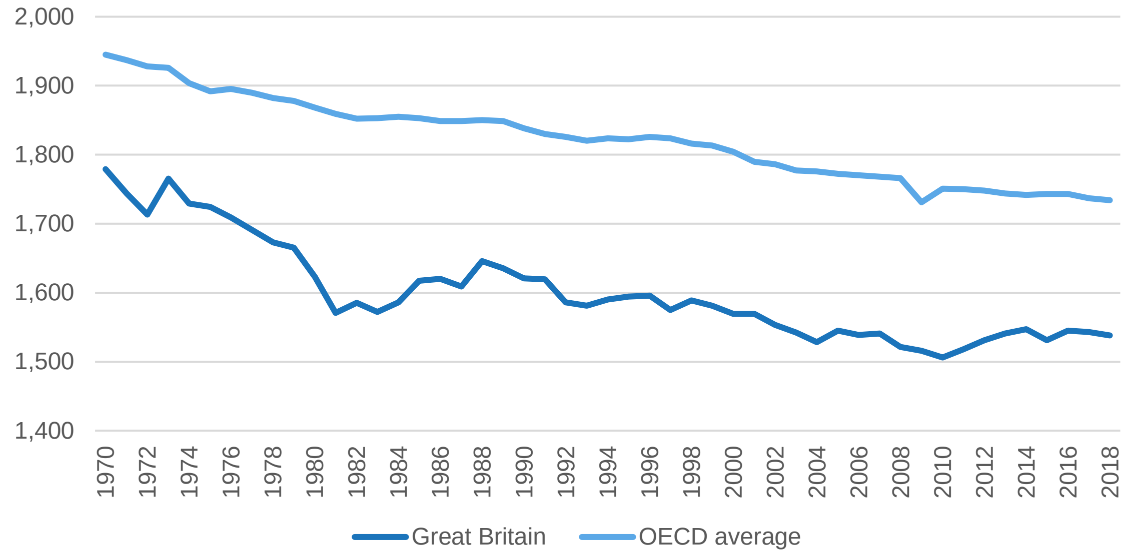
Source: Annual Population Survey

In the the fourteen year period from 2004 and 2018 the share of people in these occupations grew from 35% to 41% in the Peninsula and the overall number of people in these occupations grew by around 120,000 while the number of jobs in other occupations grew by only around 10,000 and the share declined. This mirrors a national trend. During the same period, the national share of managerial, professional and associate technical and professional occupations grew from 40% to 46%. If this trend continues, an increasing share of people in the Peninsula will work in these occupations.

Working hours

Another important way that work is affecting lifestyles can be seen in the number of hours worked. The average number of hours worked is steadily declining. This is a very long term trend dating back to the industrial revolution[10] and is common to most countries.

Figure 5-2: Average hours worked per year per person in employment[11]



Source: OECD

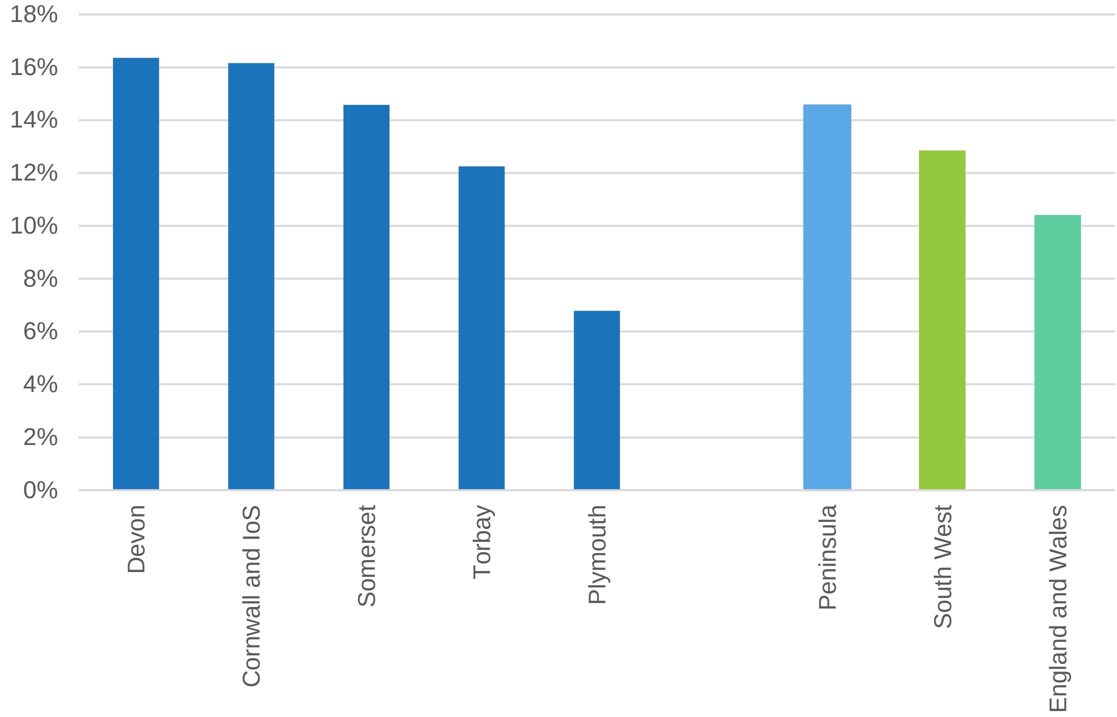
There appear to be several factors contributing to this trend[12]. In part this is due to a change in the share of part time workers, a change in the gender balance and adoption of more flexible working hours and working arrangements. However, these factors do not explain all of the changes, and one of the contributing factors is a simple reduction in hours worked even amongst full time workers[13].

Place of work

As employment patterns change, the number of people working from home is also rising quickly, and the Peninsula has a higher than average share of such people. Overall, around 150,000 people work at or mainly from home in the Peninsula. This is almost 15% of employed people, and compares to only around 10% in England and Wales as a whole.

[10] Boppart, T. and Krusell, P., How much we work: The past, the present, and the future, 2016. [https://voxeu.org/article/how-much-we-work-past-present-and-future accessed 03/01/2020]
[11] Average annual hours worked is defined as the total number of hours actually worked per year divided by the average number of people in employment per year. Actual hours worked include regular work hours of full-time, part-time and part-year workers, paid and unpaid overtime, hours worked in additional jobs, and exclude time not worked because of public holidays, annual paid leave, own illness, injury and temporary disability, maternity leave, parental leave, schooling or training, slack work for technical or economic reasons, strike or labour dispute, bad weather, compensation leave and other reasons. The data cover employees and self-employed workers.
[12] Faggio, G., Nickell, S. "Patterns of work across the OECD." Economic Journal 117:521 (2007): F416−F440.
[13] There is evidence that people choose to work fewer hours as productivity and incomes rise. This can be seen, for example, in international analysis of average hours worked by full time workers. Reasons for this are complex and could also include, for example, the role played by trade unions and labour laws. Finally, this is not a universal trend and there is some evidence, at least in the USA, that working time is becoming increasingly polarised with working hours growing for those on high incomes and reducing for people on lower incomes in part due to changes in part-time and zero hours contracts.

Figure 5-3: Share of people working from home, 2011
"Do you work mainly at or from home?"



Source: Census 2011

The excess of home workers is in all age groups and all occupations. By occupation, it is particularly concentrated in managers, directors and senior officials and in skilled trade occupations, and by age it is particularly common in the Peninsula amongst older workers.

Table 5-1 shows how many additional people work from home in the Peninsula compared to if the Peninsula exhibited the average working patterns seen in England and Wales. Overall, the table shows that around 43,000 more people work from home than we might expect if the Peninsula was 'average'. The columns show the breakdown by occupation. Of the overall excess of home workers, around 19,000 of them are in the skilled trades and occupations and another 11,000 are managers, directors and senior officials. Together, these make up around 70% of the excess home workers in the Peninsula. Home working is more prevalent in less urbanised areas. This effect can be seen in Plymouth and to a certain extent in Torbay. However, a range of other factors also drive the prevalence of home working and these are not fully understood.

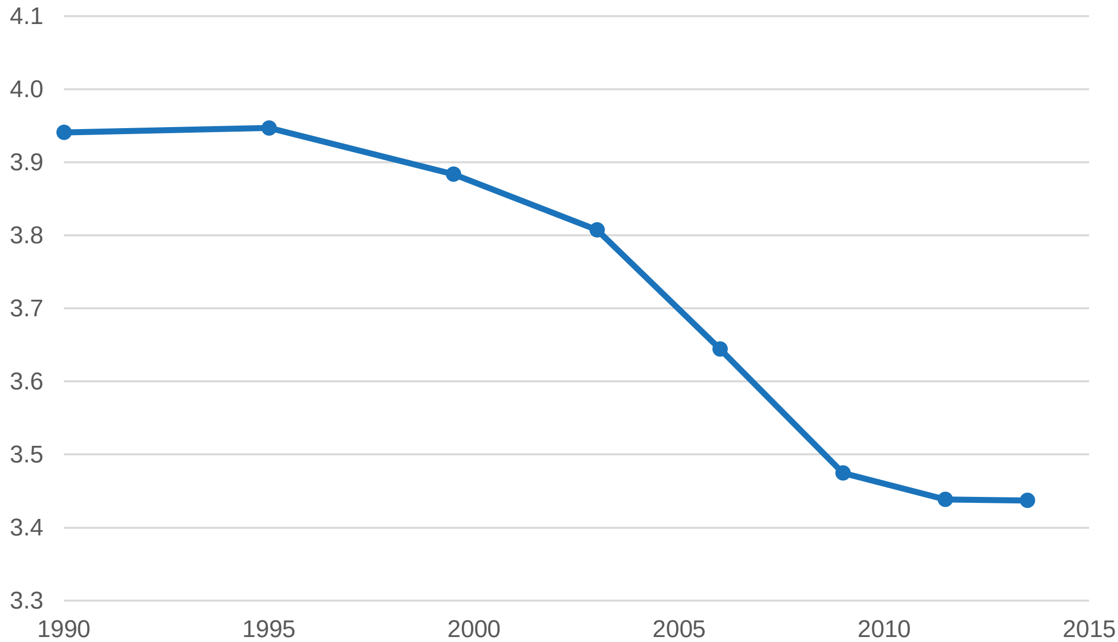
Table 5-1: Additional Peninsula home workers compared to if the Peninsula had the England and Wales average pattern of home working

	Managers, directors and senior officials	Professional occupations	Associate professional and technical occupations	Administrative and secretarial occupations	Skilled trades occupations	Caring, leisure and other service occupations	Sales and customer service occupations	Process, plant and machine operatives	Elementary occupations	**All occupation**
Age 16 to 24	159	-54	400	-40	908	134	28	58	801	**2,393**
Age 25 to 34	133	-722	-569	-123	1,393	-51	-93	-16	355	**307**
Age 35 to 49	2,296	-177	416	678	5,368	188	4	100	596	**9,470**
Age 50 to 64	6,064	1,975	2,233	1,447	7,899	663	402	645	971	**22,300**
Age 65 and over	1,898	649	743	559	3,672	199	163	234	489	**8,606**
All age groups	**10,549**	**1,671**	**3,224**	**2,521**	**19,240**	**1,133**	**504**	**1,020**	**3,213**	**43,076**

Source: Connected Economics analysis of data from Census 2001

Data from the National Travel Survey shows that the average number of days that people commute has been shrinking. Some interpretation of the survey data is required to derive averages, but based on reasonable assumptions, the average number of days that a full time worker commutes to a workplace has shrunk from a little under 4 days per week to a little under 3½ days a week over a period of approximately 25 years from 1990 to around 2015.

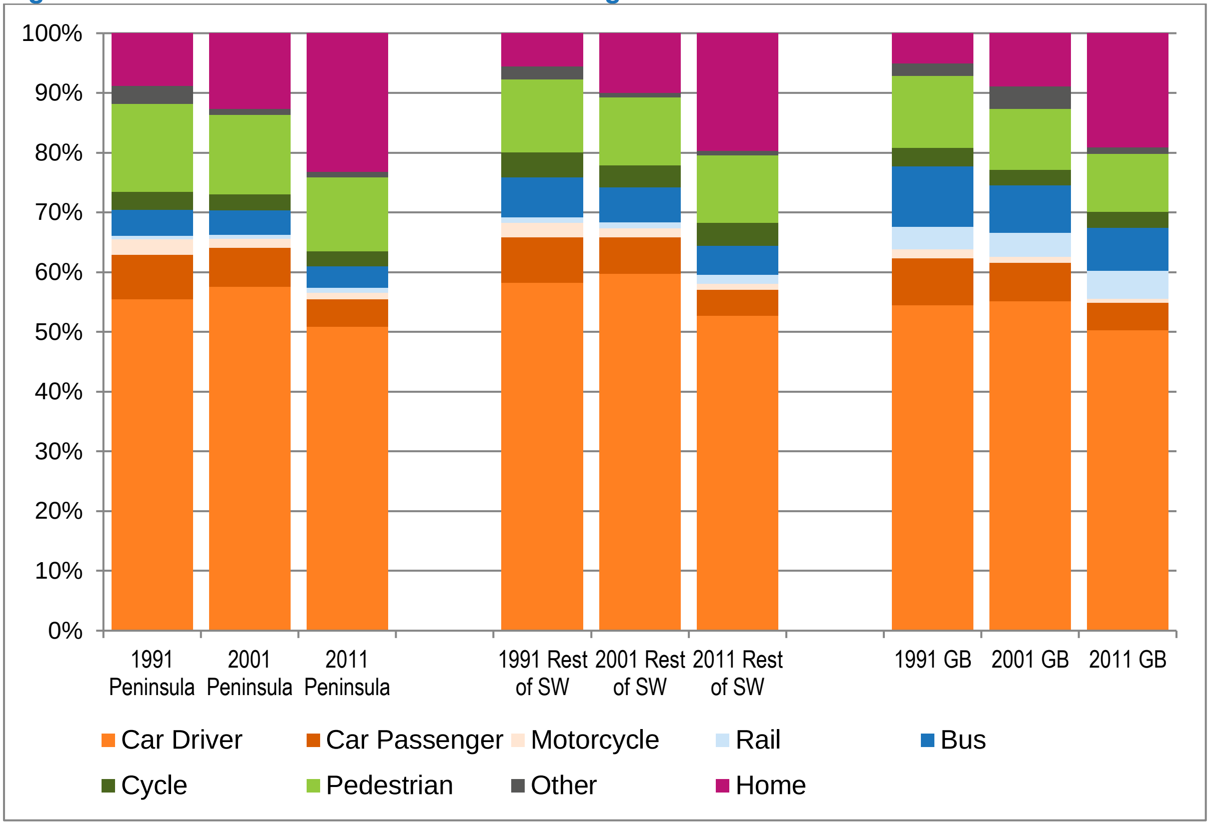
Figure 5-4: Average number of days that people work from an employer workplace, UK



Source: Connected Economics analysis of National Travel Survey data

The growth in home working is common across the Peninsula, the wider South West and across Great Britain more broadly. However, home working has long been more common in the Peninsula than elsewhere and it is growing faster here.

Figure 5-5: Method of travel to work and working from home over time



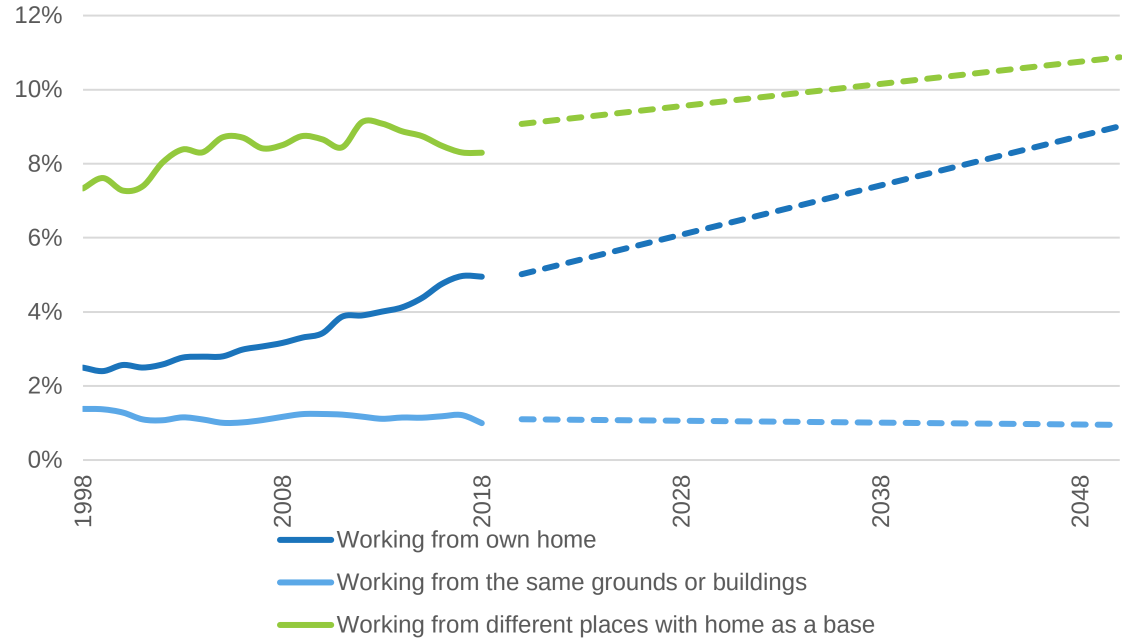
Source: Census data

Data from 1991, 2001 and 2011 shows that homeworking has grown consistently across all the places in the chart, and in both of the decades shown. While the questions asked and definitions used in the Census differ from that in the National Travel Survey, both show a pattern of significantly higher levels of home working in the Peninsula compared to the GB average.

Together, these data show that: people in work are working from home more frequently; the share of people who consistently work from home is increasing; the Peninsula has a very high share of home workers; and the share in the Peninsula is rising particularly quickly. Growth in home working has happened alongside growth in the Peninsula population. It may be that the expansion of consistent and available broadband has enabled home working and contributed to making the Peninsula a more attractive place to live. If this was true, then continued development of supportive homeworking infrastructure could be an important driver of future population growth in the Peninsula, particularly among managers and senior officials in somewhat older and higher earning cohorts. This would benefit from additional research.

We do not know whether these trends will flatten, continue or accelerate and this will likely depend on continuing developments in technology, roll out of improved broadband as well as changes in company cultures and practices. Technology has already enabled some surprising tasks to be undertaken remotely such as operation of machinery and equipment. Telemedicine could substantially chance how health care expertise is delivered. If trends do continue, they could have very significant impacts on travel patterns. In Figure 5-6 below, we show patterns of home working from the Labour Force Survey for the UK. Again, definitions are slightly different, but the trend is clear. The advantage of the Labour Force Survey is that data is available over a long period. We have extrapolated historic twenty year trends for the UK forward for another thirty years.

Figure 5-6: Share of people working from home, UK
"In your main job, do you work mainly from your own home, from the same grounds and buildings as your home, or from different places with home as a base?"



Source: Labour Force Survey

This shows that, if these trends continue, around 9% of UK workers could be working from their own home by 2050, and another 11% could be working from different places with home as a base. Of course, people in the Peninsula already have a much higher propensity to work from home than the UK averages shown in the chart. With around 40% more home working in the Peninsula than the England and Wales average, these numbers could be much larger locally.

Meanwhile, the flexibility of work has increased. Increasing numbers of people are able to negotiate their hours with employers and task based work via digital platforms (the 'gig economy') continues to grow quickly. The Department for Business, Energy and Industrial Strategy estimated that around 4.4% of people (2.8 million people) had worked in the gig economy in 2017[14] and other work by the University of Hertfordshire showed that gig economy workers more than doubled between January 2016 and mid-2019[15].

5.3 Leisure and shopping

The decline in average working hours over the last thirty years means that the average worker has an additional two hours per week in which to do other things. However, there is little evidence that people are using their growing incomes and leisure time to undertake additional leisure trips or other activities. The average number of trips we make to visit friends or undertake personal business have both been relatively static for the last 15 years[16]. Although people regularly talk of more complex lives, there is little evidence either of higher trip rates or of more 'trip chaining' where people undertake multiple activities in different places on a single trip out of the house[17].

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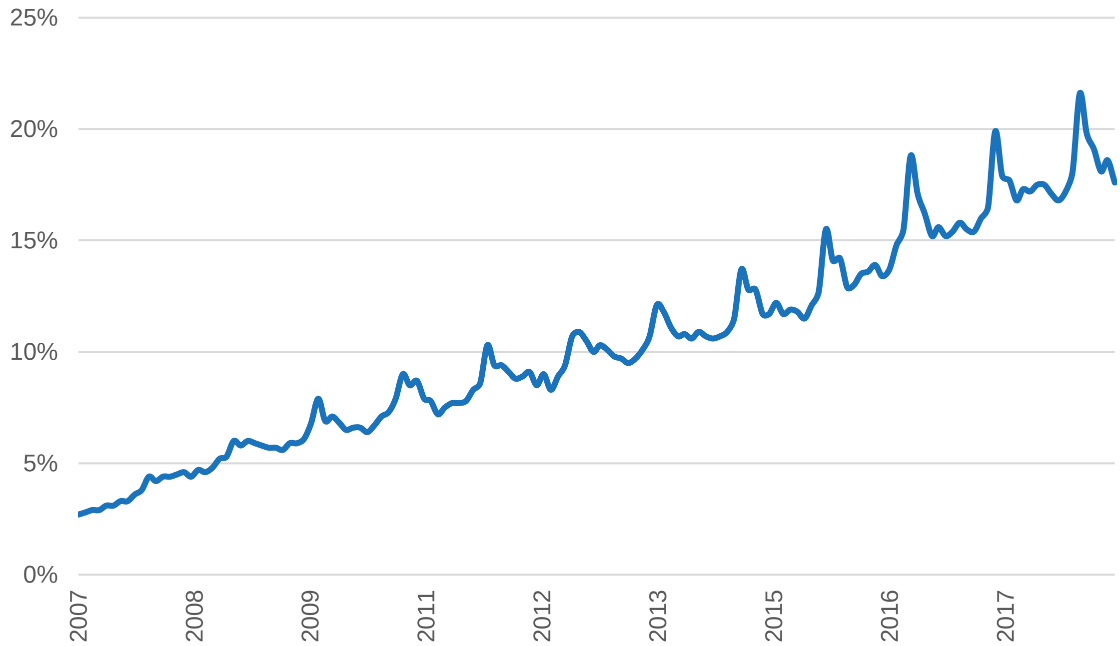
[14] The characteristics of those in the gig economy, Final report, February 2018 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/687553/The_characteristics_of_those_in_the_gig_economy.pdf accessed 06/02/2020]
[15] Platform work in the UK, University of Hertfordshire [https://www.feps-europe.eu/attachments/publications/platform%20work%20in%20the%20uk%202016-2019%20v3-converted.pdf accessed on 06/20/2020]
[16] National Travel Survey 2018 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/823068/national-travel-survey-2018.pdf accessed on 06/01/2020]
[17] National Travel Survey 2014 special analysis [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/509447/nts-trip-chaining.pdf accessed 06/01/2020]

The average number of shopping trips we make declined steadily from 2002 to 2014 but now appears to have stabilised at around 750 per year on average. The figure below shows the inexorable rise of online shopping in Great Britain.

Figure 5-7: Share of retail expenditure through online shopping, Great Britain



Source: UK Retail Sales Index

Online shopping now accounts for around 20% of retail expenditure. However, the impacts on trip making are complex. Delivery trips are rising quickly to fulfil final mile deliveries and the types of shopping trips and destinations are likely to be changing. The most common type of 'gig economy' role is courier/delivery driver. It is not clear how these trends will play out in future, although there are no signs yet of saturation in overall levels of online shopping.

Shopping trips are also strongly related to age with older cohorts making more shopping trips. An ageing population suggests that more active older people will make additional shopping and leisure trips in the Peninsula over the coming decades.

5.4 Transport implications of flexible lifestyles

We have attempted to codify some of these trends and examine their impacts using the Peninsula Area Model (PAM)[18]. Many of the trends identified are already captured within the PAM. For example, population growth rate trends over recent years will be extrapolated into the future, along with future age structures.

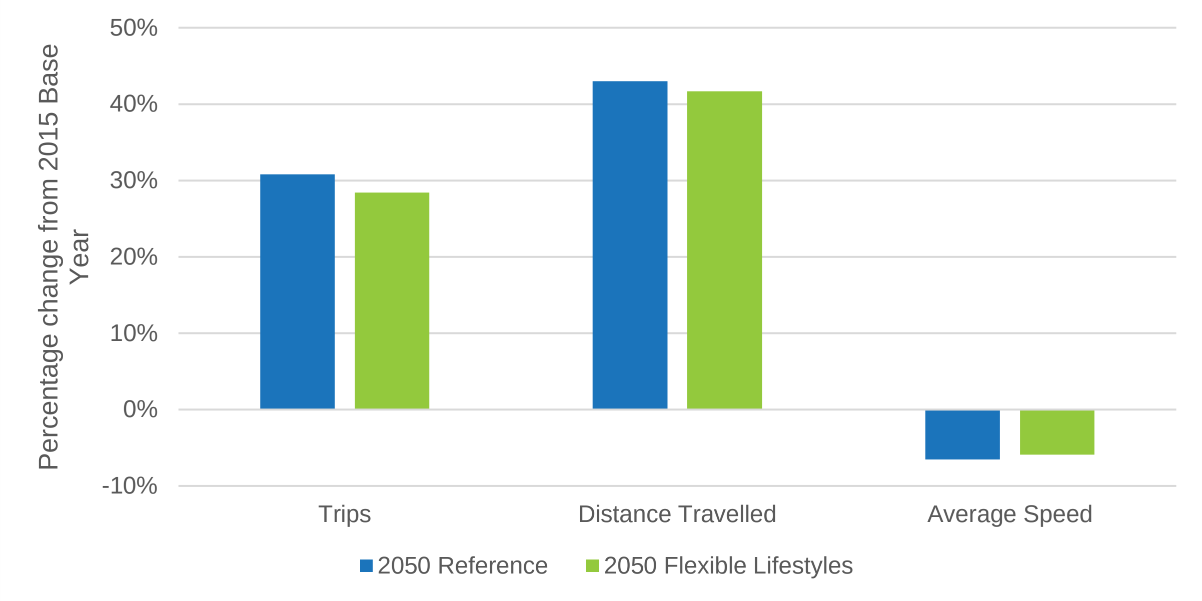
One important exception is that the PAM does not capture future trends in working from home. These are likely to reduce peak time commuting, but to have other effects as home workers make other trips. Likewise, changing patterns of employment represented by the gig economy are likely to affect future work related travel patterns. Unfortunately, we are not aware of any research into the travel patterns of people working in the gig economy and evidence for travel behaviour of homeworkers is likewise scant. There is therefore little evidence to support changes in trip rates except relating to formal commuting. We have applied a 10% reduction in commuting trip rates compared to the reference

[18] The Peninsula Area Model (PAM) is a development of the South West Regional Traffic Model (SWRTM) provided to Peninsula Transport by Highways England. In accordance with the terms of our arrangement with Highways England is should be noted that outputs from the PAM do not reflect the views of Highways England or the outputs of the SWRTM. Forecast transport demand within the PAM has been produced using standard TEMPro forecasts modified as discussed within each chapter to represent test scenarios.

PAM figures in 2050 to measure the possible quantum of change to highway travel demand and journey times for this aspect of the trend towards more flexible lifestyles.

Figure 5-8 presents outputs from the PAM providing a comparison between the 2050 reference case and 2050 with a 10% reduction in commuting trips. The figure presents percentage change compared with a 2015 base year for weekday (0700 – 1900) trip numbers, distance travelled (vehicle kilometres) and average speeds.

Figure 5-8: Forecast Impact of Commuting Reduction on Highway Travel in 2050



The first observation from looking at the outputs is that the reference forecast is expected to result in a 31% increase in trips by 2050. The equivalent growth in vehicle kilometres is 43%. This reflects the substantial population growth which is likely to occur in the Peninsula over this period as well as a continuing trend of longer average road journeys over time. The increased vehicle kilometres on the network is increased journey time equating to a 7% reduction in average speeds.

The impact of the 10% reduction in commuting is reflected in a small reduction in trips compared with the reference scenario (28% higher than the 2015 base year), an even smaller reduction in distance travelled and a small increase in average speed (but still 6% lower than the 2015 base). Whilst there is therefore a small benefit in terms of journey times from the application of the flexible lifestyles trend, the model responds to the reduction in trips by increasing average trip lengths compared with the reference scenario so that some of that potential benefit is lost.

In summary, there are positive implications for travel arising from the adoption of more flexible lifestyles and the changes in travel patterns which result; however, on their own these are unlikely to result in substantial reductions in the demand for highway space.

5.5 Flexible lifestyles - summary

Trends in flexible working and home working affect the Peninsula more than most places. These trends present an opportunity to reduce peak congestion. However, there is currently little data and only a weak understanding of travel patterns of non-traditional commuters. Peninsula Transport can play an important role in helping to better understand these trends which are common to areas across the Peninsula. It can also help to coordinate policy across the Peninsula to encourage the reduction of traditional peak period commuting. Testing the impact of reduced commuting in the PAM has identified possible benefits, but these are small scale and the limited understanding of the trips people make when working from home means they should not be taken for granted.

Online shopping has widened the range of available goods and services available to Peninsula residents. Modern delivery systems can often fulfil these needs on the same or the next day. For many residents, particularly younger groups, this level of service is now expected. However, a consequence has been the rapid increase in couriers and small vans making last mile deliveries.

The impact of this, and other freight traffic patterns on the performance of the Peninsula's transport network is not well understood. Before developing a transport strategy, it is important that the Peninsula develops a clearer understanding of the nature, level and outlook for different types of freight traffic.

Different solutions to the last mile delivery challenge are being investigated (such as droids, van/drone-integrated delivery systems, smart door locks, etc.) and it is not clear how these will develop. This is a complex market where Peninsula Transport's role may be limited. However, we recommend that Peninsula keeps a watching brief on emerging last mile delivery innovations and ensures that transport policies in the Peninsula are supportive of these innovations where they have the opportunity to reduce congestion from last mile deliveries without compromising environmental quality. This may mean, for example, working to ensure that planning policy does not obstruct vehicle use on pavements or the development of local delivery micro-hubs.

6. The Economy & Employment

The World of Work

Chapter Overview

The economy depends on high quality and efficient transport, and transport demand is driven by economic activity. Over the last 30 years, the Peninsula economy has transformed and restructured, outpacing employment growth in the UK as a whole. In this chapter, we examine the Peninsula economy, how the Peninsula might earn its living in future and what this means for transport.

This section briefly describes key features of the Peninsula economy. Much information already exists in the existing Local Enterprise Partnership Economic Strategies and other documents, including:

- HotSW LEP's Strategic Economic Plan and Productivity Strategy and CIoS LEP's Vision 2030;
- Emerging Local Industrial Strategies and the evidence bases underpinning them; and
- Local Development Plans.

The purpose of this chapter is to describe the critical aspects of the region's economy and its anticipated growth insofar as it affects strategic regional connectivity. We concentrate on relatively long timescales consistent with infrastructure planning.

To begin with, we examine the current spatial patterns of employment and output across the Peninsula and historic growth trends.

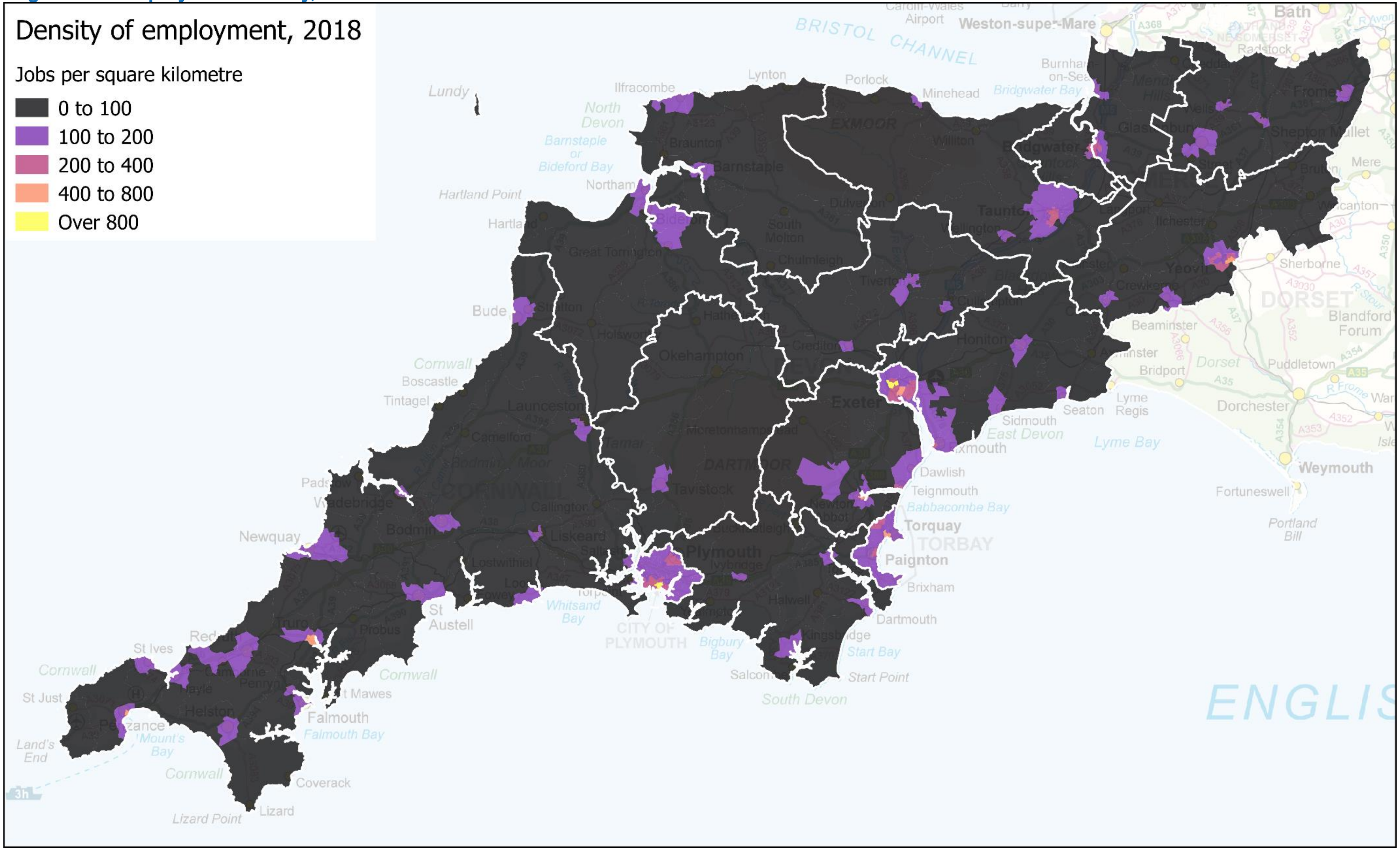
6.1 Overview of the spatial economy

The Peninsula is host to around one million jobs and covers an area of over 13,700 square kilometres. Within this large area, employment is heavily clustered in:

- The cities of Exeter, Plymouth and Truro and in Torbay;
- Along the M5 corridor in the towns of Taunton, Bridgwater and Burnham-on-Sea;
- In a dispersed pattern of settlements across Devon and Somerset including Glastonbury, Yeovil, Honiton and other towns;
- In relatively isolated settlements on the north coast of Devon and Somerset such as Ilfracombe and Minehead; and
- Across towns in Cornwall that are geographically spread along the coast and estuaries including, Falmouth, Camborne, Newquay and others.

The rest of the Peninsula is mainly rural in character or comprised of national parks and areas of outstanding natural beauty, providing a very high quality natural environment.

Figure 6-1: Employment density, 2018

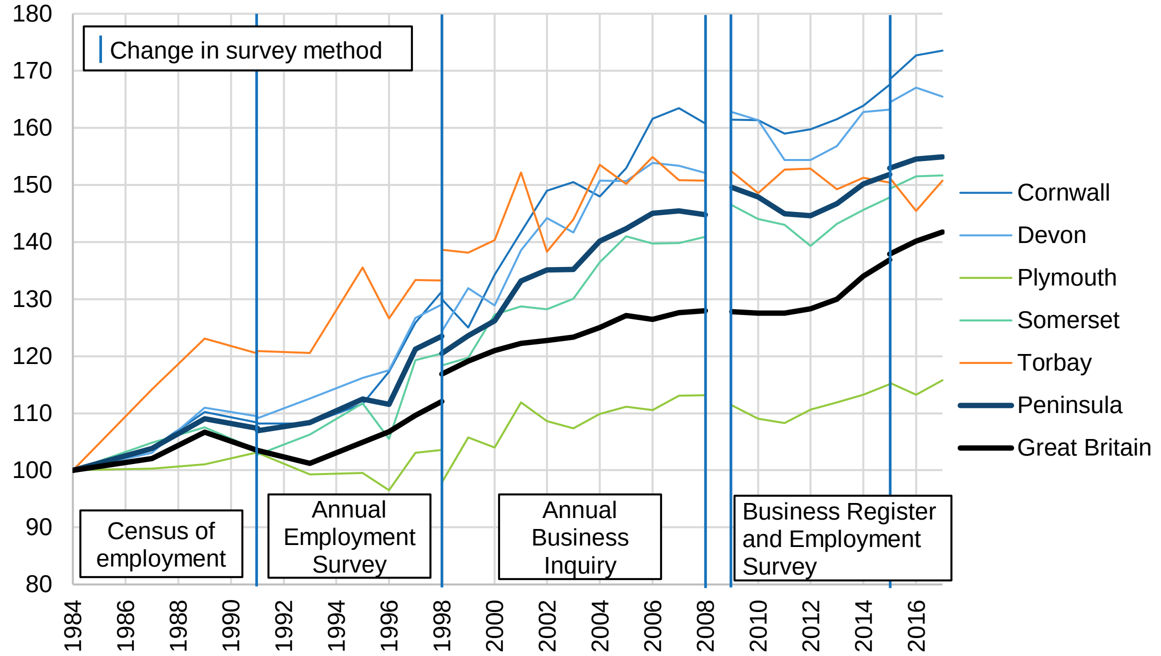


Source: Data from the Inter Departmental Business Register and Business Register and Employment Survey

Devon is the largest economy in the Peninsula hosting around 320,000 jobs, of which around 90,000 are in Exeter. Somerset and Cornwall are similar in economic size with Somerset hosting around 230,000 jobs and Cornwall 210,000. There are around 110,000 jobs in Plymouth and 50,000 in Torbay.

To better understand how the economy has evolved, we have examined the recent economic history of the Peninsula and its sub-regions. Figure 6-2 shows how employment has changed over approximately the last 35 years, and compares this to the UK average.

Figure 6-2: Index of employment, 1984 = 100



Source: Various Employment Surveys as shown

The earliest available local employment data is for 1984. This provides a 36 year period across which longer term trends in employment can be studied[19]. The most striking feature is the scale of change. The number of jobs has grown by more than half this period. Across the Peninsula, 590,000 jobs in 1984 grew to 920,000 in 2017, an increase of 55%. Despite various changes in survey methods and data definitions, it is clear that employment in the Peninsula has grown substantially faster than across Great Britain as a whole. Indeed, if employment in across the country had grown at the same rate as the Peninsula, there would be around 2.4 million additional jobs in Great Britain. The Peninsula performed particularly strongly through to 2006 when it had grown by 45% from 1984 compared to only 26% for the UK as a whole. However, the UK has subsequently begun to catch up and closed approximately half of this gap.

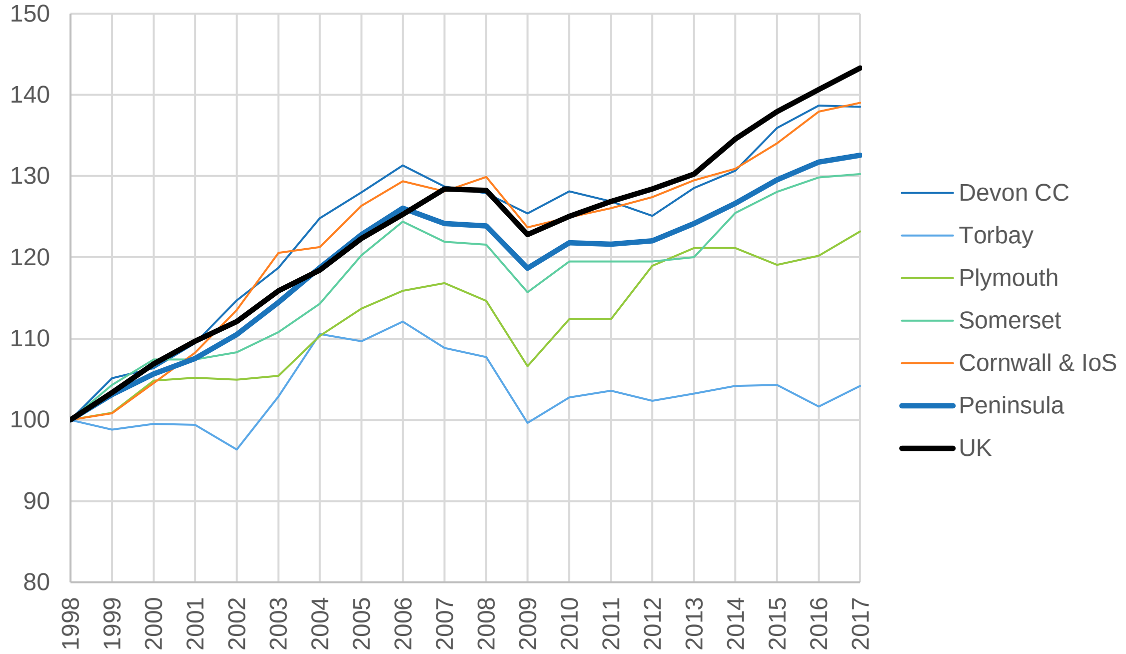
At a local level, employment performance across the Peninsula has been mixed. Through the mid-1980s and early 1990s, Torbay saw very rapid employment growth while Cornwall and Devon grew strongly through the early 2000s. Overall Cornwall and Devon have significantly outperformed the UK and Peninsula in terms of employment growth. Plymouth is notable for its relatively weak employment performance compared to other parts of the Peninsula, growing employment by 16% since 1984, compared to 55% for the Peninsula as a whole.

The economic output of the region is best represented by Gross Value Added (GVA). This reflects the value of the goods and services sold by businesses in the region minus the cost of the inputs that they use to make them.

[19] Survey methods have changed substantially which makes comparisons over time difficult. In particular, the switch from the Annual Employment Survey to the Annual Business Inquiry in 1998 caused a large upward revision in the number of employees in Great Britain. This was largely due to reporting inaccuracies with the AES where, for example, employers were sent pre-printed forms for each site but changes were often missed when sites were closed or new sites were opened.

Overall, the economic output of the Peninsula was £44bn in 2017 measured in 2016 prices. The largest economy is Devon County Council which makes up 37% of the Peninsula's economic output. Torbay is the smallest with an economy worth a little over £2bn and making up around 5% of the Peninsula's economy.

Figure 6-3: Growth in Gross Value Added, chained volume measures, 2016 prices, 1998 = 100



Source: ONS Sub-regional GVA data

The GVA performance of the region has been mixed over the last 20 years for which data is available. The Peninsula kept pace with the UK as a whole until around 2006 but saw considerably worse performance from 2006 to 2007. In this year at the start of the recession, the real value of the Peninsula economy shrank by 1.5% while the UK economy grew by 2.5%. Between 1998 and 2006 the Peninsula's economic output kept pace with the UK economy, but faltered earlier and was hit harder by the recession in 2007 and 2008. The Peninsula did not recover from this year of poor performance and saw further relative decline from 2010 onwards. Over 20 years then, the Peninsula economy grew by 33% compared to 43% in the UK as a whole.

Local GVA data must be treated with caution. In some cases, it is difficult to geographically pinpoint how much value firms generate in different locations, particularly where they operate across multiple sites such as headquarters, production sites, retail premises or call centres. The data is drawn from company accounts and to some extent will be biased towards where a company reports it activities.

The earliest available data is from 1998 and the latest data available is for 2017. It does not cover the period from 1984 to 1998 where employment data shows that the Peninsula saw rapid growth compared to the UK average. Taking a longer view, it therefore appears that the Peninsula economy has grown at a broadly similar rate to the UK economy as a whole.

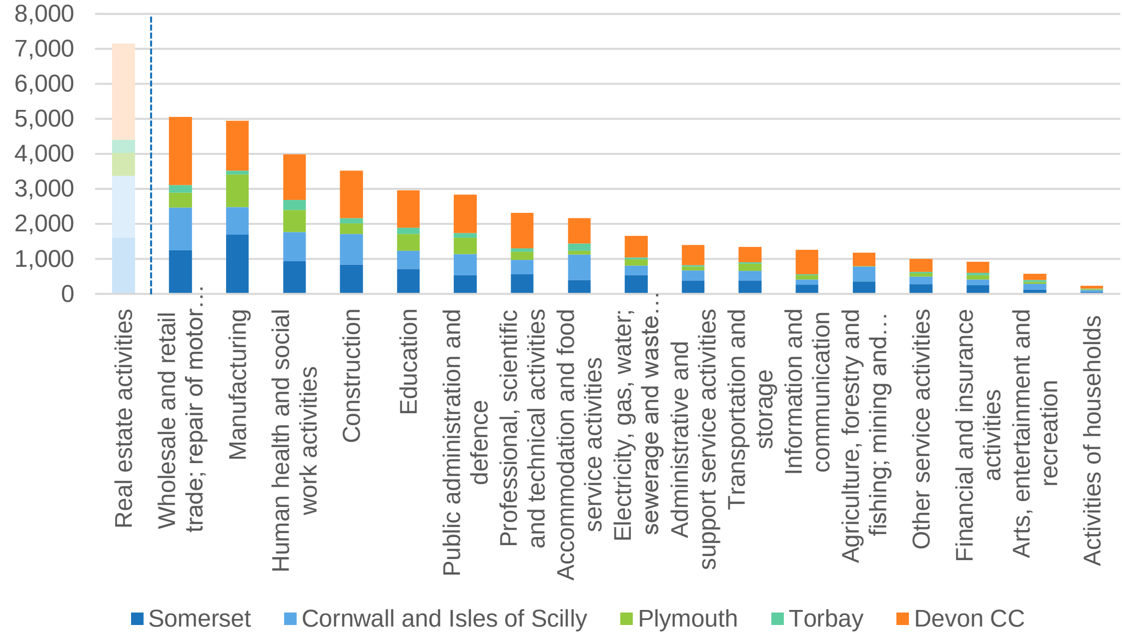
Performance is more volatile at a local level, particularly in the relatively smaller economies of Torbay and Plymouth. Figure 6-3 shows that Devon and Cornwall grew strongly on the early 2000s while Plymouth saw a period of strong relative growth from 2009 to 2013 before slipping back in the years since. Overall, the main conclusion is that the data is highly variable, particularly at the local level. There is little coherent spatial pattern to geographic economic performance, at least on the basis of overall economic output.

It is tempting to pick data for particular years to support different hypotheses. For example, Plymouth's economy grew by 15% between 2009 and 2017 – faster than any of the other areas in the Peninsula, although this masks worse performance in the years before 2009. Rather than attempt to draw firm conclusions about future trends from these mixed patterns, we consider it more prudent to conclude that future performance is likely to be spatially varied but difficult to predict, particularly over relatively long timescales. Certainly, an attempt to use economic performance between 1998 and 2008 to predict growth patterns over the next ten years would have resulted in incorrect predictions.

6.2 Sectors, specialisation and structural change

Looking across all industries (defined broadly), we have identified the sectors of the economy in which the Peninsula generates the largest output. This is shown in Figure 6-4. Overall, when segmented into sections of the 2007 Standard Industrial Classifications, the largest part of the Peninsula economy is wholesale and retail[20] generating £5,061m of output in 2017, followed by manufacturing which generates very similar levels of economic output (£4,942m in 2017). The smallest business sectors were the 'activities of households' (mainly household employment of domestic staff) and 'arts, entertainment and recreation' (including for example theatres, libraries, museums and sporting activities).

Figure 6-4: Economic output by business sector, 2016, 2016 prices



Source: ONS subregional accounts

The overall output by sector shows, at an aggregate level, the types of economic activity that the Peninsula engages in. However, these patterns are relatively similar across the country. The Peninsula's specialisms are defined by how it differs from the UK as a whole.

Table 6-1 shows the relative intensity of economic activity in different sectors compared to the UK average. This is known as a 'location quotient'. In the Peninsula as a whole, the construction sector accounts for 7.9% of economic output, while in the UK as a while it accounts for 6.3%. The Peninsula is therefore more specialised towards the construction sector with a location quotient of 1.3 (=7.9% ÷ 6.3%). The table shows that the Peninsula overall is specialised in agriculture, manufacturing, utilities, construction, wholesale and retail, accommodation and food services (much of it reflecting tourism activities), public administration and defence, education, health and social work, other service activities and activities of households. It is under-represented compared to the UK average in transport and storage, ICT, finance and insurance, professional services, administrative and support activities, and arts and entertainment.

[20] Technically, the largest sector is 'real estate activities' generating £7,144m. However, almost all of this reflects the value that homeowners derive from living in their own properties. Rented property is traded on a market and captured within the GVA figures. The services derived from owned properties must therefore also be imputed and included in the GVA figures so that GVA does not change when the balance of renting and homeownership changes. From a policy perspective, there is little that can be done to change the flow of services derived from the housing stock, so we have set this aside when discussing policy implications.

Table 6-1: Regional specialisation, gross value added location quotients compared to UK average, 2016

	Agriculture, forestry and fishing; mining and quarrying	Manufacturing	Electricity, gas, water; sewerage and waste management	Construction	Wholesale and retail trade; repair of motor vehicles	Transportation and storage	Accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities	Administrative and support service activities	Public administration and defence	Education	Human health and social work activities	Arts, entertainment and recreation	Other service activities	Activities of households	All industries
Somerset	1.9	1.5	1.8	1.2	1.1	0.8	1.2	0.4	0.3	1.1	0.7	0.7	1.0	1.1	1.2	0.8	1.2	1.3	1.0
Cornwall and Isles of Scilly	2.6	0.8	1.0	1.4	1.2	0.6	2.5	0.2	0.2	1.3	0.5	0.6	1.3	0.9	1.2	1.1	1.0	1.7	1.0
Plymouth	0.1	1.8	1.3	0.9	0.8	1.0	0.8	0.4	0.3	0.9	0.6	0.5	2.0	1.6	1.6	0.8	0.9	1.2	1.0
Torbay	0.3	0.5	0.9	1.1	1.0	0.4	3.3	0.2	0.4	1.3	0.6	0.4	1.3	1.4	1.9	1.9	0.8	2.0	1.0
Devon CC	1.4	0.9	1.4	1.3	1.1	0.6	1.5	0.6	0.3	1.2	0.8	0.7	1.5	1.1	1.1	0.7	1.1	1.3	1.0
Peninsula	**1.6**	**1.1**	**1.4**	**1.3**	**1.1**	**0.7**	**1.6**	**0.4**	**0.3**	**1.2**	**0.7**	**0.6**	**1.4**	**1.1**	**1.2**	**0.9**	**1.1**	**1.4**	**1.0**

Key

Highly specialised	2.00 +
Somewhat specialised	1.25 - 2.0
Unspecialised	0.80 – 1.20
Somewhat underrepresented	0.50 – 0.80
Highly underrepresented	0 – 0.50

Source: Connected Economics analysis of national statistics regional GVA data

The greatest areas of under-representation are information and communication, and financial and insurance activities. These sectors have 44% and 83% higher labour productivity than average[21], highlighting how sectoral mix poses an important part of the South West Peninsula's productivity challenge.

Combining the level of specialisation with the overall output of each sector we have examined how much additional output the Peninsula produces in the sectors that it is specialised in compared to if it had the UK average share of output in these sectors. In sectors where the Peninsula is relatively underrepresented, we calculate the scale of economic output that is lost due to this underrepresentation. This analysis shows that the largest area of outperformance is in the accommodation and food services sector, followed by public administration and defence and then by health and social work and by construction. Each of these areas contribute between £700m and £900m more to the Peninsula economy than they would if they made up the same share of the economy as the UK average. The areas of relative underperformance are more heavily concentrated in a few sectors. Finance and insurance generates £2.3bn less than it would if it was the same share of the economy as the UK as a whole, information and communication generates £1.6bn less and professional, scientific and technical activities generate £1.1bn less.

This analysis paints a very broad overview of the structure of the economy. Within these large business sectors the South West has areas of particular expertise. For example, marine engineering and advanced photonics[22] are particular specialisms within the wider manufacturing sector. In future, some of these sub sectors are likely to significantly outperform the UK average and generate specific growth opportunities for the region while other areas may well decline as technologies, policies, and patterns of demand and of global competition change.

The Regional Economic Strategies of the HotSW and CIoS LEPs examine activities at a more granular level and identify the following specialisms as the focus for future growth opportunities:

Heart of the South West

- Marine;
- Aerospace;
- Advanced engineering and manufacturing;
- Agri-food;
- Nuclear;
- Environmental goods and services;
- Health and social care; and
- ICT – particularly Big Data.

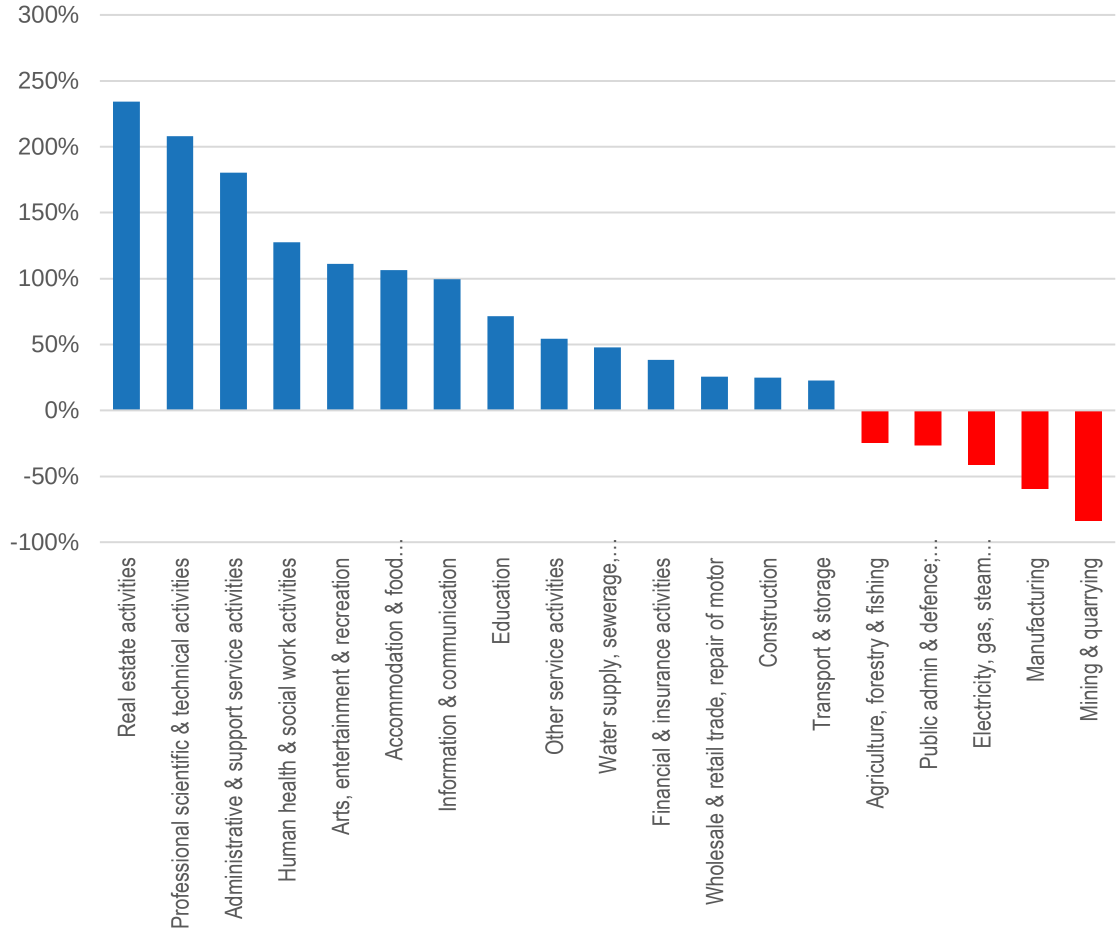
Cornwall and Isles of Scilly

- Marine;
- Aerospace;
- Space;
- Agri-food;
- Renewable energy;
- Creative;
- Tourism;
- eHealth; and
- Mining.

[21] Based on ONS data for output per hour for Q4 2019 (https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/labourproductivity/datasets/annualbreakdownofcontributionswholeeconomyandsectors)
[22] The Heart of the South West Microelectronics & Photonics Cluster, August 2017 [https://heartofswlep.co.uk/wp-content/uploads/2018/11/Microelectronics-Photonics-cluster-HotSW_TDA-Report-2017.pdf accessed 08/01/2020]

While the future performance of particular companies or subsectors is difficult to predict with accuracy, there are broad trends that have been relatively stable and which can provide some insight into likely future economic changes. Figure 2.9 shows long term changes in employment in different business sectors in the UK as a whole[23].

Figure 6-5: Growth of employment between 1978 and 2018, UK



Source: Labour Force Survey

The largest employment growth has been in various service sector activities including in real estate, professional, scientific and technical activities and administrative support. These are sectors where the Peninsula is underrepresented. The largest declines in employment have been in the extractive industries and in manufacturing. Some caution is needed in interpreting these trends, particularly where changes in business models have seen more specialisation and outsourcing. For example, if a manufacturing firm outsourced its cleaning activities to a cleaning firm when these were previously done in-house, then this job would be reclassified from manufacturing to cleaning (which falls within administrative and support service activities).

The implications of this long term structural change for the Peninsula are significant. If Peninsula employment in all business sectors had grown at the same rate since 1984, then the number of jobs in agriculture, forestry, fishing, energy and mining would have grown from 60,000 to almost 90,000 today. Instead, declining employment shares mean that there are only around 30,000 jobs in these sectors today despite strong overall growth in employment. We explore the implications of future structural changes later in this chapter.

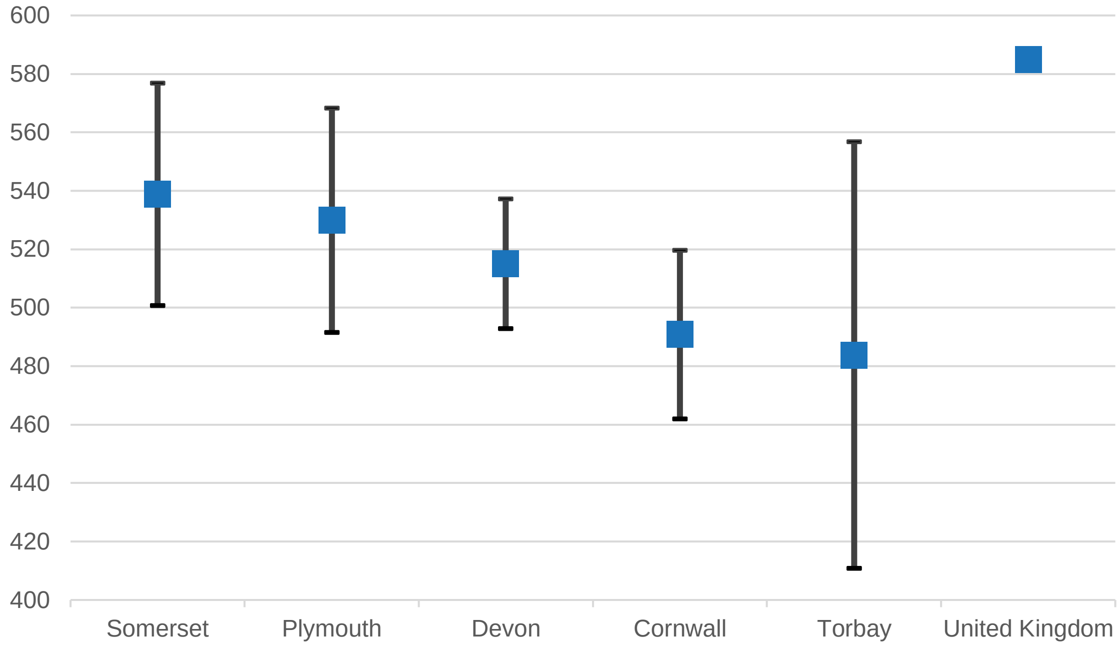
[23] UK data is used because it is more robust and available over a longer period. The same trends can be seen in the Peninsula, although sample sizes mean that data is more volatile and less reliable.

6.3 The productivity challenge

A central challenge across the Peninsula is productivity. In their Strategic Economic Plans, both LEPs highlight how productivity is lower than the UK average and recent performance has been poor. Productivity growth is essential to drive up wages and standards of living, and solving the productivity challenge is the Peninsula's top economic priority.

Figure 6-6 shows the average wages for full time workers for different parts of the Peninsula and for the UK in 2019. Local wage data is based on relatively small samples so confidence limits are relatively wide. Nevertheless, wages in the Peninsula are consistently lower than the UK average in all areas. Wages appear to be highest in Somerset and lowest in Torbay, although the confidence range is particularly wide for Torbay.

Figure 6-6: Median gross weekly wages of full time workers with 95% confidence limits, 2019



Source: Annual Survey of Hours and Earnings

The weighted average median weekly wage across the Peninsula is £515 compared to £585 in the UK as a whole. This means that Peninsula workers earn around £70 per week less than the average UK worker and around £3,600 less per year. This represents a deficit of around £3.3 billion pounds in annual wage income across the Peninsula every year.

We have drawn on research into differences in local productivity by Sheffield Hallam University to help understand the drivers of relatively low levels of economic output per head across the Peninsula. Figure 6-7 and Figure 6-8 show some of the reasons why output per head is different from the UK average. The residual difference is less easily explained.

In the Heart of the South West area, the industry mix depresses output per head by 6% compared to the UK average. This is the most important factor reason for differences from the UK average. This is followed by shorter average working hours (5%), a lower share of people of working age (4%), net out-commuting which means less is produced locally (3%), and the occupational mix. The employment rate is higher than the UK average which pushes output per person up by 4%. After these factors have been accounted for, the HotSW LEP area economy appears 10% less efficient than the UK average.

The pattern is similar for the Cornwall and Isles of Scilly LEP area. All of the same factors serve to reduce the measured level of economic output per head, while a higher than average employment rate tends to increase it. Here, the industry mix is again the largest factor driving a difference in output per head compared to the UK average. However, in CIoS, the impact of age profile is slightly larger (5%) because the difference in the share of people of working age is more pronounced. The impact of the occupational mix is also larger (4%). However, the impacts of commuting and of working hours are both smaller (at 2% and 1% respectively). As in the HotSW area, the employment rate in CIoS is higher than in the UK overall which pushes up output per person by 4%. The starkest difference between the HotSW and the CIoS is that a larger unexplained productivity difference which remains after these factors are accounted for. In CIoS the remaining unexplained difference in productivity is 24 points, compared to only 10 in HotSW.

Figure 6-7: HotSW reasons for differences in economic output per head compared to UK average, 2017

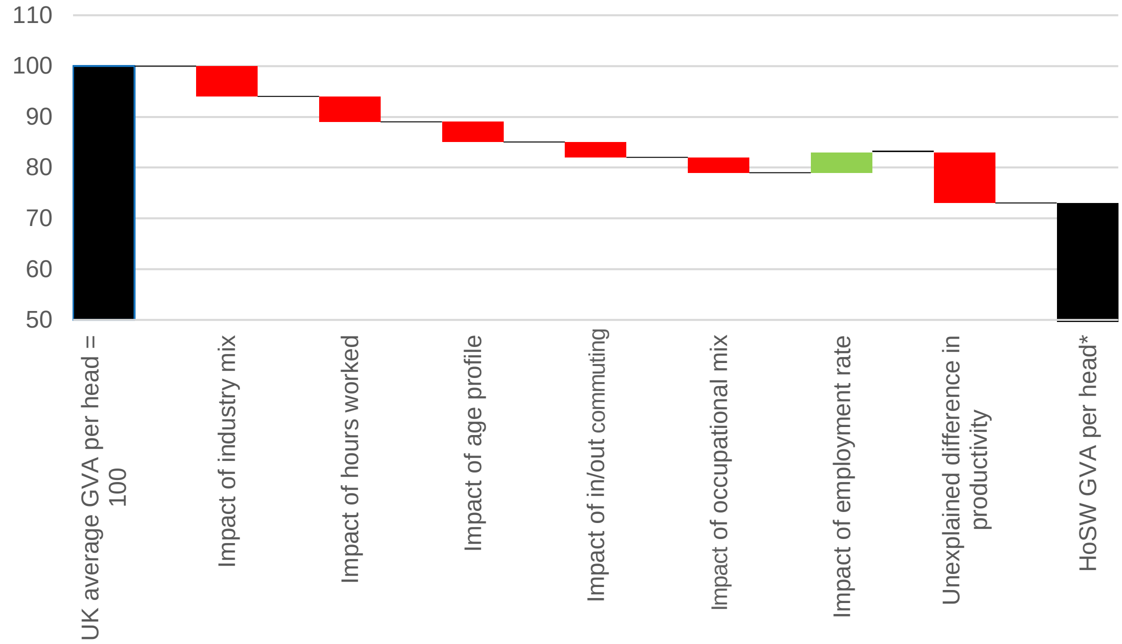
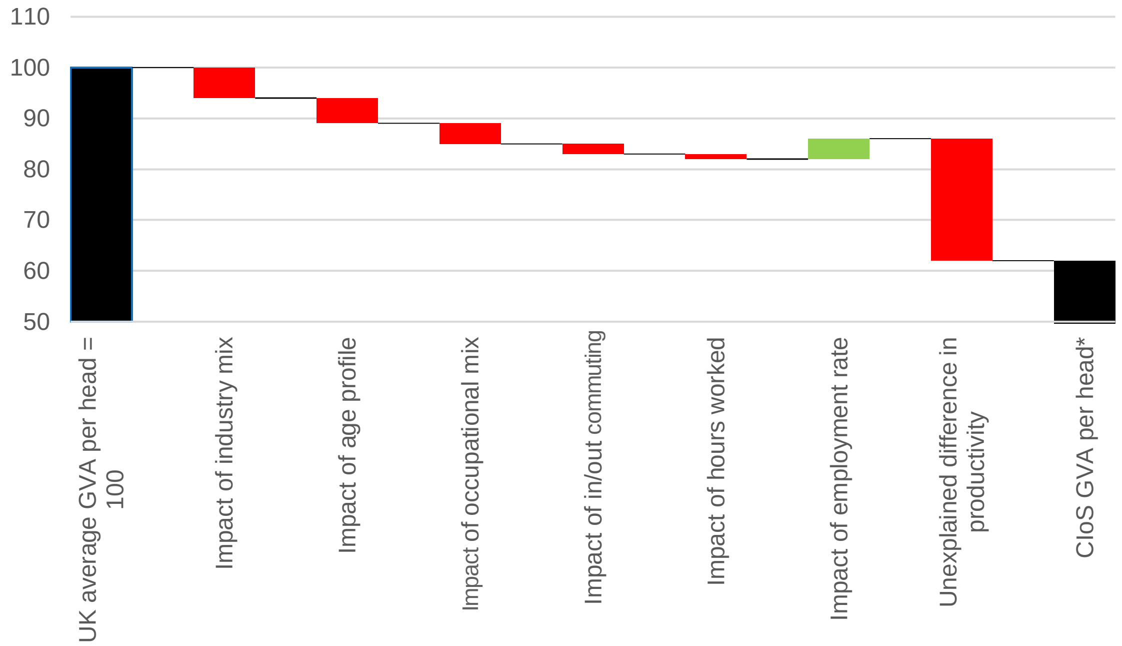


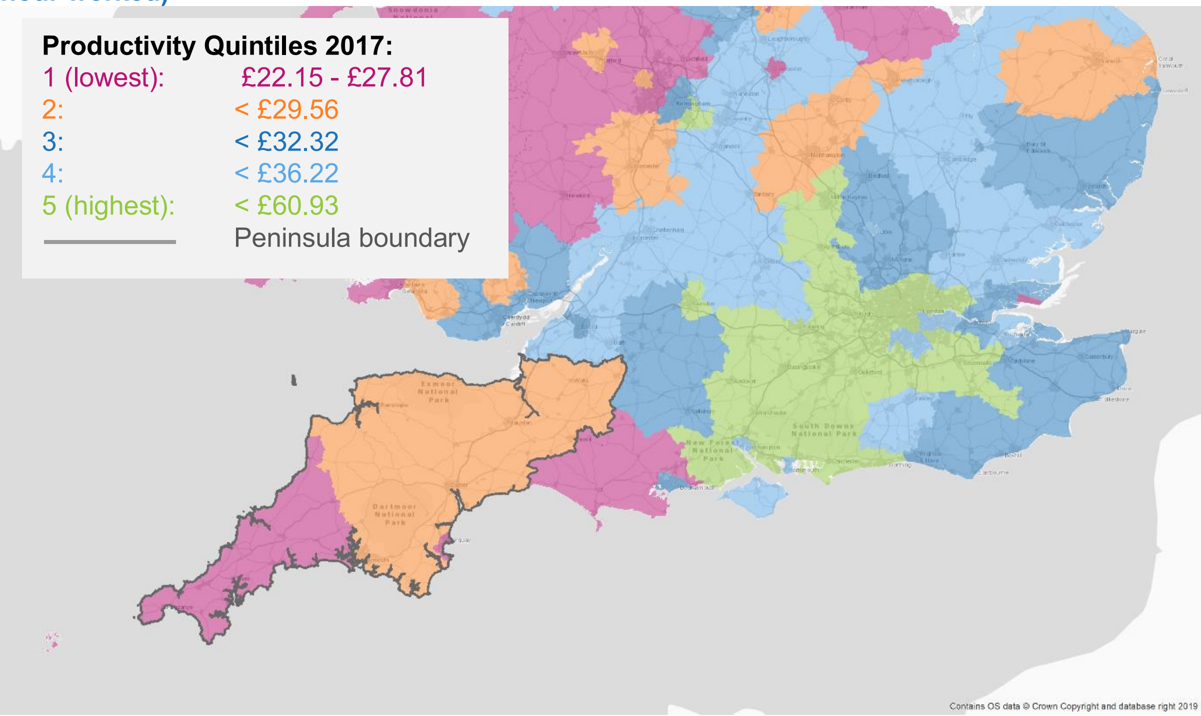
Figure 6-8: CIoS reasons for differences in economic output per head compared to UK average, 2017



Source: Heart of the South West LEP Strategic Economic Plan

One reason for lower levels of productivity could be the relative peripherality of the Peninsula. It is often observed that productivity tends to decline as distance from London tends to increase. The economics of agglomeration explain how larger markets can lead to productivity gains through greater opportunities for specialisation, better matching of suppliers and customers and of employers and employees. Figure 6-9 below shows a map of Gross Value Added per hour worked for 2017 across the south of England and Wales showing this pattern of productivity and peripherality - all of the Peninsula area sits within the bottom two quintiles for productivity.

Figure 6-9: productivity is the worst in the south of England (nominal, unsmoothed £ GVA per hour worked)



ONS Annual Sub regional Productivity Data (2019 Release)

Drawing on work by Rice and Venables (2004)[24] and on work by Imperial College for DfT, we have explored this relationship and how it might apply to the Peninsula. Rice and Venables found that distance to London did appear to be a useful explanatory factor in explaining productivity differences. However, on closer inspection they found that this was really reflecting market size which did a better job of explaining the differences. As they put it their paper: "*To investigate the first issue, we add an additional control variable that measures the travel time between the sample point and Central London. In general, in the absence of the economic mass variables, the travel time to London variable is negative and statistically significant. However, with the inclusion of the economic mass variables, this is no longer the case.*" In other words, distance to London is really representing access to economic opportunities more generally and is best measured in other ways.

We have developed three different measures to examine peripherality and market size:

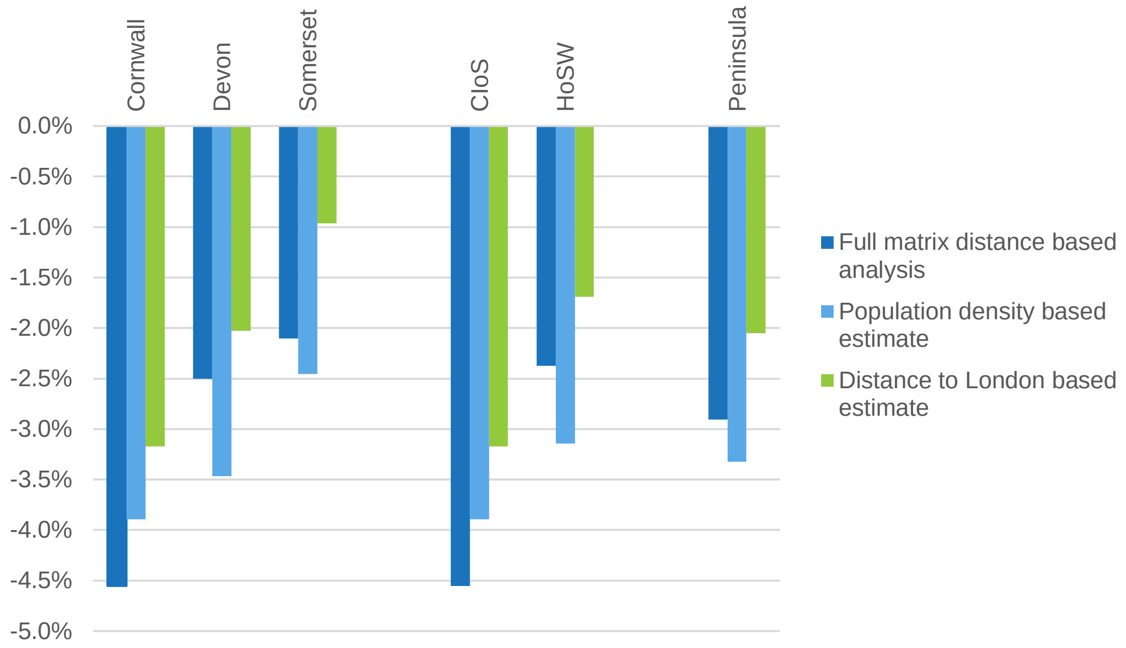
- Distance from London;
- A simple measure based on the population density reflecting the density of local markets; and
- A more sophisticated measure of economic density which captures the size of different economic centres that can be accessed and captures how their importance diminishes as distance increases.[25]

[24] RICE P. and VENABLES A. J. (2004) Spatial determinants of productivity: Analysis for the regions of Great Britain, CEP discussion paper, 642. (http://eprints.lse.ac.uk/2040/1/Spatial_Determinants_of_Productivity_Analysis_for_the_Regions_of_Great_Britain.pdf)

[25] This is consistent with the approach taken to measuring effective economic distance in Transport Analysis Guidance (TAG), although straight line distances are used instead of transport journey times. The analysis has been undertaken at local authority level.

These measure provide a range of ways of characterising connectivity to London, to other key cities and more locally. Drawing on the relationships between 'economic mass' and productivity, Figure 6-10 shows the potential contribution of peripherality to productivity across the Peninsula.

Figure 6-10: Estimated impacts of peripherality on Peninsula productivity



Source: Connected Economics analysis. Note that, in the figure, Devon includes Torbay and Plymouth.

Across the Peninsula as a whole, the impact on productivity appears to be between around 2.0% and 3.3% depending on which measure is used. The full matrix distance based analysis is likely to be more accurate, indicating that peripherality is responsible for a productivity deficit of around 3% compared to the UK average. In the HotSW LEP area, this appears closer to 2.5% while in the CIoS area it is closer to 4.5%. Comparing this to the unexplained productivity gaps in Figure 6-7 and Figure 6-8, this suggests that peripherality is responsible for roughly one quarter of the unexplained productivity deficit in both the HotSW and in CIoS.

6.4 Trade, investment and innovation

Trade, investment and innovation drive labour productivity and are important routes for addressing the regional productivity challenge. Businesses which report goods exports or imports were around 21% and 20% more productive respectively than businesses which do not trade after controlling for their size, industry and ownership status[26]. In this section, we examine the role of trade, investment and innovation and how they interact with transport in the Peninsula.

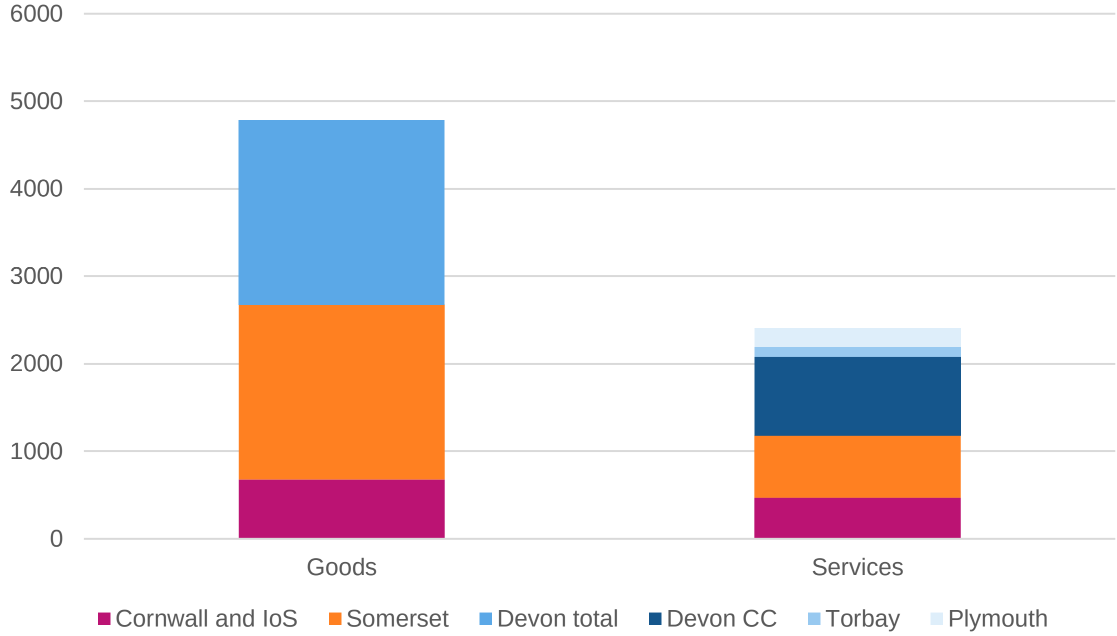
The Peninsula trades with neighbouring regions via its road, rail and digital links and with the rest of the world via ports and airports. Its universities and businesses innovate new technologies and new products and the Peninsula has a culture of strong links between business and academia. However, the Peninsula as a whole has a lower than average share of businesses in export intensive industries, a lower share of businesses that actively export and lower exports per head than the UK average.

[26] UK trade in goods and productivity: new findings, [file:///Users/dominic_walley/Downloads/UK%20trade%20in%20goods%20and%20productivity_%20new%20findings.pdf accessed 13/01/2020]

Goods exports from the Peninsula account for £4.3bn[27] and service exports for around £2.5bn[28]. Together, these make up around 16% of Peninsula GVA. This compares to around 30% for the UK as a whole[29].

Similar to the rest of the UK, the value of goods exported is around twice as high as the value of services exported.

Figure 6-11: Value of Peninsula exports, £m



Source: Connected Economics analysis of UK trade data[30].

The Peninsula's export markets for goods are concentrated in Europe, although the USA is the single largest trading partner. Figure 6-12 shows the destination of goods exports from different parts of the Peninsula.

[27] 2018 data. Note that data is only available at NUTS2 level which groups Somerset with Dorset. This data has been disaggregated according to Dorset and Somerset GAV to obtain an estimate for the Peninsula.
[28] 2016 data based on the International Trade in Services Survey and UK Balance of Payments Data
[29] UK Trade in Numbers, Department for International Trade, 2019 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/836787/190924_UK_trade_in_numbers_full_web_version_final.pdf accessed 12/01/2019]
[30] Note that goods data is for 2018 and services data is for 2016. Goods trade data is not available for Somerset but only for the UTS3 region which includes Dorset and Somerset. Data for Somerset has therefore been estimated by apportioning this NUTS3 data according to GVA for Dorset and Somerset.

Figure 6-12: Value of Peninsula goods exports by origin and destination, £m, 2018

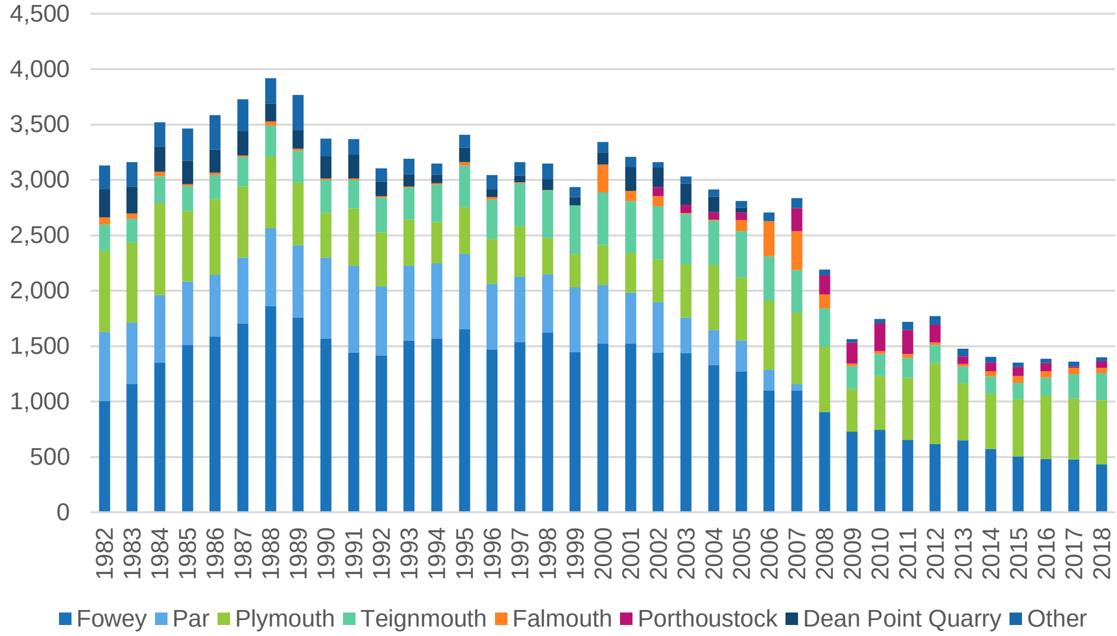
Source: UK Trade Statistics, Connected Economics analysis

For the Peninsula, EU destinations make up around 60% of goods exports, while for the UK as a whole this is 50%. This suggests that the Peninsula's goods exports could be more at risk than UK goods exports as a whole due to potential trade disruptions associated with Brexit. The Peninsula's largest non-EU goods markets are the USA, Hong Kong, China, Japan, the UAE and India.

Many of the goods traded through Peninsula ports will be from Peninsula firms, while firms outside the Peninsula also rely on Peninsula ports to get their goods to foreign markets. The Peninsula is home to the major ports of Fowey and Plymouth[31] and various smaller ports including Falmouth, Padstow, Teignmouth and others. Over the last 30 years, total freight tonnage carried through South West ports has fluctuated between 3.8 and 6.8 million tonnes per year.

[31] As defined by the tonnage of imports / exports.

Figure 6-13: Freight exports through Peninsula ports, thousands of tonnes

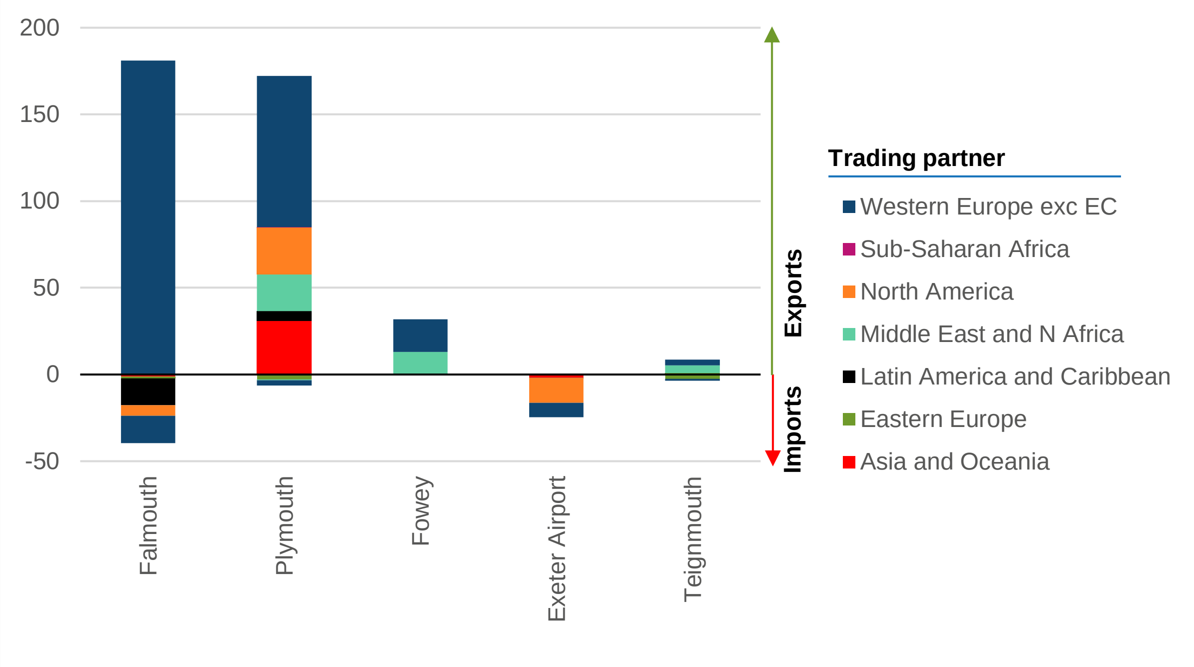


Source: Department for Transport Port Freight Statistics

Freight export tonnage is shown in Figure 6-13. Outbound freight (exports) peaked in 1988 at just under 4 million tonnes. Since then it has fluctuated and declined. Total freight exports through Peninsula ports now stand at around 1.4 million tonnes. Over the last 30 years, the largest export ports by tonnage have been Fowey (1.86m tonnes in 1988), Par (0.79m tonnes in 1991) and Plymouth (0.83m tonnes in 1984). Freight ceased from Par port in 2007 after several years of declining volumes. Plymouth is now the Peninsula's largest port by export tonnage. This reflects the overall UK experience of declining freight tonnage. In the UK freight tonnage peaked in 1997 and has declined steadily since. This partly reflects the structural changes in the UK economy and partly reflects consumer shifts towards experiences and digital products.

Some data is also available describing the value of freight passing through Peninsula ports, rather than the tonnage. However, this is only available for trade with non-EU countries. Figure 6-14 below shows the value of exports to non-EU countries by port in 2018.

Figure 6-14: Imports and exports of goods to non-EC countries via Peninsula ports, £m, 2018



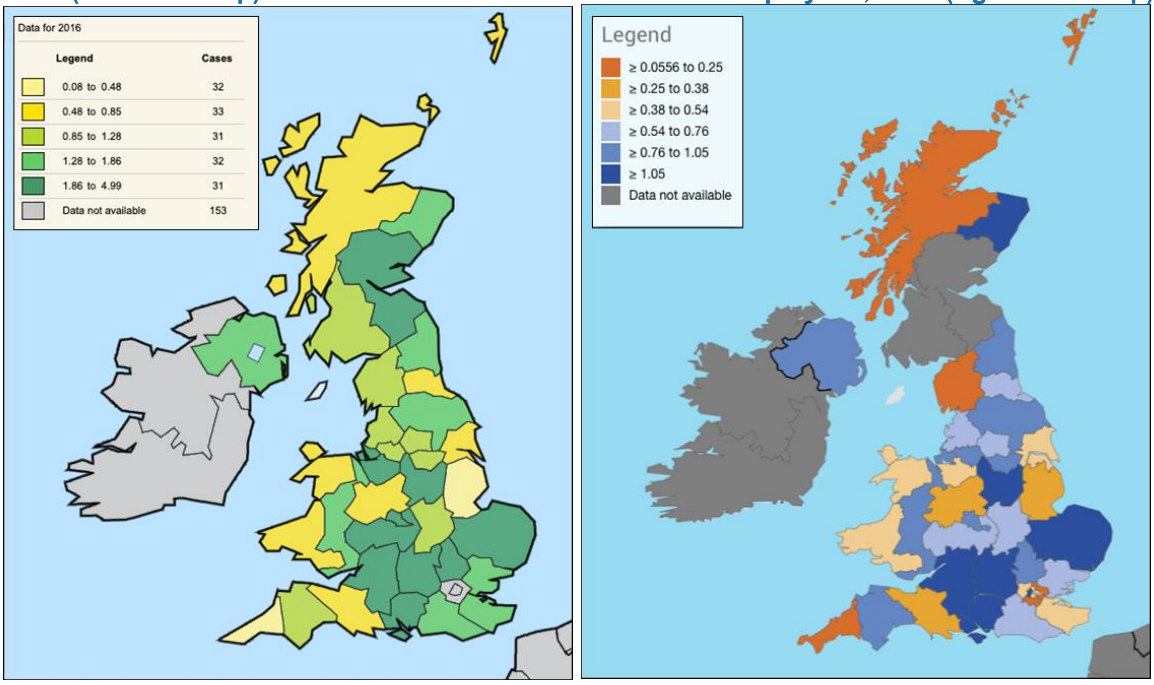
Source: UK Port Statistics

The largest port in the Peninsula by value for non-EU imports and exports is Falmouth. The largest export destination is the non-EU parts of Europe. The total value of exports captured within these statistics is around £393m. This compares to total goods exports from Peninsula firms to non-EU countries of £1.9bn and implies that only a small share of goods exports from Peninsula firms are routed through Peninsula ports. As the largest overseas markets by value are in the USA and the Far East, this implies that connections to Heathrow and other international ports may be more important to local firms that access to local facilities, although this would need further analysis to verify.

On most standard measures of innovation the Peninsula's scores are low. In this section we examine the trade and innovation patterns of the Peninsula and how they interact with the transport system.

As distance from London increases, the share of expenditure spent on research and development tends to decline. The geographical pattern is familiar and recalls the geographic pattern of UK productivity. This is certainly true on the southwest Peninsula. The left hand panel in Figure 6-15 shows research expenditure by NUTS3 region and a clear decline in visible as one travels further west from the Home Counties through Dorset and Somerset, and into Devon and Cornwall.

Figure 6-15: Gross Domestic Expenditure on Research and Development (GERD), % of GDP, 2016 (left hand map) and Researchers as a share of total employees, 2016 (right hand map)

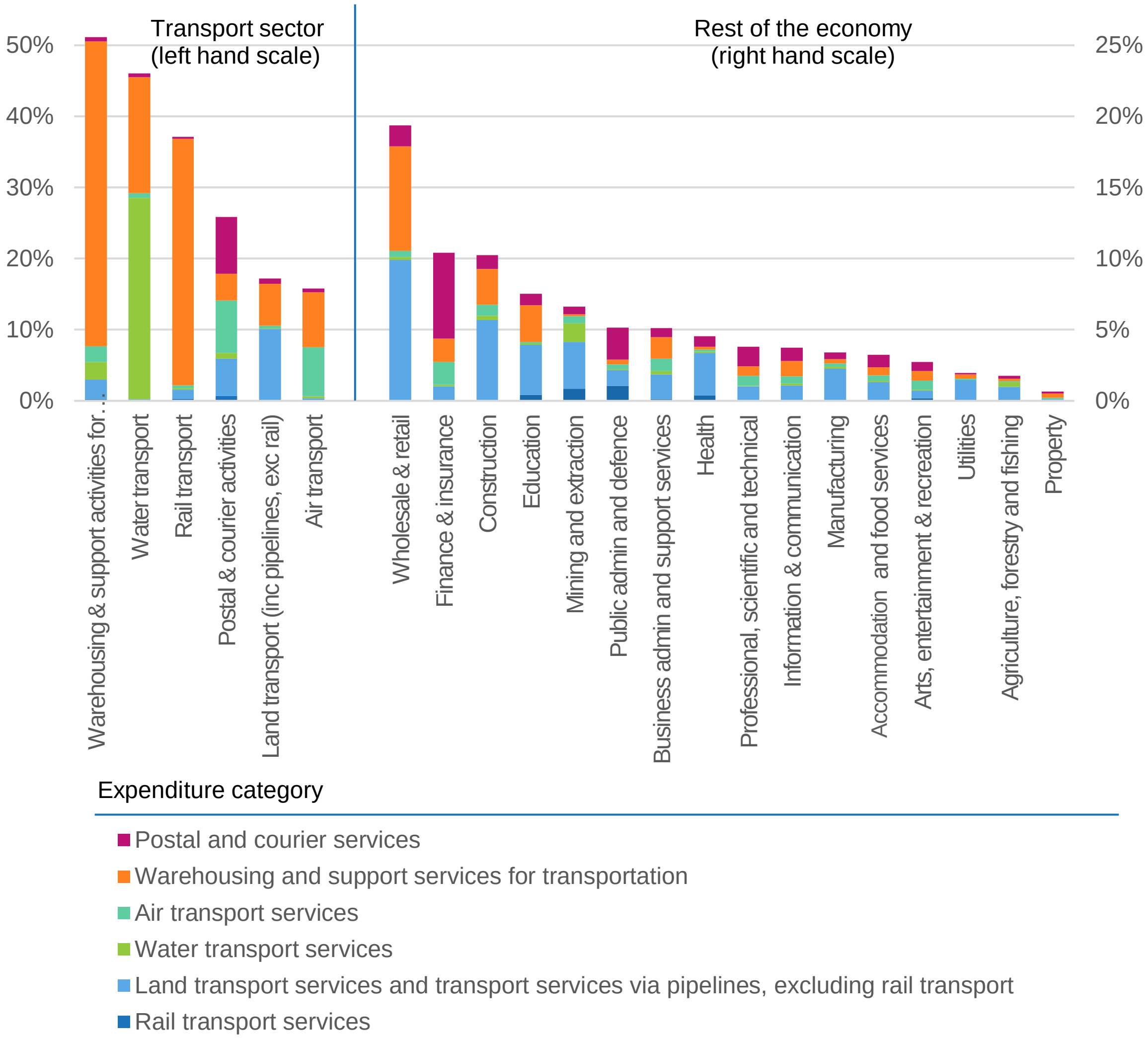


The right hand panel of Figure 6-15 shows researchers as a share of total employees. A similar geographic pattern is seen here, although Devon performs more strongly than Somerset, probably due to the presence of the Met Office and the large universities of Exeter and Plymouth. The geographic pattern suggests that peripherality may play an important part in research and development intensity.

6.5 Transport behaviour of businesses

Before looking to the future, we examine the behaviour of firms to better understand their transport expenditure patterns. Unfortunately, local data is not available for this so we have drawn on national data on how firms trade with each other from the Input-Output supply and use tables.

Figure 6-16: Transport expenditure as a share of expenditure by business sector, UK, 2017



Source: UK Input Output tables

The largest consumers of transport are firms in the transport and logistics sectors as they trade amongst themselves. This reflects, for example, a logistics firm chartering vehicles or courier firm buying air freight services. These intra-transport sector trades are shown on the left hand side of Figure 6-16 above.

Non-transport economic sectors are shown on the right. Of these, the largest consumer of transport services is the wholesale and retail sector and derives from them moving and storing goods. Their largest expenditure transport is ‘Land transport and transport services via pipelines, excluding rail transport’ which is mainly road haulage services. Most of the remainder of their expenditure is on warehousing and storage. A similar pattern is found the construction sector which is the third largest consumer of transport services. The second largest non-transport sector by expenditure is the finance and insurance sector which makes heavy use of postal and courier services.

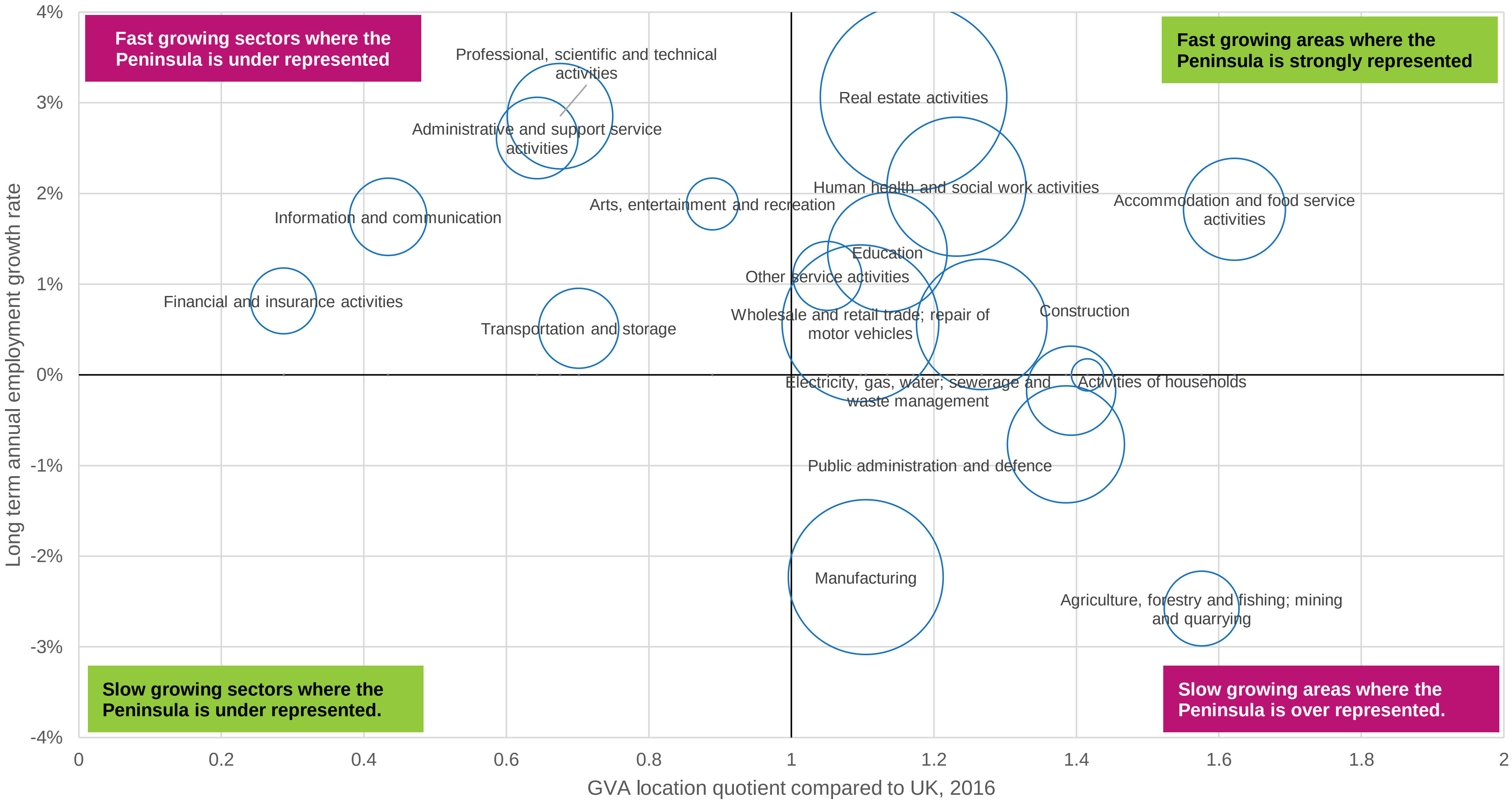
Expenditure on rail services is concentrated in the public administration and defence sector. Much of this is likely to reflect rail travel by civil servants who are often based in city centre locations, and military rail travel. This pattern of expenditure is not common to other mainly office based sectors such as the professional, scientific and technical sector which spends as much on road transport but little on rail. The other heavy user of rail is the mining and extraction sector reflecting purchases of rail freight services. Expenditure on air travel is likewise concentrated in a few sectors, particularly the finance and insurance and mining and extraction sectors.

6.6 The future economy

In this section, we look forward to how the economy of the Peninsula could look in future. Analysis of historic trends cautions against making detailed predictions about the future economy. Instead, we have drawn on some of the more stable longer term trends and extrapolated these into the future, alongside analysis of local economic plans and strategies to understand the potential ranges of future growth and how the economy might develop.

We have drawn together analysis of sector specialisms and structural employment trends to examine where long term opportunities for future Peninsula employment growth might lie. This is shown in Figure 6-17 below.

Figure 6-17: SWOT analysis of Peninsula employment growth prospects



Source: Connected Economics analysis of Labour Force Survey and sub regional GVA data

The horizontal axis shows the degree of specialisation in the Peninsula in a particular business sector while the vertical axis plots the long term growth rate of employment in that sector. The size of bubbles denotes economic output of that sector within the Peninsula. In the top right quadrant of the chart are sectors in which the Peninsula is specialised, and which have seen long term growth in employment. Employment in the accommodation and food service sector (closely associated with tourism) has grown by 1.8% per annum over the last 30 years and the Peninsula is strongly specialised in this area. However, this sector tends to suffer from low labour productivity and continuing employment growth here could hamper aspirations for long term productivity growth in the Peninsula. Likewise, human health and social work activities have been growing strongly and the Peninsula is somewhat specialised in this area, although labour productivity tends to be lower than average. Also, in this group are the construction, education, wholesale and retail trade, and other service activities, although the Peninsula's specialisation is less pronounced and their long term employment growth rates have been lower.

The bottom right hand quadrant shows sectors that have seen long term employment decline but where the Peninsula is specialised. The manufacturing sector is by far the largest in this quadrant by economic output, although the Peninsula is only somewhat specialised in this sector with a location quotient of 1.1. However, labour productivity in the manufacturing sector tends to be high because of high levels of capital equipment per worker. The Peninsula is much more heavily specialised in the agriculture, forestry and fishing sector, although it is smaller. Employment in this quadrant is at risk if historic employment trends continue.

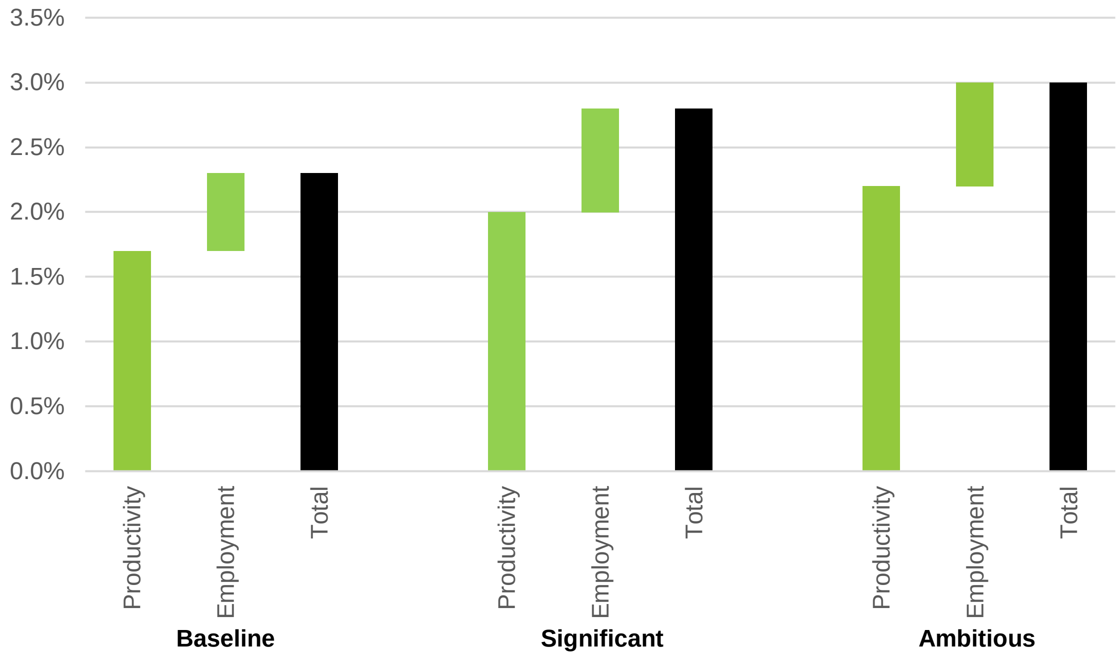
Finally, in the top left hand side of the figure are sectors which are fast growing but where the Peninsula is underrepresented. These could represent opportunities for the Peninsula to grow its employment base as structural change continues. Particularly fast growing are: professional, scientific and technical activities; administrative and support services; arts, entertainment and recreation; and the information and communication sector.

Estimates of the long term outlook for the UK economy are provided by the Office for Budget Responsibility. OBR estimates that long term real GDP growth will average between 2.2% and 2.3% per annum. This is broadly made up of productivity growth of around 2% per annum and population growth making up the rest[32]. The OBR expects productivity growth to be mostly driven by hourly improvements in productivity. However, as the population ages, a decline in participation levels are expected which will reduce economic output per head (although this is partly offset by higher participation rates amongst migrants.

There are no similar forecasts at the Peninsula level, although the HotSW LEP has published its growth ambitions in its Strategic Economic Plan. These are shown in Figure 6-18 below.

[32] OBR Long term economic determinants data – March 2019 economic and fiscal outlook [https://obr.uk/efo/economic-fiscal-outlook-march-2019/ accessed 13/01/2020]

Figure 6-18: HotSW LEP economic growth ambitions



Source: Heart of the South West LEP Strategic Economic Plan

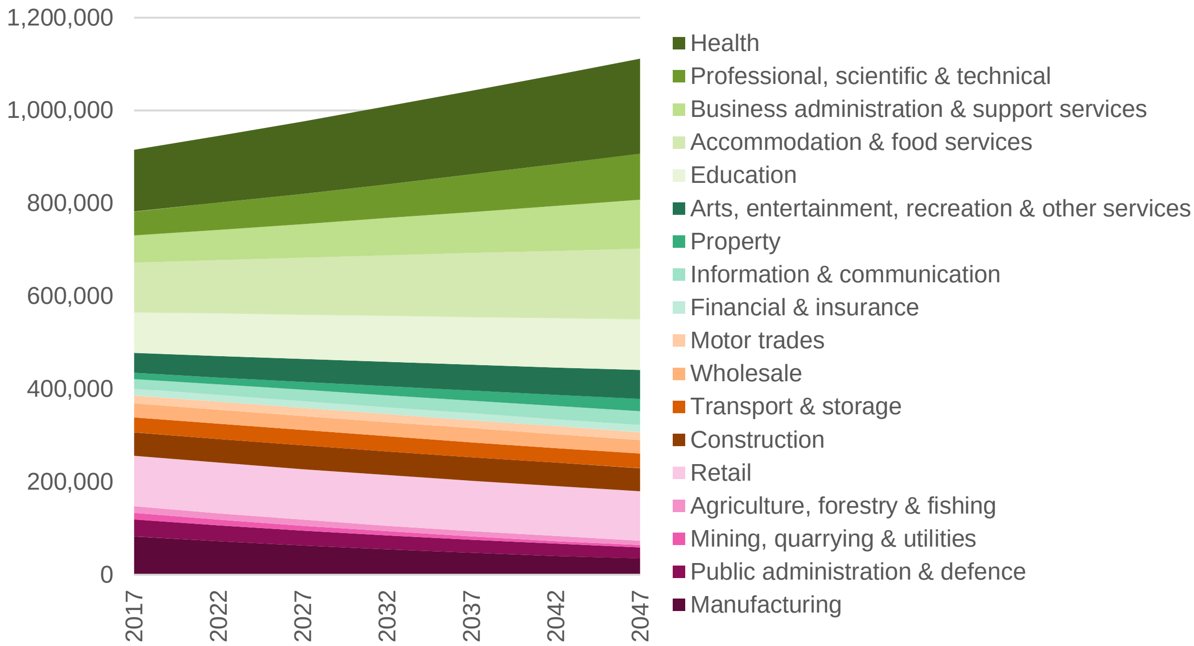
The HotSW LEP plan presents three different scenarios. In the baseline scenario, the HotSW LEP area economy is assumed to grow consistently by 2.3% per annum. This is made up of 1.7% growth in productivity and 0.6% growth in employment. This is similar to long run national growth rates expected by OBR, although with slightly lower productivity growth and slightly higher employment growth. In the short and medium term (between 2019 and around 2030) OBR expects productivity to be well below the long term 2% growth rate. The HotSW forecasts are therefore somewhat more optimistic than OBR in the short and medium term. The HotSW significant growth scenario sees growth of 2.8% with stronger productivity growth and higher employment. The ambitious scenario is likewise more ambitious and sees overall annual growth of 3.0%.

CIoS LEP has not published economic forecasts, but aspires to increase GVA per job from 69% to 80% of the England average. This implies growing productivity by 16% more that England is able to. This is equivalent to 1.0% additional annual productivity growth if achieved over 15 years and 0.7% if achieved over 20 years. Cornwall's plans don't include explicit employment growth aspirations.

The Peninsula and the HotSW LEP area have higher than average employment rates. To achieve the aspirational growth plans for the Peninsula, it would need to increase its participation rate, attract inward migrants and substantially close the productivity gap with the rest of the UK. This suggests that it needs to dramatically grow high productivity business sectors such as manufacturing and accelerate the transition towards the knowledge economy by growing employment in the professional, scientific and technical activities, and other business services sectors.

If broad sectoral trends do continue then they would have a dramatic effect on the employment patterns of the Peninsula over the long term. Figure 2.10 shows the potential path off employment in the Peninsula if these long term trends continue at the same rate for the period from 2017 to 2050.

Figure 6-19: Trend changes in Peninsula employment projected over the next 30 years



Source: Labour Force Survey

By 2050, the human health and social work sector could expand the most if trends continue. It already employs the largest number of people and could move from employing one in eleven people to employing one in seven people, an additional 70,000 people in the Peninsula. The manufacturing sector currently employs around 83,000 people and could shrink to employ only around 35,000 if trends continue. The Peninsula could expect to gain roughly equal numbers of employees in the accommodation and food services sector, the business administration and support services sector and the professional, scientific and technical sector. Each would gain around 45,000 to 50,000 employees as overall employment grows and their shares of it increase.

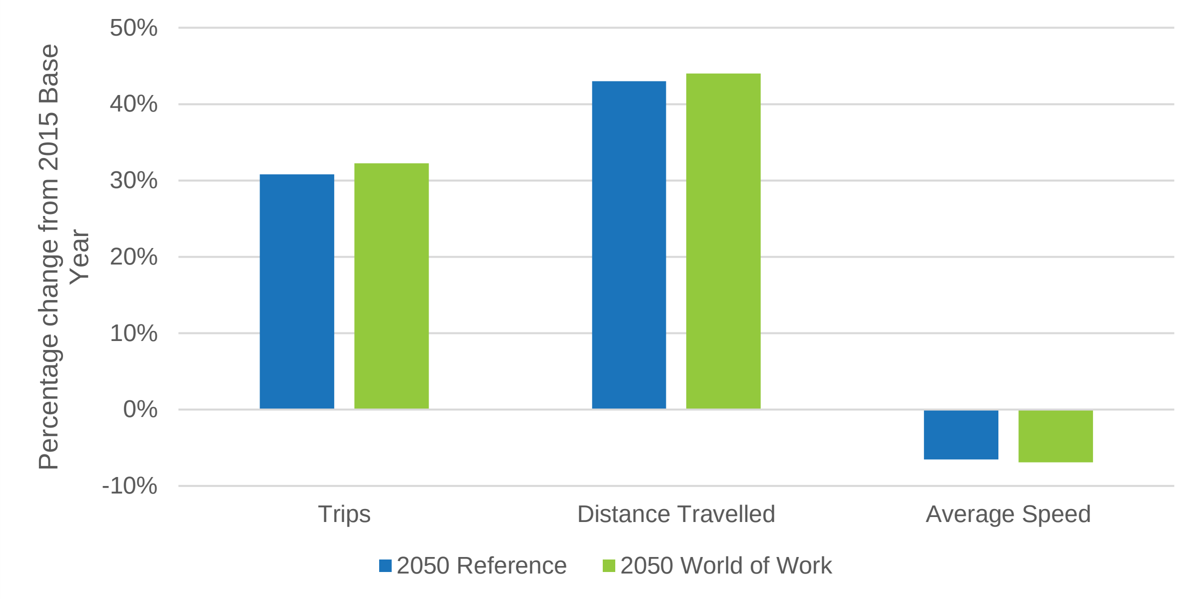
These trends reflect historic patterns of structural employment change across broad sectors. Within these there is likely to be very significant variation as the types of activities and products change. Indeed, even the classifications of business sectors have changed many times over the last 30 years to capture the changing shape of the economy. Some subsectors are likely to prosper, even while the broader sector sees slow employment growth or decline. Both the HotSW and CIoS LEPs highlight marine engineering as an example of a significant regional growth opportunity.

6.7 Transport implications of the world of work

A world of work scenario has been produced within PAM looking at a situation where productivity growth is focussed on the key sectors identified in the emerging Local Industrial Strategies of the two LEPs. The scenario models increased growth in areas containing businesses mirroring the industrial strategies growth sector plans or where future development is earmarked for those sectors. An uplift of 25% has been applied trip attractions in these areas, whilst retaining overall growth levels at the reference case level.

The scenario is therefore designed to assess the spatial impact on transport of the Peninsula economy moving in the direction set by its industrial strategies. Figure 6-20 presents outputs from the PAM providing a comparison between the 2050 reference case and 2050 with the 25% increase in growth for key sectors. The figure presents percentage change compared with a 2015 base year for weekday (0700 – 1900) trip numbers, distance travelled (vehicle kilometres) and average speeds.

Figure 6-20: Forecast Impact of Growth in Key Sectors in 2050



The modelled impacts of the 25% growth in key sectors on road travel are very small scale and given the limitations of the input assumptions and the transport model, should not be considered indicative of any definitive impact on travel patterns. The world of work scenario produces a small increase in trips compared with the reference case, a small increase in distance travelled on the network whilst average speeds remain at very similar levels. The most rational conclusion at this stage is that the spatial impact of key sectors growing faster as a result of economic plans and investment is unlikely to be a primary consideration in the way strategic road transport is planned in the Peninsula. However, local transport impacts may be significant around particular sites or settlements, so spatial planning considerations remain important for the development of transport strategies.

6.8 The world of work - summary

The Peninsula has seen very significant economic growth. In broad terms, employment in the Peninsula has grown by around half over the last 30 years. This is somewhat higher than the UK as a whole. This scale of change is broadly consistent with what we expect for the future.

Local economic performance has been extremely varied over the last 30 years. In some periods and some places, performance has been substantially stronger than the UK average, notably in the 1980s, 1990s and early 2000s. However, different parts of the Peninsula have had growth spurts that have not always coincided. The data cautions that we should be wary of detailed local economic projections. Attempts to use data from a ten or even twenty year period to predict future change at a local level would certainly have led to incorrect projections.

Nevertheless, it is clear that the way that the Peninsula earns its living will change. Over the long term, occupations are shifting towards professional, technical and managerial occupations and sectors are shifting towards business, personal and consumer services. This highlights the need for continued improvements in passenger services, digital communications, and digital communications on those passenger services.

To meet the productivity challenge, the Peninsula will need to address challenges from peripherality. The relative peripherality of parts of the region compared to other parts of the UK could be an important part of the Peninsula's productivity deficit, both directly due to poor access to markets and more indirectly through impacts on firm behaviour in research and development and innovation. This highlights the importance of high quality strategic routes and their resilience and reliability. These strategic routes are vital for the economic performance of the Peninsula but are largely controlled by Highways England and Network Rail. Peninsula Transport should consider opportunities to work with DfT, Highways England and Network Rail to develop joint visions for strategic routes and approaches to increasing their priority within regional infrastructure provision. It is beyond the scope of this study to recommend specific mechanisms, but it may, for example, be possible for Peninsula Authorities to argue for additional or accelerated enhancements on the Strategic Road Network instead of other local priorities on the Major Road Network in future.

The Heart of the South West Productivity Strategy identifies transformational potential in various sectors including advanced manufacturing, marine and energy sectors. Cornwall and the Isles of Scilly's 10 Opportunities document similarly highlights opportunities in high tech and knowledge related sectors such as creative, space, mining and aerospace sectors. At present, industry and occupational mixes drag down the Peninsula's output per employee. The transport mix must be attractive to the occupations and industries of the future, supporting specialisation through enabling efficient and wide labour markets and supporting efficient movement of freight and people.

A continued high quality environment and range of opportunities will continue to attract domestic migrants and meet growth goals. Work opportunities, perhaps supported by flexible working, will make the Peninsula attractive to younger migrants, maintaining and increasing economic participation rates. There is a critical link here between economic performance and maintaining and enhancing the Peninsula's high quality environment. CIoS Vision 2020 recognises this and elevates 'location' as a growth opportunity in itself.

If regional strategies are successful, clusters of businesses in growing sectors with distinctive regional specialisms will drive up exports and innovation and will contribute to closing the productivity gap. Critically, the regions strategic infrastructure will offer higher quality and more reliable transport journeys and digital connections, helping to reduce perceptions of peripherality and counter its negative productivity impact.

While strategic route networks connect the Peninsula to the rest of the UK, its gateways connect it to the rest of the world. The Port of Plymouth provides the only direct passenger ferry service to Europe while the two airports provide important national and international connections and enable service sector businesses to trade more easily with the Peninsula. Freight routes to ports support the region's export base which trades globally by sea from Plymouth, Falmouth, Fowey, Teignmouth and other ports. However, most of the region's physical trade passes not through international gateways within the region but leaves the UK from other national gateways. Again, this supports the continued importance of strategic national routes, for example to Heathrow and to other UK sea ports. Major trade partners are spread across the world. With a higher than average share of exports to the EU, the Peninsula is arguably more at risk from a disorderly Brexit so reliable access to long distance international trade routes are critical to support growth of a wider global export market.

As with many of the other themes we have investigated, the central challenge is one of managing and accommodating substantial growth as the population and the economy continue to develop over the next 30 years. The exact nature of this growth is likely to shape demands on the transport system to some extent, but not to fundamentally change the transport needs to the Peninsula.

7. The Future of Transport

Digitalisation

Chapter Overview

After a long period of stability, the transport sector seems poised for radical change. This change is driven by technology, including digital processing, communications and artificial intelligence, and the rapid pace that these are being accepted and adopted into people's lives. Near ubiquitous internet connections and smart phones underpin the explosion of app-based ride hailing services and presage the beginning of new mobility models. Autonomous vehicles could accelerate this.

In this section we examine the changing technology landscape, how it has affected transport and other behaviours and set out some ideas about what the technology future might look like. This an area with very high levels of uncertainty. We cannot predict how specific changes will play out, but some themes do appear to have momentum and to be the foundations of future changes in transport supply. Drawing on these, we set out some plausible visions of how technology could affect the transport of tomorrow.

7.1 Global trends

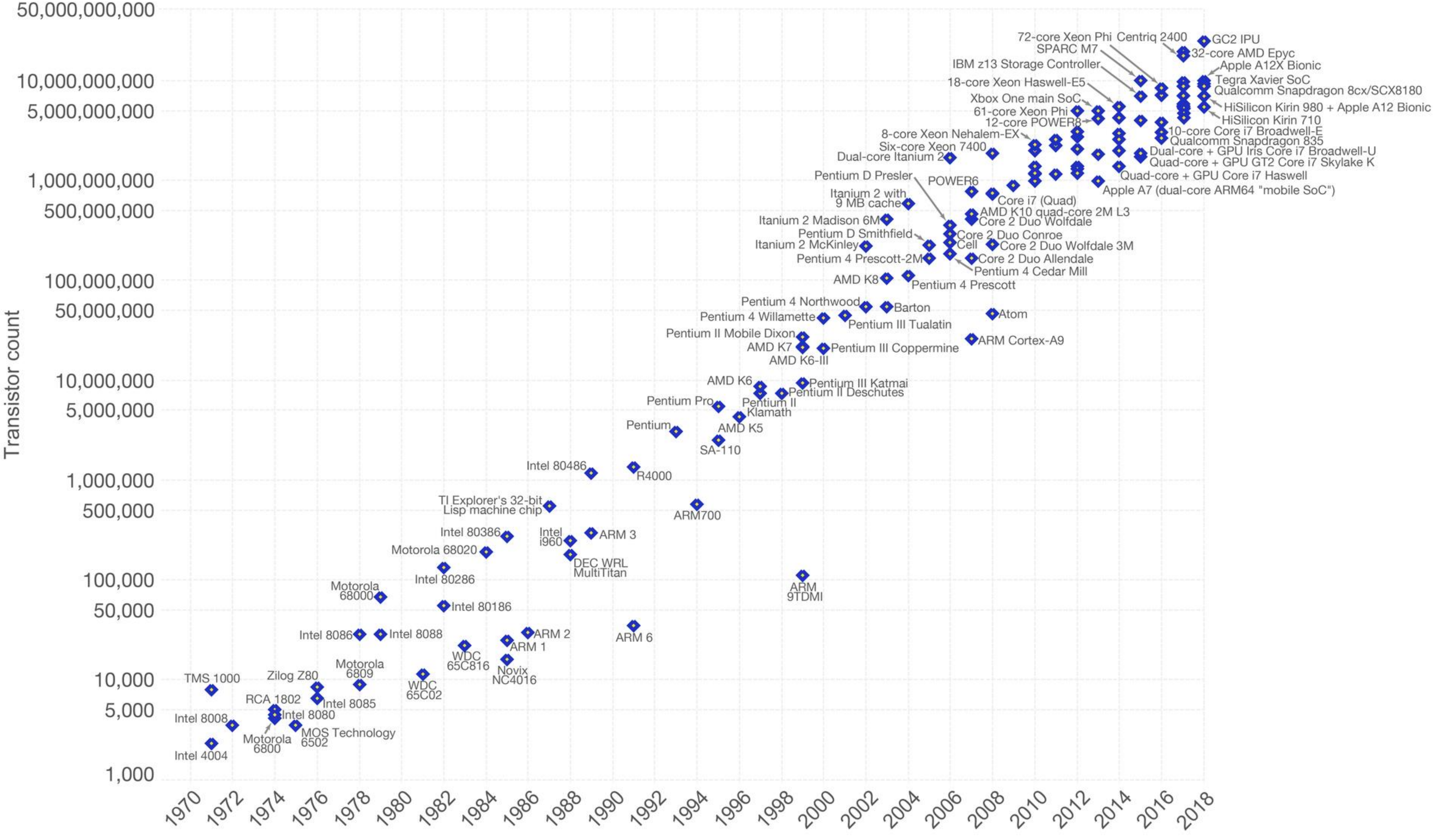
For many decades a wave of changes brought about by communications and computing technologies has been reshaping the economy and society. Since the 1950s, firms have been using computers to automate and speed up some of their business processes, and in the last seven decades, computers have changed from contraptions the size of buildings filled with punched tape and valves, to microprocessors that are vanishingly small and so inexpensive that they are put into disposable products.

Even in the last 30 years, computing and communications have changed beyond recognition. In computing, 1989 saw IBM introduce the 486 and Apple introduce its first laptop. Communications have likewise been revolutionised. The year 2019 marked the 30th anniversary of the invention of the internet by Tim Berners Lee. In 1990 the world was still building out the first generation of mobile phone infrastructure (1G) which was introduced in the late 1970s, and the first text message was sent in the UK in 1992. Now 30 years later, the fifth generation of mobile phone networks and protocols are launching with fast data speeds, low latency and high capacity. The average residential fixed broadband download speed is around 50 megabits per second and households are now more likely to stream music and video than play physical copies or watch broadcasts.

Much of this has been due to the relentless improvements in computing power. Moore's Law states that the number of transistors on a silicon chip doubles every one to two years. Figure 7-1 shows relatively consistent exponential growth according to Moore's Law for many decades, although there may be reason to doubt that this specific trend will continue because the size of transistors is approaching the size at which quantum effects start to affect electrical signals. However, ZDNet[33] note that over the last few years IBM have managed to double the speed of their quantum computers every year and suggest that 'quantum advantage' (where quantum computers have overwhelming advantages over classical computers for some tasks) could occur within the 2020s. Continual increases in computational power and communication speed seem inevitable, however these are achieved.

[33] [https://www.zdnet.com/article/ibm-hits-quantum-computing-milestone-may-see-quantum-advantage-in-2020s/ accessed 27/01/2020]

Figure 7-1: Moore's Law – the increase in power of computer chips



Source: Wikipedia article on Moore's Law, Author Max Roser

7.2 The intersection of transport and technology

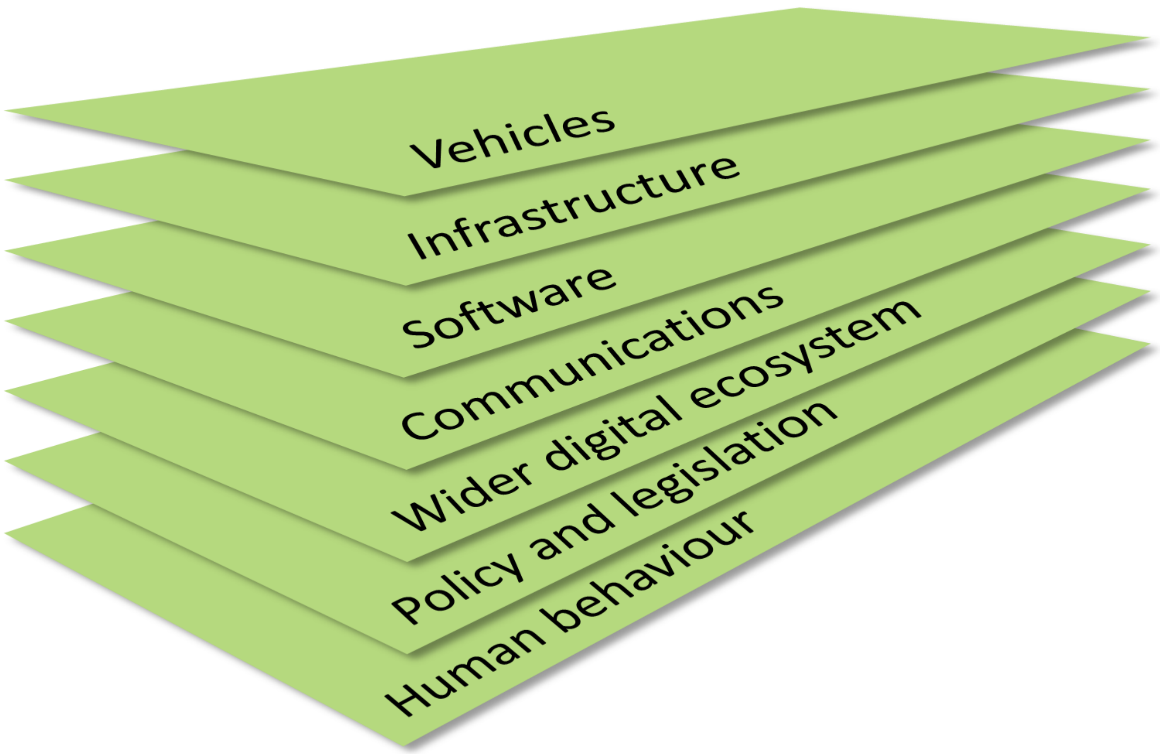
Digital technologies have developed side by side with a wide range of other technologies such as advanced robotics and additive manufacturing which are reshaping businesses in new and unexpected ways. They now seem poised to disrupt the transport sector.

Jesse Norman's (then Minister of State at the Department for Transport) forward to the Future of Mobility Strategy captures the DfT's view of this transport and technology tipping point:

"*Britain is on the verge of a transport revolution. For much of the past half century, many of the improvements to transport have been gradual and incremental, and focused on increasing the capacity of existing infrastructure to meet growing demand. Yet today, radical new technologies are emerging that within a generation will transform everyday journeys. Zero tailpipe emission cars are replacing those powered by fossil fuels. Self-driving vehicles will soon allow disabled people and older people to enjoy the freedom to travel that the rest of us take for granted. And advances in data will improve the way that transport services are devised, planned and delivered for the passenger.*"[34]

These changes will connect the more traditional elements of the transport sector, such as vehicles and infrastructure, with other technologies and sectors. Transport increasingly relies on software, communications technologies and a wider digital ecosystem including payment methods, GPS location services, digital security and cryptography, smartphone and app ecosystems, and more. Underlying this are policy and legislation which support technology change, such as legislation enabling trials of autonomous vehicles on public roads and standards relating to digital security. Alongside all of these layers is the human experience. Public acceptance of new technologies, preferences for new products and habits are evolving as more people own smartphones, experience app based mobility services or buy cars with advanced driver assistance technologies.

Figure 7-2: Digital technology in transport supply



[34] Future of Mobility, DfT, March 2019 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/846593/future-of-mobility-strategy.pdf accessed 27/01/2020]

This move towards greater integration with digital technologies is likely to bring unknown future challenges. In particular, it is likely to require transport planners and transport authorities to have a greater understanding of these digital technologies and the implications for transport supply[35]. These intersections are explored further in the sections below.

7.3 The digital railway

Whether working or using their travel time for leisure activities, rail passengers now expect on-train Wi-Fi and power connections and complain when the mobile phone signal or internet connection is poor[36]. As lifestyles become increasingly entwined with digital communications, the quality of service offered on trains will come under increasing pressure. Improvements in digital communications networks will be needed to maintain and improve the attractiveness of rail travel.

In the Peninsula, as in the rest of the country, rail services face capacity constraints and reliability challenges. Digital technologies provide opportunities to deliver greater capacity and higher reliability from existing assets, for example by improving traffic management, enabling flexible signalling systems and enabling improved management information and vehicle telemetries

These technologies are underpinned by the mobile communications network. All stations now have Wi-Fi and ticket machines connected to communications infrastructure. A long term move towards in-vehicle digital signalling systems is underway. These developments will mainly use the standalone GSM-R system (Global System of Mobile Communications – Railway) which is designed to provide communications to and from trains travelling at high speeds via GSM-R masts that cover almost all UK railway tracks. This network will soon need upgrading to a new 4G or 5G based standard. Other high quality mobile communications networks will also be needed to support other rail related activities such as communicating with level crossings and farm users, or for emerging systems to digitally track freight. Continuous mobile connectivity is one of the aspirations of the PRTF.

In the Peninsula, the need to re-signal the Exeter area will provide opportunities for increased capacity, higher frequencies, longer hours of operation and improved performance and flexibility, and will be interdependent with developments in communications technologies and infrastructure.

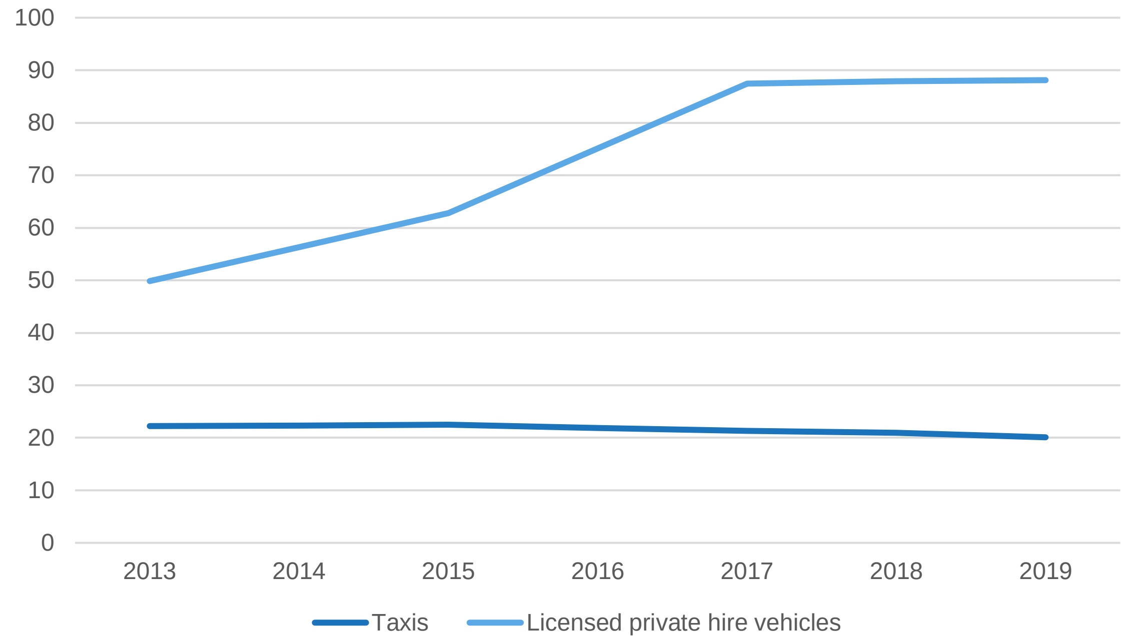
7.4 Taxis, apps and Mobility as a Service (MaaS)

Nowhere has the interface between transport and communications technologies proved so disruptive as in ride hailing apps such as Uber and Lyft within major cities. In London, private hire vehicles have grown quickly and now outnumber taxis by more than four to one. The highest profile operator to have entered the London market of these is Uber, although there are many others.

[35] This trend of cross-sector interdependency was also highlighted by Highways England in their recent ‘Connecting the Country’ report (page 11) [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/666876/Connecting_the_country_Planning_for_the_long_term.pdf accessed 27/01/2020]

[36] Only 35% of passengers were satisfied with the quality of train internet connections in the Autumn 2019 National Rail Passenger Survey [https://d3cez36w5wymxj.cloudfront.net/wp-content/uploads/2020/01/27181442/Main-Report-Autumn-2019-240120.pdf accessed 27/01/2020]

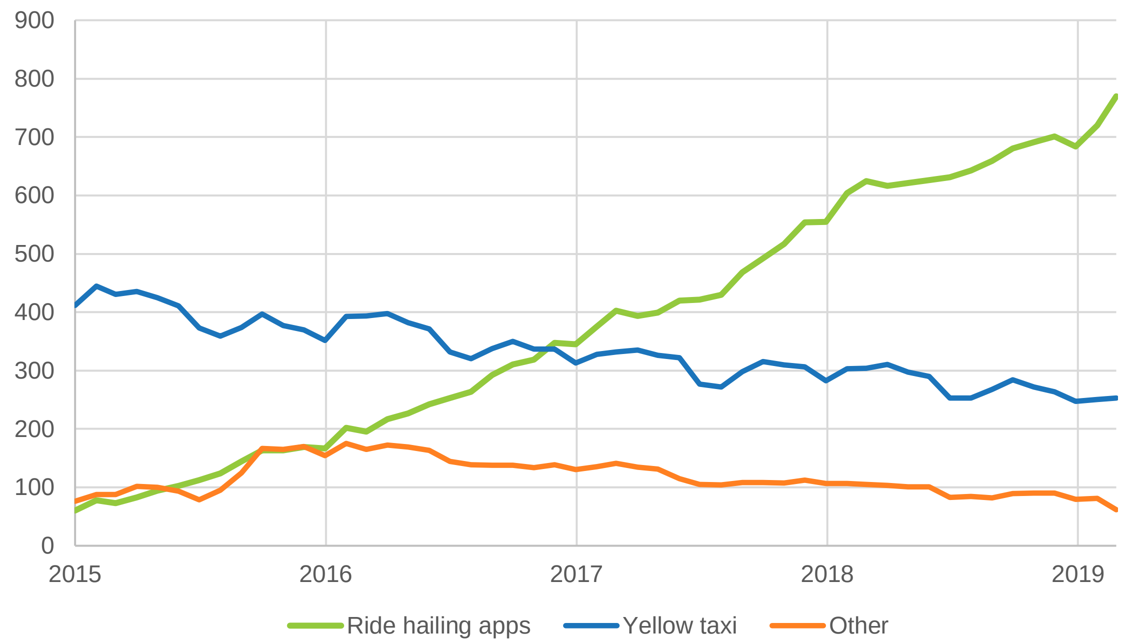
Figure 7-3: Taxis and private hire vehicles licensed in London, thousands



Source: DfT

New York provides an example of how large the market shift towards app based private hire vehicles could become. Ride hailing apps there have eclipsed competitors and now carry more than three times as many passengers every day as traditional yellow taxis.

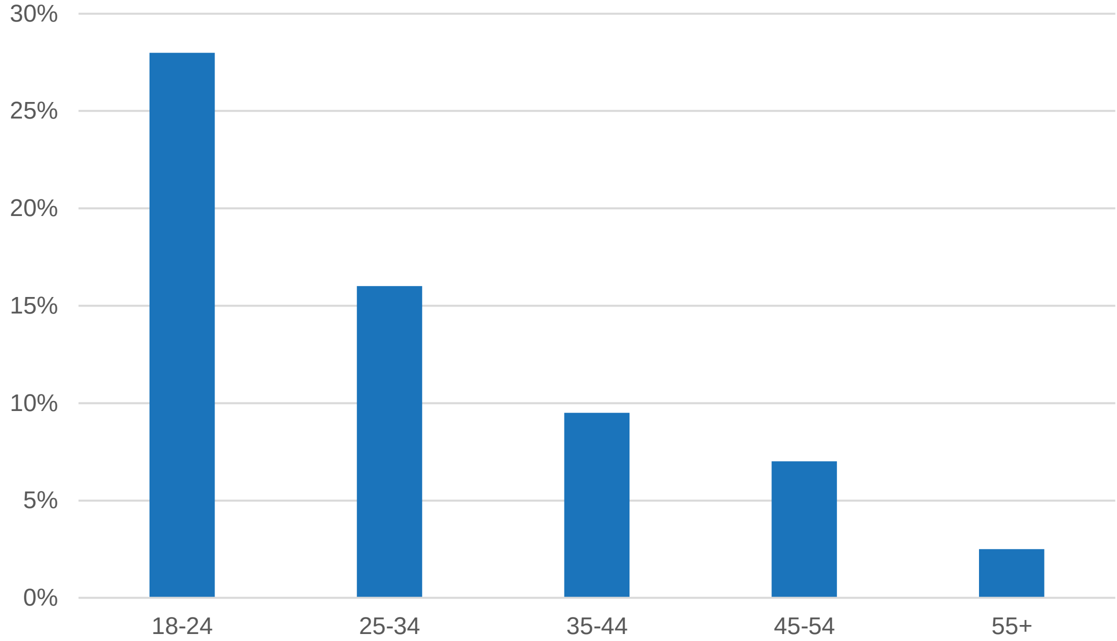
Figure 7-4: Daily trips in New York City, thousands



Source: New York City Taxi and Limousine Commission

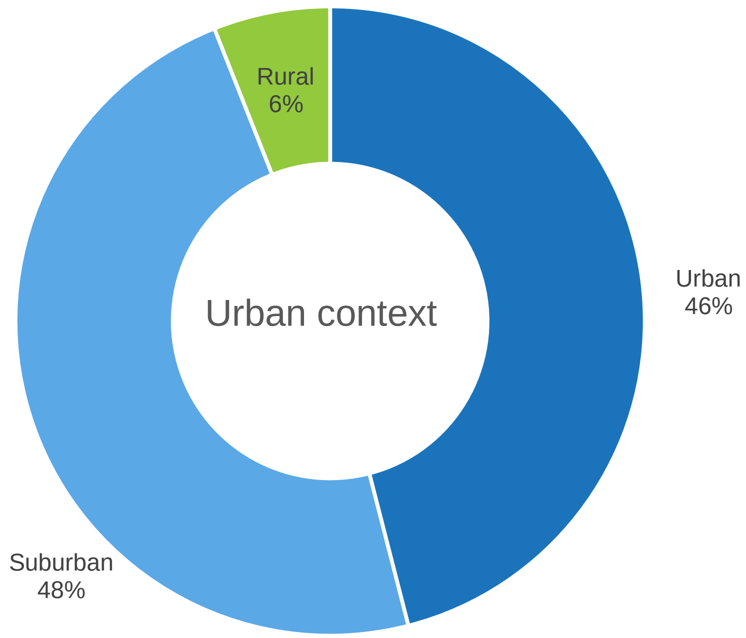
These services have spread to cities across the world, although not yet to many towns or rural areas. In the Peninsula, Ola operates in Exeter although there are no other global or national ride hailing apps available. Some local firms have developed their own app to integrate with GPS and enable customer bookings such as Tower Cabs in Plymouth. However, economies of scale in providing the quality of application and user experience can make this a difficult challenge for smaller firms. These services require good mobile phone data coverage, population density, widespread ownership of smartphones, and credit cards and a cultural willingness to use technology in this way. It is perhaps no surprise that customers are disproportionately young and likely to live in a city.

Figure 7-5: Age profile of Uber users in London



Source: OFCOM, 2018

Figure 7-6: Geographic distribution of Uber users in the USA, Q1 2017



Source: Global WebIndex Survey Q1 2017

As cohorts age and services develop, this pattern is likely to change as older users in a wider range of locations seek to use them.

The promise of integrated and connected transport via apps has given rise to the idea of 'Mobility as a Service' (MaaS), a way of consuming transport where aggregators of public and private transport services or 'gateways' offer packages of transport services which are not provider or mode specific. They may include some or all of: bus; rail; ride hailing; car hire services; bike hire services; etc. End-to-end trips are managed by the gateway and may be paid for a per-journey basis or through a subscription service. Once again, this potential market disruptor has come about from a range of interrelated technologies including smartphone adoption, mobile data, mobile payments, and internet technologies such as Application Programming Interfaces (APIs) which enable the easier integration of data from different platforms. While potentially providing convenience and lower cost journeys, there is some evidence that that mass adoption of ride hailing services can increase net CO_2 emissions,

MaaS may be one of a number of transport developments supporting a shift away from buying a vehicle or buying individual journey segments from different transport providers and towards a new model of service provision. Foresight, the Government Office for Science concluded at the end of 2018 that "*MaaS does not yet have a major presence in either the research arena or in society more generally, though this could well change very quickly. This is because MaaS potentially offers a paradigm shift from transport being fundamentally provider-led (i.e. where fixed capacity is provided to serve a predictable demand), to being a fully user-led system whereby the level and type of transport supply continually adjust in response to the specific desires of individual travellers.*" Definitions remain a little fuzzy and Foresight note that Uber and Lyft "*though possibly not strictly MaaS as currently defined, are currently by far the most significant actors in this space*".

Communications technologies and apps are also making it easier for people to arrange ride sharing and car-pooling. BlaBlaCar is a good example of a company that is already offering a service in the Peninsula, matching people with similar travel patterns to enable car sharing. Again, this is a social phenomenon which is more common among younger people. Whether this is for financial reasons, confidence with technology or other reasons, there does appear to be a shift towards the sharing economy[37] which could suggest substantial growth opportunities for ride sharing and similar services, and for models of transport use and vehicle ownership more widely.

Developing these transport service opportunities in the Peninsula requires some important foundations including, for example:

- Smart phone penetration;
- Electronic payment system penetration;
- GPS;
- Mobile data coverage; and
- Market density.

Parts of the Peninsula lack the mobile data coverage required to easily use these services. This limits their utility even for people who do have coverage where they live or work because the choices of destination are limited. Market density is another challenge for the Peninsula, with few large urban areas and considerable areas of low population and employment density. Cultural factors affecting technology use are more difficult to define but can also be important. Philip and Williams conclude that "*Territorial digital infrastructure divides compound other more nuanced reasons for a lack of digital engagement. Complex combinations of personal attributes, for example, age, income levels, digital skills, and perceived benefits of Internet use, influence the ability of individuals, households and businesses to capitalise on the opportunities presented by the digital economy.*"[38]

Across the Peninsula, we would first expect to see similar services developing in areas like Plymouth, Exeter, Torbay and Truro. The Peninsula's low densities, age distribution, relatively low levels of entrepreneurship and digital skills could all act as barriers to the development of innovative new mobility services.

7.5 Driver assistance and autonomous vehicles

Digital technologies have already changed our cars. The first Lidar based distance warning system was introduced by Mitsubishi as far back as 1992 and partial automatic speed control was introduced

[37] See for example, Tomorrow 2.0: Transaction Costs and the Sharing Economy by Mike Munger, ISBN-13: 978-1108447348
[38] Remote rural home based businesses and digital inequalities: Understanding needs and expectations in a digitally underserved community, Philip, L. and Williams, F., Journal of Rural Studies, Volume 68, May 2019, Pages 306-318

in 1995 via the throttle and gears but not the brakes. By 1999 a variety of speed control systems such as adaptive cruise control were in operation. Automatic lane detection and steering technologies have taken longer although the first lane detection technology was introduced by Nissan in 2001 in Japan. Coming to Europe more slowly, these technologies were introduced by Citroen in 2005 with active steering introduced by Lexus in 2006 with complex pattern and object recognition processors.

In 2014 the Society of Automotive Engineer published its six level taxonomy for autonomous driving systems:

- **Level 0: No automation.** The driver is in complete control although automatic warning systems may operate.
- **Level 1: Driver assistance.** The driver is in control of all aspects of the system, although the system may modify speed or direction (such as via a lane keeping or adaptive cruise control feature).
- **Level 2: Partial automation.** The driver must be able to control the vehicle if corrections are needed but is no longer in control of speed and steering. Parking assistance and Tesla's 2014 autopilot feature are examples of this.
- **Level 3: Conditional automation.** The vehicle is in control of all aspects of driving, including monitoring its environment, but only in specific sets of circumstances, such as on fenced highways between intersections or limited speeds.
- **Level 4: High automation.** The vehicle drives itself and a human presence is no longer needed – but only in specific conditions such as when it is not snowing or icy. If conditions are unsuitable, the system can safely abort the journey, for example by parking the vehicle safely.
- **Level 5: Full automation.** The system is fully autonomous in all conditions.

Now in 2019, various kinds of level 3 automation are in operation including automatic parking systems, automatic driving on motorways and automatic driving within specific mapped geographic areas.

Level 4 and level 5 automation are proving more difficult to deliver but are progressing. Waymo 'robotaxis' are now operating without a human driver at the wheel in Phoenix, Arizona. However, this service is currently limited to a geofenced part of the city and to a limited set of users. Tesla now sells vehicles which can 'navigate on autopilot', although a human driver is required to take over when the vehicle encounters situations which it cannot safely handle. The company offers a 'full self-driving' option for its cars, claiming that the vehicles come equipped with all the necessary hardware for full self-driving and that the option will be enabled 'soon' subject to regulatory approval. However, they have provided and missed optimistic timescales before. Tests have moved from well-marked and maintained highways and quiet suburban areas to busy cities. Baidu is testing self-driving in Guangxou on city streets where driving behaviour tends to be aggressive and unpredictable, while start-ups like Zoox are testing vehicles in the crowded and chaotic environments of downtown San Francisco. Such testing is also taking place in the UK. Wayve, for example, is conducting ongoing trials of autonomous cars on central London streets. The legislative support for autonomous vehicles is also being put into place. In the UK the Law Commission is reviewing the regulatory framework for the safe deployment of automated vehicles and is currently in its second round of consultation. In the USA, 41 states[39] have enacted laws or executive orders to regulate autonomous vehicles, while federal guidelines for autonomous vehicle testing were introduced in September 2019.

Some claim that some of the challenges faced by full self-driving may never be solved by AI, predicting that applications will remain limited for years to come. Over the last few years, progress has been slower than the high expectation, supporting this view to a certain extent. Predictions about the future of these technologies vary widely, but there does seem to have been steady and incremental progress in vehicle autonomy while the development and roll-out of more limited driver assistance technologies has been widespread.

We cannot predict when or where vehicles with high levels of autonomy (level 4 or level 5) will be rolled out. However, some trends are clear. Autonomous driving is easier in sub-urban environments

[39] As of October 2019

and on major roads than it is in urban environments and minor roads with poor road markings or narrow clearances. In the Peninsula, a high proportion of routes are smaller roads confirming to lower standards than the Strategic or Major Route Networks. These will pose significant challenges for automated vehicles such as narrow carriageways or lanes, lack or road markings, mud on the road and foliage. Likewise, the Peninsula's towns and cities offer challenging conditions for autonomous driving.

However, it is likely that autonomous driving could come to parts of the Highways England network and to larger locally owned roads and later spread to wider set of driving situations over time. The specific technologies underpinning successful deployments remain unknown. Some use lidar, some optical cameras. Some rely on detailed pre-existing 3D maps of their environment while some do not. There is a risk that firms in the Peninsula may find themselves at a competitive disadvantage if limited autonomy, for example to enable goods vehicles to operate between depots without drivers, does become possible on some routes or in some areas with particular types of road layouts. It may be that locations become designated as 'autonomous vehicle accessible' or accessible for different levels of autonomous functioning.

In the longer term, there is no certainty around when or whether edge cases, like driving on single track roads, are solved to an acceptable degree of safety and convenience. It may be that the Peninsula will need to consider key routes and locations where autonomous vehicle access is valuable and to consider interventions, such as widening stretches of single track road, to enable this.

Likewise, it is not known how connected infrastructure could play into this. There are many ways that this could develop. Smart infrastructure may communicate to vehicles negotiating narrow routes to enable autonomous vehicles to pass safely without traffic signals, or vehicles could communicate their intentions to each other directly where rights of way are unclear or are negotiated. Regardless of developments in vehicle autonomy, connected infrastructure provides many other opportunities for more efficient use of the network, such as automatic condition and fault reporting,

The somewhat chaotic picture of technology development and early adoption create many unknowns. Highways England have also recognised this[40]. Their view is that these trends require them to keep a watching brief and to be prepared to take targeted action to support useful future change

Critical Uncertainty 1. How fast will technology be developed and taken up?

There is always great uncertainty about the timing of future technology change and we must recognise this when making predictions about technology uptake in road transport. Not only is there uncertainty around the pace of change, but there are also variations in the solutions which will be explored by different suppliers and users, both at home and abroad.

So a question we must answer is how quickly should we respond to emerging trends? Should we be strategically patient and see what the future holds? Or should we seek to predict what may happen?

We believe that our role is to enable and support, rather than to drive vehicle technology change. So this requires us to take a watching brief, be prepared to change course as technology evolves, and identify where our playing an enabling role can help catalyse wider change.

Source: Highways England, Connecting the Country

7.6 Future transport

The sections above describe the technology changes that are already disrupting the transport market or appear poised for mainstream user adoption over the coming years. There may be good reasons for believing that we are now in a state of transformation, or at least of increased uncertainty about the future. This has happened before. In the 1890s transport was dominated by horse power and in 1894 commentators were fixated on the 'Great Horse Manure Crisis'. The Times newspaper predicted that 'every London street would be buried under nine feet of horse manure within 50 years' and could scarcely have imagined the seismic shift to motorcars that would change transport for ever over the coming decades.

[40] Connecting the Country: Planning for the long term, Highways England, December 2017 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/666876/Connecting_the_country_Planning_for_the_long_term.pdf accessed 28/01/2020]

Although we cannot know whether a similar revolution is soon to take place (or indeed is already underway), it is in this spirit that reference some potentially transformative technologies which may emerge over the coming decades.

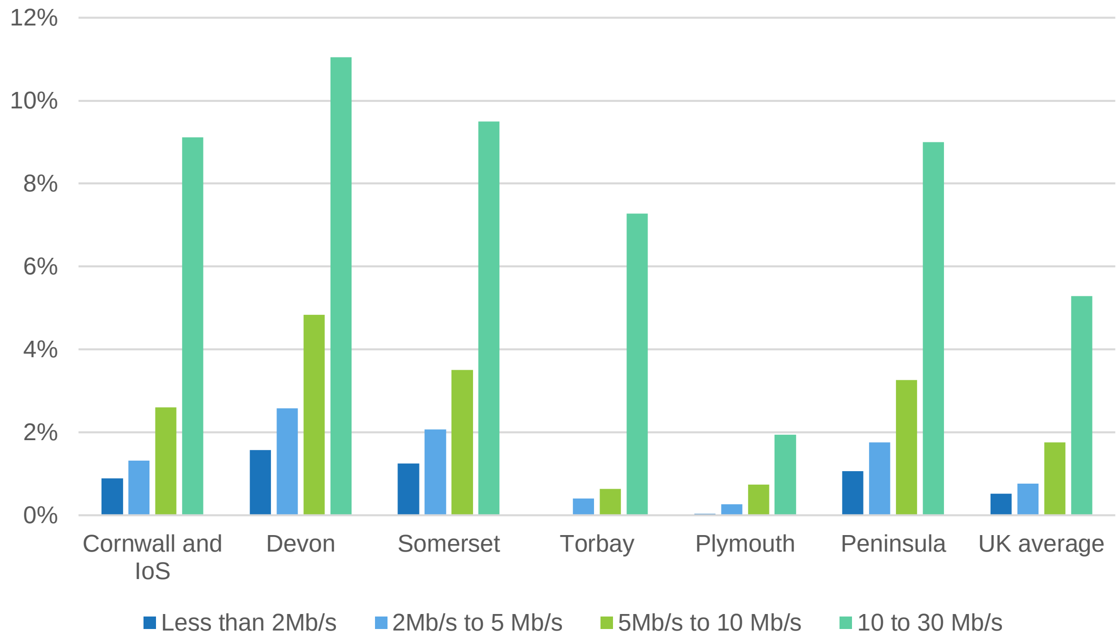
- **Tunnels:** Much has been made of the Boring Company's claim that they will reduce the cost of tunnel boring by up to 90%. This requires much more efficient tunnel boring machines and narrower tunnels. However, with level 3 autonomy and electric vehicles, could tunnels safely become narrower, cheaper and safer and help provide a solution to urban congestion?
- **High speed rail:** With HS2 due to open completely in the late 2030s and Northern Powerhouse Rail proposals for a new line between Manchester and Leeds and from HS2 to Liverpool, how might high speed rail develop in the future? Are routes along the M4 corridor or to the South West a next logical step in a national network?
- **Rockets and space planes:** Virgin Orbit and Spaceport Cornwall are collaborating to bring satellite launch to Cornwall from the early 2020s with ambitions to later develop space tourism through Virgin Galactic's White Knight and SpaceShip2 launch system. As Virgin say, "In time, we expect to be operating a variety of vehicles from multiple locations to cater for the demands of the growing space-user community […] providing a world-shrinking, transcontinental service." Likewise, SpaceX plans a network of intercontinental passenger rocket services using its Starship rockets which are currently in development. If spaceplanes shrink global distances, could the South West Peninsula be a UK gateway?

Clearly, these futures are highly speculative. With the exception of high-speed rail, none of these technologies have proven mass markets yet and it is simply too early to say whether they will amount to anything, but all have the potential to radically disrupt the transport sector if they can be made to work reliably, safely and cost effectively. We do not suggest that any of these will make a significant difference to the transport system of the South West Peninsula within the coming decades – but they might.

7.7 Digital provision in the South West Peninsula

Perhaps the most important enabler of many of the new technologies is a fast and reliable internet connection. The roll out of broadband is now close to ubiquitous across the population. Only around 1 in 190 premises are unable to get download speeds on 2Mbps across the UK as a whole. However, in the Peninsula, connection speeds lag the UK average. One in 94 properties cannot get a 2mbps connection speed or greater. It is also more difficult to get a superfast connection with 9.0% unable to get a connection speed of 30mbps in the Peninsula compared to 5.4% in the UK as a whole.

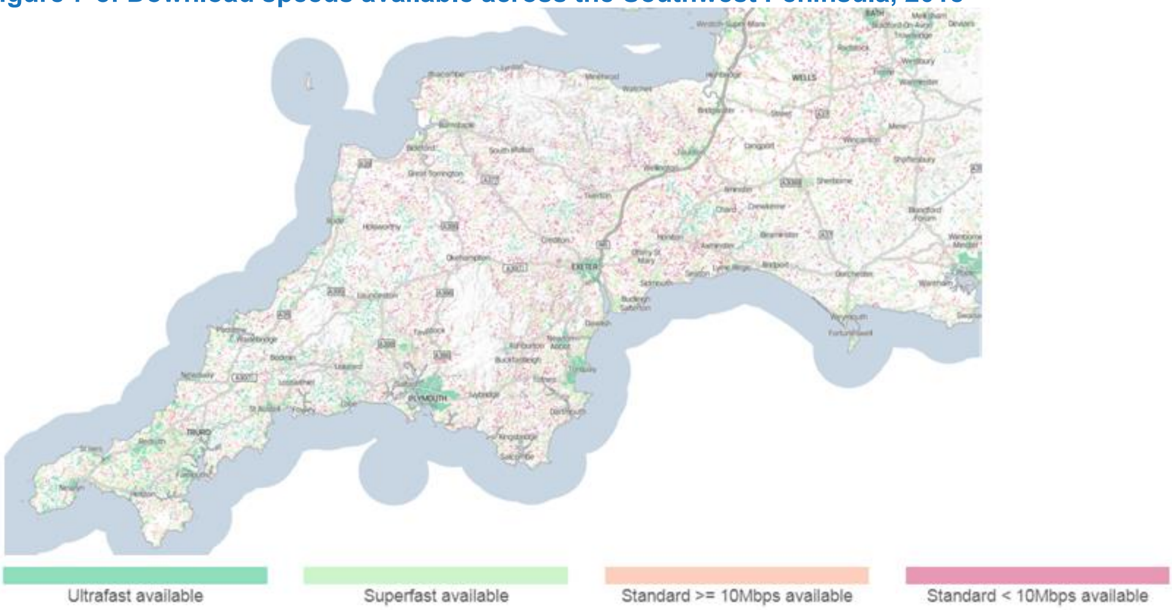
Figure 7-7: Inability to access fixed line broadband connections by connection speed, 2018



Source: OFCOM

The story is different in the more urbanised areas of Plymouth where broadband availability is near universal and fast 30Mbps connections are unavailable to only 1.9% of premises. Across the rest of the Peninsula, available connection speeds vary with a pattern which does not show a simple urban/rural divide. Exeter and Plymouth benefit from the availability of ultrafast connections along with Falmouth, Penzance, Torquay, Paignton, Newton Abbott along with large patches of the rural Peninsula, for example in West Cornwall, and around Redruth and Camborne. This shows that it is not axiomatic that rural broadband must lag urban or suburban broadband.

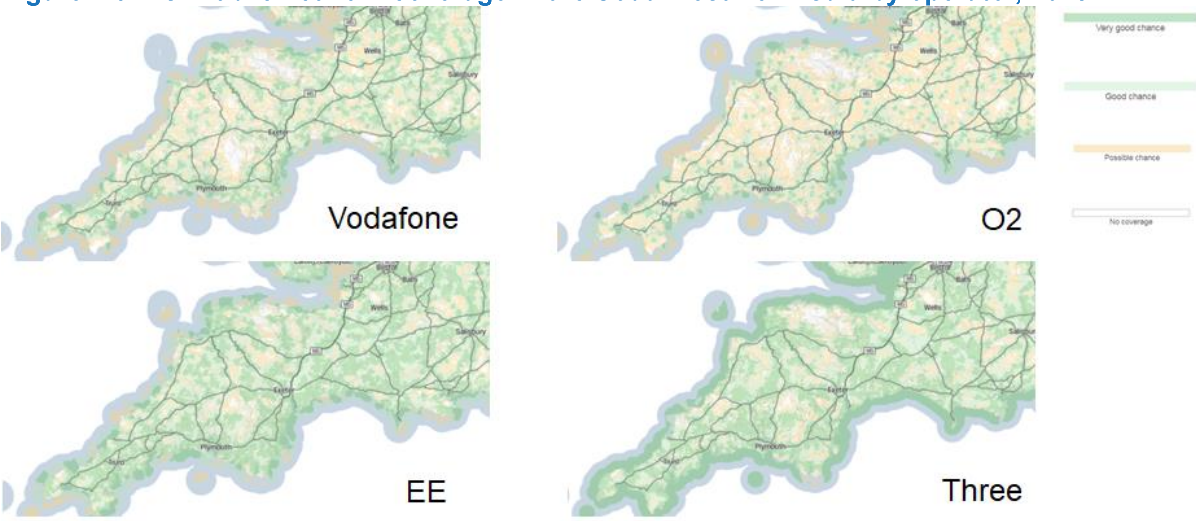
Figure 7-8: Download speeds available across the Southwest Peninsula, 2018



Source: OFCOM

Media and communications use is seeing a rapid switch to mobile devices and many of these use data through the cellular network rather than via Wi-Fi. Mobile phone infrastructure is in transition between 4G and 5G infrastructure. At the time of writing 5G has become available in several of the UK's major cities but is not yet available anywhere in in the Peninsula. The dispersed nature of the population in the Peninsula makes it difficult for coverage via mobile phone masts to cover a very high share of the population. 4G network coverage by different network operators is shown in Figure 3.10 below.

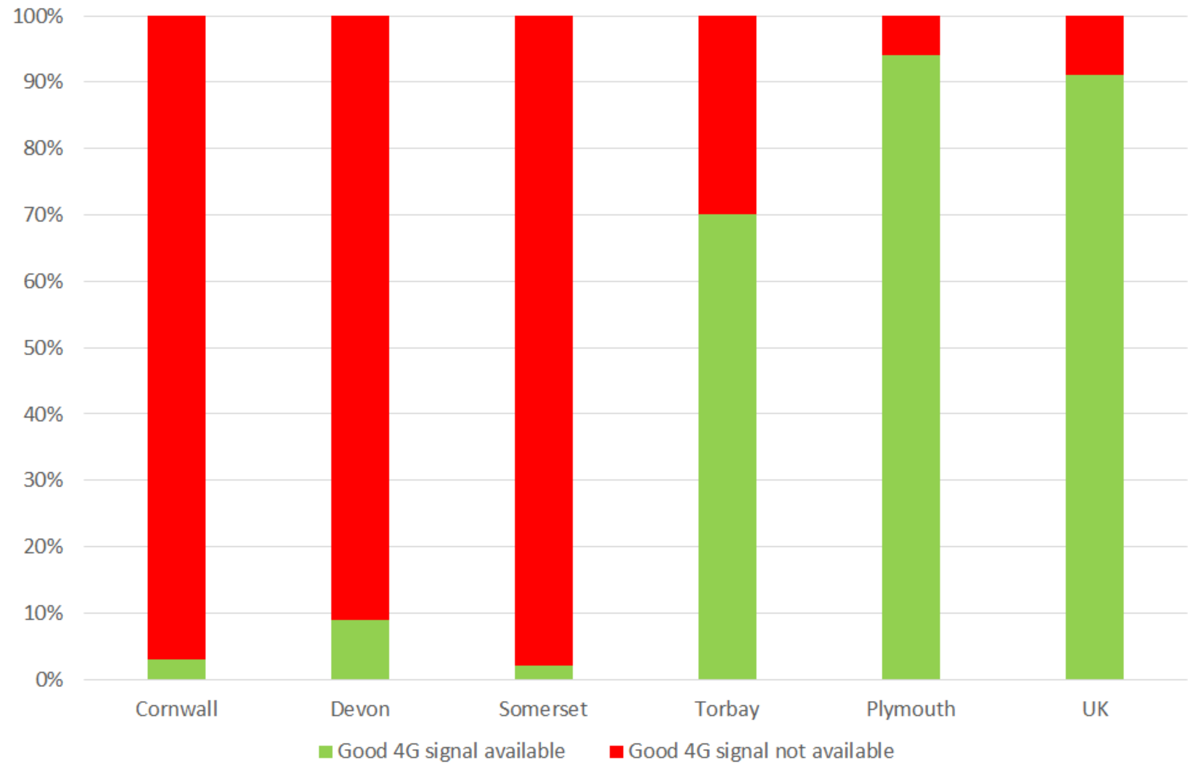
Figure 7-9: 4G mobile network coverage in the Southwest Peninsula by operator, 2018



Source: OFCOM

Given that people in the UK now check their smartphones, on average, every 12 minutes of the waking day and "most people now say they need and expect a constant internet connection, wherever they go"[41], it is clear that ubiquitous data coverage is becoming increasingly important. Overall, 91% of the UK landmass is covered by a good[42] outdoor 4G connection from at least one operator. Across the Peninsula, coverage is substantially poorer than the UK average. According to OFCOM, only 2% of Somerset, 3% of Cornwall and 9% of Devon by land area achieve a good outdoor 4G connection.

Figure 7-10: Share of landmass that has a good 4G connection, 2018



[41] OFCOM Communications Market Report, August 2018 [https://www.ofcom.org.uk/about-ofcom/latest/features-and-news/decade-of-digital-dependency accessed 27/01/2020]
[42] Consistently faster than 2Mb/s download speed

Source: OFCOM

If trends continue as previously, we would expect a continued increase in 4G coverage across the Peninsula, the gradual introduction of 5G connectivity (initially in the cities) and the continued roll out of ADSL broadband and fibre to ever growing share of the population. In general, we would expect digital connectivity across the Peninsula to lag behind the UK average due to the Peninsula's relatively dispersed population.

However, technology does not stand still and building out 4G and 5G coverage will not mean that the Peninsula eventually 'catches up'. The generations of mobile phone technology have been introduced on roughly ten year cycles, so we might expect 6G or even 7G to follow in the coming decades. Likewise, fixed line internet saw dial-up connections replaced by broadband and are now seeing a transition to fibre connections. However, these trends may also be disrupted in coming years. Various companies are developing satellite constellations[43] to provide low cost ubiquitous and fast global internet provision. It is possible that this may reduce the Peninsula's geographic disadvantages compared to the rest of the UK and to help level the global playing field for digital connectivity.

7.8 Economic and behavioural responses to transport and communications technology

The economic changes brought about by communications and computing advances are complex and interdependent, and economists vigorously debate their impacts. Difficulties of measuring and understanding arise partly because of the interplay between specific IT investments by firms, wider digital ecosystems (like digital payment systems, cloud computing or digital marketplaces) and the development of the skills and business models to capitalise on the opportunities that these technologies bring.

The evidence suggests that it can take decades for the combination of technologies, culture and know-how to combine and enable new businesses or new working practices. This suggests that while the impacts of future technological change may evolve into something very significant, these changes are likely to develop gradually.

The explosion of digital and communications technologies have occurred alongside increased business formation rates, a shift towards micro businesses, increased working from home, and trends towards developing the Sharing Economy or the Membership Economy. Since 2000, the stock of UK businesses has risen by 66%. This coincides with a 67% increase in the number of people who are self-employed between 2000 and 2016. Kim and Orazem[44] find that "*broadband availability has a positive and significant effect on location decisions of new firms in rural areas [...]. The broadband effect is largest in more populated rural areas and those adjacent to a metropolitan area, suggesting that this effect increases with agglomeration economies*". Phillip and Williams[45] find that poor rural communications coverage is exacerbated by other factors. They find that "*Complex combinations of personal attributes, for example, age, income levels, digital skills, and perceived benefits of Internet use, influence the ability of individuals, households and businesses to capitalise on the opportunities presented by the digital economy.*" Other research finds that improved connectivity alone could exacerbate productivity differences between urban and rural areas – particularly where there are differences in the types of businesses and the skills of local people. Examining the roll out of broadband across Ireland, McCoy et al[46] found that "*the availability of basic digital subscriber line (DSL) broadband resulted in increased numbers of both low and high-tech firms, while the benefits of*

[43] Both OneWeb and Starlink have begun launching their internet satellite constellations. Starlink envisages around 12,000 satellites once the constellation is complete providing 1 Gb/s speeds (comparable to current fibre networks). Other companies are investing in high altitude drone or balloon based broadband provision.
[44] Kim, Yand Orazem, P, Broadband Internet and New Firm Location Decisions in Rural Areas, American Journal of Agricultural Economics, Vol 99, 2016
[45] Philip, L. and Williams, F., 2019, Remote rural home based businesses and digital inequalities: Understanding needs and expectations in a digitally underserved community, Journal of Rural Studies, Volume 68, May 2019, Pages 306-318
[46] McCoy et al, November 2017, The impact of broadband and other infrastructure on the location of new business establishments, Grantham Research Institute, LSE

middle mile fibre in drawing firms to regional towns and cities appear to be concentrated in the high-tech sector."

Communications technologies are critical to the successful growth of businesses in the Peninsula. However, this relationship is complex and is likely to be mediated by other factors such as IT literacy and entrepreneurialism. With the growing importance of the intersection between transport and communications technologies, the development of ubiquitous mobile data services and fast reliable broadband are critical.

7.9 Transport implications of digitalisation

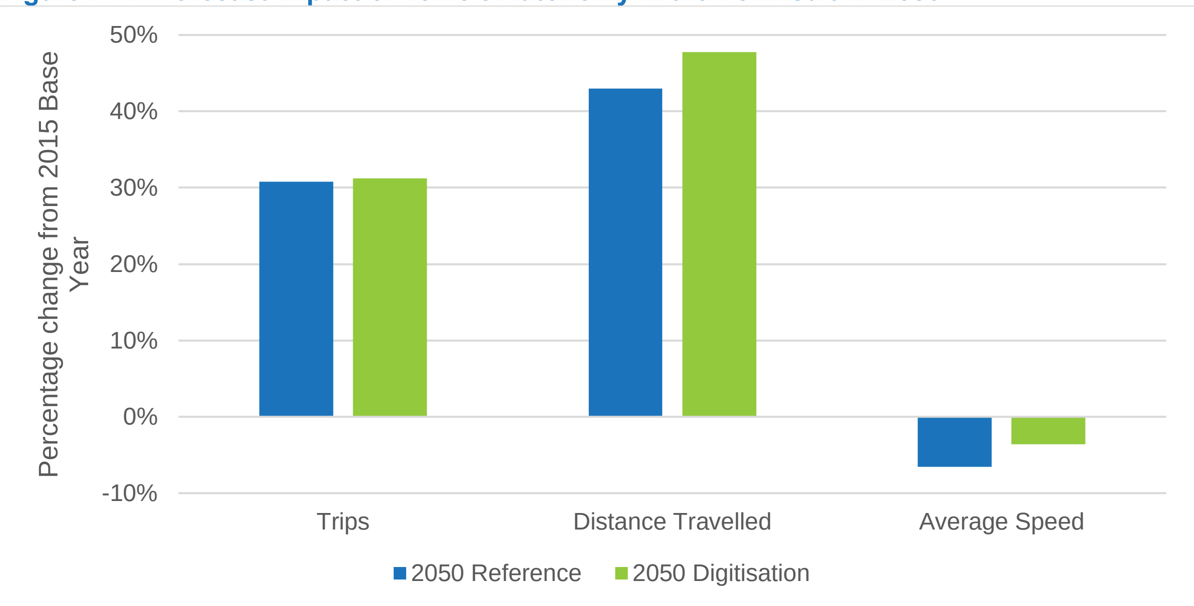
It is not possible to comprehensively model the impact of digitalisation on travel in the Peninsula, there are simply too many facets of the changes in technology which are influencing behaviours and introducing new possibilities for moving people and freight. It has been possible to look at the effects of two of the principal changes associated with increasing autonomy in vehicles: the potential for greater traffic volumes to be carried on existing roads and the reduced in-vehicle values of time where time can be use productively.

This scenario has been based on an assumption that in 2050 50% of the vehicle fleet will be automated at Level 4 and the remaining 50% will be a combination of Level 2 and Level 3. We have assumed Level 5 automation (allowing automated use on all roads) will not be developed/available to any great extent by this time. On this basis we are forecasting a relatively modest capacity increase of 25% on roads in the Peninsula where it could reasonably be assumed that a Level 4 vehicle could operate. This includes motorways, dual carriageways and single carriageways designed to a current standard.

In terms of changes to the modelled generalised cost, to reflect reduced values of time the following adjustments have been applied: a reduction of 25% for commuting and leisure purposes and a reduction of 65% for working (employer's business) trips. Freight values of driver time have been reduced by 75%.

Figure 7-11 presents outputs from the PAM providing a comparison between the 2050 reference case and 2050 with the two responses representing the use of autonomous vehicles on the road network. The figure presents percentage change compared with a 2015 base year for weekday (0700 – 1900) trip numbers, distance travelled (vehicle kilometres) and average speeds.

Figure 7-11: Forecast Impact of Vehicle Autonomy in the Peninsula in 2050



The key impacts of modelling the scenario are seen in the measure of distance travelled and average speed. The effect of reducing generalised cost for trips is to increase the average length of trips as other activities can now be undertaken whilst travelling. The digitalisation scenario has an additional

5% of growth in vehicle kilometres above 2015 compared with the reference scenario in 2050 (which is 43% higher than 2015). However, because of the increased capacity achievable through automation on the strategic and major routes the model predicts increases in the average speed of traffic despite the additional vehicle kilometres which the network has to accommodate. The digitalisation scenario in 2050 has average network speeds 4% less than in 2015, whereas the reference case is 7% lower.

The complexity of vehicle interactions combined with uncertainties around the development profile for autonomous vehicles on UK roads mean that it is not realistic to pronounce on the impacts of digitalisation, even when this is limited to one aspect of technological transformation: autonomous vehicles. This is demonstrated by the discussion on the impacts of these technologies on how road space is used with experts predicting everything from major increases in capacity to some reductions. However, the results of this scenario do indicate the potential for technologies to have a meaningful impact on trip lengths and network congestion levels as the proportion of vehicles in the fleet with moderate to high levels of automation increase.

7.10 Digitalisation - summary

The technology revolution is rapidly extending through the transport sector and bringing changes in business models. In particular, a communications and software layers are rapidly developing which link vehicles, service operators and travellers – putting the 'smart' in smart transport. Smart transport technologies, such as smart routing algorithms or Mobility as a Service, offer opportunities for lower cost and more efficient transport, with consequent opportunities to reduce carbon emissions and support economic objectives.

However, smart transport relies on reliable and fast data connections covering a wide area. The Peninsula's geography, relatively low density population and poor spatial coverage of communications pose critical challenges to the viability and adoption of such services. Poor connectivity and reception 'not spots' threaten all of these technologies from smart transport to basic route planning and ticket purchasing. This in turn threatens potential economic gains from more efficient and lower cost transport solutions.

On the railways, the Digital Railway strategy is based on the GSM (2G) mobile network providing on-train signalling. In future it could rely on 4G or 5G mobile communications. Mobile communications are also becoming a basic expectation of travellers as Wi-Fi provision on trains is expanded. This can help to increase productivity and counter the challenges to business of longer journeys to, from and within the Peninsula. Wide area digital connectivity is critical here as well.

National government has a target of enabling fully autonomous vehicles on UK roads without a human driver by 2021 and the continual progress in vehicle automation technologies seems set to continue. However, the nature and timing of the roll-out of autonomous vehicle technologies is highly uncertain. The SMMT forecast this to be a gradual change and have not made a judgement about whether or when Level 5 automation will become available. Initially, vehicles are likely to operate only in specific environments or on specific routes (known as Level 4 autonomy) and the range of circumstances that can be safely navigated seems likely to increase steadily.

If a high level of autonomy is achieved and drivers are no longer required for many journeys, then this could be transformative. The Technology Strategy Board found that in 2013, the total global value of time spend travelling by car was around £3.7 trillion. Could automated vehicles return an appreciable share of this to people as useful or valuable time? These technologies provide an opportunity for radical changes in transport provision as well as significant reductions in transport costs, and improvements in driving efficiency.

The Peninsula's road network poses particular challenges for autonomous vehicles. It comprises a very high share of local roads of variable widths, potentially hampered by vegetation, lack of curbs, poor signage, etc. Peninsula Transport should keep a watching brief on developments in this area and help local authorities to ensure that local transport policy and local network management facilitates future autonomous vehicles.

Although some time in the future, the combination of smart transport routing and autonomous vehicles may offer the opportunity for cost effective, on-demand services which substantially improve rural transport opportunities. This again points to the critical role that communications networks will play in future transport provision, as well as the importance of overcoming potential barriers to autonomous driving on rural routes.

Ride-hailing and Maas products seem set for rapid growth. The characteristics that make them urban phenomenon at the moment show signs that they may change as mobile communications expand and user bases mature. However, population density may be a significant barrier to their roll-out in parts of the Peninsula. The future of these different disruptors is closely bound together. If autonomous vehicle technology develops quickly, then this could rapidly accelerate the expansion of ride hailing and MaaS services. In this scenario, the costs of road transport may fall quickly and models of car ownership could see radical change.

Autonomous driving may offer the opportunity to increase network utilisation but, by improving transport options and reducing costs, it also raises the possibility of inducing transport demand with implications for road congestion.

The Peninsula does not have a digital strategy that covers a congruent area. Peninsula Transport will therefore need to engage with Superfast Cornwall, Connected Devon and Somerset and others to highlight the importance of wide area digital communications coverage to enable smart transport services to develop thrive within the Peninsula.

We cannot say which technology trends will continue, which will stall, and which will accelerate. The uses that we will find for these future technologies are likewise unknowable. However, we can be confident that there is a good chance that technology developments will disrupt our activities, lifestyles and ways of working in the years to come. All of this points to a complex complementarity between digital and physical connectivity, and the need for a flexible approach to emerging technologies and patterns of behaviour.

8. Spatial Planning

Urbanisation

Chapter Overview

Transport and spatial development go hand in hand. Over recent decades the Peninsula has seen a mixed pattern of development with growth along the M5 corridor, in its largest population centres and in some rural areas.

Globally, patterns of spatial development are dominated by the megatrend of urbanisation, but in the UK recent experience has been much more complex. Long term patterns of urbanisation have been interrupted by hollowing out of city centres and shifts to the suburbs through the 70s, 80s and 90s as the manufacturing sector declined. Now, at least for the largest cities, people have been flocking back to city centre living, drawn by booming service sector activities like finance and professional services which thrive on the dense knowledge networks that cities provide.

In this chapter we examine the future spatial development of the Peninsula and examine what this might mean for Peninsula transport.

8.1 Global and national spatial development

Over the long term, economic forces can have dramatic effects on where people live. In 1800, only around 2% of the global population lived in cities, but now this is 50% and climbing quickly. These trends began in the UK many centuries ago and now well over 80% of the UK population live in urban areas. Urbanisation has been driven by the growing benefits of being close to markets as workers and businesses have become increasingly specialised.

While the very long term experience in the UK does follow this global pattern, recent history has been much more complex. Through the 1980s and 1990s economic restructuring saw the decline of many manufacturing jobs within city and town factories. For example, the Farley's Rusks factory closed in 1990 in Plymouth and restructuring at Clarks shoes resulted in both the Plymouth factory closing and the head office in Street closing in 1996 with the losses of 320 and 330 jobs respectively.

Since the mid-1990s, the UK has seen something of an urban renaissance in the largest cities and population growth has returned to the centres of Liverpool, Manchester, Leeds, London and others. Again, the driving force behind this is economic. Finance and business services are the sectors that gain the most from dense urban agglomerations[47], and these sectors grew quickly generating wealth for city centre workers. Much of the smaller towns do not appear to have grown as quickly, although this may partly be due to a focus on places that suffered from the decline of specific industries like mining and manufacturing, particularly in the north of England.

Outside of cities and towns, development has followed a different pattern. Transport corridors have attracted commercial developments in the form of distribution centres, out of town retail centres, 'big box stores' and new business parks. While factories were closing through the 1980s and 90s, the UK was rapidly developing its business and industrial parks with areas on city fringes such as Marsh Mills and Langage near Plymouth, Pynes Hill and Sowton on the Exeter fringes, and Treliske and

[47] There is a large body of evidence supporting this which is well summarised in Ed Glaeser's Book, "Triumph of the City" (Glaeser, Edward L. Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier. New York: Penguin Press, 2011.)

Threemilestone near Truro. As urban centres declined, people also started to move out and population shifted to the suburbs[48]. In the 1990s and 2000s geographers talked of 'counter-urbanisation'. Recently, access to good digital communications has begun to change patterns of demand for housing as digital commuters weaken the spatial link between where people live and where they work[49].

Elements of this complex pattern are reported in the Future of Cities working paper from 2014 which states that: '*The slowing of the 'urban exodus' observed by Lomax et al (2012) is consistent with the 'urban resurgence' reported as taking place in the UK and many other countries over the last two decades (see, for instance, Turok and Mykhnendo, 2007). This would seem to contradict earlier speculation that the post-industrial era following the contraction of the manufacturing sector after the 1960s was linked to a fundamental reversal in population redistribution away from urbanization to a 'counter-urbanisation' pattern involving a rural and non-metropolitan renaissance and a negative relationship between population growth and city size (Berry, 1976; Champion, 1989, 2001; Fielding, 1982)*."[50]

While broad patterns of development have favoured clustering of activity, over short timescales and in particular places, patterns have been much more complex. This suggests that predicting future changes in patterns of settlement and economic activity is uncertain. While the planning system can help to shape future development demands, it is also driven by complex economic forces which can pull in different directions.

8.2 Urbanisation within the Peninsula

In the Peninsula, the 2011 census showed that 56% of Peninsula residents lived in urban area compared to 82% in England and Wales as a whole. Rurality and low population density are particular features of much the Peninsula STB area and create distinct transport challenges. Figure 8-1 shows the pattern of urbanisations across England and Wales.

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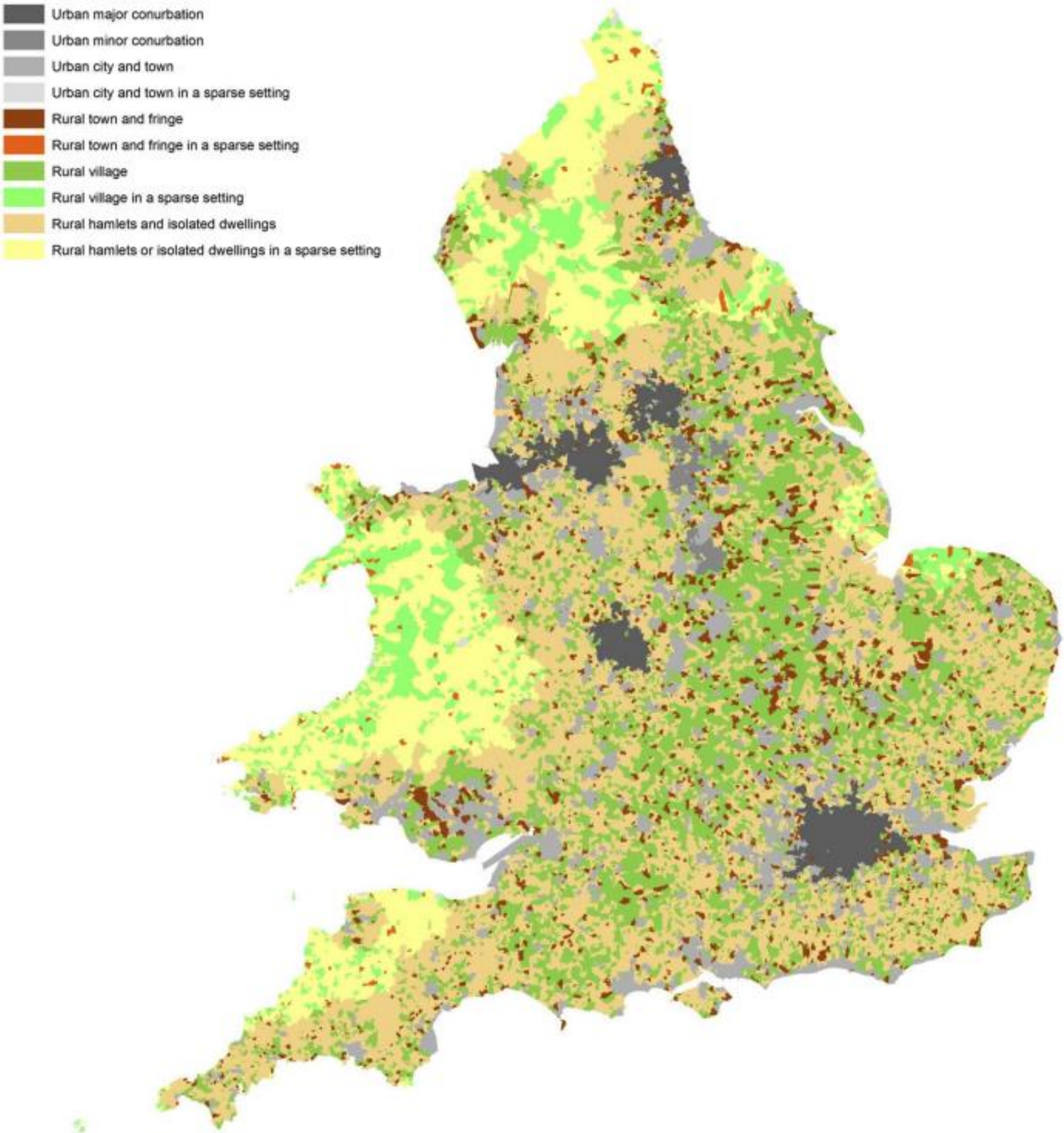
[48] See, for example, Champion, T., 2001, The continuing urban-rural population movement in Britain: trends, patterns, significance, Espace Populations Sociétés 19 (1), 37-51

[49] Ahlfeldt, Gabriel M. and Koutroumpis, Pantelis and Valletti, Tommaso (2017) Speed 2.0: evaluating access to universal digital highways. Journal of the European Economic Association, 15 (3). pp. 586-625. ISSN 1542-4766

[50] People in cities: the numbers, Future of cities: working paper, Foresight, Government Office for Science, June 2014 [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/321814/14-802-people-in-cities-numbers.pdf accessed 02/02/2020]

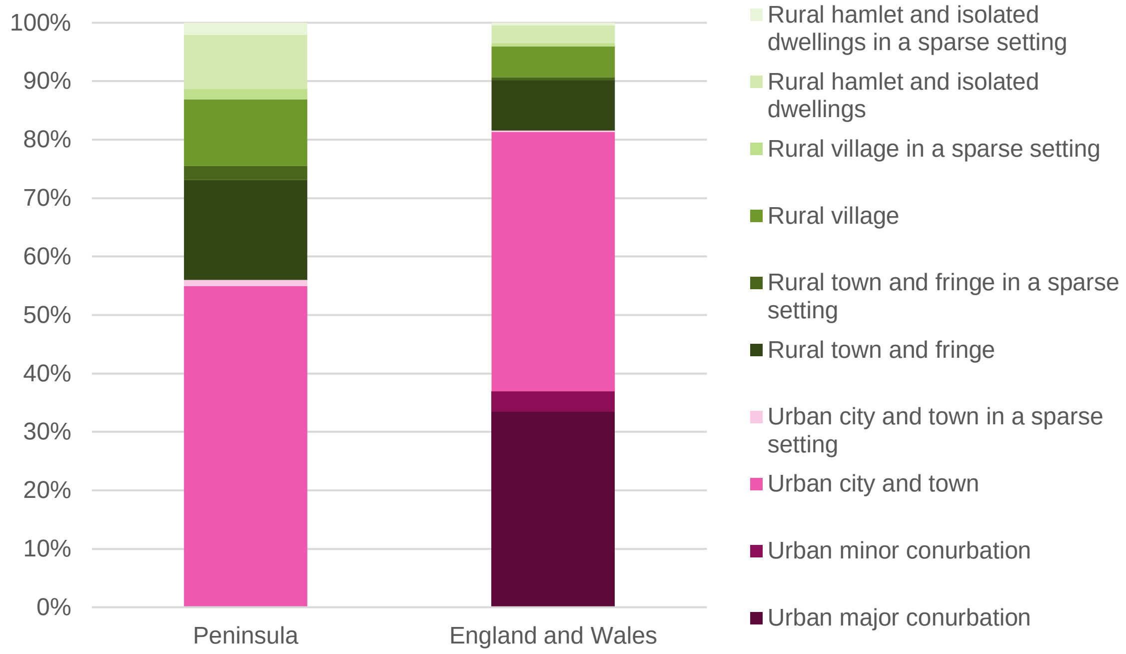
Figure 8-1: UK urban-rural classification map, 2011



Source: Urban and Rural Area Definitions for Policy Purposes in England and Wales [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/239477/RUC11methodologypaperaug_28_Aug.pdf accessed 02/02/2020]

Spatially, the Peninsula is mainly made up of rural areas and isolated dwellings, punctuated by urban cities and towns.

Figure 8-2: Urban-rural classification

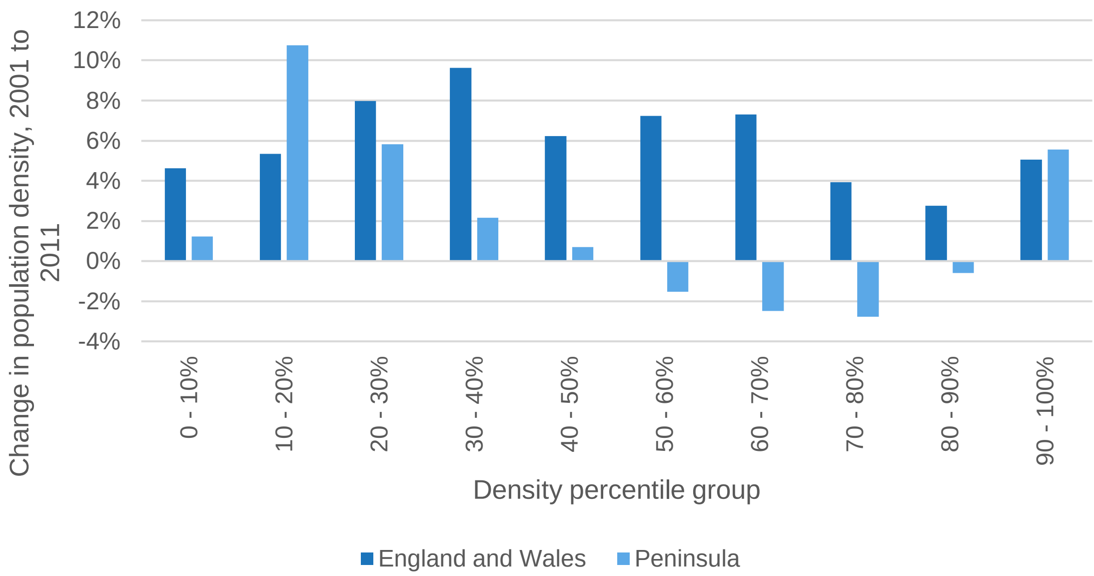


Source: 2011 Census

Data consistency makes it very difficult to examine how development patterns have evolved over time within the Peninsula. Areas definitions have changed, as has the urban/rural classifications system that is used to describe them. However, we have been able to examine the raw data to see whether recent patterns of growth and densification in the Peninsula are similar to those seen in England and Wales as a whole.

We collected and analysed data on the density of the usual resident population for each lower layer super output area from the 2001 and in the 2011 censuses. For each census, the areas were grouped into deciles based on their population density. The average density within each decile group was calculated for each census year. We then compared the change in average densities between the two census years to see which decile groups were growing fastest. Figure 8-3 shows the outcome of this analysis.

Figure 8-3: Change in population density in different population density decile groups, 2001 to 2011.



Source: Connected Economics analysis of Census data

England and Wales shows a relatively consistent twin peaked pattern. The second decile group (i.e. the 10% of areas population densities ranging from the 10th to the 20th percentile) saw the strongest population growth. As areas became denser, the growth rate declines until the 8th decile of density, after which it begins to climb again. The 6th, 7th, 8th and 9th decile groups all saw declining population density. However, the 10% of densest areas grew strongly. The twin peaks in this pattern appear to reflect the trend of 'urban resurgence' in the largest cities while at the other end of the distribution technology and other factors continue to attract people to less dense residential environments. The least dense 10 percent of areas in England and Wales buck this pattern, but this may reflect unique factors such as difficulty developing additional housing within national parks, or other protected areas.

The pattern of development in the Peninsula is somewhat different. All decile groups saw population density increase. However, the strongest growth was in the 3rd and 4th decile groups. It should be noted that the population density of England and Wales is around twice as high as the population density of the Peninsula. The 10% of areas with the lowest population density in the Peninsula therefore represent more sparsely populated areas than the 10% of least sparsely populated areas in England and Wales as a whole. Indeed, only 2.8% of the Peninsula's 1,360 Lower Layer Super Output Areas would make it into the national top 10% of areas by population density

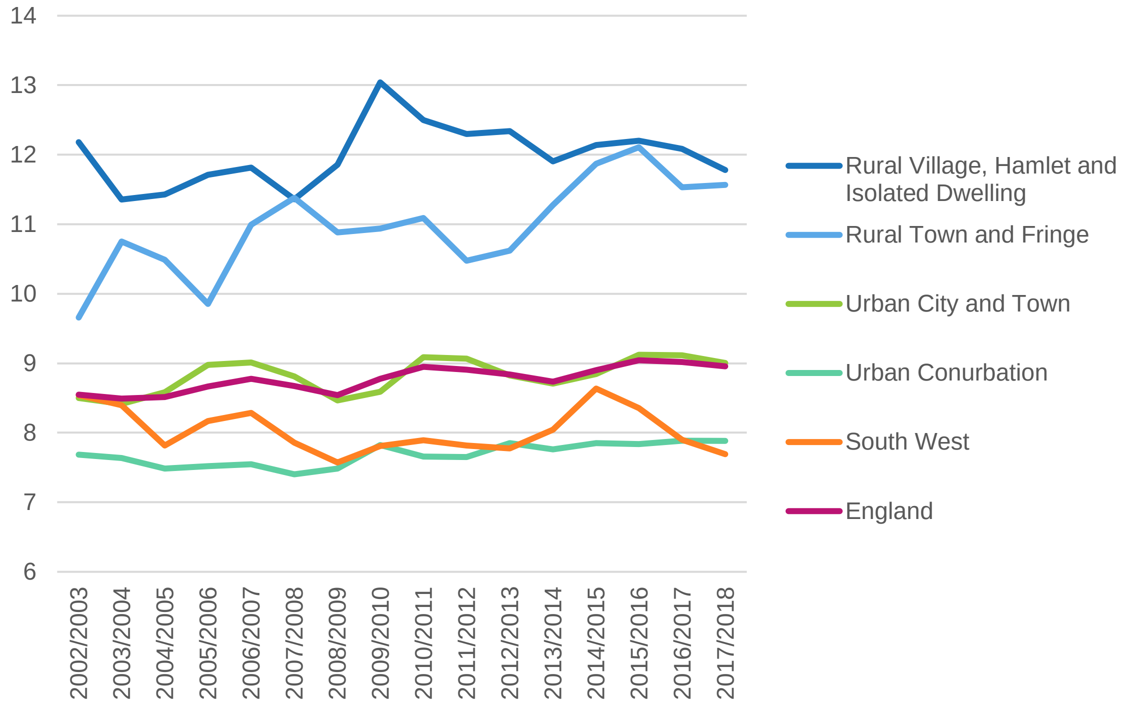
This analysis only represents 10 years of data. However, it does appear that national patterns of urbanisation are not clearly reflected in the Peninsula. A more comprehensive and longer term analysis could help to shed light on patterns of spatial development but are beyond the scope of this study. Pressure for development in the Peninsula may not respond in the same way to longer term economic trends around economic restructuring and service sector growth, or it may behave in a way which uniquely reflects the opportunities to locate in the Peninsula and enjoy quiet places with low population densities.

8.3 Spatial development and transport behaviour

The sectoral and occupational patterns of economic restructuring playing out across the UK are also seen in the Peninsula (see Chapter 6). Employment has shifted away from factories and towards the service sector knowledge economy. As factory employment declined, city fringe commercial developments attracted the newly created employment opportunities out of city centres in recent decades. How similar trends develop in future could have important implications for future transport needs in the Peninsula.

As the knowledge economy and the service sector has grown, particularly in centres like Exeter, commuting has grown to match and travel to work areas have expanded. Across England, the average length of a commute has risen quite steadily from 8.5 miles to 9.0 miles from 2002/3 to 2017/18. However, this average growth is not clear in all locations. In particular, commuting distances are longest and have grown fastest in rural towns and fringes however, across the South West as a whole, commuting distances have fluctuated and do not seem to show a clear pattern of growth.

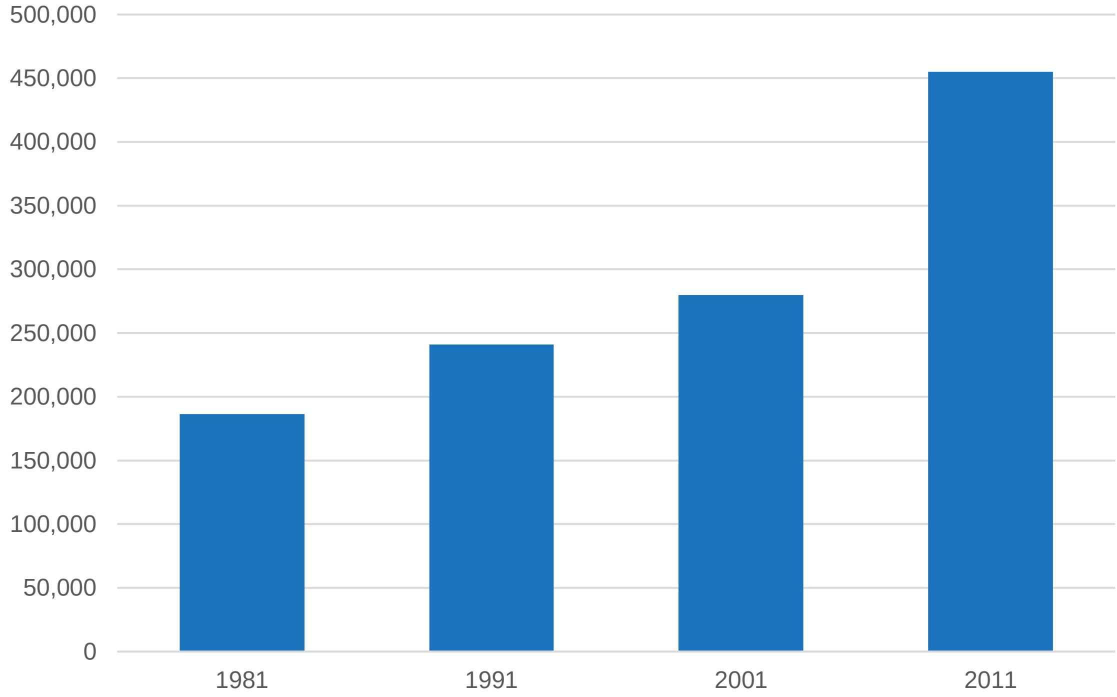
Figure 8-4: Average commuting distance in miles



Source: National Travel Survey

Nevertheless, other evidence shows that commuting distances are expanding and labour markets are becoming more interconnected. Travel-to-work areas map distinct labour markets and show areas where at least 75% of the economically active people who live there, also work there. Travel-to-work areas in the Peninsula have merged as commuting behaviour has changed. Figure 8-5 shows how Exeter's travel to work area has expanded over recent decades.

Figure 8-5: Growth of Exeter's Travel to Work area population



Source; Census data

The expansion of travel to work areas reflects both the growing distances that people travel to work, but also population growth within the catchments of the Peninsula's cities and towns.

Planning can play a role in supporting people to make fewer trips and to live closer to employment opportunities. However, co-location of housing and workplaces does not necessarily guarantee that people will live close to where they work. As the labour market has changed, two income households have grown and residential location for these households can be a trade-off between commuting to two different towns or cities to work. This is just one example of how economic changes and changes in lifestyles can act to change patterns of transport demand in ways that we may not be able to accurately predict.

8.4 Development plans and growth forecasts

The future of these economic and spatial patterns of development could have important implications for the development of transport demand across the Peninsula. Economic and technological forces of the next thirty years may act to increase the concentration of activities in cities and already developed places, or may disperse it more widely to towns, villages and rural locations. Planning policy can have an important influence on this by responding to pressure for development and shaping it to reduce impacts on transport and the environment. In the Peninsula, planning functions are distributed between authorities and districts. There is therefore no Peninsula plan with congruent boundaries to Peninsula Transport.

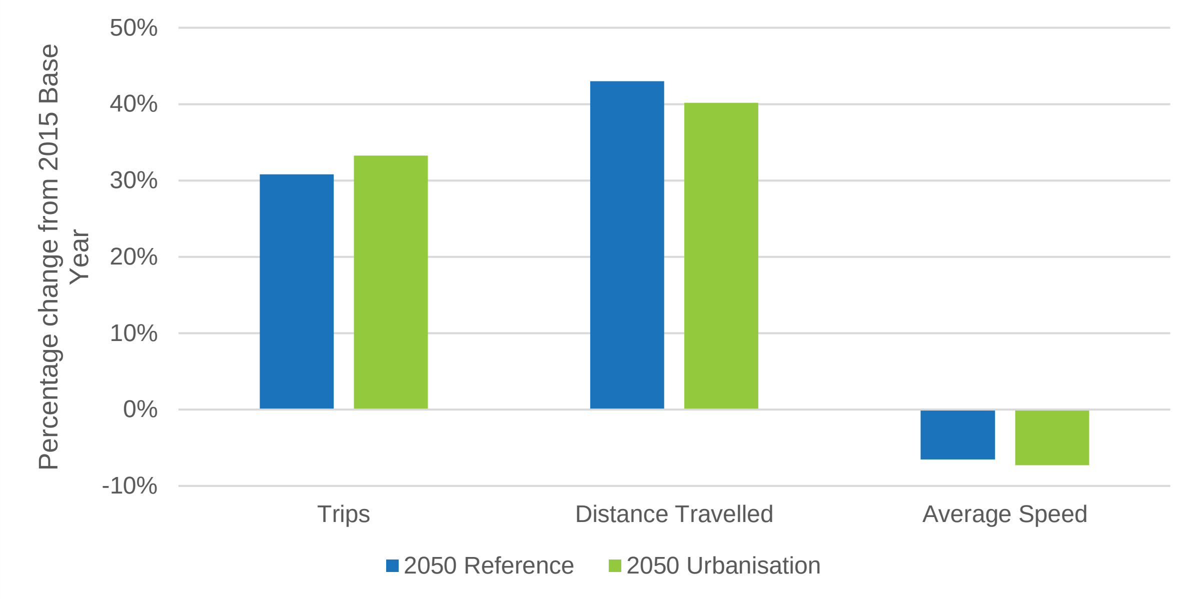
The Heart of the South West Regional Economic Strategy recognises the largely rural character of the area but notes that urban spatial strategies are in place to support growth in the major urban areas and highlights specific opportunities for spatial development, for example at Hinkley Point, at the Exeter Global Campus and around the coast through developments related to the South West Marine Energy Park. Likewise, the Economic Growth Strategy for CIoS LEP notes that "polycentric urban form and for the most part, sparsity of population defines the canvass for economic activity", although it does not identify specific future spatial patterns of development. It is beyond the scope of this study to undertake a detailed assessment of future spatial patterns of economic activity. Indeed, uncertainties about future changes in technology and the nature of economic growth pose critical challenges to anticipating where people and businesses will want to locate in future.

8.5 Transport implications of urbanisation

The urbanisation modelled scenario tests a world where housing and employment growth is focussed on the largest urban areas within the Peninsula to explore the impacts of this on the road network. This will allow us to provide some indication of the strategic impacts of urbanisation alongside qualitative work describing the potential benefits for urban mobility of increased growth within key centres. Higher levels of growth have been assigned to some of the key urban centres in the Peninsula, specifically: Truro, Barnstaple / Bideford, Plymouth, Torbay, Exeter, Taunton and Yeovil. In each case an additional 25% has been added to trips to represent housing and employment growth above the reference case, with the remainder of growth across the Peninsula constrained so that overall levels correspond with the reference case.

Figure 8-6 presents outputs from the PAM providing a comparison between the 2050 reference case and 2050 with the spatial changes representing growth in urban areas applied. The figure presents percentage change compared with a 2015 base year for weekday (0700 – 1900) trip numbers, distance travelled (vehicle kilometres) and average speeds.

Figure 8-6: Forecast Impact of Urbanisation in the Peninsula in 2050



The urbanisation scenario results in additional trips compared to the reference case, a lower number of vehicle kilometres travelled on the network and very slightly reduced average speeds. Most important in this scenario is the interaction between trip making and distance travelled with the result of additional growth in urban areas reducing average trip lengths and some trips off the strategic interurban roads and onto urban routes. This frees up some capacity on the more strategic routes and encourages some additional trip making; however, because a higher proportion of trips are now made on slower urban routes the average overall speed of traffic reduces slightly.

As with earlier scenarios the effects of urbanisation, as measured by the PAM, are small compared with those of from population and economic growth between 2015 and 2050. But this scenario does highlight the potential for development concentrated in smaller geographical areas to reduce travel demand on longer distance, interurban routes. It is also a useful reminder that the concentration of trip making in urban areas increases the potential for car sharing, public transport and active modes to reduce individual car use and realise reductions in congestion and benefits in terms of local air quality, wellbeing and reduced carbon emissions.

8.6 Urbanisation - summary

The global megatrend of urbanisation continues apace, driven by the opportunities that cities provide for specialisation. Countering these centripetal forces in the UK, has been a pattern of deindustrialisation that has seen decline in city and town manufacturing activities, and more recently by digital communications which increasingly enable people and businesses to remain connected while operating in more dispersed locations. We don’t know how the future battle between these push and pull factors will affect the pattern of demand for development in the Peninsula.

The Peninsula far is less urbanised that the rest of England and Wales. While the UK has seen growth in the largest urban centres and in more rural areas while smaller towns have grown more slowly, this pattern is not repeated in the Peninsula which has seen broad based growth.

There is no planning function at the Peninsula level and no integrated spatial strategy to help guide our understanding of future spatial development at a strategic level, and assessment of detailed local plans is beyond the scope of this study. Forecasts of future development patterns have been collated to underpinning transport modelling and these do reflect broad population trends as well as specific plans for local development sites. However, the reliance on broad demographic trends means that this is not able to pick out future hotspots of development activity at a strategic level. We recognise that this leaves the future pattern of spatial development uncertain.

Analysis using the transport model shows that the impact of concentrating growth in key Peninsula towns and cities is to increase the number of road trips made, but to reduce the overall number of vehicle kilometres, reflecting an increased intensity of short trips in urban areas.

PART 3

9. Conclusions & Recommendations

Chapter Overview

This is a time of great change. Across all of the potential futures we have explored, our assessment has found that powerful forces of demography and migration from the rest of the UK are likely to create unprecedented demand for trip making across the Peninsula. This challenge comes at a time when it has never been more important to protect our environment and maintain the natural capital that make the Peninsula so special.

This section provides conclusions and recommendations relating to the chapters covering the five trends expected to impact the ways people connect in the Peninsula: decarbonisation, flexible lifestyles, the world of work, digitalisation and urbanisation. Key recommendations are shown in **bold, blue text**.

9.1 Decarbonisation

The decarbonisation of transport is one of the primary challenges Peninsula Transport faces in the coming decades. Each of the local authorities that make up the STB have declared Climate Emergencies so it is clear that regionally the political will is in place to focus on a transition to a low carbon economy.

Emissions from road transport contribute the most CO_2 and so are the biggest challenge for Peninsula Transport especially in the context of expected future growth in transport demand. There are essentially two ways to reduce the carbon impacts of travel in the Peninsula:

1. Reduce the carbon emitted for any given journey (efficiency improvements); and
2. Change the quantity and pattern of journeys to reduce the amount of energy used and enable carbon reductions.

The first of these is largely driven by technological improvements. For road transport the development of zero emission vehicles provides a seemingly convenient solution to reducing emissions without necessarily changing travel patterns. With the exception of providing supporting infrastructure, driving changes in vehicle fleets is largely outside the remit of Peninsula Transport. This also comes with its own set of challenges because of the emissions associated with the manufacture of vehicles and batteries (or hydrogen fuel cells) and the requirement for charging infrastructure to ensure both local and strategic journeys can be made. The Government's latest plan to ban the sale of new petrol, diesel or hybrid cars by 2035 should drive the market to deliver the required zero emission vehicle fleet. Alongside this, **Peninsula Transport (together with other STBs) has an important role to play in considering the strategy for charging and refuelling infrastructure. A key recommendation is that Peninsula Transport considers this from a strategic perspective ensuring that inter-regional and inter-settlement road journeys can be made comfortably by zero emission vehicles**. Indeed, all of the STBs have formed a Decarbonisation Task and Finish Group to look at these types of issue. The focus on strategic journeys should not preclude discussions with local highway authorities around the delivery of local supporting infrastructure, such as charging for homes, businesses and other key locations where private parking is not available, to ensure a co-ordinated approach.

Efficiency benefits can also be achieved immediately through encouraging changes in driver behaviour for existing journeys: reducing cruise speeds, anticipating conditions to reduce the need to brake and accelerate etc. Whilst it is hard to quantify the impact such changes can make (although it is clear they are relatively small scale) the opportunity to influence Peninsula residents and businesses to consider and mitigate the environmental impact of their journeys wherever possible should not be ignored. **A recommendation is therefore that Peninsula Transport promotes personal responsibility for carbon emissions, emphasising the opportunity for individuals to reduce carbon and air pollutant emissions through their travel choices and behaviour.**

The second method of reducing emissions is to change the pattern of journeys. There are a number of ways of doing this:

- Choosing not to make a journey (e.g. working from home, attending a meeting via teleconferencing facilities);
- Selecting transport modes to minimise the emissions of a journey (e.g. making a journey by train, bus or active mode instead of driving, using a park and ride or parkway station to limit the use of a car to only part of a journey); or
- Increasing the load factors of the existing mode of travel (e.g. car sharing on a commute, closer tailoring of the supply-side of public transport services to the demand).

The Flexible Lifestyle chapter of the report has discussed the opportunities for reducing travel demand which arise from changing work patterns and the increasing ability to connect workers with their colleagues and required systems from locations remote from the workplace. This requires a better understanding of the travel patterns of flexible workers alongside support for digital connectivity. Encouraging people to use more sustainable modes has been one of the main aims of transport planning over the past twenty years. There have been some notable successes; however, generally the picture is less positive - perhaps because of the affordability and convenience of car travel compared to other modes (particularly once the sunk costs of vehicle ownership, insurance and tax have been committed). Peninsula Transport has limited influence over many of these elements: fuel duty and taxation are set centrally by the Government and the cost of vehicles is impacted by market forces, trading rules and other external factors.

There are significant opportunities for decarbonisation within public transport fleets, particularly buses, and this will be critical if public transport is to play a wider role in accelerating the transition to zero emissions. There is a risk that decarbonisation of vehicle fleets in the Peninsula may lag behind the average, as historically older vehicles have been cascaded into the Peninsula from other locations. Peninsula Transport has a role to play in highlighting the benefits of low or zero carbon public transport and working with central government and others to resist these pressures. This could be particularly important when travel for other purposes is considered, including education, leisure and shopping, which make up the majority of trips. The fact that the cost of running an electric vehicle is lower than that of vehicles powered by internal combustion engines could be seen as a double-edged sword. On the one hand this provides an incentive to switch to zero emissions technology (noting that the purchase price of these vehicles is still higher on average than their petrol and diesel counterparts), and on the other an incentive to make more or longer trips as the cost of doing so has reduced. However, Peninsula Transport and its constituent authorities do have some tools which can be deployed including, for example, parking controls, the operations of their own vehicle fleets, taxi licensing, and opportunities to shape public charging/refuelling networks. By providing coordination in these policy areas, Peninsula Transport could help provide a consistent experience and consistent incentives for Peninsula residents and businesses to go electric. **This is also an area where discussions with national policy makers are important and the best opportunity for STBs to influence decisions will be through presenting a single voice, using channels such as the Decarbonisation Task and Finish Group.**

There is more work to be done understanding where and how rail, bus, walking, cycling and higher occupancy vehicles could achieve the biggest scale reductions in transport emissions in the Peninsula. This is not just a passenger issue; road freight is poorly understood and there may be significant opportunities to consolidate freight movements in order to improve the emissions per tonne of freight travelling on the Peninsula's road network. **A better understanding of the opportunities and next steps can be developed through more detailed work focussed on particular areas**

including proposed future workstreams such as the Carbon Transition Plan, Economic Corridor Studies and Freight Study.

9.2 Flexible lifestyles

Trends in flexible working and home working affect the Peninsula more than most places. These trends present an opportunity to reduce peak congestion. However, there is currently little data and only a weak understanding of travel patterns of non-traditional commuters. **Peninsula Transport can play an important role in helping to better understand these trends which are common to areas across the Peninsula. It can also help to coordinate policy across the Peninsula to encourage the reduction of traditional peak period commuting.**

Online shopping has widened the range of available goods and services available to Peninsula residents. Modern delivery systems can often fulfil these needs on the same or the next day. For many residents, particularly younger groups, this level of service is now expected. However, a consequence has been the rapid increase in small vans making last mile deliveries.

The impact of this, and other freight traffic patterns on the performance of the Peninsula's transport network is not well understood. Before developing a transport strategy, it is important that the Peninsula develops a clearer understanding of the nature, level and outlook for different types of freight traffic.

Different solutions to the last mile delivery challenge are being investigated (such as droids, van/drone-integrated delivery systems, smart door locks, etc.) and it is not clear how these will develop. This is a complex market where Peninsula Transport's role may be limited. **However, we recommend that Peninsula keeps a watching brief on emerging last mile delivery innovations and ensures that transport policies in the Peninsula are supportive of these innovations where they could reduce congestion from last mile deliveries without compromising environmental quality.** This may mean, for example, working to ensure that planning policy does not obstruct vehicle use on/adjacent to pavements or the development of local delivery micro-consolidation hubs.

9.3 The world of work

The way that the Peninsula earns its living is changing. Over the long term, occupations have been shifting towards professional, technical and managerial occupations and sectors are shifting towards business, personal and consumer services. This highlights the need for continued improvements in passenger services, digital communications, and digital communications on those passenger services.

The Heart of the South West Productivity Strategy identifies transformational potential in various sectors including advanced manufacturing, marine and energy sectors. Cornwall and the Isles of Scilly's *10 Opportunities* document similarly highlights opportunities in high-tech and knowledge related sectors such as creative, space, mining and aerospace sectors. The high-tech, knowledge intensive and agile businesses of the future will rely on high quality and reliable passenger services as well as sophisticated freight networks supporting efficient and reliable supply chains across the Peninsula.

The relative peripherality of parts of the region compared to other parts of the UK could be an important part of the Peninsula's productivity deficit. This highlights the importance of high quality strategic routes and their resilience and reliability, particularly in the context of high seasonal demand associated with the visitor economy. These strategic routes are vital for the economic performance of the Peninsula but are largely controlled by Highways England and Network Rail. **Peninsula Transport should consider opportunities to work with DfT, Highways England and Network Rail to develop joint visions for strategic routes and approaches to increasing their priority within regional infrastructure provision.** It is beyond the scope of this study to recommend specific mechanisms, but it may, for example, be possible for Peninsula Authorities to argue for additional or accelerated enhancements on the Strategic Road Network instead of other local priorities on the Major Road Network in future.

While strategic route networks connect the Peninsula to the rest of the UK, its gateways connect it to the rest of the world. The Port of Plymouth provides the only direct passenger ferry service to Europe while the two airports provide important national and international connections and enable service sector businesses to trade more easily with the Peninsula. Freight routes to ports support the region's export base which trades globally by sea from Plymouth, Falmouth and Teignmouth ports. **However, trade data provides limited information about the origin of freight shipments within the UK or within Europe – an omission which is an important gap in understanding the region's trade with Europe and how this might be affected by Brexit. The commissioning of a Peninsula Transport Freight Study will help to fill the gap in trade data for airports and ports in the region.**

9.4 Digitalisation

The technology revolution is rapidly extending through the transport sector and bringing changes in business models. In particular, a software layer is rapidly developing which links vehicles, service operators and travellers. Smart transport technologies, such as smart routeing algorithms or Mobility as a Service, offer opportunities for lower cost and more efficient transport, with consequent opportunities to reduce carbon emissions and support economic objectives.

However, smart transport relies on reliable and fast data connections covering a wide area. The Peninsula's geography, relatively low density population and poor spatial coverage of communications pose critical challenges to the viability and adoption of such services. Poor connectivity and reception 'not spots' threaten all of these technologies from smart transport to basic route planning and ticket purchasing. This in turn threatens potential economic gains from more efficient and lower cost transport solutions.

On the railways, the Digital Railway strategy is based on the GSM (2G) mobile network providing on-train signalling. In future it could rely on 4G or 5G mobile communications. Mobile communications are also becoming a basic expectation of travellers as Wi-Fi provision on trains is expanded. This can help to increase productivity and counter the challenges to business of longer journeys to, from and within the Peninsula. Wide area digital connectivity is critical here as well.

National government has a target of enabling fully autonomous vehicles without a human driver on parts of the UK road network by 2021 and autonomous driving technologies are developing and improving at pace. However, the nature and timing of the roll-out of autonomous vehicle technologies is highly uncertain. Initially, vehicles are likely to operate only in specific environments or on specific routes (known as Level 4 autonomy). These technologies provide an opportunity for radical changes in transport provision as well as significant reductions in transport costs, and improvements in driving efficiency.

The specific technologies underpinning successful deployments remain unknown. Some use lidar, some optical cameras. Some rely on detailed pre-existing 3D maps of their environment while some do not. The Peninsula's road network poses particular challenges for autonomous vehicles. It comprises a very high share of local roads of variable widths, potentially hampered by vegetation, lack of curbs, poor signage, etc. **Peninsula Transport should keep a watching brief on developments in the area of autonomous vehicles and help local authorities to ensure that local transport policy and local network management facilitates their future roll-out.**

At some time in the future, the combination of smart transport routeing and autonomous vehicles may offer the opportunity for cost effective, on-demand services which substantially improve rural transport opportunities. This again points to the critical role that communications networks will play in future transport provision, as well as the importance of overcoming potential barriers to autonomous driving on rural routes.

Autonomous driving may offer the opportunity to increase network utilisation but, by improving transport options and reducing costs, it also raises the possibility of inducing transport demand with implications for road congestion.

The Peninsula does not have a digital strategy that covers a congruent area. **Peninsula Transport will therefore need to engage with Superfast Cornwall, Connected Devon and Somerset and**

others to highlight the importance of wide area digital communications coverage to enable smart transport services to develop and thrive within the Peninsula.

9.5 Urbanisation

The population of the Peninsula is growing quickly. As a desirable location for people and businesses, migrants from other parts of the country are moving in increasing numbers and the Peninsula's population is expected to swell by around 12% within 20 years. Whatever tomorrow's technologies, working patterns and spatial development patterns look like, this tide of population growth – driven by our success – will place a substantial additional burden on the Peninsula's transport network.

The historical pattern of growth within the Peninsula has seen the emergence of edge-of town employment sites and warehouse and distribution centres along major transport corridors. Residential development has largely been urban and suburban contributing to the growth of the Peninsula's towns and cities.

Spatial strategies generally set out plans over a long time period and are these are already set for the Peninsula area. **Peninsula Transport will need to feed into the spatial strategies of the area as they are refreshed to help shape them to meet the changing needs of the transport network associated with current and future growth in population and employment.**

Although this study has not examined the development of specific sites, overall expectations of population growth are the single most significant driver of future transport challenges within the Peninsula. The nature of the future Peninsula population may also pose additional challenges for spatial planning and transport demand patterns. Population growth is expected largely through domestic migration and is likely to be concentrated in middle aged and older age groups. This, alongside future increases in home working, may both support demand for lower density housing and more dispersed settlement.

Modelling suggests that differences in the spatial distribution of housing or employment alone are unlikely to have a significant impact on the overall level of transport demand. However, different patterns of future spatial development will change the pattern of future trip making and affect where congestion hotspots arise. Urban development will generate pressure on town and city networks, contributing to the case for a switch to high capacity urban public transport services.

It is therefore not so much where people live, but rather how they live that determines their impact on traffic and congestion. This points to the importance of development planning for public transport, walking and cycling and the co-location of housing and services. However, whilst this is largely outside of the remit of Peninsula Transport, the importance of changes in how people are living should be emphasised to local authorities when making planning decisions.

9.6 Future Work

This economic connectivity study forms part of Peninsula Transport's evidence base and will be used to support the development of a **Transport Strategy for the Peninsula** for publication in 2021. Further analytical work will be undertaken to support the strategy and this will include building on the five behavioural trends discussed in this report within more detailed studies covering topics including: economic corridors, carbon reduction, technology, rail, freight, rural mobility and strategic gateways.

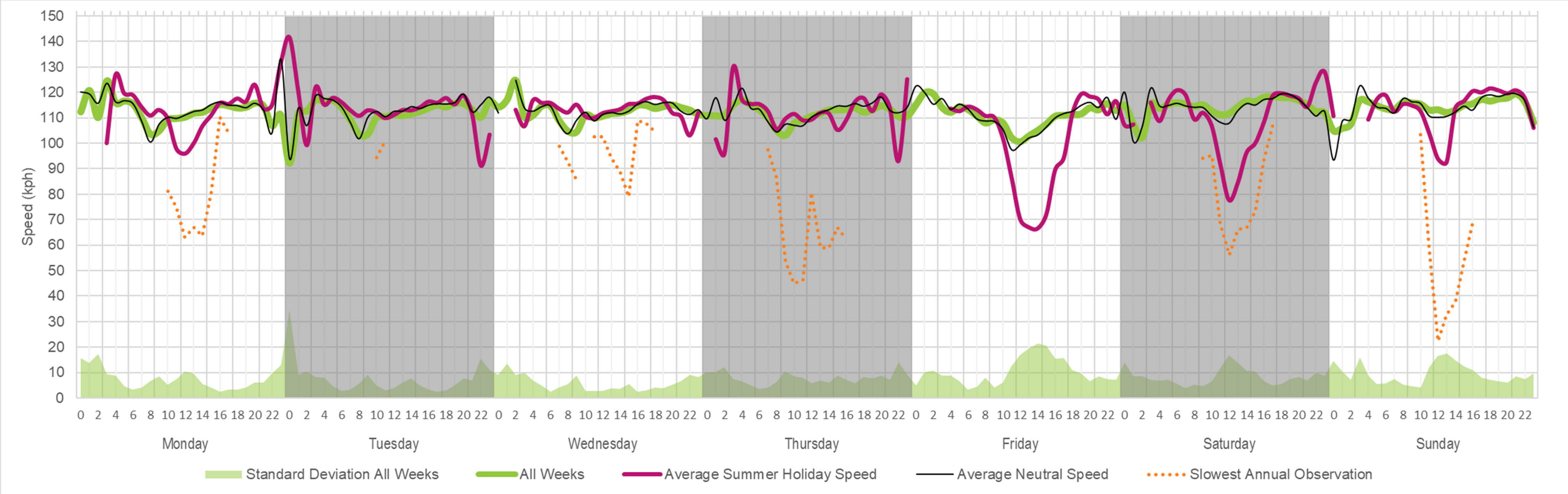
Appendix A: Journey Time Profiles for Peninsula Road Corridors

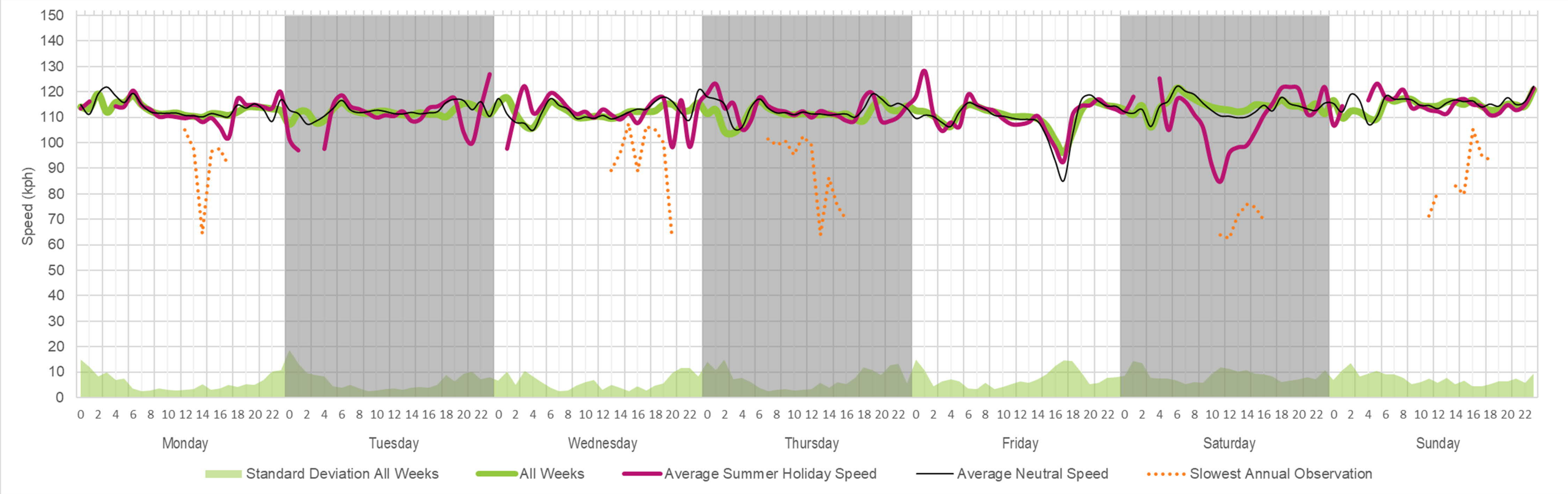
This appendix provides plots of journey time profiles for the principal road corridors in the Peninsula, including Strategic Road Network corridors (managed by Highways England), Major Road Network corridors and two additional priority links for the Peninsula. The data analysis to produce the plots is as described in section 4.5 of the main report. For corridors with lower traffic flows it has sometimes been necessary to reduce the threshold of the proportion of the corridor which must be observed in order for a value to be displayed (set at 90% as standard). In some cases this has been reduced to 75%, and for one corridor 50%, in order to provide a sufficiently detailed profile of speeds across the week. Where a reduced threshold has been applied this is stated in square brackets at the end of the relevant chart title.

The table below summarises the corridors presented in this Appendix, their length in kilometres and a page reference.

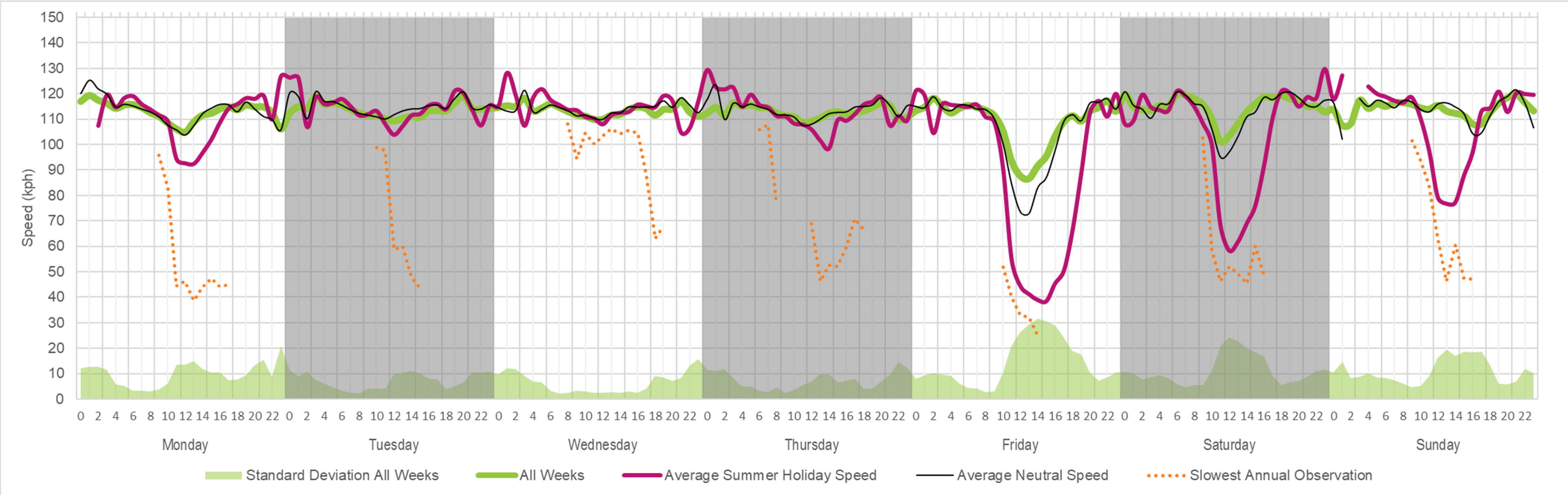
Corridor	Length	Page Reference
M5 J25 – J31 (Taunton to Exeter)	54km	A2
M5 J22 – J25 Peninsula boundary to Taunton	35km	A3
A38 from the junction with the M5 south of Exeter to Carkeel Roundabout west of Plymouth	72km	A4
A38 from Carkeel Roundabout west of Plymouth to the junction with the A30 around Bodmin	38km	A5
A30 from M5 J31 south of Exeter to the junction with the A38 near Bodmin	101km	A6
A30 from the junction with the A38 near Bodmin to Carland Cross Roundabout east of Truro	28km	A7
A30 from Carland Cross Roundabout east of Truro to Chy-An-Mor roundabout east of Penzance	44km	A8
MRN Corridor A: the A30 from Chy-An-Mor roundabout east of Penzance to Mount Misery Roundabout west of Penzance	5km	A9
A30/A303 from the A30 at M5 J29 to the A303 on the Somerset border east of Wincanton	95km	A10
A35 from the junction with the A30 in Honiton through the border of the Peninsula west of Charmouth	21km	A11
MRN Corridor P: the A358 from the M5 J25 at Taunton to the junction with the A303 at Southfields Roundabout	14km	A12
MRN Corridor B: the A390 from Chiverton Cross junction with the A30 west of Truro to the Arch Hill junction with the A39 in Truro	8km	A13
MRN Corridor C: the A39 from Carland Cross junction with the A30 east of Truro to the junction with Castle Hill in Falmouth	31km	A14
MRN Corridor D: the A3059 from the junction with the A39 at Trekenning Roundabout to the junction with the A3058 east of Newquay	8km	A15
MRN Corridor E: the A391 from the junction with the A30 to the junction with the A390 in St Austell	13km	A16
MRN Corridor F: the A39 Atlantic Highway from the junction with the A30 at Highgate Hill to the junction with the A386 north of Bideford	113km	A17
MRN Corridor G: the A374/A386/A3064 through Plymouth from the junction with the A38 at Marsh Mills to the junction with the A38 at St Budeaux	11km	-
MRN Corridor H: A38 Tamar Bridge reported as part of wider A38 corridor	-	A18
MRN Corridor I: the A385 from its junction with the A38 in the west to the junction with the A380/A3022 in Paignton	17km	A19
MRN Corridor J: the A380/A3022 from the junction with the A38 in the north to the junction with the A379 at Windy Corner north of Brixham in Paignton	32km	A20
MRN Corridor K: the A382 from the junction with the A38 at Drumbridges to the junction with the A381 in Newton Abbot	7km	A21
MRN Corridor L: the A361/A39 North Devon Link Road from the M5 J27 to the junction with the A386 north of Bideford	56km	A22
MRN Corridor M: the A379 in Exeter from the M5 J30 to the junction with the A38 west of Exeter	7km	A23
MRN Corridor N: the A376 from the M5 J30 in Exeter to the Imperial Road Roundabout in Exmouth	12km	A24
MRN Corridor O: the A38 from the M5 J26 near Wellington to the Dunball Roundabout junction with the A39 just west of the M5 J23 near Bridgwater	32km	A25
MRN Corridor Q: the A38 from the M5 J22 north to the Peninsula border	12km	A26
MRN Corridor R: the A3088/A37 from the Cartgate Roundabout on the A303 south to the Peninsula border	15km	A27
MRN Corridor S: the A37 from the Podimore Roundabout on the A303 north to the Peninsula border	35km	A28
MRN Corridor T: the A39/A361 from the M5 J23 through to the Peninsula border east of Frome	61km	A29
A386 from the junction with the A30 west of Okehampton to the junction with the A38 at Manadon in north Plymouth	40km	A30
A39 from the M5 J23 to the junction with the A396 in Minehead	44km	A31

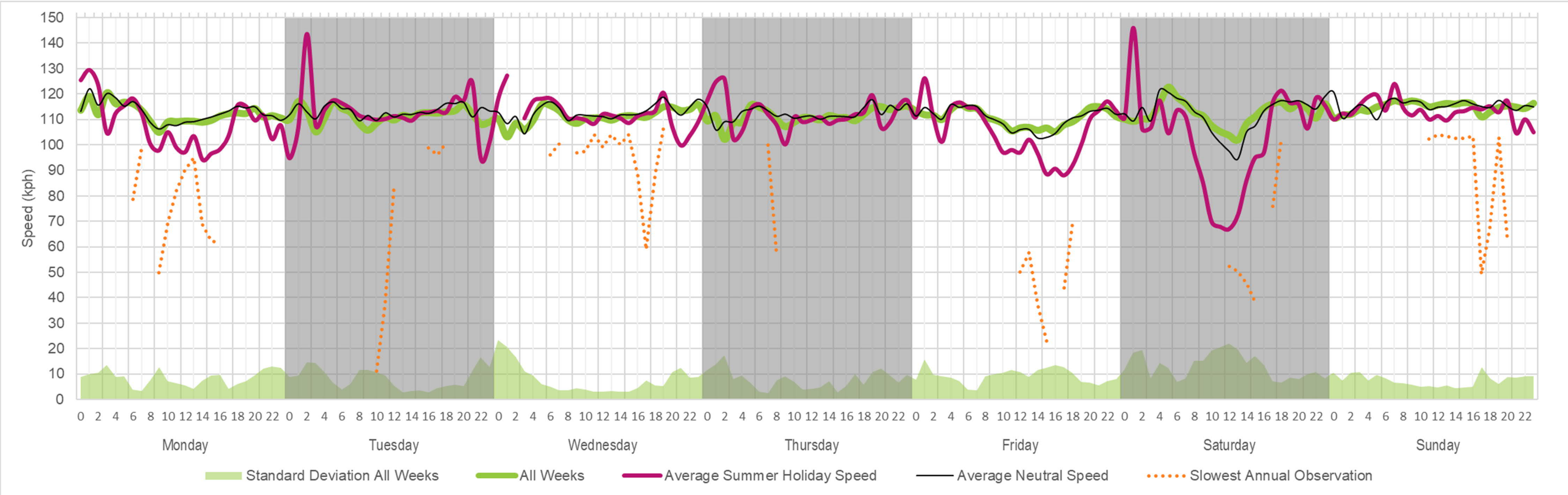
Journey Time Reliability Plot for the M5 J25 – J31 (Taunton to Exeter) in 2018 (Top = Northbound, Bottom = Southbound)



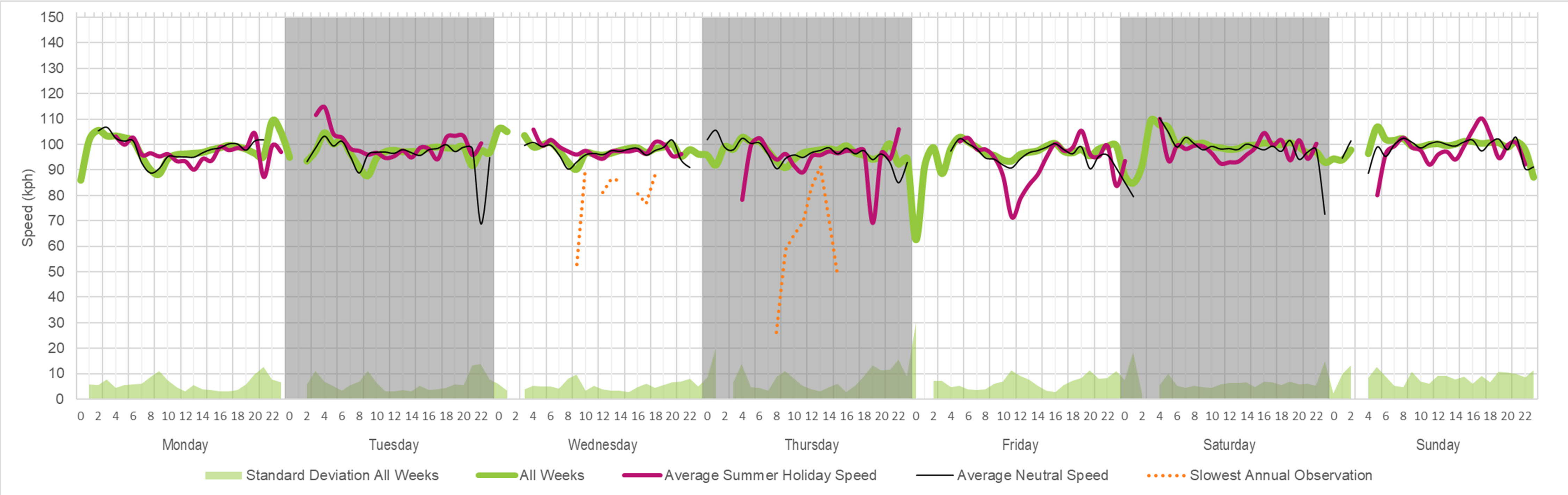


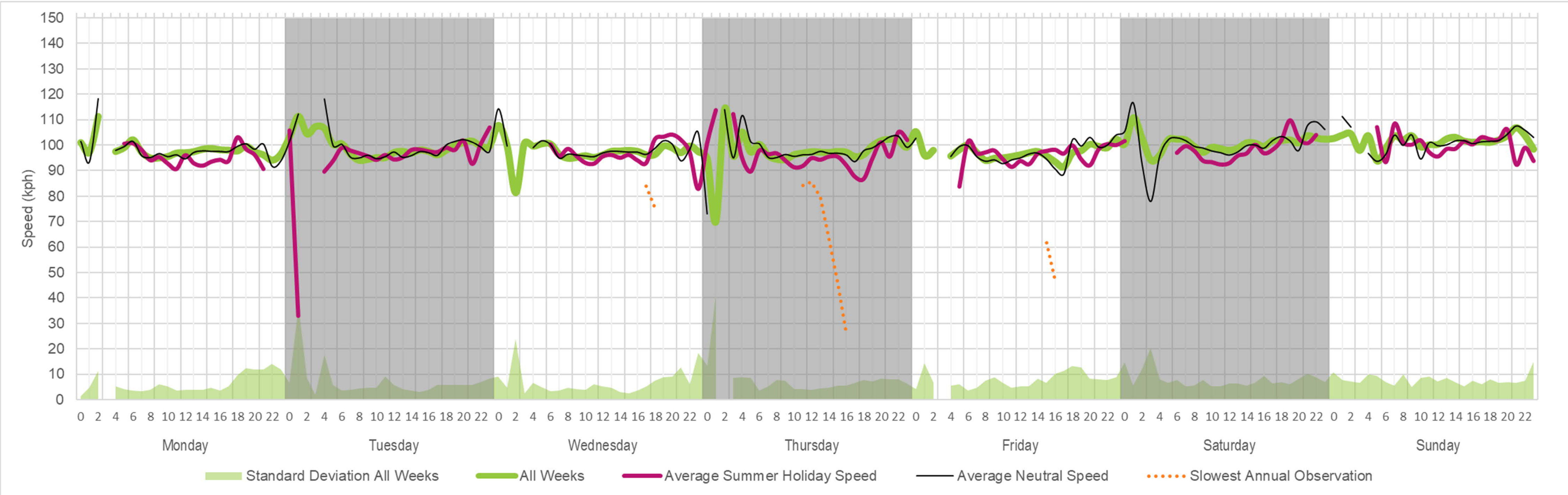
Journey Time Reliability Plot for the M5 J22 – J25 Peninsula boundary to Taunton in 2018 (Top = Northbound, Bottom = Southbound)



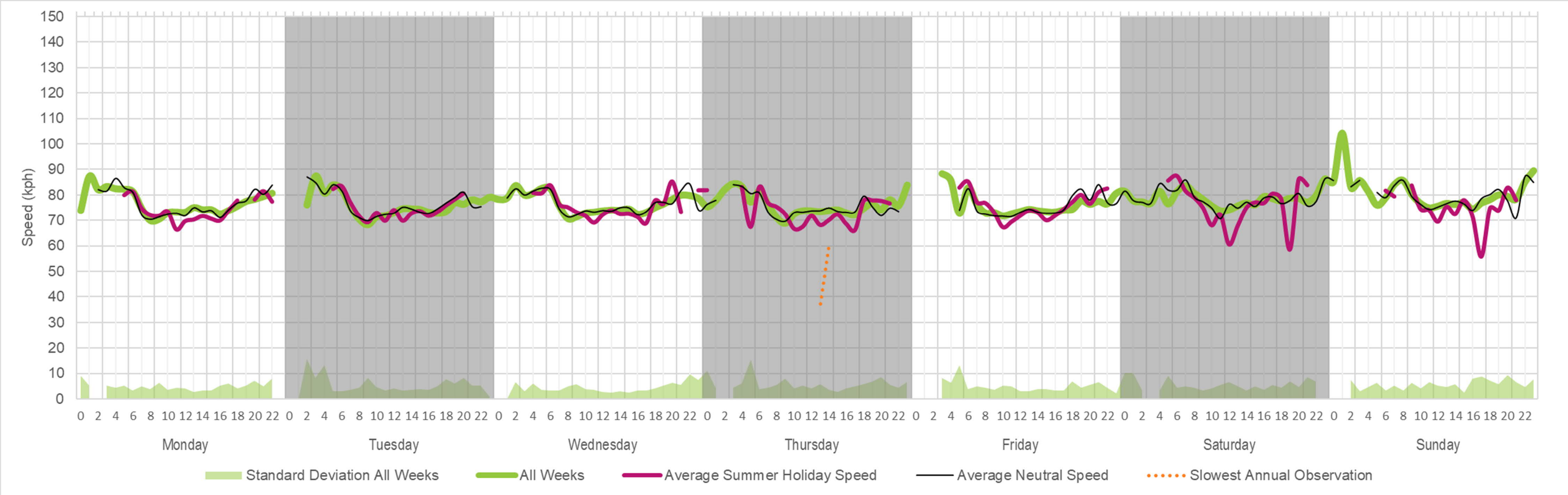


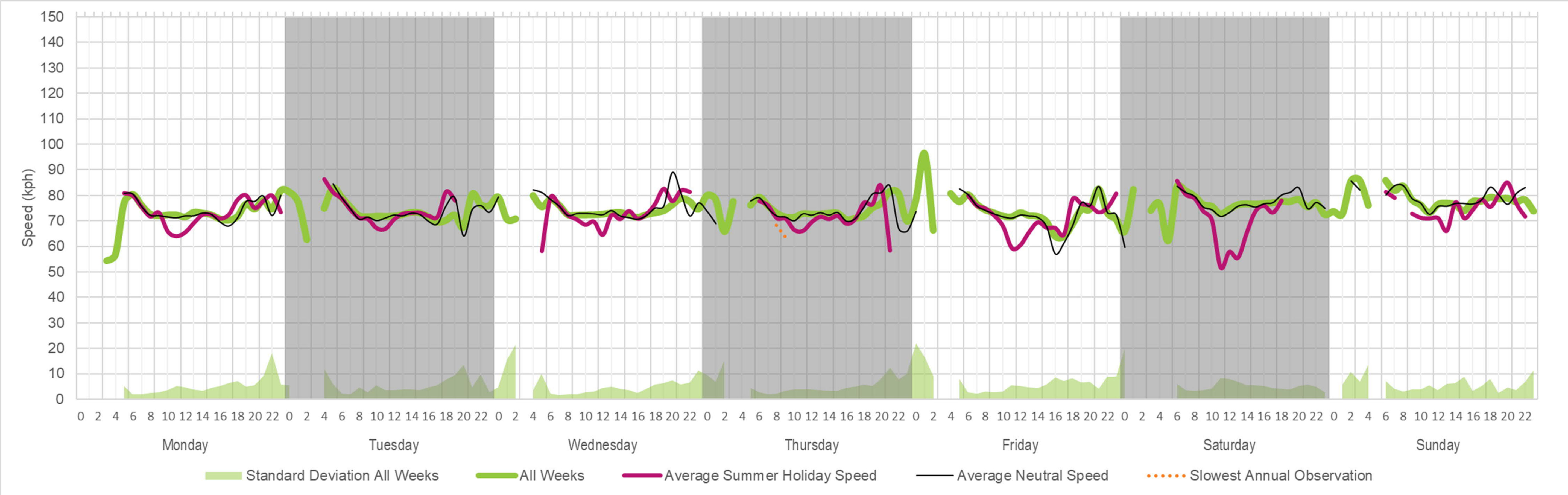
Journey Time Reliability Plot for the A38 from the junction with the M5 south of Exeter to Carkeel Roundabout west of Plymouth in 2018 (Top = Eastbound, Bottom = Westbound)



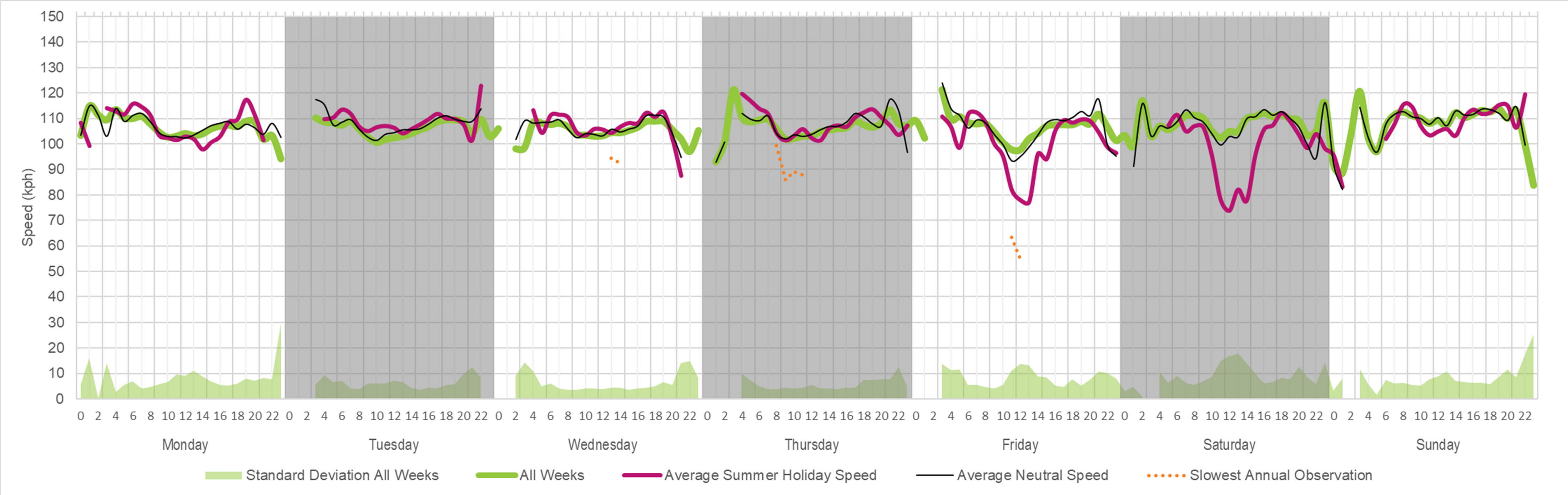


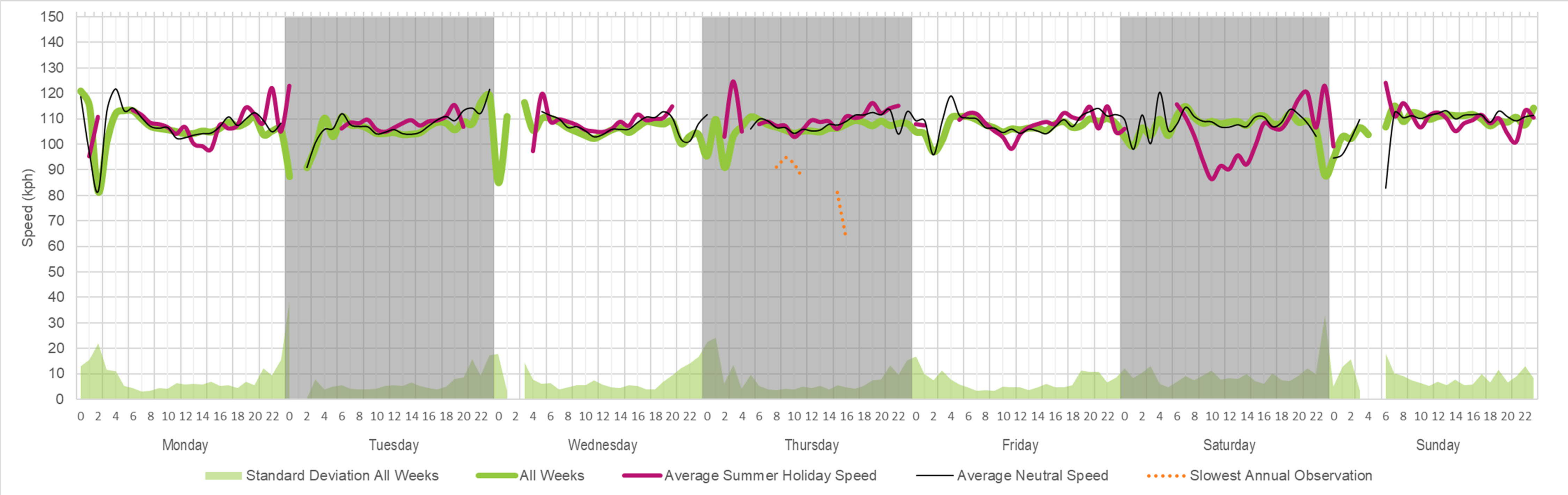
Journey Time Reliability Plot for the A38 from Carkeel Roundabout west of Plymouth to the junction with the A30 around Bodmin in 2018 (Top = Eastbound, Bottom = Westbound)



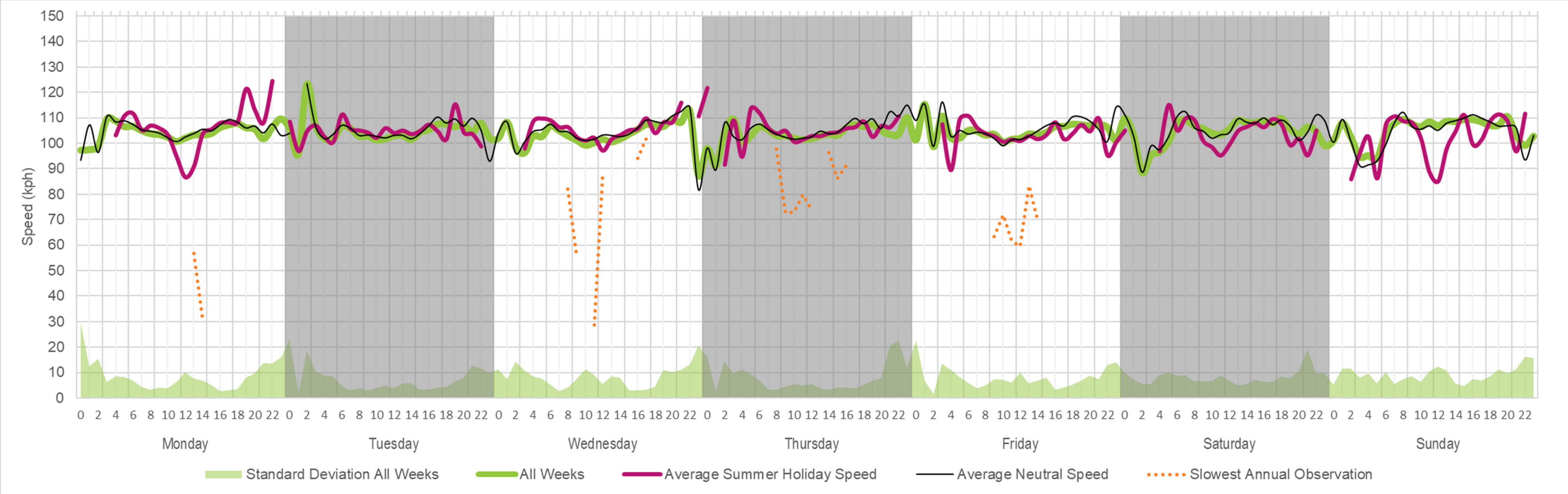


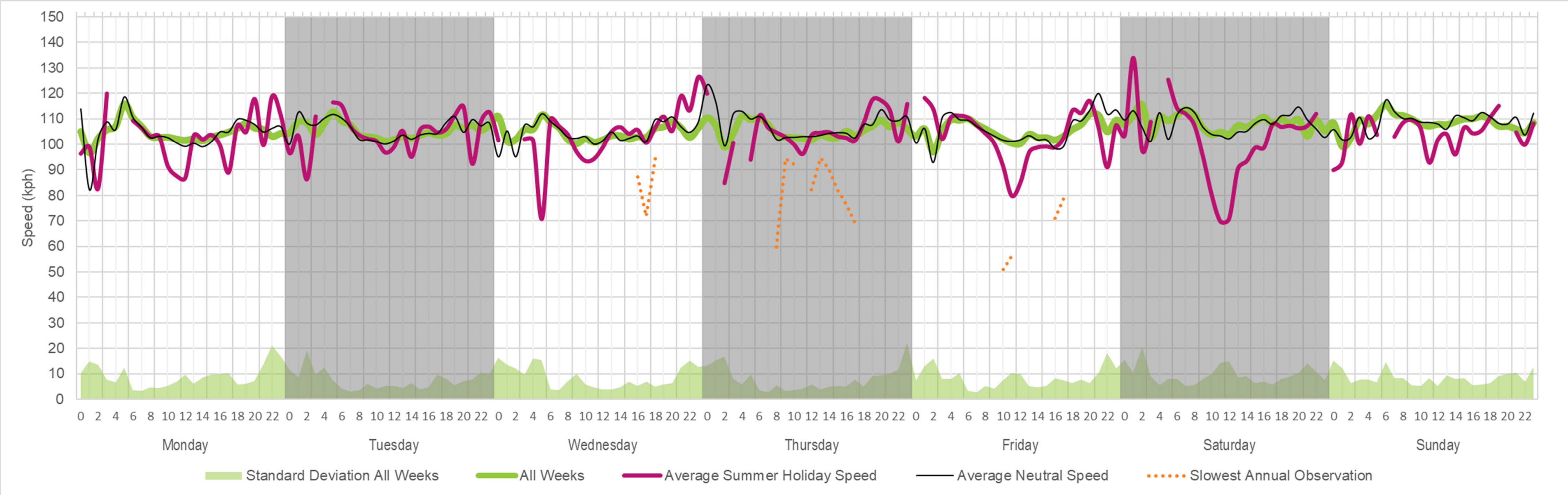
Journey Time Reliability Plot for the A30 from M5 J31 south of Exeter to the junction with the A38 near Bodmin in 2018 (Top = Eastbound, Bottom = Westbound)



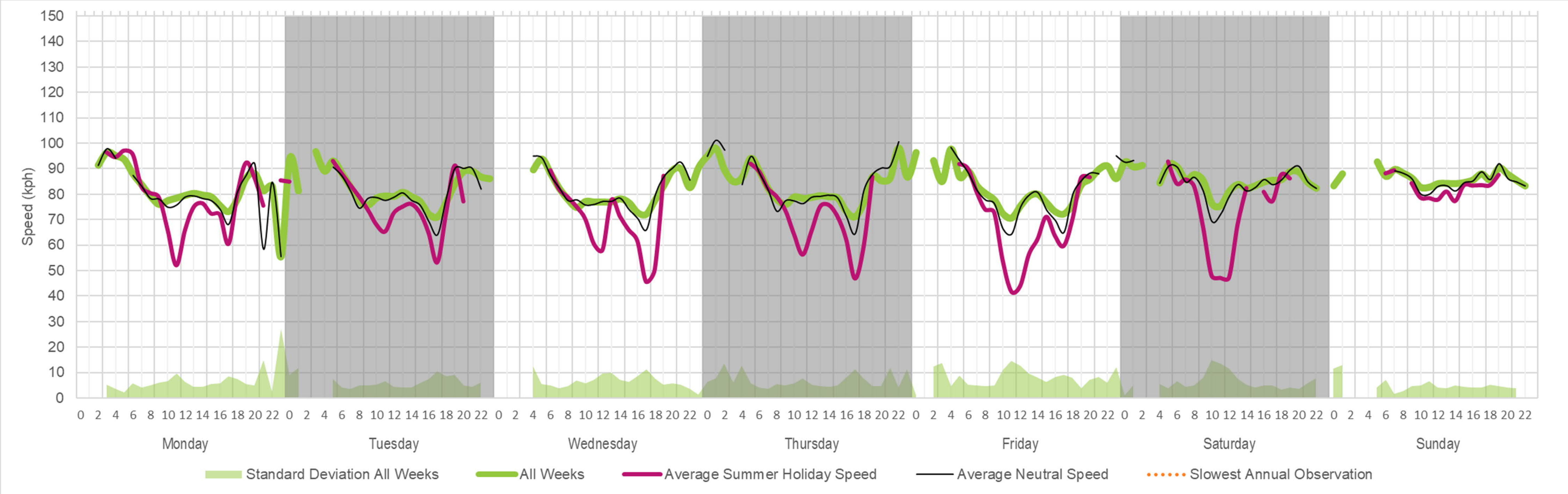


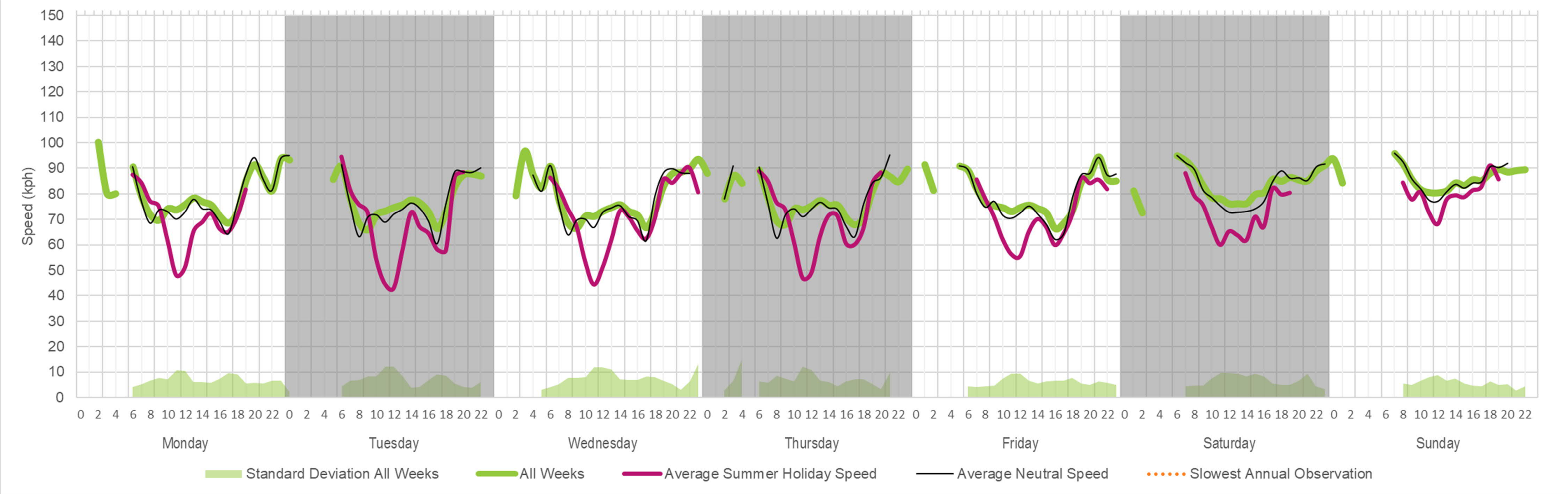
Journey Time Reliability Plot for the A30 from the junction with the A38 near Bodmin to Carland Cross Roundabout east of Truro in 2018 (Top = Eastbound, Bottom = Westbound)



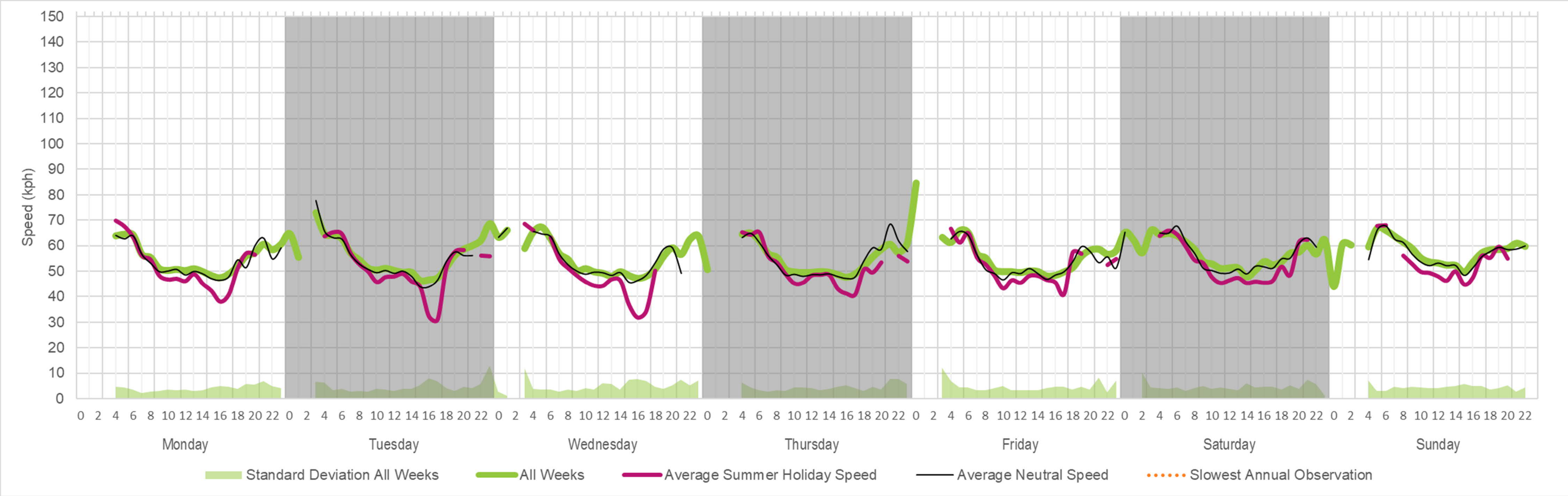


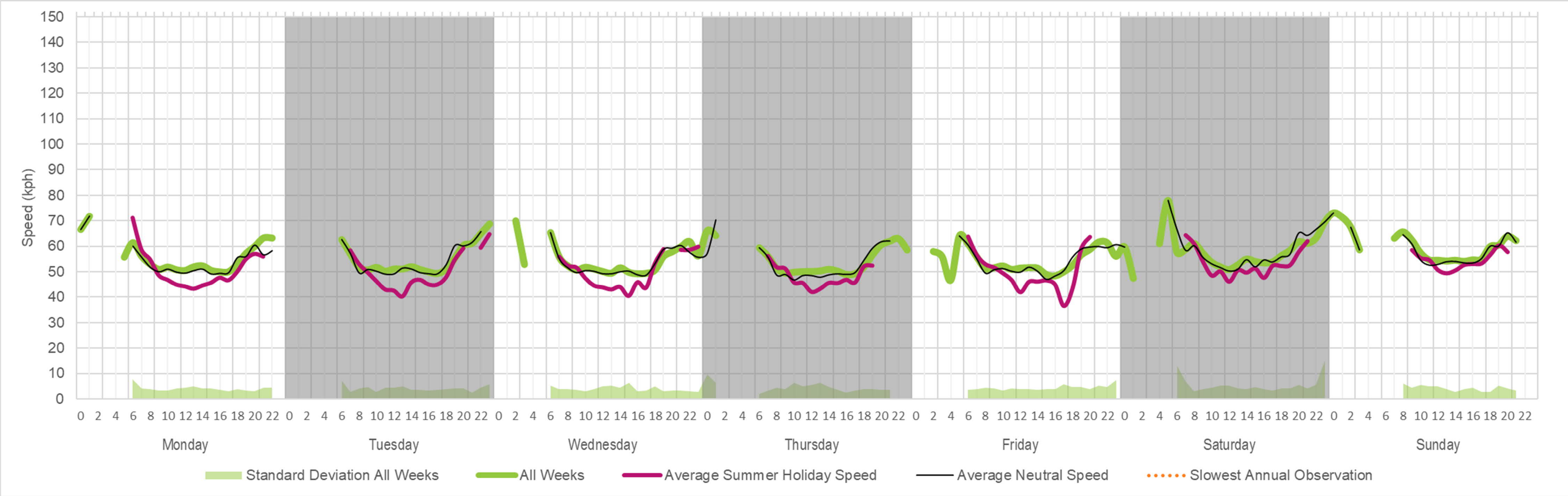
Journey Time Reliability Plot for the A30 from Carland Cross Roundabout east of Truro to Chy-An-Mor roundabout east of Penzance in 2018 (Top = Eastbound, Bottom = Westbound)



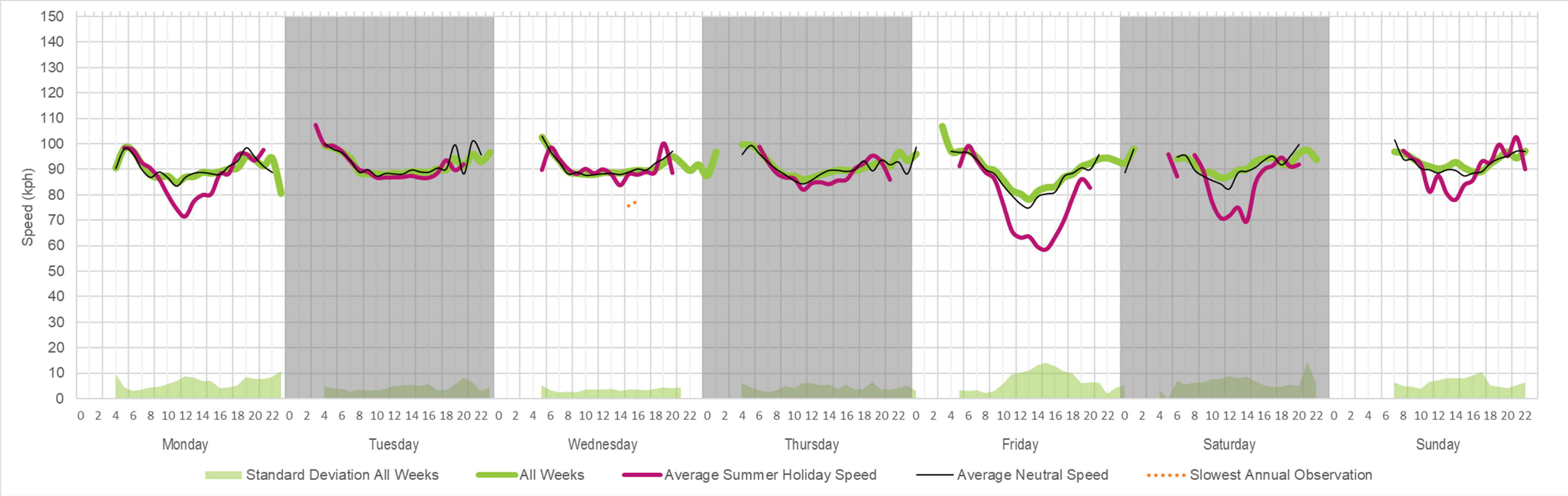


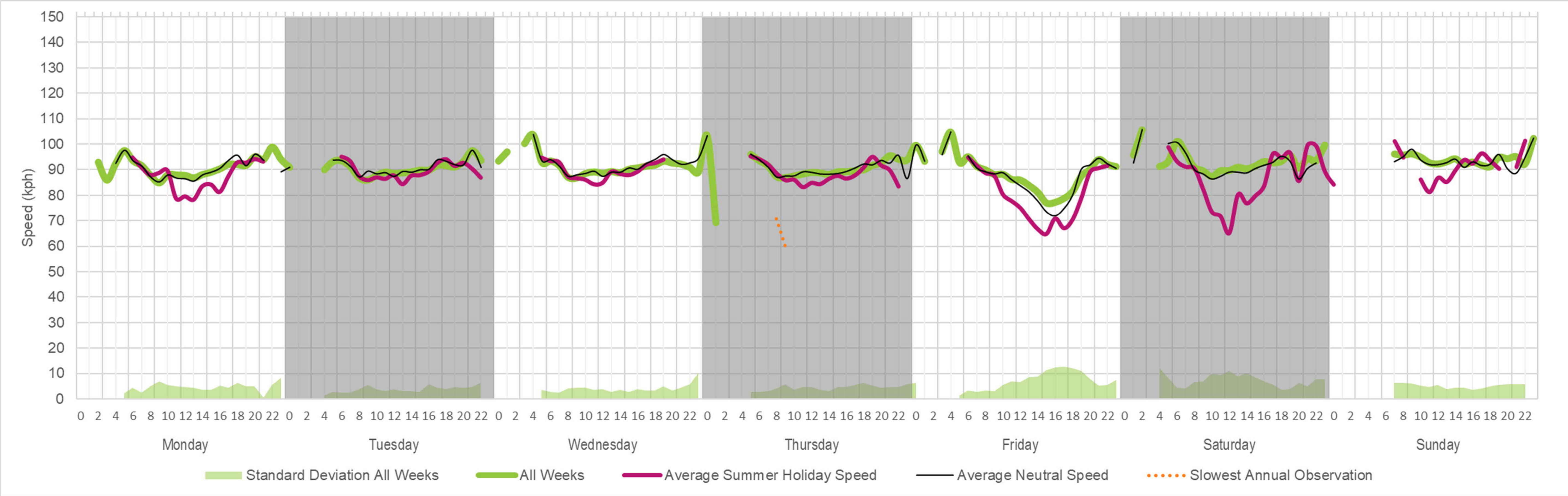
Journey Time Reliability Plot for MRN Corridor A: the A30 from Chy-An-Mor roundabout east of Penzance to Mount Misery Roundabout west of Penzance in 2018 (Top = Eastbound, Bottom = Westbound)



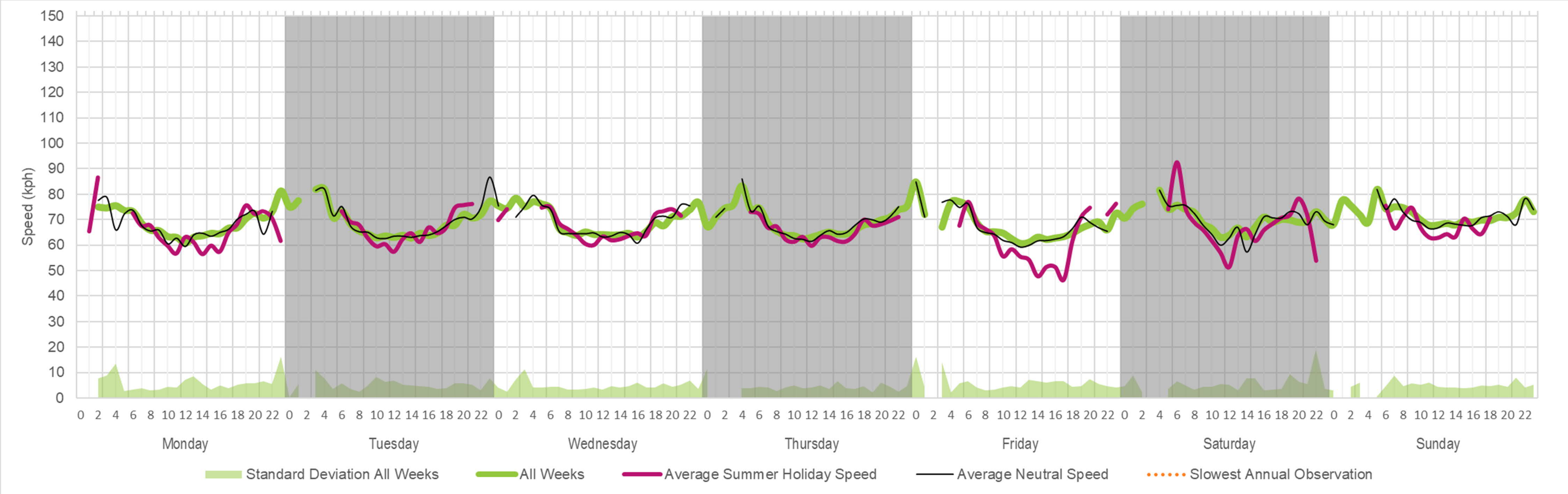


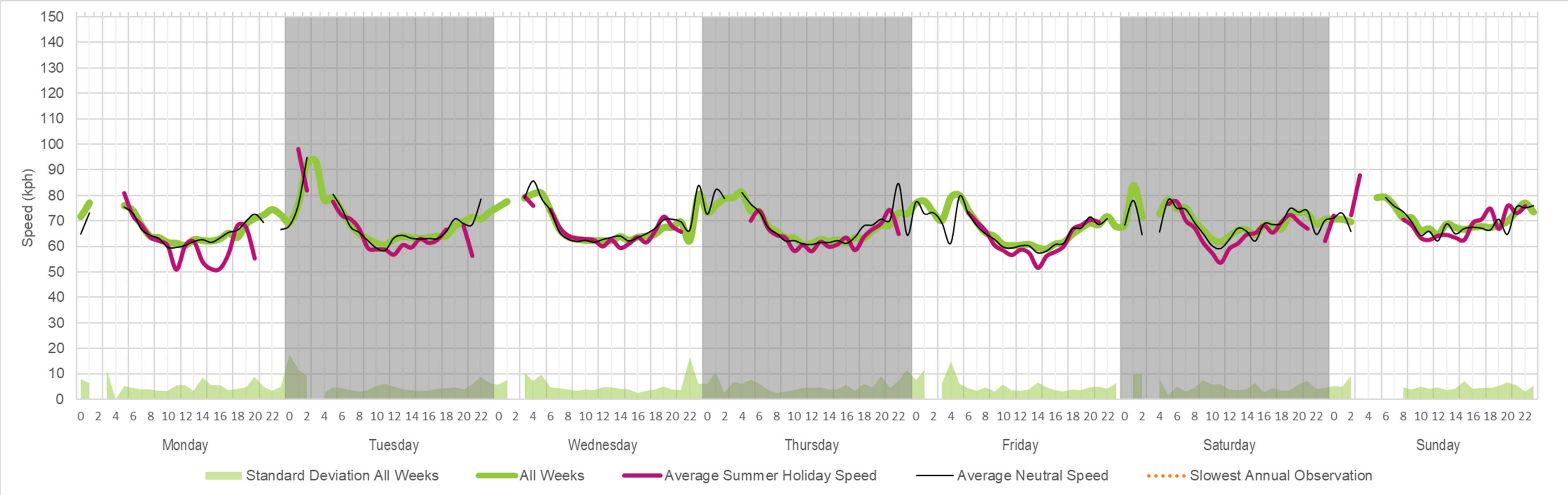
Journey Time Reliability Plot for the A30/A303 from the A30 at M5 J29 to the A303 on the Somerset border east of Wincanton in 2018 (Top = Eastbound, Bottom = Westbound)



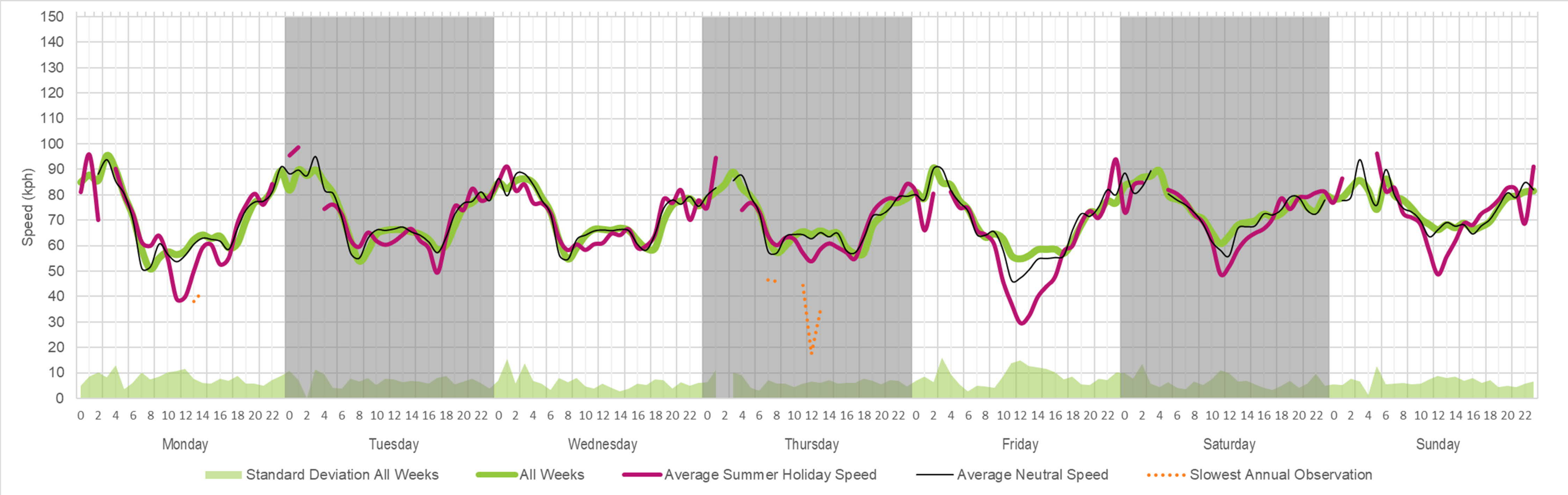


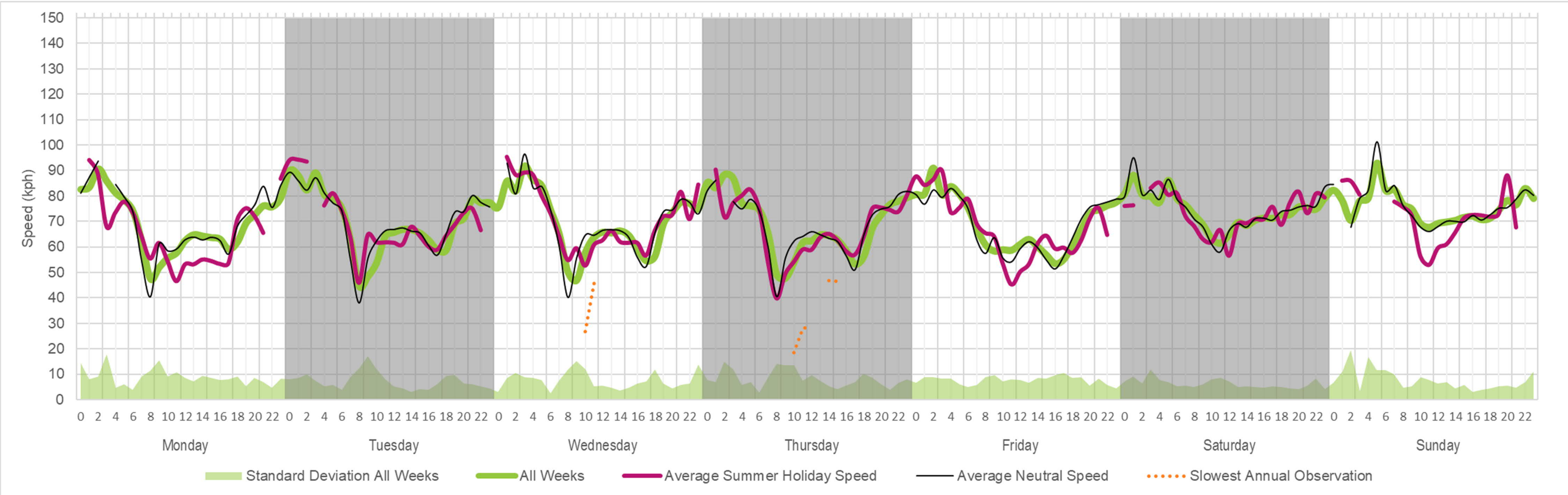
Journey Time Reliability Plot for the A35 from the junction with the A30 in Honiton through the border of the Peninsula west of Charmouth in 2018 (Top = Eastbound, Bottom = Westbound)



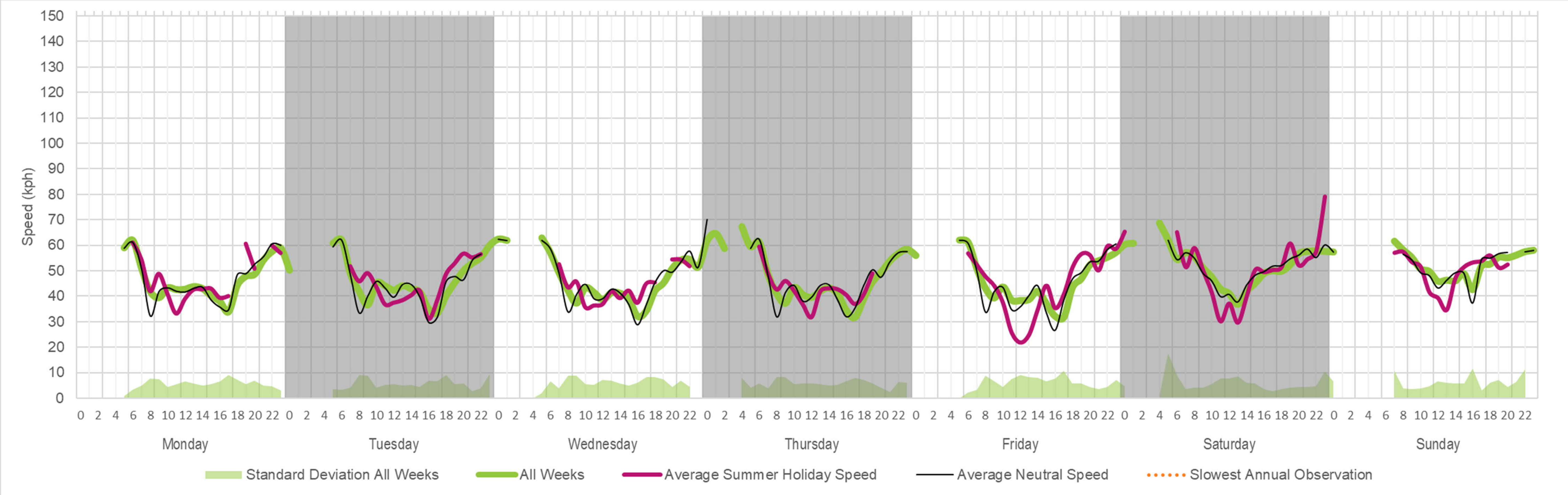


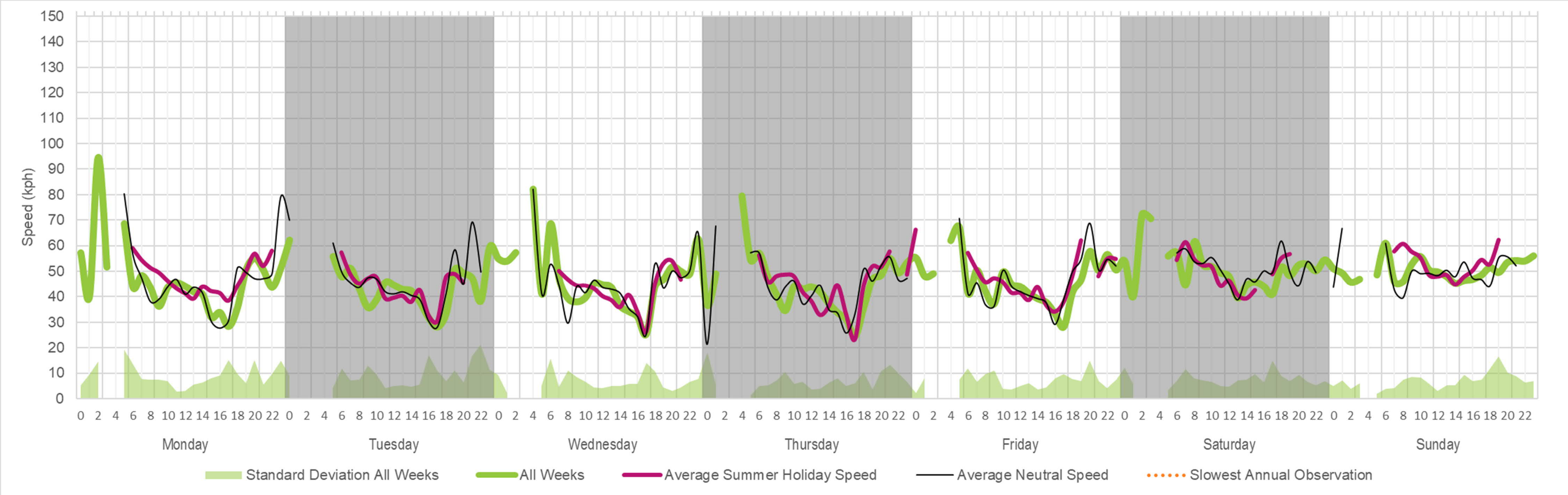
Journey Time Reliability Plot for MRN Corridor P: the A358 from the M5 J25 at Taunton to the junction with the A303 at Southfields Roundabout in 2018 (Top = Eastbound, Bottom = Westbound)



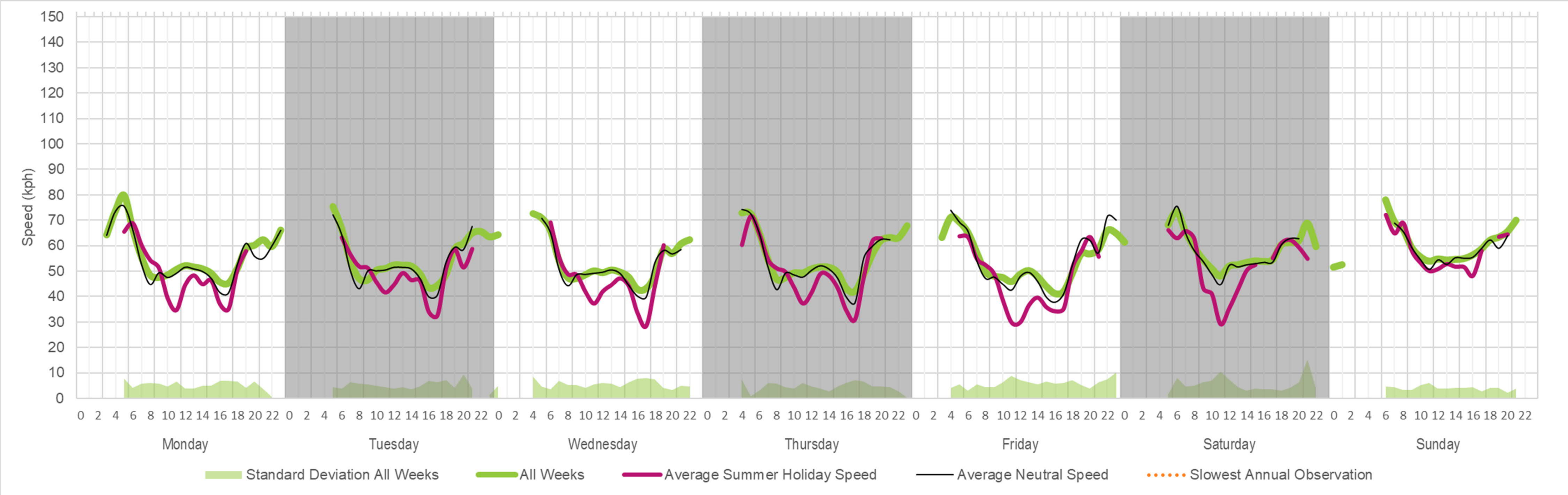


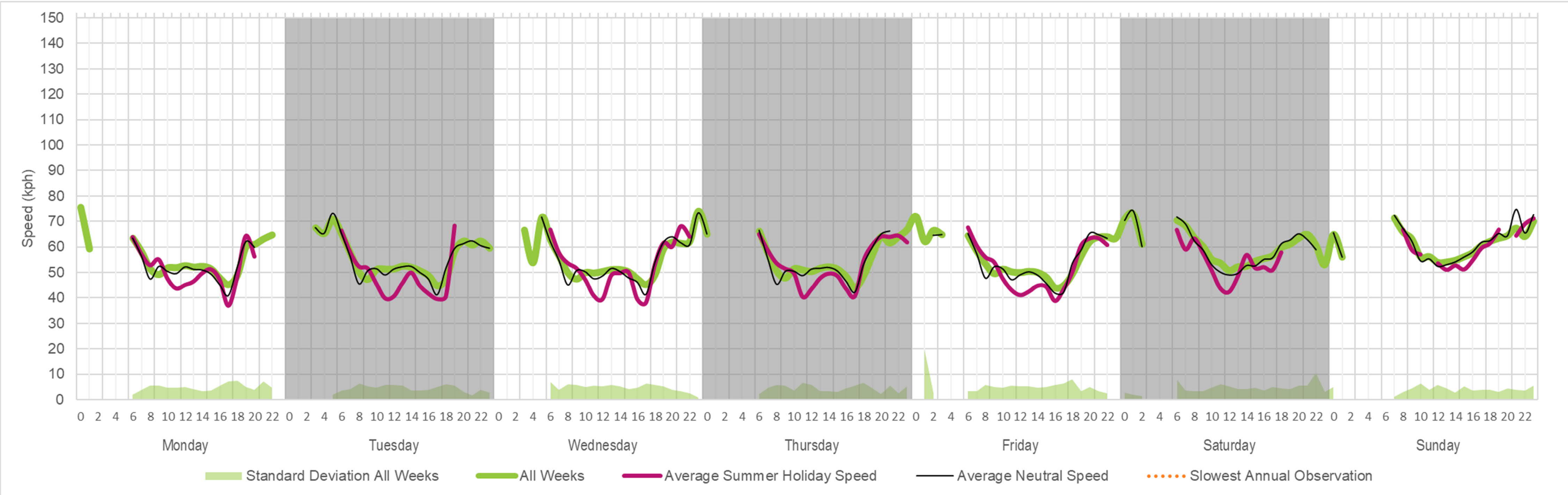
Journey Time Reliability Plot for MRN Corridor B: the A390 from Chiverton Cross junction with the A30 west of Truro to the Arch Hill junction with the A39 in Truro in 2018 (Top = Eastbound, Bottom = Westbound)



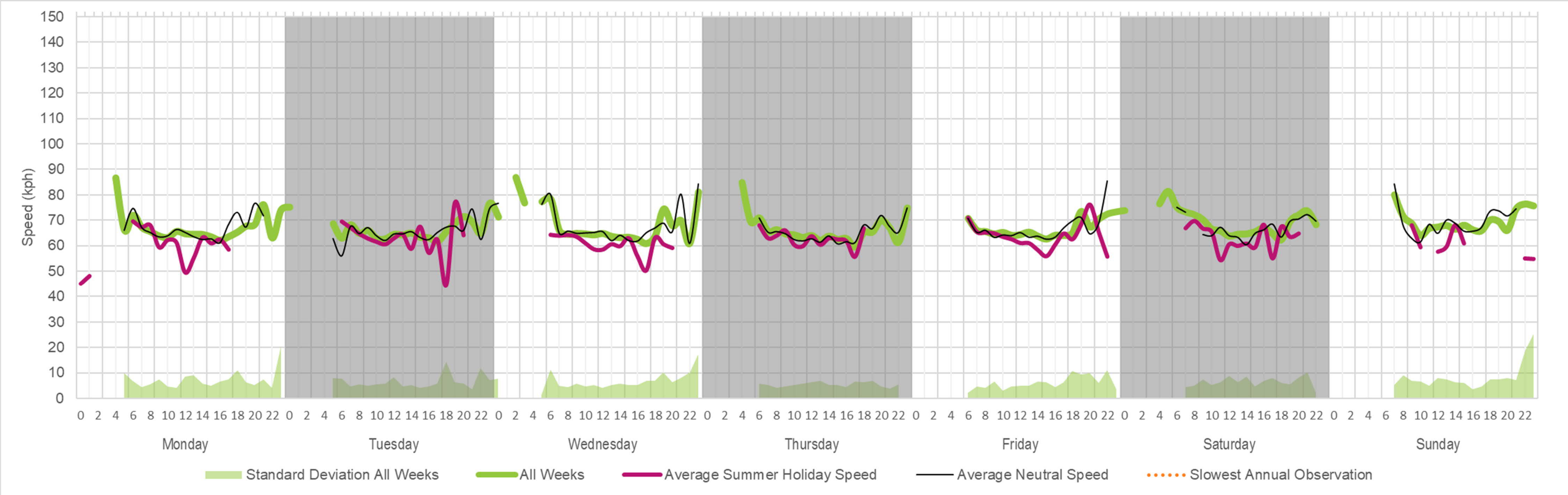


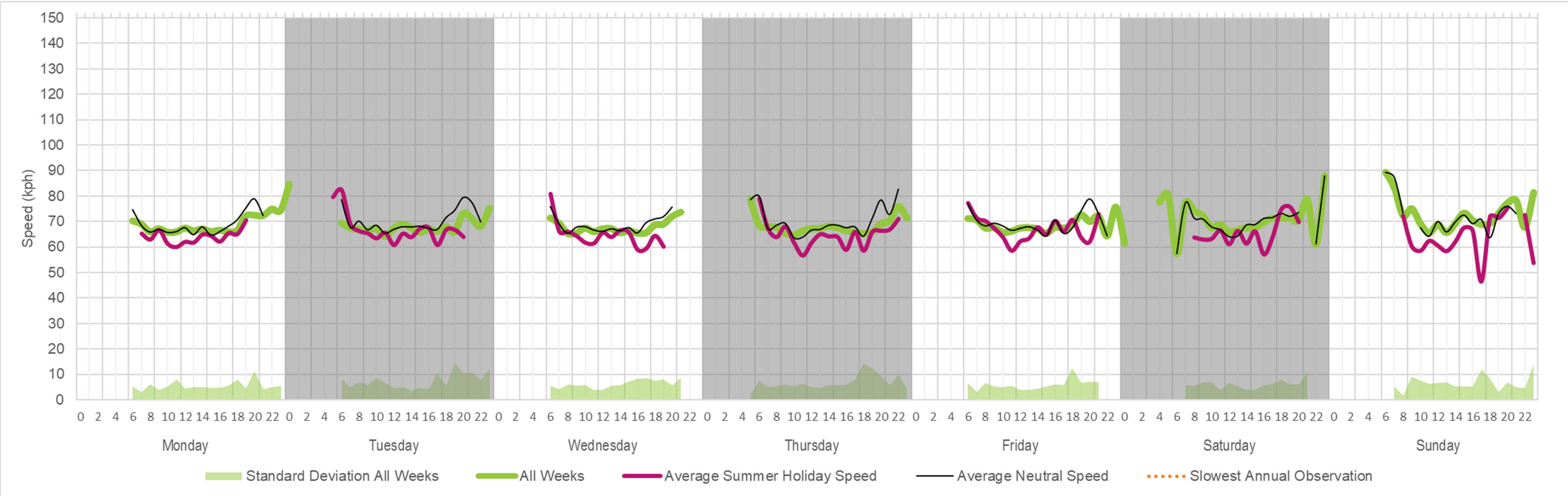
Journey Time Reliability Plot for MRN Corridor C: the A39 from Carland Cross junction with the A30 east of Truro to the junction with Castle Hill in Falmouth in 2018 (Top = Northbound, Bottom = Southbound) [75%]



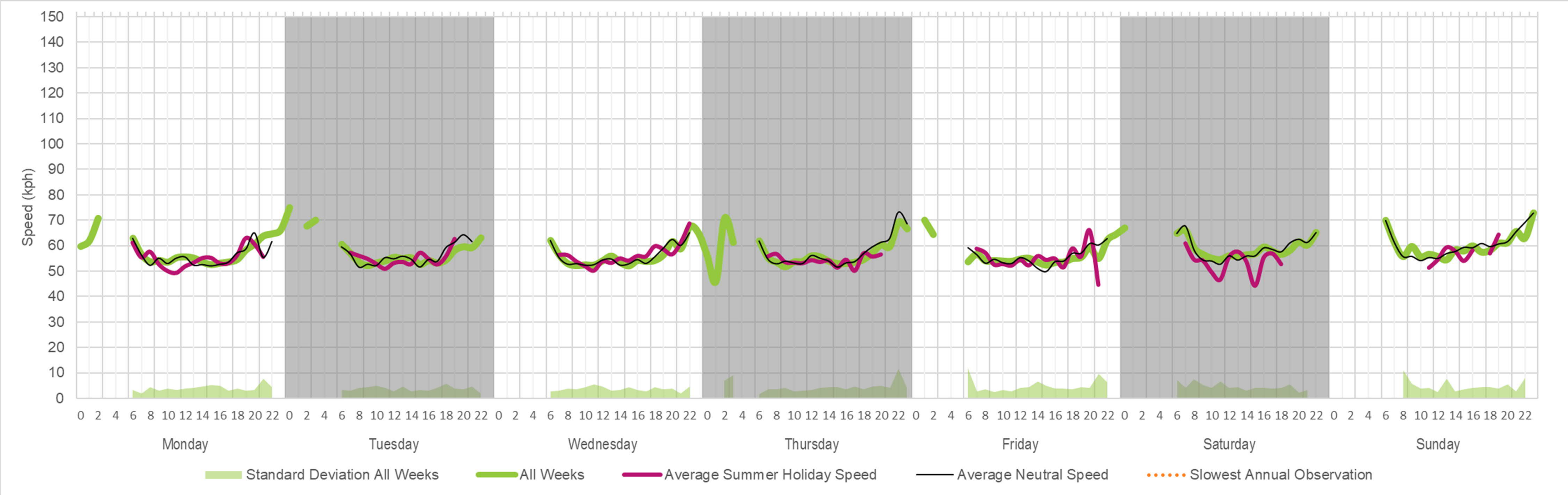


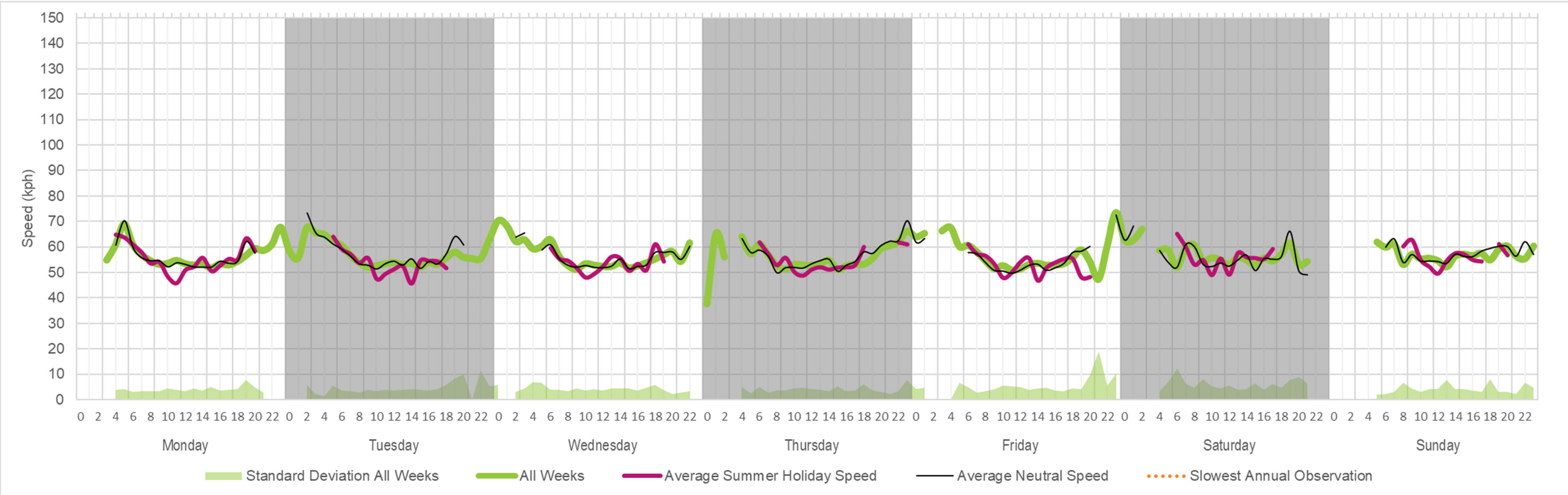
Journey Time Reliability Plot for MRN Corridor D: the A3059 from the junction with the A39 at Trekenning Roundabout to the junction with the A3058 east of Newquay in 2018 (Top = Eastbound, Bottom = Westbound)



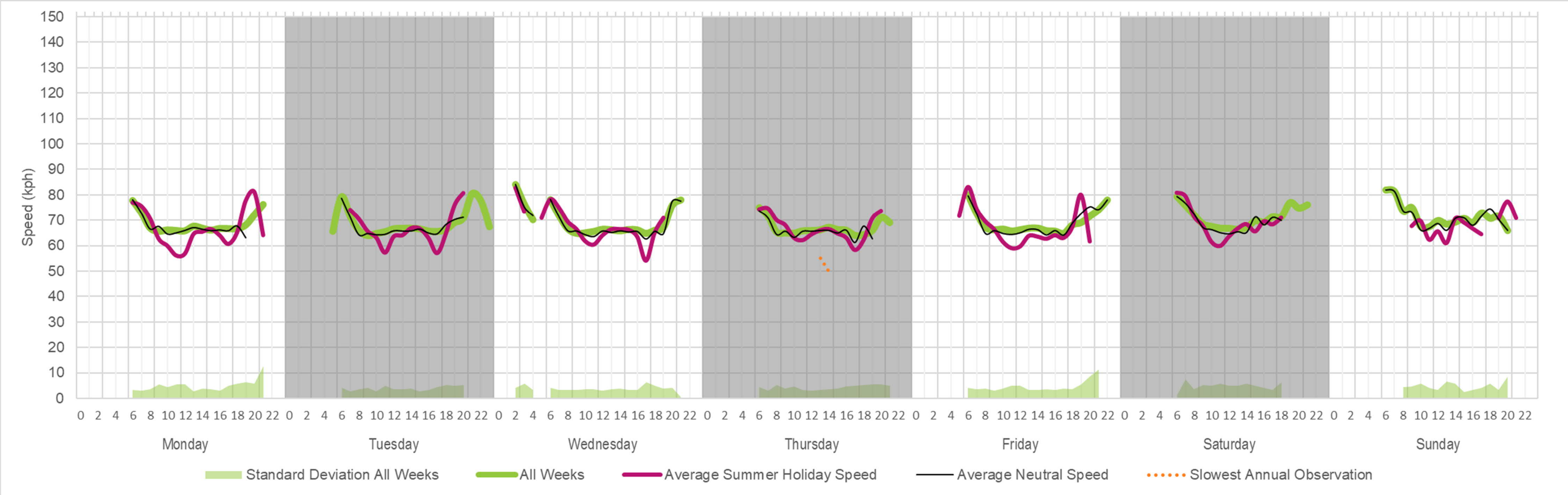


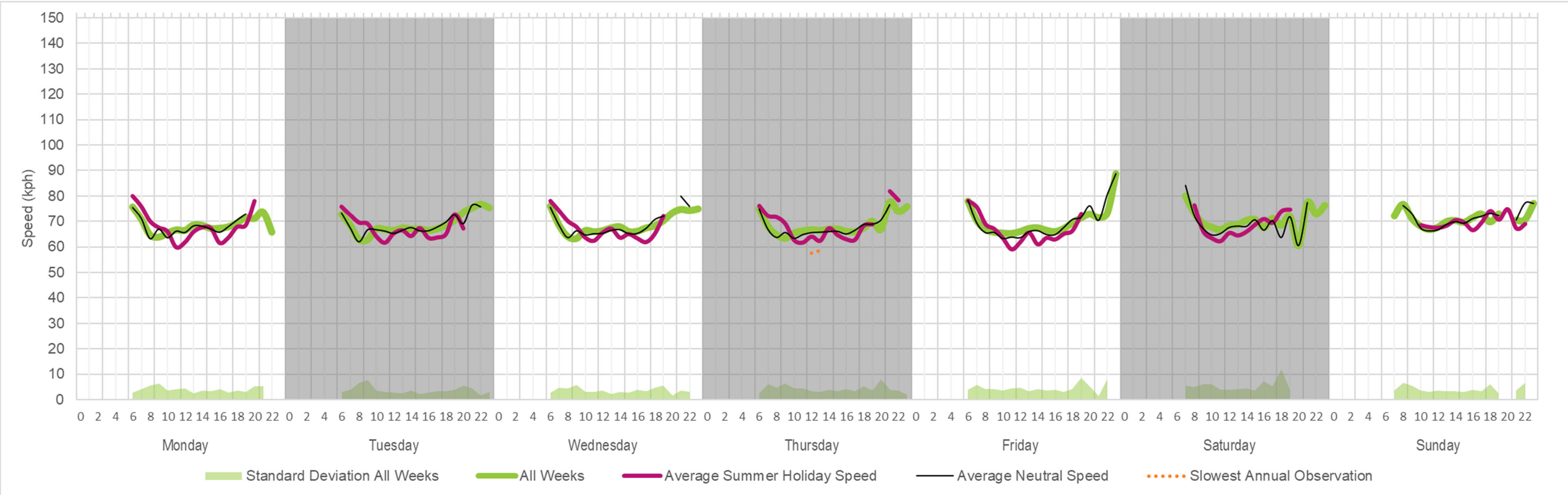
Journey Time Reliability Plot for MRN Corridor E: the A391 from the junction with the A30 to the junction with the A390 in St Austell in 2018 (Top = Northbound, Bottom = Southbound) [75%]



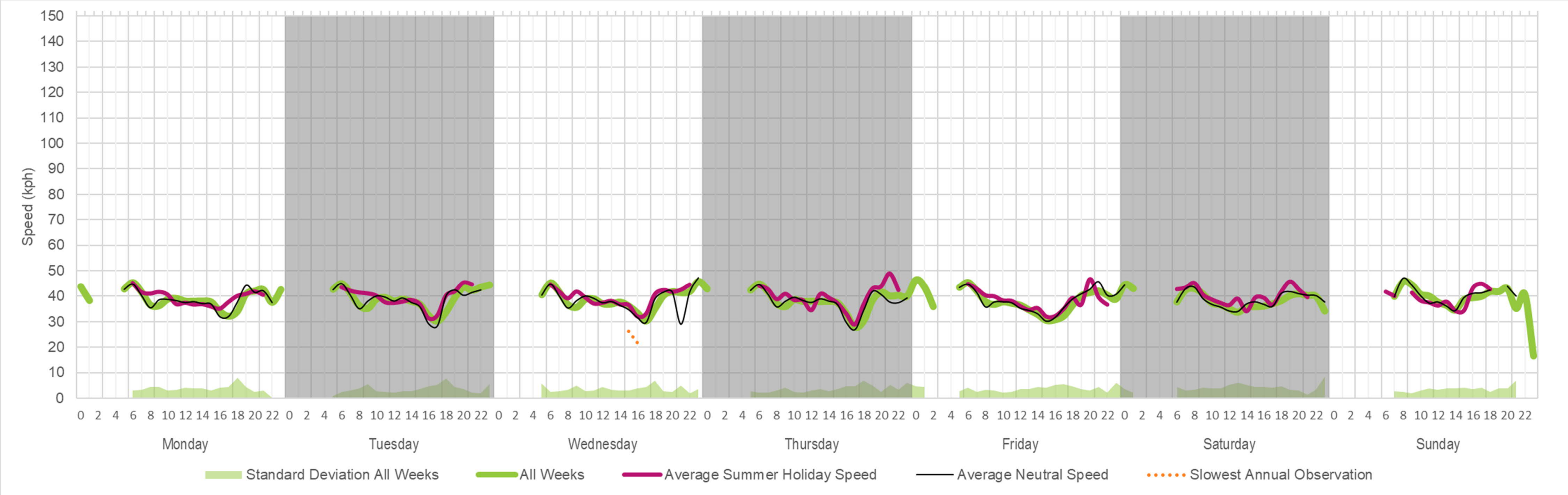


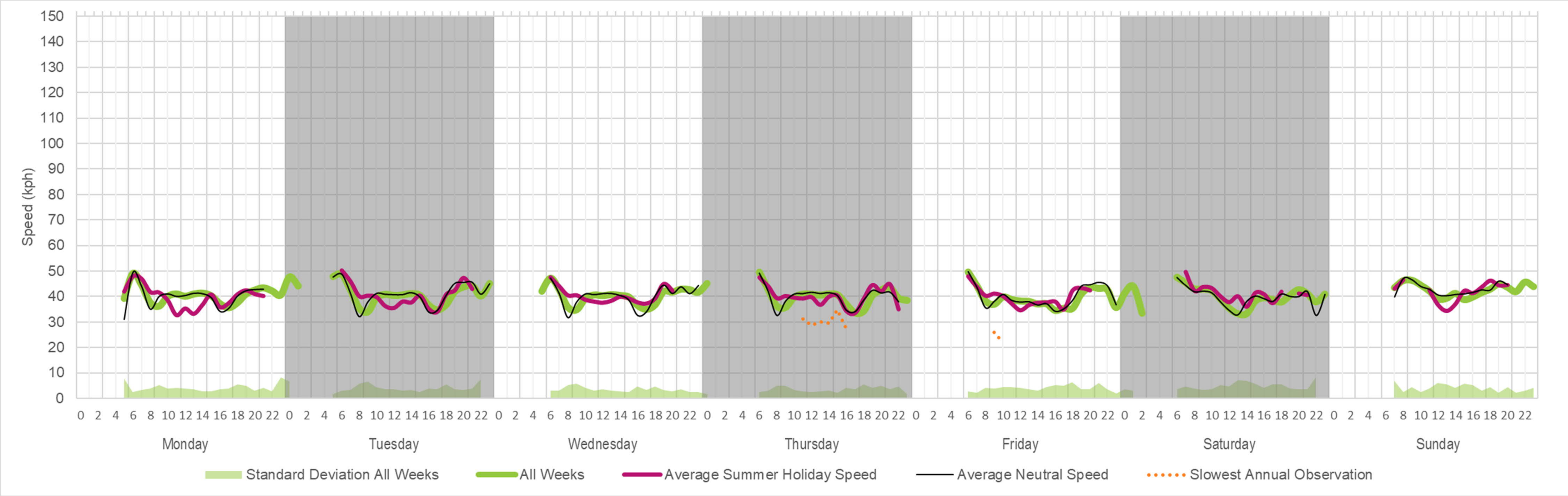
Journey Time Reliability Plot for MRN Corridor F: the A39 Atlantic Highway from the junction with the A30 at Highgate Hill to the junction with the A386 north of Bideford in 2018 (Top = Northbound, Bottom = Southbound) [50%]



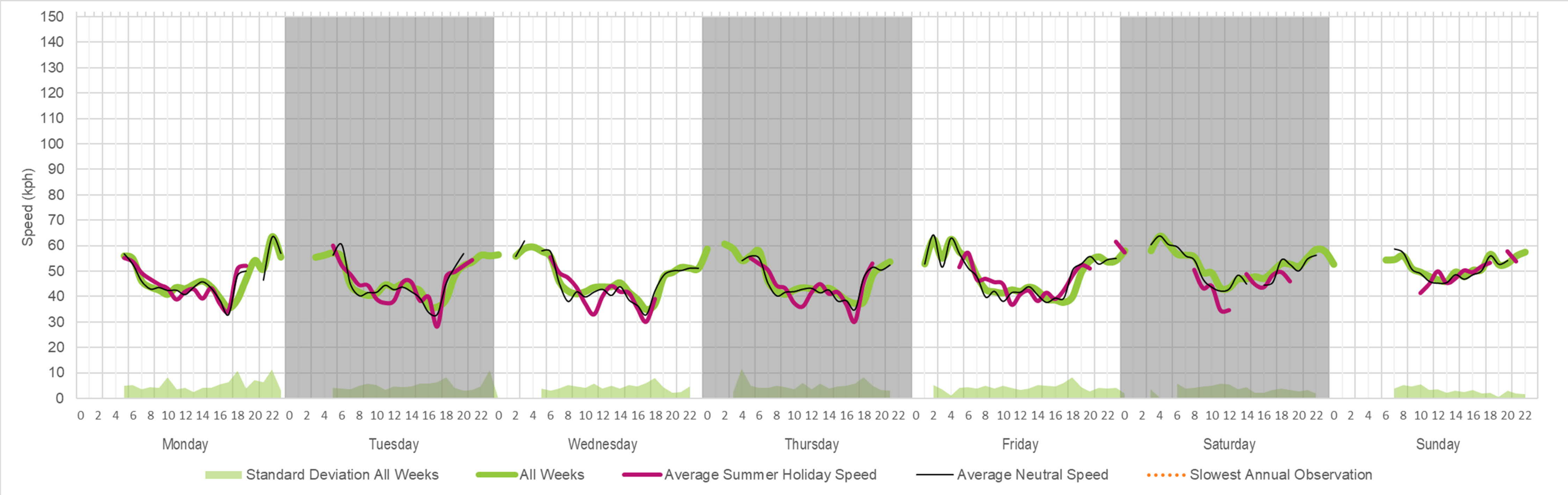


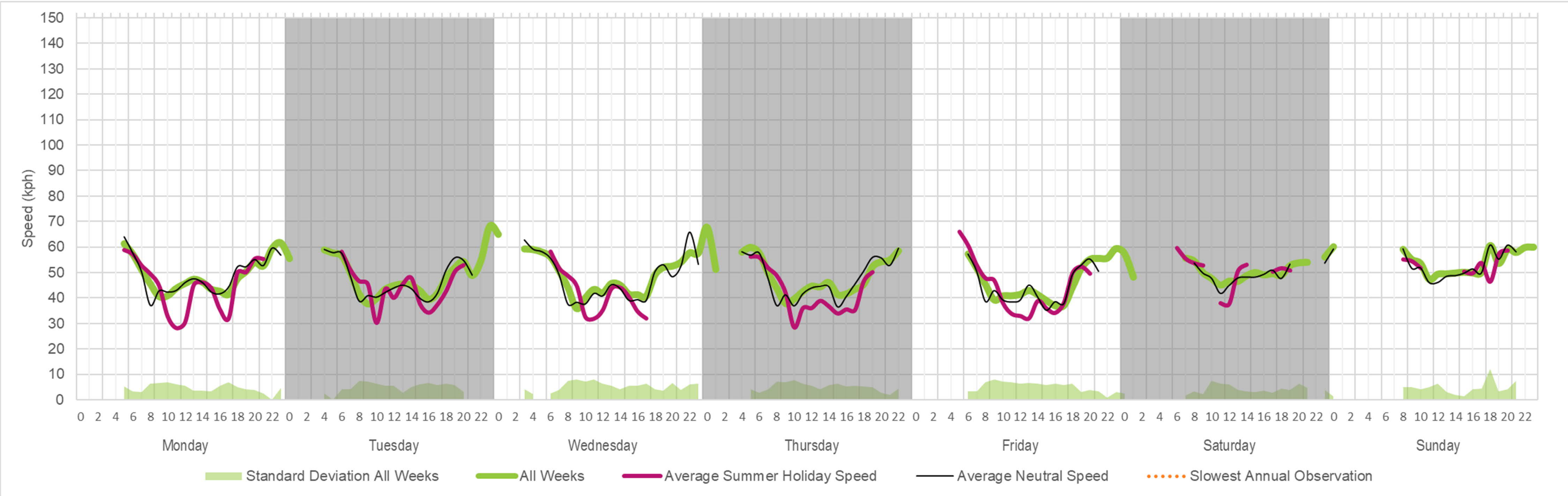
Journey Time Reliability Plot for MRN Corridor G: the A374/A386/A3064 through Plymouth from the junction with the A38 at Marsh Mills to the junction with the A38 at St Budeaux in 2018 (Top = Eastbound, Bottom = Westbound) [75%]



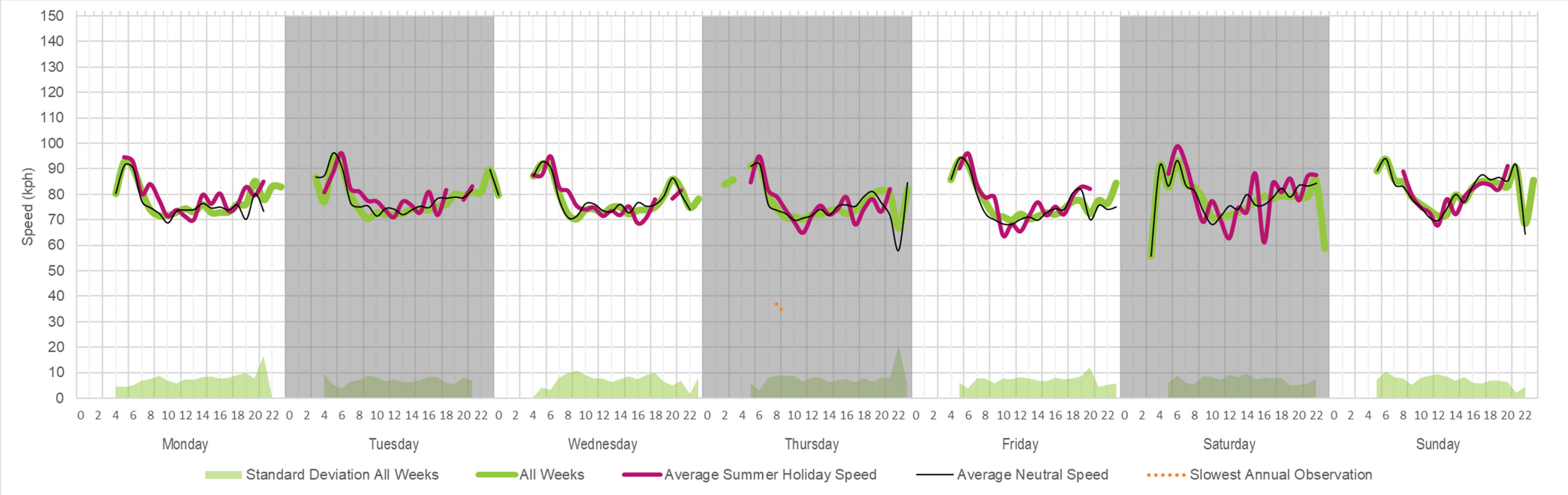


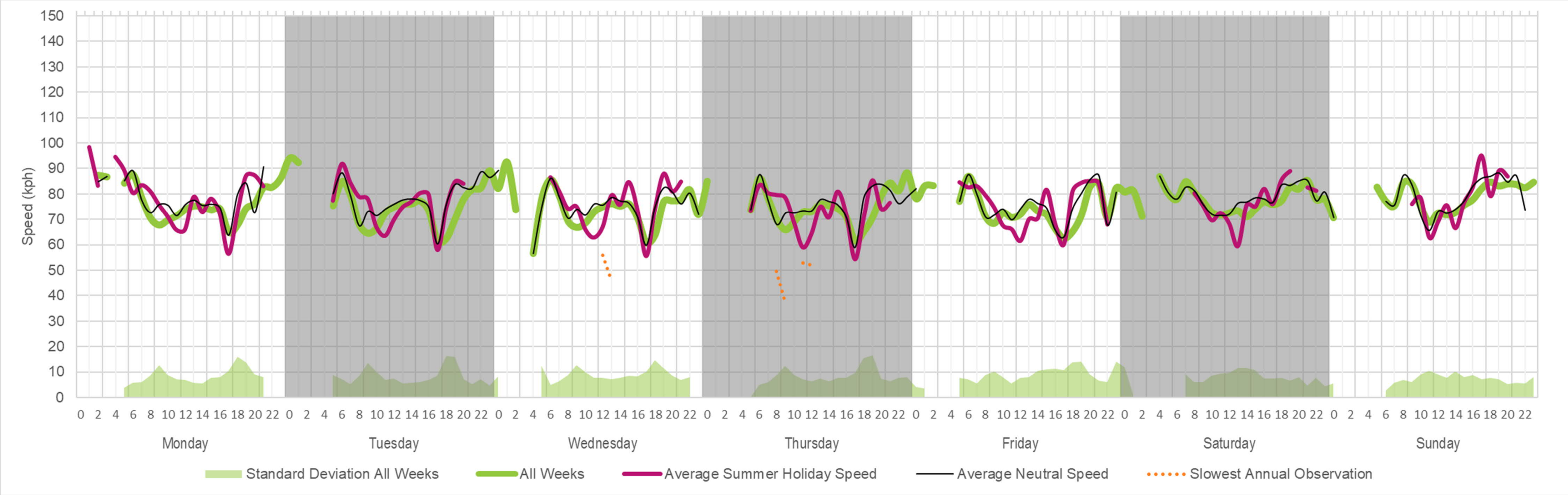
Journey Time Reliability Plot for MRN Corridor I: the A385 from its junction with the A38 in the west to the junction with the A380/A3022 in Paignton in 2018 (Top = Eastbound, Bottom = Westbound)



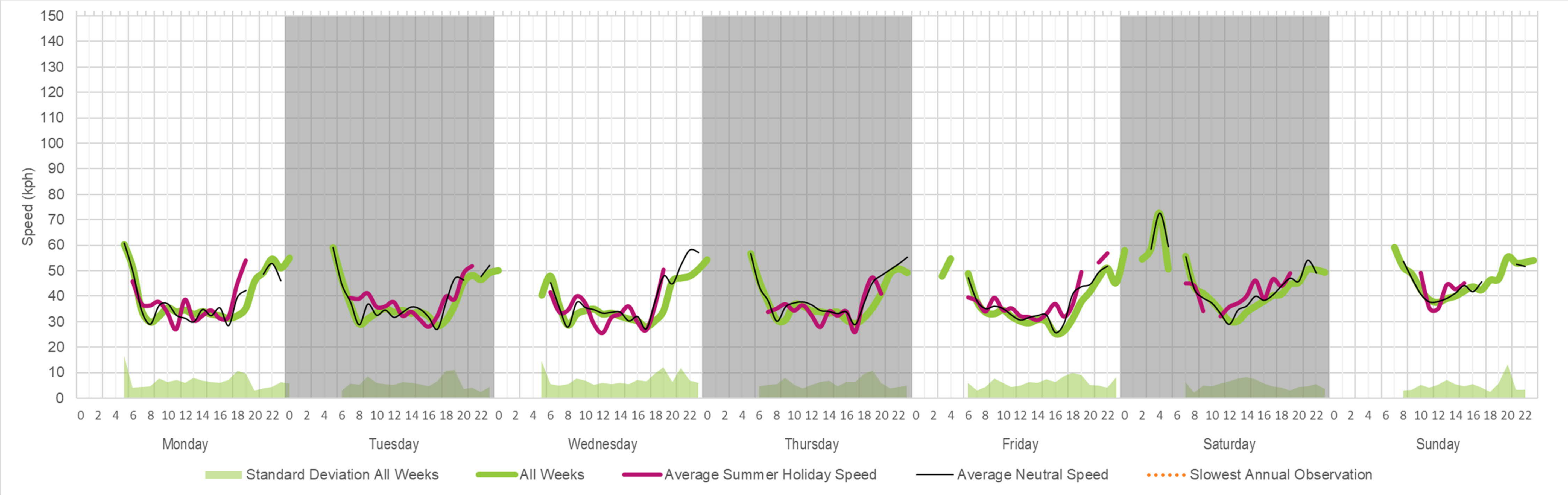


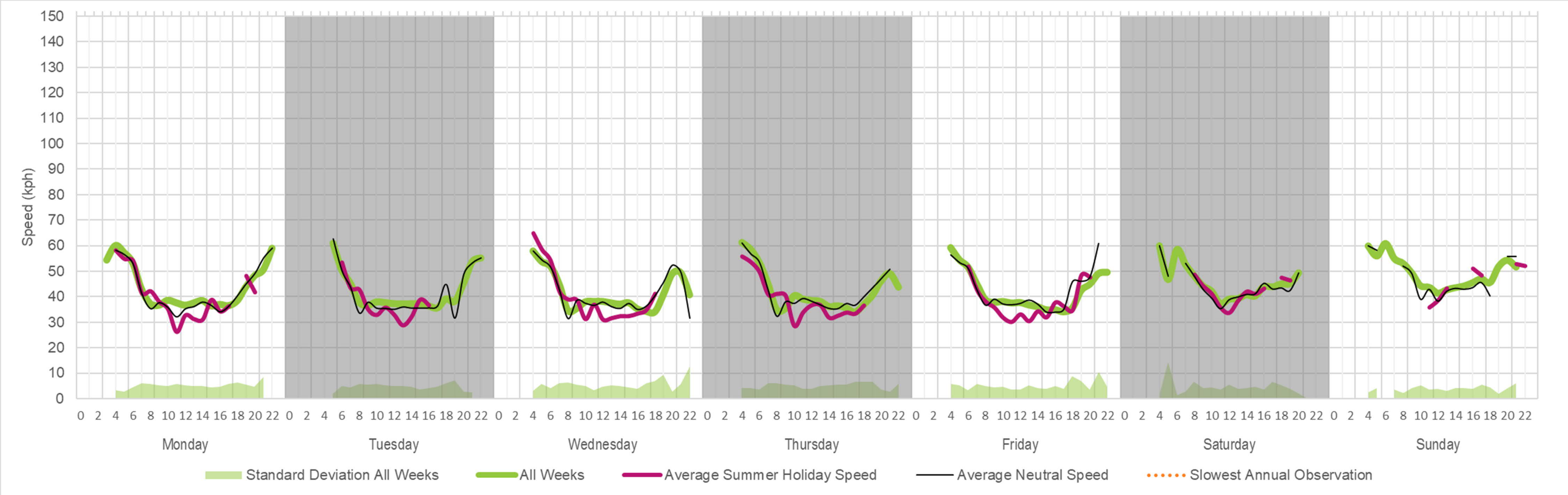
Journey Time Reliability Plot for MRN Corridor J: the A380/A3022 from the junction with the A38 in the north to the junction with the A379 at Windy Corner north of Brixham in Paignton in 2018 (Top = Northbound, Bottom = Southbound)



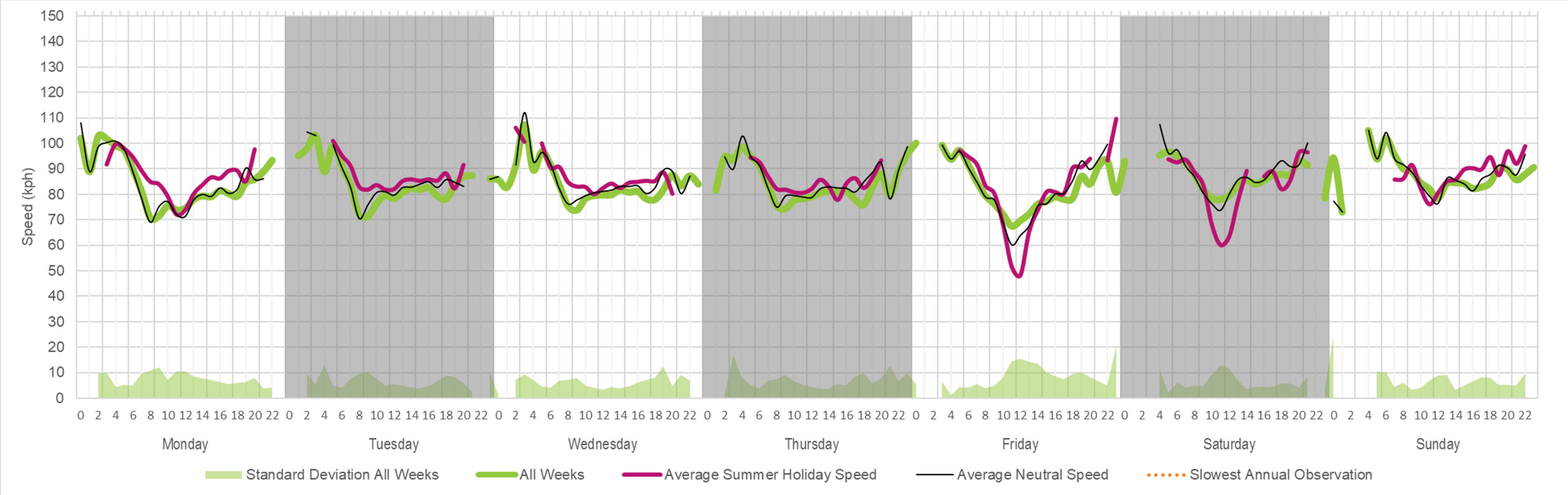


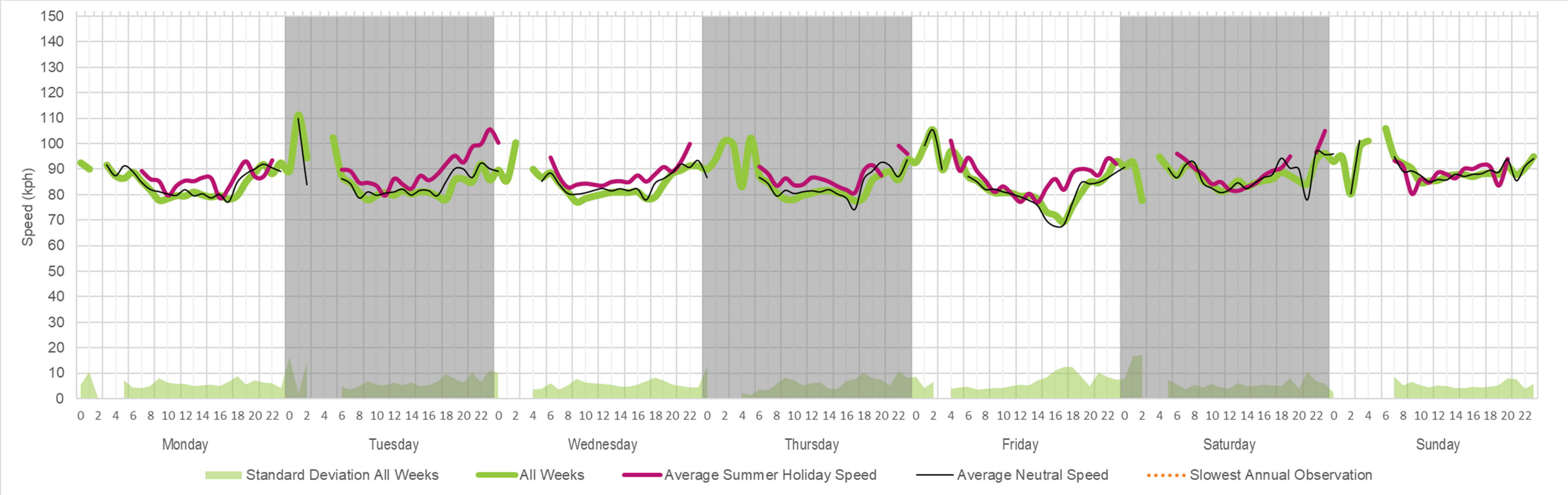
Journey Time Reliability Plot for MRN Corridor K: the A382 from the junction with the A38 at Drumbridges to the junction with the A381 in Newton Abbot in 2018 (Top = Eastbound, Bottom = Westbound)



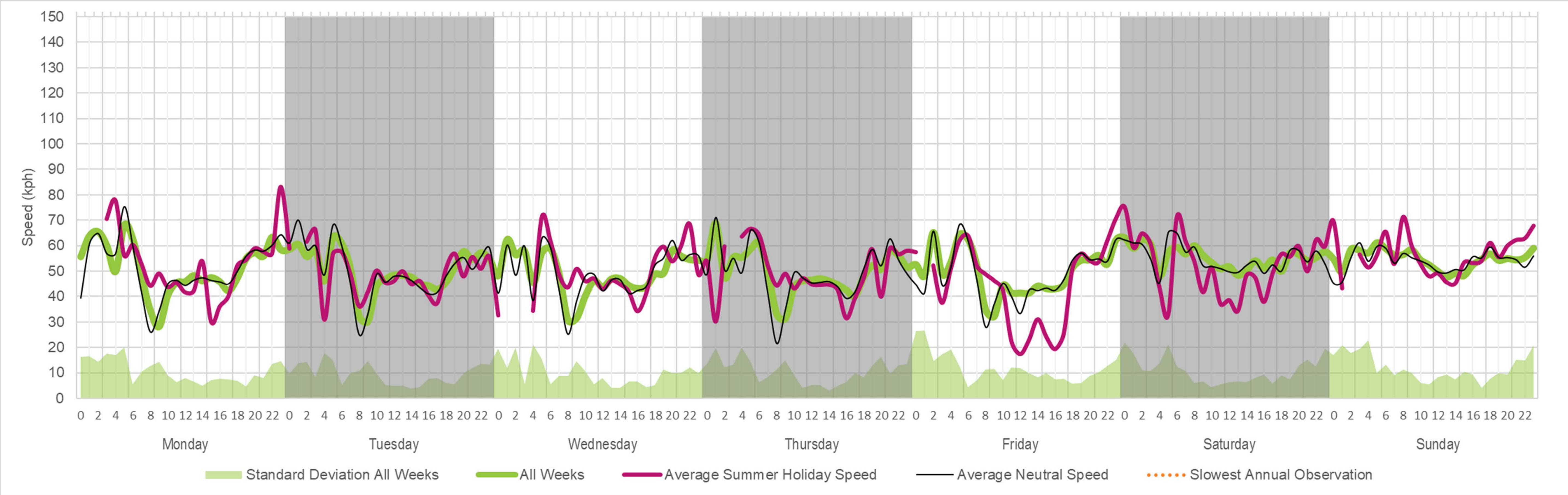


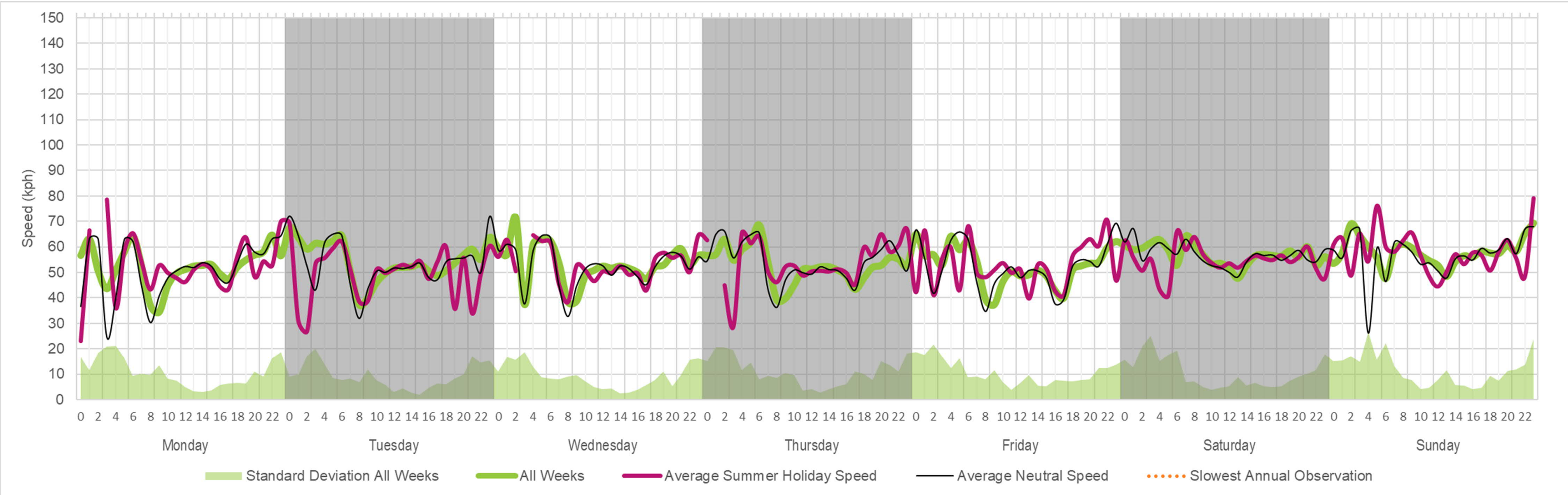
Journey Time Reliability Plot for MRN Corridor L: the A361/A39 North Devon Link Road from the M5 J27 to the junction with the A386 north of Bideford in 2018 (Top = Eastbound, Bottom = Westbound) [75%]



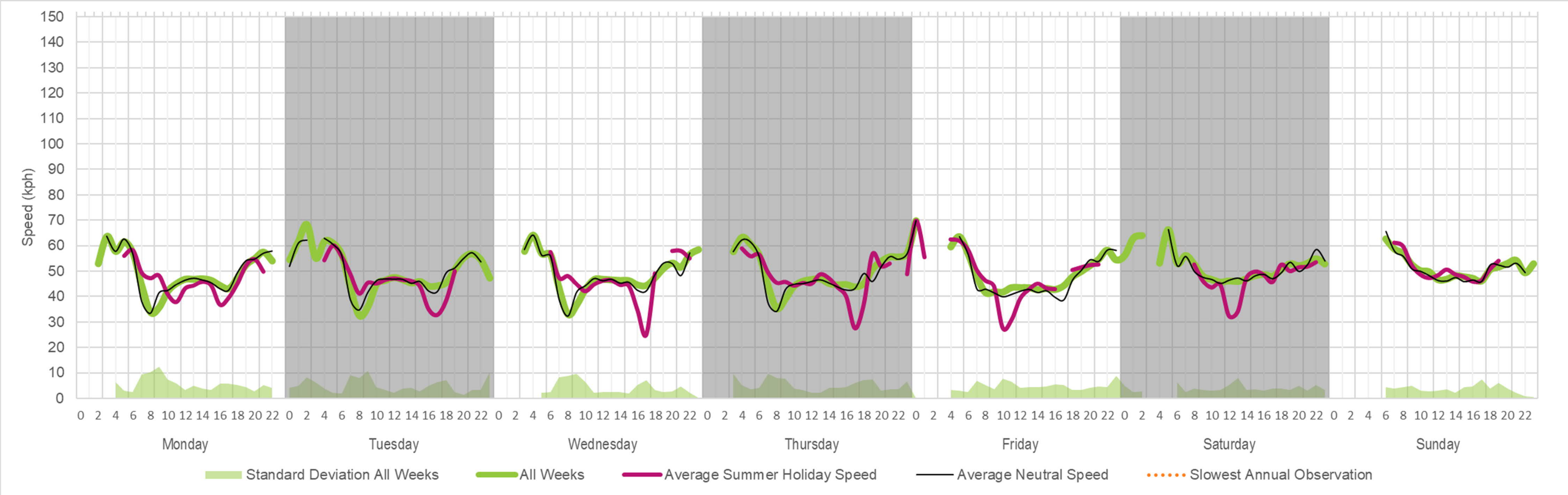


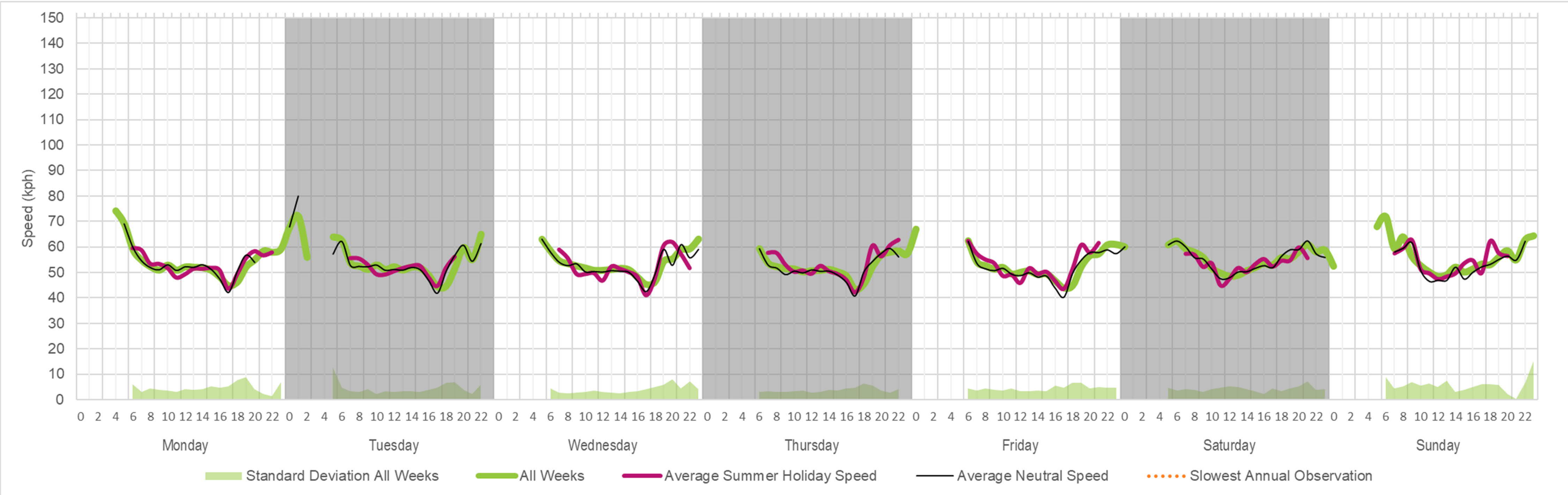
Journey Time Reliability Plot for MRN Corridor M: the A379 in Exeter from the M5 J30 to the junction with the A38 west of Exeter in 2018 (Top = Eastbound, Bottom = Westbound)



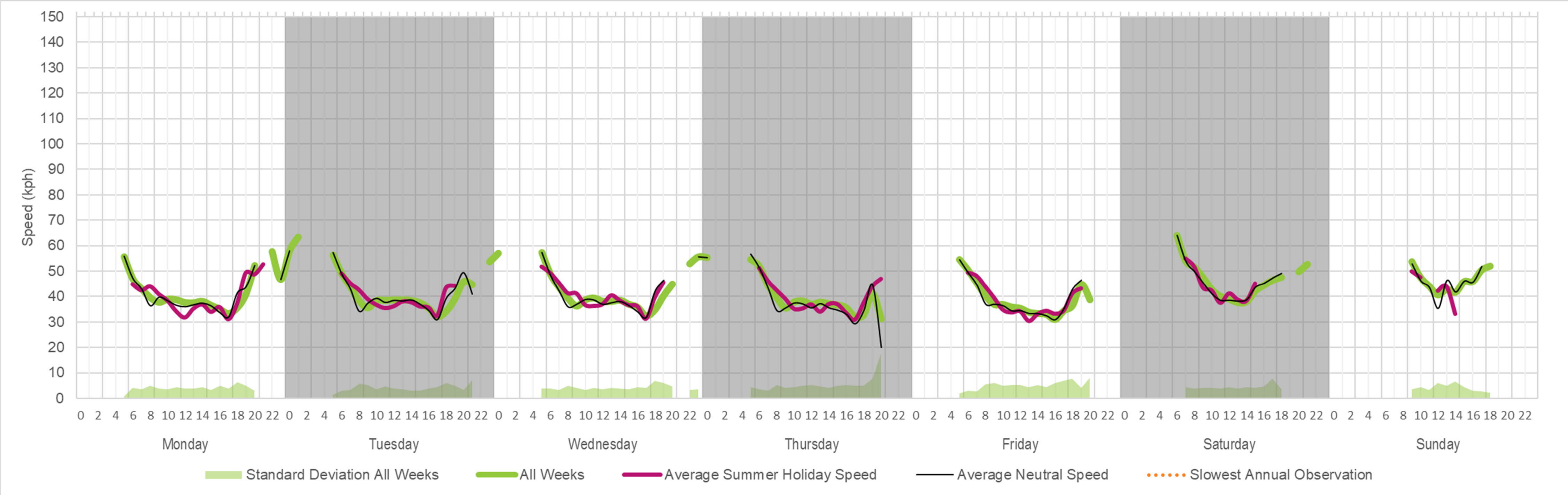


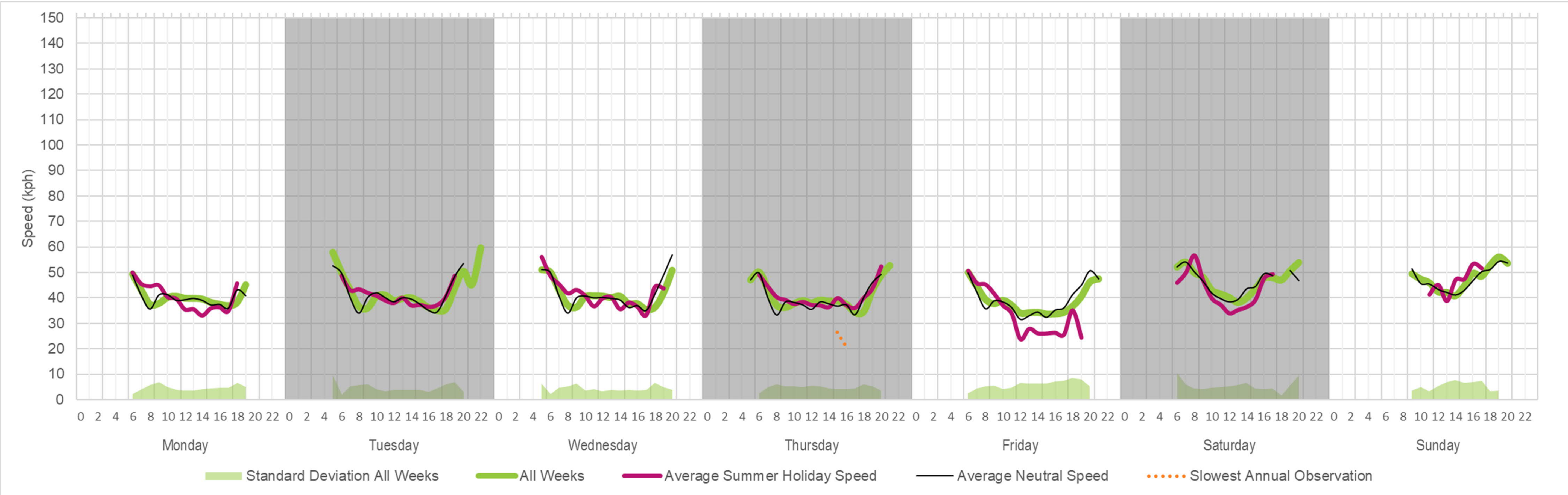
Journey Time Reliability Plot for MRN Corridor N: the A376 from the M5 J30 in Exeter to the Imperial Road Roundabout in Exmouth in 2018 (Top = Northbound, Bottom = Southbound)



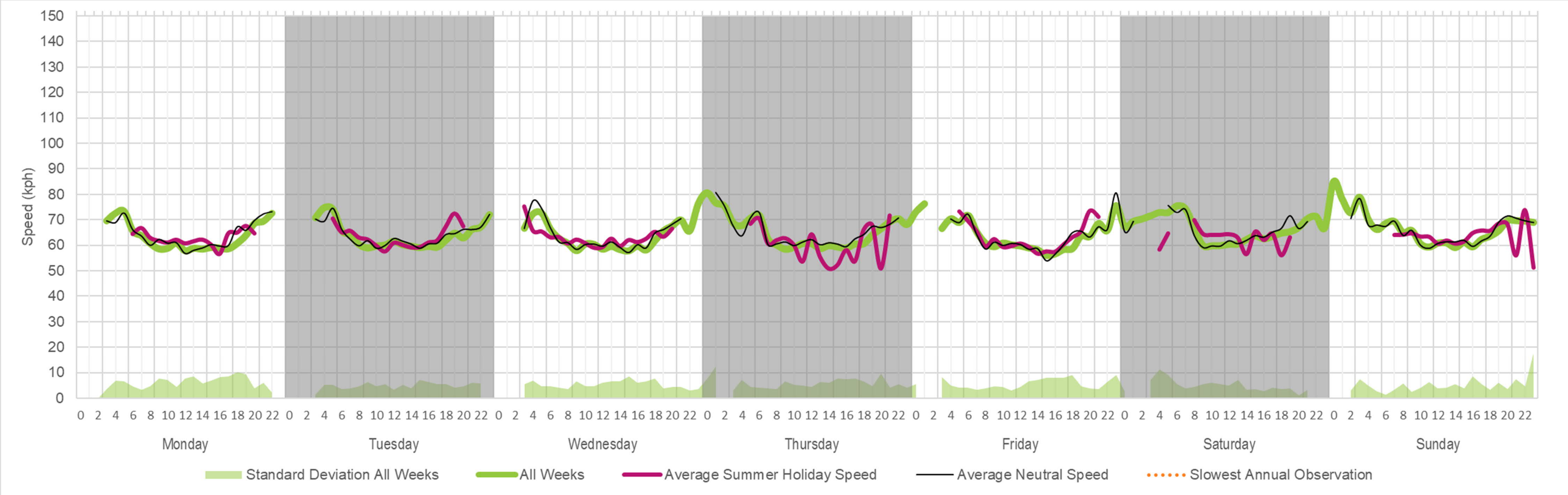


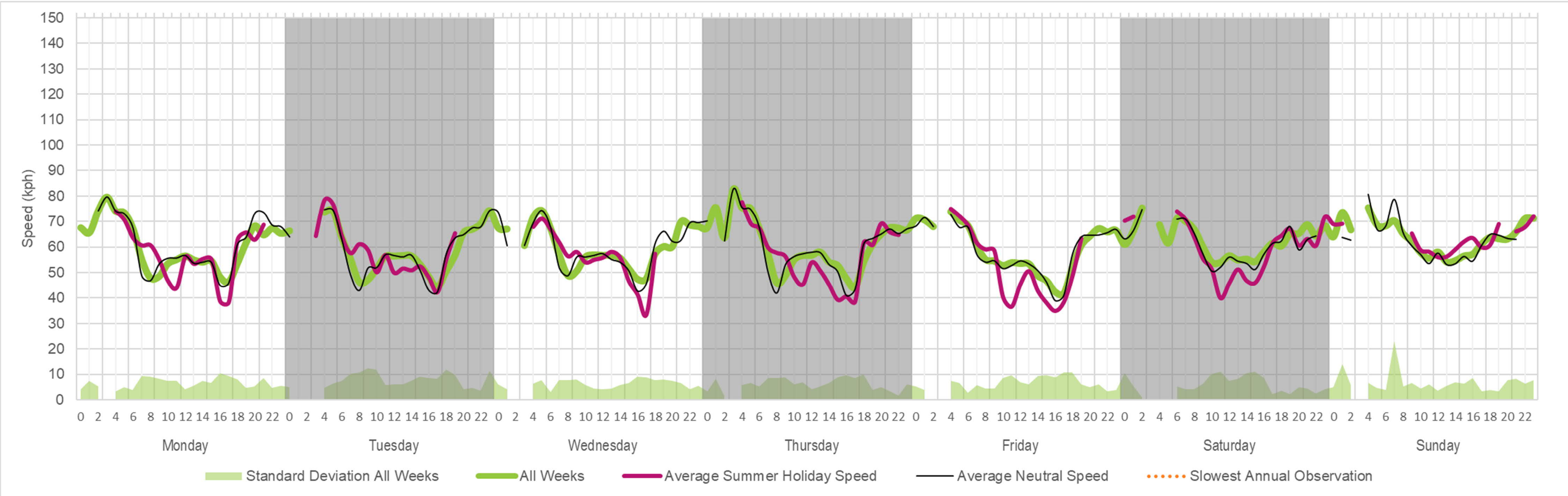
Journey Time Reliability Plot for MRN Corridor O: the A38 from the M5 J26 near Wellington to the Dunball Roundabout junction with the A39 just west of the M5 J23 near Bridgwater in 2018 (Top = Northbound, Bottom = Southbound)



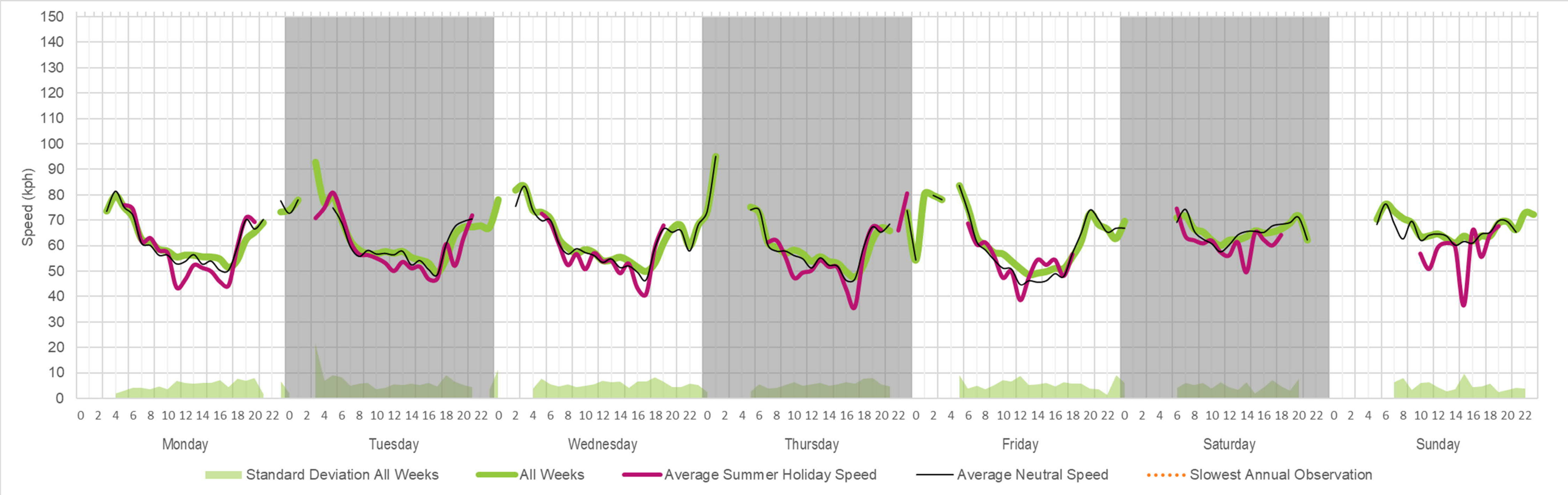


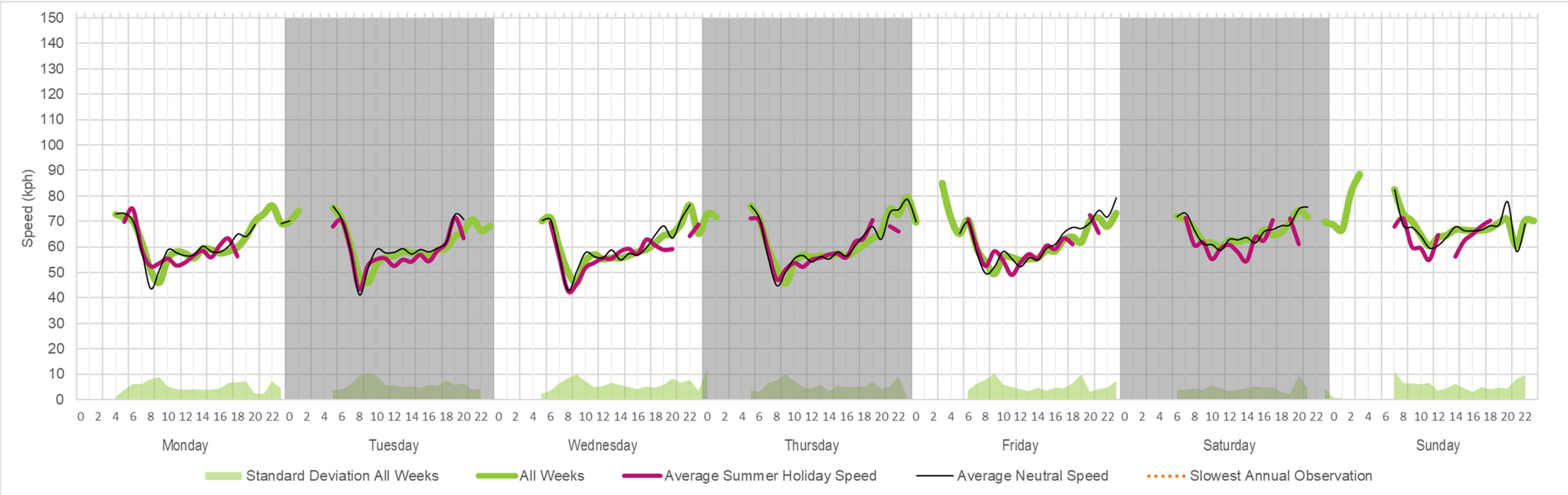
Journey Time Reliability Plot for MRN Corridor Q: the A38 from the M5 J22 north to the Peninsula border in 2018 (Top = Northbound, Bottom = Southbound)



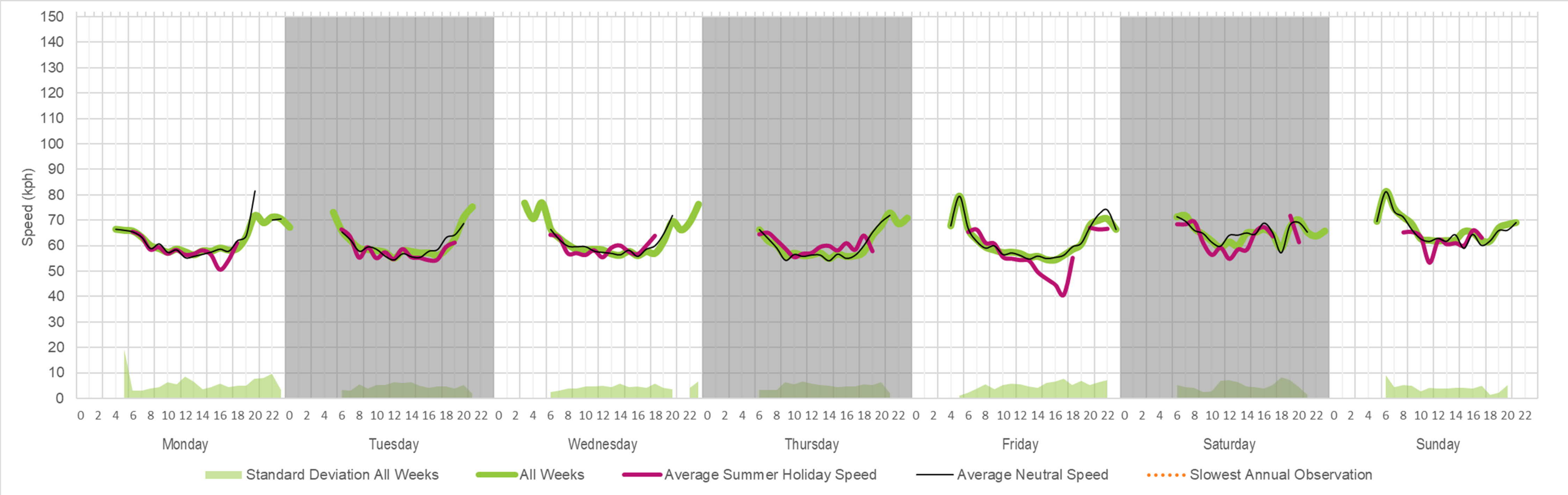


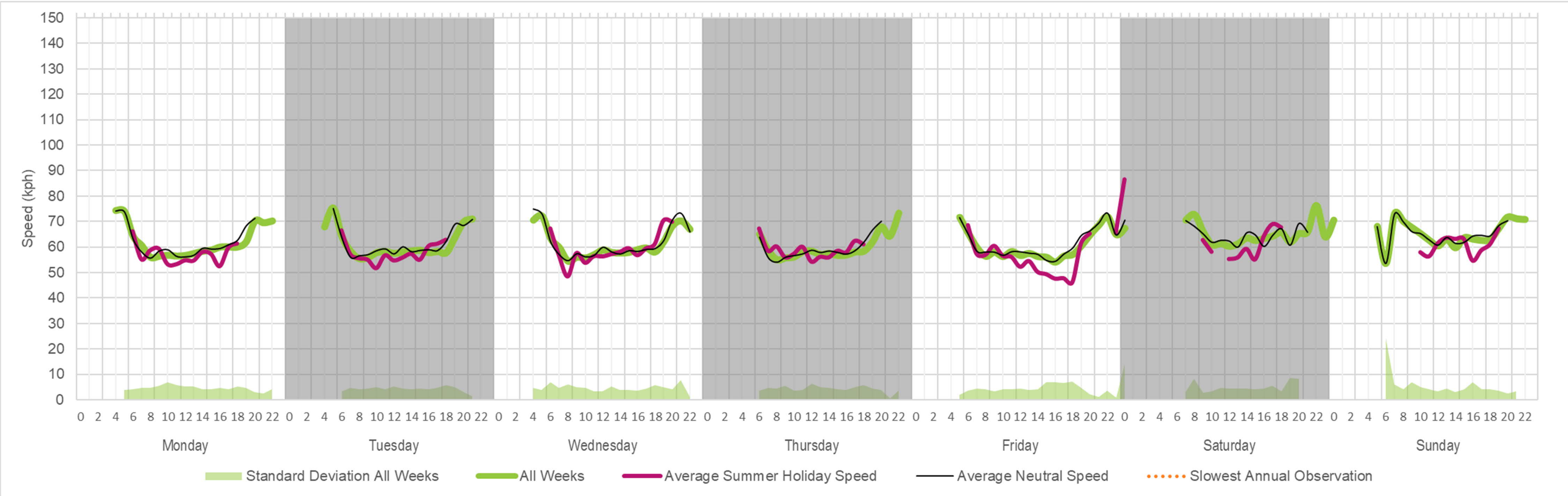
Journey Time Reliability Plot for MRN Corridor R: the A3088/A37 from the Cartgate Roundabout on the A303 south to the Peninsula border in 2018 (Top = Eastbound, Bottom = Westbound)



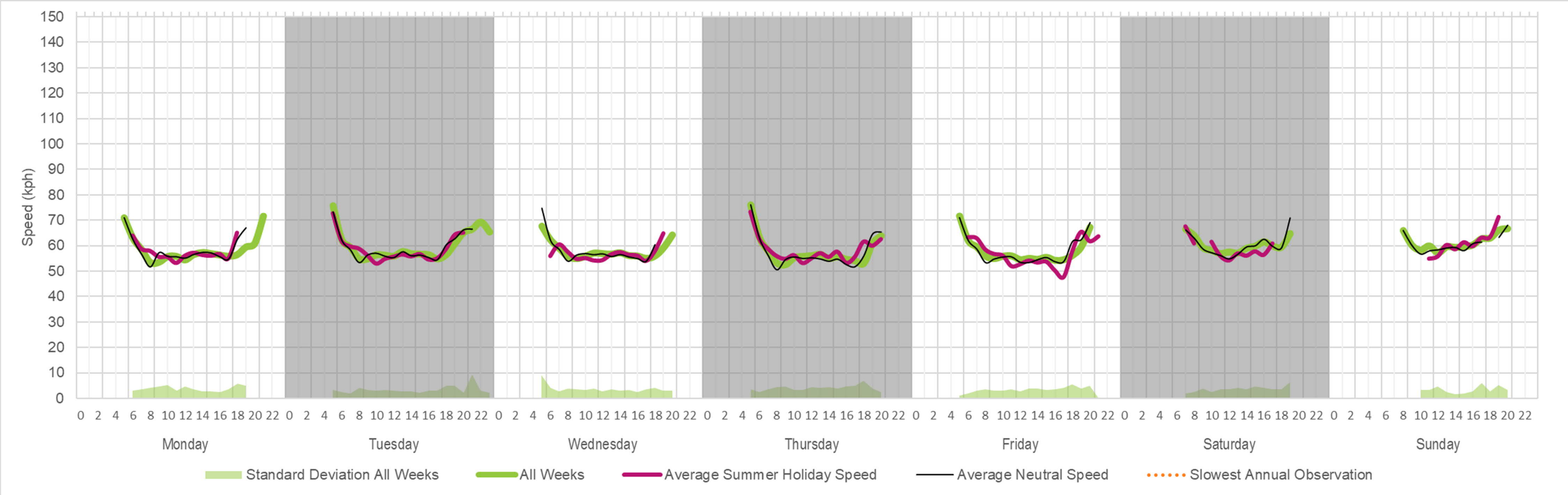


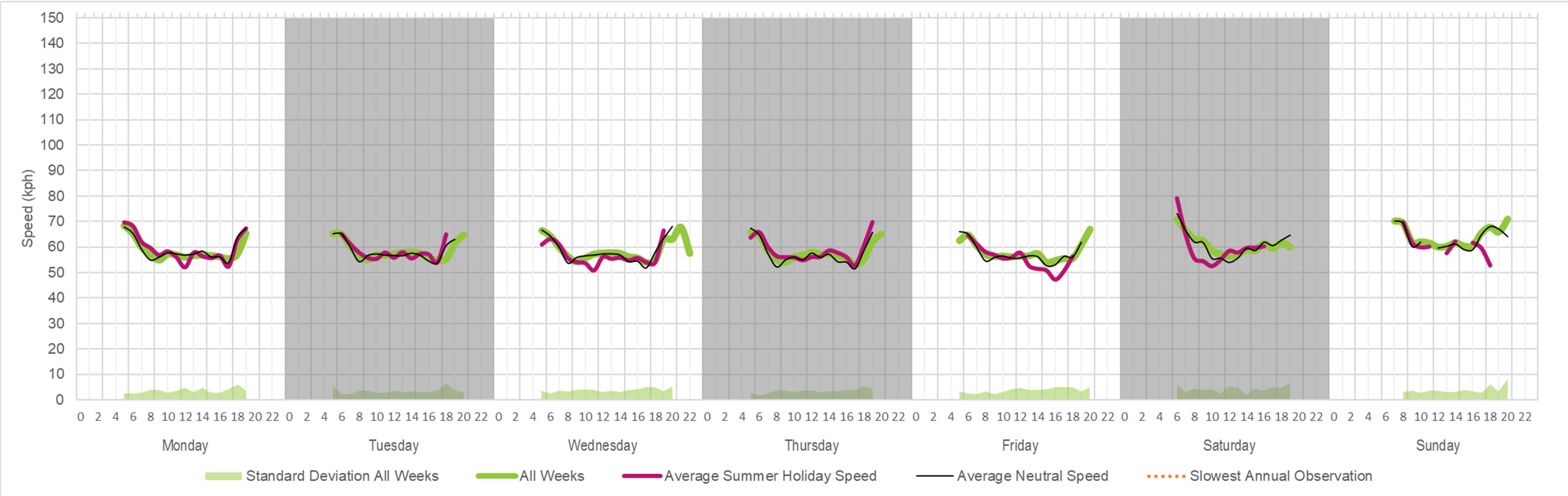
Journey Time Reliability Plot for MRN Corridor S: the A37 from the Podimore Roundabout on the A303 north to the Peninsula border in 2018 (Top = Northbound, Bottom = Southbound) [75%]



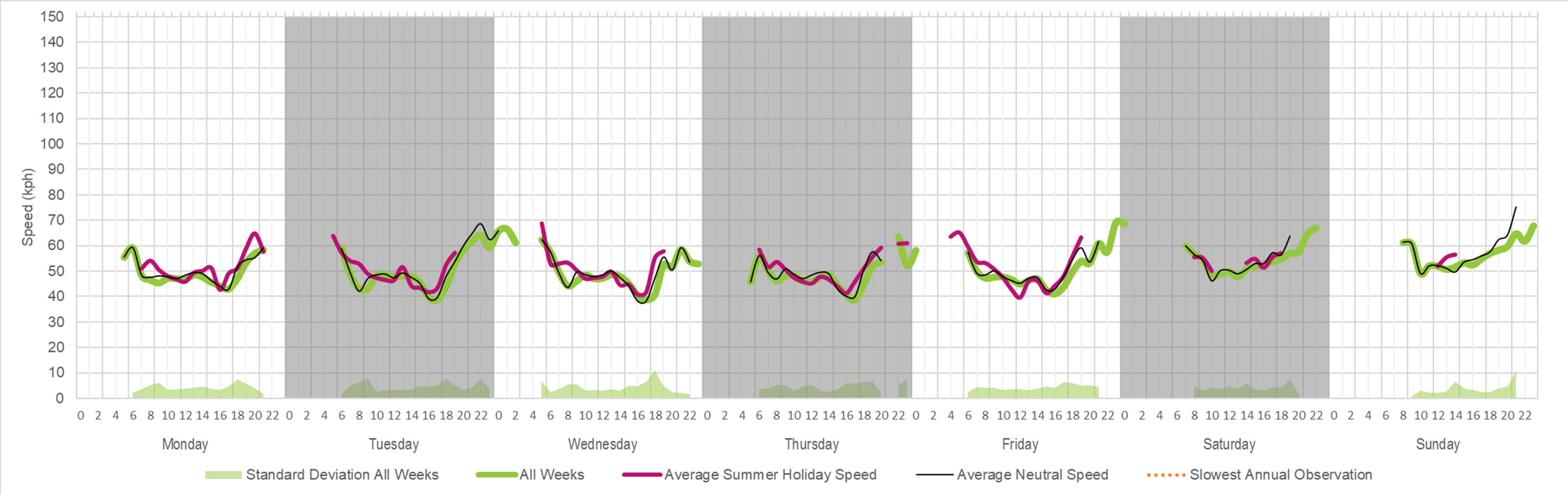


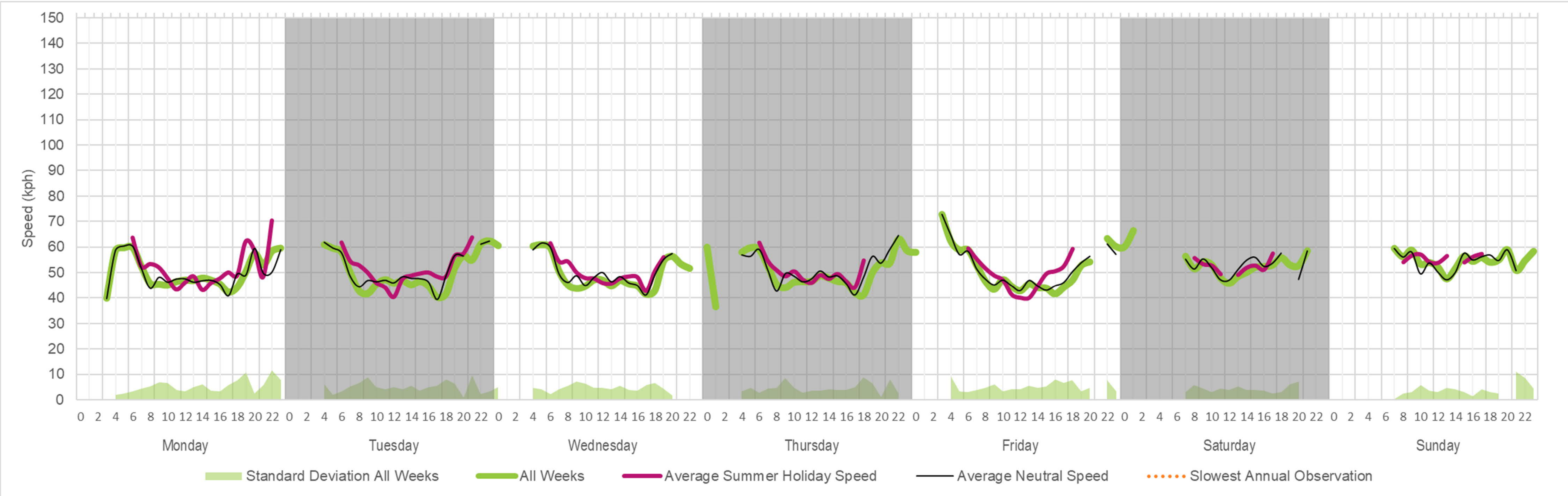
Journey Time Reliability Plot for MRN Corridor T: the A39/A361 from the M5 J23 through to the Peninsula border east of Frome in 2018 (Top = Eastbound, Bottom = Westbound) [75%]



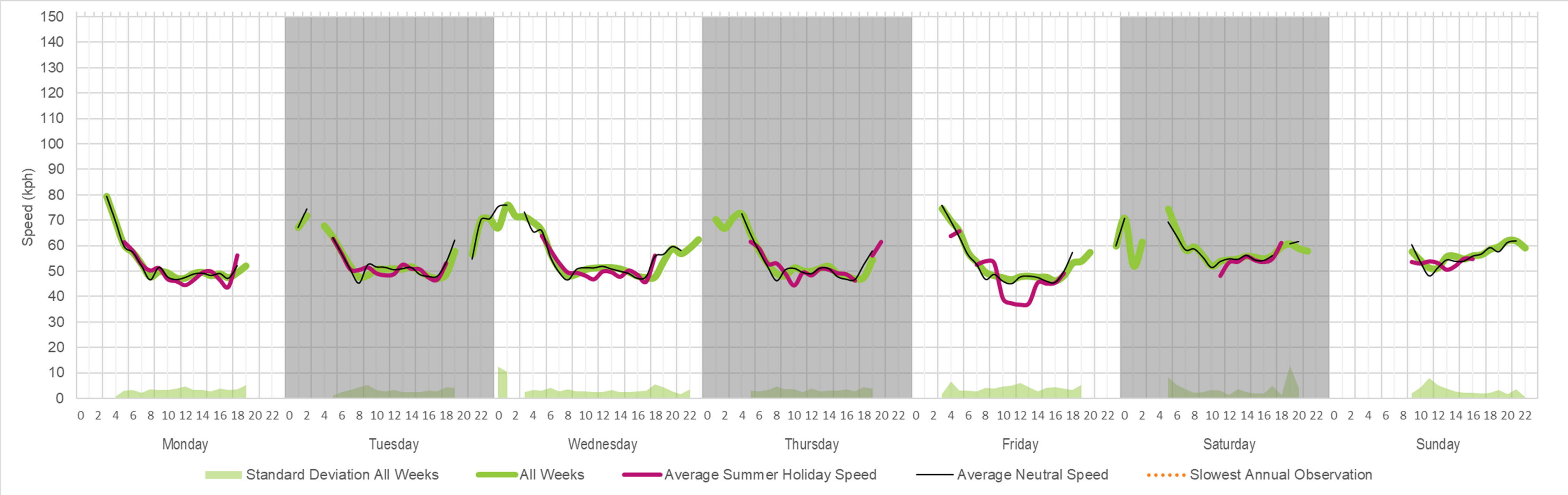


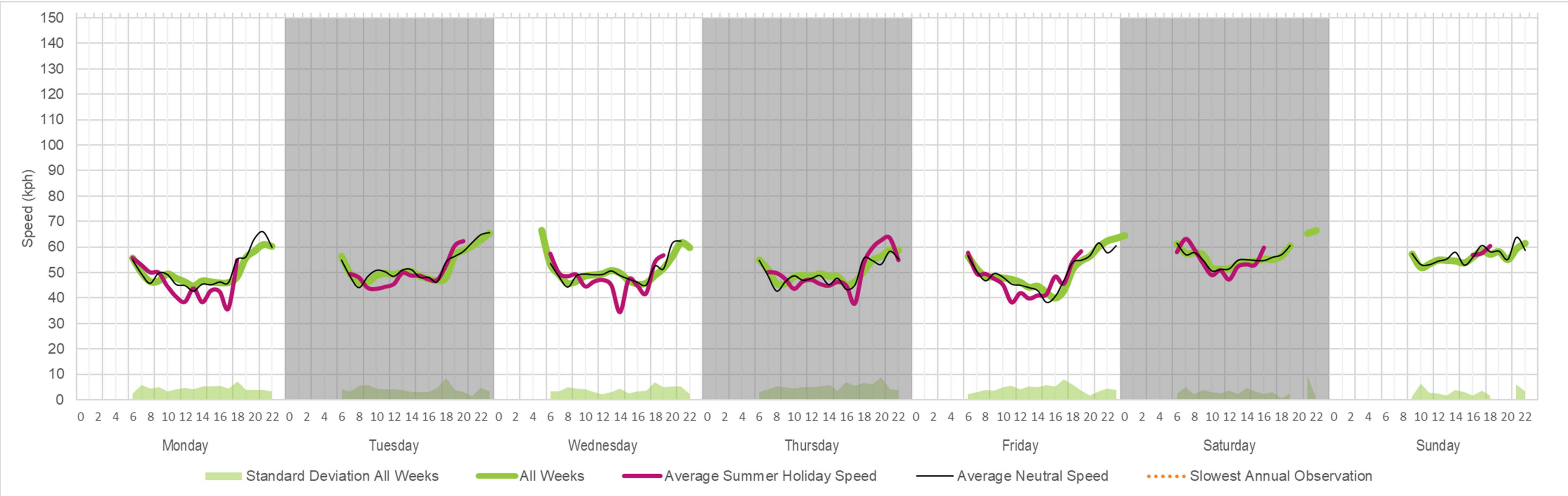
Journey Time Reliability Plot for the A386 from the junction with the A30 west of Okehampton to the junction with the A38 at Manadon in north Plymouth in 2018 (Top = Northbound, Bottom = Southbound) [75%]





Journey Time Reliability Plot for the A39 from the M5 J23 to the junction with the A396 in Minehead in 2018 (Top = Eastbound, Bottom = Westbound) [75%]





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