Barrow Borough Local Plan

Transport Modelling Report

August 2016

Executive Summary

i. The Barrow Local Plan Transport Modelling Report summarises the transport modelling study undertaken to assess the cumulative impact of the local plan proposals. The results of this study inform the Barrow Transport Improvement Study which identifies potential transport improvements in Barrow. This report summarises the methodology and results of the modelling study and forms part of the evidence base for the Barrow Local Plan.

ii. The report used the Barrow transport model to assess the local plan proposals. The Barrow transport model is a traffic model of the Barrow urban area and the surrounding district. It covers the morning and evening weekday peak periods and was updated in 2015 to consider the impact of BAE Systems development in Barrow.

iii. The model was amended to include changes to the highway network, which include proposed site accesses for the development sites. The traffic generation and distribution of future developments was also estimated and included within the model.

iv. The report considers future year of 2031 in line with the plan period. Traffic growth was applied to the base traffic demand to take account of forecast changes in traffic demand in line with guidance from the Department of Transport.

v. The results of the forecast scenarios were then analysed to assess the impact of the local plan proposals. The model outputs include traffic flows, queues, delays and the ratio of flow to capacity, which is a measure of congestion.

vi. The results show that congestion and journey times are forecast to increase on key routes from 2014 to 2031 as a result of the local plan proposals.

vii. As part of this report the transport improvements identified in the Barrow Transport Improvement Study have also been tested in the Barrow transport model to assess their cumulative impact. The results of the assessment show that the improvements would help to mitigate the transport impacts of the local plan. With the local plan and sustainable transport improvements, the number of junction operating above the capacity would reduce significantly.

viii. Further details on the nature and cost of improvements proposed to support the Barrow Local Plan are provided in the Barrow Transport Improvements Study report. The improvements study report forms part of the evidence base for the local plan.

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1 Introduction

1.1 Introduction

1.1.1 Cumbria County Council has undertaken a transport modelling report to help support the development of Barrow Borough Council's Local Plan. The plan is the Barrow Borough Council's strategy for growth from 2016 to 2031. The Borough Council has a statutory duty to prepare a local plan, which will be used to guide development and inform planning decisions once adopted.

1.1.2 The purpose of the modelling report is to assess the cumulative transport impact of the local plan proposals. The study identifies locations on the highway network which are forecast to suffer increased delays as a result of the proposals.

1.1.3 This report summarises the methodology and results of the modelling report for the Barrow Borough Local Plan. A separate note on the modelling aspects will be prepared for the National Grid North West Coastal Connectivity (NWCC) development.

1.1.4 The results of this report are used in further work to help identify potential transport improvements in the Barrow Transport Improvements Study. This Study forms part of the evidence base for the Barrow Borough Local Plan.

1.2 Contents

1.2.1 The report includes the following information:

- The methodology of the transport study
- The assumptions used for forecasting future travel demand
- A summary of the key results
- Conclusions and recommendations

2 Methodology

2.1 Overview

2.1.1 The transport modelling report has been undertaken using Cumbria County Council's Barrow transport model.

2.1.2 The methodology used was based on information available in the Department for Transport's Transport Analysis Guidance (TAG) and the Planning Practical Guidance document *Transport evidence bases in plan making* .

2.2 Barrow transport model

2.2.1 The Barrow-in-Furness transport model has been used to assess the impact of the local plan development proposals on the highway network. The model is a SATURN traffic model of the morning and evening weekday peak periods. The model was originally constructed with a base year of 2009 and was updated in 2012. The SATURN model was subsequently updated in 2015 to test the BAE Systems development proposal.

2.2.2 Further information on the Barrow-in-Furness transport model can be found in the following reports:

- Traffic Data Report, Capita Symonds, December 2009;
- Local Model Validation Report, Capita Symonds, February 2010;
- 2012 Traffic Model Update, Cumbria County Council, March 2012; and
- BAE Systems, Barrow Transport Modelling Methodology and Results, November 2015

2.2.3 The 2015 update of the model included updating both the highway network and the travel demand within the model. Following the update, the model outputs were compared against actual traffic data to validate the results of the model.

Model Coverage

2.2.4 The Barrow-in-Furness transport model has been used to assess the impact of the local plan development proposals on the highway network. The Barrow transport model is a strategic SATURN traffic model of the Barrow urban area and surrounding district.

Peak Periods

2.2.5 The model covers the morning and evening weekday period periods of 8–9am and 4–5pm.

Vehicle and User Classes

2.2.6 The model considers car, light goods vehicle (van) and heavy goods vehicle trips. The car trips are segmented by 5 following trip purpose

i. Commute
ii. Business
iii. Others
iv. LGV
v. HGV

2.3 Forecasting

2.3.1 The report considered future years of 2031 in line with the plan period. These future year scenarios contained various assumptions relating to potential changes to the highway network and traffic demand.

2.3.2 The future year scenarios considered in this study are shown below. More detail on each scenario is provided in Section 3.

i. 2031 Base

ii. 2031 Local Plan

2.3.3 Traffic growth was applied to the base model to account for forecast changes in traffic demand. The growth was calculated based on best practice guidance and future housing targets.

2.3.4 Committed changes to the highway network were included the model. These generally took the form of site accesses for specific sites. Highway network changes associated with the BAE Systems development are also included in the model.

2.3.5 The traffic demand related to specific development sites were added to the model. This involved estimating the traffic demand of each development, and distributing these trips across the model.

2.3.6 The model outputs were used to assess the impact of these scenarios. The model outputs include traffic flows, forecast junction capacity, queues and delays.

2.3.7 The outputs from the model have been used to inform a further study which identifies potential transport improvements in Barrow. The improvements study identifies potential measures and costs and assesses their effectiveness using detailed junction modelling software like ARCADY, PICADY and LinSIG.

2.3.8 Further details on the nature and cost of improvements proposed to support the Barrow Local Plan will be provided in the Barrow Transport Improvements Study report by WSP.

3 Development scenarios

3.1 Introduction

3.1.1 A number of future year demand scenarios were considered as part of the study. The future year demand scenarios are summarised below:

1. 2031 Base:
2. 2031 Local Plan: includes the Local Plan proposals for housing, employment, retail and leisure.
3. Local Plan and the major development impacts associated with the North West Coastal Connection project (peak construction) is also considered though not included in this report. A separate technical note is prepared which deals with the impact of NWCC development.

3.1.2 Scenario 1, *2031 Base*, is the reference case scenario. It includes developments which have planning permission and live applications with the potential to gain permission soon. Other developments that are likely to gain planning permission and be constructed by 2031 will be included where information is available; this will include the proposals at BAE and the extension to Walney Windfarm. This is not meant to be prejudicial to the planning process and is based on guidance on uncertainty as defined by Table A2 in TAG Unit M4 *forecasting and uncertainty* .

3.1.3 Scenario 2, 2031 *Local Plan*, is the local plan scenario. As well as the development in Scenario 1, it includes all local plan proposals for housing, employment and leisure.

3.1.4 Scenario 3 considers the cumulative impact of the local plan developments and the other major development impacts on the highway network in Barrow. Impacts associated with the North West Coastal Connections and 2026 Moorside developments (peak construction) are considered in this scenario.

3.1.5 The modelling report will provide results for the all scenarios except scenario 3. This is because scenario 3 is a National Significance Important Scheme (NSIP). The transport modelling for scenario 3 is undertaken separately and a detailed modelling report will be prepared.

Traffic Generation

3.1.6 The estimated traffic demand for all developments in these scenarios was estimated using the industry standard TRICS database. TRICS is a database of traffic and person surveys from different development sites throughout the UK. TRICS is used to estimate the trip generation of a proposed development by selecting surveys from similar sites in the database based on use class, size and location. The output of TRICS includes a trip rate which estimates the traffic or person trip generation per unit of the proposed development.

3.1.7 A separate TRICS analysis was undertaken for each development type included in the future year scenarios. More details on the development assumptions and trip generation in each scenario is provided in the following sections. The trip rates and overall trip generation are provided in the appendix.

3.2 Scenario 1: 2031 Base

3.2.1 Scenario 1 consists of the following assumptions

- Developments which have been completed between October 2014 and April 2016
- Developments which have been granted planning permission
- Developments where planning application has been outlined as of April 2016 which have not yet been determined but are likely to receive planning permission.

3.2.2 Scenario 1 includes a mix of development types, and included residential, offices, health, light industrial and warehousing.

3.2.3 The development included in Scenario 1 includes the following:

- 711 residential dwellings
- BAE Logistic facility
- Mixed/other developments, including:
  - GP's Primary Care, Ambulance base and a pharmacy
  - Relocation of Furness College

3.2.4 A summary of the trip generation of developments in Scenario 1 is provided in Table 3.1. A detailed list of all the developments in this scenario and their trip generation is given in Appendix A.

Table 3.1: Scenario 1: 2031 Base trip generations

Development type	Vehicle trips			
	Morning peak		Evening peak	
	In	Out	In	Out
Residential	127	312	282	164
Employment	28	15	11	24
Mixed/other	108	47	45	91
Total	263	374	338	279

3.2.5 The site access for each development was taken from the relevant planning application. Details of the site access location are provided in Appendix A.

3.3 Scenario 2: 2031 Local Plan

3.3.1 Scenario 2 considers specific development sites identified in the local plan up to 2031. Similar to Scenario 1, it includes a mix of development types. A plan showing the location of development sites in Scenario 2 is provided in the appendix as Figure A2 in Appendix A.

3.3.2 The development included in Scenario 2 includes the following:

- Residential dwellings, including:
  - 1,382 residential dwellings in Barrow including 600 residential units for Marina Village;
  - 338 residential dwellings in Dalton;
  - 124 residential units in Askam and Irleth;
  - 36 residential dwellings in Lindal; and
  - 107 residential units at other broad locations within the Barrow-in-Furness local authority.
- Employment/mixed use development, including:
  - 29.3 hectors of B1, B2 and B8 employment land around Barrow;
  - 15,900 sqm of strategic employment site in Furness Business Park, Barrow; and
  - 4,000 sqm of B1 – office.

3.3.3 A summary of the trip generation of developments in Scenario 2 is provided in Table 3.2. A detailed list of all the developments in this scenario and their trip generation is given in Appendix A.

Table 3.2: Scenario 2: 2031 Local Plan trip generation

Development type	Vehicle trips			
	Morning peak		Evening peak	
	In	Out	In	Out
Residential	293	787	641	370
Employment	683	377	400	578
Total	976	1,164	1,041	948

3.3.4 The site access for each development was assumed based on the location of the site and the surrounding highway network. This assumption was made for the purposes of this study and is not a preference of the council or prejudicial to future planning applications.

3.4 Trip distribution

3.4.1 The trips generated by each new development were distributed across the model using a synthetic gravity model. A gravity model distributes trips based on an assumed relationship between the length of a trip and the number of trips made. Traffic is therefore distributed based on the total forecast traffic generation and the cost of travel between origins and destinations in the model.

3.4.2 The cost of travel varies depending on trip purpose, so a separate model was used for each trip purpose. The trips were disaggregated by purpose using data from NTEM.

3.4.3 The gravity model used for trip distribution in this study was of the form

$$T_{ij} = \alpha O_i D_j f(c_{ij}) \quad (1)$$

where T_{ij} is the number of trips between origin i and destination j, α is a proportionality factor, O_i is the total number of trips starting at origin i, D_j is the total number of trips ending at destination j and $f(c_{ij})$ is a generalised function of travel costs known as the deterrence function.

3.4.4 The deterrence function used was of the form

$$f(c_{ij}) = c_{ij}^{n} e^{\beta c_{ij}} \quad (2)$$

where c_{ij} is the cost of travel between origin i and destination j and n, β are parameters to be defined.

3.4.5 Finally, the furness procedure was applied to the future year matrix to ensure the trip totals for each development are correct.

3.4.6 It should be noted that the assumptions regarding the highway network and traffic demand in small rural settlements included in the model are simplistic. The network only includes key routes and traffic demand is aggregated into broad locations. This means that the costs used within the gravity model are often inaccurate for new trips that could potentially stay within the rural settlements. The result of this is that trips generated by new developments in rural locations are all external to that settlement. This represents a pessimistic assessment of trip generation on the wider highway network that is likely to be an overestimate.

3.5 Summary of development scenarios

3.5.1 The forecast traffic demand from development sites is shown in Table 3.3. The totals are cumulative, so the 2031 Local Plan totals include traffic demand from the 2031 Base scenario.

Table 3.3: Forecast development sites traffic demand

Time period	2014 Base	2031 Base	2031 Local Plan
Morning peak	0	998	2,747
Evening peak	0	2,553	4,809

4 Traffic growth

4.1 Introduction

4.1.1 Traffic growth is the change over time of the number of cars and goods vehicles on the highway network. When forecasting the performance of the highway network in the future, it is necessary to allow for changes in traffic demand.

4.1.2 Traffic growth can be split into two broad areas:

1. **New trips:** Changes in population, employment and car ownership directly affect how many vehicles travel on the highway network.
2. **Frequency of trips:** Changes in GDP, income and travel costs affect how frequently people travel

4.2 Forecast traffic demand

4.2.1 Growth in traffic demand in the future year scenarios was considered in line with the fixed demand approach defined in TAG Unit M4 *forecasting and uncertainty*. A fixed demand approach ignores effects such as induced or suppressed traffic due to changes in travel costs, and changes in travel choice such as peak spreading. A fixed demand approach was used so the impact of the proposed development can be clearly assessed between scenarios without the impact of other variables.

4.2.2 Uncertainty in relation to the growth factors has not been considered as part of the study. It is considered that this is not necessary as the key outputs of the study are the differing impacts between scenarios.

4.2.3 The National Trip End Model (NTEM) dataset represents the Department for Transport's standard assumptions about growth in travel demand. Access to the dataset is provided through the TEMPRO software.

4.2.4 TEMPRO was used to calculate growth factors for cars based on the future year, trip purpose, time period and the origin and destination of trips. The assumptions within NTEM were adjusted using the alternative assumptions facility within TEMPRO.

4.2.5 The Barrow Local Plan has an annual average housing target of 126 dwellings per year from 2015 to 2021, and 100 dwellings per year from 2021 to 2031, totalling 1,630 dwellings over the whole plan period. This was used as the baseline for future housing numbers. The housing numbers from the specific developments in each scenario were then subtracted from this baseline, and the housing assumptions within TEMPRO were adjusted to match this target.

4.2.6 This ensures that the impact of new housing is not double-counted by including the developments in the model directly as well as applying a growth factor. The growth factors still account for other forecast changes that may affect traffic growth, such as demographic changes and car ownership.

4.2.7 As a fixed demand approach was used, fuel and income factors were calculated using TAG Databook Table M4.2.1 *Forecast fuel price and income adjustment factors*. These factors are based on relationships between car travel, household income and fuel costs.

4.2.8 Growth factors for light goods vehicles and heavy goods vehicles were estimated from the National Transport Model, adjusted using local NTEM factors.

4.2.9 The forecast traffic demand totals for each scenario is shown in Table 4.1. The totals shown exclude the additional traffic generation from specific development sites. The traffic generation for specific sites is provided in Section 3.

Table 4.1: Forecast traffic demand excluding specific development sites

Time period	**2014 Base**	**2031 Base**	**2031 Local Plan**
Morning peak	13,489	15,884	15,635
Evening peak	12,365	14,408	14,137

4.2.10 The growth factors used in the forecasting are provided in Appendix B.

4.2.11 The forecast traffic demand totals for each scenario are shown in Appendix B. The totals shown include the traffic generated from specific development sites.

Table 4.2: Forecast traffic demand including specific development sites

Time period	**2014 Base**	**2031 Base**	**2031 Local Plan**
Morning peak	13,489	16,882	18,383
Evening peak	12,365	16,961	18,946

5 Results

5.1 Introduction

5.1.1 The forecast scenarios were created by amending the network to include new accesses, applying traffic growth and including additional development traffic to the validated base model.

5.1.2 The measures identified in the improvements report have also been tested in the strategic model as part of this study to assess their cumulative impact. This is important as improvements to capacity in one location may have further impacts at other locations.

5.1.3 The forecast scenarios also included a traffic signal optimising procedure. The signal timings contained within the model are fixed, and changes in traffic flow due to developments may result in the original timings becoming inappropriate. The majority of signalised junctions within Barrow operate on a system which coordinates signal timings, so junction capacity at these locations may be underestimated without optimisation.

5.1.4 The results of the forecast scenarios were then analysed. The model outputs include traffic flows, queues, delays, and the Ratio of Flow to Capacity (RFC) for junctions and links in the model.

5.1.5 The RFC of a movement at a junction is a measure of the congestion of that movement. A movement with a capacity of 1,000 vehicles per hour and a traffic demand of 900 vehicles per hour has an RFC of 0.9.

5.1.6 The maximum ideal junction performance is when all movements have an RFC of around 0.85–0.9. A junction is defined as operating over capacity if it has a movement with an RFC greater than one. Over capacity junctions experience an increased sensitivity to variations in traffic flow which manifest in unreliable journey times and an increase in queuing.

5.1.7 The RFC results for key junctions in the model are included as Table C1 and Figures C1–C3 in Appendix C [1]. This details the maximum RFC for any movement at each junction for each forecast scenario. This also details the results for the tested improvement schemes.

5.1.8 The RFC of a junction can be an abstract concept as it is not easy to relate to when travelling along a road. To counter this, the impact of development can also be assessed by using journey times. Seven routes along key corridors have been selected for journey time analysis, with separate journey times calculated for each direction of travel. These routes are presented below.

[1] The RFCs presented in the appendix vary slightly when compared to those in the Barrow Transport Improvements Study. This is due to minor amendments to the model to correct errors identified during the infrastructure study. These small variations do not alter the conclusions of either study.

- Bridge Road to Park Road northbound
- Abbey Road (John Whinnerah Roundabout) to Park Road
- Leece Lane, Roose to Hindpool Rd
- Bank Lane to Friars Lane/Roose Rd
- Crossmill Road to A5087/ Leece Lane/ Roose Rd
- Ulverston Rd/Urswick Rd junction to Abbey Road/Long Lane via Market St. Dalton

5.1.9 Finally, it should be noted that these results are average results for the whole peak hour and represent what is forecast to typically occur. As junction operation approaches capacity junction performance becomes more sensitive to variations in traffic flow. This means that small changes in traffic flow can result in large increases in queuing and delay throughout the peak hour.

5.1.10 The following sections summarise the RFC and journey time results from the model for each scenario. The RFC figure for each peak period is from the movement with the highest RFC value.

5.2 Scenario 1: 2031 Base results

5.2.1 A summary of overall junction performance across the network is provided in Table 5.1. This gives the total number of junctions in the model approaching capacity, with an RFC greater than 0.85 but less than one, and those over capacity, with an RFC greater than one.

Table 5.1: Scenario 1 2031 Base: junction performance results

RFC criteria	Morning peak	Evening peak
No. junctions with 0.85 > RFC < 1.0	12	9
No. junctions with RFC > 1.0	17	24

5.2.2 The results shown that there is an increase in both the number of overcapacity junctions, and the number of junctions approaching capacity. This is as a result of additional traffic demand from new developments and other traffic growth factors.

5.2.3 A summary of journey time performance across the network is given in Table 5.2. This gives the journey time in seconds and the average speed in kilometres per hour for the routes defined in Section 5.1.

Table 5.2: Scenario 1 2031 Base: journey time summary results

Route	Dir	Length (km)	Morning peak		Evening peak	
			Time (s)	Speed (kph)	Time (s)	Speed (kph)
Bridge Road to Park Road northbound	NB	6.83	941	26	563	44
	SB	6.78	627	39	803	30
Abbey Road (John	EB	4.09	461	32	550	27

Route	Dir	Length (km)	Morning peak		Evening peak	
			Time (s)	Speed (kph)	Time (s)	Speed (kph)
Whinnerah Roundabout) to Park Road	WB	4.09	462	32	506	29
Leece Lane, Roose to Hindpool Road	EB	3.31	353	34	483.3	25
	WB	3.31	397	30	355	34
Bank Lane to	NB	3.95	333	43	350	41
Friars Lane/Roose Road	SB	3.95	381	37	421	34
Crossmill Road to A5087/ Leece Lane/ Roose Road	EB	3.43	383	31	509	24
	WB	3.43	466	26	425	30
Ulverston Road/Urswick Road junction to Abbey Road/Long Lane via Market Street Dalton	NB	2.89	364	28	280	37
	SB	2.89	270	38	269	39

5.3 Scenario 2: 2031 Local Plan results

5.3.1 Scenario 2 consists of specific development sites identified in the local plan, in addition to the development included in Scenario 1.

5.3.2 A summary of overall junction performance across the network is provided in Table 5.3. This gives the total number of junctions in the model approaching capacity, with an RFC greater than 0.85 but less than one, and those over capacity, with an RFC greater than one.

Table 5.3: Scenario 2 2031 Local Plan: junction performance results

RFC criteria	Morning peak	Evening peak
No. junctions with 0.85 < RFC < 1.0	6	11
No. junctions with RFC > 1.0	32	36

5.3.3 The results show a further increase in the number of junctions approaching capacity, but a small increase in the number of junctions operating over capacity.

5.3.4 A summary of journey time performance across the network is given in Table 5.4. This gives the journey time in seconds and the average speed in kilometres per hour for the routes defined in Section 5.1.

Table 5.4: Scenario 2 2031 Local Plan: journey time summary results

Route	Dir	Length (km)	Morning peak		Evening peak	
			Time (s)	Speed (kph)	Time (s)	Speed (kph)
Bridge Road to Park Road northbound	NB	6.83	948	26	597	41
	SB	6.78	773	32	911	27
Abbey Road (John Whinnerah Roundabout) to	EB	4.09	483	30	596	27
	WB	4.09	530	28	512	29

Route	Dir	Length (km)	Morning peak		Evening peak	
			Time (s)	Speed (kph)	Time (s)	Speed (kph)
Park Road						
Leece Lane, Roose to Hindpool Road	EB	3.31	357	33	558	21
	WB	3.31	447	27	357	33
Bank Lane to Friars Lane/Roose Road	NB	3.95	372	38	609	39
	SB	3.95	415	34	475	30
Crossmill Road to A5087/ Leece Lane/ Roose Road	EB	3.43	397	31	588	21
	WB	3.43	542	23	441	29
Ulverston Road/Urswick Road junction to Abbey Road/Long Lane via Market Street Dalton	NB	2.89	675	15	270	39
	SB	2.89	277	38	293	36

5.3.5 The results show an increase in journey times along most of the routes, particularly along the key routes like Bridge Road/North Road, internal route along Frair's Lane to Bank Lane in northbound direction experiencing an average delay of approximately four minutes; and a route in northbound direction from Abbey Road to Ulverston Road via Market Street, Dalton which will experience average five minutes delays. All other routes will have minimal or no delays. This indicates that the local plan sites would have an impact on journey times along these key routes in Barrow-in-Furness and Dalton.

5.4 Improvement Schemes

5.4.1 The Barrow Transport Improvements Study identifies a number of highway and sustainable transport improvements in the Barrow Borough area. These include junction improvements at key locations on the highway network and walking, cycling and public transport improvements to encourage mode shift and reduce reliance on car travel.

5.4.2 The impact of the improvements has been tested in the Barrow transport model to assess the cumulative impact of the improvements. This is important as capacity improvements at one location have the potential to create additional problems in other areas.

5.4.3 See Barrow Transport Improvement Study Report for further details of key highway and sustainable transport improvements.

5.4.4 Highways improvements at the following junctions have been accessed:

Table 5.5: Junctions Identified for Highway Improvement

Sr #	Junction Name	Existing Junction Type
1.	Abbey Road/Hollow Lane/Hawcoat Lane	Traffic Signals
2.	Abbey Road/Rawlinson Street/Holker Street	Traffic Signals
3.	A590 Park Road/Bank Lane	Priority Junction
4.	A590 Park Road – Ormsgill	Priority Junction
5.	A590 Walney Rd/Phoenix Road	Priority Junction
6.	A590 Walney Road/Wilkie Road	Priority Junction
7.	A590 Walney Road/Asda	Priority Junction
8.	A590 Walney Rd/Ironworks Road	Traffic Signals
9.	A5087 Roose Rd / Risedale Rd	Traffic Signals
10.	Holbeck Road/Leece Lane	Priority Junction
11.	Greengate Street/Risedale Road	Priority Junction
12.	Park Drive/Bridgegate Ave/Risedale Road	Priority Junction
13.	A590 North Road/Bridge Road	Roundabout
14.	A590 Ironworks Road / Phoenix Road	Priority Junction
15.	A590 Jubilee Bridge/Promenade/Central Drive	Traffic Signals
16.	Abbey Road/Market Street	Priority Junction
17.	Long Lane/Newton Road	Priority Junction

5.5 Impact of junction Improvement

5.5.1 A summary of overall junction performance across the network is provided in Table 5.3. This gives the total number of junctions in the model approaching capacity, with an RFC greater than 0.85 but less than one, and those over capacity, with an RFC greater than one.

Table 5.6: Scenario 2 2031 Local Plan: junction performance results

RFC criteria	Morning peak	Evening peak
No. junctions with 0.85 < RFC < 1.0	13	13
No. junctions with RFC > 1.0	12	24

5.5.2 The results provided in the above table shows that with network improvements in place, the number of junctions operating at and above the capacity would reduce significantly, both in the AM peak and the PM peak hours.

5.5.3 The transport modelling report will not attempt to comment on the efficiency of the individual junctions. The junction flow information, maximum average queue length and maximum delays are provided in the appendix.

5.5.4 A summary of journey time performance across the network is given in Table 5.4. This gives the journey time in seconds and the average speed in kilometres per hour for the routes defined in Section 5.1.

Table 5.7: Local Plan Network Improvement: journey time summary results

Route	Dir	Length (km)	Morning peak		Evening peak	
			Time (s)	Speed (kph)	Time (s)	Speed (kph)
Bridge Road to Park Road northbound	NB	6.61	523	45	751	32
	SB	6.78	674	35	794	30
Abbey Road (John Whinnerah Roundabout) to Park Road	EB	4.09	470	31	528	28
	WB	4.09	477	31	463	32
Leece Lane, Roose to Hindpool Road	EB	3.31	348	34	454	26
	WB	3.31	352	34	374	32
Bank Lane to Friars Lane/Roose Road	NB	3.95	322	44	329	43
	SB	3.95	351	41	438	33
Crossmill Road to A5087/ Leece Lane/ Roose Road	EB	3.43	385	32	491	25
	WB	3.43	414	30	465	27
Ulverston Road/Urswick Road junction to Abbey Road/Long Lane via Market Street Dalton	NB	2.89	394	28	398	35
	SB	2.89	305	37	285	36

5.6 Sustainable transport measures

5.6.1 Barrow Transport Improvement Study has identified a number of sustainable transport measures across different areas of Barrow Borough. As a result of the implementation of sustainable transport measures, it is assumed there will be a net reduction in number of car trips across Barrow. However, it is not possible to directly assess the impact of the proposed sustainable transport improvements in the Barrow transport model. However, the improvements study concludes that the successful implementation of these measures has the potential to reduce peak hour traffic demand. The impact of these improvements has therefore been tested in line with this conclusion by reducing traffic demand by eight per cent. Further details on the nature and cost of improvements proposed to support the Borough Local Plan are provided in the Barrow Transport Improvements Study report.

Table 5.8: Sustainable Transport Improvement results

RFC criteria	Morning peak	Evening peak
No. junctions with 0.85 < RFC < 1.0	11	12
No. junctions with RFC > 1.0	8	17

5.6.2 The results show a significant decrease in the number of junctions approaching capacity or operating over capacity. The detail results are provided in the appendix.

5.6.3 A summary of journey time performance across the network is given in Table 5.4. This gives the journey time in seconds and the average speed in kilometres per hour for the routes defined in Section 5.1.

Table 5.9: Local Plan Sustainable Transport Improvement: journey time summary results

Route	Dir	Length (km)	Morning peak		Evening peak	
			Time (s)	Speed (kph)	Time (s)	Speed (kph)
Bridge Road to Park Road northbound	NB	6.61	521	46	557	42
	SB	6.78	655	36	658	36
Abbey Road (John Whinnerah Roundabout) to Park Road	EB	4.09	465	32	442	33
	WB	4.09	473	31	481	31
Leece Lane, Roose to Hindpool Road	EB	3.31	347	34	339	35
	WB	3.31	346	34	351	34
Bank Lane to Friars Lane/Roose Road	NB	3.95	322	44	328	43
	SB	3.95	351	41	358	40
Crossmill Road to A5087/ Leece Lane/ Roose Road	EB	3.43	383	32	383	32
	WB	3.43	408	30	417	30
Ulverston Road/Urswick Road junction to Abbey Road/Long Lane via Market Street Dalton	NB	2.89	342	30	338	31
	SB	2.89	280	37	280	37

5.7 Network Statistics Comparison

5.7.1 To understand the impact of the junction improvements and sustainable transport measures, a comparison of Network Statistics for the AM peak and PM peak for the DM and DS scenarios has been undertaken. The network statistics include the following:

- Transient queues: the sum of time spent queuing at junctions by all vehicles in PCU-hours;
- Over-capacity queues: the sum of time spent queuing at junctions by all vehicles due to them operating in excess of capacity in PCU-hours;
- Link cruise time: the sum of time spend travelling along roads in PCU-hours;
- Total travel time: the sum of the above three times/delays in PCU-hours;
- Travel distance: the sum of total distance travelled by all vehicles across the network in PCU-kilometres; and
- Overall average speed: average speed of all PCUs on network in kilometres per hour.

5.7.2 A comparison of network statistics has been carried out for the Local Plan Base models, local plan model with the improvements suggested in Barrow Improvement Study, and local plan model with sustainable transport measures. Table given below provides a summary of some key statistics

Table 5.10: 2031 Barrow local plan network statistics

	LP Base		**LP Improvements**		**LP Sustainable Transport**	
	AM	PM	AM	PM	AM	PM
Transient queues	580	665	522	608	455	478
Over-capacity queues	1,162	1,388	873	782	555	654
Total travel time	3,344	3,693	2,965	3,030	2,484	2,617
Total travel distance	78,095	82,066	77,439	80,725	73,412	73,835
Overall average speed	23	22	26	27	30	28
Fuel consumption	8,746	9,570	8,162	8,651	7,304	7,529

5.7.3 The results show that with the network improvements and sustainable transport measures, the network would be less congested. There would be a reduction in transient queues, link cruise times, fuel consumption and travel time, and an increase in average speeds and the total distance travelled across the network is recorded. With the introduction of sustainable transport measures, there would be a significant reduction in transient queues and link cruise time. Travel time would also decrease because of a net reduction significant amount of traffic would use car as main mode of travel. Smaller queues and less congestion in the network would result in an increase in average speed. Total travel distance has also decreased because people would travel on more direct routes .

5.7.4 A comparison of network statistics for 2030 between 2031 local plan and local plan improvements with sustainable transport scenarios reveals the followings

- Transient queues in the sustainable network reduced by 22% in the AM peak and 28% in PM peak.

- Approximately 52% reduction is recorded in over-capacity queues in both peak periods.
- Increased journey time reliability across the network as total link travel time would reduce by 26% and 29 in the AM and the PM peak respectively.
- Overall reduction in distance to 6% in the AM peak and 10% in the PM.
- Average speed is forecast to increase from 23 km/h to 30 km/h in the AM peak and in the PM peak it would also increase from 22 km/h to 28 km/h.

6 Summary

6.1.1 A summary of the junction performance results for all scenarios is presented below in Table 6.1. The summary shows how the number of over capacity junctions is expected to increase in each scenario.

Table 6.1: Summary of over capacity junction performance results

Scenario	Morning peak	Evening peak
2031 Base	17	24
2031 Local Plan	32	36
2031 with highway improvements	12	24
2031 with highway and sustainable transport improvements	8	17

6.1.2 The summary tables show that the number of over capacity junctions is forecast to increase in the future as a result of additional development. There are larger increases in the number of junctions approaching capacity.

6.1.3 The impact of the development can also be considered by analysing the average speed of vehicles across the whole of Barrow. Table 6.3 shows the average network speed in kilometres per hour across Barrow for all forecast scenarios.

6.1.4 The highway improvements are forecast to result in a significant change in the number of over capacity junctions in 2031 with the local plan, compared to the base scenario.

6.1.5 The results in the previous sections detail how the improvements reduce the number of junctions approaching capacity in both scenarios. With the highway improvements in place, in 2031, there is a decrease in the number of over capacity junctions. With both the highway and sustainable transport improvements the number of junctions over capacity is forecast to decrease significantly. The sustainable transport improvements are shown to reduce the number of over capacity junctions in 2031 when compared to the base scenario.

6.1.6 The results for the highway and sustainable transport improvements show that these are only forecast to improve journey times along key routes. This indicates that more significant improvement in the capacity and reductions in delays as journey times along different routes will improve.

Table 6.2: Average speed across Barrow (kph)

Scenario	Morning peak	Evening peak
2031 Base	26	29.3
2031 Local Plan	23	22
2031 with highway improvements	26	27

2031 with highway and sustainable transport improvements	30	28

6.1.7 Table 6.2 shows the average network speed in kilometres per hour across Barrow for all forecast scenarios and improvement options. The average speed in 2031 is shown to be 30 kph in the morning and 28 kph in the evening peak.

6.1.8 The results for the forecast scenarios show that the average speed is expected to increase in the future with the junction and sustainable transport improvement .This increase generally correlates with the journey time results.

6.1.9 It should also be reiterated that these results are average results for the whole peak hour and represent what is forecast to typically occur. Small changes in traffic flow can result in large variations in queuing and delay throughout the peak hour, and certain traffic effects are not included in the transport model.

7 Conclusion

7.1 Summary

7.1.1 The results of the forecast scenarios have been analysed to assess the impact of the local plan proposals. This included assessing the number of junctions forecast to operate over capacity and the journey times along key routes within Barrow.

7.1.2 The results forecast that the Barrow Local Plan proposals would lead to an increase in congestion in Barrow, based on the maximum RFC of junctions, compared to the base scenario. Journey times are forecast to increase on key routes in the city, particularly on routes where a large proportion of development is located.

7.1.3 The outputs from the model have been used to identify areas of Barrow which are forecast to experience increased queuing and delay with the local plan proposals.

7.1.4 The outputs from the model have been used to identify areas of Barrow which are forecast to experience increased queuing and delay with the local plan proposals. This information is used in further work to help identify potential highway improvements in Barrow and the cost of delivering these improvements. This improvements study also includes measures to increase the use of walking, cycling and public transport, along with indicative costs.

7.1.5 The impact of the measures proposed in the improvements study has also been assessed in the transport model. The results of this assessment show that the highway improvements and successful implementation of the sustainable transport improvements would help mitigate the transport impacts of the local plan.

7.1.6 Further details on the nature and cost of improvements proposed to support the Barrow Local Plan are provided in the Barrow Transport Improvements Study report by PB|WSP. A summary of this study which details the key themes and findings is also available. The improvements study will inform Barrow Borough Council's Infrastructure Delivery Plan, which forms part of the evidence base for the local plan.

Site Name	Location	No. approved	AM Peak Car		PM Peak Car		AM Peak HGV		Traffic Gen - PM Peak HGV	
			Arrivals	Depart	Arrivals	Depart	Arrivals	Depart	Arrivals	Depart
Residential Development										
Roose Garden Centre	Flass Lane	32	7	12	11	7	0.1	0.1	0.1	0.1
Former Arlington House	Abbey Road	11	2	4	4	2	0.0	0.0	0.0	0.0
Barrow Amalgamated Engineers Club	Abbey Road	12	2	4	4	3	0.0	0.0	0.0	0.0
Victoria Park Hotel	Victoria Road	16	3	6	5	3	0.0	0.0	0.0	0.0
Thorncliffe School (South Site)	Thorncliffe Road	29	6	11	10	6	0.1	0.1	0.1	0.1
11 Smallholdings & land adjacent to Duchy Court	Duchy Court	30	6	11	10	6	0.1	0.1	0.1	0.1
Former Lonsdale Hospital Site	School Street	41	8	15	14	9	0.1	0.1	0.1	0.1
Land off Holker Street	Holker Street	63	13	31	32	20	0.1	0.1	0.1	0.1
Bradys Yard (Former)	Wilkie Road	84	13	34	32	18	0.2	0.2	0.2	0.2
Land off Holbeck Park Avenue	Holbeck Park Avenue	106	14	40	35	18	0.2	0.2	0.2	0.2
Listers North Site	Flass lane	168	23	64	55	29	0.3	0.3	0.3	0.3
Land off Sherborne Ave	Sherborne Ave	93	21	57	54	32	0.2	0.2	0.2	0.2
Park View, Barrow in Furness	Park View	54	8	22	17	11	0.0	0.0	0.0	0.0
Mixed/Other Use Development										
GP's Primary Care, Ambulance base	Duke St/Church St	-	108	47	45	91	0.0	0.0	0.0	0.0
Employment										
BAE Logistics Facility	Barrow	-	28	15	11	24	0.0	0.0	0.0	0.0

Site Reference	Address	Site Size	Land Use Type	Traffic Generation Information (Car)				Traffic Generation Information (HGVs)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
EMR01	Remaining part of Furness Business Park, Barrow	4,000 sqm	B1 - Office	94	14	20	24	0	0	0	0
EMR03_a	Waterfront Business Park, Barrow	15,900 sqm	Industrial Estate	88	52	59	81	3	3	3	2
EMR05	Land East of Park Road, Barrow	8.1 Hect.	Industrial Estate	134	81	85	127	4	4	4	3
EMR06	Land West of Robert McBride, Park Rd, Barrow	3.67 Hect.	Industrial Estate	61	37	38	58	2	2	2	1
EMR07	Land South of Kimberley Clark, Park Rd, Barrow	5.45 Hect.	Industrial Estate	90	55	57	86	3	3	3	2
EMR08	Land West of County Park Industrial Estate, Park Rd, Barrow	1.47 Hect.	Industrial Estate	24	15	15	23	1	1	1	1
EMR14	Site at Sandscale Park (West of Railway Line), Barrow	7.86 Hect.	Industrial Estate	130	79	82	124	4	4	4	3
EMR15	Land opposite Phoenix Court, Barrow	0.54 Hect.	Industrial Estate	9	5	6	8	0	0	0	0
EMR16	Phoenix Road (by Travelodge), Barrow	0.65 Hect.	Industrial Estate	11	7	7	10	0	0	0	0
OPP1	Land at Channelside (South), Barrow	1.58 Hect.	Industrial Estate	26	16	16	25	0	0	0	0

Appendix B
Traffic growth factors

Table A1: Morning peak NTEM car growth factors

NTEM Zone	Origin/ Destination	Trip purpose	2014–2031 Base	2014–2031 Local Plan
Barrow-in-Furness	Origin	Commute	0.97027	0.96141
Barrow-in-Furness	Origin	Business	0.98268	0.97727
Barrow-in-Furness	Origin	Other	1.08050	1.07275
Barrow-in-Furness	Destination	Commute	1.01101	1.01054
Barrow-in-Furness	Destination	Business	1.00868	1.00868
Barrow-in-Furness	Destination	Other	1.09536	1.09193
Isle of Walney	Origin	Commute	1.03536	0.99364
Isle of Walney	Origin	Business	1.03546	1.00000
Isle of Walney	Origin	Other	1.15413	1.11009
Isle of Walney	Destination	Commute	1.01684	1.00842
Isle of Walney	Destination	Business	1.03279	1.01639
Isle of Walney	Destination	Other	1.12468	1.09091
Dalton-in-Furness	Origin	Commute	1.01453	0.94592
Dalton-in-Furness	Origin	Business	1.01527	0.96183
Dalton-in-Furness	Origin	Other	1.11845	1.05239
Dalton-in-Furness	Destination	Commute	1.01301	1.00372
Dalton-in-Furness	Destination	Business	1.01429	1.00000
Dalton-in-Furness	Destination	Other	1.11869	1.07122
Askam in Furness	Origin	Commute	0.99088	0.92701
Askam in Furness	Origin	Business	0.98246	0.92982
Askam in Furness	Origin	Other	1.09040	1.03390
Askam in Furness	Destination	Commute	1.00000	0.98765
Askam in Furness	Destination	Business	1.00000	1.00000
Askam in Furness	Destination	Other	1.10656	1.04918
rural (Barrow-in-Furness)	Origin	Commute	0.99638	0.96926
rural (Barrow-in-Furness)	Origin	Business	1.00000	0.97260
rural (Barrow-in-Furness)	Origin	Other	1.08612	1.06220
rural (Barrow-in-Furness)	Destination	Commute	1.01289	1.01105
rural (Barrow-in-Furness)	Destination	Business	1.01408	1.01408
rural (Barrow-in-Furness)	Destination	Other	1.10476	1.09048

Table A2: Evening peak NTEM car growth factors

NTEM Zone	Origin/ Destination	Trip purpose	2014–2031 Base	2014–2031 Local Plan
Barrow-in-Furness	Origin	Commute	1.00562	1.00464
Barrow-in-Furness	Origin	Business	1.00974	1.00886
Barrow-in-Furness	Origin	Other	1.05415	1.04921
Barrow-in-Furness	Destination	Commute	0.96767	0.95898
Barrow-in-Furness	Destination	Business	0.98763	0.98247
Barrow-in-Furness	Destination	Other	1.04490	1.03863
Isle of Walney	Origin	Commute	1.01307	1.00000
Isle of Walney	Origin	Business	1.02817	1.01408
Isle of Walney	Origin	Other	1.09500	1.05877
Isle of Walney	Destination	Commute	1.03245	0.99002
Isle of Walney	Destination	Business	1.04762	1.00680
Isle of Walney	Destination	Other	1.10815	1.06953
Dalton-in-Furness	Origin	Commute	1.01022	0.99387
Dalton-in-Furness	Origin	Business	1.01282	1.00000
Dalton-in-Furness	Origin	Other	1.07701	1.02378
Dalton-in-Furness	Destination	Commute	1.01056	0.94338
Dalton-in-Furness	Destination	Business	1.02206	0.96324
Dalton-in-Furness	Destination	Other	1.08273	1.02172
Askam in Furness	Origin	Commute	1.00000	0.98026
Askam in Furness	Origin	Business	1.00000	0.96154
Askam in Furness	Origin	Other	1.05294	1.00294
Askam in Furness	Destination	Commute	0.98906	0.92560
Askam in Furness	Destination	Business	0.98305	0.93220
Askam in Furness	Destination	Other	1.06510	1.00260
rural (Barrow-in-Furness)	Origin	Commute	1.01316	1.00877
rural (Barrow-in-Furness)	Origin	Business	1.01370	1.01370
rural (Barrow-in-Furness)	Origin	Other	1.06263	1.04848
rural (Barrow-in-Furness)	Destination	Commute	0.99142	0.96567
rural (Barrow-in-Furness)	Destination	Business	0.98667	0.97333
rural (Barrow-in-Furness)	Destination	Other	1.05444	1.03831

Table A3: Fuel and income growth factors

Factors	2014–2031 Base	2014–2031 Local Plan
Income	1.04314	1.04314
Fuel	1.06757	1.06757

Table A4: NTM growth factors

NTEM Zone	Road type	Time period	2014–2031 Base	2014–2031 Local Plan
Barrow-in-Furness	Urban all	AM	1.16491	1.15945
Isle of Walney	Urban all	AM	1.21931	1.18441
Dalton-in-Furness	Urban all	AM	1.19706	1.14496
Askam in Furness	Urban all	AM	1.17796	1.12529
rural (Barrow-in-Furness)	Rural all	AM	1.18742	1.17071
Cumbria	Rural motorway	AM	1.22215	1.22215
Cumbria	Rural trunk	AM	1.20775	1.20775
Cumbria	Rural principal	AM	1.16430	1.16430
Cumbria	Rural minor	AM	1.18075	1.18075
Barrow-in-Furness	Urban all	PM	1.16997	1.16428
Isle of Walney	Urban all	PM	1.22587	1.18630
Dalton-in-Furness	Urban all	PM	1.20281	1.14364
Askam in Furness	Urban all	PM	1.18136	1.12155
rural (Barrow-in-Furness)	Rural all	PM	1.19392	1.17622
Cumbria	Rural motorway	PM	1.23645	1.23645
Cumbria	Rural trunk	PM	1.22188	1.22188
Cumbria	Rural principal	PM	1.17792	1.17792
Cumbria	Rural minor	PM	1.19456	1.19456

Site number	Site name	Settlement	No of dwellings	Traffic Generation Information (Car)				Traffic Generation Information (HGVs)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
SHL001	Marina Village	Barrow	650	87	263	200	122	2	2	1	1
SHL010	Park Vale, Walney	Barrow	178	24	73	57	33	0	0	0	0
REC26	Land East of Holbeck	Barrow	90	12	37	29	17	0	0	0	0
SHL037	E5 Land South of Ashley & Rock, Park Road, Barrow	Barrow	77	10	32	25	14	0	0	0	0
SHL009	Former Golf Driving Range, Walney Road, Barrow	Barrow	80	11	33	26	15	0	0	0	0
SHL071	No. 11 smallholding (including building)	Barrow	35	7	13	12	7	0	0	0	0
SHL047	North Central Clearance Area, Barrow	Barrow	33	7	12	11	7	0	0	0	0
SHL13b	Former Candleworks Site (South), Schneider Rd, Barrow	Barrow	32	7	12	11	7	0.1	0.1	0.1	0.1
SHL068	Fields to rear of Croslands Park (Holly Croft)	Barrow	28	6	10	9	6	0.1	0.1	0.1	0.1
SHL070a	Land to South of Abbey Meadow, Barrow	Barrow	26	5	10	9	5	0.1	0.1	0.1	0.1
SHL100a	Land North of Westpoint Hse (western section), Solway Drive, Walney	Barrow	23	5	9	8	5	0.0	0.0	0.0	0.0
SHL061	Former Kwik Save Premises, Holker St, Barrow	Barrow	22	4	8	7	5	0.0	0.0	0.0	0.0
SHL103	Land off Meadowlands Ave, Barrow	Barrow	22	4	8	7	5	0.0	0.0	0.0	0.0
SHL101	Land South of Westpoint Hse, Solway Drive, Walney	Barrow	21	4	8	7	4	0.0	0.0	0.0	0.0
REC05	Land South of Leece Lane, Barrow	Barrow	19	4	7	6	4	0.0	0.0	0.0	0.0
REC19B	Thorncliffe South (tennis courts/field section)	Barrow	19	4	7	6	4	0.0	0.0	0.0	0.0
REC18	Field to East of Park View, Barrow	Barrow	15	3	6	5	3	0	0	0	0
REC09	Field between Netherby Drive and Ormsgill Lane, Barrow	Barrow	12	2	4	4	3	0	0	0	0

Site number	Site name	Settlement	No of dwellings	Traffic Generation Information (Car)				Traffic Generation Information (HGVs)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Arrivals	Departures	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
REC47	Elliscales Quarry Dalton & Land to West, Dalton	Dalton	70	9	27	23	12	0	0	0	0
REC25a	Land at Greenhills Farm, Dalton	Dalton	69	9	26	23	12	0	0	0	0
REC10	Land to West of Crooklands Brow, Dalton	Dalton	65	9	25	21	11	0	0	0	0
SHL005	Land at Crooklands Brow, Dalton	Dalton	32	4	12	10	5	0	0	0	0
REC43	Land East of Greystone Lane, Dalton	Dalton	30	4	11	10	5	0	0	0	0
REC34	Site at junction of Long Lane & Newton Rd, Dalton	Dalton	24	3	9	8	4	0	0	0	0
REC52	Land at Tantabank, Dalton	Dalton	15	2	6	5	3	0	0	0	0
REC48	Land East of Askam Road, Dalton	Dalton	12	2	5	4	2	0	0	0	0
SHL096	Crompton Drive, Dalton	Dalton	11	1	4	4	2	0	0	0	0
REC49	Land at Hollygate Road, Dalton	Dalton	10	1	4	3	2	0	0	0	0
SHL017	Urofoam Factory, Duddon Road	Askam	48	6	18	16	8	0	0	0	0
REC31	Land North of New Road, Askam	Askam	27	4	10	9	5	0	0	0	0
REC03	Land at junction of Lots Rd and Duke St, Askam	Askam	16	2	6	5	3	0	0	0	0
REC01	Land East of Saves Lane, Ireleth	Ireleth	15	2	6	5	3	0	0	0	0
REC02	Duke Street, Askam	Askam	9	1	3	3	2	0	0	0	0
REC36	Land South of New Road, Askam	Askam	9	1	3	3	2	0	0	0	0
REC37	Land East of London Road, Lindal	Lindal	36	5	14	12	6	0	0	0	0
SHL082	Land East of Rakesmoor Lane	Barrow	107	14	41	35	18	0	0	0	0