A96 Forecasting Report
VISUM Modelling Results

The Highland Council
01/02/07

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A96 Forecasting Report

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Introduction

1 Introduction

1.1 Project Background

The Highland Council required a traffic model of the A96 corridor between Inverness and Nairn to forecast future traffic levels and patterns relative to a development masterplan which has been recently produced. Faber Maunsell was commissioned to develop and run this strategic traffic model using VISUM software.

Halcrow Group Limited presented Faber Maunsell with details of all the proposed developments along the A96 corridor. This information was translated in to future year matrices and assigned to modified networks which incorporated the proposed designs for the A96 and surrounding road network.

This file note has been prepared to present the results from the model runs and to illustrate the potential benefits and problems facing the A96 corridor up to the year 2041.

1.2 Modelling Background Information

The models which are presented in this file note are based on the 2005 Inverness models, which were calibrated and validated using turning count and journey time information. These models were extended to incorporate the road network between Inverness and east of Nairn. Additional journey times and link flows were used to calibrate and validate these models.

It must be stated that the models presented in this file note are going through a number of enhancements which will result in more robust models. Consequently, this may result in changes to the outcomes presented in this file note as the model is developed further.

1.3 Model Capabilities

It should be noted that the model reported upon in this note contains only one of the possible behavioural responses to increases in congestion: that of rerouting the journey. This is a highway assignment model that can represent the generation of car trips due to housing, retail, industrial or commercial developments, and the routing decisions of trips through the road network from their origins to destinations in the morning and evening peak hours. It cannot, however, represent the following:

- destination choice;
- mode choice;
- macro time of day choice;
- peak spreading; and
- slow modes.

Destination choice is the tendency of people to change where they travel to depending upon the costs of travel. For example, as the travel time to access Inverness through Raigmore Junction increases, people will tend to try to relocate their destination so that they do not have to pass through that bottleneck. Some types of journey are, of course, more discretionary than others, so that, for example, a shopping trip will be more likely to change than a commute. This would be reflected in any model, with different journey purposes modelled separately.

Mode choice is also available to people as a behavioural response. There is the option to change their mode of travel from private car to public transport modes such as rail and bus. Bus speeds are closely related to congestion levels on the general road network. However, the introduction of bus priority can 'decouple' the bus speeds from that of private car, allowing buses to travel at higher average speeds, making them relatively more attractive, especially as road congestion continues to increase.

Macro time of day choice and ***peak spreading*** are responses in which people change their time of travel in response to travel costs. The phenomenon of peak spreading is the result of small changes in individuals' time of departure leading to the increased duration of the busiest periods. Macro time of day choice is a large change in departure time: again, this sort of response will be more likely in more discretionary journeys i.e. a commute to work cannot be changed to late morning as a shopping trip could, but can start half an hour earlier to try to avoid the worst of the congestion.

Slow modes are usually dealt with separately in modelling, if at all. This is a collective term for non-motorised modes of transport, especially cycling and walking. The forecasting of the levels of car trips generated by the proposed developments was undertaken using 'trip rates' derived from studies of developments built over the last couple of decades. However, these developments are to be designed in line with current best practice, with all possible efforts made to integrate different types of land use in order to encourage cycling and walking. It is likely, therefore, that the use of private car for journeys made from these developments will be lower than that seen historically.

The incorporation of any of the above responses would be likely to reduce the amount of car trip making through the most congested areas of the road network. The scenarios reported upon in this note therefore represent the worst case for road traffic and congestion.

Matrix Enhancements

Originally the base 2005 Inverness models used 1991 matrices taken from The Highland Council's Land Use Model TRANUS, therefore the origin and destination trips ends are dated. The Highland Council are aware of the inherent problems associated with this matrix and has acknowledges that trip movements may change once more up to date information becomes available.

Recently, a number of Road Side interviews (RSi) have been carried out by consultants Scott Wilson for their A9 / A82 link road commission. When this data has been processed it will be used within VISUM model to produce better assignments thus making the model more robust. It is anticipated that the results in this file note may change once the RSi information is incorporated it.

Peak Periods

Two time periods have been modelled, the morning and evening peak, however due to the high flow rates in the evening peak, it was deemed appropriate only to report on the evening peak (worst peak).

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Schemes

2 Schemes

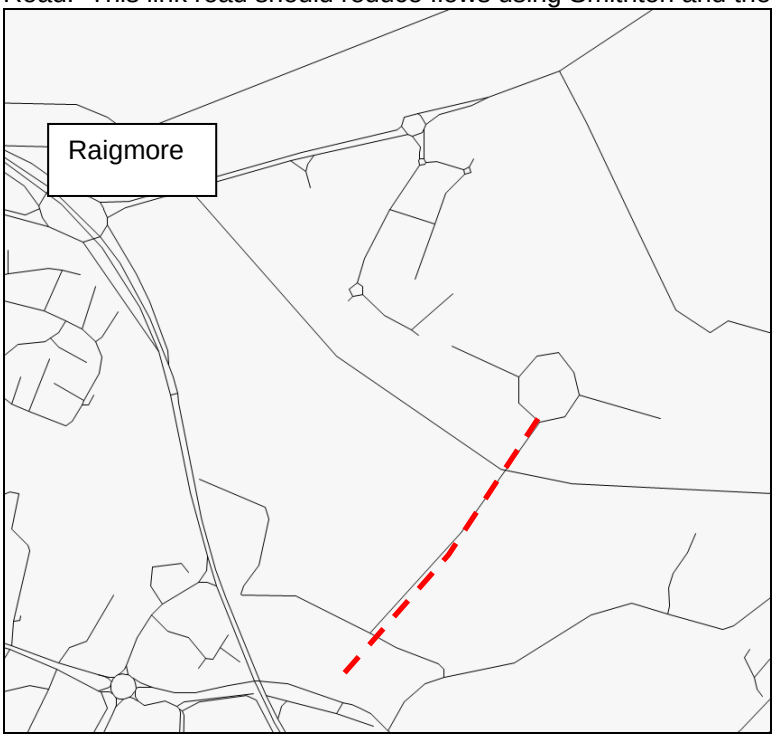
2.1 Network Schemes

The following networks have been developed by Halcrow Group Limited and supplied to Faber Maunsell, via their A96 Corridor Masterplan report (Dated October 2006), to incorporate into the calibrated and validated base models.

In order to understand when the network would require upgrading e.g. dualling the A96, Faber Maunsell produced "building block" networks based on Halcrow Group Limited Masterplans. As traffic flows were projected, Faber Maunsell used these "building block" networks to ease the growing congestion. The following were constructed:

1. Partial Link road between The proposed University of Highland and Islands (UHI) to Culloden Road;
2. 2 lane Dualling of the A96 up to the Inverness Airport Roundabout;
3. 2 lane Dualling of the A96 up to the Inverness Airport Roundabout, with the Link road between the A96 and Inshes Roundabout and a partial Nairn Bypass;
4. 2 lane Dualling of the A96 up to the Inverness Airport Roundabout, with the Link road between the A96 and Inshes Roundabout;
5. 2 lane Dualling of the A96 up to the proposed Nairn Bypass, with the Link road between the A96 and Inshes Roundabout; and
6. 2 lane Dualling of the A96 up to the proposed Nairn Bypass, with the Link road between the A96 and Inshes Roundabout; and the Nairn Bypass.

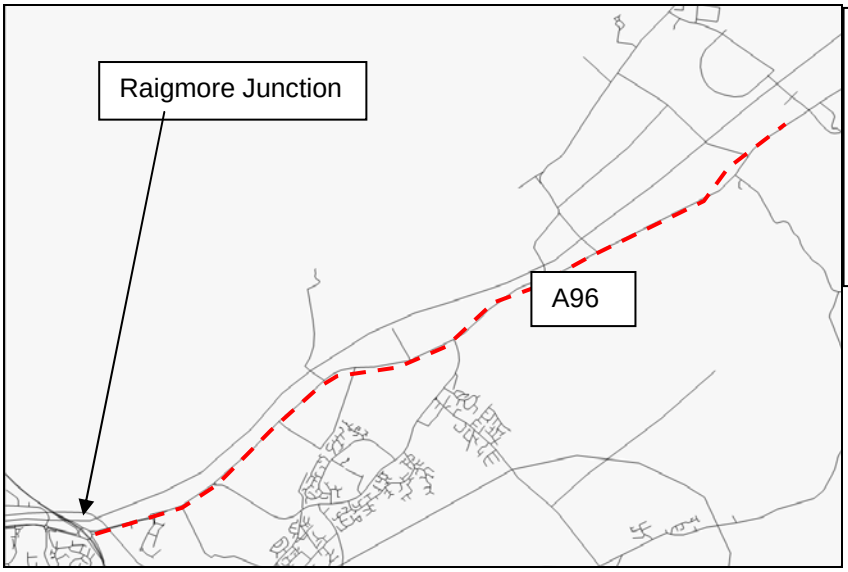
The first network proposes the construction of a partial link road between the UHI and Culloden Road. This link road should reduce flows using Smithton and the A96 (see Figure 1).



- The RED dotted line highlights the Partial link road which is proposed to continue northbound onto the A96 in the future.

Figure 1 – Partial Link Road between UHI and Culloden Road

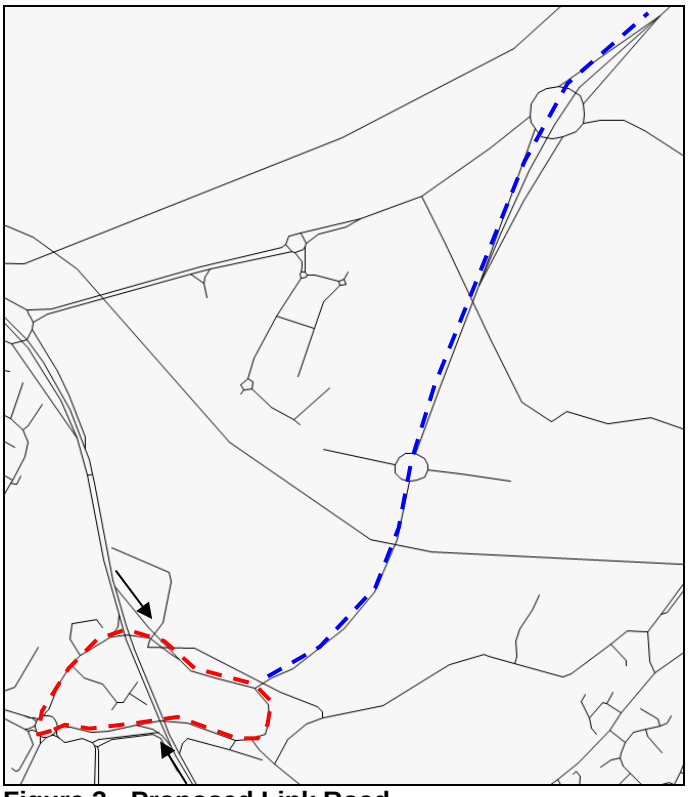
The second network extends the existing 2 lane dual carriageway up to the Inverness Airport roundabout; as illustrated in Figure 2.



- The RED dotted line indicates the extent of the dualling required

Figure 2 – 2 Lane Dualling of the A96 up to Inverness Airport

Networks 2, 3, 4, 5 and 6 all incorporate the full link road between the A96 and Inshes roundabout. As present, Faber Maunsell has proposed the following design for this link (see Figure 3)

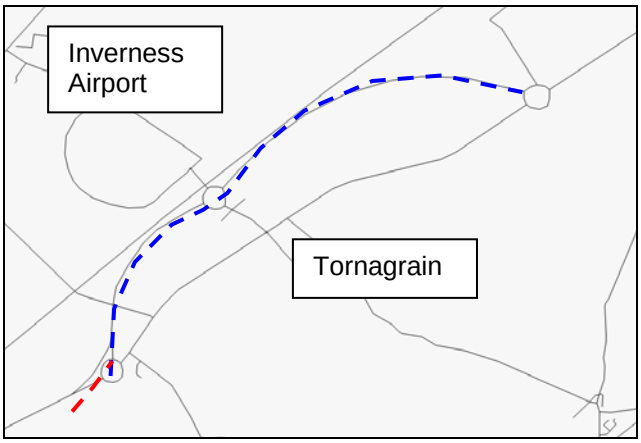


- The BLUE dotted line highlights the Link Road from the A96 to Beechwood area.
- The RED dotted line highlights the gyratory (clockwise) of the road network linking the Link Road with Inshes roundabout. 2 circulating lanes are available for this gyratory traffic.
- At present Faber Maunsell have indicated 2 roundabouts, firstly on the A96, allowing the through movement along the A96; and the roundabout adjacent to Smithton which allows access to the proposed development.
- Two new off slips from the A9 would be required; the locations of these are highlight by the black arrows.

Figure 3 - Proposed Link Road

The Link road has been modelled as a 2 lane dual carriageway, with a similar specification to the A96.

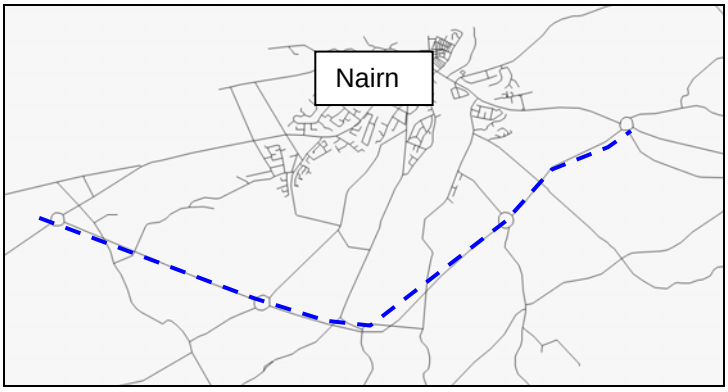
Included in Network 5 is the extension of the 2 lane dual carriageway up to the proposed location of the Nairn Bypass. This network also considers the development at Tornagrain, which has been accommodated by a northern Bypass, which takes the A96 traffic around the Tornagrain development (see Figure 4)



- The BLUE dotted line plots the path of the Tornagrain Bypass.
- Three new roundabouts are required along this stretch to facilitate access to development areas.
- The RED dotted line indicates a slip road to avoid using the roundabout to the west. This was considered to be necessary in the future years due to high levels of traffic (see chapter 1.4).

Figure 4 – Tornagrain Bypass

Network 6 includes all of the above network improvements, plus the Nairn Bypass, as illustrated in Figure 5 below.



- The BLUE dotted line highlights the path of the Nairn Bypass.
- 4 new roundabouts are required, 2 of which would provide access to developments and access to Nairn from the south.
- The proposed bypass should ease the continuing traffic pressures within Nairn

Figure 5 - Nairn Bypass

A partial bypass has also been modelled to facilitate development earlier in the programme.

At present the Nairn Bypass has been modelled as a 2 lane dual carriageway in order to keep continuity of capacity and route character along the length of the A96. However, traffic flows determined from the model and presented within Chapter 1.4 indicate a single lane carriageway would suffice.

The development matrices were developed in 5 year increments, starting at 2011 and continuing up to 2041. At each step the performance of the network was reviewed and the appropriate modifications applied in order to reduce congestion where possible.

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Modelling Results

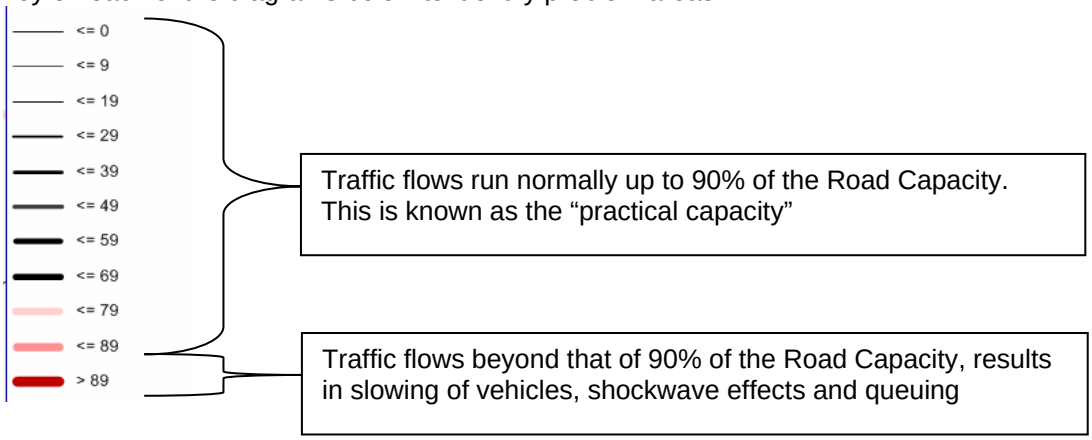
3 Modelling Results

Model Results

It is beneficial for The Highland Council and road users that network problems are identified before they occur on the road network. The following chapter reports on the modelling results extracted from the model. These results clearly outline areas of concerns and the network improvements required to reduce these problem areas.

Firstly, in order to correctly define when network improvements maybe required, volume over link capacities were used (V/C ratios). Each link on the network was examined and given a colour identification to highlight whether it was coping with the level of traffic.

The diagram below indicates V/C ratios and their associated colour. The reader should use the V/C key on each of the diagrams below to identify problem areas.



These V/C ratios allow comparisons to be highlighted between two models e.g. comparing 2 different schemes to establish which one would suffice the current levels of traffic flow. As well as V/C ratios, link flows have also be extracted from the models to illustrate the growth in traffic in the following areas:

A96 East of Raigmore Junction
A96 West of Tornagrain Development
A96 Between Tornagrain Development and Nairn
Culloden Road West of A9
Nairn, Through Road
Nairn Bypass
Link Road

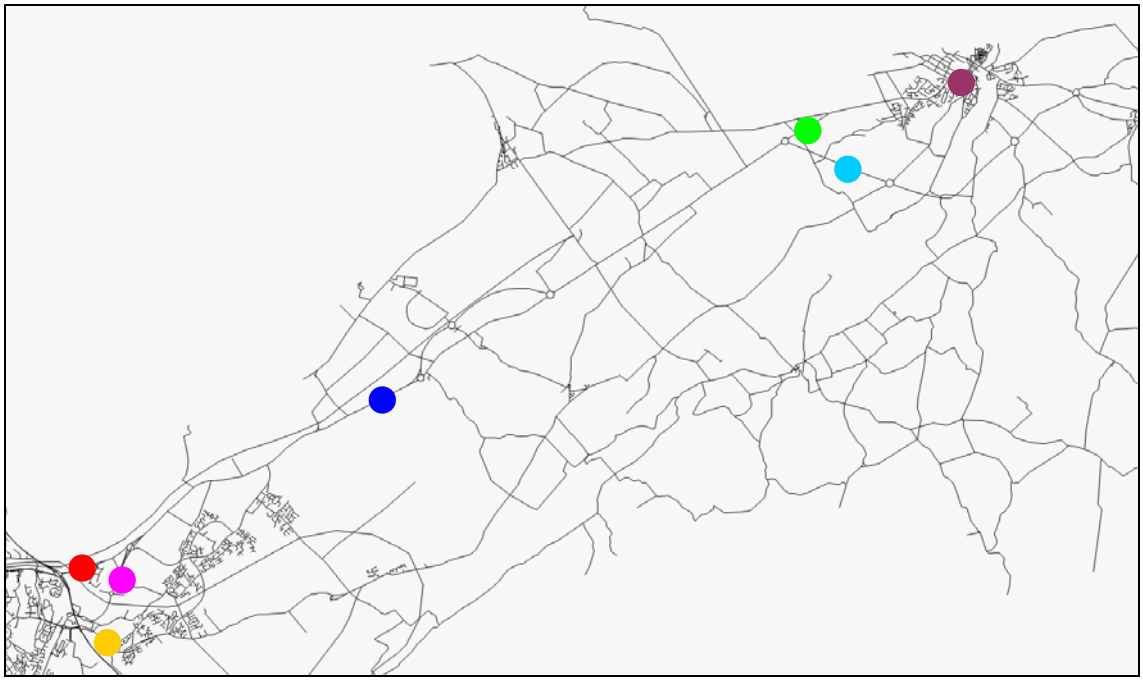


Diagram 1 – Location of Two-Way Count Sites

Model Results

In order to assist the reader in understanding the affects additional traffic has on the network, each model has been compared with the preceding model (Diagram 2 illustrates this further).

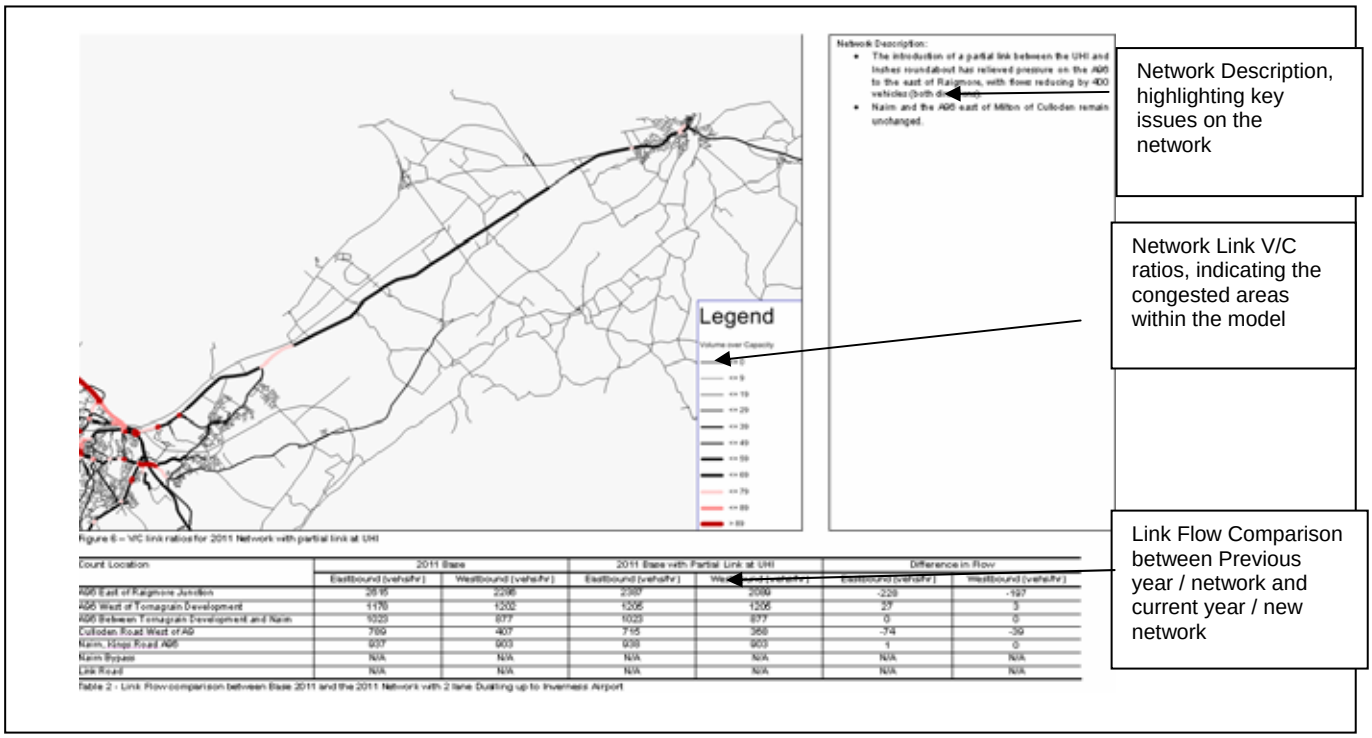


Diagram 2 – Model fact sheet Layout Description

Firstly, the current situation has been modelled to illustrate the 2005 base situation (Figure 6).

The first projection to the year 2011 indicates limited capacity issues along the A96 and parallel routes. Raigmore Junction and the Culloden approach to Inshes are indicating some capacity problems (Figure 7). Nairn at present has limited traffic problems; with link capacities within the practical capacity.

Figure 6 – V/C link ratios for PM 2005 Network

Network Description:

- The 2005 situation indicates junction problems at Raigmore Junction and the Retail Park to the east.
- The A96 links indicate no capacity problems with V/C link ratios under 70%

Count Location	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2216	1798
A96 West of Tornagrain Development	876	791
A96 Between Tornagrain Development and Nairn	818	618
Culloden Road West of A9	421	149
Nairn, Through Road	731	618
Nairn Bypass	N/A	N/A
Link Road	N/A	N/A

Table 1 - Link flow for 2005 Base Network

Figure 7 – V/C link ratios for PM 2011 Network

Network Description:

- Projecting forward to 2011 indicates link capacities to the east of Raigmore are reaching capacity.
- East of Inshes roundabout also indicates link capacity problems with link V/C ratios above the practical capacity.
- In Nairn, V/C link capacity ratios of between 70 and 80% are seen.

Count Location	2005 Base		2011 Base		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2216	1798	2615	2286	399	488
A96 West of Tornagrain Development	876	791	1178	1202	302	411
A96 Between Tornagrain Development and Nairn	818	618	1023	877	205	259
Culloden Road West of A9	421	149	789	407	368	258
Nairn, Through Road	731	618	937	903	206	285
Nairn Bypass	N/A	N/A	N/A	N/A	N/A	N/A
Link Road	N/A	N/A	N/A	N/A	N/A	N/A

Table 2 - Link Flow comparison between Base 2005 and the 2011 Base Networks

Network Description:

- The introduction of a partial link between the UHI and Inshes roundabout has relieved pressure on the A96 to the east of Raigmore, with flows reducing by 400 vehicles (both directions).
- Nairn and the A96 east of Milton of Culloden remain unchanged.
- Junction, including Raigmore interchange and Smithton roundabout are displaying V/C ratios higher than their practical capacity.

Figure 8 – V/C link ratios for 2011 Network with partial link at UHI

Count Location	2011 Base		2011 Base with Partial Link at UHI		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2615	2286	2387	2089	-228	-197
A96 West of Tornagrain Development	1178	1202	1205	1205	27	3
A96 Between Tornagrain Development and Nairn	1023	877	1023	877	0	0
Culloden Road West of A9	789	407	715	368	-74	-39
Nairn, Through Road	937	903	938	903	1	0
Nairn Bypass	N/A	N/A	N/A	N/A	N/A	N/A
Link Road	N/A	N/A	N/A	N/A	N/A	N/A

Table 3 - Link Flow comparison between Base 2011 Base Network and the 2011 Base Network with Partial Link at UHI

Although not indicated in the 2011 model, it would be prudent to consider partial dualling of the A96 up to the airport as highlighted in the 2016 results below. Escalating capacity restraint is evident after 2011, due to the increased development demand.

It is indicated from the figures above, that the inclusion of part of the A9 / A96 link road may relieve traffic pressure from the A96 east of Raigmore and the Smithton area.

Table 3 clearly shows a drop in traffic flow on the A96 east of Raigmore Interchange with the introduction of the partial Link road.

Moving onto 2016, traffic volumes have started to cause the A96 problems between Raigmore and Inverness Airport as illustrated in Figure 9.

Figure 9 – V/C link ratios for 2016 Network with partial link at UHI

Network Description:

- Projecting forward to 2016 indicates that the A96 will suffer greater queues than at present to the east of Milton of Culloden, with V/C Link ratios rising above that of the practical capacity.
- Nairn is also displaying signs of congestion due to activities from new developments. These additional trips require travelling through Nairn to access the A96.
- All links display a general rise in traffic as would be expected.

Count Location	2011 Base with Partial Link at UHI		2016 Base with Partial Link at UHI		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2387	2089	2796	2569	409	480
A96 West of Tornagrain Development	1205	1205	1572	1605	367	400
A96 Between Tornagrain Development and Nairn	1023	877	1152	1085	129	208
Culloden Road West of A9	715	368	840	689	125	321
Nairn, Through Road	938	903	1085	1186	147	283
Nairn Bypass	N/A	N/A	N/A	N/A	N/A	N/A
Link Road	N/A	N/A	N/A	N/A	N/A	N/A

Table 4 - Link Flow comparison between Base 2011 and 2016 Base Networks with Partial Link at UHI

Network Description:

- Introducing the full link between Inshes Roundabout and the A96 has removed 600 vehicles (both directions from the A96 east of Raigmore roundabout.
- The dualling of the A96 up to Inverness Airport, has resulted in the potential for less queuing on the A96 west of the Airport
- The introduction of the Partial Nairn bypass has also removed trips going through Nairn to access the A96. Traffic volumes in Nairn have dropped by 220 vehicles (both direction).
- The increase in capacity on the A96 has resulted in traffic reducing on the Culloden road in favour of the A96.

Figure 10 – V/C link ratios for 2016 Network with 2 lane Dualling up to Inverness Airport, plus Link Road and Partial Nairn Bypass

Count Location	2016 Base with Partial Link at UHI		2016 with link, partial dualling and part Nairn bypass		Difference in Flow	
	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2796	2569	2434	2324	-362	-245
A96 West of Tornagrain Development	1572	1605	2014	2210	442	605
A96 Between Tornagrain Development and Nairn	1152	1085	870	793	-282	-292
Culloden Road West of A9	840	689	540	260	-300	-429
Nairn, Through Road	1085	1186	980	1093	-105	-93
Nairn Bypass	N/A	N/A	249	233	N/A	N/A
Link Road	N/A	N/A	1163	1067	N/A	N/A

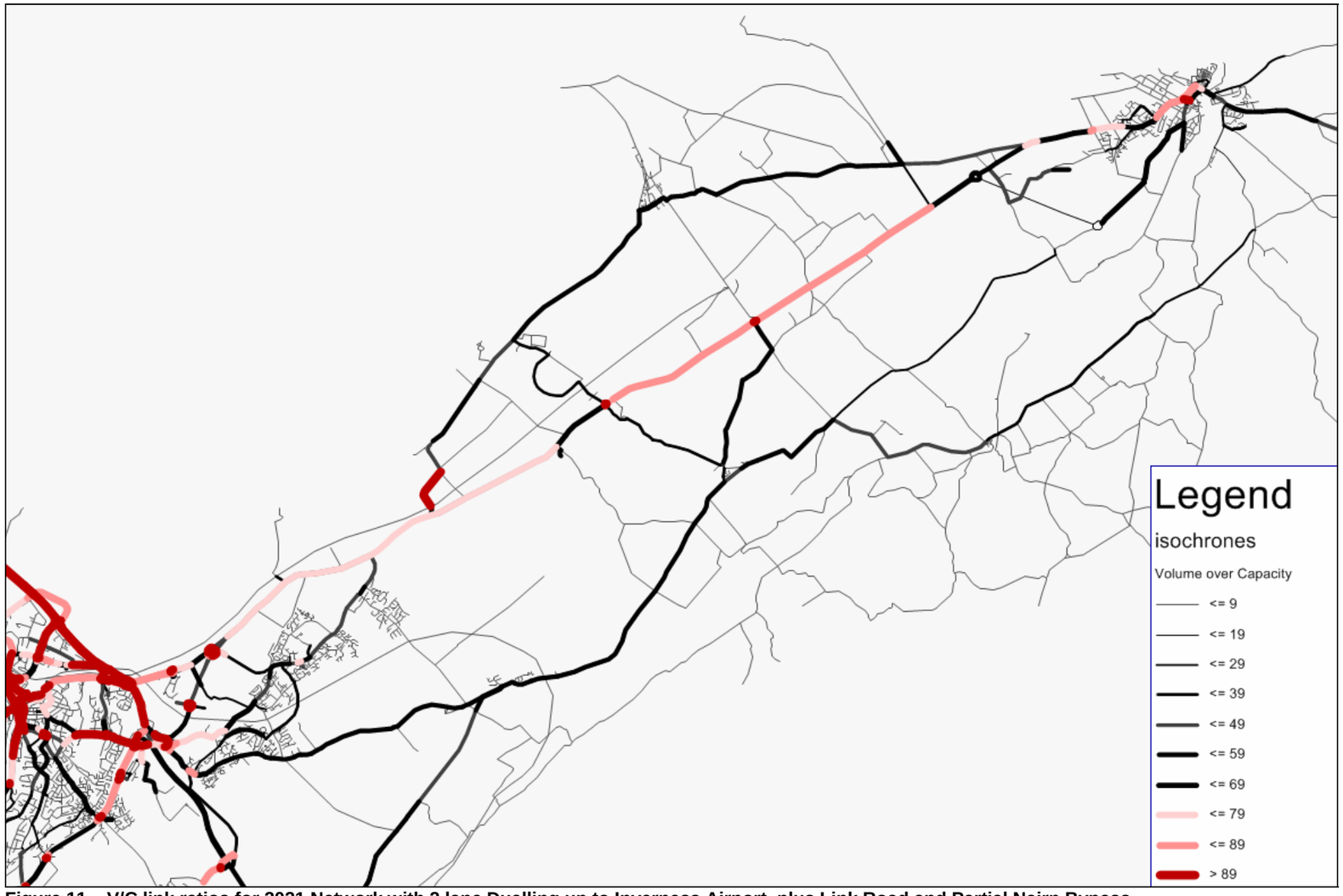
Table 5 - Link Flow comparison between the 2016 Network with Partial Link at UHI and the 2016 Network with link, partial dualling and part Nairn bypass

With the Link Road and 2 lane dualling between Raigmore and Inverness Airport in place, traffic flows at Raigmore, A96 west of Inverness Airport and the Culloden Road are anticipated to reduce. The Link Road flows are predicted to be in the order of 2250 vehicles (both directions).

Nairn has also benefited with the introduction of the western end of the Nairn bypass which enables traffic to access the A96 without travelling through Nairn.

Although these network changes have been modelled in the year 2016, it is suggested that these changes be in operation at some point between 2011 and 2016.

Projecting forward to 2021, the traffic demand is such that the Nairn town centre displays capacity problems, with through traffic causing V/C link ratios within Nairn increasing above their practical capacity (Figure 11).



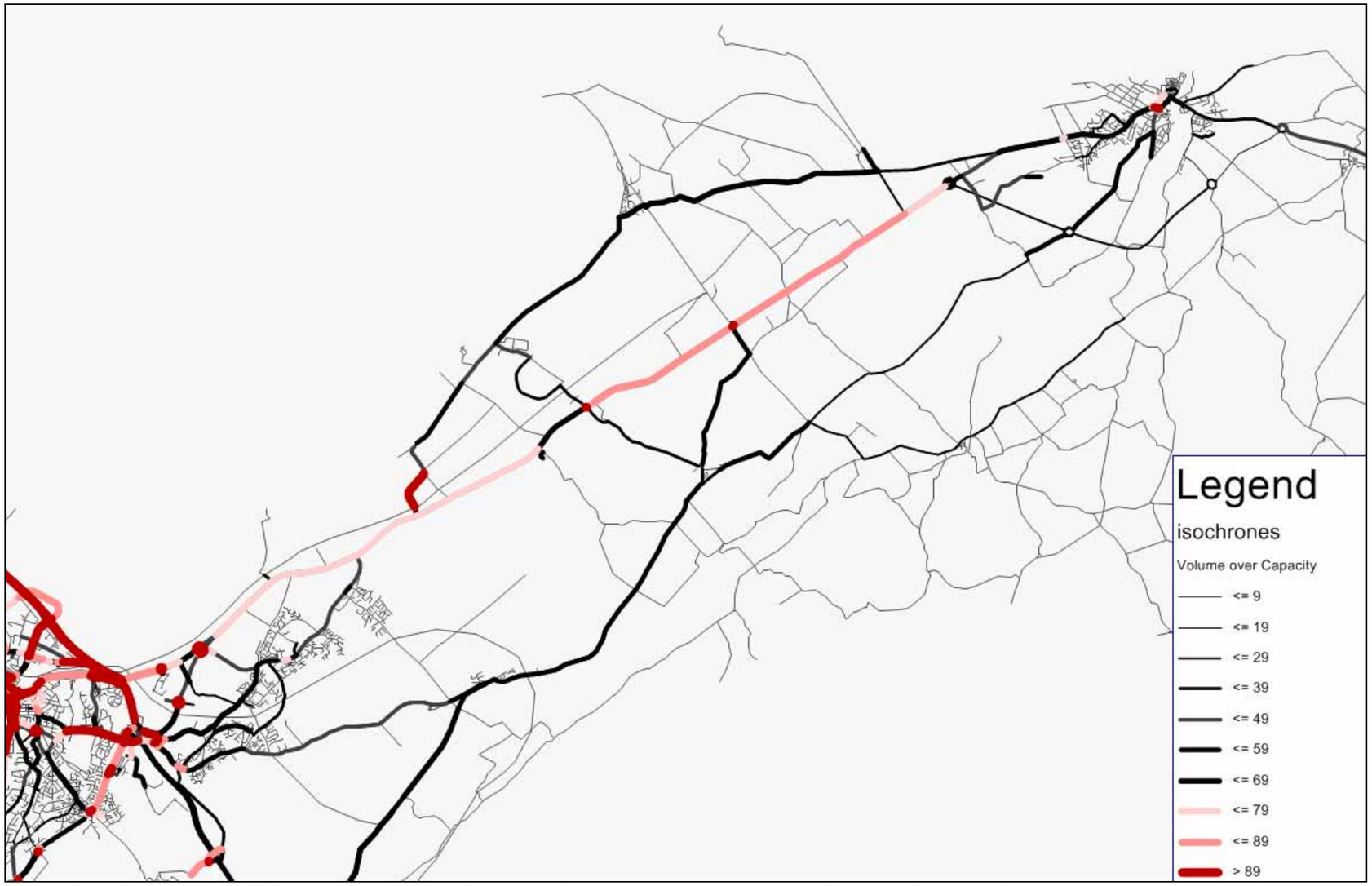
Network Description:

- Moving forward to 2021, the V/C link capacities tend towards 90% (practical capacity).
- The partial Nairn bypass has assisted in the removal of traffic from Nairn, however through traffic is now causing congestion problems.
- A number of junctions along the A96 are displaying link capacity problems.
- Traffic volumes have all increased with the exception of the Nairn bypass, due to delays on the A96 making alternative roads which link to Culloden Road more attractive.

Figure 11 – V/C link ratios for 2021 Network with 2 lane Dualling up to Inverness Airport, plus Link Road and Partial Nairn Bypass

Count Location	2016 with link, partial dualling and part Nairn bypass		2021 with link, partial dualling and part Nairn bypass		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2434	2324	2784	2669	350	345
A96 West of Tornagrain Development	2014	2210	2710	2558	696	348
A96 Between Tornagrain Development and Nairn	870	793	924	884	54	91
Culloden Road West of A9	540	260	683	354	143	94
Nairn, Through Road	980	1093	1094	1229	114	136
Nairn Bypass	249	233	160	171	-89	-62
Link Road	1163	1067	1698	1330	535	263

Table 6 - Link Flows comparison between the 2016 and 2021 Networks with link, partial dualling and part Nairn bypass



Network Description:

- The introduction of the complete Nairn bypass removes approximately 350 vehicles from Nairn.
- The Culloden Road also experiences a marginal reduction in flow due to the bypass.
- Little effect is experienced to the west of Tornagrain is expected.

Figure 12 – V/C link ratios for 2021 Network with 2 lane Dualling up to Inverness Airport, plus Link Road and Full Nairn Bypass

Count Location	2021 with link, partial dualling and part Nairn bypass		2021 with link, partial dualling and full Nairn bypass		Difference in Flow	
	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2784	2669	2780	2665	-4	-4
A96 West of Tornagrain Development	2710	2558	2732	2550	22	-8
A96 Between Tornagrain Development and Nairn	924	884	786	741	-138	-143
Culloden Road West of A9	683	354	661	333	-22	-21
Nairn, Through Road	1094	1229	924	1036	-170	-193
Nairn Bypass	160	171	363	375	203	204
Link Road	1698	1330	1675	1340	-23	10

Table 7 - Link Flow comparison between the 2021 Network with link, partial dualling and part Nairn bypass, and the 2021 Network with link, partial dualling and full Nairn bypass

The introduction of the Nairn Bypass reduces traffic flows within Nairn by almost 400 vehicles (both directions). The inclusion of the bypass has little effect on A96 west of Tornagrain as expected.

It is suggested that these changes be in operation at some point between 2016 and 2021.

Moving forward to 2026, the network displays problems on the A96 east of Tornagrain, with V/C link capacities rising above the 90% (Figure 13).

Network Description:

- By 2026 the traffic volumes are such that practical link capacity has been reached between Tornagrain and Nairn.
- Link capacities are also expected to be reached west of Tornagrain adjacent to Balloch.
- The largest increase in flow is experienced west of Tornagrain with volumes increasing by 800 vehicles (both directions).

Figure 13 - V/C link ratios for 2026 Network with 2 lane Dualling up to Inverness Airport, plus Link Road and Full Nairn Bypass

Count Location	2021 with link, partial dualling and full Nairn bypass		2026 with link, partial dualling and full Nairn bypass		Difference in Flow	
	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2780	2665	2863	2796	83	131
A96 West of Tornagrain Development	2732	2550	3157	2916	425	366
A96 Between Tornagrain Development and Nairn	786	741	772	727	-14	-14
Culloden Road West of A9	661	333	698	408	37	75
Nairn, Through Road	924	1036	941	1102	17	66
Nairn Bypass	363	375	368	412	5	37
Link Road	1675	1340	1945	1523	270	183

Table 8 - Link Flow comparison between the 2021 and 2026 with link, partial dualling and full Nairn Bypass

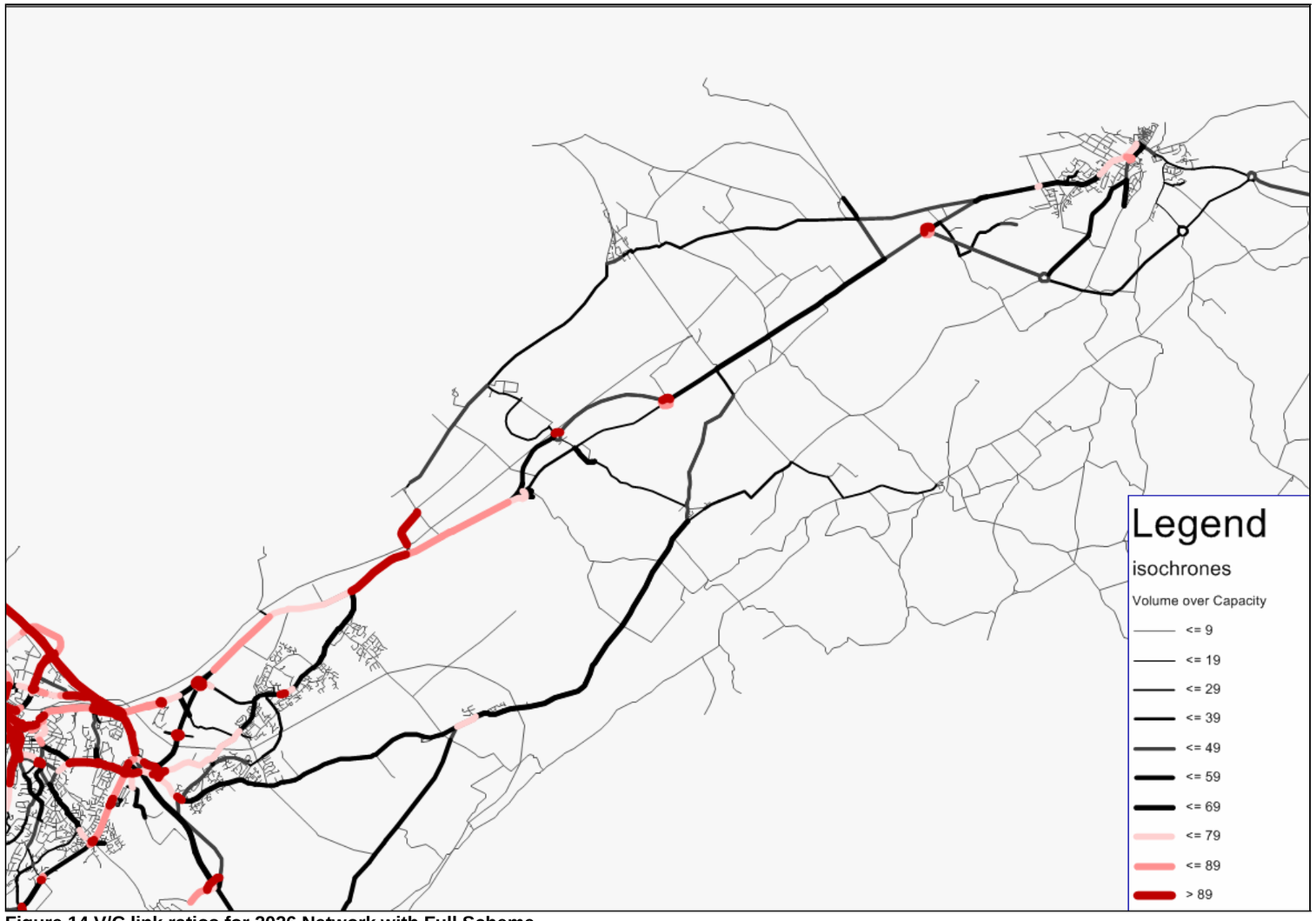


Figure 14 V/C link ratios for 2026 Network with Full Scheme

Network Description:

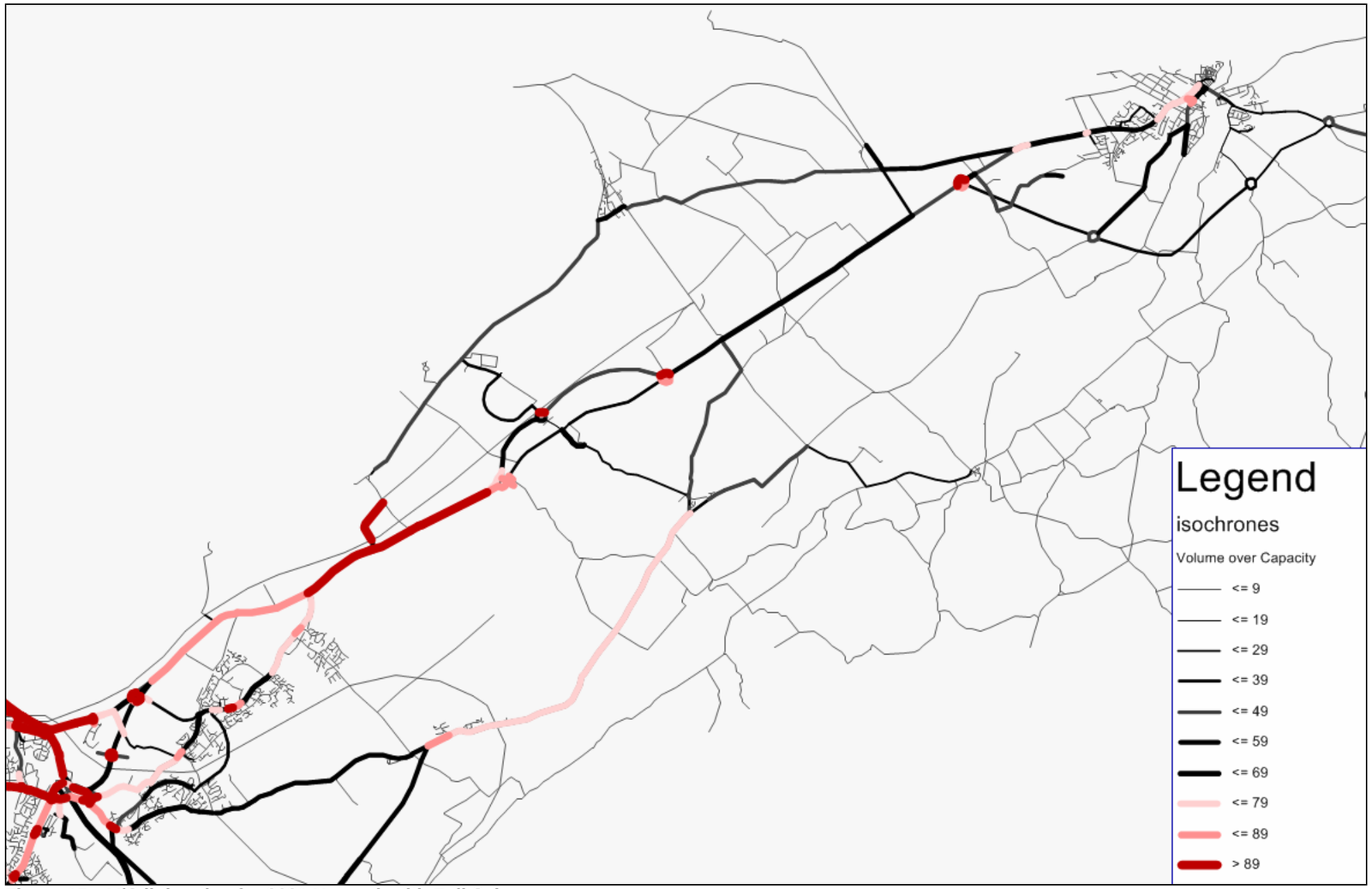
- Due to the levels of traffic volumes, it was deemed necessary to introduce the finally network improvements, Tornagrain bypass and 2 lane dualling up to the Nairn bypass.
- The introduction of these improvements resulted in the V/C link ratios for the A96 east of Tornagrain reducing to acceptable levels.
- The Nairn bypass continues to assist flow in Nairn with an additional 700 vehicles (both directions) being accommodated.
- Problems are still being experienced on the A96 adjacent to Balloch.

Count Location	2026 with link, partial dualling and full Nairn bypass		2026 with Full Scheme		Difference in Flow	
	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2863	2796	2834	2760	-29	-36
A96 West of Tornagrain Development	3157	2916	3204	2875	47	-41
A96 Between Tornagrain Development and Nairn	772	727	760	726	-12	-1
Culloden Road West of A9	698	408	790	394	92	-14
Nairn, Through Road	941	1102	930	1073	-11	-29
Nairn Bypass	368	412	719	780	351	368
Link Road	1945	1523	1917	1528	-28	5

Table 9 - Link Flow comparison between the 2026 Network with link, partial dualling and full Nairn bypass and 2026 Full Schemes

While traffic congestion levels are stabilised with the full scheme in place between 2021 and 2026, however, the network is now required to accommodate a further 15 years of growth to the projected year of 2041.

The following Figures show the comparison between the years 2026 and 2031, 2031 and 2036, and finally 2036 with 2041 Full Schemes. With no more network improvements, the V/C ratios along the A96 and parallel roads gradually worsen as illustrated in Figures 15 to 17.



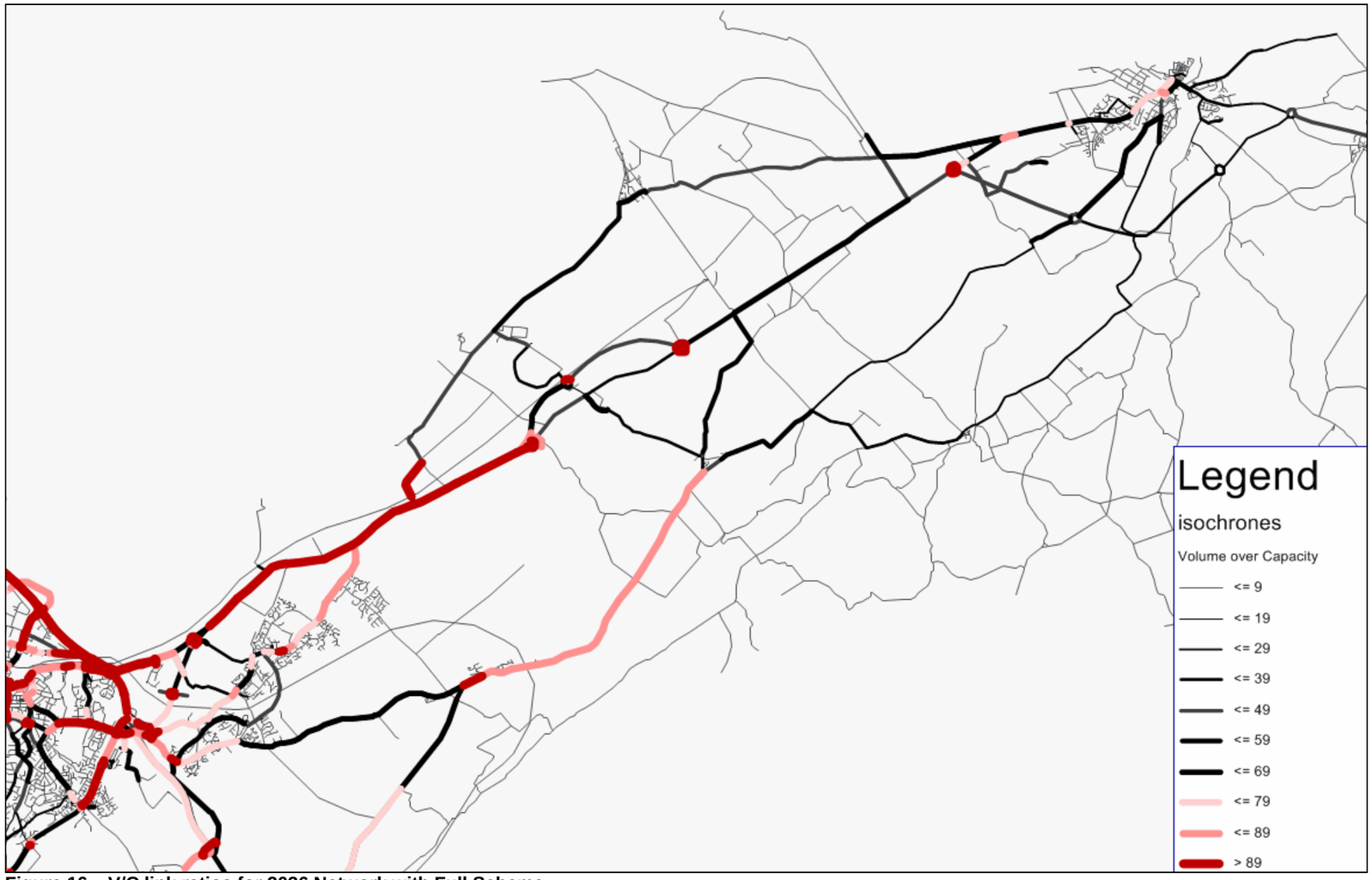
Network Description:

- With the full scheme in place the traffic situation is expected to gradually worsen up to the year 2041.
- The A96 west of Tornagrain displays problems with the V/C link ratios between 90 – 100%.
- The Nairn bypass is indicating reduced flows due to alternative routes being used to avoid the A96.
- The Culloden Road is now starting to show signs of congestion with V/C ratios moving towards 90%.

Figure 15 – V/C link ratios for 2031 Network with Full Scheme

Count Location	2026 with Full Scheme		2031 with Full Scheme		Difference in Flow	
	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2834	2760	2937	2855	103	95
A96 West of Tornagrain Development	3204	2875	3560	3161	356	286
A96 Between Tornagrain Development and Nairn	760	726	834	779	74	53
Culloden Road West of A9	790	394	800	466	10	72
Nairn, Through Road	930	1073	947	1113	17	40
Nairn Bypass	719	780	660	737	-59	-43
Link Road	1917	1528	2038	1628	121	100

Table 10 - Link Flow comparison between the 2026 and 2031Full Schemes



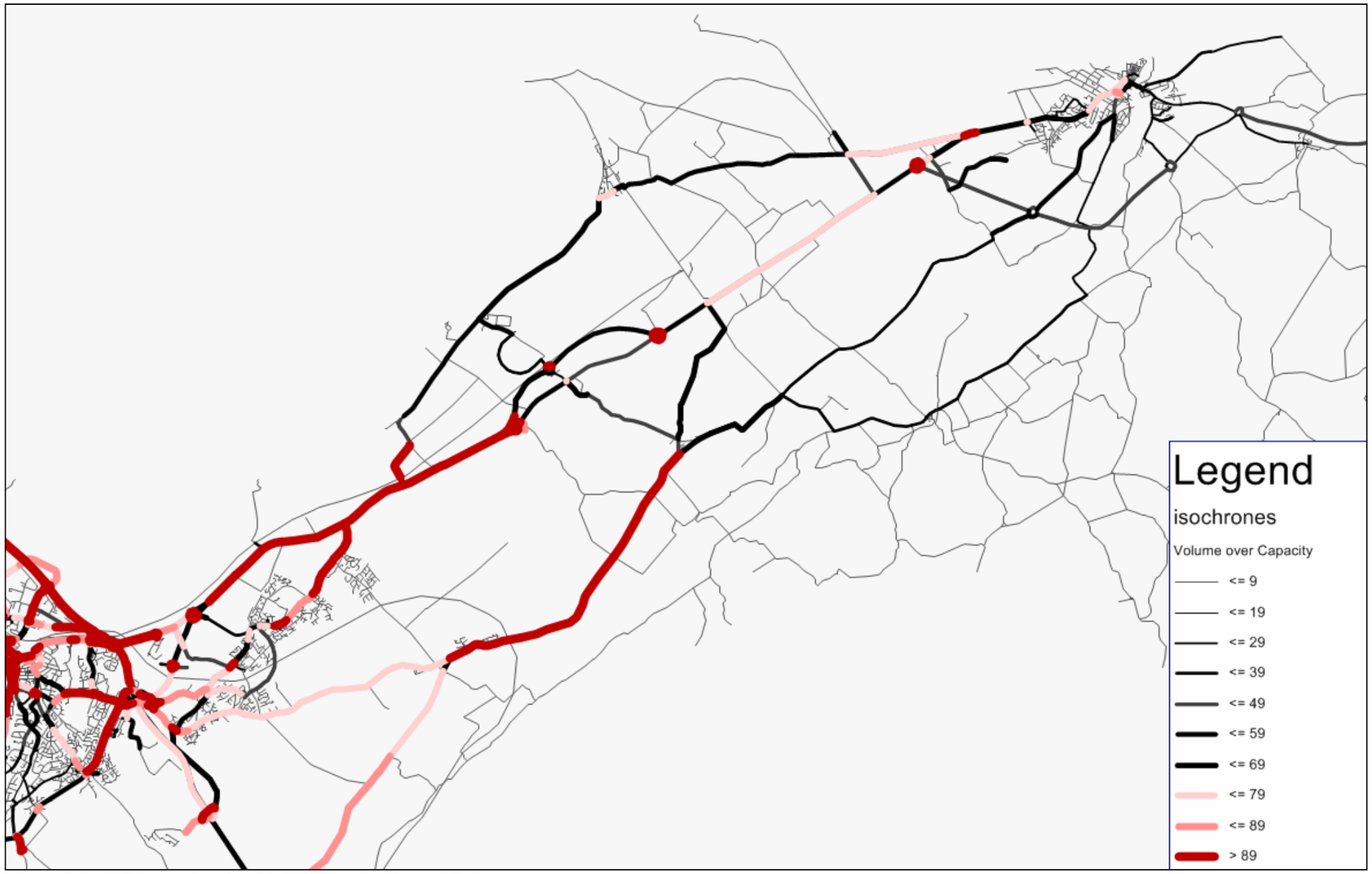
Network Description:

- Flows on all links have increase with the exception of the eastbound movement on the Nairn Bypass which is indicating a drop in flow of 50 vehicles.
- The A96 west of Tornagrain remains an issue with flows increasing by 700 vehicles (both directions). Flows eastbound have now risen above the capacity of the link (3800 vehicles).
- The Culloden Road, adjacent to Newlands has now gone above the practical capacity of the road.

Figure 16 – V/C link ratios for 2036 Network with Full Scheme

Count Location	2031 with Full Scheme		2036 with Full Scheme		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2937	2855	3051	2949	114	94
A96 West of Tornagrain Development	3560	3161	3949	3452	389	291
A96 Between Tornagrain Development and Nairn	834	779	923	811	89	32
Culloden Road West of A9	800	466	834	511	34	45
Nairn, Through Road	947	1113	946	1140	-1	27
Nairn Bypass	660	737	606	759	-54	22
Link Road	2038	1628	2145	1691	107	63

Table 11 - Link Flow comparison between the 2031 and 2036 Full Schemes



Network Description:

- By 2041, the majority of links west of Tornagrain are in excess of the practical link capacity.
- Traffic flows west of Tornagrain increase to around 4300 vehicles in the eastbound direction, 500 vehicles above link capacity
- Culloden Road is also experiencing a similar situation with flow breakdown occurring between Newlands and Croy.
- The Nairn bypass is continuing to assist the town of Nairn. With flows reducing by 70 vehicles (both directions)

Figure 17 – V/C link ratios for 2041 Network with Full Scheme

Count Location	2036 with Full Scheme		2041 with Full Scheme		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	3051	2949	3121	3013	70	64
A96 West of Tornagrain Development	3949	3452	4294	3730	345	278
A96 Between Tornagrain Development and Nairn	923	811	1073	945	150	134
Culloden Road West of A9	834	511	852	496	18	-15
Nairn, Through Road	946	1140	897	1118	-49	-22
Nairn Bypass	606	759	621	770	15	11
Link Road	2145	1691	2283	1822	138	131

Table 12 - Link Flow comparison between the 2036 and 2041 Full Schemes

The projection of traffic growth resulting from the developments proposals between 2026 and 2041 suggests that the proposed full scheme design would experience congestion levels in excess of the present day levels. However it must be re-emphasised that this is the worst case scenario.

Areas of Concern

The main area of concern is between Inverness Airport and the Link Road, where traffic volumes of approximately 4300 and 3700, east and westbound respectively, are predicted. The volume to eastbound is 500 vehicles over the link capacity of 3800 vehicles.

Many of the junctions on the network, including the Link Road and the Tornagrain bypass, indicate that delays due to high traffic volumes may be expected. These junctions would require more detailed modelling, eg micro-simulation modelling within VISSIM, to assess modifications e.g. left slip roads, signalisation etc.

Benefits

The Nairn and Tornagrain Bypasses benefit the local road networks by reducing the number of vehicles travelling through residential areas, as illustrated in Figure 18, thus reducing accident potential and noise and air pollution. The Nairn bypass also enables future expansion to the south, providing access onto the A96.

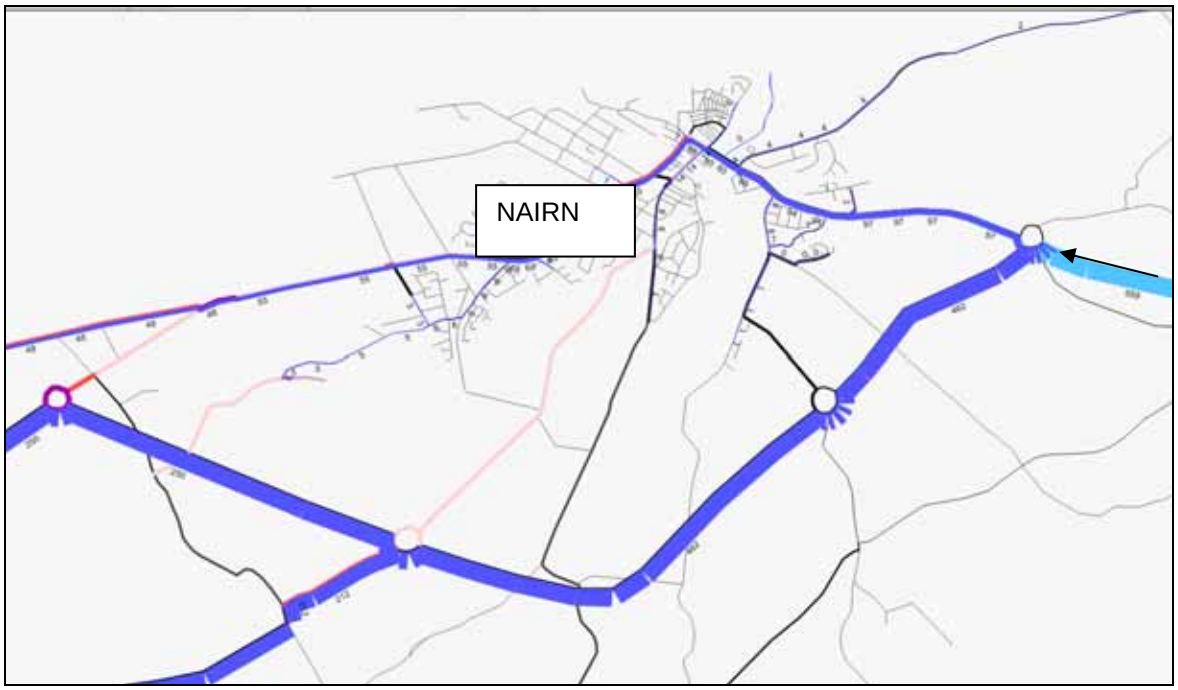


Figure 18 – Route choice from the East of Nairn

As mentioned previously, the Nairn Bypass is modelled as a 2 lane dual carriageway, it is expected that due to volumes being less than 1000 in either direction, the bypass would only require a single lane carriageway; however there is merit for keeping this additional lane for public transport or future development opportunities east of Nairn.

NRTF Growth Rates

As part of this analysis, 2006 base matrices were growthed using the National Road Traffic Forecast (NRTF), in order to understand the expected growth without any proposed development. For the purpose of this analysis, Central Growth was used, which results in a 34.7% increase in traffic over the years 2006 and 2031, the final year given in the NRTF data..

Figure 19 illustrates the V/C link ratios when using the Base network (with no network improvements). Table 13 indicates the difference in flow between the 2006 and 2031 models.

It can be seen that traffic flow increases, however not to the same extent as the development proposal, for example; the link to the west of Tornagrain has been estimated to accommodate a flow of 2100 vehicles in 2031 using NRTF (central growth). This is 450 vehicles more than the 2006 base model, however the 2031 development option indicates a traffic volume of over 6700 vehicles.

Network Description:

- Using the NRTF Central Growth rate the base network is displaying less congestion that that displayed in the 2031 development model with full scheme.
- Generally traffic increases on all links.
- The A96 east of Raigmore indicates approximately a 1000 vehicle (both directions) increase.

Figure 19 – V/C link ratios for 2031 Base Model using NRTF Central Growth

Count Location	2006 Base		2031 Base (using NRTF)		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	2216	1798	2676	2272	460	474
A96 West of Tornagrain Development	876	791	1123	980	247	189
A96 Between Tornagrain Development and Nairn	818	618	1040	816	222	198
Culloden Road West of A9	421	149	753	248	332	99
Nairn, Through Road	731	618	931	833	200	215
Nairn Bypass	N/A	N/A	N/A	N/A	N/A	N/A
Link Road	N/A	N/A	N/A	N/A	N/A	N/A

Table 13 - Link Flow comparison between the 2026 and 2031 Full Schemes

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Public Transport Considerations

4 Public Transport Considerations

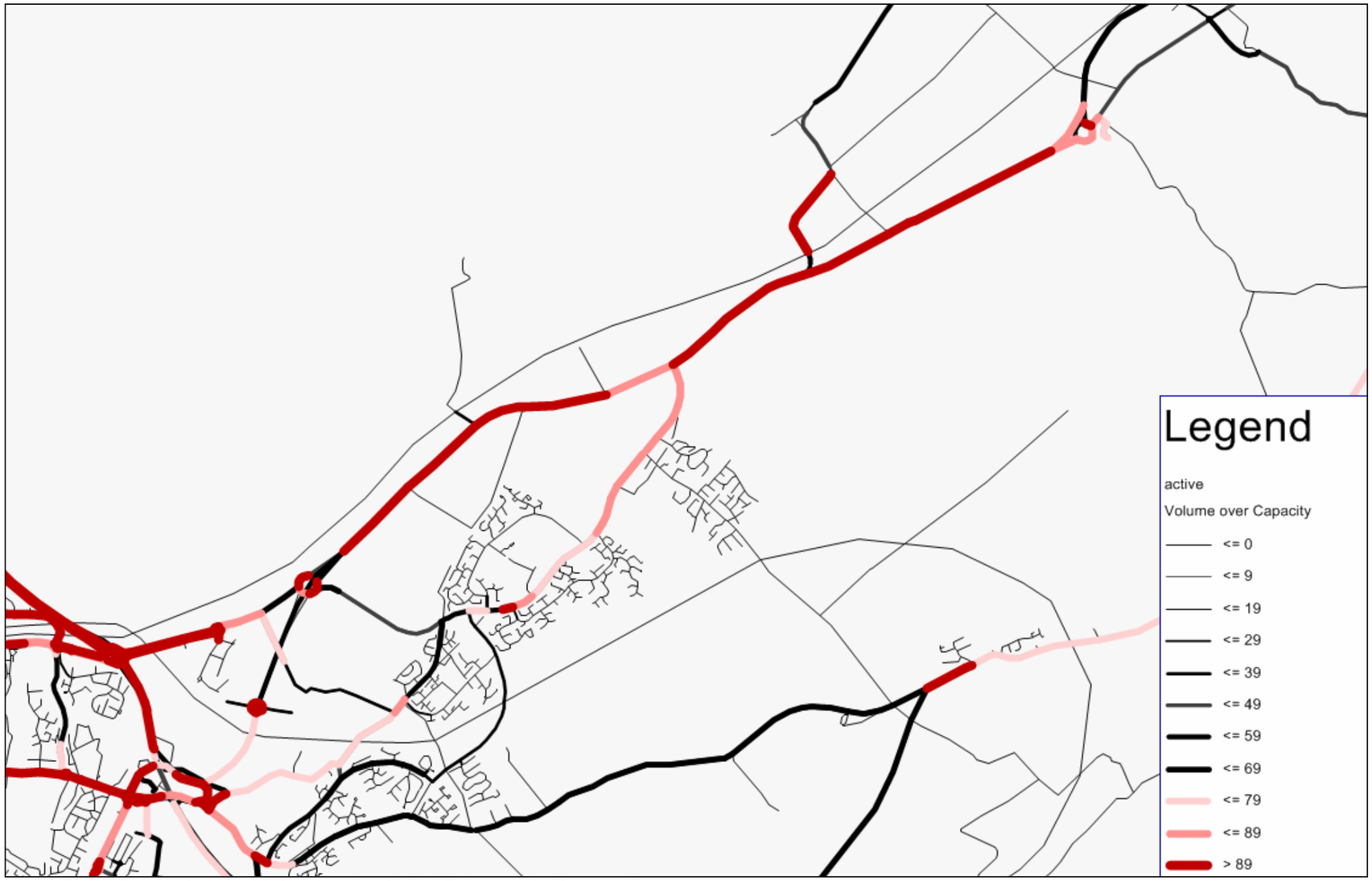
Public Transport Improvements

Public transport has not been a consideration in our modelling analysis. Therefore, the results shown above are “worst case” scenarios. In considering the 2041 network status, it is clear that the A96 west of Tornagrain may experience a break down in traffic flow which would result in queuing and delays. It is therefore a reasonable conclusion that introducing a public transport facility at Tornagrain would ease the traffic pressure on the A96. It is also assumed that due to the proximity of Tornagrain to the Airport / Park and Ride site that greater use of ‘slow modes’ would occur, however this has not been quantified by the model.

The initial recommendation would be the introduction of a park and ride site at Tornagrain. With appropriate bus priorities /. bus lanes along side the A96, the park and ride site has the potential to remove 1000 trips in the PM peak to and from Inverness.

The other potential improvement available is improving the rail services between Inverness and the east. Depending on the level of improvements, it is suggested that there may be a further 700 trips which could potentially be removed from the network.

Figures 20 and 21 indicate the impact this would have on the 2041 PM model.



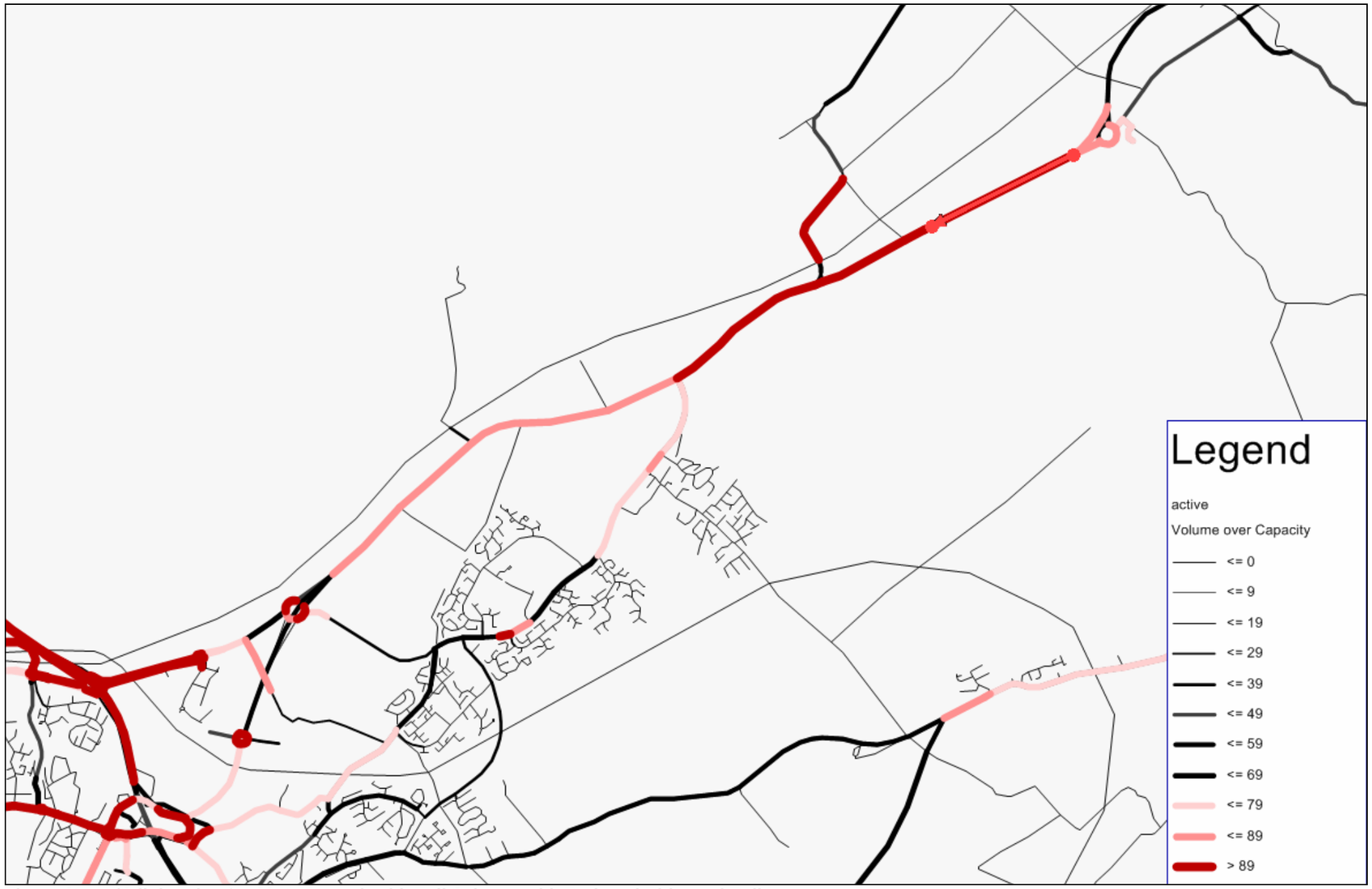
Network Description:

- The introduction of a park and ride site has the potential to remove 700 vehicles (2 way flow) west of Tornagrain.
- The resultant reduction in traffic makes the A96 more attractive and pulls in traffic from the Culloden Road.
- However, even with the Park and Ride site link capacities are still higher than the practical capacity.

Figure 20 – V/C link ratios for 2041 Network with Full Scheme with Park and Ride

Count Location	2041 with Full Scheme		2041 with Full Scheme with Park and Ride		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	3121	3013	3066	2944	-55	-69
A96 West of Tornagrain Development	4294	3730	3909	3400	-385	-330
Culloden Road West of A9	852	496	824	510	-28	14
Link Road	2283	1822	2126	1652	-157	-170

Table 14 - Link Flow comparison between the 2036 and 2041 Full Schemes



Network Description:

- With further improvements to rail links between Inverness and the east, there is a further potential reduction in flow of 400 vehicles (2-way flow) west of Tornagrain.
- It can be seen that this further reduction has resulted in many of the links between Tornagrain and Raigmore falling under the practical capacity.
- However links between Tornagrain and Balloch, and east of Raigmore remain above 90%

Figure 21 – V/C link ratios for 2041 Network with Full Scheme with Park and Ride, and Rail Improvements

Count Location	2041 with Full Scheme		2041 with Full Scheme with Park and Ride, and Rail Improvements		Difference in Flow	
	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)	Eastbound (vehs/hr)	Westbound (vehs/hr)
A96 East of Raigmore Junction	3121	3013	2873	2880	-248	-133
A96 West of Tornagrain Development	4294	3730	3587	3234	-707	-496
Culloden Road West of A9	852	496	769	477	-83	-19
Link Road	2283	1822	2054	1624	-229	-198

Table 15 - Link Flow comparison between the 2036 and 2041 Full Schemes

It can be seen from Figures 20 and 21 that a reduction in traffic volumes along the A96 may be achieved. The Park and Ride site has the potential to remove 390 trips eastbound and a further 330 trips westbound. Improvements to Rail services could potentially result in a further reduction of 320 and 170 trips east and westbound respectively.

These figures are only a guide based on potential trips which are within public transport catchment areas.

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Summary

5 Summary

5.1 Summary

Considering the above results it is clear that predicted traffic volumes are such that the full scheme may be require between the years 2021 and 2026. Initially the network would benefit from a partial link between Culloden and the UHI. 2 lanes of dualling of the A96 up to Inverness Airport is expected to be required and this should be constructed in early course. Between the years 2011 and 2016, the full Link Road and the west side of the Nairn Bypass is predicted to be required. Soon after 2016 the full Nairn Bypass should be in operation and finally the Dualling up to the Nairn Bypass and the Tornagrain bypass will be required after 2021 (see Table 16).

Year	Partial Link Road between UHI and Culloden Road	Full Link Road between A96 and Culloden Road	2 lane Dualling up to Inverness Airport	Partial Nairn Bypass	Complete Nairn Bypass	Full Dualling of the A96 with Tornagrain Bypass
2006			-	-	-	-
2006 - 2011	✓			-	-	-
2011 - 2016	✓	✓	✓	✓	-	-
2016 - 2021	✓	✓	✓	✓	✓	
2021 - 2026	✓	✓	✓	✓	✓	✓
2026 - 2031	✓	✓	✓	✓	✓	✓
2031 - 2036	✓	✓	✓	✓	✓	✓
2026 - 2041	✓	✓	✓	✓	✓	✓

Table 16 – Time Line for Network Improvements

Comparing 2031 NRTF (central growth) Model with 2031 development model, it is clear that the development has a significantly greater impact on the network.

It must be re-emphasised that these results are a “worse case” scenario. Considering the public transport provisions, park and ride and Rail improvements, could reduce traffic flows along the A96 by over 1000 vehicles (both directions), which would extend the life of the network.

It is considered that with greater knowledge of travel patterns the model would be more robust and produce results which may vary the distribution of traffic, resulting in a less congested network.