highways england

A66 Northern Trans-Pennine project

Local Traffic report

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Acronym	Definition
A66TM	A66 Traffic Model
AADT	Average Annual Daily Traffic
AONB	Area of Outstanding Natural Beauty
ATC	Automatic Traffic Count
COBALT	Cost and Benefit to Accidents – Light Touch
DCO	Development Consent Order
DfT	Department for Transport
DI	Distributional Impacts
DIADEM	Dynamic Integrated Assignment and Demand Modelling Software
DM	Do Minimum
DoS	Degree of Saturation
DS	Do Something
DTDV	Day to Day Variability
GPS	Global Positioning Service
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
LinSig	A software tool by JCT Consultancy which allows traffic engineers to model traffic signals and their effect on traffic capacities and queuing
LGV	Light Goods Vehicle
LSOA	Lower Super Output Area
MCC	Manual Classified Count
MMQ	Mean Max Queue
MND	Mobile Network Data
MyRIAD	Motorway Reliability Incidents and Delays
NRTM	Northern Regional traffic Model
NTEM	National Trip End Model
NTM	National Traffic Model
NTPR	North Trans-Pennine Routes
OBR	Office for Budget Responsibility
OD	Origin – Destination
OS ITN	Ordnance Survey Integrated Transport Network
PCU	Passenger Car Unit
PRC	Practical Reserve Capacity
RTF	Road Traffic Forecasts (Published by the Department for Transport)
RTM	Regional Traffic Model
SATURN	Simulation and Assignment of Traffic to Urban Road Networks
SRN	Strategic Road Network
TAG	Transport Analysis Guidance (Published by the Department for Transport)
Tempro	Modelling Software used to interrogate the National Trip End Model
TIS	Traffic Information System
TRICS	Trip Rate Database

Acronym	Definition
VDM	Variable Demand Model
VISSIM	German for "Traffic in cities - simulation model"
VPD	Vehicles per Day
WCH	walkers, cyclists and horse-riders
WebTRIS	Highways England Web based Traffic count Information System

1 Introduction

1.1 Introduction and Purpose of this Document

1.1.1 This document comprises of a Local Traffic Report that has been produced to support the development of the DCO application for the A66 Northern Trans-Pennine Project ('the Project'). The purpose of this document is to provide information about the operational traffic assessments undertaken to date to inform the documents which form the Statutory Consultation for the Project.

1.1.2 The traffic modelling and assessment work is ongoing and therefore this report provides a 'point in time' rather than a final state. As such, this Local Traffic Report will continue to develop and will eventually be subsumed into the Transport Assessment which will accompany the application.

1.1.3 This Local Traffic Report does not consider construction traffic impacts of the Project. Please refer to the Construction Method and Management Statement which has been produced to support the Statutory Consultation. An assessment of the construction traffic will be included in the Transport Assessment which will support the DCO application.

1.2 Structure of this Document

1.2.1 The following chapters are structured in the following manner.

- Chapter 2 describes the existing highway operation and traffic flows.
- Chapter 3 describes the approach to modelling.
- Chapter 4 describes the strategic development impact.
- Chapter 5 describes the development impact between M6 Junction 40 and Kemplay Bank.
- Chapter 6 describes the development impact between Penrith and Temple Sowerby.
- Chapter 7 describes the development impact between Temple Sowerby and Appleby.
- Chapter 8 describes the development impact between Appleby and Brough.
- Chapter 9 describes the development impact at Bowes.
- Chapter 10 describes the development impact between Cross Lanes and Rokeby.
- Chapter 11 describes the development impact between Stephen Bank and Carkin Moor.
- Chapter 12 describes the development impact at Scotch Corner.
- Chapter 13 concludes the report.

1.3 Project Description

1.3.1 The A66 is a key national and regional strategic link for a range of traffic movements for east/west journeys in the North of England and provides vital connections for freight and businesses in the regions. The route carries a high levels of freight traffic, accounting for between 18 to 29% heavy goods vehicles (HGVs), depending on location and time of day, compared to the national figures of 12%.

1.3.2 The Project involves the improvement of the A66 between the M6 at Penrith and the A1(M) J53 at Scotch Corner, which is around 49.5 miles. The aim is to have the entire route as a dual carriageway, which at present still has more than 18 miles of single carriageway sections, making the route accident prone and unreliable.

1.3.3 The key aspects of the Project are as follows:

- Upgrading of the A66 between M6 J40 Penrith and A1(M) J53 at Scotch Corner to dual carriageway standard over its entire length; and
- Junction upgrades at the M6 J40 Penrith, Kemplay Bank roundabout and at A1(M) J53 at Scotch Corner.

1.3.4 The sections of the A66 that are currently single carriageway are displayed in the diagram below.

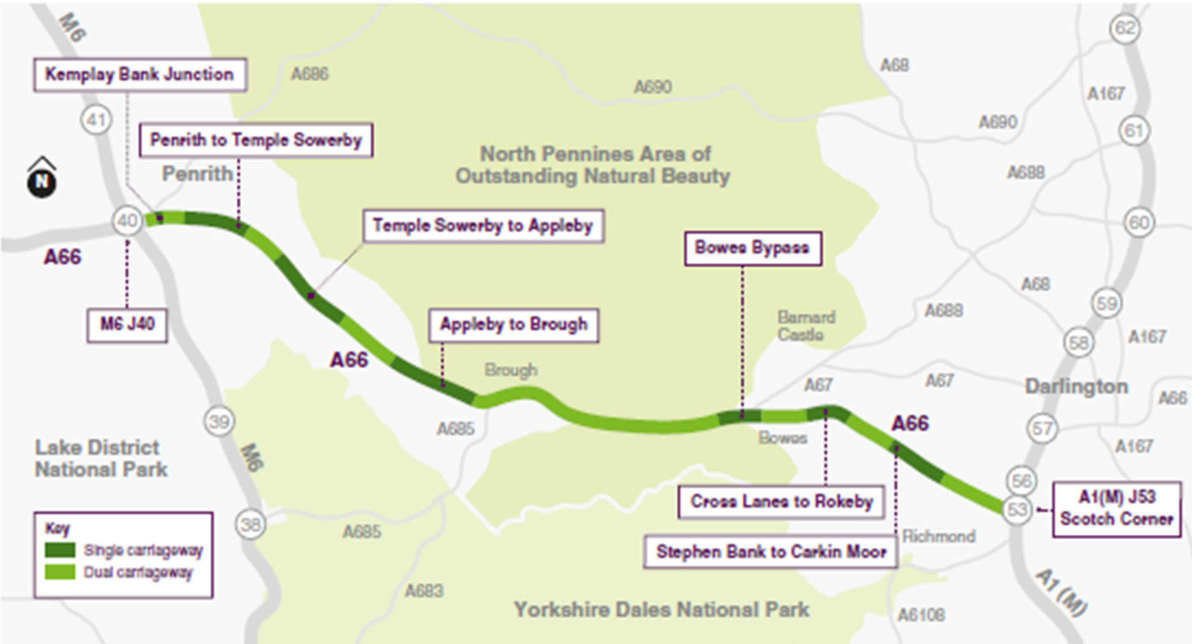

Figure 1-1: A66 Northern Trans-Pennine Project: Current Route

1.4 Study Area

1.4.1 This report considers the traffic impact of the project on the surrounding road network. In the absence of any other criteria, it is considered reasonable to define the surrounding road network within this context as based on the definition of the affected road network for air quality purposes. This is defined within LA 105[1] and LA111[2] as any road that meet any of the following criteria:

- Daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- where there is the possibility of a change of 1 dB LA10,18h or more in the short-term or 3 dB LA10,18h or more in the long-term. A change in noise level of 1 dB LA10,18h is equivalent to a 25% increase or a 20% decrease in traffic flow, assuming other factors remain unchanged and a change in noise level of 3 dB

[1] Design Manual for Roads and Bridges - Standards for Highways LA105 – Air Quality https://www.standardsforhighways.co.uk/dmrb/search/10191621-07df-44a3-892e-c1d5c7a28d90
[2] Design Manual for Roads and Bridges - Standards for Highways LA111 – Noise and vibration https://www.standardsforhighways.co.uk/dmrb/search/cc8cfcf7-c235-4052-8d32-d5398796b364

LA10,18h is equivalent to a 100% increase or a 50% decrease in traffic flow

1.4.2 The study area is shown as the 'Fully Modelled (Study) Area' in Figure 3-2.

2 Existing Highways Operations and Traffic Flows

2.1 Existing Highways Operations

2.1.1 The A66 between Penrith and Scotch Corner currently operates as an all-purpose trunk road on the Strategic Road Network (the SRN). The SRN is the network of nationally significant roads used for the distribution of goods and services, and a network for the. The SRN are those roads which are the responsibility of the Secretary of State for Transport and managed by Highways England. The A66 is a combination of single carriageway and dual carriageway sections in each direction. There is currently around 18 miles of single carriageway and partly dual carriageway in each direction.

2.1.2 The A66 provides an important strategic, regional and local route, connecting east and west coasts, as well as providing local access (Figure 2-1). It is the most direct route between the Tees Valley, North Yorkshire, South Yorkshire, parts of West Yorkshire, the East Midlands, Eastern England and North Cumbria, Glasgow, and much of the central belt of Scotland and Cairnryan (for access to Northern Ireland and the Republic of Ireland).

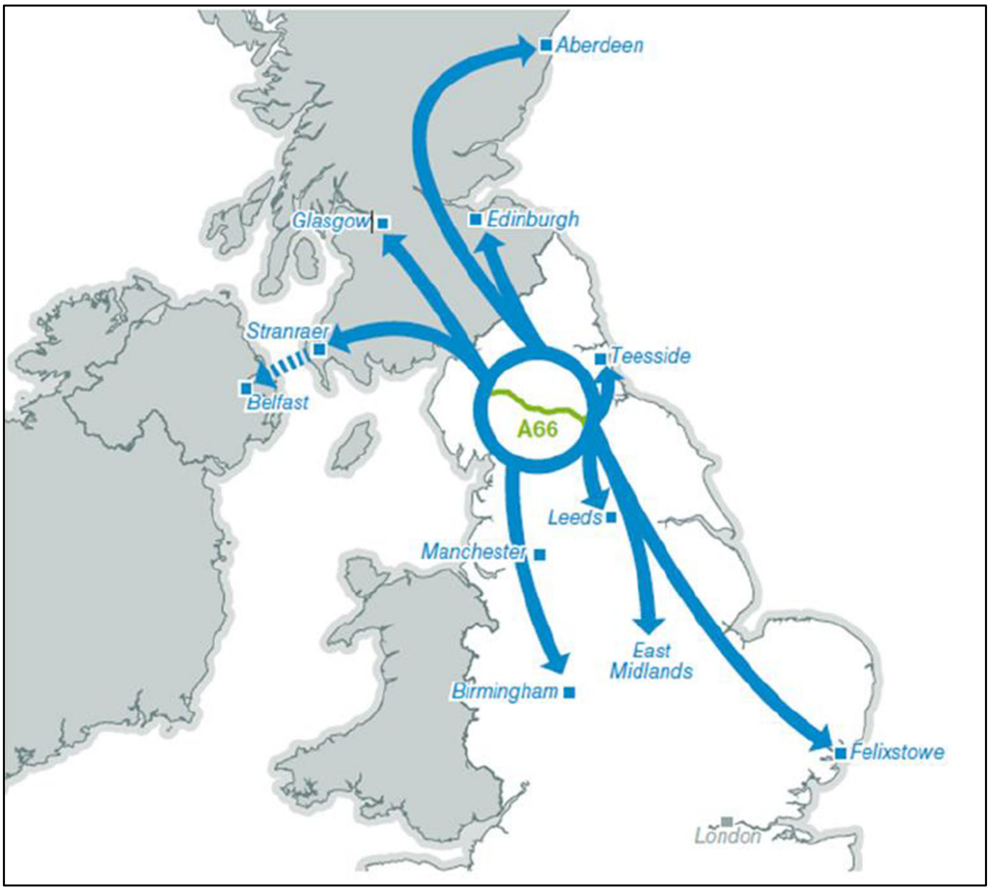

Figure 2-1: A66 key strategic links

2.1.3 There is a lack of public transport infrastructure on the A66, with minimal bus service provision and no direct east-west rail connections. This emphasises the importance of the A66 in terms of strategic connectivity across the UK.

2.1.4 For key journeys across the UK, such as trips from the east and south east of England to the north west of England or Scotland, the A66 is the most direct and quickest route. The only strategic alternative east-west route for road traffic in the north of England is the M62 or the A69, both of which require a significantly longer journey time.

2.1.5 The main transport-related issues identified on the A66 within the study are:

- road safety
- journey times
- journey reliability and route resilience, and
- local severance.

2.2 Existing Traffic Flows

2.2.1 In the latest modelled year (i.e. 2015), around 16,500 vehicles travel along the A66 each day in both directions, with approximately between 18 to 29% of vehicles identified as HGVs. The typical proportion of HGVs expected (as a proportion of AADT) is 15% on motorways, 12% on trunk roads and 8% on principal roads. Therefore, it is noted that the percentage of HGVs is significantly higher than the average figure for other road types. Further information regarding; the base year of the modelling assessment used within this report, how demand is anticipated to be affected by Covid, and what modelling will be used to inform the Transport Assessment is contained within chapter 3.5.

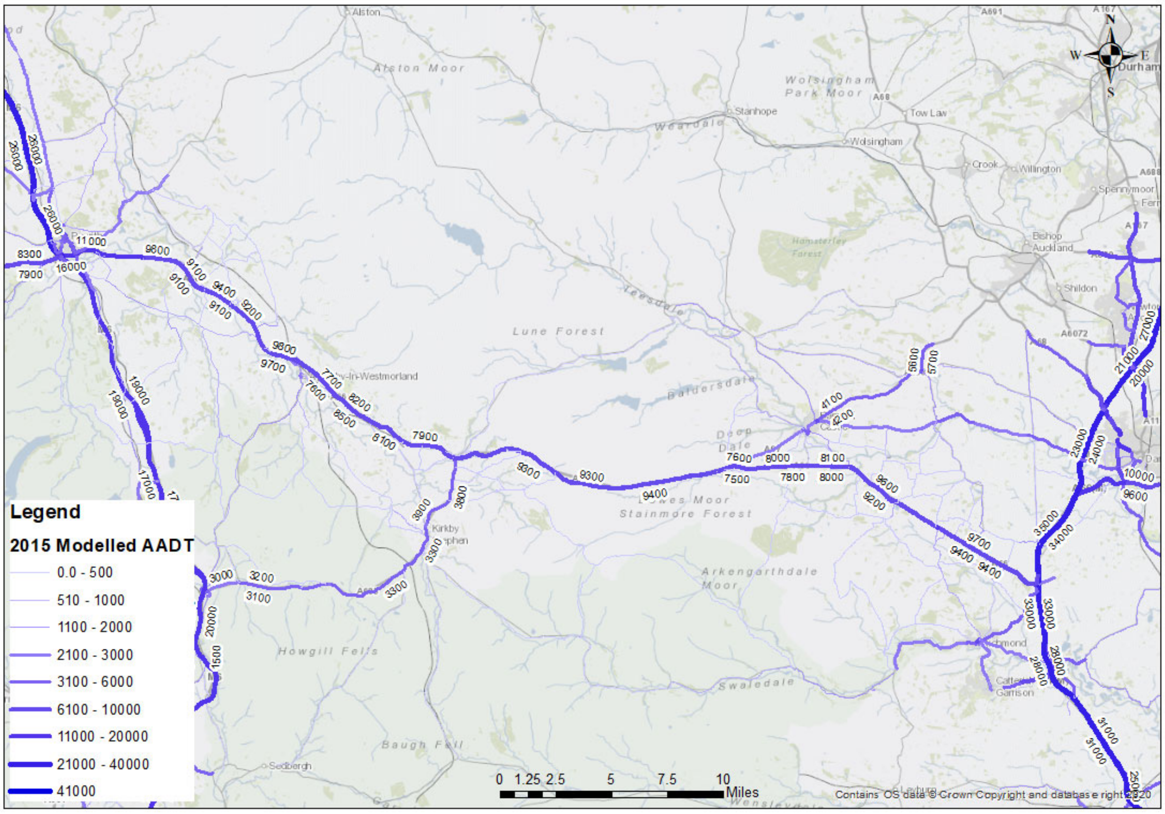

Figure 2-2: AADT flows across route

2.2.2 There is evidence that the A66 is affected by seasonality with high flows during August and lower flows during the winter months. Monthly flow profiles of weekday traffic in 2019 is shown at 3 locations along the A66 route as follows:

- Between Kemplay Bank and M6 J40 at the western end of the A66 (Figure 2-3 and Figure 2-4);
- Near Appleby towards the central section of the A66 (Figure 2-5 and Figure 2-6);
- East of Bowes at the eastern end of the A66 (Figure 2-7 and Figure 2-8)

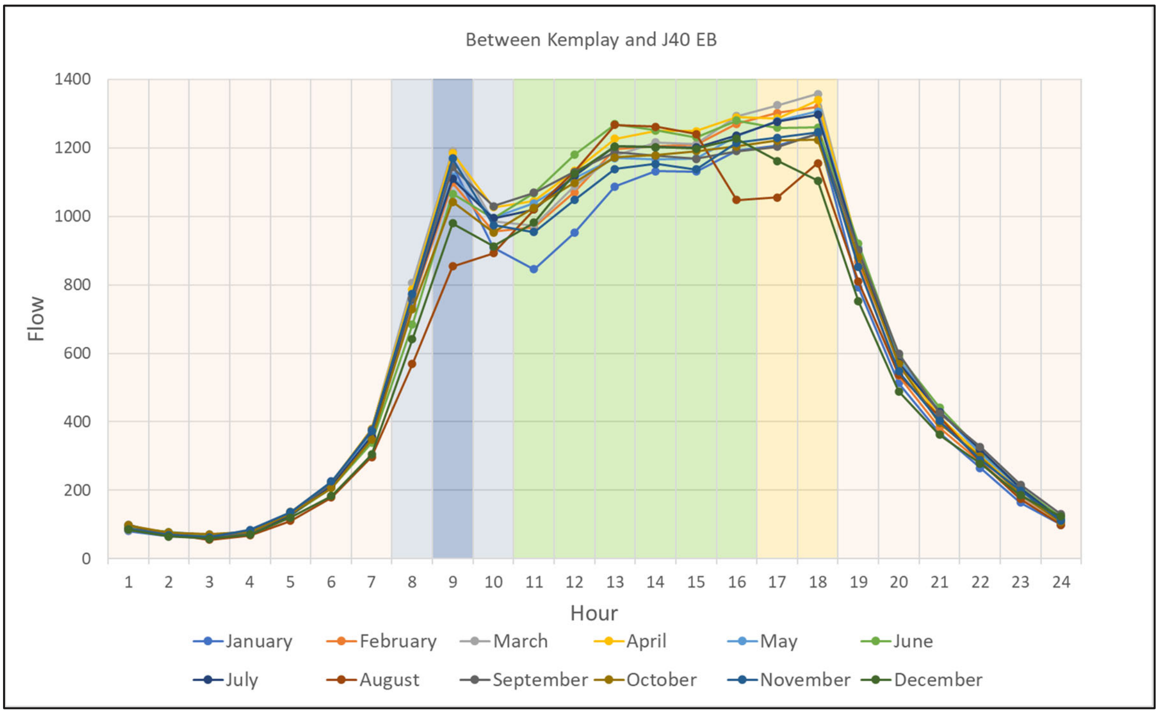

Figure 2-3: A66 Weekday Flow by Month between Kemplay Bank and M6 J40 (EB)

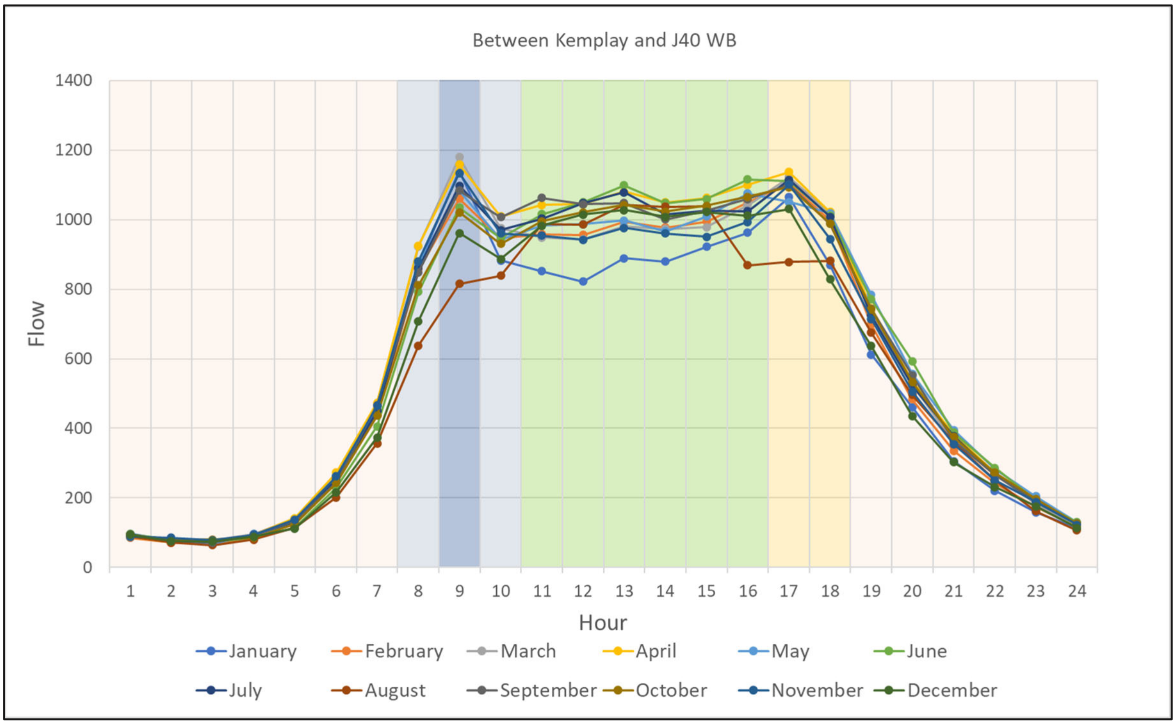

Figure 2-4: A66 Weekday Flow by Month between Kemplay Bank and M6 J40 (WB)

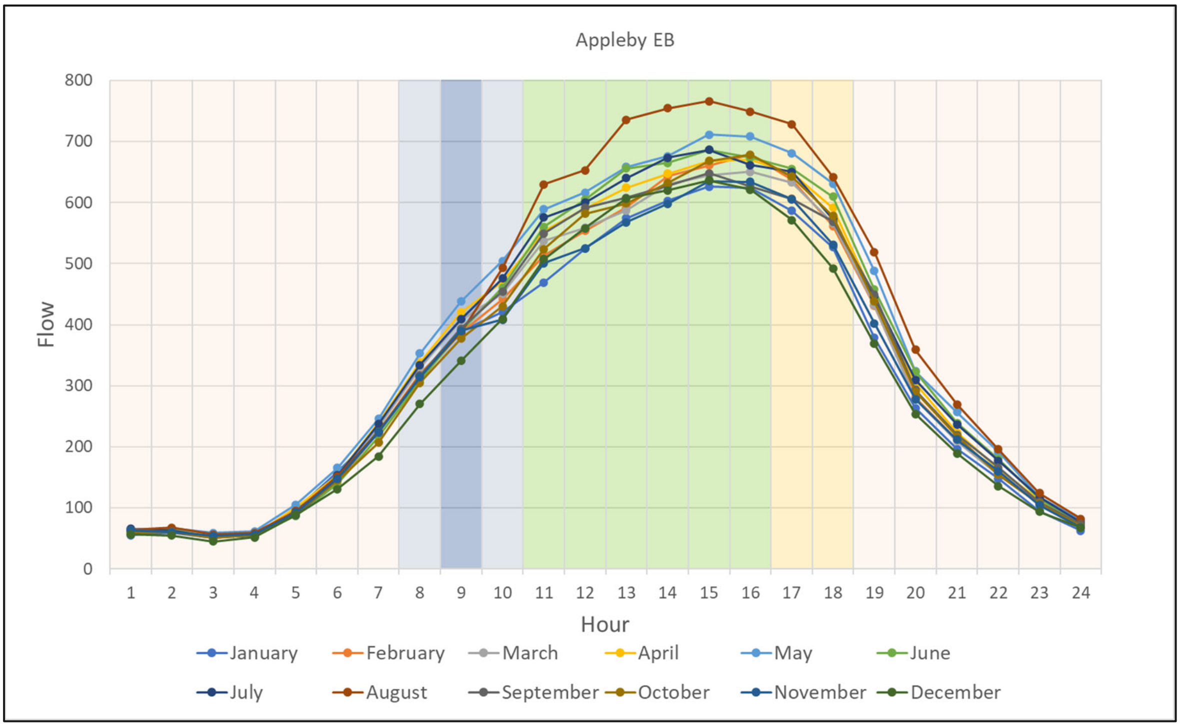

Figure 2-5: A66 Weekday Flow by Month at Appleby (EB)

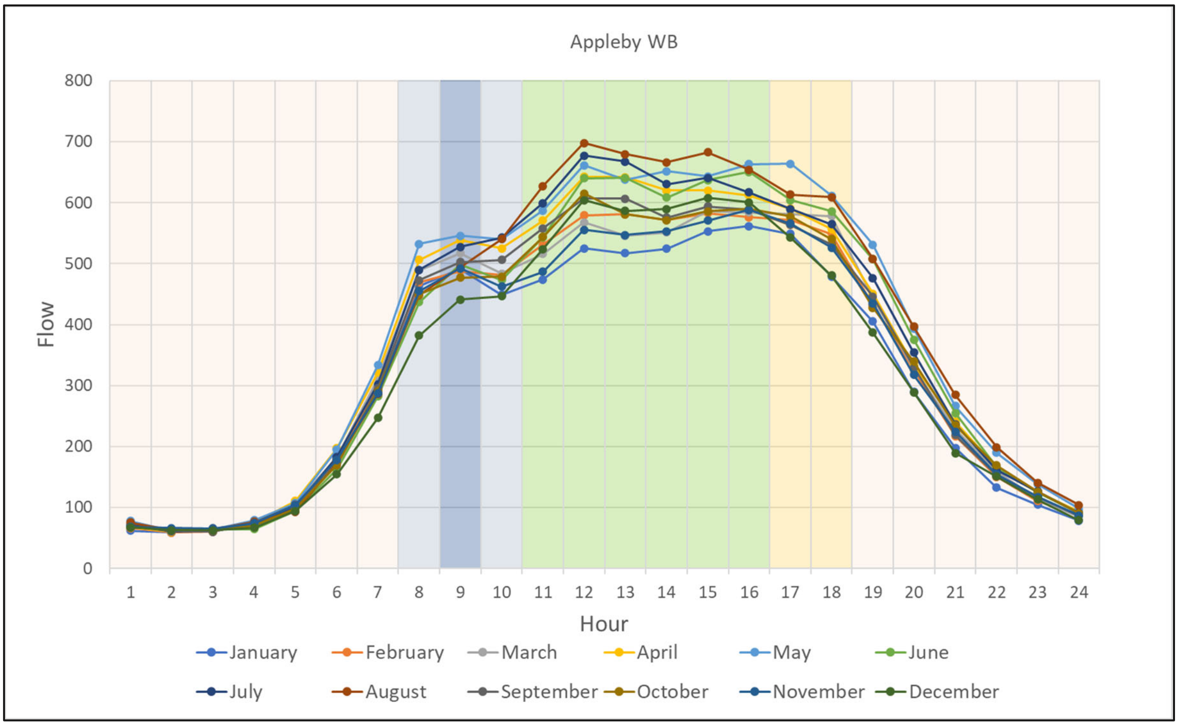

Figure 2-6: A66 Weekday Flow by Month at Appleby (WB)

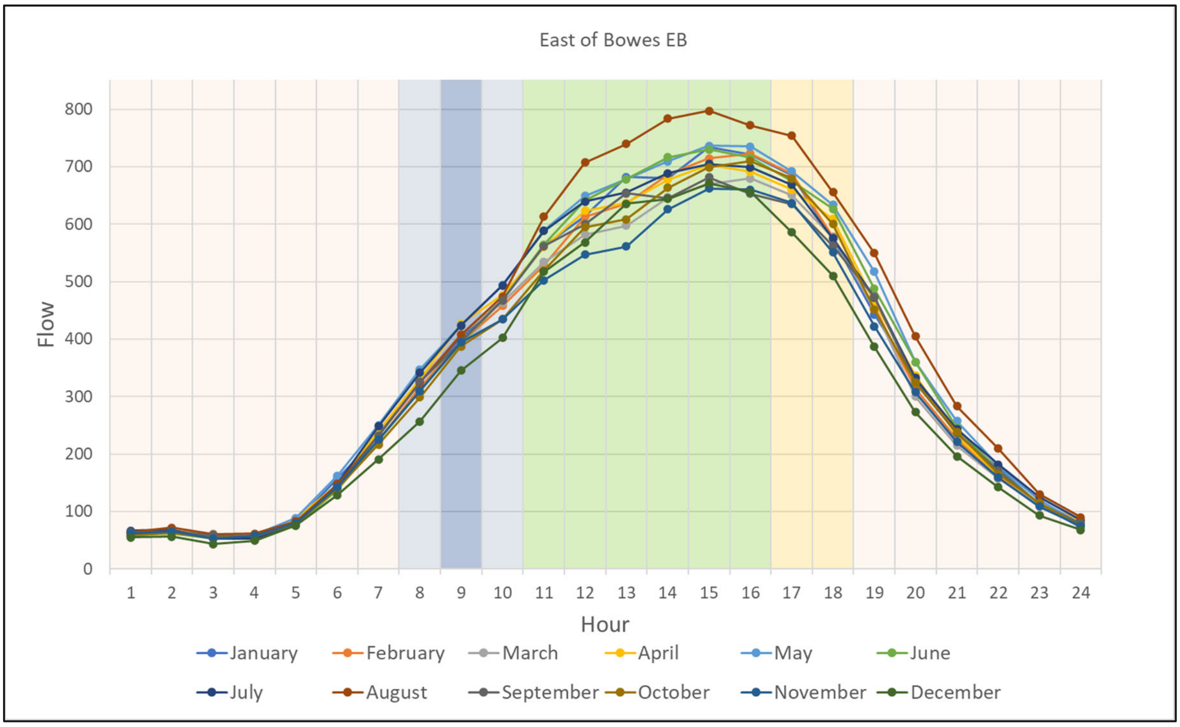

Figure 2-7: A66 Weekday Flow by Month East of Bowes (EB)

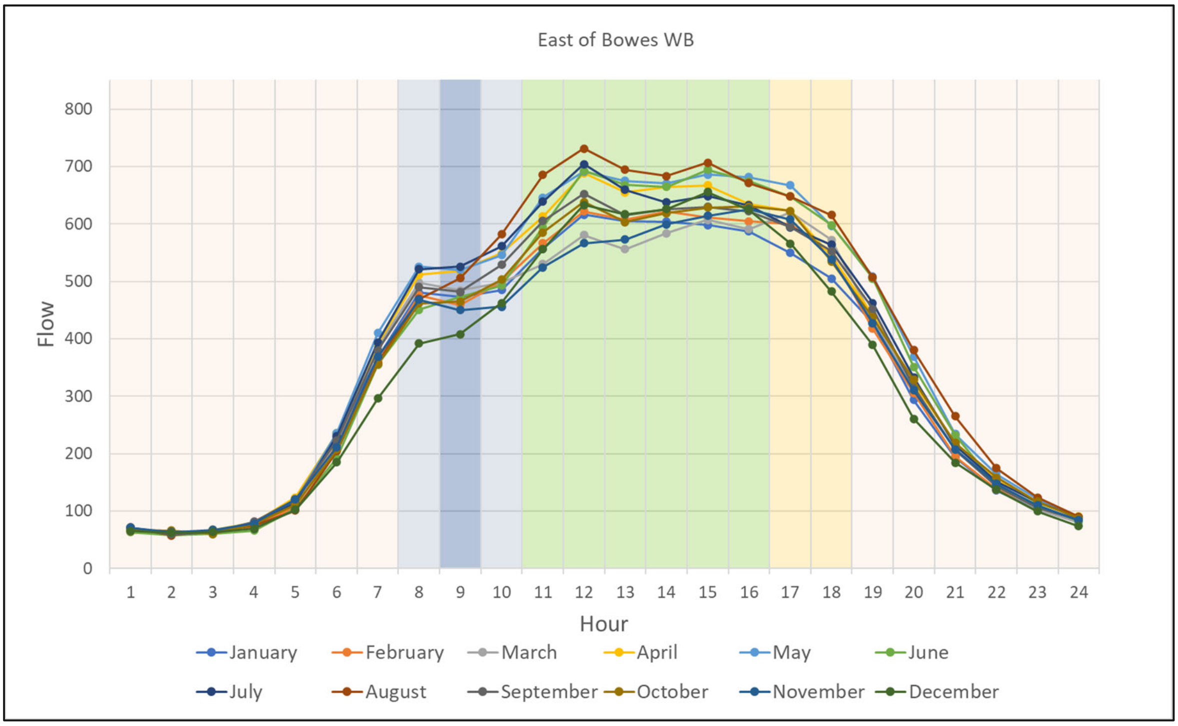

Figure 2-8: A66 Weekday Flow by Month East of Bowes (WB)

2.2.3 The flow on the route during August is generally higher than during the rest of the year, particularly at Appleby and Bowes. Operational experience on the route suggests that local capacity issues on the route occur around Penrith when leisure traffic mixes with commuting traffic during the afternoon / early evening peak period.

2.3 Road Safety

2.3.1 The A66 has average casualties[3] 50% higher than the average casualties across SRN[4]. Road traffic accidents are a major cause of incidents and closures on the route. More than 20% of these road closures last over five hours (between 2014 and 2016)[5]. Therefore, this route's overall performance is deemed low[6]

2.3.2 The A66 has a higher-than-average number of accidents in some sections of the route, with a number of accident cluster sites, as shown in Figure 2-9. A number of these sites are either located in single carriageway sections or in dual sections adjacent to single carriageway sections. Varying standards along the route with a mixture of single and dual carriageway sections leads to difficulties with overtaking, poor forward visibility, and difficulties at junctions as a result of short merges and diverges and right turning traffic off and on to the A66.

[3] Casualties per million vehicle kilometers travelled

[4] 29 casualties on average per hundred million vehicle miles on route compared to 19 casualties on average across SRN and 24 casualties on average across dual carriageway A-roads,

[5] These statistics will be updated with more recent data to inform the DCO application.

[6] Road safety is approximately 30% better compared to A-road single carriageway casualties. However, A-road single carriageway safety is 80% worse on average compared to dual carriageways across SRN.

2.3.3 Between 2013 and 2017[7], there were 197 accidents which occurred along the route, equating to an average of 40 accidents per year. Of the 197 reported accidents, 74% resulted in slight injuries, 21% resulted in serious injuries and 5% resulted in fatality. Over the five-year period, accidents which resulted in fatalities increased, with five fatal accidents in 2015, including three which involved head-on collisions at the Warcop bends and at Crackenthorpe. There was also one fatality in 2016 and 3 fatalities in 2017, see Table 2-1.

Table 2-1: Number of Accidents and Accident Severity by Year

Year	No. of Accidents			
	Fatal	Serious	Slight	Grand Total
2013	0	11	28	39
2014	0	7	36	43
2015	5	10	30	45
2016	1	5	26	32
2017	3	9	26	38
Grand Total	9	42	146	197

2.3.4 In some cases, accidents caused multiple casualties; the 197 accidents resulted in 340 casualties, of which 18 were fatal, 93 were serious and 229 were slight. The casualties' distribution by year is shown in Table 2-2. The highest casualties over a five-year period was recorded in 2015 with 12 fatalities.

Table 2-2: Number of Casualties by Year

Year	No. of Casualties			
	Fatal	Serious	Slight	Grand Total
2013	0	27	39	66
2014	0	11	66	77
2015	12	22	51	85
2016	1	16	37	54
2017	5	17	36	58
Grand Total	18	93	229	340

2.3.5 Figure 2-9 shows the location of a number of sites along the route where clusters of accidents occur.

[7] These statistics will be updated with more recent data to inform the DCO application.

Figure 2-9: Accident Cluster Sites

2.3.6 Figure 2-9 shows a strong correlation between accident cluster sites and the remaining sections of single carriageway. Following investigations of sections of single carriageway with a poor safety record and as a precursor to a dualling scheme, a number of interim safety improvements have been introduced along the route, some of which have involved reductions in the speed limit, as described below:

- The speed limit through Kirkby Thore village is 40mph, with average speed enforcement cameras installed in 2016.
- A 50mph speed limit was introduced between Appleby and Brough in 2016.
- A scheme to provide a right turn lane at Llama Karma Kafe was completed in 2016, following a number of incidents involving eastbound vehicles waiting to turn right into the café.
- A safety improvement scheme has also been implemented at Ravensworth, which reduces the speed limit to 50mph.

2.3.7 There is not yet enough evidence to conclude how successful these interim safety improvements have been, although this review will be completed in time to inform the DCO application.

2.4 Journey Times and Journey Time Reliability

2.4.1 Apart from the congestion issue discussed in 2.2.3, the A66 is not a highly congested route. Journey times increase in peak periods and this is exacerbated by changing standards along the route from dual to single carriageway and vice versa.

2.4.2 For instance, on a good day, a journey from Hull to Carlisle is 40 miles and 40 minutes shorter via the A66 than the M62. However, the road repeatedly widens and narrows, and the fact that some sections of road do not match modern standards, can cause significant congestion and delay[8] due to lack of overtaking opportunities and slow-moving traffic due to a high proportion of HGVs and the frequent use of the route by agricultural vehicles.

2.4.3 40mph and 50mph speed limits have been adopted on single carriageway sections as a result of safety concerns and local severance problems. With the high percentage of HGVs (25% compared to the national average of 12%), this variation of speed limit, together with the variation in road standards and geometry along the route, results in slow-moving traffic, longer journey times and unreliable journeys. Figure 1-4 illustrates the current variations in speed limits on the A66.

2.4.4 Consistency of journey times during incidents has been identified by stakeholders as a major issue for the A66 between Penrith and Scotch Corner. Due to the varying standard of the route and lack of suitable diversionary routes, the route's ability to maintain smooth traffic flow during periods of disruption such as road traffic accidents and severe weather events is poor. The high elevation of the route at Bowes Moor and Stainmore and severe weather events are common in this area, making the route particularly vulnerable to accidents.

2.4.5 The ability to keep the route open during accidents, incidents and other disruptions is significantly affected by the existence of the single carriageway sections. Generally, traffic movements can be better managed when incidents happen on dual carriageway sections. This is because:

- Where only one lane is affected by the incident, traffic can continue to flow on the second lane, and
- emergency services can access and clear the incident more quickly

2.4.6 The central reserve prevents traffic flow in the opposite direction from being affected. If necessary, HGVs have enough space to turn around and take a different route.

[8] To evidence how the varying standard of the A66 route and lack of diversionary routes affect journey time variability due to major incidents, various Highways England datasets have been identified and analysed. To assist in the assessment of road closures resulting from accident incidents, Stats 19 and National Incident Liaison Officer (NILO) data was used. Network Occupancy Management System (NOMS) data was used for the assessment of maintenance closures. Command and Control data was used for the assessment of accident, maintenance and weather-related closures. In addition to this 2018 TrafficMaster journey time data was used to calculate the standard deviation of journey time for the single and dual carriageway sections.

Figure 2-10: A66 Speed Limit Variation

2.5 Local Severance

2.5.1 There are local severance issues where the local road network intersects with the A66 carriageway, causing delays and road safety issues, such as in Kirkby Thore.

2.5.2 The majority of communities along the route have had bypasses built through previous interventions. Kirkby Thore, which has a population of 7586, is the only remaining settlement along the A66 without a bypass. The A66 passes directly through part of the village, causing issues of noise and severance, especially due to the high proportion of HGV traffic.

2.5.3 There are also issues of severance for walkers, cyclists and horse-riders (WCHs) who wish to cross over the A66, with poor crossing provision in some areas. These are discussed further in the Project Design Report which also forms part of the Statutory Consultation.

2.5.4 The A66 also causes ecological severance, with the existing route acting as a barrier to existing habitats, and the A66 project provides opportunities to enhance connectivity and provide habitats of greater ecological value than those that are lost, for example by altered management of retained habitat or providing treelines and hedgerows to provide safe commuting routes for wildlife. This is discussed further within the Preliminary Environmental Information Report which also forms part of the Statutory Consultation.

2.6 Businesses, Freight and Port Operators

2.6.1 The A66 is an important route for freight traffic, with HGVs comprising on average 25% of total vehicles on most sections of the route between Scotch Corner and Penrith, with select sections seeing 29% of total vehicle traffic as freight movements. The typical proportion of HGVs expected (as a proportion of annual average daily traffic (AADT)) is 12% on trunk roads and 8% on principal roads.

2.6.2 In the event of a closure on the A66, there are limited diversion routes and this leads to delays, longer journey distances and longer journey times. For a closure of the A66 between Scotch Corner and Bowes – journey distance 24km (15miles), the diversion route follows the A1(M), A66(M) and the A67, and is 43km (27miles) in length. This route has 30mph speed restrictions through Darlington, weight restrictions at Barnard Castle and is unsuitable for abnormal loads due to the width of the road. In the event of a closure between Penrith and Brough – journey distance of 34km (21miles), the diversion route follows the M6 and A685, and is 53km (33miles) in length. This route has a speed limit of 30mph through Kirkby Stephen and 40mph through Brough, and vehicles weighing in excess of 18 tonnes are restricted from using the A685 between Brough and Kirkby Stephen, with the exception of access, permit holders or vehicles moving livestock.

2.6.3 In the event of a full route closure, or due to weight restrictions, the diversion route for heavy goods vehicles is significantly longer than the direct distance of 80km (50miles) as it uses the A1(M), the A69 and the M6 and has a length of 184km (115miles). Freight traffic will often use the diversion route if delays are likely to be long term, but sometimes will remain on the A66 waiting for the traffic to clear, either because they cannot physically turn back due to lack of turning facilities, or the driver does not have the required driving hours left to reach the nearest truck stop or rest location. Due to weight restrictions and height restrictions on highways structures, and also the proximity of buildings to the carriageway, it is not feasible to enable HGV traffic to use the shorter diversion routes.

2.6.4 These diversion routes and their impacts in terms of travel distance are summarised in Table 2-3 and shown in Figure 2-11 and Figure 2-12.

2.6.5 In light of the above, it is clear that freight and transport businesses will benefit from improvements to journey time reliability across the A66 and coupled with additional capacity on the carriageway, the project will have positive trade impacts. For instance, the A66 is on a key route between the ports of Teesport, Grimsby and Immingham to north west England and Scotland. Teesport accounts for 28.4 million tonnes of cargo and Grimsby & Immingham for 54 million tonnes of cargo, showing the importance of transport improvements to the freight industry in the region.

Table 2-3: Diversion Routes

Route	Direct distance	Diversion distance	Change	Notes
Scotch Corner – Bowes	24km (15mi)	43km (27mi)	80% increase	30mph through Darlington. Weight restrictions at Barnard Castle Unsuitable for abnormal loads
Penrith – Brough	34km (21mi)	53km (33mi)	57% increase	30mph through Kirkby Stephen 40mph through Brough. Weight restrictions on A685
Scotch Corner – Penrith	80km (50mi)	184km (115mi)	130% increase	

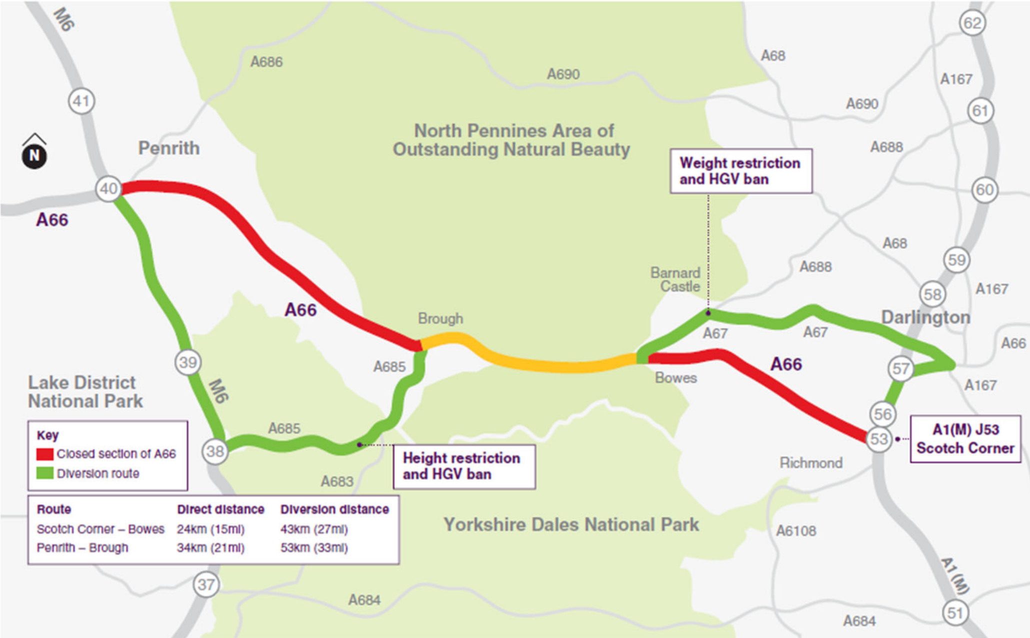

Figure 2-11: Local Diversion Routes

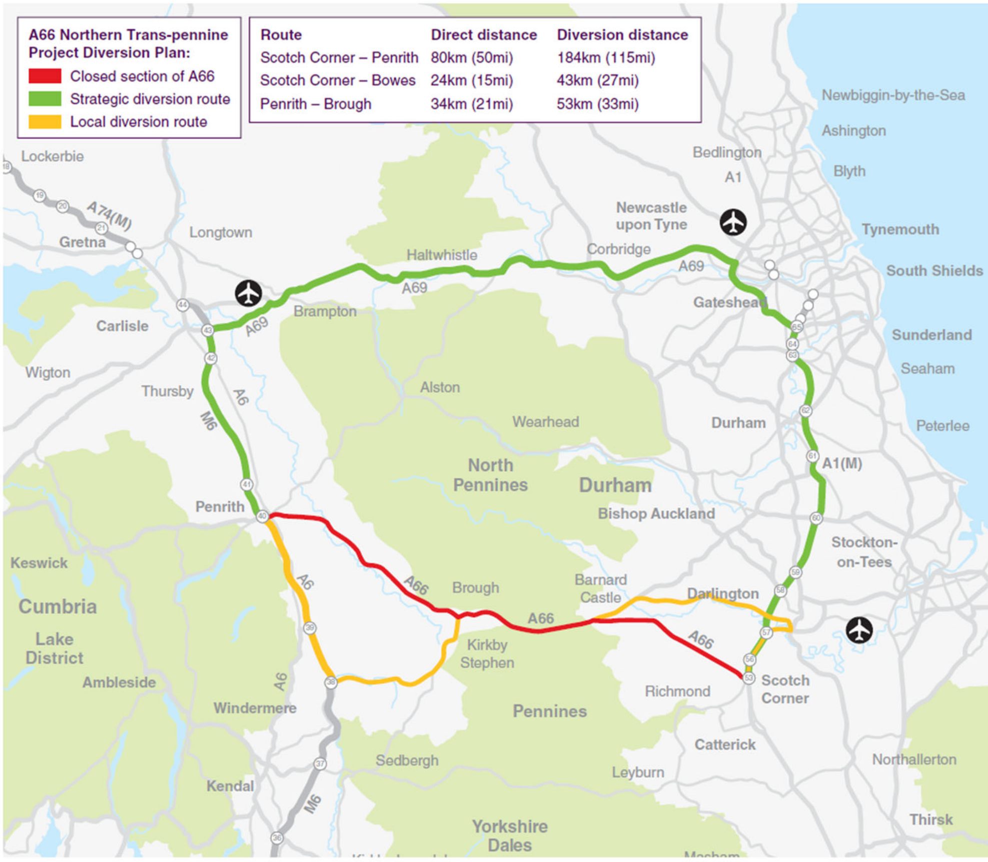

Figure 2-12: Long Distance Diversion Routes

2.7 Summary

2.7.1 The A66 provides an important strategic, regional and local route, connecting east and west coasts, as well as providing local access. It currently operates as an all-purpose trunk road on the Strategic Road Network (SRN) with a combination of single carriageway and dual carriageway sections in each direction. There is a lack of public transport infrastructure on the A66, with minimal bus service provision and no direct east-west rail connections.

2.7.2 The main transport-related issues identified on the A66 within the study are:

- road safety
- journey times
- journey reliability and route resilience, and
- local severance.

2.7.3 In the latest modelled year, around 16,500 vehicles travel along the A66 each day in both directions, with approximately 25% of vehicles identified as HGVs.

2.7.4 The A66 has average casualties 50% higher than the average casualties across SRN and more than 20% of the road closures last over five hours (between 2013 and 2017).

2.7.5 Whilst the A66 is not a highly congested route, journey times increase in peak periods and this is exacerbated by changing standards along the route from dual to single carriageway and vice versa.

2.7.6 The ability to keep the route open during accidents, incidents and other disruptions is significantly affected by the existence of the single carriageway sections.

2.7.7 In the event of a closure on the A66, there are limited diversion routes, and this leads to delays, longer journey distances and longer journey times.

3 Approach to Modelling

3.1 Introduction

3.1.1 This section describes the model development process and data sources used for the A66 dualling Project. This process has been undertaken in line with the DfTs Traffic Analysis Guidance (TAG) and agreed with Highways England's Transport Planning Group, and through consultation with Stakeholders. The impact that the Covid Pandemic has had on the assessment, and the process to overcome these impacts are discussed in section 3.5.

Approach to modelling to inform the Consultation Design

3.1.2 The Northern Trans-Pennine Routes (NTPR) Strategic Study identified nine route options. These nine options were assessed and appraised using the Northern Regional Transport Model (NRTM). Two end-to-end options for the A66 route were identified as the preferred route.

3.1.3 The A66TM (A66 Traffic Model) was developed to assess the two options. Further economic appraisal, including analysis of factors such as journey times, road safety and route resilience was also undertaken. A preferred route set out in the Preferred Route Announcement was identified and modelled using the A66TM.

3.1.4 Chapter 4 of this document considers the strategic impact of the proposed upgrade using the results of the preferred route modelling. Chapters 5 to 12 present the local impact of the Project and where appropriate considers the impact of options developed since the Preferred Route Announcement.

Approach to modelling for the DCO application

3.1.5 The traffic model is currently being updated. The opportunity is being taken to update the base year model from 2015 to 2019. The base year is not being updated to 2020 or 2021 due to the effect of Covid as discussed in section 3.5. The updated modelling is currently ongoing and therefore the results are not yet ready so cannot be used to inform this Local Traffic Report, however they will be used to inform the Transport Assessment which will accompany the DCO application.

3.1.6 The updates being undertaken are described in section 3.5. Notwithstanding these updates, the results of the modelling undertaken prior to these updates can still be considered reasonable for the following reasons.

- The changes undertaken to the base model, to update from 2015 to 2019, reflect the general increase in traffic flow of around 9%[9] across the north of England. Some developments (such as the opening of the A1 Leeming to Barton Scheme in 2018) may result in greater local traffic flow impacts however such developments are built into the forecasts developed from the 2015 base model. The change in the base year is therefore anticipated to result in an updated model reflecting that the road network is behaving in a similar, albeit busier manner in 2019 to that experienced in 2015.
- The traffic assignment and variable demand forecasting methodologies are the same, only the input data and forecasting assumptions have been updated to account for the passing of four years between 2015 and 2019.

[9] Calculated from Dft Road traffic statistics Motor vehicle traffic (vehicle miles) by road class, region and country in Great Britain

3.1.7 It is therefore reasonable to assume that the scheme impact forecast by the modelling will not vary significantly between the Statutory Consultation and DCO modelling. The PEIR results which rely on the modelling should be considered sufficient to enable consultees to have an 'informed' view of the effects of the scheme, as per the EIA Regulations.

3.1.8 Once the model update is complete, a full suite of traffic forecasting and appraisal will be undertaken in support of the DCO application. The updated results will be analysed and presented in the Transport Assessment.

3.2 Traffic Model Development to Inform Consultation Design

3.2.1 The remainder of this chapter will discuss the development of this model (and operational models) and the forecasting undertaken up until now. The traffic forecasts produced as a result of this modelling exercise will be presented in subsequent chapters of this report.

Overview of Regional Traffic Models

3.2.2 Highways England Regional Traffic Models (RTMs) provide a multi-modal platform for transport scheme assessment and include all roads within the SRN. There are a total of five RTMs developed by Highways England:

3.2.3 The RTM covering the A66 corridor between Penrith and Scotch Corner is the North Regional Traffic Model (NRTM). The NRTM covers the whole of the North-East Region, the County of Cumbria from the North-West region and northern districts of North Yorkshire.

3.2.4 The A66 sits entirely within the NRTM area, with the Project's location in the model area shown in Figure 3-1.

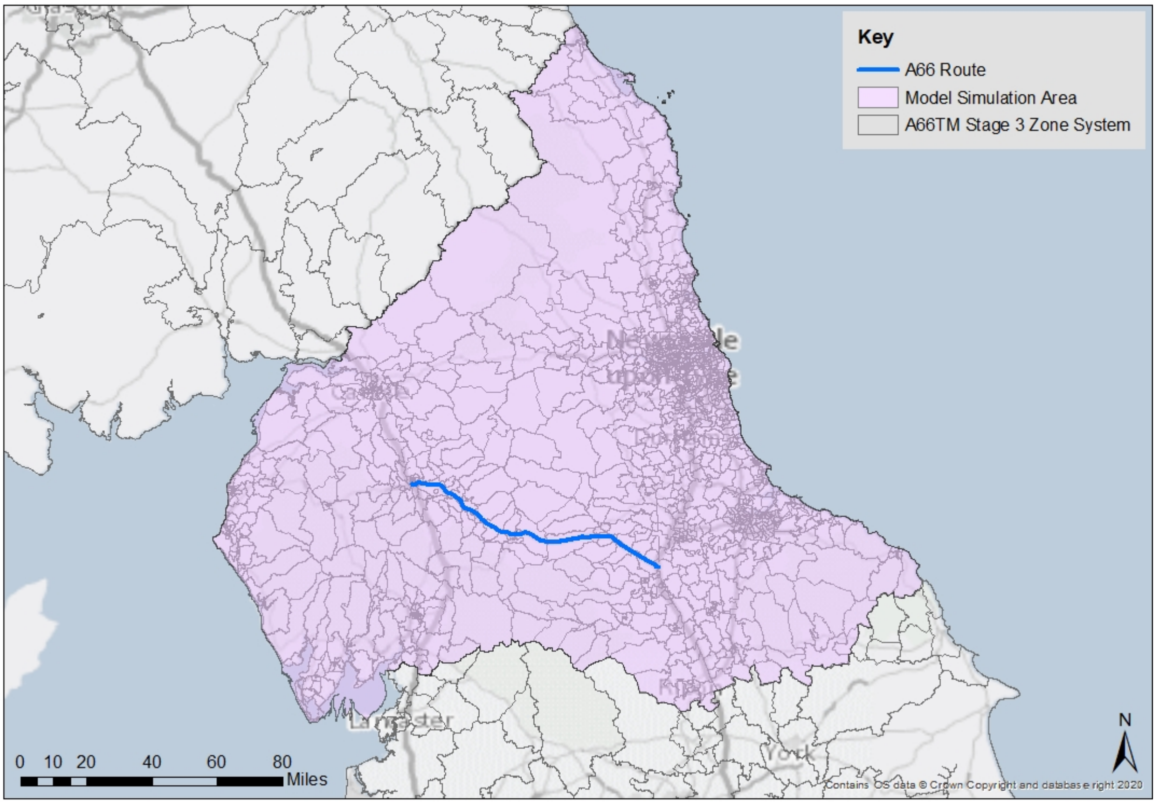

Figure 3-1: NRTM and A66 geographical context.

3.2.5 The NRTM consists of a SATURN (Simulation and Assignment of Traffic to Urban Road Networks) highway traffic assignment model together with a Variable Demand Model (VDM) using the DfT's Dynamic Integrated Assignment and Demand Modelling (DIADEM) software. The NRTM was completed in 2017 and comprises of validated March 2015 base models and future year forecast models.

3.2.6 The NRTM has formed a starting point and a fundamental part of the development of the Project to date.

Base Year Model

3.2.7 To develop the A66TM, the NRTM has been used as a starting point, with the key elements of the model structure retained and the networks, representation of demand and validation refined in the area of interest.

3.2.8 The A66TM has been developed using SATURN software. Models representing average AM, interpeak and PM peak time periods have been developed so that the different levels of demand and travel patterns can be reflected.

3.2.9 The A66TM extents are illustrated in **Figure 3-2**. The model comprises of a simulation area and buffer area. The simulation area includes the full A66 corridor, the main parallel routes and the surrounding road network. The simulation area is coded with a high level of detail to assess the impacts of the Project. The buffer area covers the rest of England, Scotland and Wales and is coded in less detail, as its main purpose is to enable traffic to be fed in and out of the simulation area on the appropriate links. The intermediate area and external area are part of the simulation area and so are coded in detail but are outside of the core Project area where significant impacts are expected.

3.2.10 The A66TM base year represents an average March weekday in 2015. This is consistent with NRTM and reflects that the NRTM origin destination (OD), traffic count and journey time datasets that are being adopted for the A66TM.

3.2.11 The time periods modelled as part of the development of the A66TM align with the NRTM and are as follows:

- Morning peak: 07:00–10:00;
- Inter-peak hour: average hour between 10:00–16:00;
- Evening peak hour: 16:00- 19:00.

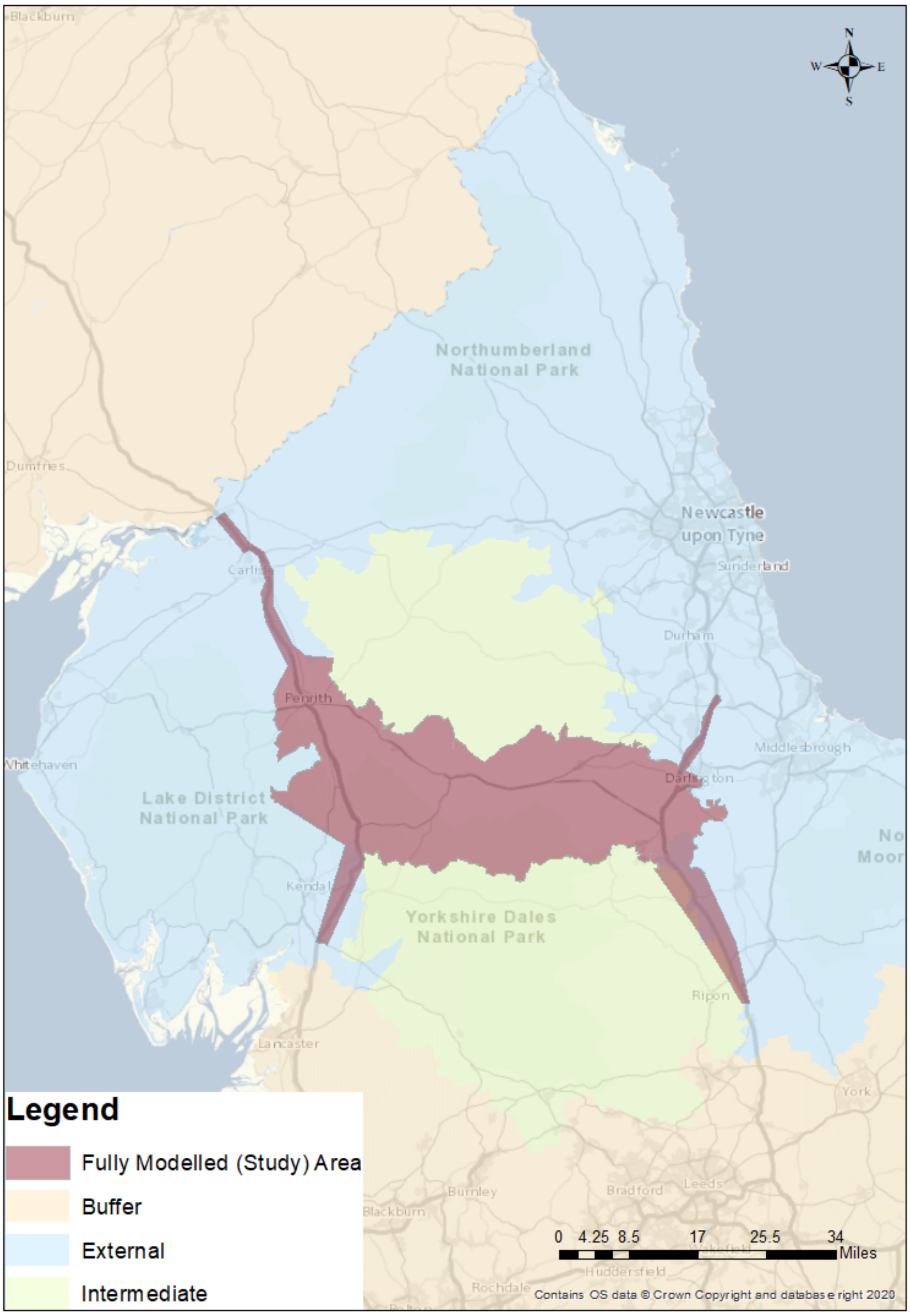

Figure 3-2: A66 Transport model geographical coverage

Data Collection

3.2.12 A review of existing data and models from the NRTM identified a significant amount of existing information for the A66 corridor, but some additional data to support the Project were identified in relation to volumetric traffic data. Therefore, data collection was undertaken at various points between November 2017 and March 2019 as the study developed. The following data was collected.

- Automatic Traffic Counts (ATC)- collected over a period of 2 weeks at 27 locations within proximity of the A66 corridor, covering 24 hours, undertaken in November 2017.

- Manual Classified Link Counts (MCC)- undertaken at 12 locations where ATCs could not be carried out due to the nature of the road location, over a period of 12 hours (07:00-19:00) on the same weekday- Thursday 23rd November 2017.
- Manual Classified Turning Counts- undertaken at junctions along the A66 corridor over a period of 12 hours (07:00-19:00) on the same weekday- Thursday 23rd November 2017.
- Recent volumetric and classified count data collected by Cumbria County Council for the update of the Penrith Traffic Model, used to enhance the Penrith cordon in the A66TM (over a period of 12 hours, 07:00-19:00 collected in June 2018).
- Data collected in April 2019 of minor side road flows along the A66 corridor previously not available.

3.2.13 It should be noted that this project specific data will be retained within the modelling to inform the DCO application, given it will still be less than 5 years old at the time of submission. All data has been collected and processed in line with the guidance contained within TAG units M1.2[10] and M2.2[11]. Checks of the data have been undertaken to ensure that the data collected is representative. Factors have been applied to data where necessary to ensure it is representative of the model base year.

3.2.14 Other data used within the model included:

- demand data- existing origin-destination data from March 2015 collected as part of the NRTM;
- journey time data- March 2015 TrafficMaster data used for the development of the NRTM, covering the whole NRTM area;
- network data and mapping- the basic network structure has been inherited from the NRTM which was developed from the OS ITN layer, together with digital aerial mapping and onsite visits;
- operational data- this included classified link and junction turning counts, video footage and additional signal timing data at the M6 J40 and A6/A66 junction at Penrith and A1(M)/A66 junction at Scotch Corner; and
- accident data- personal injury accident data for the latest five-year period (2013-2017[12]) was obtained from the Road Safety Data website, published by the DfT, for the A66 corridor. Observed data was obtained from WebTRIS.

Zones and Matrices

3.2.15 The model is split into a number of zones representing geographic areas, which reflects the NRTM zoning system. The NRTM zoning system utilises Lower Super Output Areas (LSOA) as a starting point, with these being altered where appropriate.

3.2.16 The model demand comprises of matrices of trip numbers between each zone pair. Demand matrices are based on NRTM prior matrices, where the demand derived from mobile phone data supplied through Highways England's Traffic Information System (TIS) is assigned to the model network as an initial assignment. Adjustments are then made during a matrix estimation process in order to accurately reflect observed traffic flows. Furthermore, synthetic matrices were produced for the NRTM to infill short distance trips, and therefore improve the NRTM prior matrix quality.

[10] TAG Unit M1.2 Data Sources and Surveys, DfT May 2020
[11] TAG Unit M2.2 Base Year Matrix Development, DfT May 2020
[12] This will be updated with more recent data to inform the DCO application.

Assignment Procedures

3.2.17 The assignment procedure adopted for the highway model is based on an equilibrium assignment with multiple demand segments. The assignment methodology includes both the path-based algorithm and blocking back. Each time period is modelled as a standalone model.

3.2.18 The assignment works across the multiple user class with traffic flow measured in passenger car units (PCU), where cars/ LGVs equate to 1 PCU and HGVs are equal to 2.5 PCUs.

3.2.19 The generalised costs with the assignment model are essential as they affect traffic routing on the road network. They are applied in the following form:

Generalised Cost = Time + PPK/PPM*Distance + Toll

Where:

PPK =pence per kilometer

PPM =pence per mile

Toll = monetary value of toll (applicable to the A19 Tyne Tunnel only)

3.3 Traffic Forecasting Procedure to Inform Consultation Design

Forecast Years

3.3.1 The forecast years for the future year models associated with the Project are represented as follows:

- 2031 - Project opening year;
- 2046 - forecast year (15 years after opening);
- 2051 - horizon year (latest year traffic growth forecasts are available for).

3.3.2 It should be noted that these were the forecast years at the time that this element of the traffic forecasting took place, and they have since been amended. The models are currently being updated (as discussed in section 3.1) and will reflect the current proposals; a 2029 opening year and 2044 forecast year. The change to the forecast years (of 2 years in each case) will not cause a substantial difference to the results. For instance, within Department for Transport (DfT) Road Traffic Forecasts (RTF) (2018), overall growth in vehicle kilometers on all roads within the North of England is set to grow evenly at around 1% per annum, as shown in Figure 3-3 below. It is therefore reasonable to assume that the forecasts may change by 1 to 2% between 2029 and 2031, and between 2044 and 2046, as such the results set out in this report are a more conservative assessment.

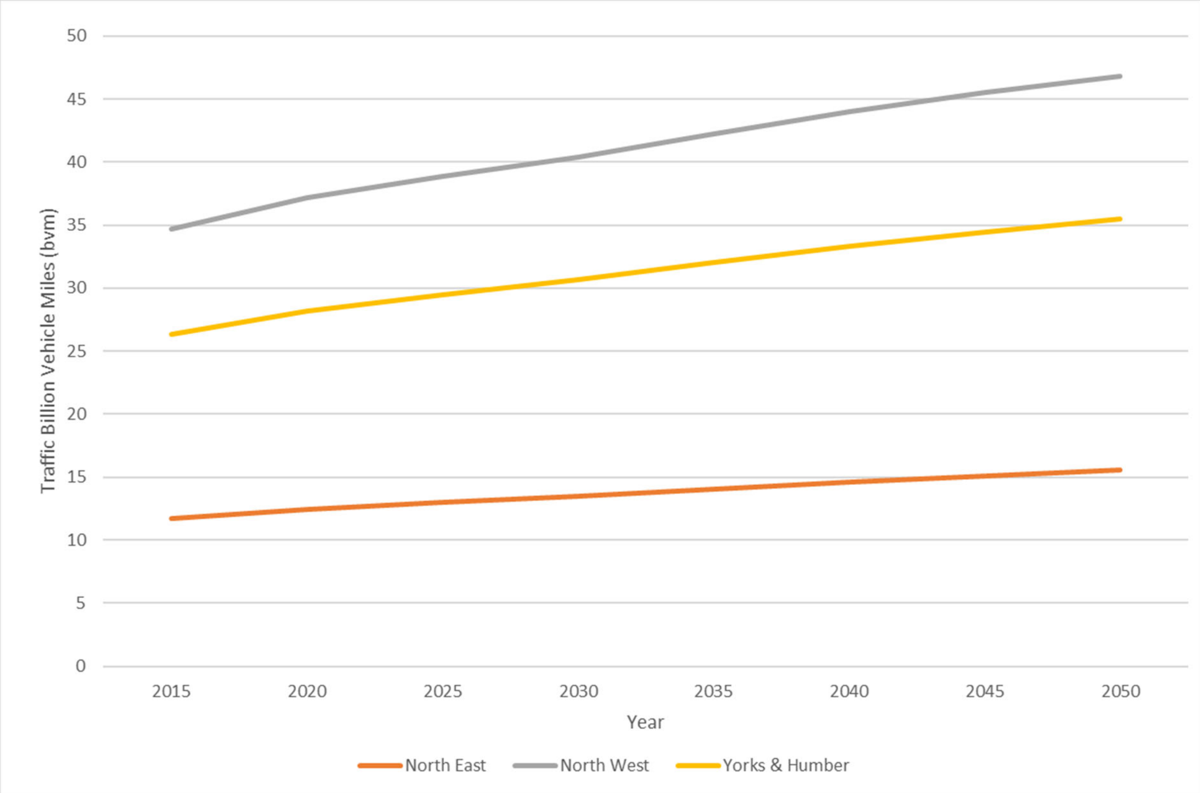

Figure 3-3: RTF18 Forecast Traffic Growth on all Roads in the North of England.

Variable Demand Model (VDM)

3.3.3 The VDM approach was developed using DIADEM software. The VDM system developed for the A66 preferred route is unchanged from that developed for the NRTM. Changes are limited to updating and recalibrating to reflect the enhanced A66TM networks and zoning systems, recalibrated demand and generalised costs.

National Trip End Model and the National Transport Model

3.3.4 The National Trip End Model version 7.2 (NTEM 7.2) has been used to provide forecast trip end growth factors for car and rail. Light goods and heavy goods vehicle forecasts have been derived using RTF 2018.

3.3.5 Projections of the monetary values of different users values of time, and of vehicle operating costs contained within the TAG Databook[13] are then input to the variable demand model. Together with the NTEM 7.2 projections, these values control the overall person trips and vehicle kilometer growth within the forecast models.

3.3.6 Development trip rates for Car and Rail were also derived from the NTEM 7.2 dataset, using the TEMPRO alternative planning assumptions to establish trip rates per job and trip rates per household at district level. Goods vehicle trip rates were derived using TRICS.

[13] https://www.gov.uk/government/publications/tag-data-book

Local Road Network Upgrades and Committed Development

3.3.7 Both infrastructure schemes and land use developments have been a key consideration when forecasting demand. Developments most likely to have an impact on the A66 were reviewed as part of this process.

3.3.8 Details of potential infrastructure projects within the network were obtained from a review of strategic and infrastructure plans from; local and combined authorities, the Planning Inspectorate, as well as reference to Highways England Road Investment Strategy and Transport for the North's uncertainty log.

3.3.9 For land use developments, the status of developments was sought from Local Authorities in the model area. It was further updated with development sites based on the latest available log of developments assumptions provided by TfN. The resultant uncertainty log is shown in Appendix A. Developments along the A66 corridor area such as housing locations with over 45 dwellings and employment sites were included in the Uncertainty Log. Wider area housing sites over 1200 dwellings in size were also included, as were employment sites over 60 hectares. This information was cross referenced with the information gathered by the Environmental team for their cumulative impact work. This data was initially gathered in 2019 when the traffic forecasting to inform the consultation design was undertaken. The log will be updated to inform the DCO application.

Uncertainty

3.3.10 Uncertainty levels for both infrastructure schemes and land use developments were assigned to each scheme based on their probability and development status as defined in TAG.

Scenario Development

3.3.11 A series of scenarios were developed to demonstrate the case for the Project. Each modelled option is termed as a scenario and these were classified as either Do-Minimum (DM) or Do-Something (DS).

3.3.12 The DM scenarios comprise of the existing road network with all schemes identified within the Uncertainty Log as 'near certain' and 'more than likely' within submitted development proposals. This set of models was built to understand the operation of the network without the Project.

3.3.13 The DS scenario comprised of the DM scenario plus the inclusion of the Project. These scenarios also included likely schemes and developments identified from the Uncertainty Log. These models were produced to understand the traffic impact along the A66 corridor with the delivery of the Project.

3.3.14 Differences between the model predictions of flows, journey times and travelled distances were identified to inform the assessment of monetised and non-monetised impacts of the Project in the economic appraisal.

Assessment of Strategic and Local Impacts

3.3.15 The modelling results presented in Chapter 4, i.e. the strategic development impact, has assumed the design announced at the preferred route stage, as this was the last time a design fix was undertaken to allow the full scheme appraisal to be undertaken. The potential changes in traffic flows due to the different scheme options presented at Statutory Consultation, while may induce local impacts, are not significant enough to cause large flow or journey time differences across the length of the study area.

Therefore, the A66TM has been used to model the impacts of different scheme options presented at Statutory Consultation, at;

- Temple Sowerby to Appleby, and
- Cross Lanes to Rokeby.

3.3.16 The local impacts of the scheme options at these locations are discussed in Chapter 7 and Chapter 10.

3.3.17 The strategic model has not been rerun to assess the alignment and local junction differences on the Appleby to Brough scheme as the changes to the scheme options are not considered to be significant enough in strategic modelling terms to justify rerunning the model. This is because the changes to the alignment of the A66 between each scheme option would not be significant enough to affect the overall length of the A66, or the surrounding road layout. In contrast, within the Temple Sowerby to Appleby options, the alternative routes pass either side of the village of Kirkby Thore, whilst the junction options at Cross Lanes and Rokeby impact the assignment of traffic between the A66 and Barnard Castle.

3.3.18 Strategic modelling development will also take account of the developing design of the rest of the Scheme as it is refined for the DCO application. The assessment within this report is based on current designs. Further design development will take place before the DCO application is made.

3.4 Operational Model Development

3.4.1 Operational assessments to consider how each of the following junctions on the A66 corridor will perform in terms of anticipated queues and delays , have been undertaken at:

- M6 Junction 40 Penrith;
- Kemplay Bank roundabout;
- CenterParcs access;
- Bowes A66/A67 junction; and
- A1(M) Junction 53 Scotch Corner.

3.4.2 The SATURN model has been interrogated to demonstrate the performance of the major junctions on this Project at Statutory Consultation.

3.4.3 The Transport Assessment will additionally include operational assessments of the access points to the A66 that are part of the Project, including those affected by the different options that are being presented at Statutory Consultation. No capacity issues are anticipated at these locations as grade separated junctions with significantly enhanced capacity are replacing the existing lower capacity at grade junctions. Grade separation removes any right turning traffic across the A66 which therefore removes the most likely cause of operational issues. Therefore, throughout the development of the options being presented at Statutory Consultation it has been found that junction performance is not a critical factor in option choice.

3.4.4 At those locations where an operational model has been developed, the junction layout being brought forward to Statutory Consultation has been assessed. The layouts have been determined through earlier stages of the A66 project. At each location the DS 2046 scenario has been considered for operational purposes.

M6 Junction 40 Penrith and Kemplay Bank

3.4.5 For the M6 J40, an operational assessment has been undertaken using LinSig traffic signal software.

3.4.6 Forecast year traffic flows have been derived by applying growth from the strategic traffic model to the observed 2017 traffic flows (determined from traffic turning count surveys) at these locations. Future year operational assessments are based on an average neutral month. A neutral month is a month that is not impacted by seasonal variation in traffic flows. Typical neutral months are April, May, June, September and October[14].. As the traffic count represents a November weekday, factors have been applied to convert between the two. Future year growth factors have been calculated by comparing traffic flows between the A66TM base year model and future year model. Growth factors have calculated by each approach arm and turn. As the traffic count is from 2017 and the strategic model has a base year of 2015, the growth factors from the A66TM has been adjusted to take account of the different base year.

Center Parcs Access and the A66 / A67 Interchange

3.4.7 The major junctions on the route that are not traffic signal controlled have been assessed using the strategic SATURN model for the purposes of Statutory Consultation.

3.4.8 It should be noted that assessments using Junctions10 software will be undertaken prior to the DCO submission. This software is developed by TRL (the UK's Transport Research Laboratory), is used to model and predict capacity, queues and delays at roundabouts, and priority intersections.

3.4.9 Due to the relatively lightly trafficked nature of these typically rural junctions, combined with the fact that new grade separated interchanges are being provided on the A66 in place of the existing at grade priority junctions, a proportionate approach (i.e. using the SATURN model) is considered to be appropriate at this stage.

A1(M) Junction 53 Scotch Corner

3.4.10 The A1(M) J53 Scotch Corner has been assessed through the development of a VISSIM microsimulation model. VISSIM is a widely used traffic simulation software used in over 2,500 cities worldwide.

3.4.11 It is noted that the A1(M) J53 was upgraded as part of the A1 Leeming to Barton scheme, which was completed in August 2018. The design layout used for all modelled scenarios at this junction is the layout proposed as part of this Project.

3.4.12 Forecast year traffic flows have been derived by applying growth from the strategic traffic model to the observed 2019 traffic flows (determined from traffic turning count surveys) at this location. Future year operational assessments are based on an average neutral month. As the traffic count represents a March weekday, factors have been applied to convert between the two. Future year growth factors have been calculated by comparing traffic flows between the A66TM base year model and future year model. Growth factors have calculated by each approach arm and turn. As the traffic count is from 2019 and the strategic model has a base year of 2015, the growth factors from the A66TM has been adjusted to take account of the different base year.

[14] Design Manual for Roads and Bridges – CA 185 Vehicle Speed Measurement.

3.4.13 Manual adjustments have been made to include possible 'near certain' and 'more than likely' commercial developments within the area notably;

- (14/00687/FUL and 15/00806/FUL) Scotch Corner - Designer Outlet Centre
- (20/00955/FULL) Scotch Corner Phase 2 - Proposed Garden Centre
- (19 00395 FULL) Scotch Corner Services – Redevelopment including Drive Through.

3.5 Impact of the Covid Pandemic on the Traffic Modelling Informing the DCO Application

3.5.1 The work to update the traffic model to inform the DCO application is ongoing but is not yet ready to report. The commentary below provides details on what data collection and model updates have been possible since the start of the Covid Pandemic.

3.5.2 Covid has had an impact upon the ability to collect traffic data with which to update the 2015 model to something more contemporary, such that it is suitable to inform the DCO application. Initially it was planned to update the traffic model to a 2020 base year. However, due to the onset of Covid, a decision was taken to generate a 2019 'pre Covid' base year model to make best use of the most up to date, representative data available. This is detailed below.

3.5.3 In terms of volumetric traffic count data, a number of ATC surveys were undertaken in March 2020, although the programme was curtailed due to the onset of lockdown. This data has been supplemented by 2019 data from Highways England / DfT permanent traffic counters, recent Local Authority data (less than 5 years old), and data collected historically as part of the A66 study.

3.5.4 Nevertheless, a small number of data gaps remain, which have been filled by using an innovative method of generating synthesised counts making use of the DfT Teletrac dataset. Teletrac provide processed anonymised GPS data for the fleet of vehicles it operates - approximately 0.5% of all vehicles on the roads. By developing a relationship between Teletrac data and known count locations, this relationship can be used to calculate traffic flows at location where the flow is not known. Out of 475 count locations across the network, around 60 sites have been synthesised in this manner. This method was developed for Highways England's national programme of Regional Transport Models and will be applied as a data infill method for the RTMs as they are updated this year.

3.5.5 Travel time data has been collated from Teletrac data for 3 months of 2019.

3.5.6 In terms of origin destination data, it has been concluded that the traffic distribution patterns from the 2015 Mobile Network Data (MND) provide the best starting point for the Stage 3 modelling work and that the most appropriate way to update them will be to apply growth from 2015 to 2019 from the NTM taken from TEMPRO. Applying changes from observed data has not been possible within the project timescales for the following reasons.

- The Covid-19 pandemic has rendered any data collection exercise post March 2020 both impractical and meaningless as traffic movements are untypical.
- While significant effort has been made to infer any changes in trip patterns from the available data (i.e. by comparing available 2019 MND with 2015 MND), it is concluded that it is impossible to separate the effects of changes in trip making and the change in the way that the data has been captured or processed. It should be noted that para 4.4.4 of TAG Unit M2.2 states that former guidance

relating to the '5 year rule' should no longer be used, and that older data may be acceptable.

- Following the NMD data analysis above, there is no evidence to show a reduction in the strategic trip making, such as between Scotland and areas to the south such as Yorkshire, the midlands, or the south of England. Given that there have been no significant developments within the area since 2015 that would significantly affect the patterns of movement on the A66 it is considered that continuing with the 2015 data is the most pragmatic approach to undertaking a representative appraisal of the Project within the required timescales.

3.5.7 The base year HGV matrices are being updated using observed 2018 freight movements based on available data supplied by Transport for the North and MDS Transmodal. MDS Transmodal is a firm of transport economists which specialises particularly in freight modes of transport. Due to the timeframes required to acquire and process the data, 2018 data was the most up to date data available for use. It is not anticipated that that the patterns of freight movement across the region will have changed significantly between 2018 and 2019.

3.5.8 The base year LGV matrices have been updated to reflect 2019 movements. LGV data has been sourced from TeletracNavman. This data is a record of the GPS movements from vehicles fitted with certain proprietary satellite navigation systems. Each record in both OD dataset relates to a single trip from a TeletracNavman vehicle. While data is available for all vehicle types it is considered to be most robust for LGVs given the relative prevalence of satellite navigation and vehicle tracking systems within LGV fleets. The data has been provided for the North England for March, June and October 2019, representing three neutral months.

3.5.9 In terms of traffic forecasting, i.e. what will the effect of Covid be moving forward, the project will follow advice from DfT. In July 2020 DfT issued 'Appraisal and Modelling Strategy: A route map for updating TAG (Transport Analysis Guidance) during uncertain times'. The Appraisal and Modelling Strategy route map sets out the DfT's approach to change. Amongst many issues, the Route Map considers both; long term Office for Budget Responsibility (OBR) growth revisions issued in March 2020 at the time of the budget, and also growth revisions issued in July 2020 in their Fiscal Sustainability Report in response to Covid-19 impacts in the period up to 2025. These revisions in tandem represent a significant reduction in growth compared to any previous OBR update. An appraisal update was issued in May 2021, which provided minor updates to the appraisal parameters issued in July 2020. The May 2021 parameters will therefore be used within the modelling informing the DCO application.

3.5.10 It should be noted that the appraisal update issued by DfT also accounts for the department's latest view on likely technology changes within the forecast years. Most pertinently this reflects anticipated changes to the vehicle fleet in terms of the mix of fuel types and fuel efficiency.

3.6 Summary

3.6.1 The model development process and data sources used have been described for two distinct elements of traffic forecasting described below.

- Modelling to inform the Consultation Design, based on a model with a base year of 2015. The results from this model process have informed the later chapters of this report.
- Modelling to inform the DCO application, based on a model with an updated base year of 2019. The data for this model has been taken from 2019 to generate a 'pre Covid' base year model to make best use of the most up to date,

representative data available. In terms of the impact of Covid on traffic forecasting, the project will follow the latest TAG advice from DfT as set out in advice issued in July 2020 and May 2021.

3.6.2 This process has been undertaken in line with the DfTs Traffic Analysis Guidance (TAG) and agreed with Highways England's Transport Planning Group, and through consultation with Stakeholders.

4 Strategic Development Impact

4.1 Introduction

4.1.1 This chapter provides an overview of the strategic traffic impact of the Project from M6 J40 Penrith to A1(M) Scotch Corner. This will include a summary of the strategic modelling results, accident analysis and user experience, comparing these impacts with and without the Project.

4.2 Traffic Flow Forecasts

4.2.1 This section presents the future traffic impact on the A66 with (DS) and without (DM) the delivery of the Project. Table 4-1 to Table 4-3 show the impact of the Project in the three modelled years in terms of AADT at a number of locations on the Strategic Road Network.

4.2.2 The key conclusions from the 2031 strategic flow forecasts are:

- The average traffic growth between 2015 and 2031 DM (i.e. without the Project) is 25% across all locations considered.
- Typically flows on the A66 in 2031 without the Project are between 20,000 AADT (between Appleby and Brough) and 38,000 AADT (between M6 Junction 40 and Kemplay Bank).
- The average additional growth on the A66 due to the Project (i.e. DS v DM) is 34%.
- The resultant flows on the A66 in 2031 with the Project are between 28,000 AADT (between Appleby and Brough) and 46,000 AADT (between M6 Junction 40 and Kemplay Bank).

4.2.3 The key conclusions from the 2046 strategic flow forecasts are:

- The average traffic growth between 2015 and 2046 DM (i.e. without the Project) is 46% across all locations considered.
- Typically flows on the A66 in 2046 without the Project are between 23,000 AADT (between Appleby and Brough) and 44,000 AADT (between M6 Junction 40 and Kemplay Bank).
- The average additional growth on the A66 due to the Project (i.e. DS v DM) is 39%.
- The resultant flows on the A66 in 2031 with the Project are between 31,000 AADT (between Appleby and Brough) and 53,000 AADT (between M6 Junction 40 and Kemplay Bank).

4.2.4 The key conclusions from the 2051 strategic flow forecasts are:

- The average traffic growth between 2015 and 2051 DM (i.e. without the Project) is 51% across all locations considered.
- Typically flows on the A66 in 2051 without the Project are between 24,000 AADT (between Appleby and Brough) and 46,000 AADT (between M6 Junction 40 and Kemplay Bank).
- The average additional growth on the A66 due to the Project (i.e. DS v DM) is 34%.
- The resultant flows on the A66 in 2051 with the Project are between 28,000 AADT (between Appleby and Brough) and 46,000 AADT (between M6 Junction 40 and Kemplay Bank).

4.2.5 This growth in the DM scenario from 2015 to the forecast year is due to national changes in; population, trip rates, GDP and income, cost of driving, licence holding, and demand for goods.

4.2.6 The growth due to the scheme is due to the provision of a higher standard route. The increase in traffic flow reflects people benefiting from the opportunity that the dualling offers. The connectivity which the route provides between England, Scotland and Northern Ireland is critical in relation to the physical integration of the Union.

4.2.7 The improved linkage benefits communities within the north of England, who, due to the rural nature of the region, often lack access to key local services for example, GP surgeries, primary schools and supermarkets. These people are often required to commute over longer distances to access improved employment opportunities. The increased flow also reflects more tourists benefiting from improved links to areas such as the Lake District and the North Pennines Area of Outstanding Natural Beauty (AONB), thereby improving the economies within this area.

Table 4-1: 2031 Strategic Flows AADT (vehicles, two-way)

	Base 2015	DM 2031	DM 2031 V 2015 Base		DS 2031	DS V DM	
			Increase	%		Increase	%
M6 North of Penrith	51,900	67,700	15,800	30%	69,700	2,000	3%
M6 South of Penrith	38,300	50,200	11,900	31%	47,900	-2,300	-5%
Between M6 Jnc 40 And Kemplay Bank	32,800	38,600	5,800	18%	45,700	7,100	18%
Penrith to Temple Sowerby	21,100	24,700	3,600	17%	32,900	8,200	33%
Temple Sowerby to Appleby – Kirby Thore	18,100	21,300	3,200	18%	27,800	6,500	30%
Temple Sowerby to Appleby – Crackenthorpe	19,300	22,700	3,400	18%	29,100	6,300	28%
Appleby to Brough	16,600	19,800	3,200	19%	26,600	6,800	34%
Bowes Bypass	14,900	18,800	3,900	26%	28,100	9,200	49%
Cross Lanes to Rokeby	16,000	20,100	4,100	25%	32,100	12,000	60%
Stephen Bank to Carkin Moor	18,900	23,000	4,100	22%	32,700	9,700	42%
West of Scotch Corner	19,700	24,200	4,600	23%	33,000	8,800	36%
A1(M) North of Scotch Corner	66,000	87,700	21,700	33%	90,200	2,500	3%
A1(M) South of Scotch Corner	65,700	81,500	15,700	24%	85,100	3,700	4%

Table 4-2: 2046 Strategic Flows AADT (vehicles, two-way)

	Base 2015	DM 2046	DM 2046 V 2015 Base		DS 2046	DS V DM	
			Increase	%		Increase	%
M6 North of Penrith	51,900	82,000	30,100	58%	84,600	2,600	3%
M6 South of Penrith	38,300	61,900	23,600	62%	59,800	-2,100	-3%
Between M6 Jnc 40 And Kemplay Bank	32,800	44,100	11,300	34%	53,000	8,900	20%
Penrith to Temple Sowerby	21,100	28,000	6,900	32%	38,600	10,600	38%
Temple Sowerby to Appleby – Kirby Thore	18,100	24,200	6,000	33%	34,700	10,500	44%
Temple Sowerby to Appleby – Crackenthorpe	19,300	25,800	6,500	34%	34,300	8,500	33%
Appleby to Brough	16,600	22,800	6,200	38%	31,700	8,900	39%
Bowes Bypass	14,900	22,800	7,800	53%	34,600	11,800	52%
Cross Lanes to Rokeby	16,000	23,900	7,900	49%	39,000	15,100	63%
Stephen Bank to Carkin Moor	18,900	26,700	7,800	41%	39,400	12,700	48%
West of Scotch Corner	19,700	28,100	8,500	43%	39,300	11,200	40%
A1(M) North of Scotch Corner	66,000	101,400	35,400	54%	103,700	2,300	2%
A1(M) South of Scotch Corner	65,700	95,700	30,000	46%	99,200	3,400	4%

Table 4-3: 2051 Strategic Flows AADT (vehicles, two-way)

	Base 2015	DM 2051	DM 2051 V 2015 Base		DS 2051	DS V DM	
			Increase	%		Increase	%
M6 North of Penrith	51,900	85,600	33,700	65%	88,300	2,700	3%
M6 South of Penrith	38,300	65,000	26,700	70%	62,800	-2,200	-3%
Between M6 Jnc 40 And Kemplay Bank	32,800	45,600	12,800	39%	55,300	9,700	21%
Penrith to Temple Sowerby	21,100	28,800	7,700	36%	40,500	11,700	40%
Temple Sowerby to Appleby – Kirby Thore	18,100	25,000	6,800	38%	36,500	11,500	46%
Temple Sowerby to Appleby – Crackenthorpe	19,300	26,700	7,300	38%	36,000	9,300	35%
Appleby to Brough	16,600	23,600	7,100	43%	33,400	9,700	41%
Bowes Bypass	14,900	23,900	8,900	60%	36,700	12,800	54%
Cross Lanes to Rokeby	16,000	24,900	8,900	56%	41,200	16,300	65%
Stephen Bank to Carkin Moor	18,900	27,700	8,800	46%	41,500	13,800	50%
West of Scotch Corner	19,700	29,200	9,500	48%	41,300	12,100	42%
A1(M) North of Scotch Corner	66,000	104,200	38,300	58%	106,200	2,000	2%
A1(M) South of Scotch Corner	65,700	99,200	33,400	51%	102,700	3,500	4%

4.2.8 Table 4-4 to Table 4-6 provides a summary of the forecast flows by vehicle type at the same locations for the base year, 2015 and for 2046, by hour of day.

4.2.9 There are two notable features of the traffic flow on the A66 in the base year:

- Traffic flows are roughly equal across the morning, inter peak and evening peak. This is also true of the flows on the M6, but less so for traffic flows on the A1(M) which are higher in the morning and evening peaks.
- There is a very high proportion of HGVs, typically in excess of 25% within the interpeak, with the exception of the section between the M6 and Kemplay Bank. The HGV proportions are lower within the morning peak and lower again within the evening peak.

4.2.10 The proportion of HGVs on the M6 (around 20%) is lower than on the A66, whilst the proportion is lower again (typically around 16%) on the A1(M).

4.2.11 By 2046 the traffic increase in the DM on the A66 is primarily related to car and LGV traffic, which has increased by around 40% between the base and the DM, while the HGV traffic has only grown by 2%.

4.2.12 These results show a high proportion of HGVs, however that the proportion of HGVs reduces in the DM future year scenario. This reflects the difference in central government projections for these different vehicle classes, as contained in NTEM v7.2, RTF18 and the TAG databook.

4.2.13 Within the DS scenario the additional traffic attracted to the route is mostly car traffic however there is some additional HGV traffic attracted also.

Table 4-4: Vehicle Flows By Vehicle Type Base Year 2015

	AM		IP		PM	
	Cars + Vans	HGV	Cars + Vans	HGV	Cars + Vans	HGV
M6 North of Penrith	2,693	735 (21%)	2,711	706 (21%)	3,037	666 (18%)
M6 South of Penrith	1,985	517 (21%)	2,115	510 (19%)	2,210	453 (17%)
A66 Between M6 and Kemplay Bank	1,835	401 (18%)	1,730	438 (20%)	2,072	357 (15%)
A66 Penrith to Temple Sowerby	1,043	318 (23%)	1,063	358 (25%)	1,192	310 (21%)
A66 Kirby Thore	869	300 (26%)	872	337 (28%)	1,030	303 (23%)
A66 Crackenthorpe	959	299 (24%)	944	340 (26%)	1,128	303 (21%)
A66 Appleby to Brough	764	287 (27%)	799	328 (29%)	918	296 (24%)
A66 Bowes Bypass	698	240 (26%)	723	284 (28%)	829	267 (24%)
A66 Cross Lanes to Rokeby	755	255 (25%)	767	308 (29%)	890	277 (24%)
A66 Stephen Bank to Carkin Moor	946	269 (22%)	913	326 (26%)	1,095	290 (21%)
A66 West of Scotch Corner	985	282 (22%)	942	336 (26%)	1,151	296 (20%)
A1(M) North of Scotch Corner	3,856	867 (18%)	3,192	751 (19%)	4,665	553 (11%)
A1(M) South of Scotch Corner	4,200	726 (15%)	3,390	862 (20%)	3,940	628 (14%)

Table 4-5: Vehicle Flows By Vehicle Type Do Minimum 2046

	AM		IP		PM	
	Cars + Vans	HGV	Cars + Vans	HGV	Cars + Vans	HGV
M6 North of Penrith	4,520	780 (15%)	4,703	742 (14%)	5,075	682 (12%)
M6 South of Penrith	3,418	544 (14%)	3,703	530 (13%)	3,883	480 (11%)
A66 Between M6 and Kemplay Bank	2,580	414 (14%)	2,438	446 (15%)	2,845	357 (11%)
A66 Penrith to Temple Sowerby	1,464	327 (18%)	1,496	367 (20%)	1,615	303 (16%)
A66 Kirby Thore	1,248	310 (20%)	1,253	346 (22%)	1,398	297 (18%)
A66 Crackenthorpe	1,370	308 (18%)	1,364	349 (20%)	1,527	297 (16%)
A66 Appleby to Brough	1,166	297 (20%)	1,201	338 (22%)	1,305	291 (18%)
A66 Bowes Bypass	1,230	251 (17%)	1,203	295 (20%)	1,370	263 (16%)
A66 Cross Lanes to Rokeby	1,290	266 (17%)	1,249	319 (20%)	1,384	274 (17%)
A66 Stephen Bank to Carkin Moor	1,484	260 (15%)	1,406	331 (19%)	1,538	254 (14%)
A66 West of Scotch Corner	1,582	274 (15%)	1,484	343 (19%)	1,626	261 (14%)
A1(M) North of Scotch Corner	6,427	685 (10%)	5,760	715 (11%)	6,934	474 (6%)
A1(M) South of Scotch Corner	5,776	804 (12%)	5,319	832 (14%)	6,406	642 (9%)

Table 4-6: Vehicle Flows By Vehicle Type Do Something 2046

	AM		IP		PM	
	Cars + Vans	HGV	Cars + Vans	HGV	Cars + Vans	HGV
M6 North of Penrith	4,721	785 (14%)	4,898	744 (13%)	5,243	696 (12%)
M6 South of Penrith	3,276	539 (14%)	3,652	534 (13%)	3,598	464 (11%)
A66 Between M6 and Kemplay Bank	3,214	441 (12%)	2,986	468 (14%)	3,643	385 (10%)
A66 Penrith to Temple Sowerby	2,192	355 (14%)	2,191	387 (15%)	2,567	329 (11%)
A66 Kirby Thore	1,953	342 (15%)	1,941	371 (16%)	2,326	328 (12%)
A66 Crackenthorpe	1,948	327 (14%)	1,918	358 (16%)	2,329	318 (12%)
A66 Appleby to Brough	1,770	317 (15%)	1,770	349 (16%)	2,116	313 (13%)
A66 Bowes Bypass	1,995	275 (12%)	1,967	313 (14%)	2,335	288 (11%)
A66 Cross Lanes to Rokeby	2,279	308 (12%)	2,196	362 (14%)	2,576	313 (11%)
A66 Stephen Bank to Carkin Moor	2,289	306 (12%)	2,229	355 (14%)	2,558	309 (11%)
A66 West of Scotch Corner	2,289	316 (12%)	2,235	362 (14%)	2,435	312 (11%)
A1(M) North of Scotch Corner	6,448	703 (10%)	5,985	718 (11%)	6,888	501 (7%)
A1(M) South of Scotch Corner	5,976	805 (12%)	5,471	834 (13%)	6,755	659 (9%)

4.2.14 The forecast journey times along the A66 from the M6 J40 to the A1(M) Scotch Corner without the delivery of the Project are shown in Table 4-7.

Table 4-7: A66 Corridor average journey times (minutes)- DM (Cars)

Year	Base 2015	DM	DM v Base
2031	54	56	2 (4%)
2046		59	5 (9%)
2051		59	5 (9%)

4.2.15 The results above show that there will be an increase in journey time of approximately 5 minutes (9%) along the A66 corridor if the Project is not delivered. This is because the single carriageway sections near their capacity throughout the assessment period. The Congestion Reference Flow (CRF) of a Single Carriageway Road is typically between 22,000 to 23,000 AADT[15], and as can be seen in Table 4-2, all single carriageway sections of the route exceed 22,000 AADT by 2046.

4.2.16 The CRF of a Dual Carriageway Road is much greater (68,000 to 70,000 AADT) than a Single Carriageway Road and therefore the delivery of the Project will provide significantly more capacity.

4.2.17 Traffic flows across the A66 corridor are forecast to increase significantly if the Project is delivered.

4.2.18 The forecast journey times along the A66 from the M6 J40 to the A1(M) Scotch Corner with the delivery of the Project are shown in Table 4-8.

Table 4-8: A66 corridor journey times (minutes)- DS (Cars)

Year	Base 2015	DM	DS	DS v DM
2031	54	56	45	-11 (-20%)
2046		59	46	-13 (-23%)
2051		59	46	-13 (-23%)

4.2.19 The results above demonstrate journey time savings between M6 J40 and A1(M) Scotch Corner with the delivery of the Project. It is anticipated that users will save between 11 and 13 minutes (20-23%) when travelling along the A66 corridor in future years.

4.3 Accident Analysis

4.3.1 This section outlines the analysis of accidents and casualties within the A66 study area. A summary of existing accident statistics has been undertaken, alongside a review of accident savings as a result of the Project.

4.3.2 The starting point for the accident analysis is the determination of the study area within which the traffic changes are sufficiently significant for the production of quantifiable future year accident forecasts. There is no quantifiable criteria provided in the COBA manual or TAG used for selecting the study area for accident assessment. The criterion of a change of 5% or more in Annual Average Daily Traffic (AADT) flow is followed in most highway schemes.

4.3.3 Based on this, in Stage 2, a criterion of a change in ± 5% in Average Annual Daily Traffic (AADT) flows between the 'Without Project' and 'With Project' scenarios for all

[15] While it is recognised that the DMRB chapter that describes congestion reference flows has been withdrawn, there has been no equivalent measure to replace the CRF. The CRF is therefore being used to indicate at what flow level delays would be likely to occur.

forecast years with a flow change of +/-50 AADT was used. Only the links in Simulation area have been considered for the selection of the study area.

4.3.4 Figure 4-1 shows the study area for Stage 2. Highlighted links in blue represents where a change of ±5% in AADT flows was observed for years 2031, 2046 and 2051.

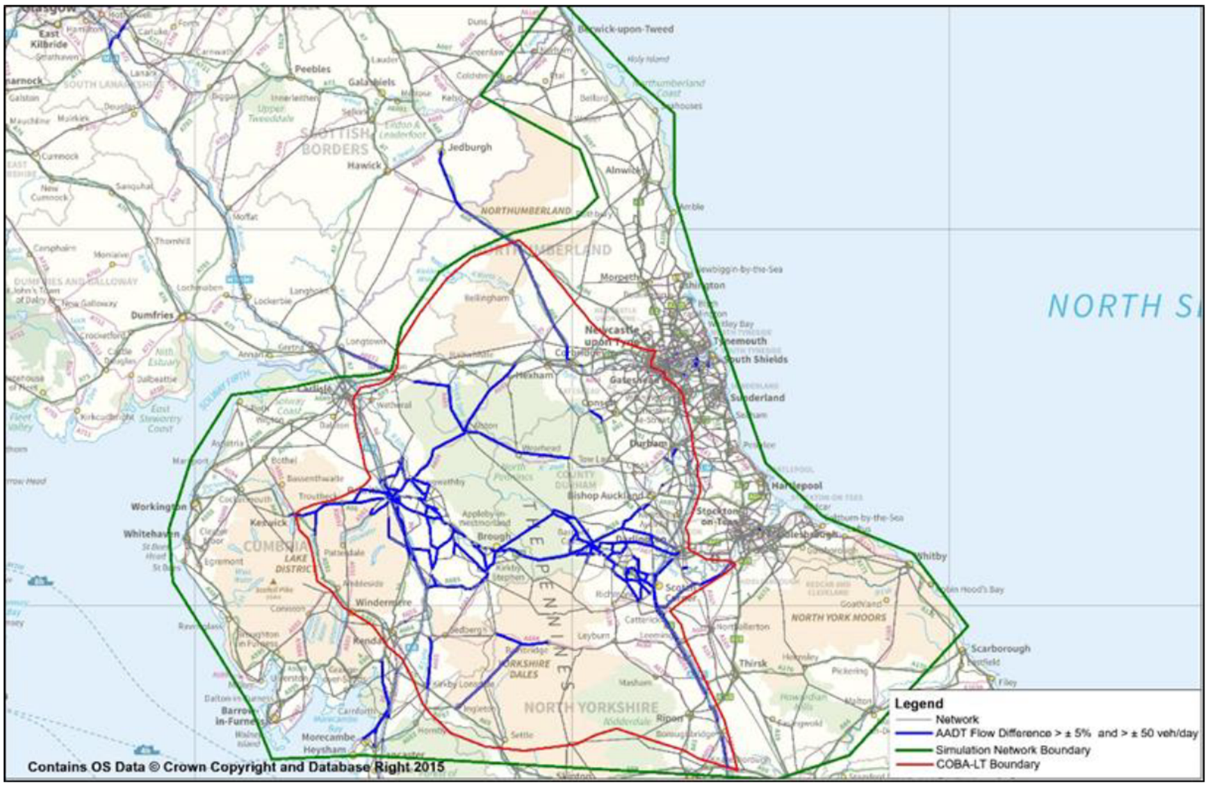

Figure 4-1: Accident study area

4.3.5 The personal injury accident data was obtained from the Road Safety Data website, published by the Department for Transport for the latest five-year period (2013-2017) available at the time the modelling to inform the consultation design was undertaken[16]. The observed flow data, along the A66 between Penrith to Scotch Corner, for this period was obtained from WebTRIS.

4.3.6 Road safety is a key problem along the route, with a higher-than-average number of accidents. Between 2013 and 2017, there was a total of 197 collisions which occurred along the route, equating to an average of 40 collisions per year. Of the 197 reported collisions, 74% resulted in slight injuries, 21% resulted in serious injuries and 5% resulted in fatality.

4.3.7 The A66 has a higher-than-average number of accidents in some sections of the route, with a number of accident cluster sites, as shown in Figure 4-2. A number of these sites are either located in single carriageway sections or in dual sections adjacent to single carriageway sections. Varying standards along the route with a mixture of single and dual carriageway sections leads to difficulties with overtaking, poor forward visibility, and difficulties at junctions as a result of short merges and diverges and right turning traffic off and on to the A66.

[16] This analysis will be updated with the latest available data to inform the DCO application

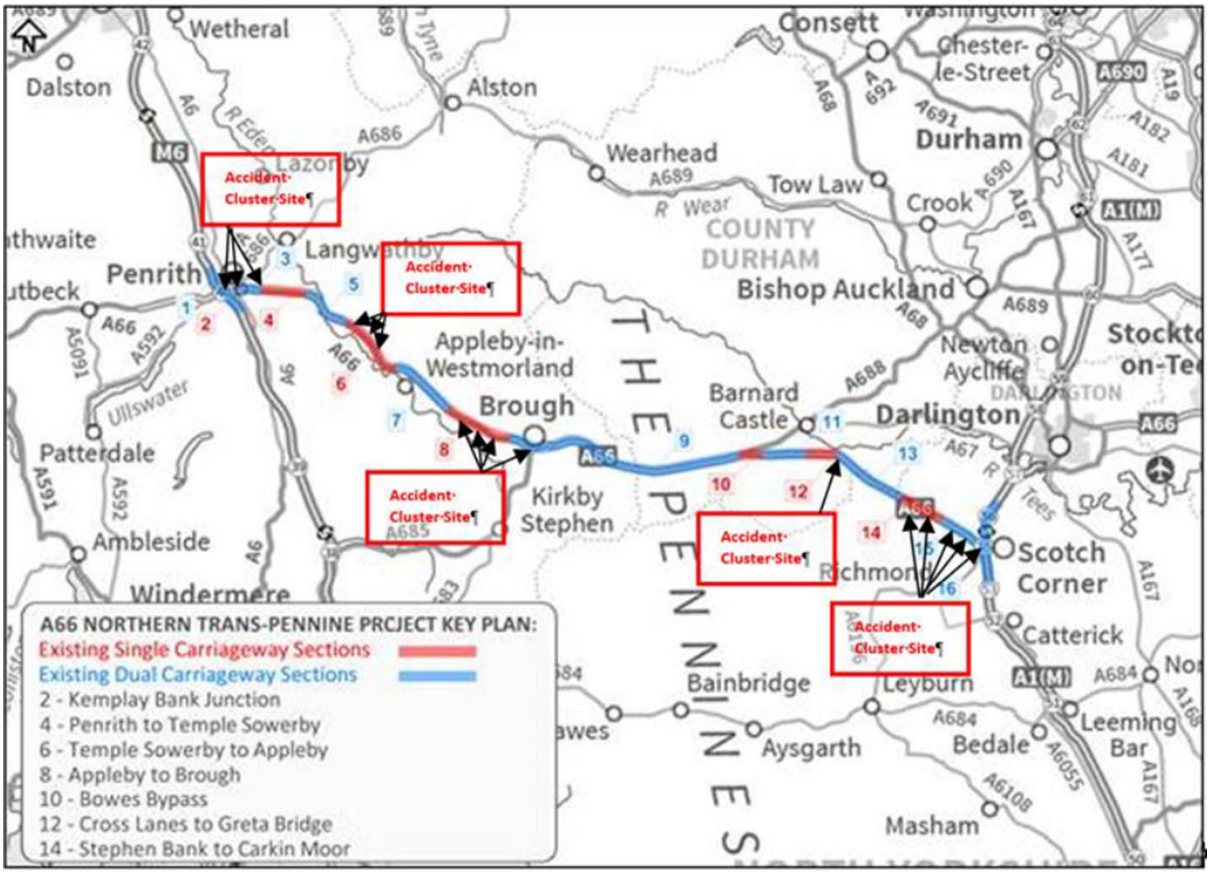

Figure 4-2: Accident cluster sites

4.3.8 Local accidents were calculated using the following steps:

- A geocoded database of road accidents on the A66 (Scotch Corner to Skirsgill Interchange at Penrith) between 2013 and 2017 through MapInfo
- COBALT road types being allocated to the relevant SATURN links
- 24-hour AADT (2-way) flow being worked out for each SATURN link for each year between 2013 and 2017
- Annual million vehicle kilometres were estimated (traffic flow * link length * 365 * 10^-6)
- Average number of accidents in the study area by link type were calculated
- Local accident rates were calculated by road type (accidents by link type per year / million veh km) which were applied to a combined link and junction COBALT analysis.

4.3.9 The results of the accident rate calculations for the A66 for the five-year period from 2013-2017 are shown in **Table 4-9**.

Table 4-9: Local accident rates

Accident rates (discounted to 2010)- taking 2015 as median year (for 2013-2017					
Road Type	Road	Speed	Beta Factor	Revised Accident Rate	Standard Accident Rate
4	Modern S2 Road (single carriageway)	>40	0.955	0.150	0.143
10	Modern D2 Road (dual carriageway)	>40	0.956	0.076	0.077

4.3.10 Results above indicate that accident rates are lower for dual carriageway sections of road, which justifies the dualling the A66 route from a road safety perspective.

4.3.11 Accident saving benefits have been calculated using the Cost and Benefit to Accidents – Light Touch (COBALT) program, an application developed by the DfT to undertake the analysis of the impacts on accidents as part of the economic appraisal of road schemes.

4.3.12 The accidents saved as a result of the improvement of the schemes are calculated as the difference between the number of accidents in 'Without Scheme' scenario and the 'With Scheme' scenario.

Table 4-10: Accident savings

Without Scheme (DM)	With Scheme (DS)	Accidents Saved
80,201	79,954	247

4.3.13 The table refers to the accidents calculated on all links within the area covered by the COBALT assessment (i.e. not just those occurring on the A66). The table outlines a saving of 247 accidents over the appraisal period.

Table 4-11: Casualties- summary

Without Scheme (DM)			With Scheme (DS)			Casualties Saved		
Fatal	Serious	Slight	Fatal	Serious	Slight	Fatal	Serious	Slight
1,171	11,111	101,292	1,155	10,970	100,946	17	141	345

4.3.14 It is observed that there is reduction in all types of casualties i.e. fatal, serious and slight injuries over the appraisal period.

4.3.15 In summary, the Project achieves one of its key objectives of improving safety by reducing the numbers of accidents. This is due to a number of factors associated with the delivery of the Project including a consistent road layout, junction improvements and better driver visibility.

4.4 User Experience

4.4.1 This section will summarise the key issues in relation to the experience of road user experience and the justification for the Project in terms of improving the user experience.

Journey Reliability

4.4.2 Journey reliability refers to the variation in journey times that individuals are unable to predict. Journey reliability benefits are derived from the improved confidence in reliability of journey time, due to a reduction in the variability of journey times as a result of a scheme.

4.4.3 The levels of traffic in peak periods, varying road standards along the corridor and variable road quality on single carriageway sections affect journey reliability, especially in terms of the experience of road users around the consistency of repeated journeys.

4.4.4 To appraise Journey time reliability benefits, two separate approaches have been developed to capture:

- Day-to-day variability (DTDV) to estimate changes in the standard deviation of travel time from changes in journey time and distance from recurring congestion, and
- Journey time variability as a result of major traffic incidents, mainly accidents.

4.4.5 Road closures have a significant impact on route reliability, especially for freight operators. This can also be a key issue for commuters and business drivers who use the route. In the event of planned and unplanned closures on the A66, traffic must use poor quality lengthy diversion routes that add significantly to journey times and delays, and that have significant restrictions for HGVs. In the event of unplanned incidents, HGVs either have to use unsuitable local roads or wait until the road is reopened.

4.4.6 The ability to keep the route open during maintenance activities, major incidents and extreme weather events is significantly affected by the existence of the single carriageway sections. In contrast, incidents on dual carriageway sections typically only affect traffic on one carriageway so that flows can be maintained in one direction and incidents can be cleared more quickly.

Day-to-Day Variability from Recurring Congestion

4.4.7 To inform the Statutory Consultation a reliability assessment has been undertaken using a bespoke approach that follows the principles of journey time reliability appraisal set out in TAG, and which has previously been implemented on another Highways England scheme, the A303 Sparkford to Ilchester improvement.

4.4.8 The methods require a unit to measure travel time variability, and this is generally the standard deviation of travel time. The approach uses 2018 TrafficMaster data to calculate standard deviations for each dual and single carriageway section along the A66 corridor and using the MyRIAD parameter values to represent the new dual carriageway section standard deviations. The results of this assessment are shown below.

Table 4-12: Standard deviation time savings (s/km)

Direction	AM	IP	PM	OP
EB	-3.4	-6.6	-5.2	-3.2
WB	-10.2	-12.6	-4.4	-3.5

4.4.9 The scheme reduces the standard deviation of travel time in terms of seconds per km in each direction and each time period. 12 seconds per km across the full route length would equate to a reduction in the standard deviation of travel time of 16 minutes.

Journey Time Variability as a Result of Major Traffic Incidents

4.4.10 A quantitative methodology was developed to assess the benefits to users of the A66, as a result of improvements to the journey time variability due to major incidents of the A66 route caused by full dualling.

4.4.11 This identified the adoption of case studies for 3 types of incidents (Accidents, Planned Maintenance Works and Weather), that resulted in closure (partial or full) of single carriageway sections of the A66.

4.4.12 An examination of the three categories for road closures identified that all three emergency services may be required to assist at closures due to accidents. Weather closures only require the police, as they decide when road closures or restrictions should be instigated. Maintenance closures only affect the maintaining authority.

4.4.13 Further assessment of weather-related closures has identified that these affect existing dual carriageway sections of the A66, and it was therefore not be possible to identify specific benefits due to dualling of the remaining single carriageway sections.

4.4.14 Benefits from improving journey time variability due to major incidents was undertaken by only assessing road closures of single carriageway sections. Partial closures due to accidents (only closure in one direction) on single carriageway sections, was also considered, as all traffic in one direction is stopped. Partial closures however, for maintenance works on single carriageway sections, will not be considered, as this is normally undertaken using traffic control/traffic signals. This therefore does not totally close the road in either direction but only delays traffic.

4.4.15 To evidence how the varying standard of the A66 route and lack of diversionary routes affect journey time variability due to major incidents, various datasets have been identified and analysed. To assist in the assessment of road closures resulting from accident incidents, Stats 19 and National Incident Liaison Officer (NILO) data was utilised. Network Occupancy Management System (NOMS) data was used for the assessment of maintenance closures. Command and Control data was used for the assessment of accident, maintenance and weather-related closures.

4.4.16 At present, the impact the incidents have on the journey time variability of the A66 are quantified by the number of occurrences, the degree to which the A66 is closed, how long each occurrence lasts, how long it takes for operational teams to respond to incidents and how long it takes for operational teams to mitigate the impact of an incident. The average closures per year (based on 2014-2019) data is shown in Table 4-13 and for single carriageways and dual carriageways.

Table 4-13: Average Annual A66 Closure Duration by Incident Type (Single Carriageway > 6 hour duration)

Incident Type	Average Closures	Average Duration (hours)
Flooding	0.17	11.80
Traffic Collision	2.00	12.08
Weather	0.33	60.03
Other	0.00	0.00
Total	2.50	18.45

Table 4-14: Average Annual A66 Closure Duration by Incident Type (Dual Carriageway > 6 hour duration)

Incident Type	Average Closures	Average Duration (hours)
Flooding	0.17	7.75
Traffic Collision	0.67	12.65
Weather	0.67	19.12
Other	0.00	0.00
Total	**1.50**	**14.98**

4.4.17 The tables show that two-way closures are both less frequent and have shorter durations on the dual carriageway sections. The Transport Assessment will provide details of how this information is used to calculate the annual reduction in delay anticipated with the opening of the scheme.

Local Severance

4.4.18 The majority of communities along the route have been bypassed by previous interventions. Kirkby Thore, which has a population of 758 (Census, 2011), is the only remaining settlement along the A66 without a bypass. The A66 passes directly through part of the village, causing issues of noise and severance, especially due to the high proportion of HGV traffic.

4.4.19 The Project will ensure that all communities along the route are bypassed, which will create local benefits whilst also enhancing the user experience by reducing journey time and improving journey reliability and suitability to HGV traffic.

4.4.20 The Project Design Report contains further details of improvements to be made to the walking, cycling and horse-riding provision at this location as part of the Project.

4.5 Conclusions

4.5.1 The key conclusions regarding the strategic impact of the Project are as follows:

- Traffic flows are anticipated to increase for the DM scenarios from the base typically 46% between 2015 and 2046.
- The average additional growth on the A66 due to the Project (i.e. DS v DM) is typically between 34% and 39% across all years.
- Journey times will be reduced between M6 J40 Penrith and A1(M) Scotch Corner, with a journey time saving of between 11-13 minutes.
- There are a number of accident clusters identified across the route, many of which are associated with the sections that are currently single carriageway. The analysis has shown that accident and casualty savings will be made with the delivery of the Project. This is down to interventions such as junction improvements, better driver visibility and a more consistent road layout associated with the dualling.
- The Project will enhance the user experience by improving journey time reliability through a more consistent road layout, improving road quality and mitigating the impact of unplanned road closures.

5 M6 Junction 40 to Kemplay Bank Development Impact

5.1 Introduction

5.1.1 This chapter sets out the traffic impact of the Project at the M6 J40, and between M6 J40 and Kemplay Bank. There has been a combination of strategic modelling and an operational assessment using microsimulation modelling undertaken to determine the Project impact at this location.

5.2 Design Development

5.2.1 The principles of the Preferred Route are still as announced in May 2020, however, in relation to Kemplay Bank, it is now proposed to maintain the existing emergency services access underpass to the A686, rather than providing a new Fire and Police site access route to the A6. To facilitate this, it is proposed that the speed limit on the A66 between M6 Junction 40 Penrith and Kemplay Bank Roundabout will be 50mph in both directions, for a section approximately 2.3km in length.

5.2.2 This proposal is the result of ongoing engagement with Cumbria County Council and Cumbria Police as part of Preliminary Design development. Concerns were raised about the proposed access route to the A6 and upon more detailed traffic modelling it became clear that what was proposed within the Preferred Route was not a viable solution for this section of the works. The modelling showed that the operation of the additional proposed signalised junction on the A6 accessing the Fire and Police site could potentially be compromised by queueing traffic either from the Kemplay Bank Roundabout signals or the Eamont Bridge Signals. The current proposal to retain the existing access to the Fire and Police site has emerged as a result of the multi criteria optioneering exercise.

5.2.3 Further details of the option assessment process at this location are available within the Route Development Report.

5.3 Strategic Model Assessment

5.3.1 This section will provide an overview of the strategic modelling results for the A66 corridor at M6 J40 and between M6 J40 and Kemplay Bank. The DM and DS scenarios for this location will be addressed.

5.3.2 Table 5-1 outlines forecast traffic flows on the A66 between M6 J40 and Kemplay Bank for each of the forecast demand scenarios with and without the Project.

Table 5-1: M6 J40 Penrith- DM 12-hour traffic flows (vehicles, two-way)- forecast year scenarios

	2015	2031	2046	2051
Without Scheme (Base / DM)	32,844	38,596	44,120	45,607
With Scheme (DS)		45,685	53,030	55,312
Increase due to Scheme		7,089	8,910	9,705
% Increase due to Scheme		18%	20%	21%

5.3.3 The results show a gradual increase in traffic flows over time at this location without the Project. Between 2015 and 2046 there is forecast to be an increase in traffic of 34%.

5.3.4 The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 18 to 21% additional traffic at this location.

5.3.5 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DoS of 80%.

5.4 Operational Assessment

M6 Junction 40

5.4.1 An assessment of the scheme, i.e. the Do Something has been undertaken. The Traffic Assessment will contain an assessment of the Do Minimum scenario also.

5.4.2 An optimum design layout is proposed that is in accordance with the appropriate design standards and in line with the engineering constraints, user operations, construction costs and safety.

5.4.3 The proposed design includes the following features:

- A 3-lane circulatory carriageway with spiral markings on roundabout
- Widening on all 5 approach arms to provide additional lanes and controlled under their own signal phase –this provides a better alignment on approaches; preserves the operation and use of the current depot and emergency services accesses; maintains the active travel route on the western side of the junction by accommodating controlled toucan crossings facilities; and reduces the land take and environmental impact at the junction.

5.4.4 An operational assessment has been undertaken for the M6 Junction 40, testing the proposed Statutory Consultation design for this junction (to be developed further as scheme development continues) shown in Figure 5-1.

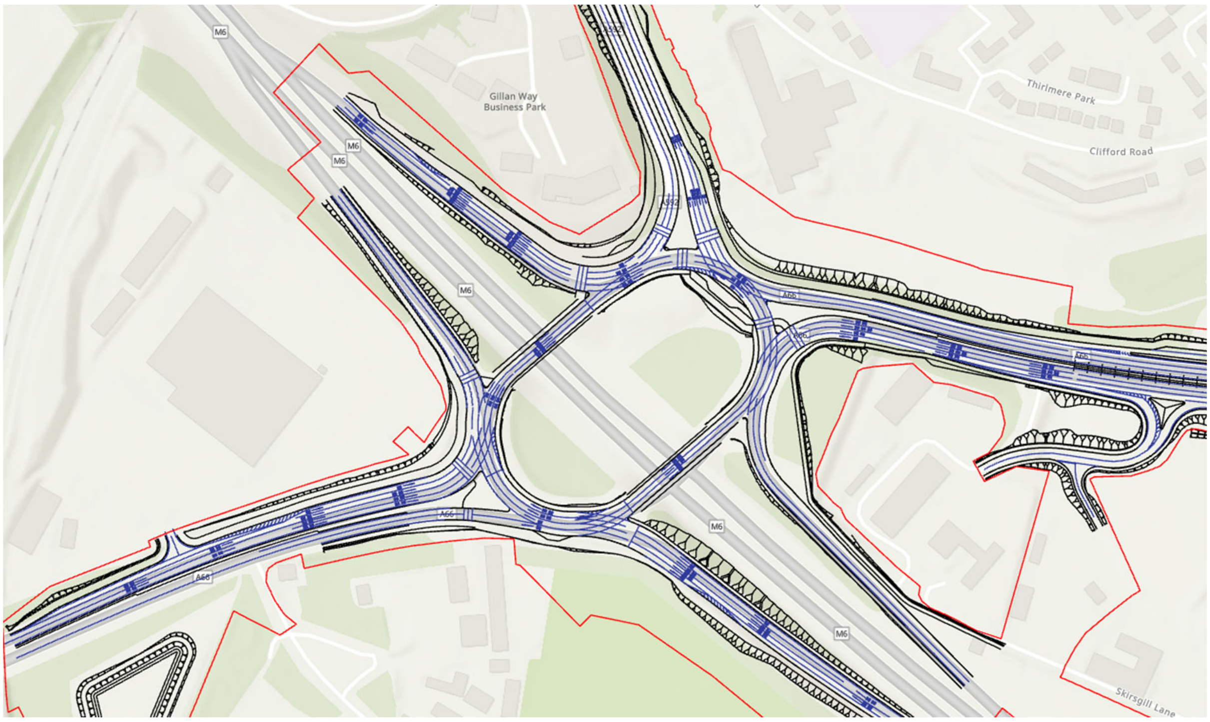

Figure 5-1: M6 J40 scheme design

5.4.5 Table 5-2 outlines the capacity assessment results for the future forecast year scenarios at the M6 J40.

Table 5-2: M6 J40 Capacity Assessment- 2046 Forecast Year

Approach	AM Peak (0730-0830)		PM Peak (1630-1730)	
	DoS %[17]	MMQ[18]	DoS %	MMQ
A66 West (EB) Approach Left Ahead	67.9	5	88.9	8
A66 West (EB) Approach Ahead	77.1	5	100.0	13
M6 Offslip Approach Left Ahead	76.5	9	85.7	13
M6 Offslip Approach Ahead	48.7	5	75.8	10
A592 Ullswater Rd Ahead Left	71.7	6	94.6	16
A592 Ullswater Rd Ahead	73.0	6	99.8	22
A66 East (WB) approach Ahead Left	42.2	5	45.6	6
A66 East (WB) approach Ahead	60.0	7	101.8	37
A66 East (WB) approach Ahead	62.5	8	102.5	39
M6 Offslip NB Ahead Ahead2	57.1	4	58.6	4
M6 Offslip NB Ahead	67.8	4	92.1	6
	PRC[19] 15.6%		PRC -13.9%	
	Total Delay (pcu hr) 68.2		Total Delay (pcu hr) 174.0	

5.4.6 The positive capacity results in Table 5-2 in terms of PRC and Total Delay indicate that the proposed design layout will provide design life of the for M6 Junction 40 in the AM scenario.

5.4.7 The modelling results show the PM peak is the most onerous peak in terms of queuing delay. Particularly during the PM peak period 1630-1730, where traffic is at its greatest, queuing and delay will be experienced on approach arms. Queuing during the 1630-1730 PM period is forecast to occur on the lanes of A592 and A66 East approaches.

Kemplay Bank

5.4.8 An assessment of the scheme, i.e. the Do Something has been undertaken. The Traffic Assessment will contain an assessment of the Do Minimum scenario also.

5.4.9 An optimum design layout is proposed that is in accordance with the appropriate design standards and in line with the engineering constraints, user operations, construction costs and safety.

5.4.10 The proposal includes for conversion of the existing at grade roundabout at Kemplay junction into a grade separated interchange with the A66 being placed in an underpass beneath the existing junction, removing between 35 to 50% of the traffic that would otherwise flow through the roundabout. Kemplay Bank will remain

[17] Degree of Saturation
[18] Mean Maximum Queue (i.e. the average of the maximum queue that occurs with each traffic signal cycle)
[19] Practical Reserve Capacity

signalised with provision for pedestrians to cross through the centre of the junction. The design provides for:

- single lane approaches on the A66 offslips; and
- flared approaches on the remaining arms (A6 north and south) and the A689.

5.4.11 An operational assessment has been undertaken for the layout at Kemplay Bank, testing the proposed Statutory Consultation design for this junction (to be developed further as scheme development continues) shown in Figure 5-2.

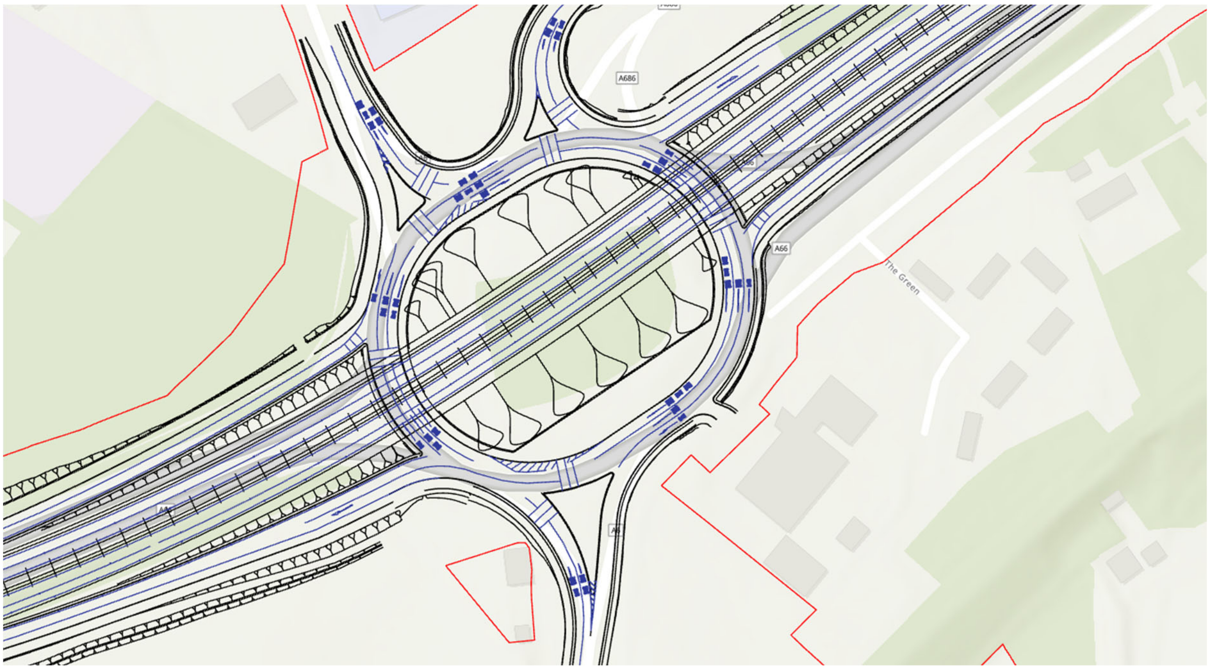

Figure 5-2: A6 / A66 Kemplay Bank Scheme Design

5.4.12 Table 5-3Table 5-3 outlines the capacity assessment results for the future design year scenarios at Kemplay Bank Roundabout.

Table 5-3: Kemplay Bank Capacity Assessment- 2046 Forecast Year

	AM Peak (0730-0830)		PM Peak (1630-1730)	
Lane Description	DoS %	MMQ	DoS %	MMQ
A66 Eastbound Off-slip	88.8	18.1	73.6	12
A6 Bridge Lane (North)	93.6	13.7	83.8	13.8
A686	58.6	5.8	68.8	7
A66 Westbound off-slip	52.3	5.2	40.1	3.4
Emergency Exit Only	1.10	0	1.30	0
A6 South	89.7	16.3	72.4	7.4
	PRC (%): -4%		PRC (%): 7.5	
	Total Delay (pcu hr): 53.72		Total Delay (pcu hr): 37.30	

5.4.13 The modelling results show the AM peak is the most onerous peak in terms of queuing delay. When traffic is at its greatest, queuing and delay will be experienced on both A6 approaches and on the A66 eastbound off slip, however non-of these arms are forecast to exceed capacity.

5.4.14 The positive capacity results in Table 5-3 in terms of PRC and Total Delay indicate that the proposed design layout will provide design life of the for Kemplay Bank in the PM scenario.

5.5 Local Road Network

5.5.1 An assessment has been made of the scheme comparing Do Something AADT against Do Minimum AADT for the design year of 2046. Figure 13-1 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model, Figure 13-2 shows the forecast traffic flows with the Project in place. Figure 13-3 shows the change in AADT due to the Project; within this the following should be noted.

- Any existing link with a traffic increase is shown in purple.
- Any existing link with a traffic decrease is shown in green.
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

5.5.2 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Project and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 5-4: M6 Junction 40 to Kemplay Bank Development Traffic Flows

Road	DM flow (Two-way)	Flow change (Two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
M6 north of Junction 40	82,000	2,600	3%	97000	85%	87%
M6 south of Junction 40	62,000	-2,130	-3%	97000	64%	62%
A66 west of Penrith	22,000	1,500	7%	68000	32%	35%
A6 Bridge Lane within Penrith	14,400	1,000	7%	22000	65%	70%
A686 Carlton Avenue within Penrith	8,200	1,100	13%	22000	37%	42%

5.5.3 The change in flows on the M6 will have a small impact on the operation of the motorway to the north of Penrith.

5.5.4 The existing flows on the A66, and A686 are low in relation to the capacity of the road and therefore the additional flows expected as a result of the scheme will not impact the operation of these roads.

5.5.5 The flow on the A6 Bridge Lane within Penrith is increased by 7% due to the Project within the design year. This will be considered further within the Transport Assessment, particularly regarding the operation of the Roper Street6 Signalised junction.

5.5.6 These increases within Penrith are balanced by small traffic reductions on the north side of Penrith, for example on Beacon Edge Road. As the Project provides more capacity and reduces delays at Kemplay Bank, traffic will be attracted to this additional capacity relative to the Do Minimum scenario, thereby providing some relief on the more remote alternative roads.

5.6 Conclusions

5.6.1 The following key conclusions have been made in relation to the development impact between the M6 J40 and the Kemplay Bank roundabout.

- When comparing DM and DS scenarios, it is forecast that traffic flows will be higher with the Project, with a difference of 18-21% across all forecast years.
- It is forecast there will be significant delays at the M6 J40 during the modelled DM scenarios. This demonstrates the need to alter the junction layout to reflect the increase in traffic flows.
- The operational assessment for Kemplay Bank and the M6 J40 shows that the proposed junction layouts ensures the junction has an acceptable operational performance in 2046.
- There is a potential impact on the A6 within Penrith that will be considered further within the Transport Assessment.

6 Penrith to Temple Sowerby

6.1 Introduction

6.1.1 This chapter outlines the traffic impact of the Project between Penrith and Temple Sowerby, comparing the impact at this location both with and without the scheme.

6.2 Strategic Model Assessment

6.2.1 This section will compare traffic flows forecast from the strategic model assessment both with and without the Project.

6.2.2 Table 6-1 shows the anticipated traffic flows from Penrith to Temple Sowerby with and without the Project.

Table 6-1: Penrith-Temple Sowerby- 12-hour traffic flows (vehicles, two-way)- forecast year scenarios

	2015	2031	2046	2051
Without Scheme	21,119	24,715	27,979	28,794
With Scheme		32,915	38,578	40,452
Increase due to Scheme		8,200	10,600	11,658
% Increase due to Scheme		33%	38%	40%

6.2.3 The results above suggest that traffic flows for DM scenarios will gradually rise over time between Penrith Bank and Temple Sowerby. The increase in flow on the A66 is 32% between the base year (2015) and the design year (2046).

6.2.4 The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 33 to 40% additional traffic at this location.

6.2.5 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DoS of 59%.

6.3 Local Road Network

6.3.1 An assessment has been made of the scheme comparing Do Something AADT against Do Minimum AADT for the design year of 2046. Figure 13-4 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model. Figure 13-5 shows the forecast traffic flows with the Project in place. Figure 13-6 shows the change in AADT due to the Project; within this the following should be noted.

- Any existing link with a traffic increase is shown in purple.
- Any existing link with a traffic decrease is shown in green.
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

6.3.2 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Project and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 6-2: Penrith to Temple Sowerby Traffic Flows

Road	DM flow (Two-way)	Flow change (Two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
A6 at Brougham	6,850	+140	+2%	22,000	31%	32%
Wetheriggs west of Moor Lane	1,090	-230	-21%	22,000	5%	4%

6.3.3 There is a small increase (2%) on the A6 past Brougham as traffic uses the A6 to access the A66. On Wetheriggs, there is a small decrease as the decreased journey time on the A66 relieves traffic on this parallel route. The changes on both roads are not expected to be significant.

6.4 Operational Assessment

6.4.1 An assessment of the scheme, i.e. the Do Something has been undertaken. The Traffic Assessment will contain an assessment of the Do Minimum scenario also.

6.4.2 The SATURN model has been interrogated to demonstrate the performance of the major junctions on this Project. The proposed A66 Center Parcs access has been identified as the only significant junction on this section. The proposed layout is shown in Figure 6-1.

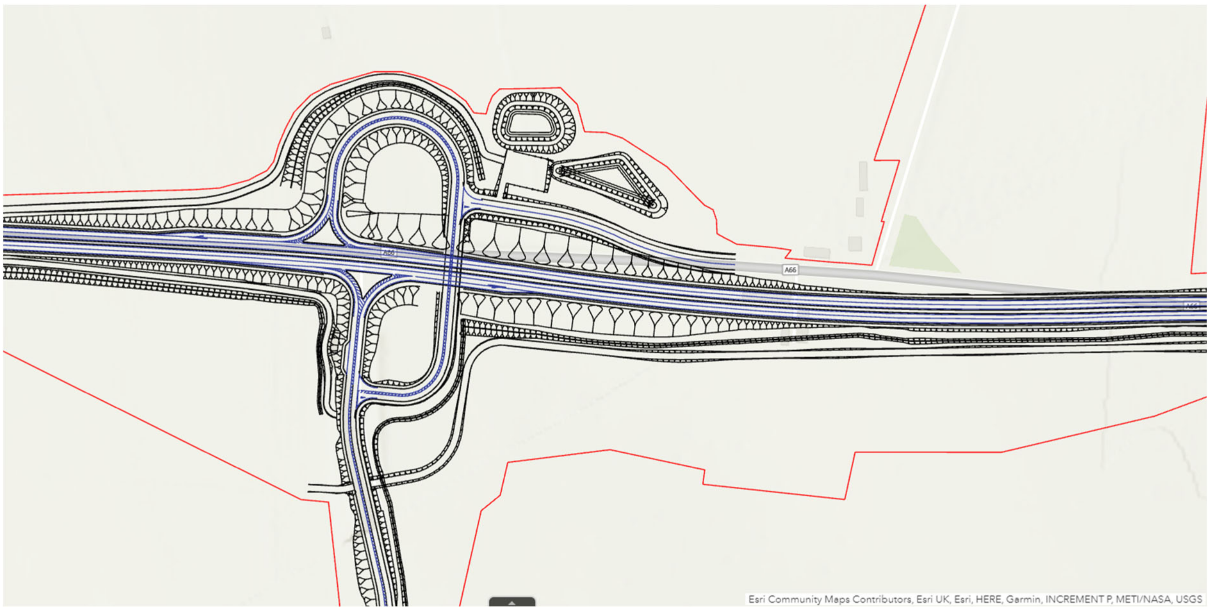

Figure 6-1: Proposed A66 Center Parcs Junction

6.4.3 The performance of this junction (within the SATURN Model) is shown in Table 6-3.

Table 6-3: Proposed A66 Center Parcs Junction performance

	AM Peak			PM Peak		
	Flow	Delay	DoS	Flow	Delay	DoS
A66 Merges						
Eastbound Merge	15	4	1%	32	5	3%
Westbound Merge	62	5	5%	107	5	8%
Center Parcs Road / A66 Eastbound Slips Priority Junction						
Northbound Right Turn	15	1	3%	32	1	6%
A66 Eastbound Give Way	106	7	17%	64	7	11%

6.4.4 The junction performs within capacity with minimal delays and no capacity issues, due to the low average weekday traffic flows on the Center Parcs arm. It is appreciated that the greatest demand at this location is most likely to occur on the Center Parcs 'swap over day', i.e. on a Friday afternoon when one set of guests leave, and a new set of guests arrive. A test of the junction under these flow conditions will be undertaken prior to the DCO submission.

6.5 Conclusions

6.5.1 The following key conclusions have been made in relation to the traffic impact from Penrith to Temple Sowerby.

- The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 33 to 40% additional traffic to the A66 at this location. This is within the capacity of a dual 2 link.
- The proposed A66 Center Parcs access performs within capacity with minimal delays and no capacity issues, due to the low average weekday traffic flows on the Center Parcs arm.

7 Temple Sowerby to Appleby Development Impact

7.1 Introduction

7.1.1 This chapter summarises the impact between Temple Sowerby and Appleby both with and without the delivery of the Project, comparing DM and DS scenarios.

7.2 Design Options

7.2.1 There are currently three alignments being brought to consultation at this location.

- The Blue Route
    - Provision of an off-line route to the north of Kirkby Thore and Crackenthorpe, leaving the existing A66 alignment at the eastern end of the Temple Sowerby Bypass and re-joining the A66 alignment at the western end of The Appleby Bypass.
    - The difference between this route and the Red Route is this blue route crosses the Trout Beck at a more southerly location. Provision would be made for a grade separated all movements junction with the local road network to the north of Kirkby Thore Main Street.
    - The existing road will then be used for local access and pedestrians, cyclists and equestrians
- The Red Route
    - Provision of an off-line route to the north of Kirkby Thore and Crackenthorpe, leaving the existing A66 alignment at the eastern end of the Temple Sowerby Bypass and re-joining the A66 alignment at the western end of The Appleby Bypass.
    - The difference between this route and the Blue Route is this Red Route crosses the Trout Beck at a more northerly location. Provision would be made for a grade separated all movements junction with the local road network to the north of Kirkby Thore Main Street.
    - The existing road will then be used for local access and pedestrians, cyclists and equestrians.
- The Orange Route
    - Provision of an on-line route following the current alignment of the A66 through Kirkby Thore, before following a similar alignment to the Blue and Red Route to the north of Crackenthorpe and re-joining the A66 alignment at the western end of The Appleby Bypass.

7.3 Strategic Model Assessment

7.3.1 This section will outline the forecast traffic flows (with and without the Project) between Temple Sowerby and Appleby calculated from the strategic model assessment undertaken.

7.3.2 The forecast traffic flows between Temple Sowerby and Appleby with and without the scheme are shown in Table 7-1 for the Blue and Red Routes. The difference between the Blue and Red Routes are imperceptible in strategic modelling terms, as the difference in road length between the options is very small compared to the length of trips being undertaken by road users. Therefore, the difference in forecast traffic flows and travel times is very small[20].

Table 7-1: Temple Sowerby-Appleby- 12-hour traffic flows (vehicles, two-way)- forecast year scenarios – Blue and Red Routes.

	2015	2031	2046	2051[21]
Without Scheme	18,133	21,339	24,175	24,953
With Scheme		28,654	33,746	36,452
Increase due to Scheme		7,315	9,571	11,499
% Increase due to Scheme		34%	40%	46%

7.3.3 The results above suggest that traffic flows for DM scenarios will gradually rise over time between Temple Sowerby and Appleby. The increase in flow on the A66 is 33% between the base year (2015) and the design year (2046).

7.3.4 The results for the DS scenarios for the Red and Blue routes demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 34 to 46% additional traffic at this location.

7.3.5 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DoS of 54%.

7.3.6 The forecast traffic flows between Temple Sowerby and Appleby with and without the Project are shown in Table 7-1 for the Orange Route.

Table 7-2: Temple Sowerby-Appleby- 12-hour traffic flows (vehicles, two-way)- forecast year scenarios – Orange Routes.

	2015	2031	2046	2051[22]
Without Scheme	18,133	21,339	24,175	24,953
With Scheme		28,955	34,040	36,452
Increase due to Scheme		7,616	9,866	11,499
% Increase due to Scheme		36%	41%	46%

7.3.7 The results for the DS scenarios for the Orange route demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 36 to 46% additional traffic at this location.

7.3.8 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DoS of 54%.

[20] During option development the demand model was rerun to test the difference of adding 60m to the overall length of the A66. This resulted in an hourly flow change of 1 vehicle in each direction on the A66. This would equate to a two way AADT change of less than 30 vehicles, which is a 0.1% change for an AADT of 30,000.
[21] It should be noted that the flows for 2051 come from the model results of a previous alignment, which were based on the assumed route at that time. The 2051 models have not been rerun during the design development stage as only 2046 models are needed for highway design and environmental assessment. 2051 models are needed for economic assessment only and will be developed on the basis of the chosen options for DCO application.
[22] It should be noted that the flows for 2051 come from the model results of a previous alignment, (similar to the blue and red alignments) which were based on the assumed route at that time

7.4 Impact on Local Road Network

7.4.1 An assessment has been made of the scheme comparing Do Something AADT against Do Minimum AADT for the design year of 2046 for the blue, red and orange routes. Figure 13-7 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model. Figure 13-8 to Figure 13-10, shows the forecast traffic flows with the Project in place. Figure 13-11 to Figure 13-13 shows the change in AADT due to the Project; within these figures the following should be noted.

- Any existing link with a traffic increase is shown in purple.
- Any existing link with a traffic decrease is shown in green.
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

7.4.2 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the blue and red options and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 7-3: Penrith to Temple Sowerby Traffic Flows (blue and red route)

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
Existing A66 alignment through Kirkby Thore and Crackenthorpe	24,000	-24,000	-100%	22,000	109%	-
Main Street to the South of Kirkby Thore	920	-540	-59%	22,000	4%	2%
Long Marton Road	2,500	-2,040	-82%	22,000	11%	2%
Chapel Street through Bolton	1,490	-640	-43%	22,000	7%	4%

7.4.3 The new route removes traffic from the existing A66. In terms of impact on other parts of the local road network there is a decrease in flows on all of the roads as the decreased journey time on the A66 relieves traffic on local roads.

7.4.4 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Orange Route and the ratio of flow to capacity.

Table 7-4: Penrith to Temple Sowerby Traffic Flows (orange route)

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
Existing A66 alignment through Kirkby Thore and Crackenthorpe	24,000	-24,000	-100%	22,000	109%	-
Main Street to the South of Kirkby Thore	920	-180	-20%	22,000	4%	3%
Long Marton Road	2,500	-950	-38%	22,000	11%	7%
Chapel Street through Bolton	1,490	-670	-45%	22,000	7%	4%

7.4.5 The Orange route, similarly, to the Red and Blue Route, results in a decrease on all roads listed as the decreased journey time on the A66 relieves traffic on local roads.

7.4.6 The environmental impact of these options will be considered within the Preliminary Environmental Information Report.

7.5 Operational Assessment

7.5.1 No operational assessment has been undertaken at this location due to the ongoing development of a preferred route in this location. It is anticipated that operational assessments will be undertaken at the new access junctions to the A66 within the Transport Assessment.

7.6 Conclusions

7.6.1 The following key conclusions have been made regarding the impact of the Project between Temple Sowerby.

- The results for the DS scenarios demonstrate a significant increase in traffic flows over time over and above those in the DM scenarios; the Project is expected to add an additional 33 to 40% additional traffic to the A66 at this location which is within the capacity of a dual 2 alignment.
- There are currently three alignments being brought to consultation at this location, each alignment option facilitates a 12,000 vpd AADT decrease in either direction on the existing A66 alignment through Crackenthorpe.

8 Appleby to Brough Development Impact

8.1 Introduction

8.1.1 This chapter provides an overview of the traffic impact both with and without the Project between Appleby and Brough.

8.2 Design Options

8.2.1 There are currently three routes being considered at this location.

- The Black Route runs mainly to the south of the existing A66 and follows the Preferred Route announced in May 2020.
  - From the end of the existing Appleby Bypass (near Café 66) to a point west of Wildboar Hill, it is proposed to use the existing A66 as the eastbound carriageway and build a new westbound carriageway to the south. A new junction will be provided at the B6259 at Sandford to provide access to and from both the eastbound and westbound carriageways.
  - The new dual carriageway will continue in a south-easterly direction, deviating from the line of the existing A66 near Moor House Lane, running through Wheatsheaf Farm. The route will be predominantly elevated through this section. From East Field Farm, the new A66 will continue to follow a line to the south of the old A66 to tie in to Brough Bypass, near West View Farm.
  - The old existing A66 will be used for local journeys between Moor House Lane and Turks Head. To provide a connection to Brough and the eastern end of the scheme, it is proposed to build a new section of local road that runs parallel to the north of the new A66 to connect to Brough Main Street.
  - A new local road is also proposed to provide connection between Flitholme and Langrigg, with a westbound-only junction at Langrigg. Another new local road is proposed at Turks Head to connect Langrigg to the old A66 via a new overbridge.
- The Blue Route moves the proposed A66 further away from the community of Warcop compared to the current Preferred Route as announced in May 2020 along the section of route from Wildboar Hill to Flitholme.
  - It is proposed that this route will follow the line of the existing A66, by using the old A66 as the new eastbound carriageway and building the new westbound carriageway to the south.
  - It is also proposed that a new road for local journeys will be constructed to the north of the new A66. Part of this new local road will be within the AONB.
  - For the Blue Route, it is proposed to lower the new A66 close to existing ground levels around Warcop, with access to the MoD training camp and local road to the north crossing over the top of the new road.
- For the Orange Route, it is proposed to build the new A66 to the south of West View Farm, starting at Langrigg and tying into the Brough Bypass further east than is shown in the Preferred Route announced in May 2020.
  - To the west of Langrigg, it is proposed that the route will follow either the Black or Blue route as described above. Following the proposed Orange Route for the eastern section will completely avoid an incursion into the AONB at the Brough end of the scheme.
  - As the new A66 will run to the south of the existing A66, the old road could be used for local journeys.

8.2.2 The options being brought to consultation at this location are summarised in Table 8-1.

Table 8-1: Appleby to Brough – Route Combinations for Statutory Consultation

Option Name	West of Wildboar Hill	Wildboar Hill to Flitholme	Flitholme to Brough
Black-Black-Black	Black Route	Black Route	Black Route
Black-Blue-Black	Black Route	Blue Route	Black Route
Black-Black-Orange	Black Route	Black Route	Orange Route
Black-Blue-Orange	Black Route	Blue Route	Orange Route

8.3 Strategic Model Assessment

8.3.1 This section summarises the forecast traffic flows between Appleby and Brough for the DM and DS scenarios and forecast years.

8.3.2 The strategic model has not been rerun to assess the alignment and local junction differences on the Appleby to Brough scheme as the changes to the scheme options are not considered to be significant enough in strategic modelling terms to justify rerunning the model. This is because the changes to the alignment of the A66 between each scheme option would not be enough to significantly affect the overall length of the A66, or the surrounding road layout (see para 1.1.1 and footnote 20).

8.3.3 Table 8-2 outlines the forecast traffic flows between Appleby and Brough with and without the Project.

Table 8-2: Appleby-Brough- 12-hour traffic flows (vehicles, two-way)- forecast year scenarios

	2015	2031	2046	2051
Without Scheme	16,576	19,777	22,795	23,630
With Scheme		26,554	31,650	33,364
Increase due to Scheme		6,777	8,855	9,734
% Increase due to Scheme		34%	39%	41%

8.3.4 The results above suggest that traffic flows for DM scenarios will gradually rise over time between Appleby and Brough. The increase in flow on the A66 is 38% between the base year (2015) and the design year (2046).

8.3.5 The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 34 to 41% additional traffic at this location.

8.3.6 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DOS of 54%.

8.4 Impact on Local Road Network

8.4.1 An assessment has been made of the scheme comparing Do Something AADT against Do Minimum AADT for the design year of 2046 for the blue, red and orange routes. Figure 13-14 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model. Figure 13-15 to Figure 13-18 shows the forecast traffic flows with the Project in place. Figure 13-19 to Figure 13-22 shows the change in AADT due to the Project; within these figures the following should be noted.

- Any existing link with a traffic increase is shown in purple.
- Any existing link with a traffic decrease is shown in green.
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

8.4.2 It should also be noted that as the traffic model has not been rerun the results within each option drawing are the same, however the roads have been realigned to represent each scheme within Figure 13-15 to Figure 13-21 for presentational purposes.

8.4.3 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Project and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 8-3: Appleby to Brough Traffic Flows (Black, Blue and Orange Options)

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
B6259 eastern approach to Warcop	350	-250	-71%	22,000	2%	>1%
A685 between Brough and Kirkby Stephen	11,500	1,650	14%	22,000	52%	60%

8.4.4 There is a significant decrease in traffic on the B6259 as a new link from the A66 is provided.

8.4.5 The existing flows on the A685 are low in relation to the capacity of the road. However, an assessment of the increase of traffic on this route will be made within the Transport Assessment.

8.4.6 The environmental impact of these options is considered within the Preliminary Environmental Information Report.

8.5 Operational Assessment

8.5.1 No operational assessment has been undertaken at this location due to the ongoing development of a preferred route in this location.

8.5.2 It is anticipated that operational assessments will be undertaken at the new access junctions to the A66 within the Transport Assessment.

8.6 Conclusions

8.6.1 The following key conclusions have been made in relation to the traffic impact of the Project from Appleby to Brough.

- The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the scheme is expected to add an additional 34 to 41% additional traffic to the A66 at this location. This is within the capacity of a dual 2-lane link.
- In terms of impact on the local road network all three route options proposed at this location are very similar.
- This includes an 800 vpd AADT increase in both directions on the A695 between Bowes and Kirkby Stephen.

9 Bowes Bypass (A66/A67) Development Impact

9.1 Introduction

9.1.1 This chapter will summarise the traffic impact both with and without the Project at the Bowes Bypass.

9.2 Strategic Model Assessment

9.2.1 This section will provide an overview of the results of the strategic model assessment for both DM and DS scenarios. Table 9-1 provides an overview of forecast traffic flows for the Bowes Bypass with and without the Project.

Table 9-1: Bowes Bypass- 12-hour traffic flows (vehicles, two-way)- forecast year scenarios

	2015	2031	2046	2051
Without Scheme	14,912	18,846	22,753	23,859
With Scheme		28,087	34,579	36,685
Increase due to Scheme		9,241	11,826	12,825
% Increase due to Scheme		49%	52%	54%

9.2.2 The results above suggest that traffic flows for DM scenarios will gradually rise over time at Bowes Bypass. The increase in flow on the A66 is 53% between the base year (2015) and the design year (2046).

9.2.3 The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the scheme is expected to add an additional 49 to 54% additional traffic at this location.

9.2.4 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DoS of 54%.

9.3 Local Road Network

9.3.1 Figure 13-23 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model. Figure 13-24 shows the forecast traffic flows with the Project in place. Figure 13-25 shows the change in AADT due to the Project; within this the following should be noted.

- Any existing link with a traffic increase is shown in purple.
- Any existing link with a traffic decrease is shown in green.
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

9.3.2 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Project and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 9-2: Bowes Bypass Traffic Flows

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
A67	5,300	-1,620	-31%	22,000	24%	17%

9.3.3 There is a decrease on the A67 as the improved (faster) A66 attracts more longer distance east west traffic from the A67 between Cumbria and the rural areas to the south and west of Darlington.

9.4 Operational Assessment

9.4.1 An assessment of the scheme, i.e. the Do Something has been undertaken. The Traffic Assessment will contain an assessment of the Do Minimum scenario also.

9.4.2 The SATURN model has been interrogated to demonstrate the performance of the major junctions on this scheme. The proposed A66 / A67 Bowes Bypass Junction has been identified as the only significant junction on this section. The proposed layout is shown in Figure 9-1.

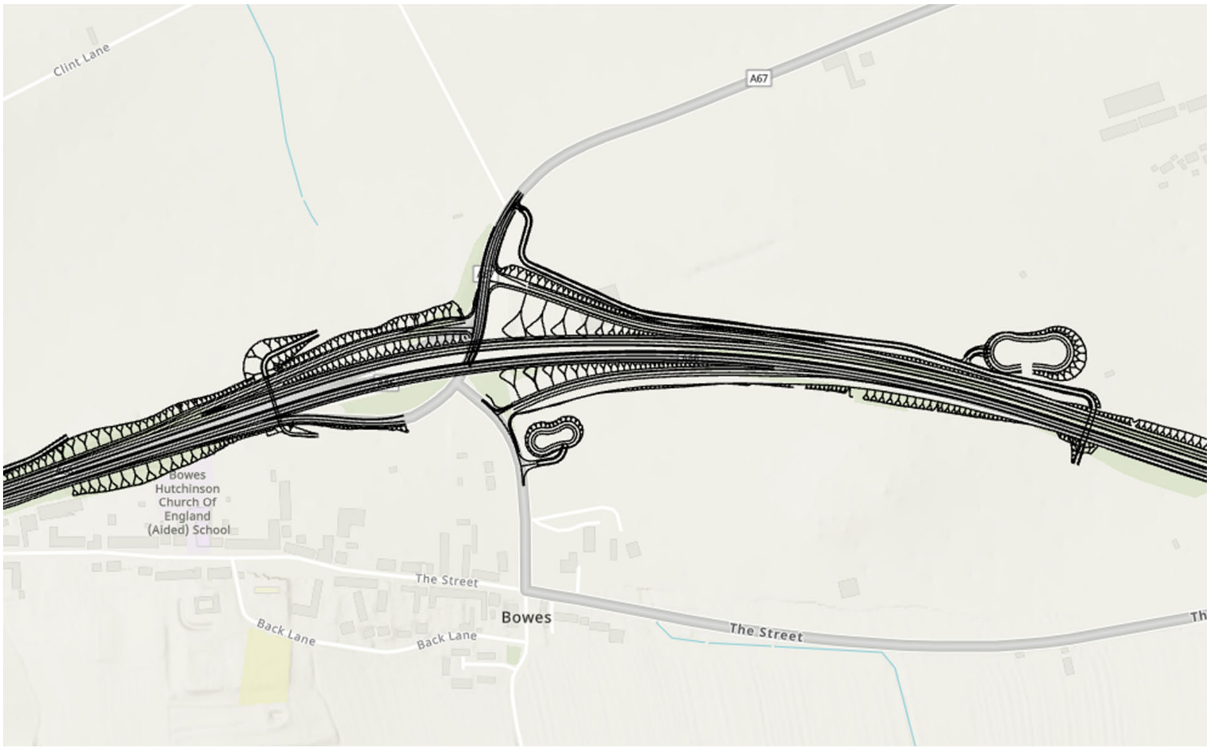

Figure 9-1: Proposed A66 / A67 Bowes Bypass Junction

9.4.3 The performance of this junction (within the SATURN Model) is shown in Table 9-3.

Table 9-3: Proposed A66 / A67 Bowes Bypass Junction performance

	AM Peak			PM Peak		
	Flow	Delay	DoS	Flow	Delay	DoS
Eastbound Merge						
Eastbound offslip give way	153	6	15%	180	9	23%
Right turn to eastbound onslip	45	6	7%	52	6	8%
Westbound Merge						
Westbound offslip give way	48	9	9%	44	9	9%
Northbound give way	72	5	10%	83	5	12%

9.4.4 The junction performs within capacity with minimal delays and no capacity issues, due to the low traffic flows entering the village of Bowes, and the fact that only traffic between the A66 west and the A67 uses this junction.

9.5 Conclusions

9.5.1 The following key conclusions have been made in relation to the traffic impact of the A66 dualling scheme, both with and without the Project, at the Bowes Bypass.

- The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 40 to 47% additional traffic to the A66 at this location. This is within the capacity of a dual 2-lane link.
- There is a 750 to 870 vapid AADT decrease (-30%) in both directions on the A67 as the improved A66 attracts more longer distance east west traffic from the A67 between Cumbria and the rural areas to the south and west of Darlington.
- The proposed A66 / A67 Bowes Bypass Junction performs within capacity with minimal delays and no capacity issues, due to the low traffic flows entering the village of Bowes, and the fact that only traffic between the A66 west and the A67 uses this junction.

10 Cross Lanes to Rokeby Development Impact

10.1 Introduction

10.1.1 This chapter will outline the traffic impact of the Project between Cross Lane and Rokeby.

10.2 Design Options

10.2.1 There are currently three alignments being brought to consultation at this location.

- For the Black Route, it is proposed to combine dualling of the A66 with the western junction options for both locations.
  - A compact grade-separated junction is proposed west of the existing Cross Lanes Junction. This will link the B6277 Moorhouse Lane and Rutherford Lane via a structure over the A66.
  - At Rokeby, a compact grade-separated junction is proposed west of St. Mary's Church and the Old Rectory. The junction will be an underpass arrangement, providing access to Barnard Castle Road for all westbound traffic and diverging eastbound traffic via the old A66, which will form part of the local road network. Eastbound merging traffic will join the A66 via a slip road at the existing Rokeby Junction with the C165 Barnard Castle Road. This junction would maintain HGV access to Barnard Castle.
- For the Red Route, it is proposed to combine dualling of the A66 between Cross Lanes and Rokeby with the eastern junction options for both locations.
  - An all-movements compact grade-separated junction is proposed east of the existing Cross Lanes Junction. The B6277 Moorhouse Lane will be realigned to connect to the junction overbridge.
  - A compact grade-separated junction is proposed east of St. Mary's Church and the Old Rectory for westbound traffic. This will be an underpass arrangement, taking traffic under the realigned A66, the de-trunked A66 and the Rokeby Registered Park and Garden. Eastbound diverging traffic will leave the A66 at the point at which the A66 mainline is re-aligned to the south of the Old Rectory. Eastbound merging traffic will join the A66 via a slip road at the existing Rokeby Junction with the C165 Barnard Castle Road. This junction will maintain HGV access to Barnard Castle.
- For the Blue Route, it is proposed to combine dualling of the A66 between Cross Lanes and Rokeby with the western junction option at Cross Lanes and the eastern junction option at Rokeby.
  - A compact grade-separated junction is proposed west of the existing Cross Lanes Junction. This links the B6277 Moorhouse Lane and Rutherford Lane via a structure over the A66.
  - A compact grade-separated junction is proposed east of St. Mary's Church and the Old Rectory for westbound traffic. This will be an underpass arrangement, taking traffic under the realigned A66, the de-trunked A66 and the Rokeby Registered Park and Garden. Eastbound diverging traffic will leave the A66 at the point at which the mainline is re-aligned to the south of the Old Rectory. Eastbound merging traffic will join the A66 via a slip road at the existing Rokeby Junction with the C165 Barnard Castle Road. This junction will maintain HGV access to Barnard Castle.

10.3 Strategic Model Assessment

10.3.1 This section will present the results from the strategic model assessment. This will include an overview of forecast traffic flows both with and without the Project. Whilst the design options at this location do change the impact on the local road network the only have a marginal impact upon the flow on the A66 mainline. **Table 10-1** summarises forecast traffic flows East of Greta Bridge with and without the A66 dualling scheme assuming the preferred route alignment. The results from the junction options developed for Statutory consultation are very similar.

Table 10-1: Cross Lane-Rokeby- DM 12-hour traffic flows (vehicle, two-way)- forecast year scenarios (All Routes)

	2015	2031	2046	2051
Without Scheme	16,008	20,085	23,911	24,904
With Scheme		32,058	39,023	41,214
Increase due to Scheme		11,974	15,112	16,310
% Increase due to Scheme		60%	63%	65%

10.3.2 The results above suggest that traffic flows for DM scenarios will gradually rise over time between Cross Lanes and Rokeby. The increase in flow on the A66 is 49% between the base year (2015) and the design year (2046).

10.3.3 The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the scheme is expected to add an additional 60 to 65% additional traffic at this location.

10.3.4 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DoS of 60%.

10.4 Impact on Local Road Network

10.4.1 An assessment has been made of the scheme comparing Do Something AADT against Do Minimum AADT for the design year of 2046 for the blue, red and orange routes. Figure 13-26 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model. Figure 13-27 to Figure 13-29 shows the forecast traffic flows with the Project in place. Figure 13-30 to Figure 13-32 shows the change in AADT due to the Project; within these figures the following should be noted.

- Any existing link with a traffic increase is shown in purple.
- Any existing link with a traffic decrease is shown in green.
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

10.4.2 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Project and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 10-2: Cross Lanes to Rokeby Traffic Flows (black route)

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
Moorhouse Lane at Cross Lanes	619	1,610	260%	22,000	3%	10%
Moorhouse Lane Near Barnard Castle	1,187	1,037	87%	22,000	5%	10%
C165	3,992	-1,619	-41%	22,000	18%	11%

Table 10-3: Cross Lanes to Rokeby Traffic Flows (red route)

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
Moorhouse Lane at Cross Lanes	619	1,054	170%	22,000	3%	8%
Moorhouse Lane Near Barnard Castle	1,187	486	41%	22,000	5%	8%
C165	3,992	-924	-23%	22,000	18%	14%

Table 10-4: Cross Lanes to Rokeby Traffic Flows (blue route)

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
Moorhouse Lane at Cross Lanes	619	701	113%	22,000	3%	6%
Moorhouse Lane Near Barnard Castle	1,187	406	34%	22,000	5%	7%
C165	3,992	-402	-10%	22,000	18%	16%

10.4.3 Considering the black route, there is an increase on the B6277 Moorhouse Lane, and a decrease on Barnard Castle Road. This is because the traffic that accesses Barnard Castle from the A66 east has easier access to the B6277 Moorhouse Lane and less easy access to Barnard Castle Road, compared to the existing situation due to the proposed junction arrangements at these locations.

10.4.4 The red and blue options are more successful at keeping the traffic flowing into Barnard Castle on the existing routes, as they discourage traffic to and from the A66 east from using Moorhouse Lane.

10.4.5 The environmental impact of these options is considered within the Preliminary Environmental Information Report.

10.5 Operational Assessment

10.5.1 No operational assessment has been undertaken at this location due to the ongoing development of a preferred route in this location. It is anticipated that operational assessments will be undertaken at the new access junctions to the A66 within the Transport Assessment.

10.6 Conclusions

10.6.1 The following key conclusions have been made regarding the traffic impact with and without the Project between Cross Lane and Rokeby.

- When comparing DM and DS scenarios, traffic flows are forecast to be 60-65% higher with the Project than without the scheme. This is within the capacity of a dual 2-lane link.
- Considering the black route, there is an increase on the B6277 Moorhouse Lane, and a decrease on Barnard Castle Road. This is because the traffic that accesses Barnard Castle from the A66 east has easier access to the B6277 Moorhouse Lane and less easy access to Barnard Castle Road due to the proposed junction arrangements at this location.
- The red and blue options are more successful at keeping the traffic flowing into Barnard Castle on the existing routes, as they discourage traffic to and from the A66 east from using Moorhouse Lane.
- Whilst the existing flows on all of these roads are low in relation to the capacity of the road, operational effects may be felt within Barnard Castle should trips reassign from Barnard Castle Road to Moorhouse Lane.

11 Stephen Bank to Carkin Moor Development impact

11.1 Introduction

11.1.1 This chapter will outline the traffic impact of the Project between Stephen Bank and Carkin Moor.

11.2 Strategic Model Assessment

11.2.1 This section will present the results from the strategic model assessment. This will include an overview of forecast traffic flows both with and without the Project. Table 11-1 summarises forecast traffic flows at locations between Stephen Bank and Carkin Moor without the Project.

Table 11-1: Stephen Bank to carkin Moor- 12-hour traffic flows (vehicle, two-way)- forecast year scenarios

	2015	2031	2046	2051
Without Scheme	18,942	23,048	26,726	27,704
With Scheme		32,714	39,429	41,497
Increase due to Scheme		9,667	12,702	13,792
% Increase due to Scheme		42%	48%	50%

11.2.2 The results above suggest that traffic flows for DM scenarios will gradually rise over time on the A66 between Stephen Bank and Carkin Moor. The increase in flow on the A66 is 41% between the base year (2015) and the design year (2046).

11.2.3 The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the scheme is expected to add an additional 42 to 50% additional traffic at this location.

11.2.4 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DOS of 60%.

11.3 Impact on Local Road Network

11.3.1 An assessment has been made of the scheme comparing Do Something AADT against Do Minimum AADT for the design year of 2046. Figure 13-33 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model, Figure 13-34 shows the forecast traffic flows with the Project in place. Figure 13-35 shows the change in AADT due to the Project; within this figure it should be noted that:

- Any existing link with a traffic increase is shown in purple
- Any existing link with a traffic decrease is shown in green
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

11.3.2 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Project and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 11-2: Stephen Bank to Carkin Moor Traffic Flows (black route)

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
B6274 to the south of the A66	1,360	820	60%	22,000	6%	10%
Stoneygate Bank Road through Ravensworth	1,430	- 1,110	-78%	22,000	7%	1%
Collier Lane	390	- 160	-41%	22,000	1%	1%
B6274 to the north of the A66	1,680	-90	-5%	22,000	8%	7%

11.3.3 There is an increase on the B6274 to the south of the A66 however as the route is not heavily trafficked in either the Do Minimum or with the Project, the increase in flow is not likely to impact journey times.

11.3.4 There is a decrease on the parallel Stoneygate Bank Road through Ravensworth. This redistribution of traffic on the roads to the south of the A66 is due to the increase in design speed and capacity on the A66 encouraging traffic to get to the A66 for more of their journey.

11.3.5 To the north of the A66 there are small reductions in traffic on Collier Lane and the B6274, as traffic is again redistributed onto the faster A66 for more of their journey.

11.4 Operational Assessment

11.4.1 The appraisal of the impacts at this location is based on the A66TM which has been developed in line with TAG guidance. The A66TM is a strategic model, representing average travel conditions across multiple hour time periods. As such it does not represent some of the known operational issues including those at the access to Mainsgill Farm Shop. An assessment of the operation of the proposed junction at the A66 Moor Lane Junction will be undertaken within the Transport Assessment. It is anticipated that this assessment will be informed by both the results of the modelling exercise undertaken with the A66TM, supplemented by local traffic count information (representing peak flow conditions) and information on proposed developments within the area.

11.5 Conclusions

11.5.1 The following key conclusions have been made regarding the traffic impact with and without the Project between Cross Lane and Rokeby.

- When comparing DM and DS scenarios, traffic flows are forecast to be 42-50% higher with the Project than without the Project. This is within the capacity of a dual 2-lane link.
- There are small changes to the traffic flows on the local road network to the north and south of the A66 due to the increase in design speed and capacity on the A66 encouraging traffic to get to the A66 for more of their journey.

12 A1(M) Junction 53 Scotch Corner Development Impact

12.1 Introduction

12.1.1 This chapter will analyse the development impact of the Project at the A1(M) J53 Scotch Corner. An overview of the strategic model assessment and operational model assessment findings will be provided, comparing the traffic impacts both with and without the Project.

12.1.2 The A66/ A1(M) junction at Scotch Corner was upgraded as part of the A1 Leeming to Barton scheme. Therefore, this upgrade has been included within both DM and DS scenarios.

12.2 Strategic Model Assessment

12.2.1 This section will provide an overview of forecast traffic flows and traffic delay, forecast as part of the strategic modelling exercise, at this location of the A66 route for the DM and DS scenarios.

12.2.2 Table 12-1 below outlines forecast traffic flows for the DM scenario at the A66 on approach to the A1(M) J53.

Table 12-1: A66 west of Scotch Corner-12-hour traffic flows (vehicles, two-way)- forecast year scenarios

	2015	2031	2046	2051
Without Scheme	19,690	24,248	28,147	29,183
With Scheme		33,034	39,304	41,296
Increase due to Scheme		8,786	11,157	12,113
% Increase due to Scheme		36%	40%	42%

12.2.3 The results above suggest that traffic flows for DM scenarios will gradually rise over time on the A66 on the approach to Scotch Corner. The increase in flow on the A66 is 43% between the base year (2015) and the design year (2046).

12.2.4 The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the Project is expected to add an additional 36 to 42% additional traffic at this location.

12.2.5 The CRF of a 2-lane dual carriageway road is 68,000 to 70,000 AADT, therefore within the DS scenario the flow will be within the link capacity, with a DOS of 60%.

12.3 Local Road Network

12.3.1 An assessment has been made of the scheme comparing Do Something AADT against Do Minimum AADT for the design year of 2046. Figure 13-36 in Appendix B shows the forecast traffic flows (AADT) from the 2046 Do Minimum model, Figure 13-37 shows the forecast traffic flows with the Project in place. Figure 13-38 shows the change in AADT due to the Project; within this figure it should be noted that:

- Any existing link with a traffic increase is shown in purple.
- Any existing link with a traffic decrease is shown in green.
- Any new link is shown in red. Within this category there is no comparison to be made in traffic as the link did not exist within the Do Minimum.
- Any link that has been replaced is shown in grey.

12.3.2 The table below presents the Do Minimum two-way traffic flows, the change forecast as a result of the Project and the ratio of flow to capacity. DMRB CRF has been used to demonstrate an indicative capacity.

Table 12-2: A1(M) Junction 53 Scotch Corner Traffic Flows

Road	DM flow (Two-way)	Flow change (two-way)	Percentage change (Two-way)	Indicative Road Capacity	DoS DM	DoS DS
A1(M) north of Scotch Corner	101,000	2,200	2%	98,000	103%	105%
A1(M) south of Scotch Corner	96,000	3,500	4%	98,000	98%	102%
A6055 south of Scotch Corner	5,600	370	7%	22,000	25%	27%

12.3.3 There is an increase on the A1(M) north and south of Scotch Corner. These increases are due to the improved A66 attracting more traffic to the strategic road network from the local road network. The DoS on the A1(M) is very high, around 100%. It is expected that if a road was operating at this level then delays would be commonplace. The A1 at this location will be considered further within the modelling for the Transport Assessment.

12.3.4 There is an increase on the A6055 north of Scotch Corner. The existing flows on the A6055 are low in relation to the capacity of the road and therefore the additional flows expected as a result of the scheme will not impact the operation of the road. It is not expected to see any deterioration in journey times as a result of the project.

12.4 Operational Assessment

12.4.1 An assessment of the scheme, i.e. the Do Something has been undertaken. The Traffic Assessment will contain an assessment of the Do Minimum scenario also.

12.4.2 An operational assessment has been undertaken for the A1(M) J53 Scotch Corner, testing the proposed design shown in Figure 5-1 within VISSIM. It should be noted that the drawing currently shows only the changes proposed to the existing design.

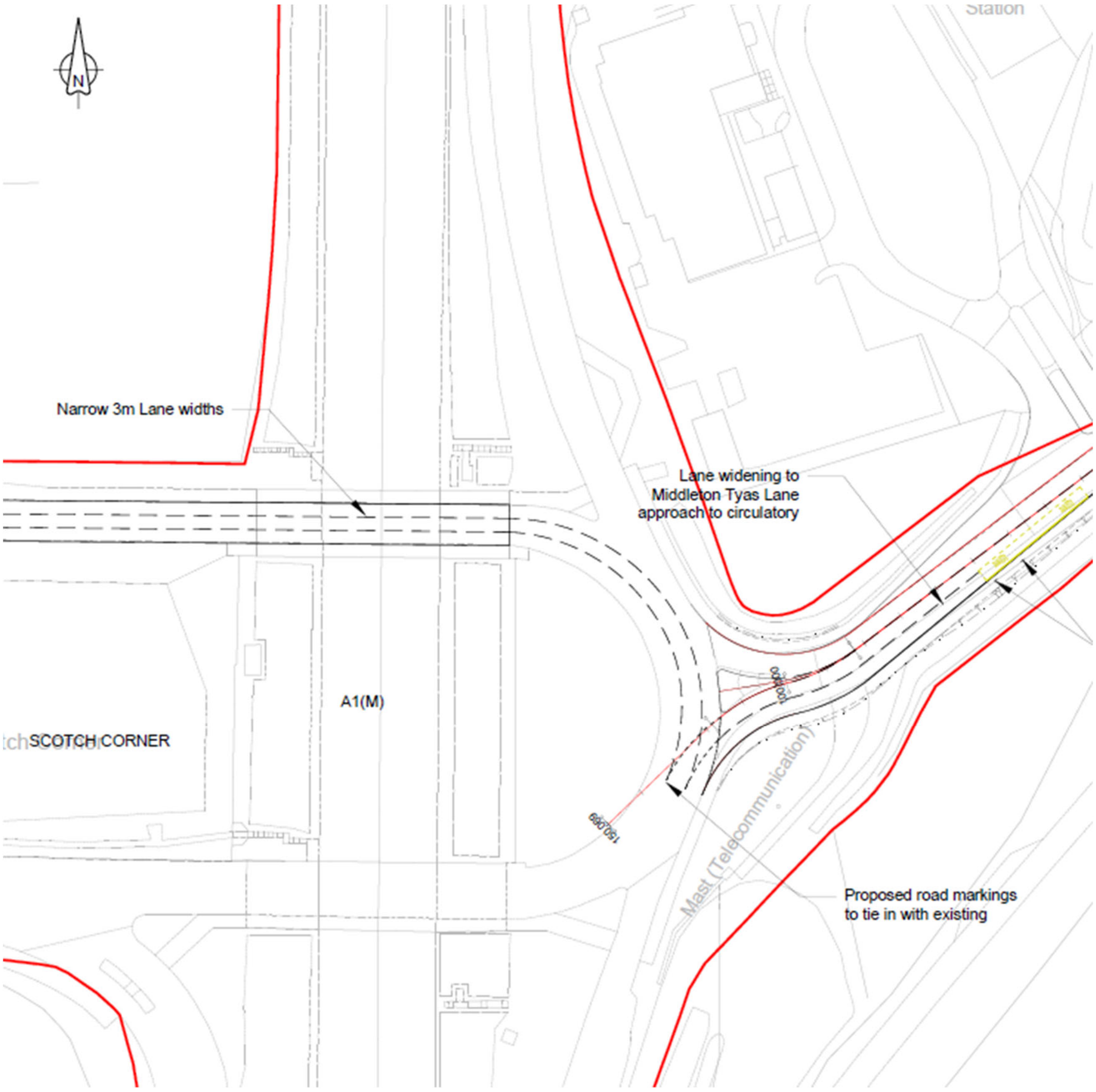

Figure 12-1: A1(M) Jnc 53 Scotch Corner scheme design

12.4.3 Operational assessment results are displayed below. Table 5-2 outlines the capacity assessment results for the future design year scenarios at the A(M) J53 Scotch Corner.

Table 12-3: Scotch Corner Capacity Assessment- 2043

	AM Peak (07:30-08:30)			PM Peak (16:30-17:30)		
	Ave Queue Length (m)	Max Queue Length (m)	Ave Delay (s)	Ave Queue Length (m)	Max Queue Length (m)	Ave Delay (s)
Middleton Tyas	100	133	117	57	124	91
A1(M) S Offslip	9	57	19	12	64	18
A6055 North	3	49	49	2	33	18
A6055 South	10	62	37	12	57	38
Holiday Inn	1	22	46	3	32	64
A66	20	181	38	50	275	48
A1 (N) Offslip	15	96	22	16	107	23

12.4.4 The junction is seen to be performing within acceptable limits, with average delays of less than 1 minute and with average queue lengths of less than 50m on all arms apart from Middleton Tyas Lane approach where the delay is within 2 minutes in the morning and 90 seconds in the evening.

12.4.5 Further assessment is required before the DCO planning application to test the performance of the junction with the updated strategic model flows, together with the performance of the planned mitigation measures.

12.5 Conclusions

12.5.1 The following key conclusions have been made regarding the impact of the Project at the A1(M) J53 Scotch Corner.

- The results for the DS scenarios demonstrate a more significant increase in traffic flows over time than in the DM scenarios; the scheme is expected to add an additional 36 to 42% additional traffic on the A66 to the west of the junction.
- There is a 1,300 to 900 vpd AADT increase (+2% to +3%) on the A1(M) north of Scotch Corner.
- There is a 1,700 to 1,800 vpd AADT increase (+4% to +4%) on the A1(M) south of Scotch Corner.
- The proposed junction is seen to be performing within acceptable limits, with average delays of less than 1 minute and with average queue lengths of less than 50m on all arms apart from Middleton Tyas Lane approach where the delay is nearly 2 minutes within the morning and 90 seconds within the evening.

13 Conclusions

13.1 Need for the Project

13.1.1 The A66 provides an important strategic, regional and local route, connecting east and west coasts, as well as providing local access. It currently operates as an all-purpose trunk road on the Strategic Road Network (SRN) with a combination of single carriageway and dual carriageway sections in each direction. There is a lack of public transport infrastructure on the A66, with minimal bus service provision and no direct east-west rail connections.

13.1.2 The main transport-related issues identified on the A66 within the study are:

- Road safety
- Journey times
- Journey reliability and route resilience, and
- Local severance.

13.1.3 Currently, around 16,500 vehicles that travel along the A66 each day in both directions, with approximately 25% of vehicles identified as HGVs. The A66 has average casualties 50% higher than the average casualties across SRN and more than 20% of the road closures last over five hours (between 2014 and 2016).

13.1.4 Whilst the A66 is not a highly congested route, journey times increase in peak periods and this is exacerbated by changing standards along the route from dual to single carriageway and vice versa. The ability to keep the route open during accidents, incidents and other disruptions is significantly affected by the existence of the single carriageway sections. In the event of a closure on the A66, there are limited diversion routes, and this leads to delays, longer journey distances and longer journey times.

13.2 Assessment Methodology

13.2.1 The model development process and data sources used have been described for two distinct elements of traffic forecasting:

- Modelling to inform the Consultation Design, based on a model with a base year of 2015. The results from this model process have informed the later chapters of this report.
- Modelling to inform the DCO application, based on a model with an updated base year of 2019. The data for this model has been taken from 2019 to generate a ‘pre Covid’ base year model to make best use of the most up to date, representative data available. In terms of the impact of Covid on traffic forecasting, the project will follow the latest TAG advice from DfT as set out in advice issued in July 2020 and May 2021.

13.2.2 This process has been undertaken in line with the DfTs Traffic Analysis Guidance (TAG) and agreed with Highways England’s Transport Planning Group, and through consultation with Stakeholders.

13.3 Key Impacts

13.3.1 The key conclusions regarding the strategic impact of the Project are as follows:

- Traffic flows are anticipated to increase for the DM scenarios from the base typically 46% between 2015 and 2046.
- The average additional growth on the A66 due to the Project (i.e. DS v DM) is typically between 34% and 39% across all years.

- Journey times will be reduced between M6 J40 Penrith and A1(M) Scotch Corner, with a journey time saving of between 11-13 minutes.
- There are a number of accident clusters identified across the route, however accident and casualty savings will be made with the delivery of the A66 dualling scheme. This is down to interventions such as junction improvements, better driver visibility and a more consistent road layout.
- The Project will enhance the user experience by improving journey time reliability through a more consistent road layout, improving road quality and mitigating the impact of unplanned road closures.

13.3.2 Local impacts have been identified in Appendix B and are discussed in chapters 5 to 12.

13.3.3 In terms of operational assessments:

- The operational assessment for Kemplay Bank and the M6 J40 shows that the proposed junction layouts ensures the junction has an acceptable operational performance in 2046.
- The proposed junction at Scotch Corner is seen to be performing within acceptable limits, with average delays of less than 1 minute and with average queue lengths of less than 50m on all arms apart from Middleton Tyas Lane approach where the delay is nearly 2 minutes within the morning and 90 seconds within the evening.

A Appendix A

A.1 Development Uncertainty Log

ID	Development Name	Type	Council	Certainty	Dwell-ings	Jobs (Est.)
C3	Residential Development at Living Land North of Bowes Road	Housing	County Durham	Near certain	162	-
C4	Residential Development at Land off Cross Croft / Back Lane, Appleby	Housing	Eden	Near certain	142	-
C6	Scotch Corner Designer Outlet	Employment	Richmondshire	Near certain	-	822
C2156	Scotch Corner Interchange – Triangular area of land	Employment	Richmondshire	More than Likely	-	-
C2157	Scotch Corner Phase 2 - Proposed Garden Centre	Employment	Richmondshire	More than Likely	-	401
C2158	Scotch Corner Services – Redevelopment incl Drive Thru	Employment	Richmondshire	More than Likely	-	197
C23	Story Homes Residential Development Carleton	Housing	Eden	Near certain	110	-
C66	Residential Development at Raiselands Farm	Housing	Eden	Near certain	229	-
C69	DIO Catterick Service Family Accommodation (Breckenbrough Lane)	Housing	Richmondshire	More than likely	155	-
C71	Residential Development at Catterick Garrison	Housing	Richmondshire	Near certain	126	-
C73	Residential Development at Bracks Farm	Housing	County Durham	Near certain	300	-
C87	Residential Development north of Coniscliffe Road	Housing	Darlington	More than likely	535	-
C92	Central Park Development site	Housing	Darlington	Near certain	180	-
C94	Employment development at Ingenium Parc	Employment	Darlington	More than likely	-	1536
C100	Residential Development to the east of Oak Tree Fram	Housing	Darlington	Near certain	350	-
C104	High Stell, MSG	Housing	Darlington	More than likely	226	-
C110	West Park Garden Village	Housing	Darlington	Near certain	1200	-
C123	Residential Development south of Burtree Lane	Housing	Darlington	More than likely	380	-
C124	Residential Development at Berrymead Farm	Housing	Darlington	More than likely	370	-
C126	Residential Development at Coniscliffe Park	Housing	Darlington	More than likely	985	-
C128	Residential Development at Carleton Fields, Penrith	Housing	Eden	Near certain	505	-
C174	Symmetry Park distribution centre	Employment	Darlington	Near certain	-	886
C175	Symmetry Park Phase 2	Employment	Darlington	More than likely	-	971

ID	Development Name	Type	Council	Certainty	Dwell-ings	Jobs (Est.)
C176	Startforth Park Barnard Castle	Housing	County Durham	More than likely	210	-
C180	Eden 41 Business Park	Employment	Eden	Near certain	-	420
C184	Sedgefield - Land to the south of Eden Drive	Housing	County Durham	Near Certain	277	-
C185	Shildon - Dale Farm Land at Dale Road	Housing	County Durham	More than likely	310	-
C192	Newton Aycliffe - Aycliffe Business Park	Employment	County Durham	More than likely	-	322
C193	Forrest Park, Newton Aycliffe	Employment	County Durham	More than likely	-	3286
W1	Brookfield (Stainsby Hall Farm/Stainsby Hill Farm)	Housing	Middlesbrough	More than likely	1125	-
W2	Hemlington Grange	Housing	Middlesbrough	Near Certain	1230	-
W3	Low Grange Farm	Housing	Middlesbrough	More than likely	1250	-
W4	South West Extension Hartlepool	Housing	Hartlepool	More than likely	1116	-
W5	High Tunstall	Housing	Hartlepool	More than likely	1200	-
W11	Benwell Scotswood - The Rise	Housing	Newcastle upon Tyne	Near Certain	2064	-
W13	Former Newgate Shopping Centre	Mixed	Newcastle upon Tyne	Near Certain	565	156
W18	International Advanced Manufacturing Park	Employment	Sunderland	Near Certain	-	7850
W19	York Potash Harbour Facilities	Employment	Sunderland	Near Certain	-	1040
W20	Beacon of Light - World of Work	Employment	Sunderland	Near Certain	-	746
W25	Dunston Hill Housing Site GN1	Housing	Gateshead	Near Certain	530	-
W26	Ryton Housing Site GV6	Housing	Gateshead	Near Certain	550	-
W28	South of Follingsby Lane KEA2	Employment	Gateshead	Near Certain	-	1635
W41	Land at Newhouse Farm	Housing	Carlisle	Near Certain	480	-
W100	Sellafield Decommissioning	Employment	Copeland	Near Certain	-	3500
W148	Lambton Park	Housing	County Durham	More than likely	400	-
W149	Milburngate House	Mixed	County Durham	More than likely	441	712
W173	Successor Programme BAE Systems, Barrow	Employment	Barrow-in-Furness	More than likely	-	2000
W184	Former Prudhoe Hospital, Prudhoe Hospital Drive Prudhoe	Housing	Northumberland	Near certain	404	-
W212	Integra61 (Land S of Bowburn Road)	Employment	County Durham	Near Certain	-	3263

ID	Development Name	Type	Council	Certainty	Dwell-ings	Jobs (Est.)
W255	Mill Hill Lane/Mount Oswald	Housing	County Durham	Near Certain	1000	-
W256	Bowburn Integra 61 Residential element	Housing	County Durham	More than likely	270	-

* Only developments classified as 'near certain' or 'more than likely' are shown

A.2 Highway Uncertainty Log

ID	Scheme Info	Source	Certainty
1	A1 Coal House to Metro Centre	Highways England	Near Certain
2	A1 Scotswood to North Brunton	Highways England	Near Certain
3	A1 Birtley to Coal House	Highways England	Near Certain
4	A19 Norton to Wynyard	Highways England	Near Certain
5	A167 Sunderland Bridge	Highways England	Near Certain
6	A1 Leeming to Barton	Highways England	Near Certain
7	A19/A1058 Coast Road	North Tyneside Council	Near Certain
8	A19 Testos	Highways England	Near Certain
9	A1 Northumberland - Mousen Bends	Highways England	Near Certain
10	A1 Northumberland	Highways England	Near Certain
11	Brigham-Broughton, Cumbria	Cumbria LEP	Near Certain
12	Ulverston Bypass, Cumbria	Cumbria LEP	More than likely
13	Wallsend Road, Howdon	North Tyneside Council	Near Certain
14	M6 Heysham Link	Lancashire County Council	Near Certain
15	Billy Mill, North Tyneside	North Tyneside Council	More than likely
16	High Flatworth, North Tyneside	North Tyneside Council	More than likely
17	Norham, North Tyneside	North Tyneside Council	More than likely
18	West Park, North Tyneside	North Tyneside Council	More than likely
19	West Shiremore, North Tyneside	North Tyneside Council	More than likely
20	Whitehouse Farm, North Tyneside	North Tyneside Council	More than likely
21	Lindisfarne, South Tyneside	South Tyneside Council	More than likely
22	Ravensworth Speed Reduction	Highways England	Near Certain
23	A64 Hopgrove	Highways England	More than likely
24	A595 Whitehaven	Highways England	More than likely
25	M62 junction 20 to 25 smart motorway	Highways England	Near Certain
26	A69 junction improvements	Highways England	Near Certain
38	Carlisle Southern Link Road	Carlisle	More than likely

* Only developments classified as ‘near certain’ or ‘more than likely’ are shown

B Appendix B

B.1 Local Traffic Impact Diagrams

A66 NTP Integrated Project Team

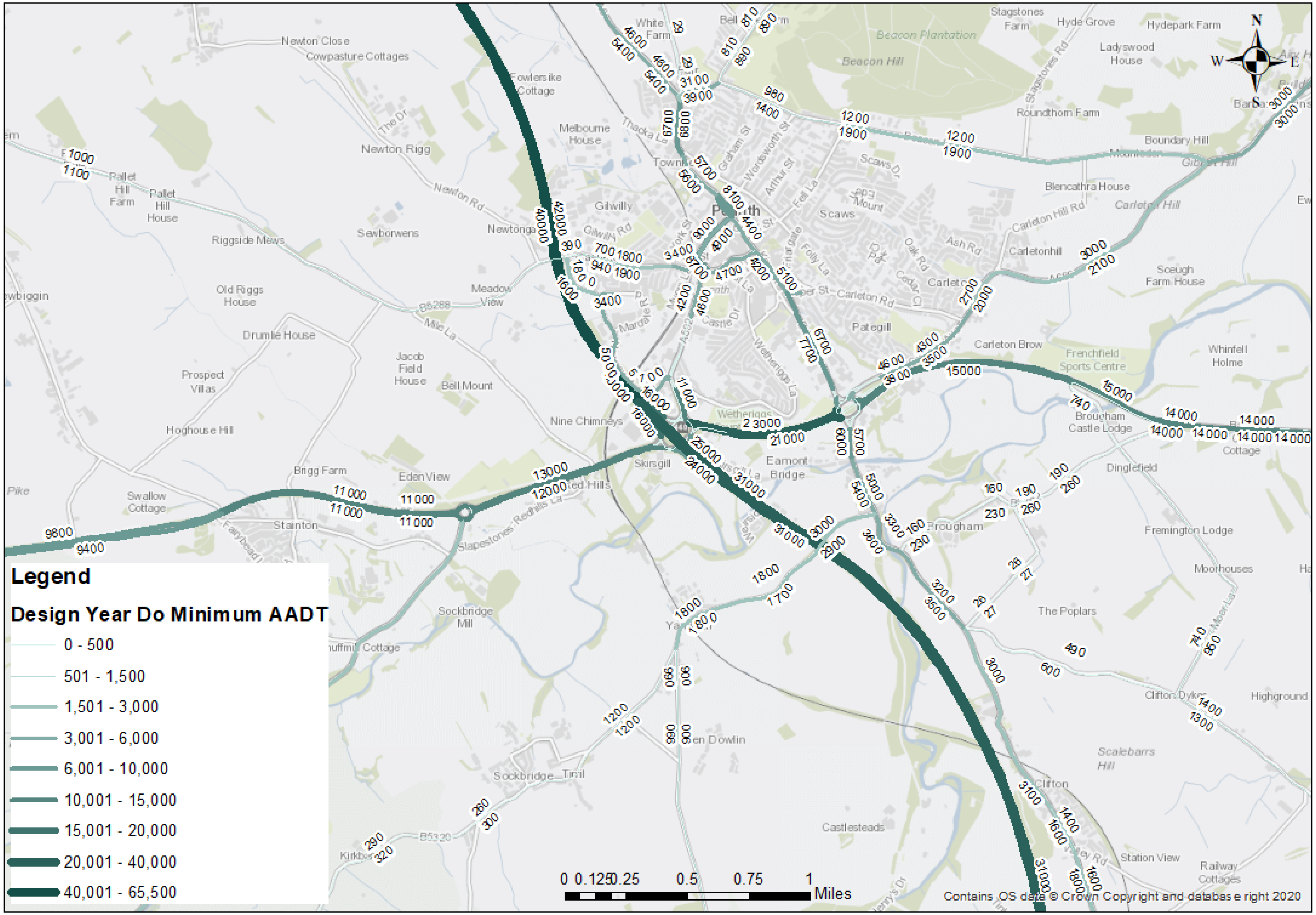

Figure 13-1: M6 Junction 40 and Kemplay Bank: Forecast Year Do Minimum Flows

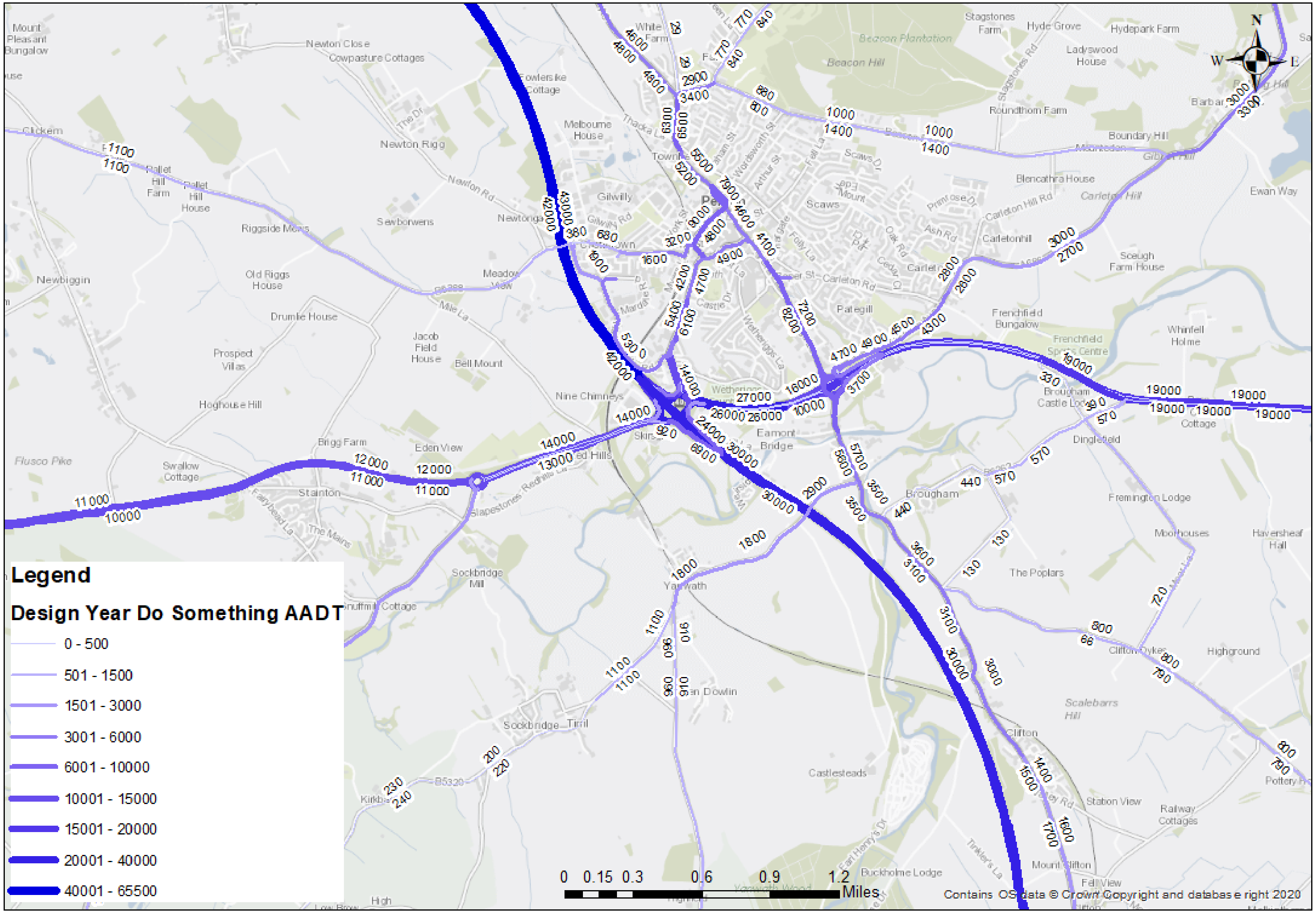

Figure 13-2: M6 Junction 40 and Kemplay Bank: Forecast Year Do Something Flows

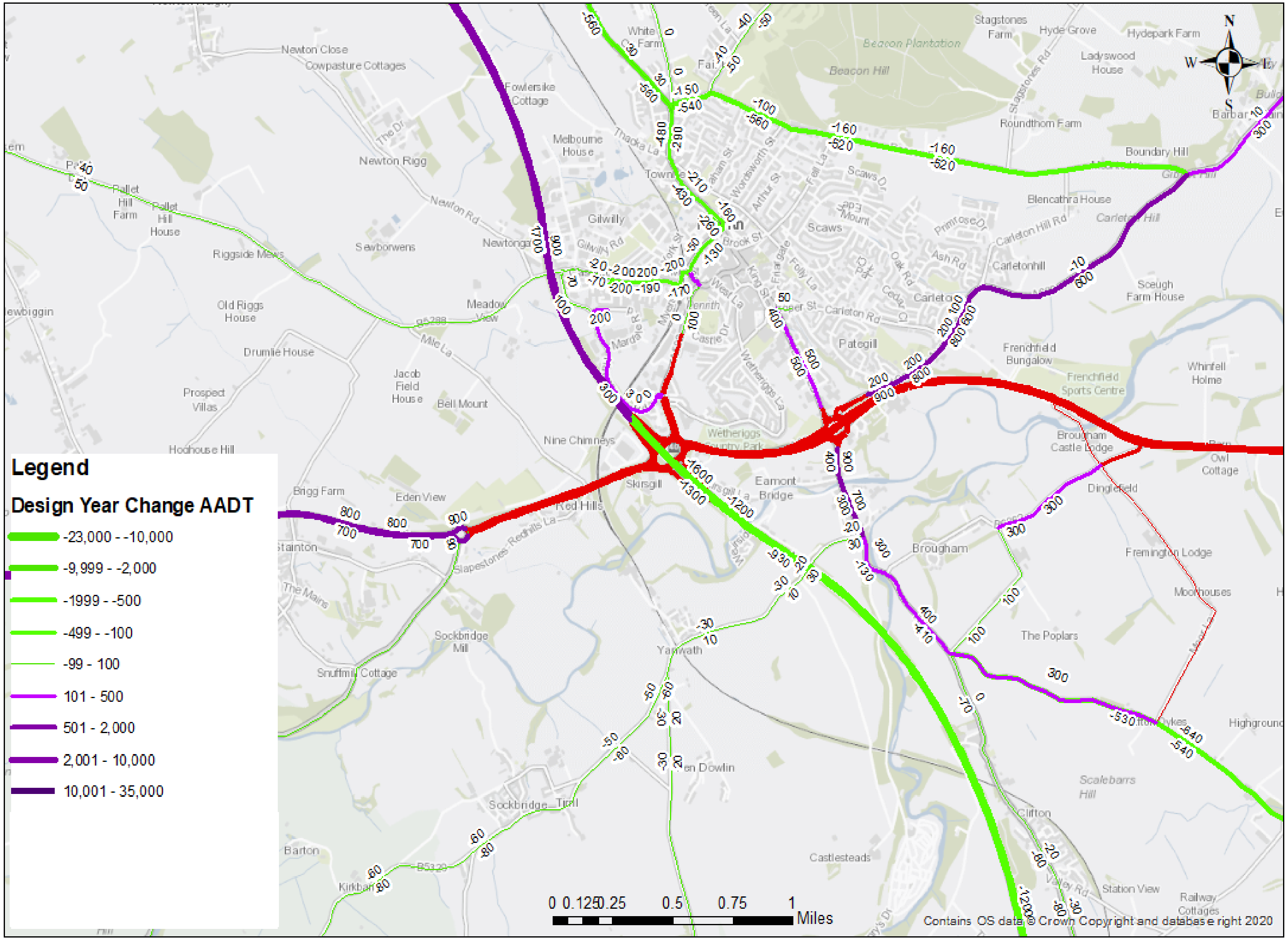

Figure 13-3: M6 Junction 40 and Kemplay Bank: Forecast Year Do Something Flow (Changes from Do Minimum)

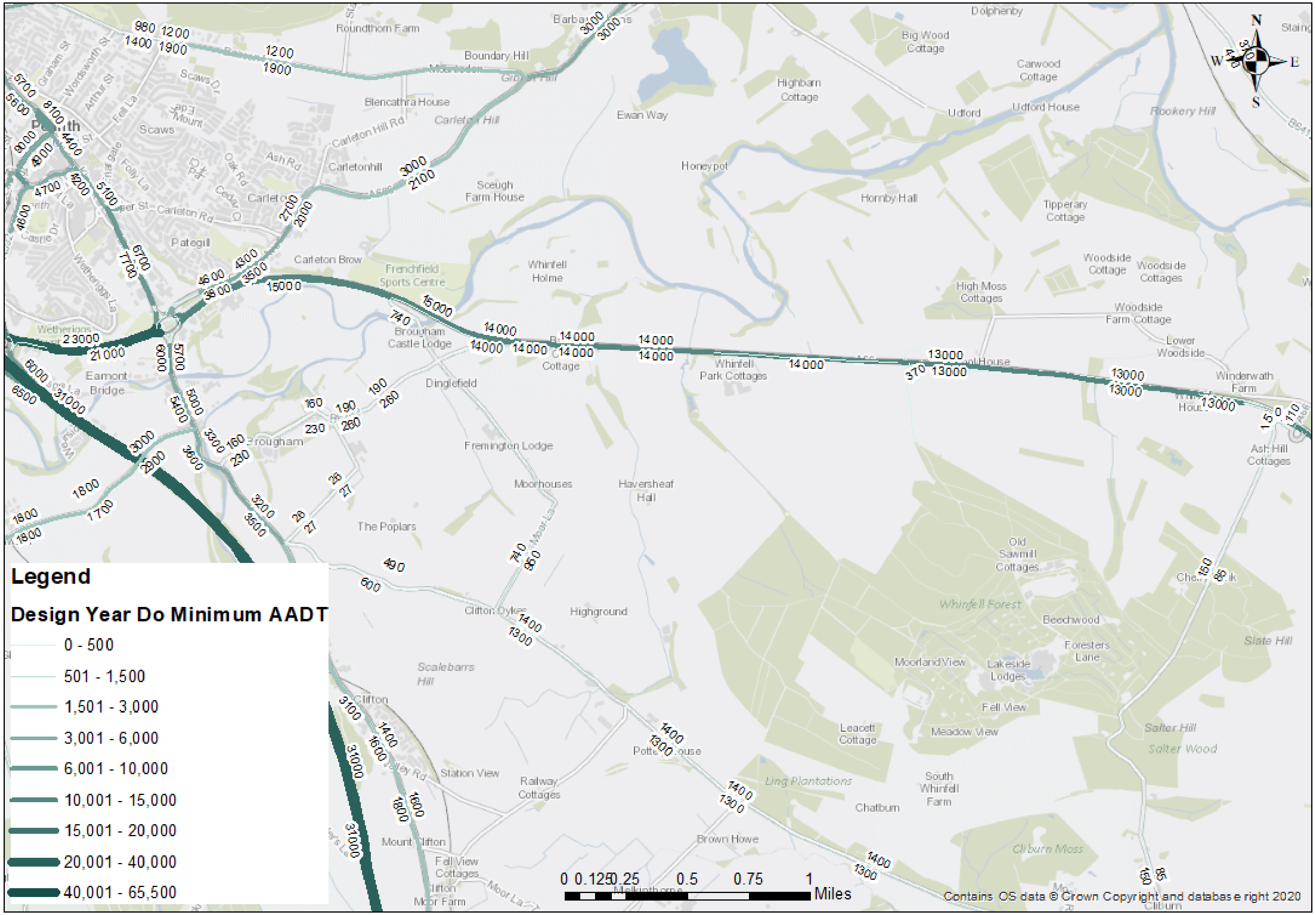

Figure 13-4: Penrith to Temple Sowerby : Forecast Year Do Minimum Flows

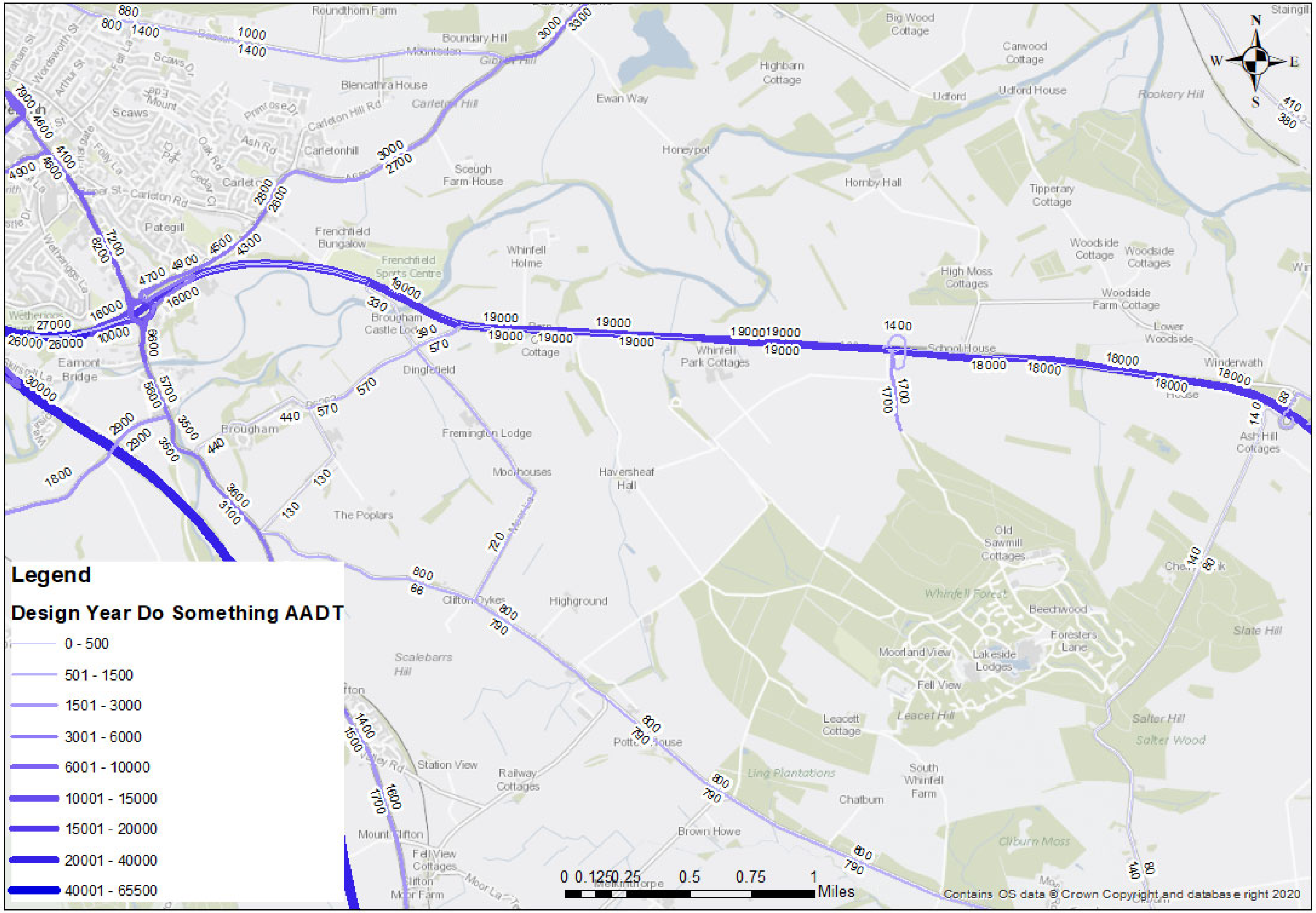

Figure 13-5: Penrith to Temple Sowerby : Forecast Year Do Something Flows

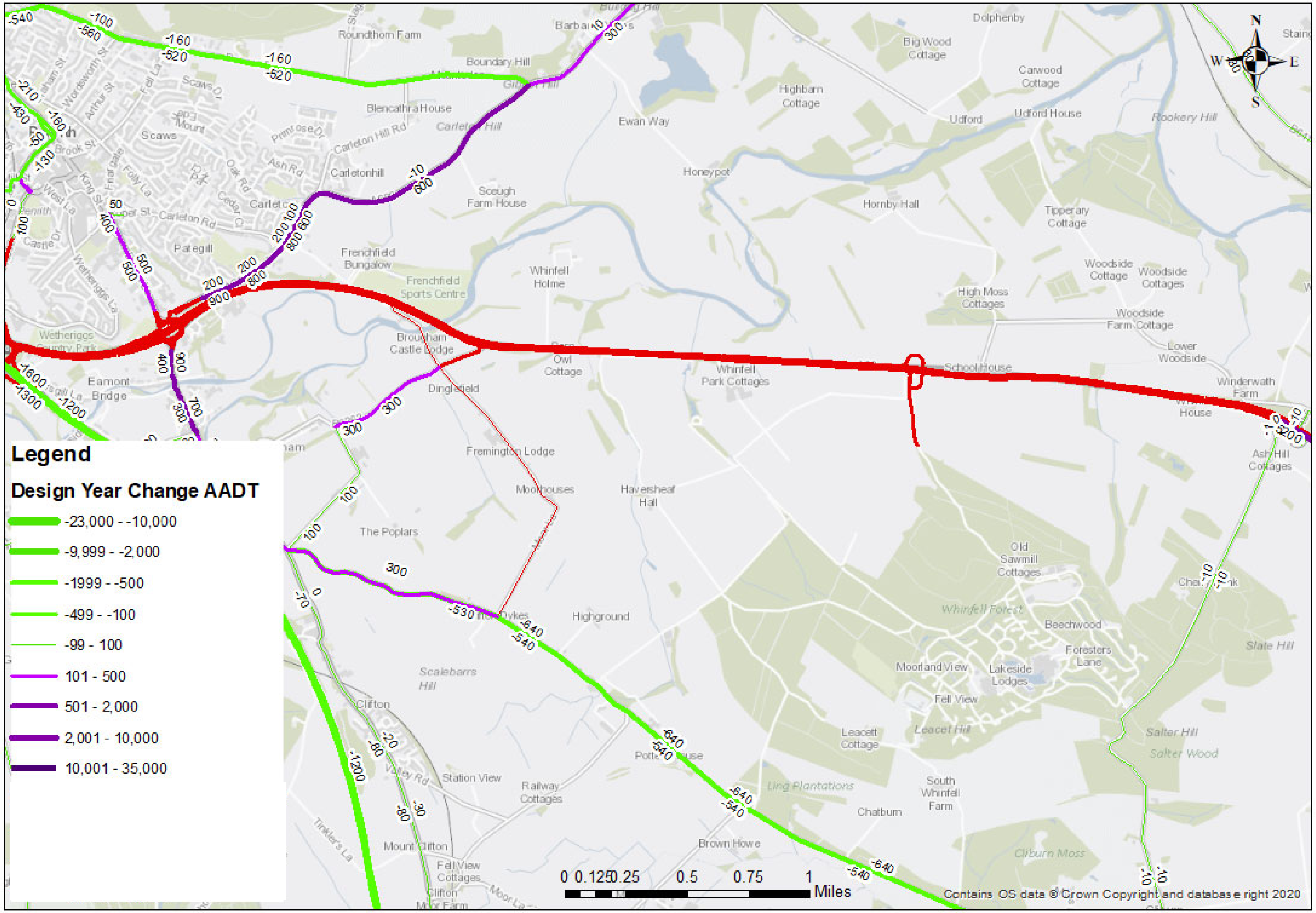

Figure 13-6: Penrith to Temple Sowerby : Forecast Year Do Something Flow (Changes from Do Minimum)

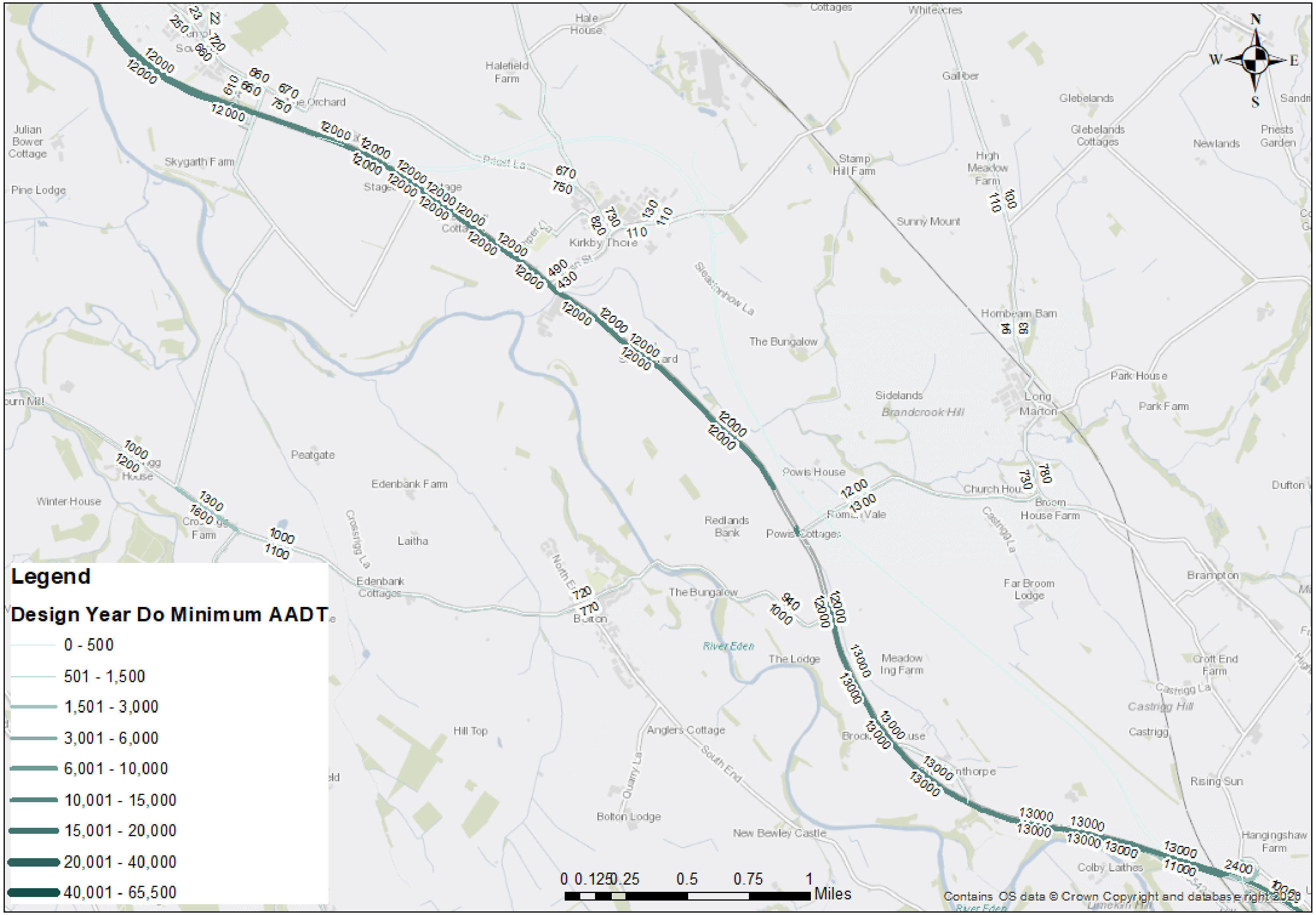

Figure 13-7: Temple Sowerby to Appleby: Forecast Year Do Minimum Flows

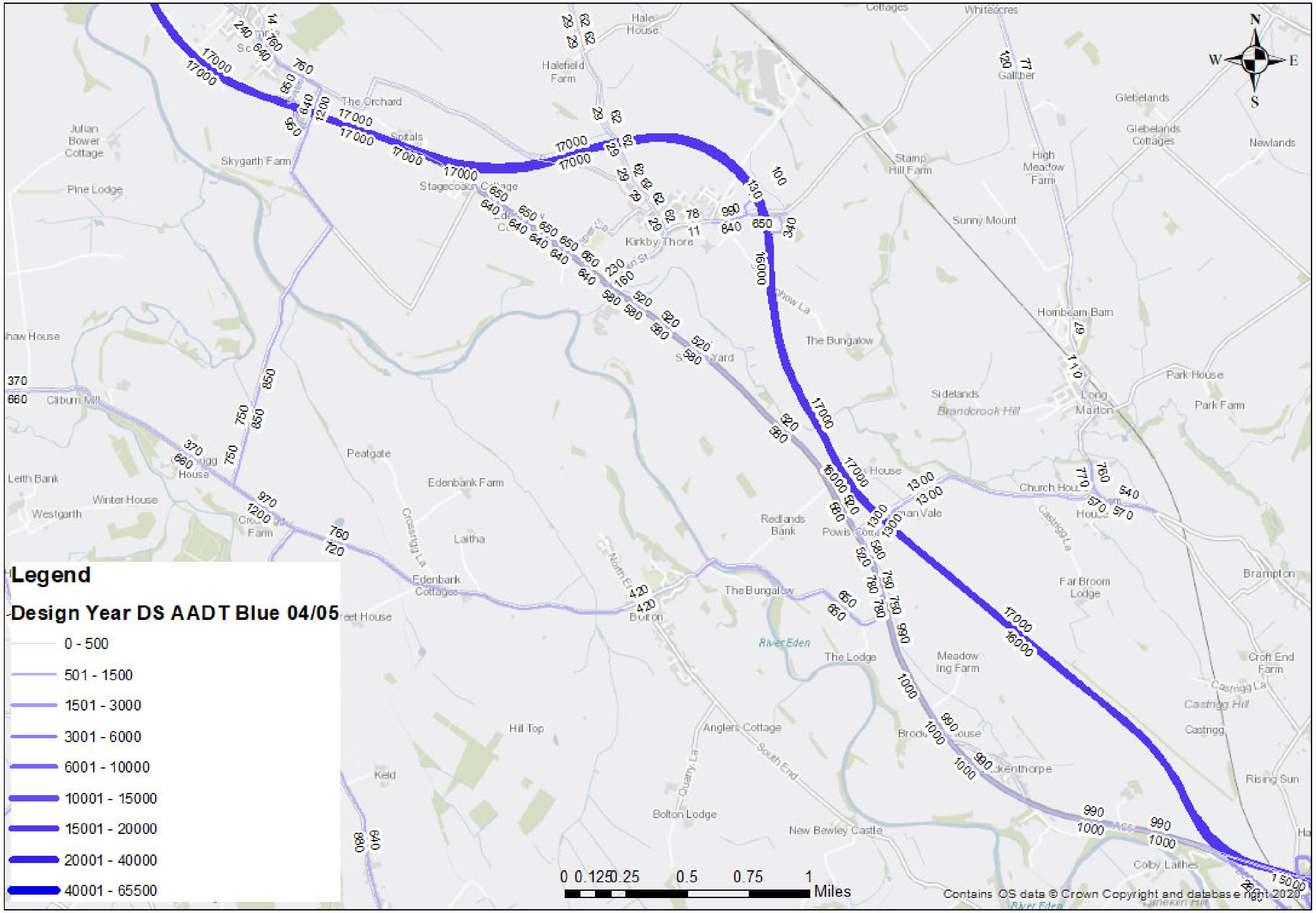

Figure 13-8: Temple Sowerby to Appleby **BLUE ROUTE** Forecast Year Do Something Flow

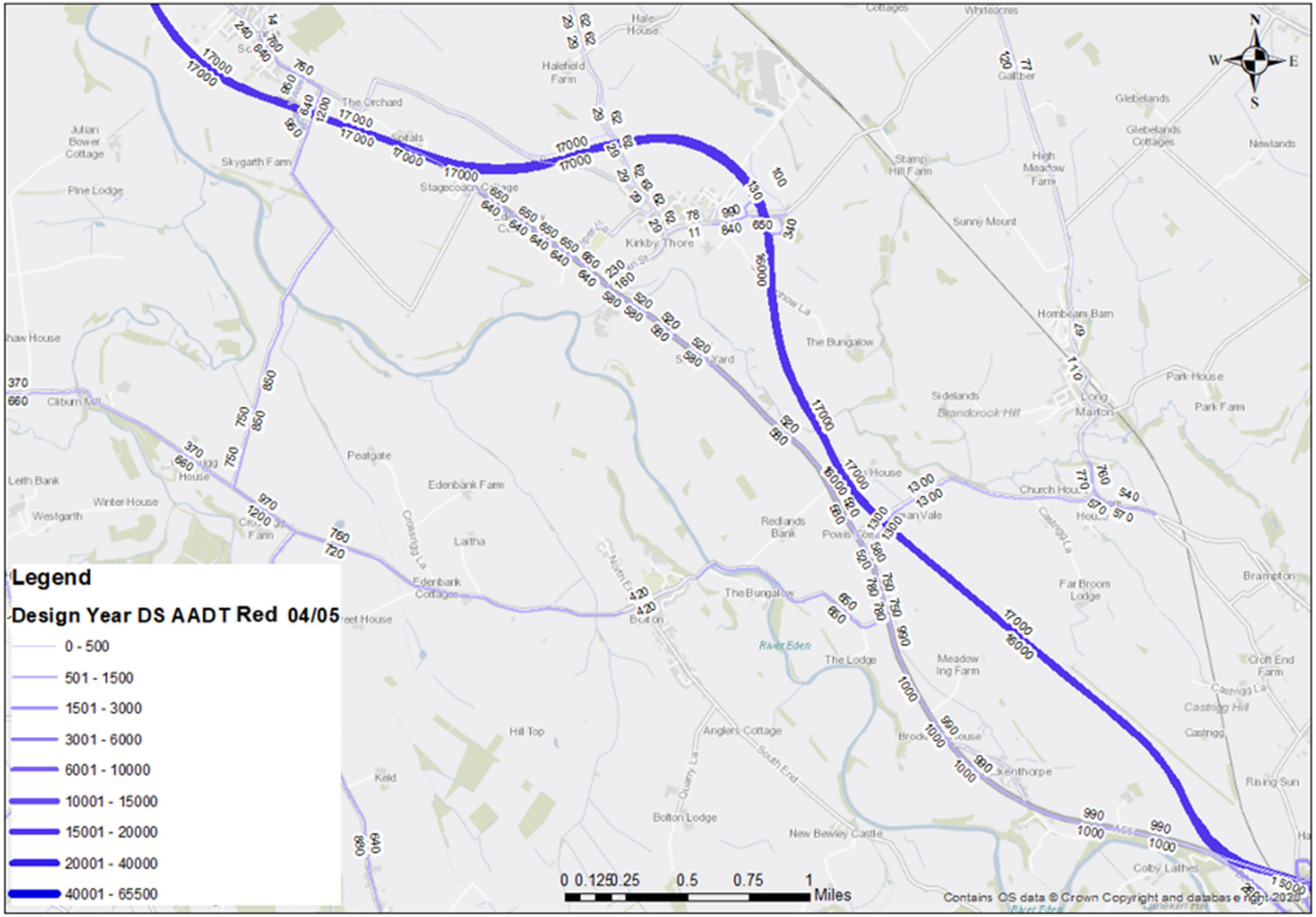

Figure 13-9: Temple Sowerby to Appleby **RED ROUTE** Forecast Year Do Something Flow

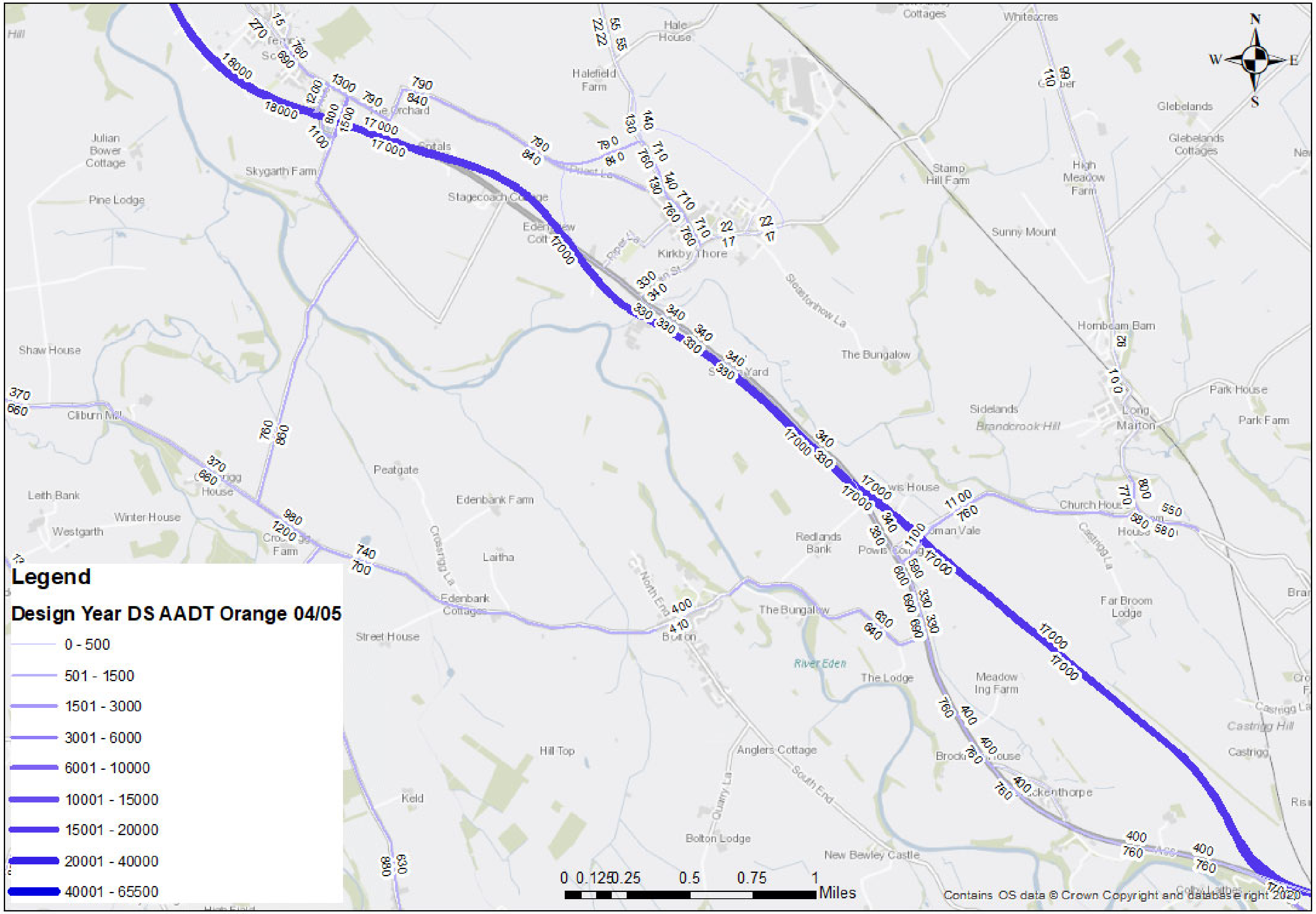

Figure 13-10: Temple Sowerby to Appleby **ORANGE ROUTE** Forecast Year Do Something Flow

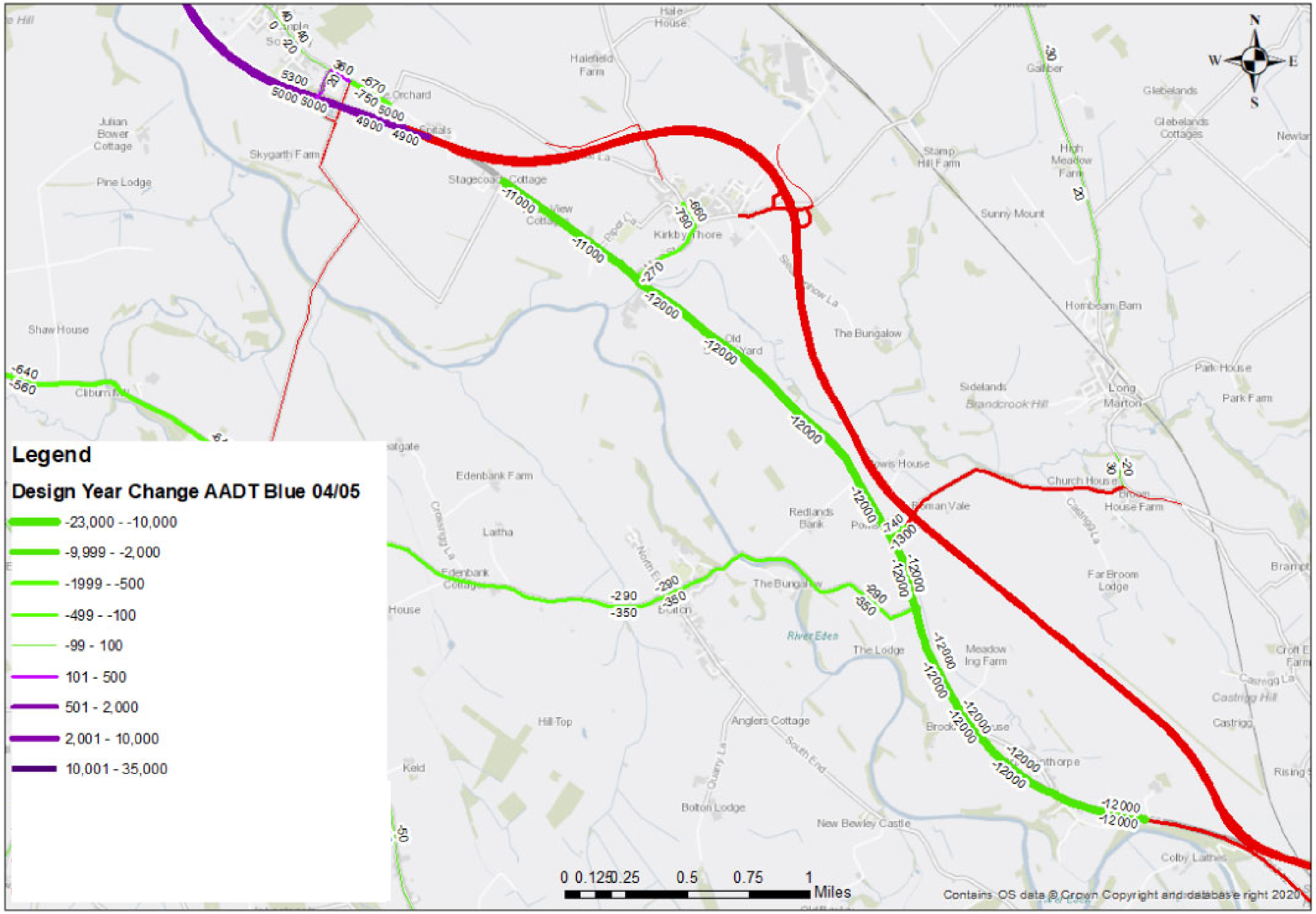

Figure 13-11: Temple Sowerby to Appleby **BLUE ROUTE** Forecast Year Do Something Flow (Changes from Do Minimum)

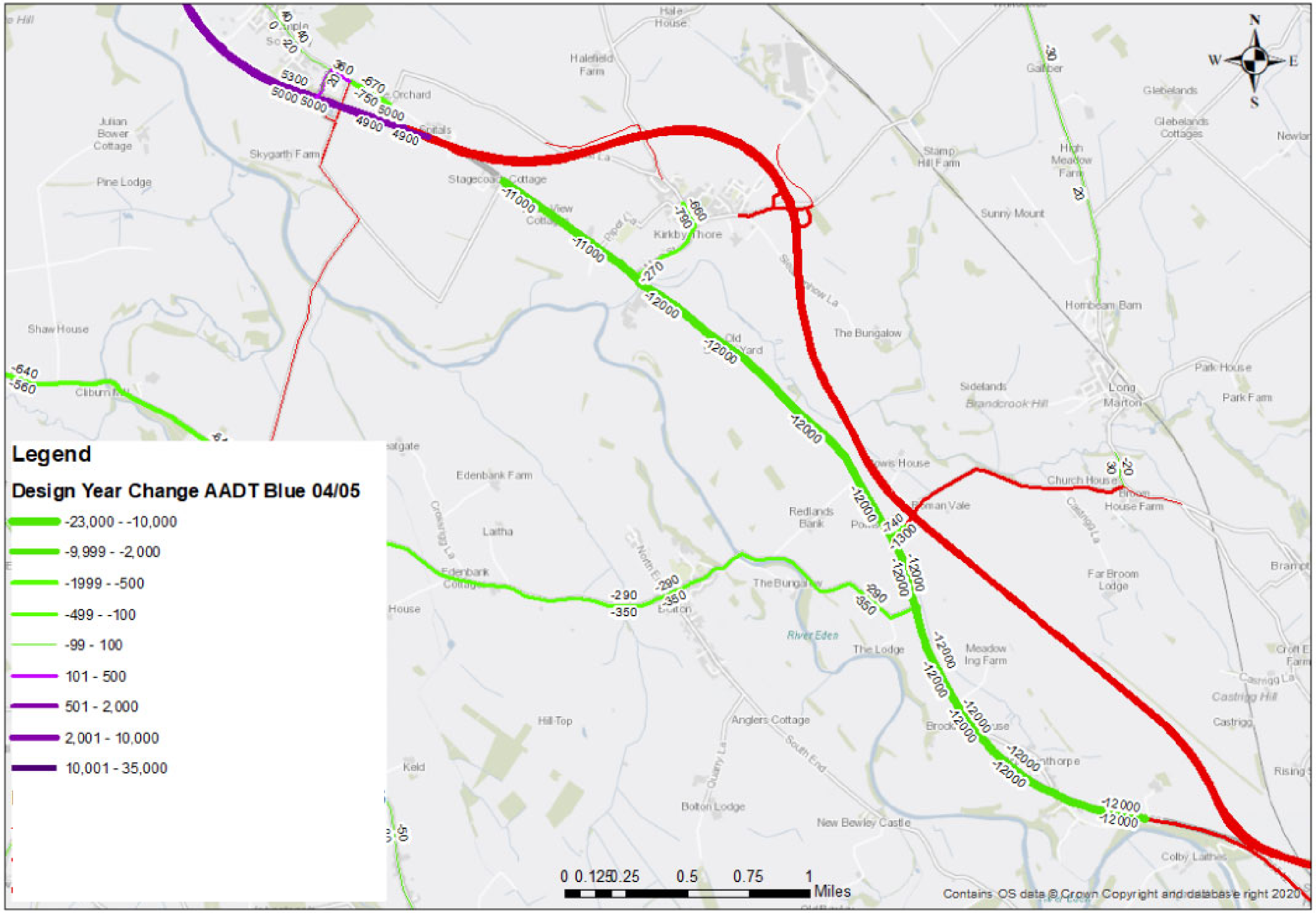

Figure 13-12: Temple Sowerby to Appleby **RED ROUTE** Forecast Year Do Something Flow (Changes from Do Minimum)

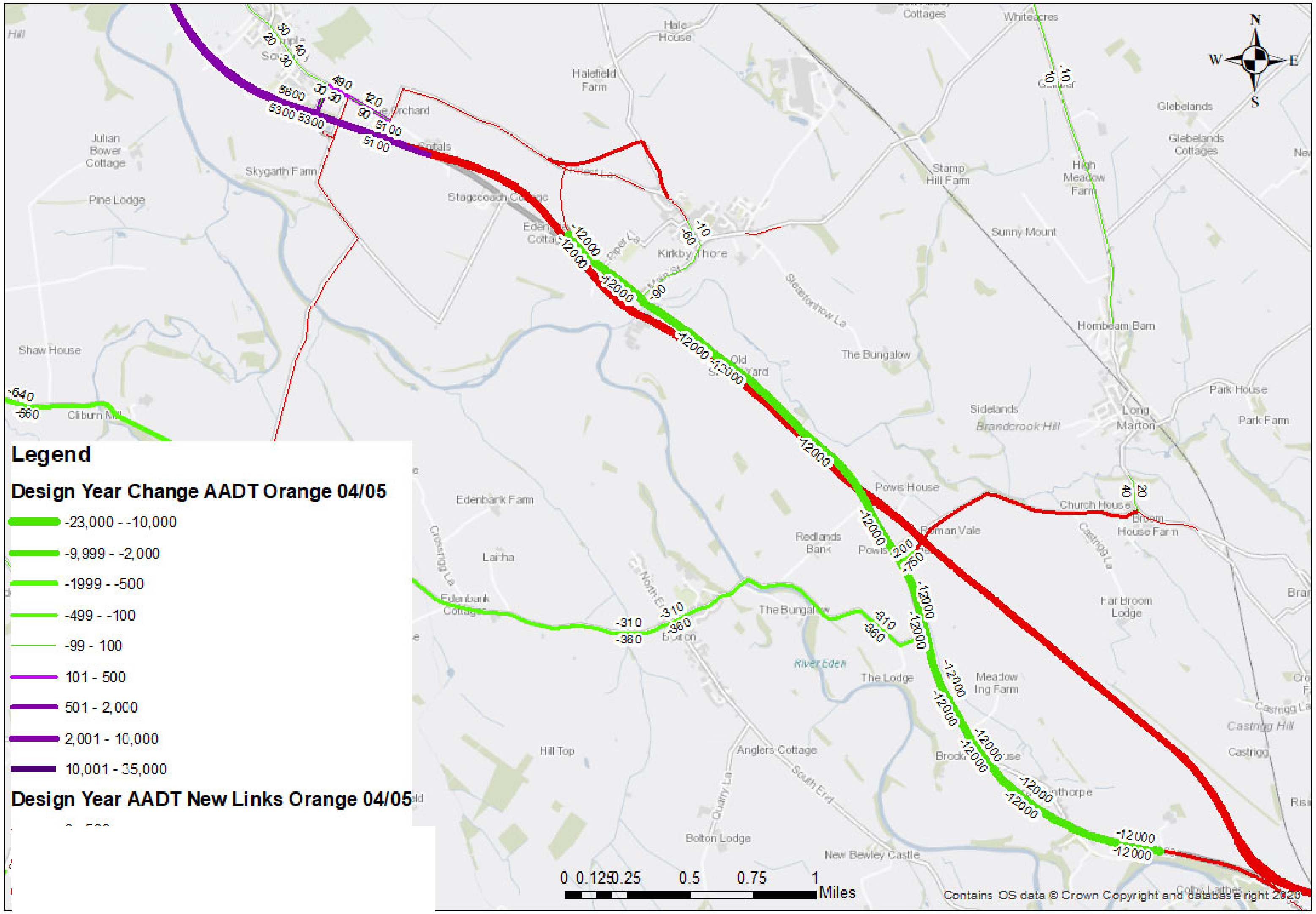

Figure 13-13: Temple Sowerby to Appleby **ORANGE ROUTE** Forecast Year Do Something Flow (Changes from Do Minimum)

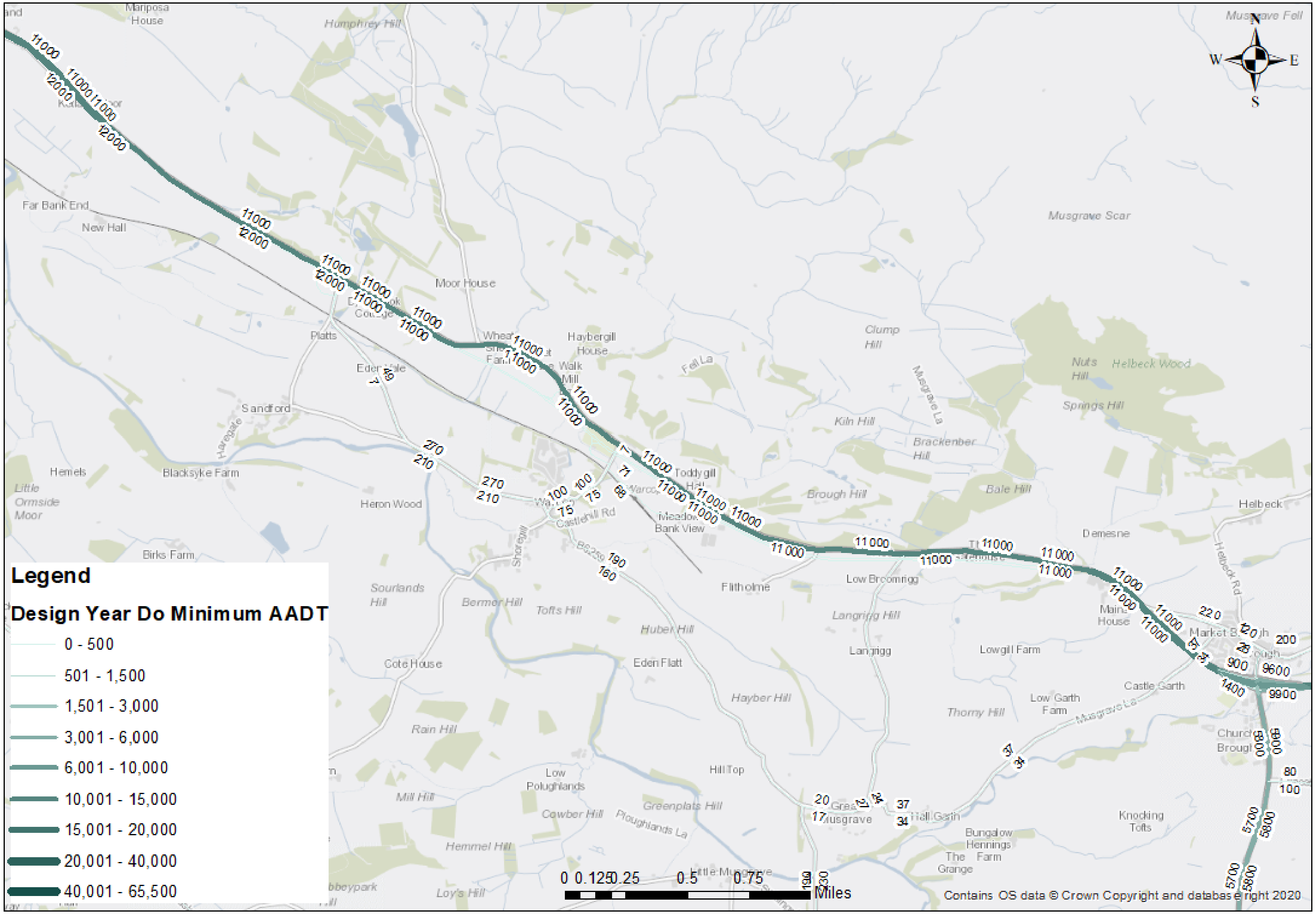

Figure 13-14: Appleby to Brough : Forecast Year Do Minimum Flows

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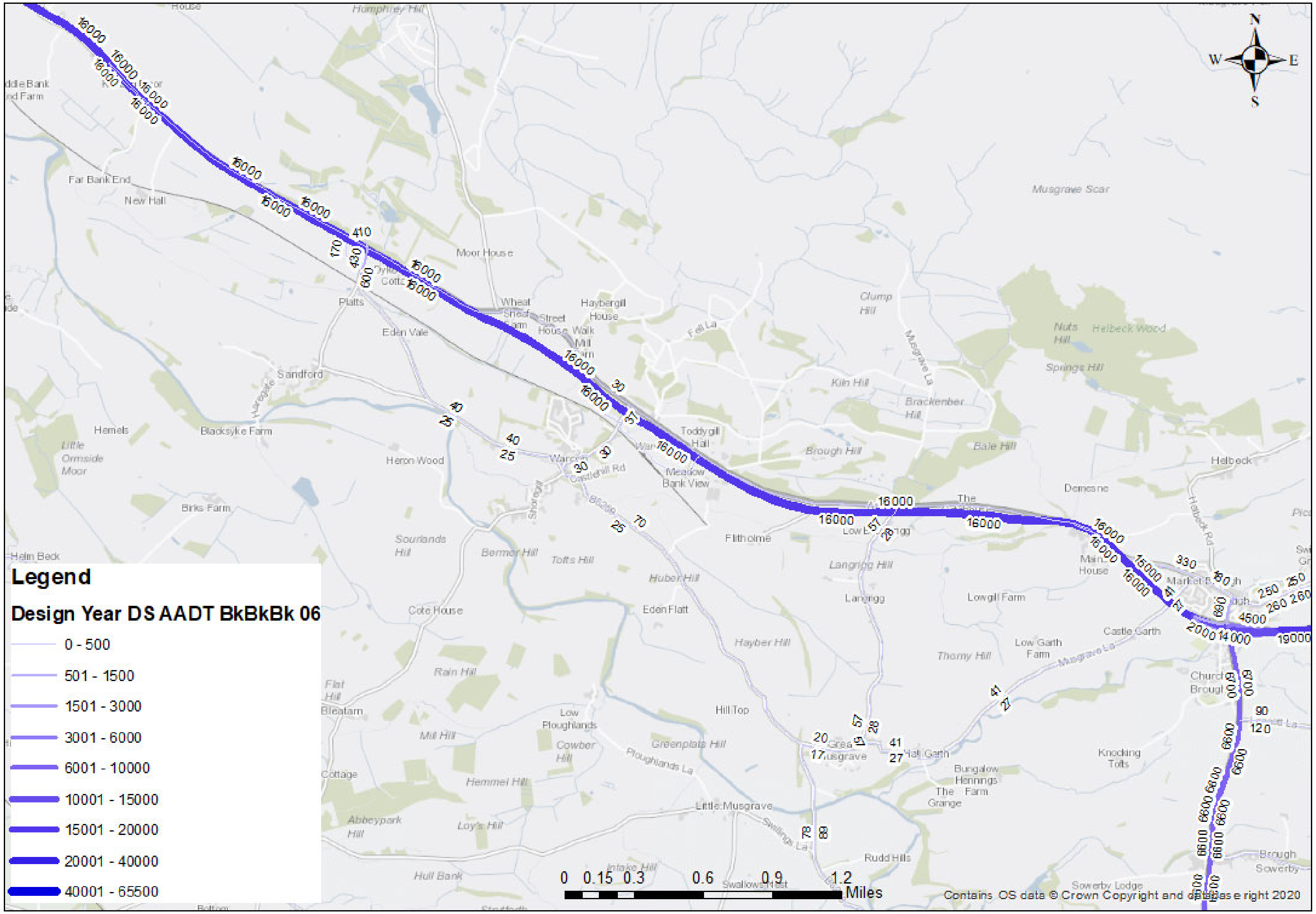

Figure 13-15: Appleby to Brough **BLACK-BLACK-BLACK ROUTE**: Forecast Year Do Something Flow

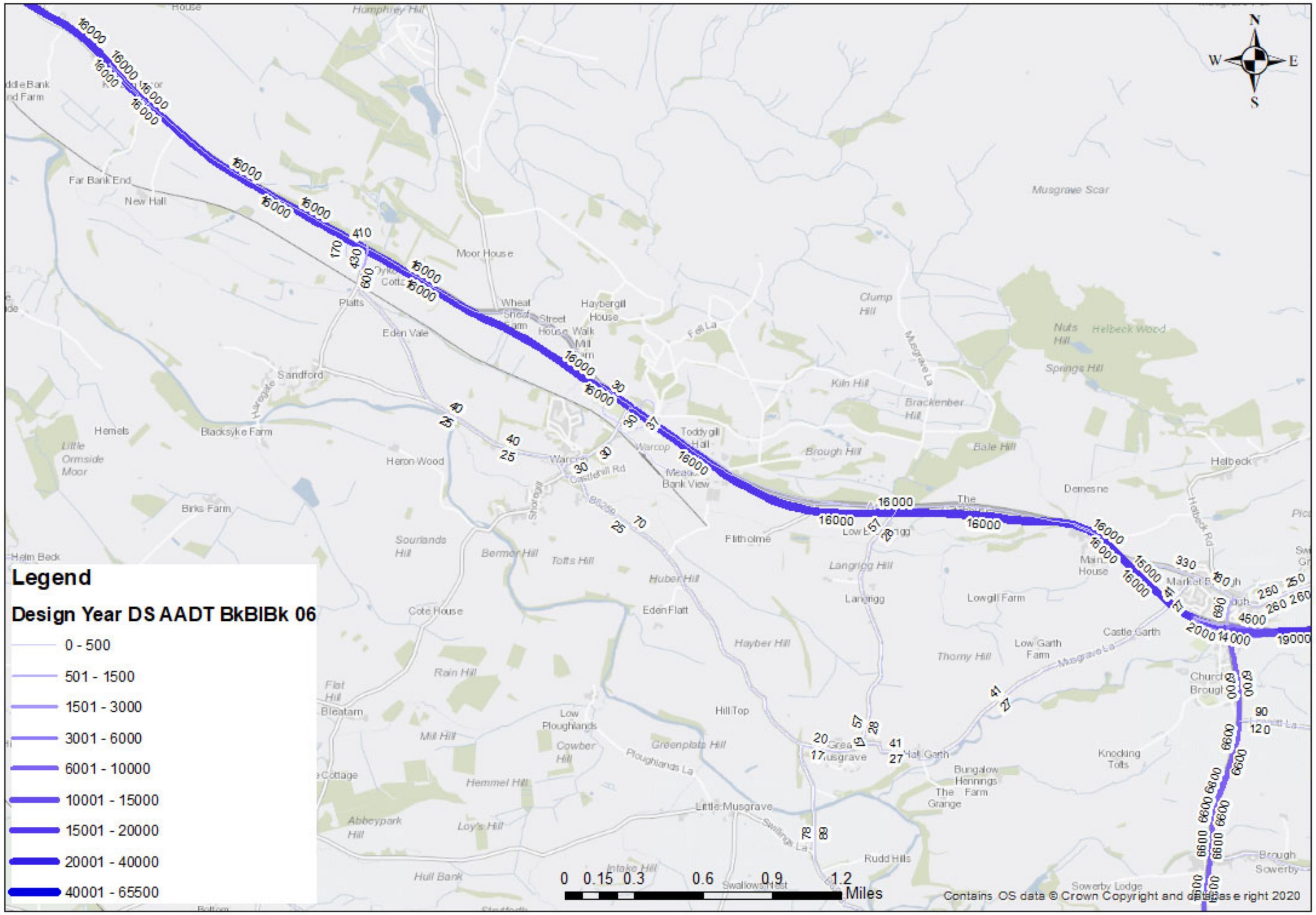

Figure 13-16: Appleby to Brough **BLACK-BLUE-BLACK ROUTE**: Forecast Year Do Something Flow

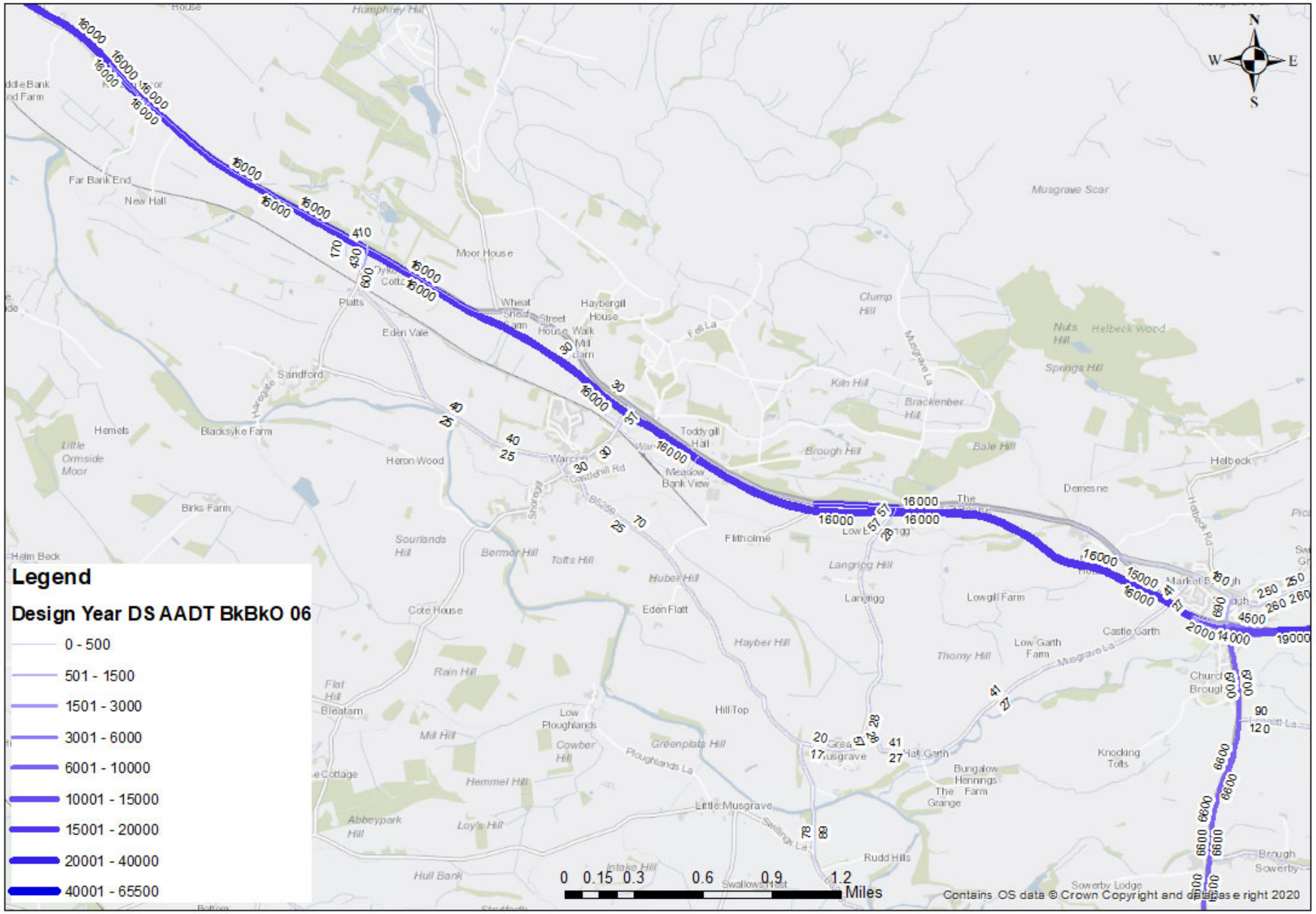

Figure 13-17: Appleby to Brough **BLACK-BLACK-ORANGE ROUTE**: Forecast Year Do Something Flow

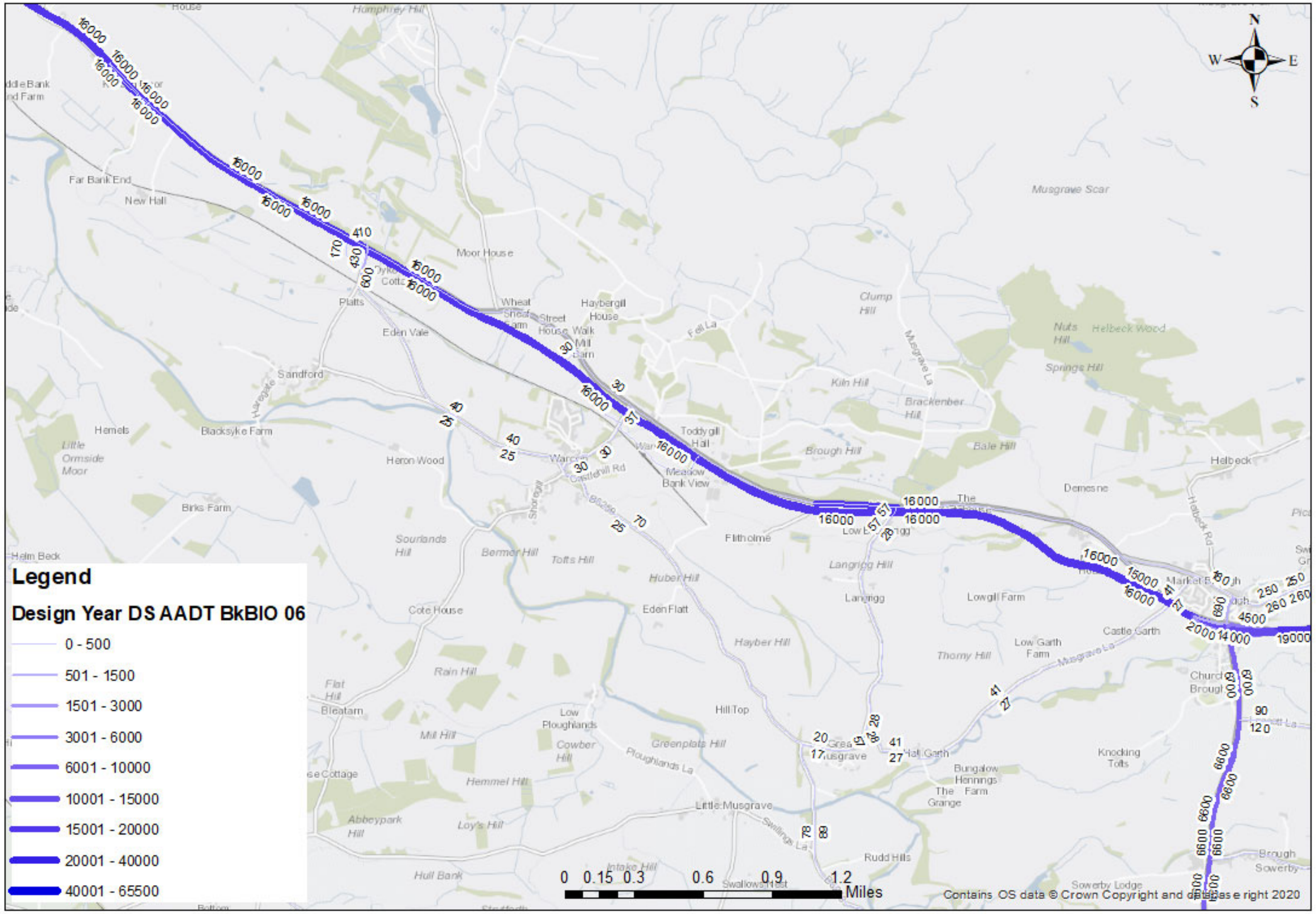

Figure 13-18: Appleby to Brough **BLACK-BLUE-ORANGE ROUTE**: Forecast Year Do Something Flow

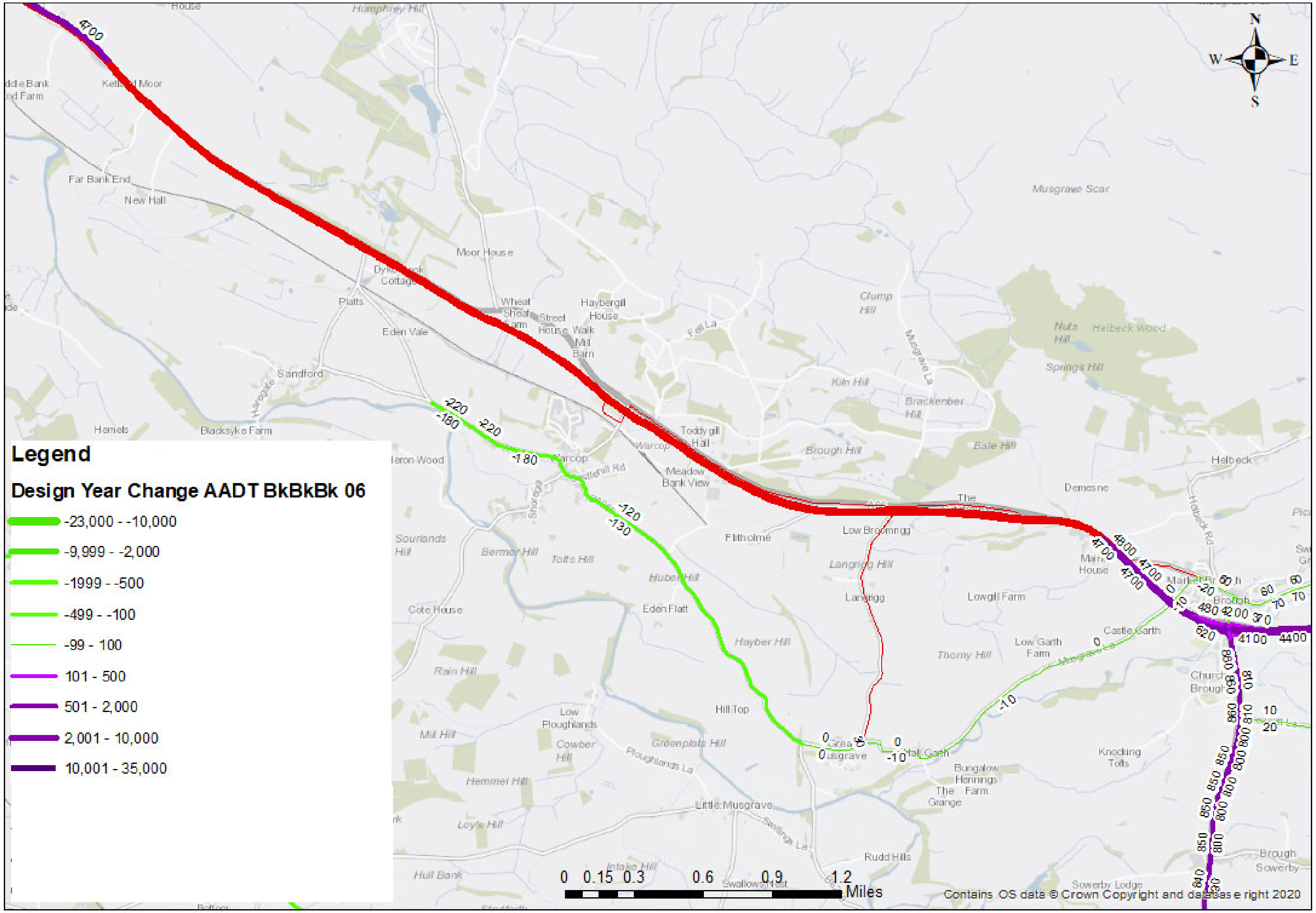

Figure 13-19: Appleby to Brough **BLACK-BLACK-BLACK ROUTE**: Forecast Year Do Something Flow (Changes from Do Minimum)

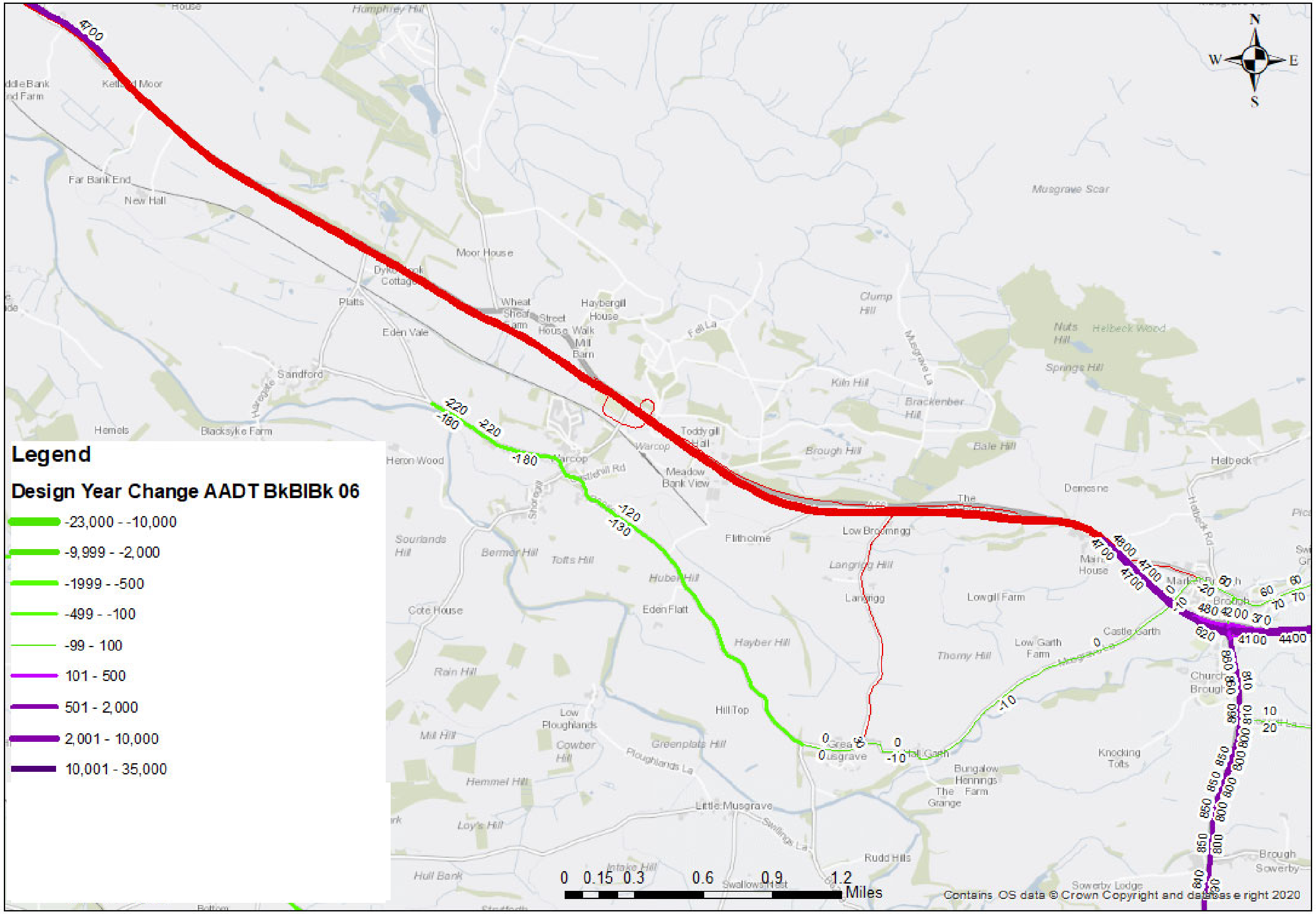

Figure 13-20: Appleby to Brough **BLACK-BLUE-BLACK ROUTE**: Forecast Year Do Something Flow (Changes from Do Minimum)

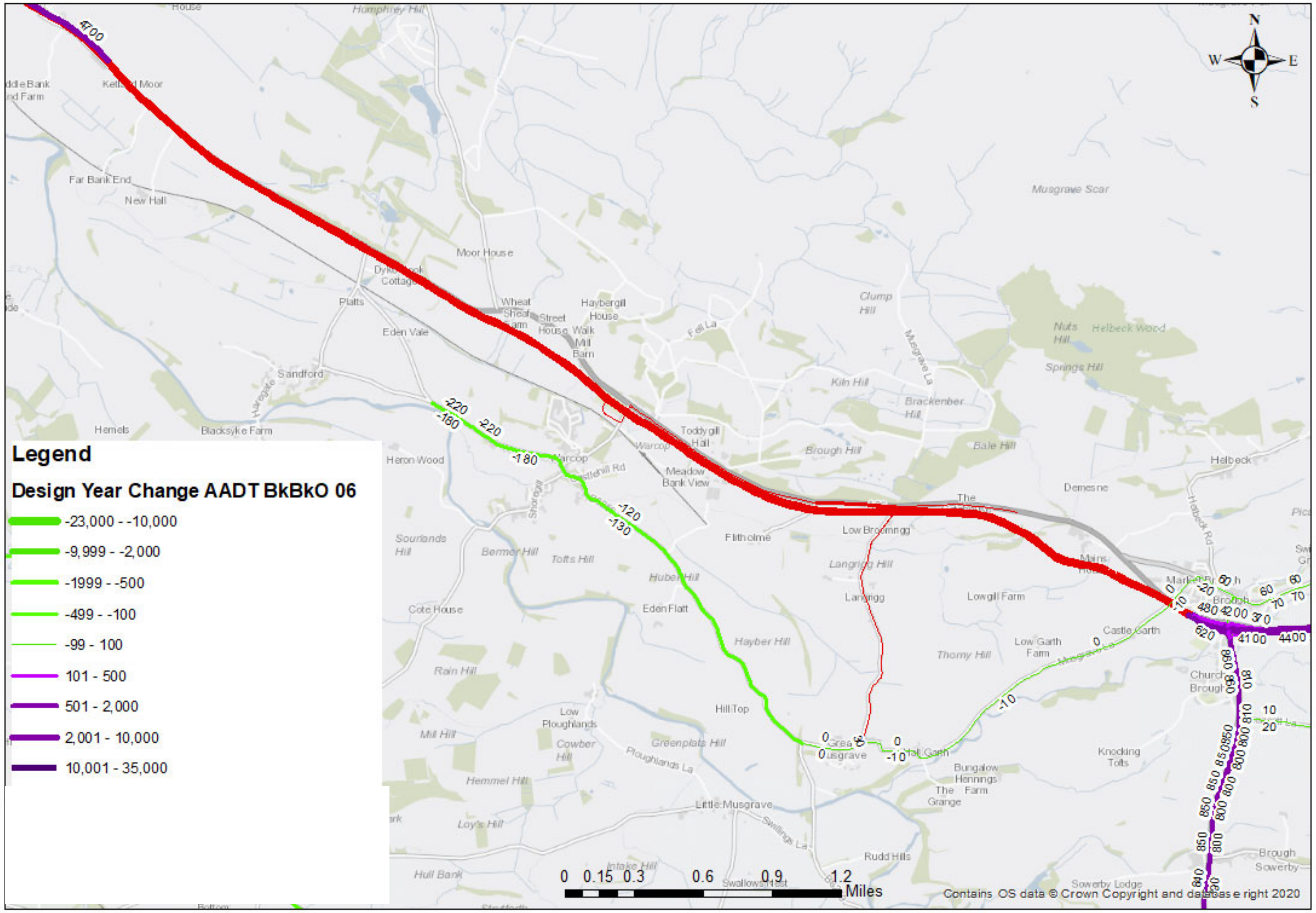

Figure 13-21: Appleby to Brough **BLACK- BLACK-ORANGE ROUTE**: Forecast Year Do Something Flow (Changes from Do Minimum)

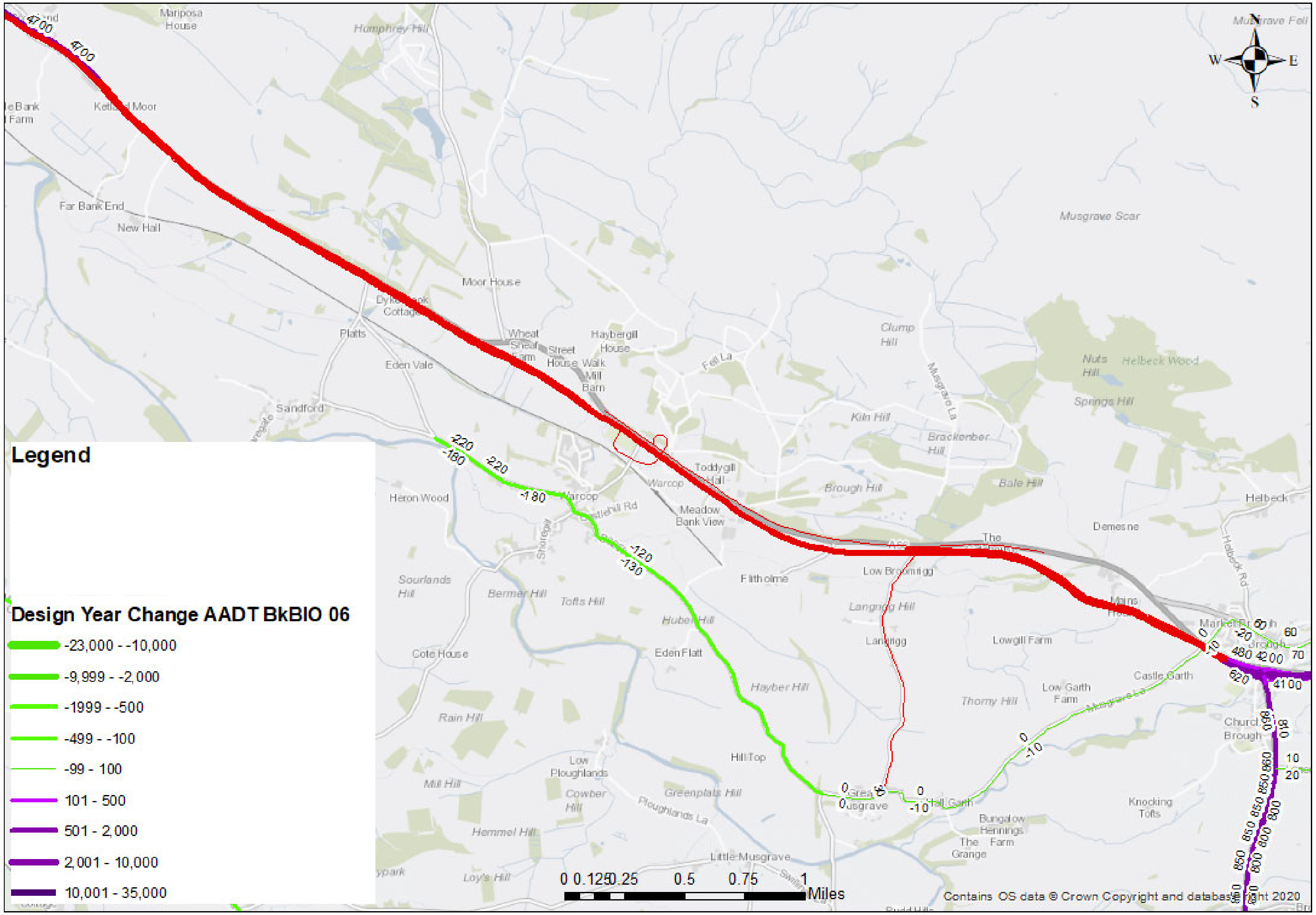

Figure 13-22: Appleby to Brough **BLACK-BLUE-ORANGE ROUTE**: Forecast Year Do Something Flow (Changes from Do Minimum)

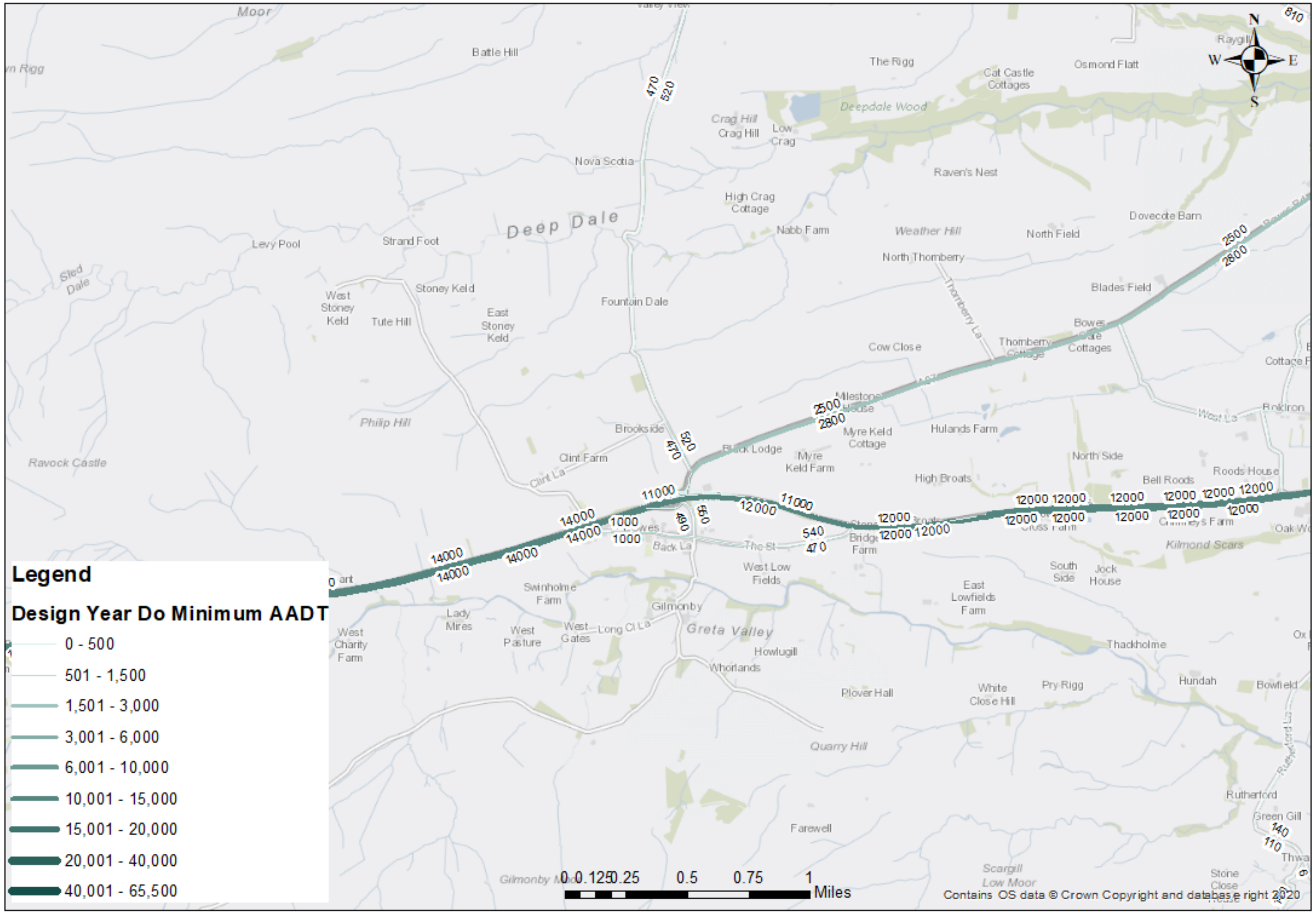

Figure 13-23: Bowes Bypass: Forecast Year Do Minimum Flows

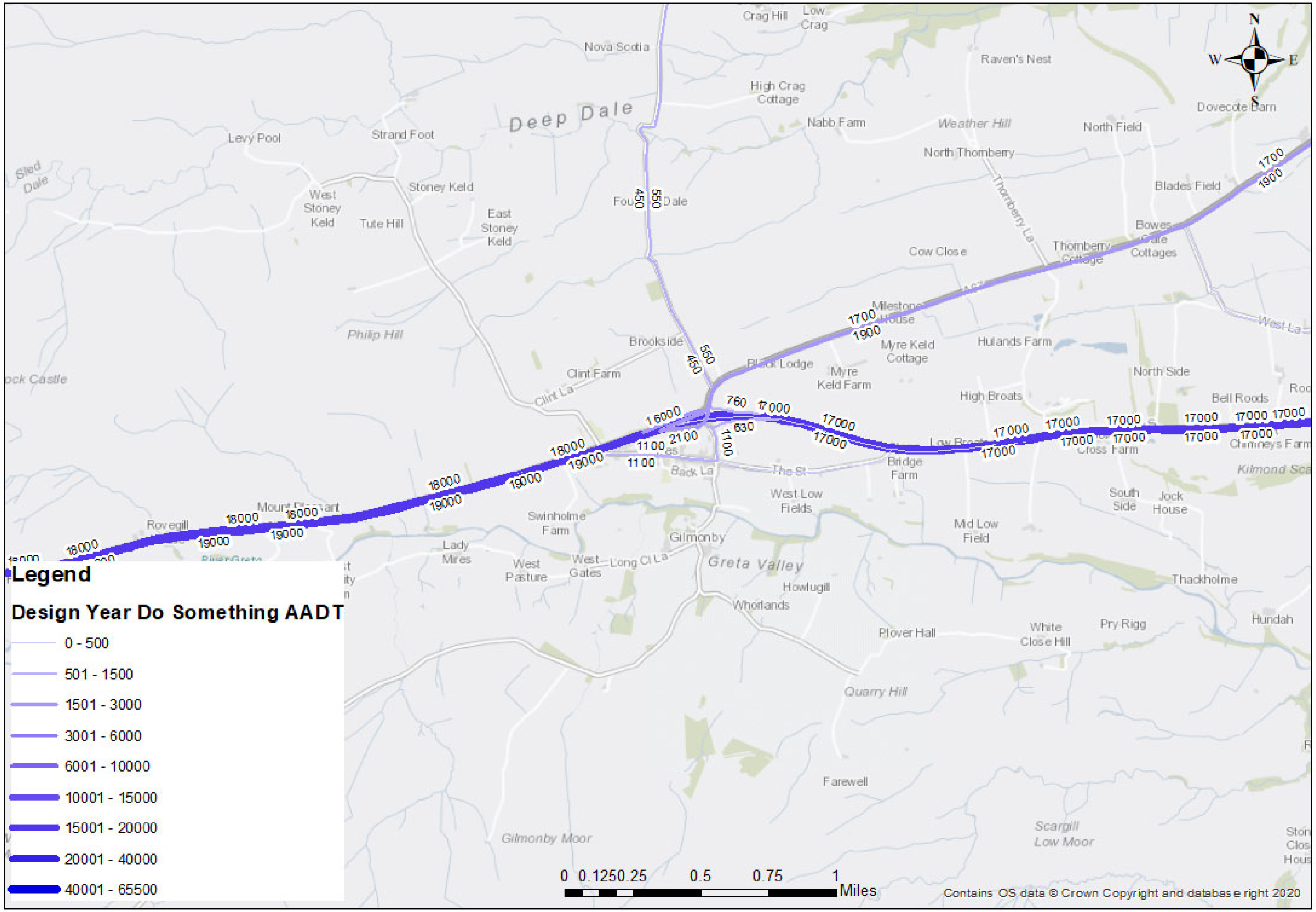

Figure 13-24: : Bowes Bypass: Forecast Year Do Something Flow

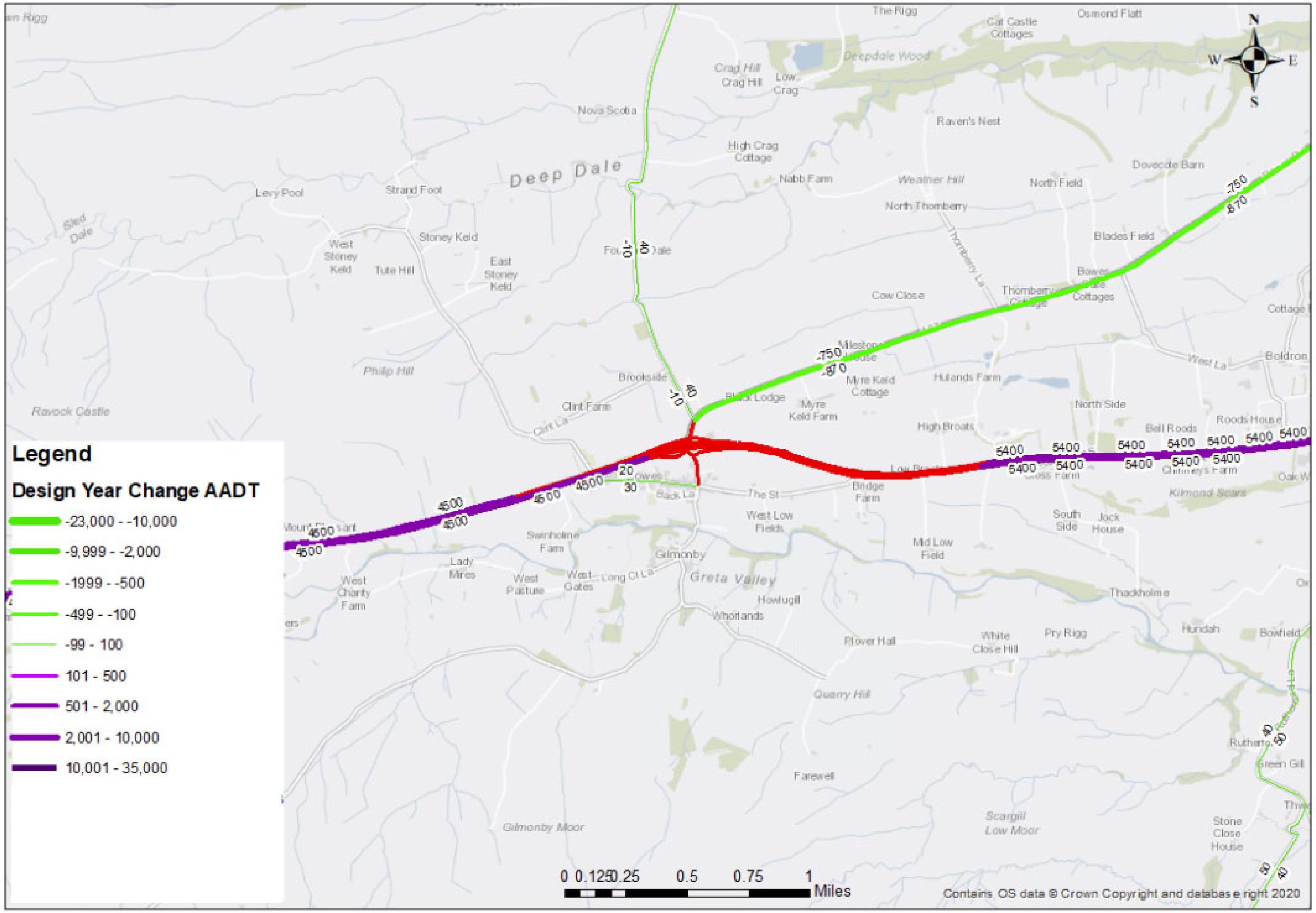

Figure 13-25: : Bowes Bypass: Forecast Year Do Something Flow (Changes from Do Minimum)

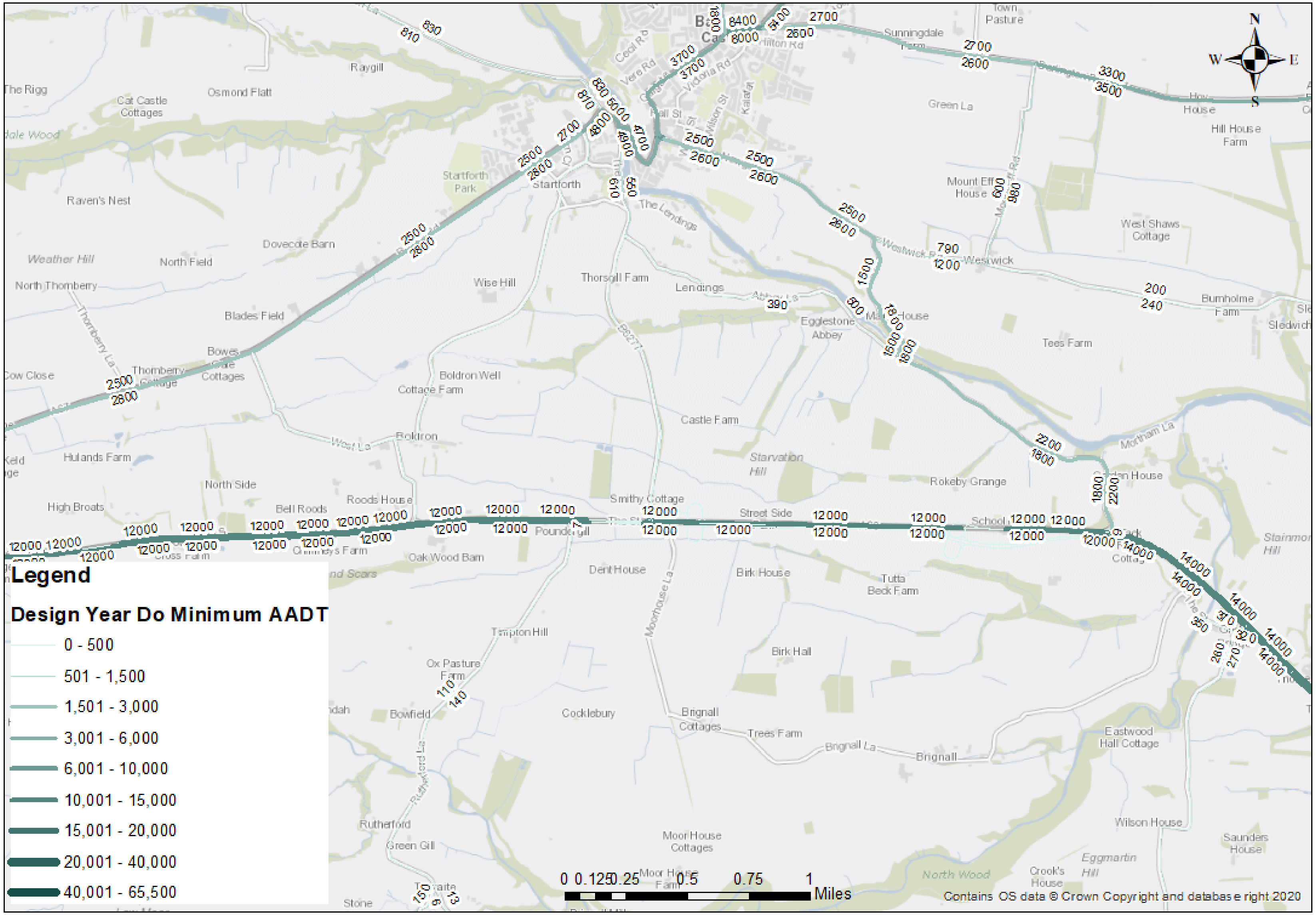

Figure 13-26: Cross Lanes to Rokeby: Forecast Year Do Minimum Flows

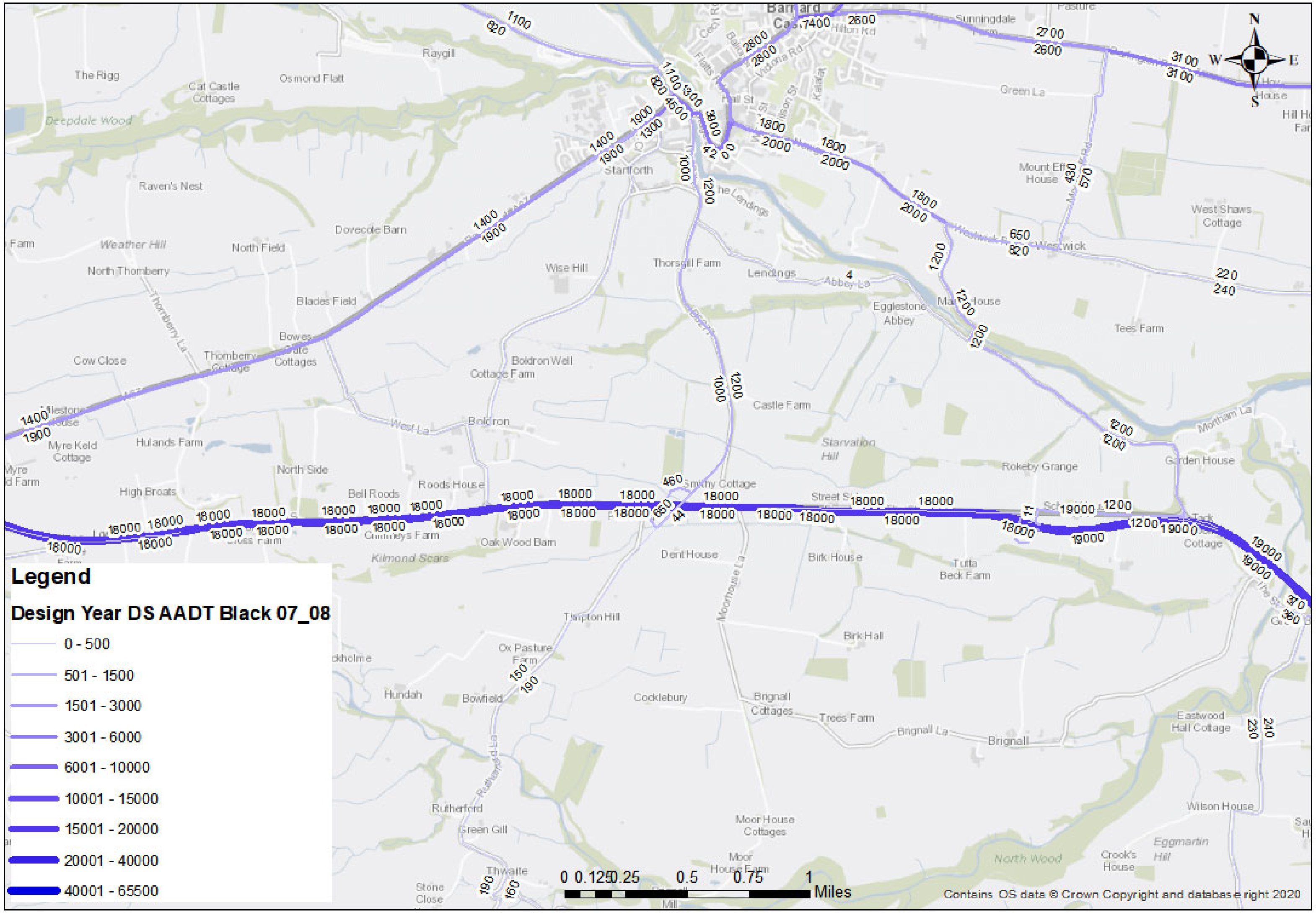

Figure 13-27: Cross Lanes to Rokeby: **BLACK ROUTE** Forecast Year Do Something Flow

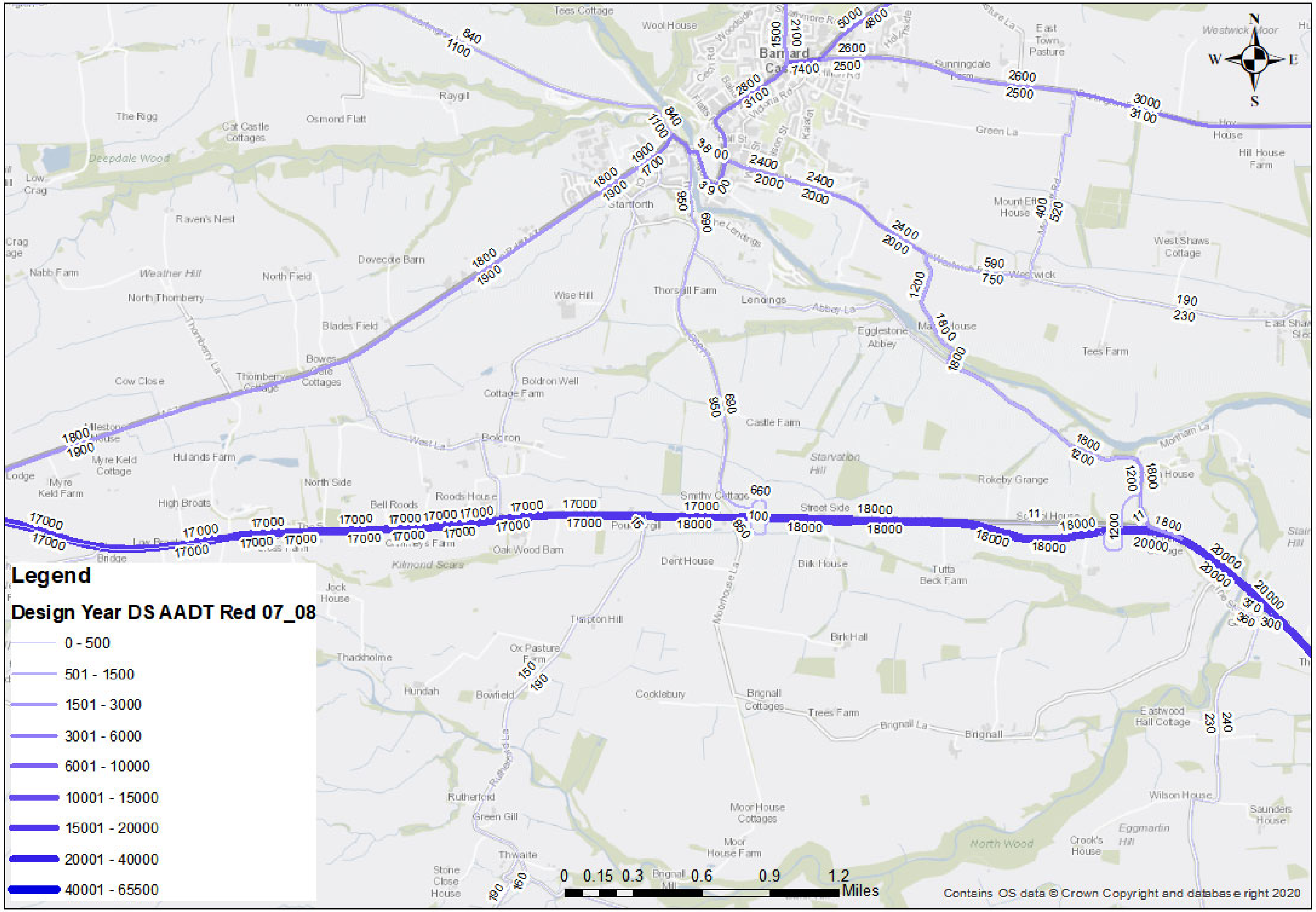

Figure 13-28: Cross Lanes to Rokeby: **RED ROUTE** Forecast Year Do Something Flow

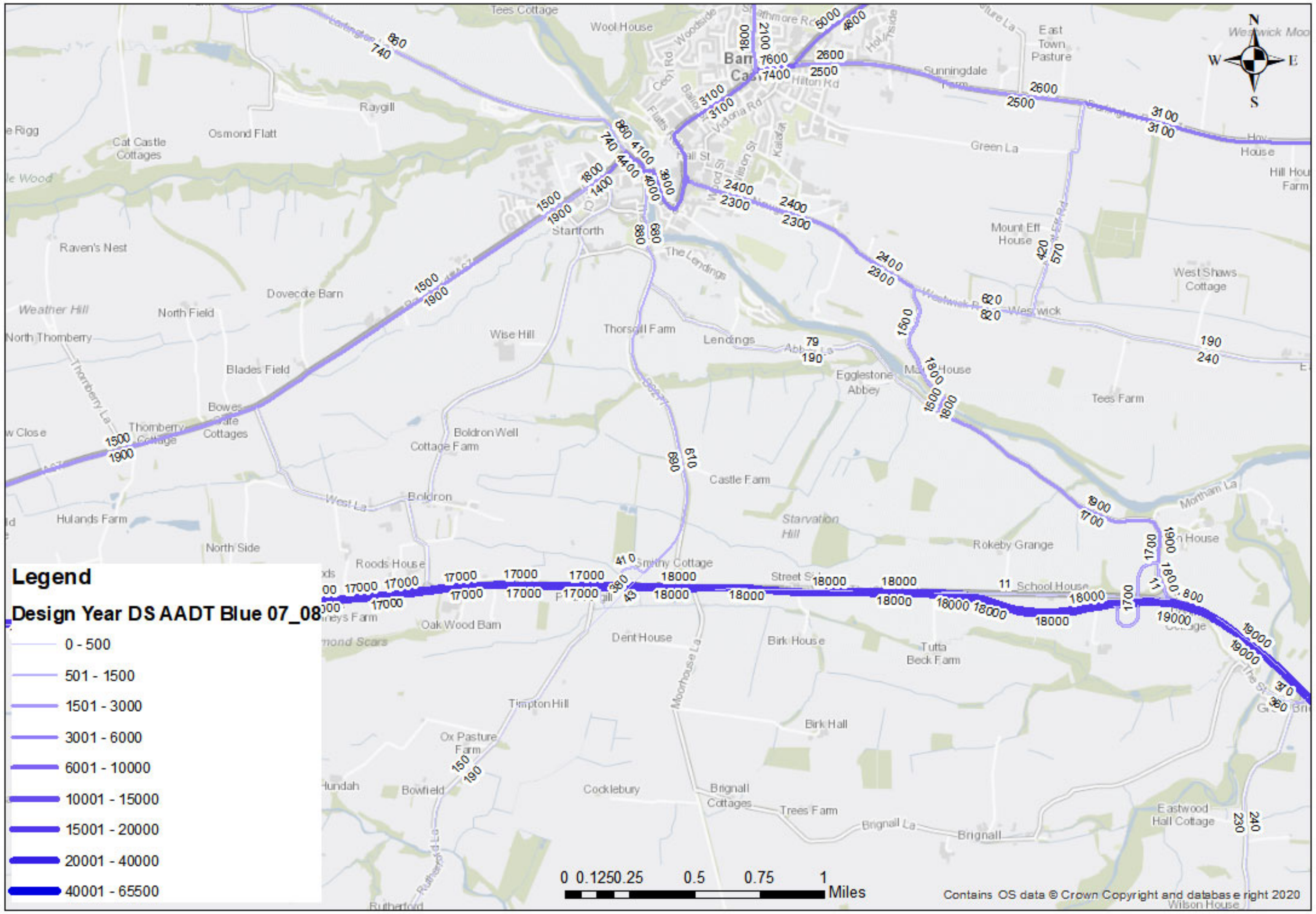

Figure 13-29: Cross Lanes to Rokeby: **BLUE ROUTE** Forecast Year Do Something Flow

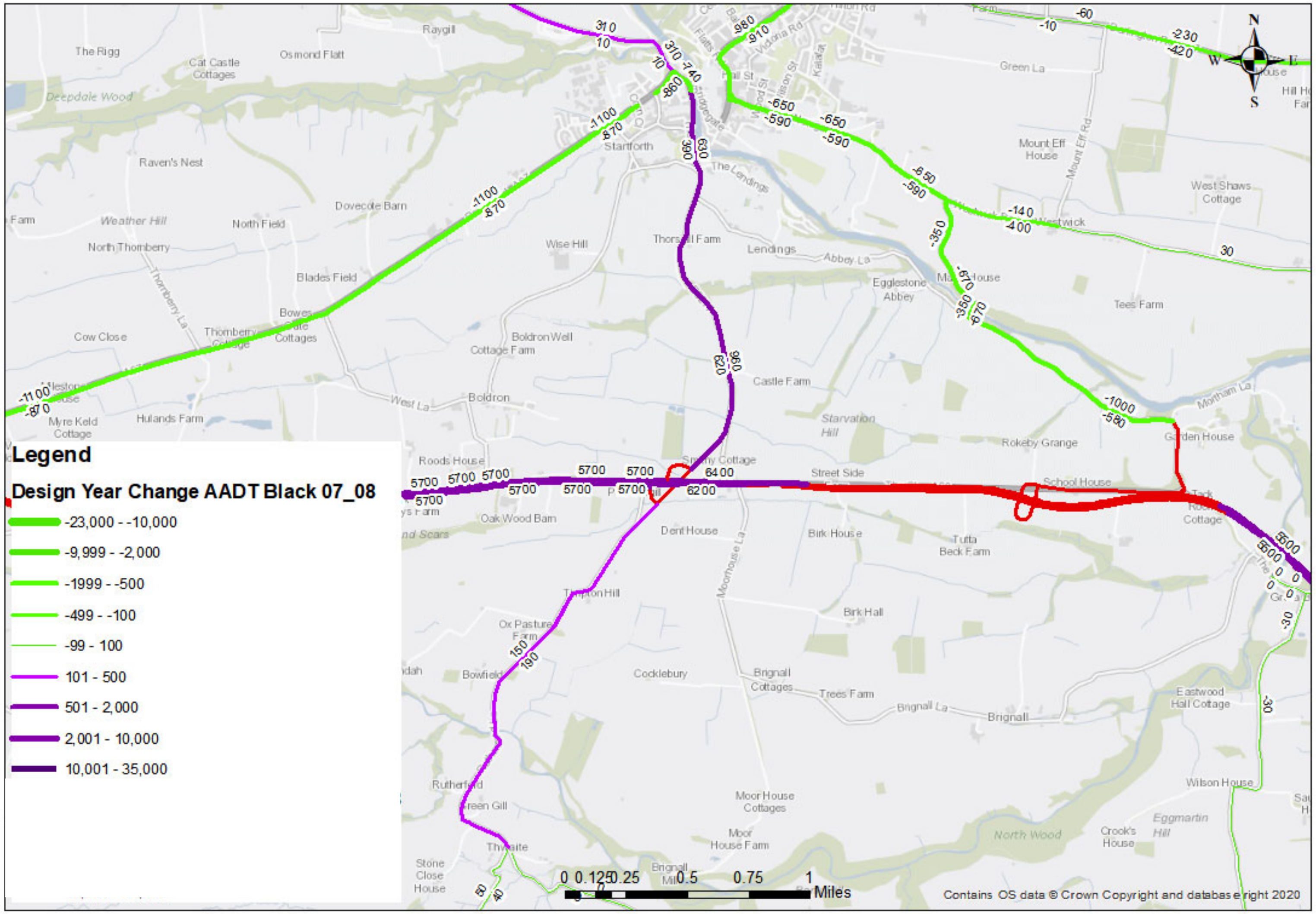

Figure 13-30: Cross Lanes to Rokeby: **BLACK ROUTE** Forecast Year Do Something Flow (Changes from Do Minimum)

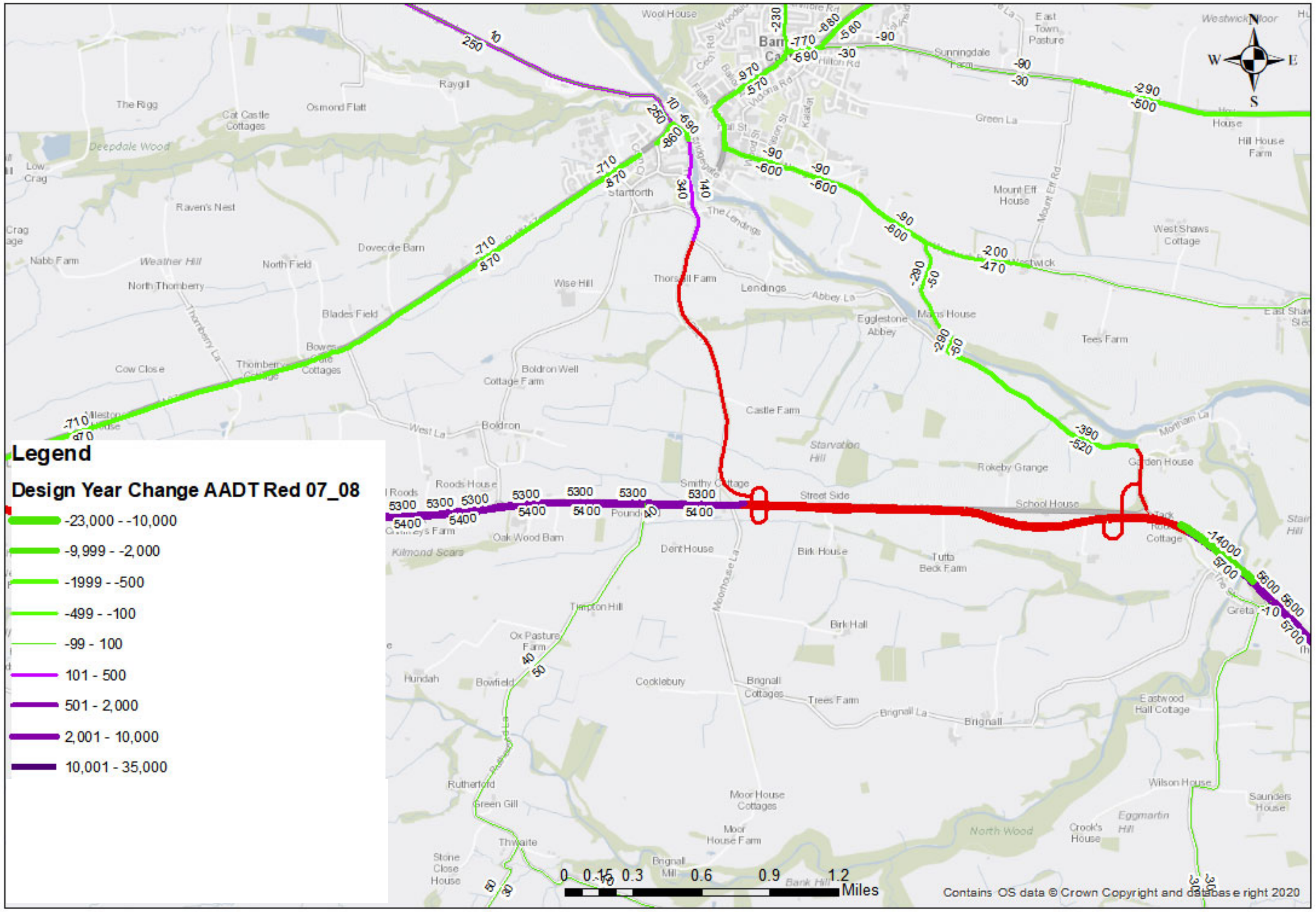

Figure 13-31: Cross Lanes to Rokeby: **RED ROUTE** Forecast Year Do Something Flow (Changes from Do Minimum)

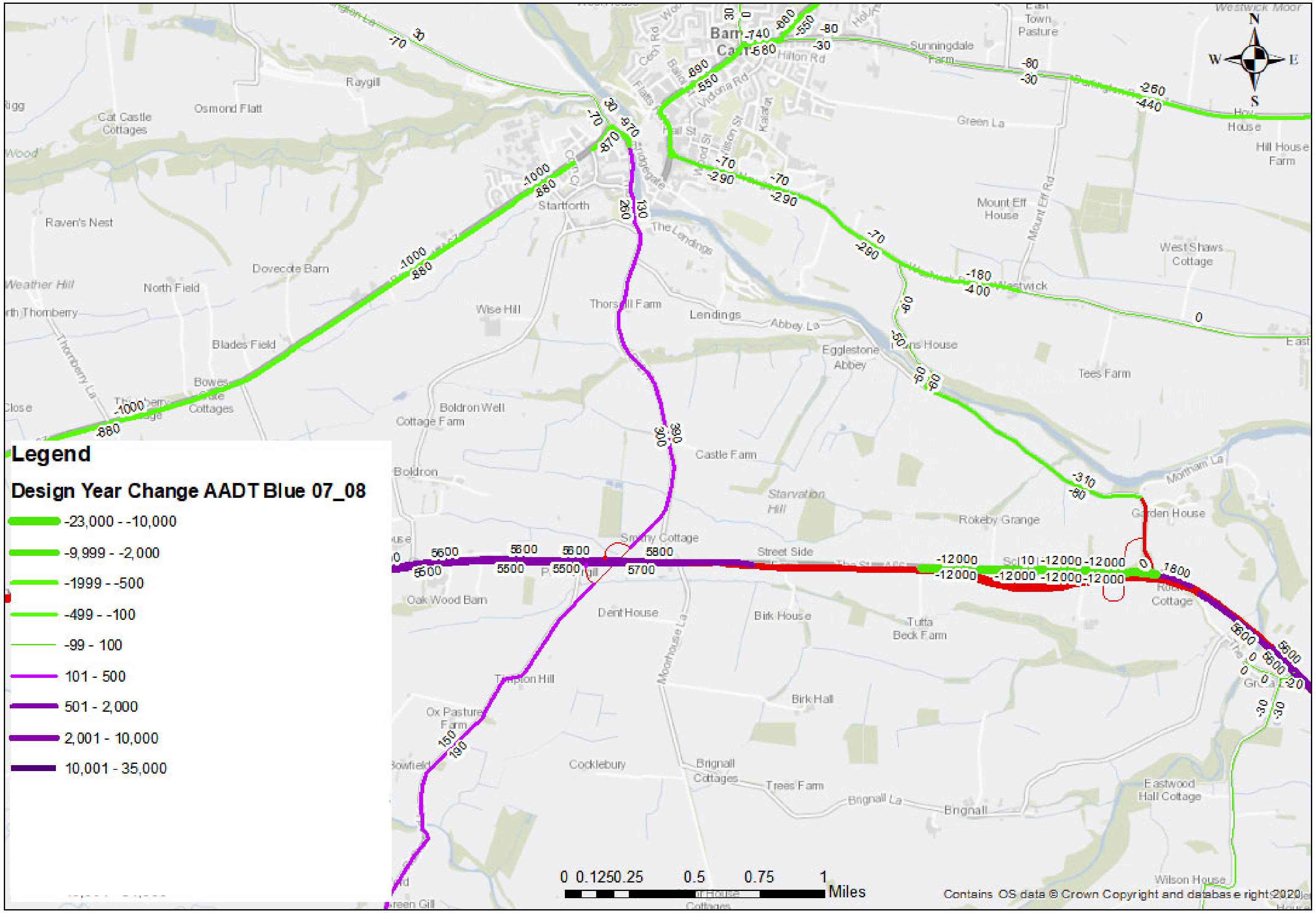

Figure 13-32: Cross Lanes to Rokeby: **BLUE ROUTE** Forecast Year Do Something Flow (Changes from Do Minimum)

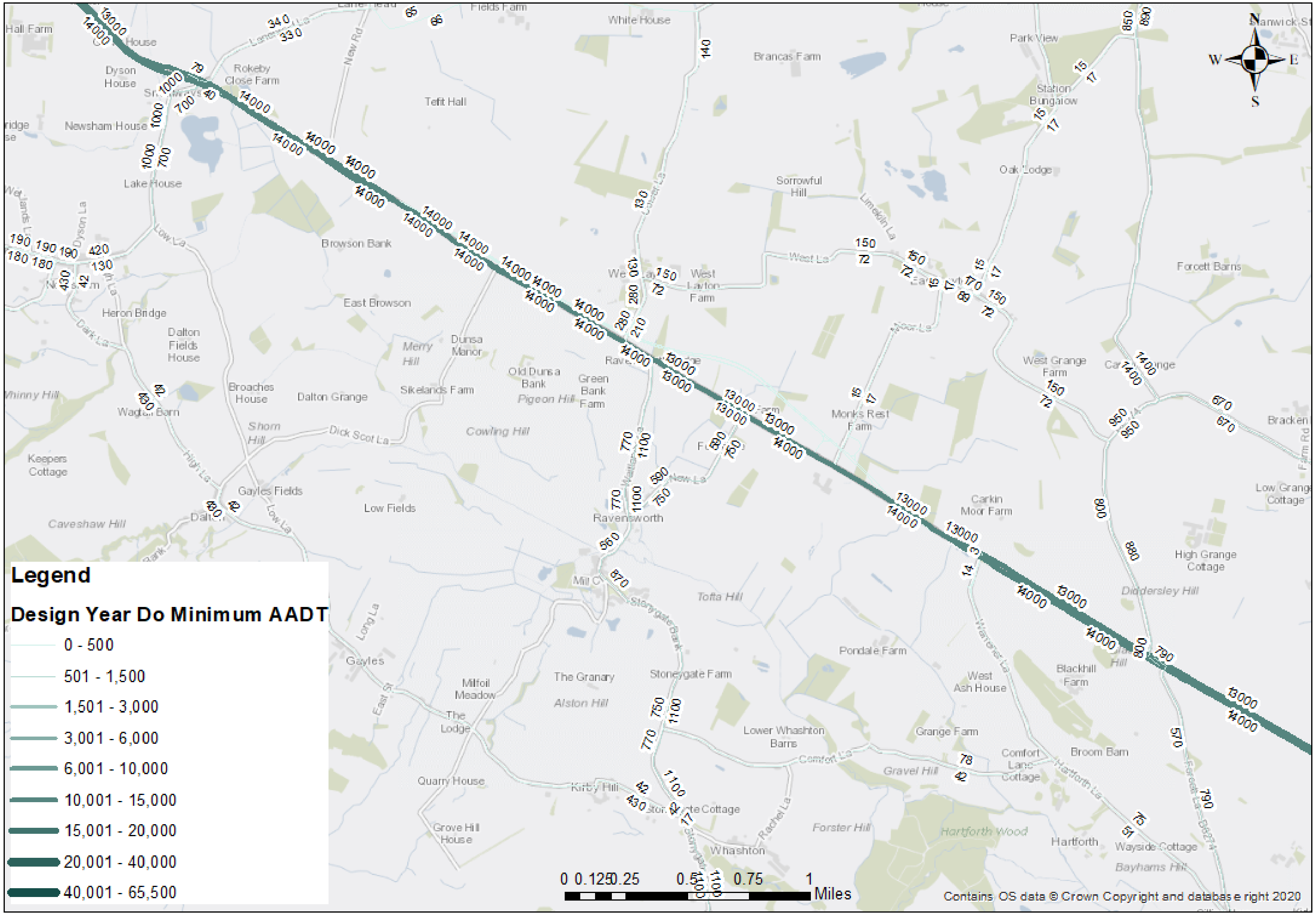

Figure 13-33: Stephen Bank to Carkin Moor: Forecast Year Do Minimum Flows

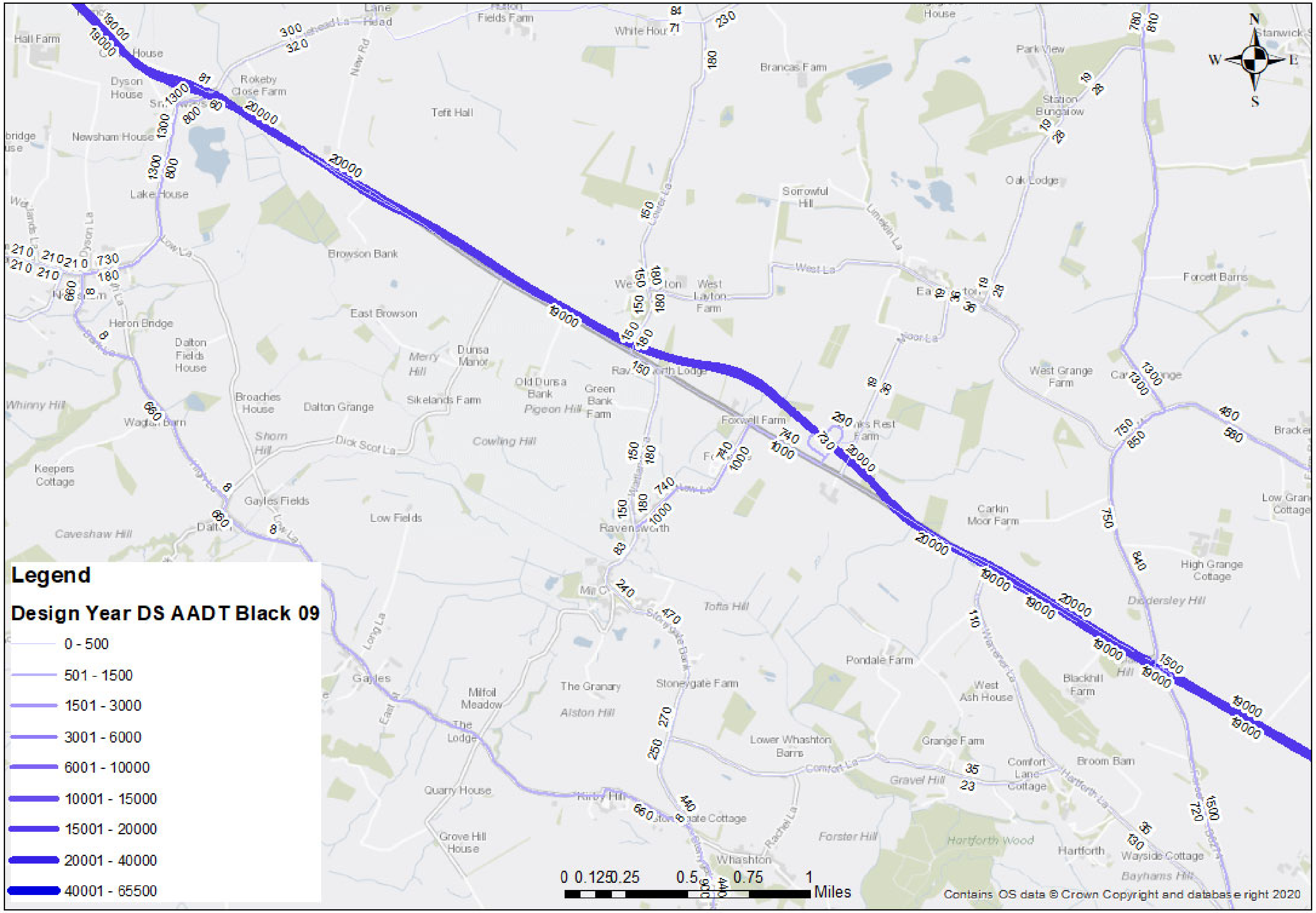

Figure 13-34: Stephen Bank to Carkin Moor: Forecast Year Do Something Flow

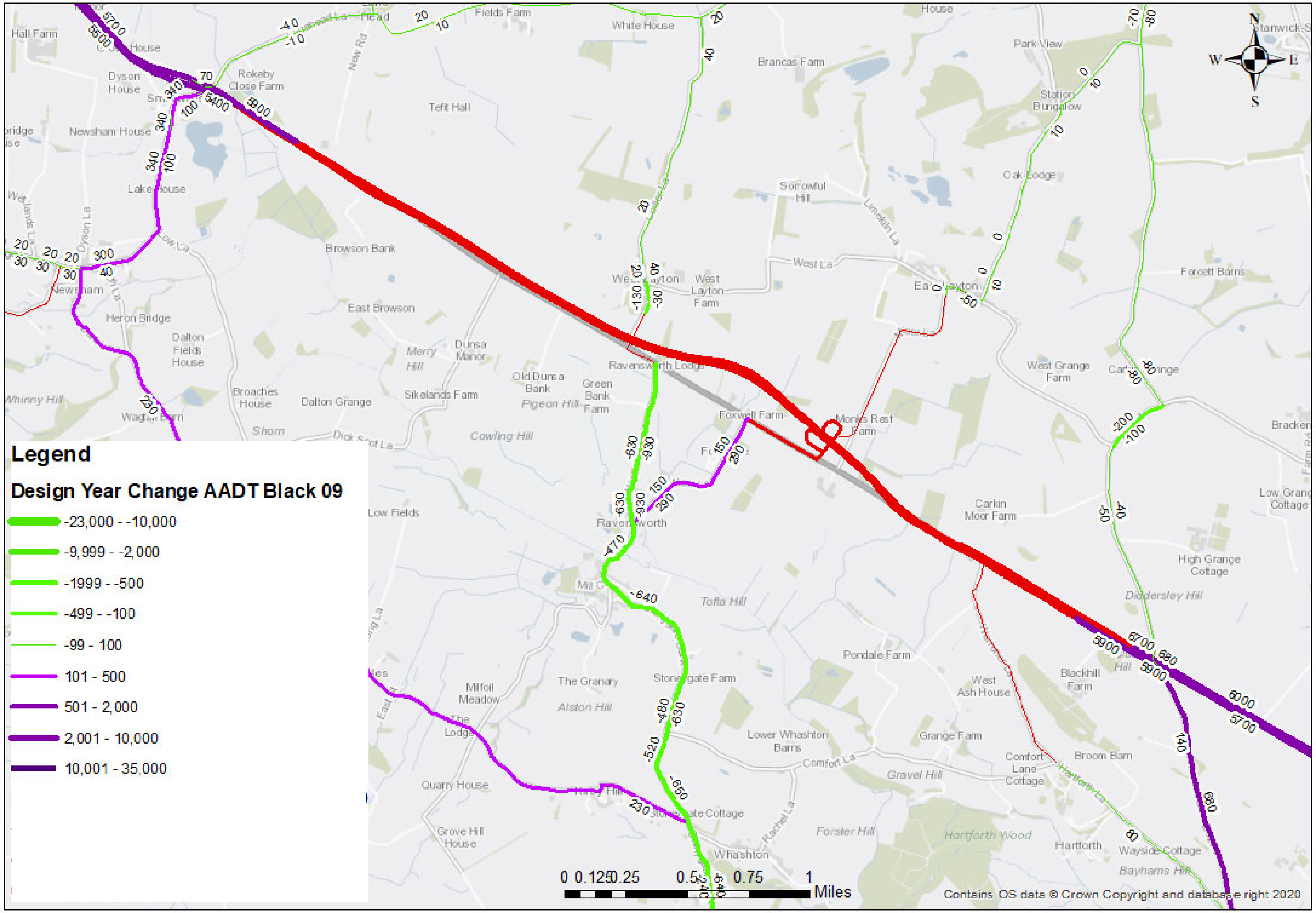

Figure 13-35: Stephen Bank to Carkin Moor: Forecast Year Do Something Flow (Changes from Do Minimum)

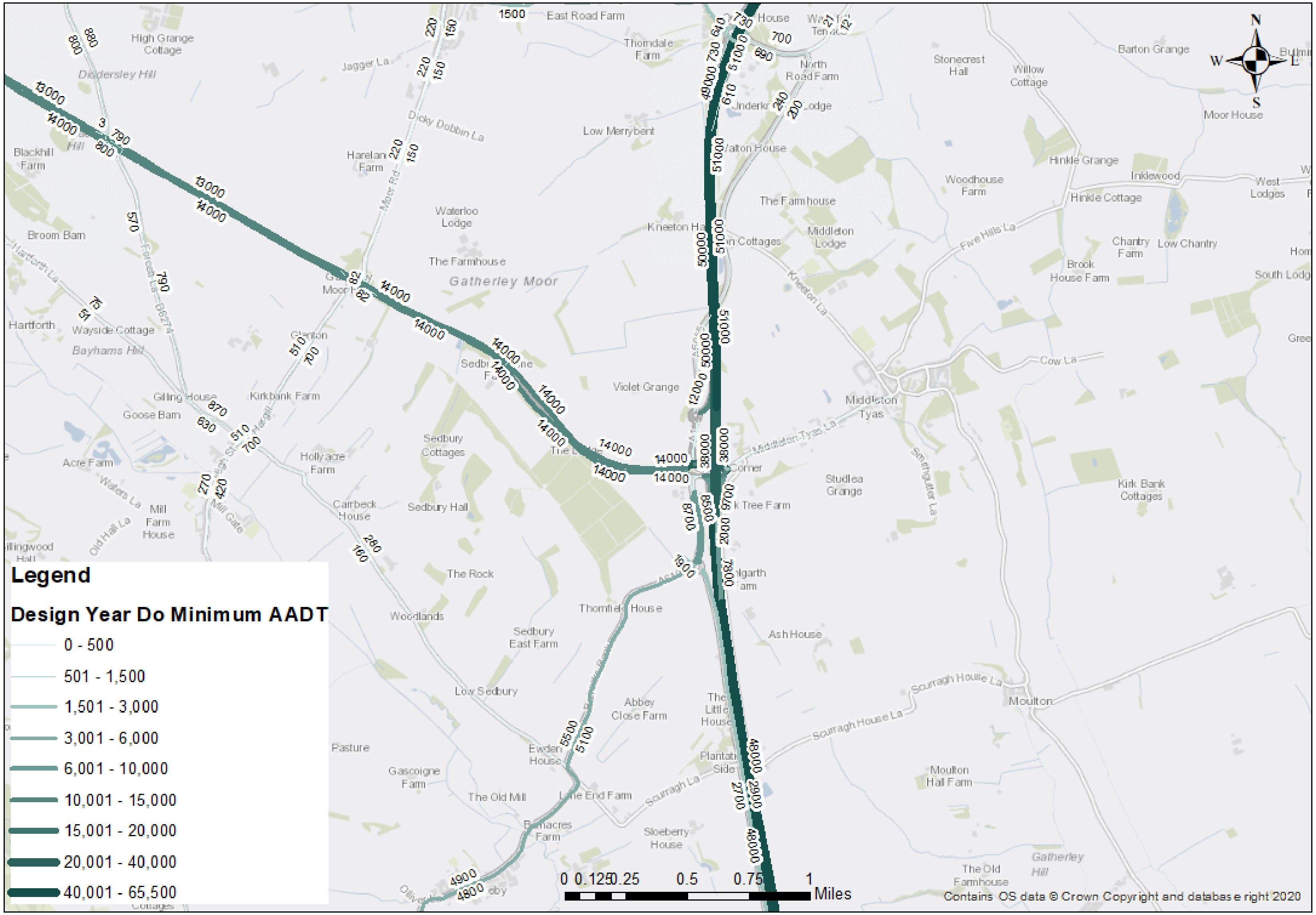

Figure 13-36: A1(M) Scotch Corner: Forecast Year Do Minimum Flows

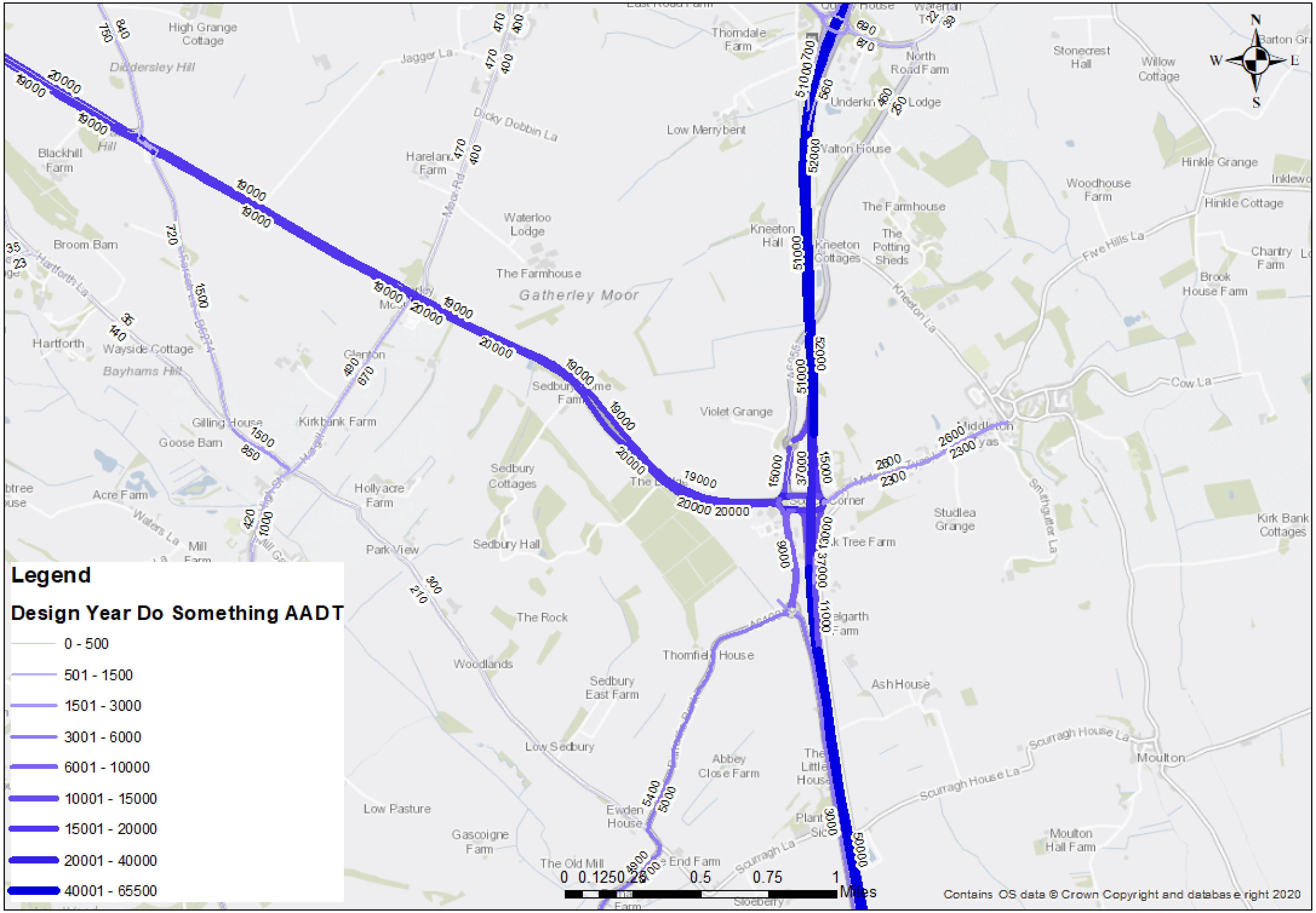

Figure 13-37: A1(M) Scotch Corner - Forecast Year Do Something Flow

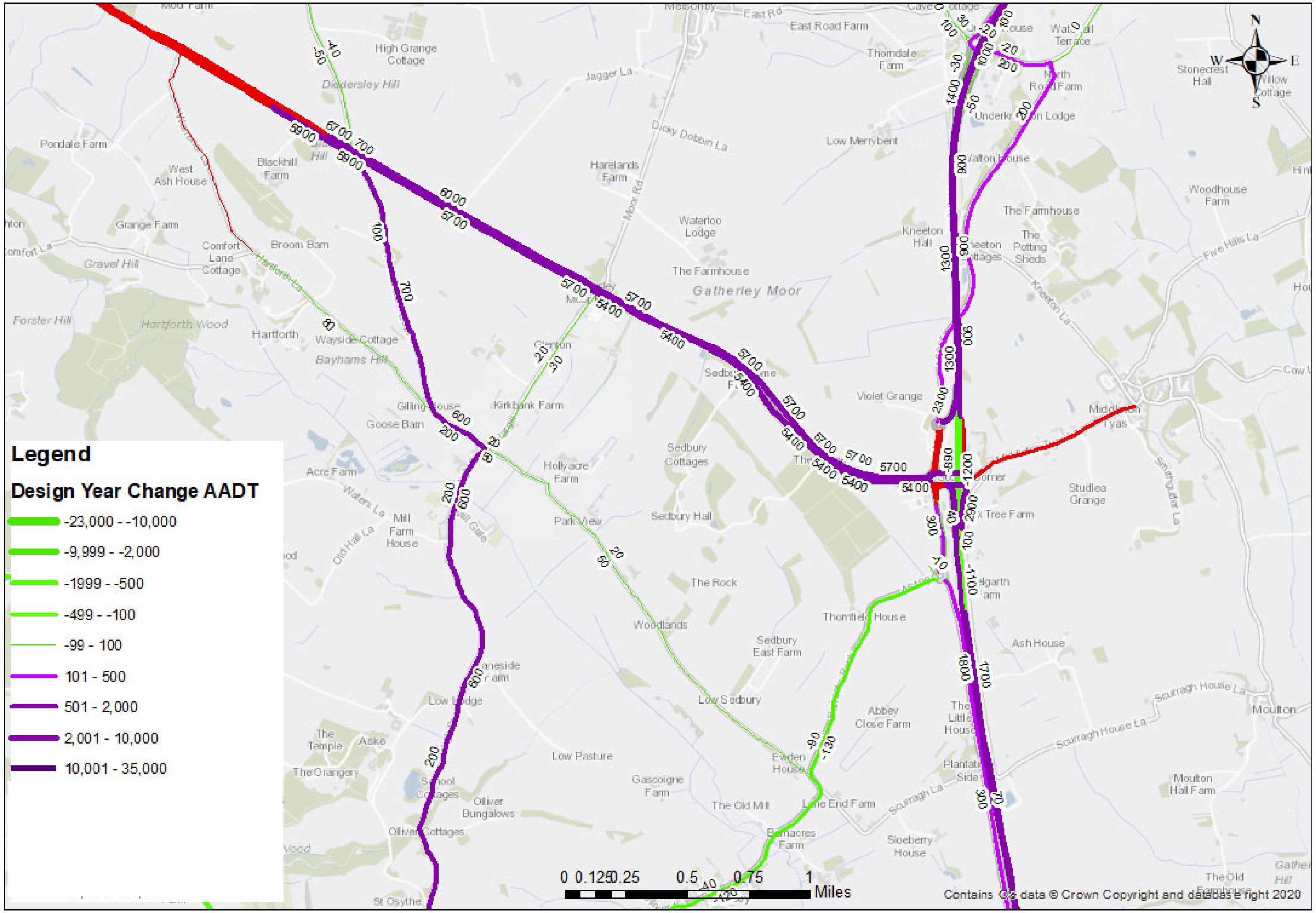

Figure 13-38: A1(M) Scotch Corner - Forecast Year Do Something Flow (Changes from Do Minimum)

On 20 August 2021, it was announced that Highways England would be changing its name to National Highways. The name change reflects the role of the strategic road network – to connect the nation's regions – and the part it plays in setting Highways standards across the UK.

We have continued this consultation under the Highways England branding to avoid confusion but will be rebranding this project as of 8 November.

The remit of the organisation has not changed, and we will continue to operate and maintain England's motorways and A roads.