THE MORAY COUNCIL

Elgin Vissim Microsimulation Model
STAG Option Testing Report
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Halcrow Group Limited
16 Abercromby Place Edinburgh EH3 6LB
Tel +44 (0)131 272 3300 Fax +44 (0)131 272 3301
www.halcrow.com

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Contents Amendment Record

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Halcrow Group Limited
16 Abercromby Place Edinburgh EH3 6LB
Tel +44 (0)131 272 3300 Fax +44 (0)131 272 3301
www.halcrow.com

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Glossary

AM Peak Period	08:00 to 09:00 Monday to Friday
PM Peak Period	17:00 to 18:00 Monday to Friday
Saturday Peak Period	12:00 to 13:00 Saturday
Average vehicle speed	The time taken and distance travelled by all vehicles in the model, expressed as an average
Blocking back	Vehicles waiting to pass through one junction queue through another junction
Convergence	The point of equilibrium in a model after a number of iterations
Flare length	The additional carriageway width on a side road at a junction to allow for left turning traffic
Green time	The period of time which a traffic signal shows a green aspect within the overall signal timing
HGV	Heavy Goods Vehicle
Journey time	Time taken for a vehicle to travel from A to B
Level of Service	The average level of delay (secs) per vehicle over a set time period on each approach arm, and expressed on a six point scale (A – F)
Matrix	The table of vehicle movements from each Origin Zone to each Destination Zone
NRTF	National Road Traffic Forecasts – Department for Transport
OD pairing	The start and end point of any unique vehicle movement
Stacking Lane	The additional carriageway width on a main road to allow right turning traffic to wait before turning
STAG	Scottish Transport Appraisal Guidance – The Scottish Executive
Total vehicle hours	The total time spent by all vehicles on a road network, expressed in hours
Trip	Any single vehicle journey from A to B
TSP	Transport Policy – from The Moray Council Local Transport Strategy
Vissim	A computerised traffic micro-simulation modelling software package
Zone	A location or area from which vehicle trips start or end

Executive Summary

The Halcrow Group was commissioned by The Moray Council (TMC) to test various options from the STAG 1 appraisal process to take forward to the more detailed STAG 2 process.

This report outlines the traffic modelling options undertaken as part of the STAG1 appraisal process in order to provide part of the rationale for taking options forward.. It sets out a description of the options tested through the traffic model and provides the quantitative results obtained from the option tests.

This report makes no explicit recommendations on what options should be carried forward but simply states the facts based on analysis.

For the traffic management options none of the options were found to be effective in traffic terms of improving conditions within Elgin.

Modelling the link options, Option 4 (Wittet drive) & Option 6 (Morriston Road Link) all improved traffic conditions for Elgin as a whole. Option 5 (Wards Road) did little to alleviate traffic conditions in Elgin.

None of the A96 and A941 improvement options were found to be particularly successful on a global basis and all benefits were highly localised in nature.

In traffic terms all of the potential bypass options had global benefits by reducing overall travel times within Elgin and increasing overall average speeds on the network.

Of the combination options, all saw marginal increases in benefits although most of these could be attributed to the link options (4&6) that they were associated with. It is debateable whether the additional costs of these combination options could justify the marginal increases in traffic benefits.

1 Introduction

1.1 *Background*

The STAG process is an appraisal methodology whereby options are appraised against several criteria in the Part 1 stage. Following this Part 1 process several options are carried forward to be appraised on a more detailed basis via a Part 2 STAG.

This report has been produced to aid the decision making process in Part 1 by outlining the results from one of the appraisal criteria – traffic impacts. This report provides the results of the various traffic modelling tests undertaken on the options. It makes no recommendations on what options should be carried forward although it states what options were beneficial in traffic terms as part of the traffic modelling tests

1.2 *Scope and Structure of the Report*

Following this introduction, Chapter 2 describes the reference case scenario that all options will be benchmarked against. The reference case scenario represents a horizon year of 2012 that includes all committed developments and infrastructure changes. Chapters 3 to 9 describe the options in detail, grouped by chapter into option categories as defined by The Moray Council (TMC. Each option is described in detail and displayed in a diagram. A summary of the key impacts of the option when compared with the reference case is then provided.

Appendix A contains Level of Service (LoS) diagrams for all successfully completed model assignments. Level of Service diagrams categorise the level of congestion on each approach arm of each intersection and also the intersection as a whole. This is calculated by examining the average level of delay per vehicle over a set time period on each approach arm. This average will then fall within a category between A and F dependent upon how much delay exists at this location. These can then be colour coded in order to provide an effective at-a-glance view of how the network is performing. All LoS diagrams have been calculated using a single peak hour from the reference case model in each time period.

Appendix B contains some basic global network statistics for all successfully completed model assignments. These are provided for each option and for each period separately. The statistics provided are total vehicle travel hours and average

vehicle speed. Both statistics are provided for the full two hour evaluation period in each time period.

A number of journey time routes through the modelled network have been used in order to compare the impact of some options with the reference case scenario. These 8 routes are shown in Appendix C.

1.3 Options to be tested

The list of Options to be tested, by their groupings was agreed with TMC and is shown in Table 1-1: Options to be Tested

Table 1-1: Options to be Tested

Group		Ref	Modelling Options
Appraisal Benchmark	Reference Case	0	Committed Development and Forecast Development
Traffic Management		1	Gyratory System
		2	HGV Routing Model
		3	Traffic Signals at A96 / Blackfriars Road (TESCO)
Link & Junction Improvements	Edgar Road to A96	4	Wittet Drive Link (TSP10-12)
		5	The Wards Link
		6	Morriston Road Link (Part TSP2)
	A96 Improvements	7	Pansport Road Junction Upgrade
		8	Pansport Road & Cumming Street Junction Upgrades
		9	Partial dualling of Alexandra Road
	A941 Improvements	10	Morriston Road Junction Upgrade
		11	BoroughBriggs Road Junction Upgrade
		12	Edgar Road Junction Upgrade
	Bypass	13	Bypass North Alignment (TSP1)
		14	Bypass South (Short) Alignment (TSP2)
		15	Bypass South (Long) Alignment (TSP2)
	Combination Options	16	Southern Distributor + Option 4
		17	Southern Distributor + Option 6
		18	Combination Option 8 + Option 9
		19	Combination Option 12 + Option 4
		20	A941 Railway Bridge Closure

1.4 Technical Data

The simulations are run using VISSIM 4.20 (update 04). A methodology explaining the convergence criteria for the initial model runs can be found in the Elgin VISSIM Model (EVM) Model Development Report. Once converged it was then

necessary to run the final assignment a number of times using different seed values in order to simulate the kind of variability associated with day to day conditions on any traffic network. In the case of the EVM, the option testing scenarios were run 25 times with different seeds and all resultant outputs were then averaged. This process was undertaken for each peak period for each option.

2 The Reference Cases

2.1 *Scheme Description*

The Elgin VISSIM Model was coded, calibrated and validated for a base year scenario of 2006. For the purposes of option analysis it is necessary to test the network in a future year scenario. 2012 was chosen as the most appropriate future year horizon for the tests. A reference case scenario has therefore been created in order to provide a comparison with the option test scenarios. The reference case scenario includes any committed road schemes and any committed developments in the study area. The following sections briefly outline these schemes and developments.

2.2 *Committed Network Infrastructure Schemes*

The following schemes are committed and are included in the 2012 reference case scenarios. All information regarding scheme layouts was provided by TMC.

Reiket Lane / A96 Roundabout: The Reiket lane priority intersection with the A96 is replaced with a new four arm roundabout.

Reiket Lane Mini Roundabout: Zone 116 is a new residential development zone between the A96 to the East of the model and Reiket Lane. A new access to this development forms a mini-roundabout with the A96 and the access to Pinefield Industrial Estate.

Wittet Drive Traffic Signals: A planning condition for the approved Garden Centre development will result in the Wittet Drive intersection with the A96 being signalised. This comprises single lane approaches on all three arms.

Yellow Box at North College Street: A yellow box layout now operates on the Eastbound lane of South College Street at the intersection with North College Street.

Sherriffmill Rd / Morriston Rd: The addition of a new Garden Centre to the North of the A96 at Sheriffmill requires improved access from Sheriffmill Road to Morriston Road. An upgraded priority intersection has been coded.

Edgar Road (New Retail Development): Changes have been coded to the alignment and access points along Edgar Road (West).

Alexandra Road Pedestrian Crossing: A pedestrian crossing has been added to Alexandra Road just to the East of the North Street intersection and the exit from the St Giles Centre car park. Cycle times are based on the existing crossing..

New Visitor Developments (Newmill Road): An improved priority junction with a ghost island has been coded for access to Johnstons on Newmill Road.

Revised Bus Timetable: The revised PT data has been coded into the model.

Lesmurdie Road Mini Roundabout: The mini-roundabout on Lesmurdie Road has been removed and replaced with a standard priority intersection.

30mph Zone Extensions: The 30mph zone now extends further South along the A941 towards Rothes (NJ22276093) and along Birnie Road (NJ21776087).

Reiket Lane Railway Bridge: Railway bridge on Reiket Lane to be replaced, signals removed and two-lane operation..

Cumming Street (food retail): A mini-roundabout now provides access for traffic to the new retail store.

2.3 Committed Developments

Table 2-1 shows a list of the developments that have been included in the 2012 reference case scenarios. In addition the number of modelled trip origins and destinations associated with each development in each peak period is also included. Development location and size data was provided by TMC whilst trip rates were developed by Halcrow in consultation with TMC. It became clear after initial testing that if the full calculated trip rates were applied to all developments the model would become gridlocked. Development traffic demand was globally factored down until the model could complete a simulation without gridlocking.

This was thought to be acceptable as not all traffic would be new and that a large proportion of this traffic would be displaced or by-pass traffic. This is where traffic changes trips to shop say at Aldi rather than Asda. In this instance although the development may be new and the trip is assumed to be additional, in fact it is an existing trip redistributed.

Additionally trips will multi-chain whereby a single trip to Edgar Road say may involve a visit to Asda, a car showroom and B&Q for example. Rather than counting this as three trips it would be in fact one trip and the trip generation would be a third of the calculated figure.

An exception to this is all new housing developments. All trips were assumed to be additional to the road network.

Table 2-1: Final Committed Developments and Generated Trips

Zone	Development	Type	AM Peak		PM Peak		Sat Peak	
			O	D	O	D	O	D
136	Aldi	Discount Supermarket	11	15	49	47	68	67
113	Lidl	Discount Supermarket	14	20	64	61	89	88
73	Springfield Xtn Pets at Home	Non-Food Retail	0	1	3	3	5	6
73	Pizza Hut	Fast Food	0	0	9	16	23	25
100	Tesco Mezzanine	Supermarket	7	8	16	11	21	24
61	ASDA	Supermarket	13	17	38	33	40	49
124	CF4 Neighbourhood Centre	Retail/Office	4	30	35	13	18	20
38	Alan Milne	Car Showroom	6	15	15	9	12	10
63	Robertson's site: non-food retail	Non-Food Retail	5	14	39	34	64	72
94	CD3 garden centre	Garden Centre	5	17	30	15	217	214
127	Bilbohall	Residential	12	4	6	11	9	9
116	R2 Housing	Residential	30	9	16	27	23	22
119	R3 Housing	Residential	87	26	45	79	65	64
123	Housing	Residential	4	1	2	4	3	3
79	R4 Housing Glasgreen	Residential	47	14	24	43	36	35
125	R5 Housing	Residential	104	31	54	94	78	77
129	R7 Housing Bilbohall south	Residential	45	13	23	40	34	33
130	R8 Elgin High School SW	Residential	12	4	6	11	9	9
133	R9 Spynie Hospital	Residential	116	34	60	105	87	86
87	Hattan Hill / Wittet Drive	Residential	6	2	3	5	4	4
117	BP1 + BP2	Business Park	11	94	86	13	0	0
131	BP3	Business Park	1	9	9	1	0	0
115	I6 Linkwood east	Industrial	69	150	120	76	139	118
35	I2 Chanonry	Industrial	44	119	67	25	84	126
49	McDonald Estates – car mart	Car Showroom	22	53	53	31	44	36

2.4 Traffic Growth

The developments outlined in Section 2.3 provide a significant level of local traffic growth in the Elgin area. As a result it was decided in consultation with TMC that no additional generic local traffic growth factor would be applied in addition to this. However, it is notable from historical count data that the level of strategic traffic in the study area is subject to growth in addition to this local traffic uplift due to new developments. As such, traffic that had both an origin AND destination in two of the following four locations was uplifted: i.e. external traffic.

- A96 West of Elgin (Zone 150)
- A96 East of Elgin (Zone 159)
- A941 North of Elgin (Zone 154)
- A941 South of Elgin (Zone 162)

The traffic identified in this way as being of a strategic nature was growthed by 12%. This figure was used after examining a combination of the NRTF high growth forecast for this time period and historical count data for sites on the A96.

Hence the change to the 2006 base matrices is a combination of new development trips and strategic traffic growth. Table 2-2 below shows the total growth in the matrices for the three time periods modelled. It should be noted some trips associated with new developments may be pass-by trips. These trips existed in the base matrices using the available zones but are now drawn to new sites as development trips. This explains why the total size of the 2012 matrices are not exactly comprised of base matrix plus development plus growth in some cases.

Table 2-2: Growth in Trip Matrices 2006 - 2012

Time Period	2006 Base	Additional Traffic	2012 Total	Change (%)
AM Peak (07:30 – 09:30)	12,581	1,357	13,938	+10.8%
PM Peak (16:30 – 18:30)	14,544	1,678	16,222	+11.5%
Sat Peak (12:00 – 14:00)	16,457	2,303	18,760	+14.0%

2.5 Reference Case Global Model Results

This section provides an overview of the impact of the increased volumes of traffic and changes to the network infrastructure on the Elgin network in the 2012

reference case scenario. Comparisons with the 2006 base model are used in order to demonstrate the effects of the changes.

Table 2-3 below shows the change in total vehicle hours between 2006 and 2012. Vehicle Hours is the summation of the time spent by each individual vehicle on the modelled network, expressed in hours.

Table 2-3: Total Vehicle Hours 2006 - 2012

	2006 Base	2012 Ref Case	% Change
AM Peak	1,076	1,385	28.7%
PM Peak	1,354	1,782	31.6%
Sat Peak	1,477	2,240	51.7%

The AM and PM peak periods show an increase in travel hours of approximately 30% whilst the Saturday peak shows an increase of approximately 50%. These increases are particularly significant when compared with the growth in trips in the matrices for each period (10.8%, 11.5% and 14.0% respectively). The discrepancy between the two figures suggests that the extra trips in the reference case model are causing significant congestion beyond the levels experienced in the base model.

Table 2-4 below shows the change in average vehicle speed across the network.

Table 2-4: Average Vehicle Speed 2006 – 2012 (mph)

	2006 Base	2012 Ref Case	% Change
AM Peak	24.0	23.1	-3.7%
PM Peak	22.6	21.1	-6.5%
Sat Peak	21.1	17.0	-19.4%

The AM peak shows a reduction in average speed of 3.7% whilst the PM peak shows a reduction of 6.5%. The Saturday peak period shows a more significant decrease in average speed of 19.4%.

These global statistics suggest that by 2012 the model forecasts that the transport network in Elgin suffers significantly worse congestion than in 2006, as shown graphically in Figure 2-1.

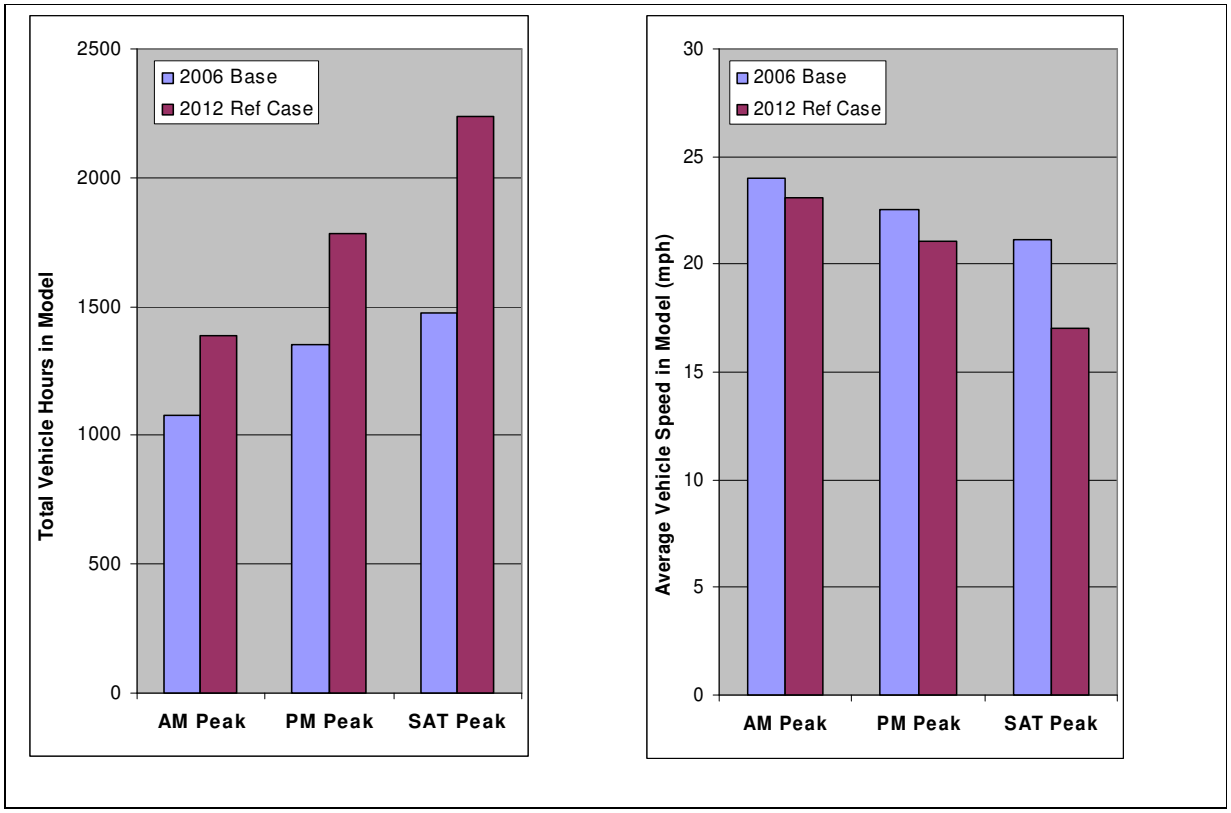


Figure 2-1: Total Vehicle Hours and Average Vehicle Speeds in 2006 Base and 2012 Reference Case models

2.6 AM Peak Reference Case Model

The AM peak period is the least congested of the modelled time periods. In the base case scenario there was significant queuing entering Elgin on the A96 from the East. However, other problems appeared confined to a short time period just before 09:00am.

The 2012 reference case model showed a number of changes when compared with the 2006 base model:

- Queuing into Elgin from the A96 to the East was slightly worse than in 2006.
- The roundabout at Edgar Road and the A941 became significantly more congested with a particular worsening of problems on the southern approach arm.
- The exit from Morriston Road to the A96 showed a significant increase in queuing.

- The exit from Morriston Road to the A941 showed a significant increase in queuing.
- The exit from Wards Road to the A941 showed a significant increase in queuing.
- The signals on the Wittet Drive junction caused significant delay to traffic on the A96 during busy periods.
- Travel times on Westbound routes through Elgin via South College Street and also those via Maisondieu Road showed an increase in travel time of between 25% and 30% over the two hour period.
- Travel times on Eastbound routes through Elgin showed an increase of just under 10% over the two hour period.
- Travel times on Northbound routes through Elgin via Hay Street/Alexandra Road and also those via Maisondieu Road/South College Street showed increases in travel time of between 10% and 15%.
- Travel times on Southbound routes through Elgin showed increases of 2% to 3%.

2.7 PM Peak Reference Case Model

The PM peak 2006 base model suffered significant congestion at both the Pansport roundabout and the Cumming Street roundabouts during busy periods. In addition, the Wittet Drive intersection and the roundabout at Moss Street / Maisondieu Road / A941 were very busy.

The 2012 reference case model showed a number of changes when compared with the 2006 base model:

- The Cumming Street roundabout shows a significant worsening in performance with large queues developing for sustained periods during busy times.
- The Pansport roundabout remains extremely busy during the modelled period.
- The Wittet Drive junction signals cause significant delays and queuing to A96 traffic on the A96.
- The exit from Morriston Road to the A941 showed a significant increase in queuing.
- The exit from Morriston Road to the A96 showed a significant increase in queuing.
- The exit from Wards Road to the A941 showed a significant increase in queuing.

- The roundabouts to the North and South of the A941 railway bridge both show increased levels of congestion.
- Travel times on Westbound routes through Elgin via South College Street and also those via Maisondieu Road showed an increase in travel time of between 20% and 35% over the two hour period.
- Travel times on Eastbound routes through Elgin showed an increase of 10% to 20% over the two hour period.
- Travel times on the Northbound route via Hay Street/Alexandra Road showed an increase of approximately 25% primarily due to increased delays at the Cumming Street roundabout. Northbound trips via Maisondieu Road/South College Street showed increases in travel time of approximately 10%.
- Travel times on Southbound routes through Elgin showed increases of 5% to 10%.

2.8 Saturday Peak Reference Case Model

The Saturday peak period showed the highest levels of congestion in the 2006 base model. Key problem areas were the Cumming Street roundabout and the exit from the St Giles Centre car park along with the Edgar Road roundabout and the exit from Morriston Road to the A941.

The 2012 reference case model showed a number of changes when compared with the 2006 base model:

- The Cumming Street roundabout shows a significant worsening in performance with extended queues developing for longer periods. Queuing from this intersection would regularly block back to upstream intersections, further affecting the network performance.
- The Edgar Road area becomes extremely slow moving with large queues and significant delays at both roundabouts. Traffic has difficulty exiting from ASDA and also queues for long periods on Edgar Road itself. The worst queuing is on the A941 from the South with queues extending almost as far back as the roundabout with Thornhill Road on some occasions.
- The Wittet Drive signals cause significant delays and queuing to traffic on the A96.
- The exit from Morriston Road to the A941 showed an increase in queuing.
- The exit from Morriston Road to the A96 showed an increase in queuing.

- The exit from Wards Road to the A941 showed a significant increase in queuing.
- The roundabouts at Moss Street and South Street with the A941 both show a worsening congestion situation.
- Travel times on the Westbound route through Elgin via Maisondieu Road showed an increase in travel time of 35% over the two hour period.
- Travel times on Eastbound routes through Elgin showed an increase of 10% to 20% over the two hour period.
- Travel times on the Northbound route via Hay Street/Alexandra Road showed an increase of approximately 95% primarily due to the large delays getting through the Edgar Road roundabout and also delays at the Cumming Street roundabout. Northbound trips via Maisondieu Road/South College Street showed increases in travel time of approximately 50% for similar reasons.
- Travel times on Southbound routes through Elgin showed increases of 5% to 15%.

3 Traffic Management Options

3.1 *Scheme Descriptions*

The following two options assess infrastructure changes in the Elgin Network that aim to improve circulation on key routes in the town.

3.2 *Option 1 – Gyratory System*

This option assesses the impact of creating a gyratory traffic system around the centre of Elgin. Designing the gyratory is a difficult task since by its nature a one way system will deny some road users easy access to locations that they could previously reach with little problem. Where possible, two way access has been retained where major trip generation zones are located (eg retail locations). However it should be immediately obvious that whilst a one way gyratory will improve traffic flow on the mainline there will be some areas of the model that will necessarily be disadvantaged. The key features of the scheme are detailed below, and shown in Figure 3-1.

- Create a two lane clockwise gyratory comprising Maisondieu Road, Station Road, Hay Street, Northfield Terrace and the A96 between the Cumming Street roundabout and Pansport Place.
- The section of the A96 between the High Street and Cumming Street roundabout to remain as two way.
- Access to the Cumming Street roundabout from Lossie Wynd and the St Giles Centre to be retained.

Figure 3-1: Layout For Option 1

3.3 Option 1 – Results

The AM peak simulation shows that the total distance travelled in this scenario was approximately 3% greater than in the reference case scenario. This amounted to 1419 extra hours of travel time reflecting the rerouting that is necessary when the gyratory system is implemented. In addition the total travel time increased by approximately 5% over the two hour simulation period.

There were significant increases in traffic on Ashgrove Road, Linkwood Road and Reiket Lane as traffic used these routes to avoid using the gyratory system for OD pairings that were disadvantaged by the new infrastructure such as Edgar Road eastbound. In addition there were significant increases in traffic on The Wards and Wards Road.

On the gyratory itself, Westbound traffic on Maisondieu Road increased by 136% whilst traffic on Station Road Northbound increased by 63%. Traffic on the A96 between High Street and Cumming Street increased by 40% whilst traffic between Cumming Street and Pansport Place increased 70%.

Travel times through Elgin showed little change Eastbound (via the A96) and decreased by approximately 10% Westbound (via Maisondieu Road and Station Road). Northbound and Southbound routes were faster by approximately 7%.

The PM peak simulation shows that the total distance travelled with the gyratory option implemented increased by approximately 3% when compared to the reference case scenario. This is an increase of 1712 hours of travel time over a two hour period. Total travel time increased by more than 7% in this option.

There were significant increases in traffic volumes on the same routes as described in the AM peak. Ashgrove Road, Linkwood Road, Reiket Lane, The Wards and Wards Road all showed significantly higher levels of usage when compared with the reference case.

On the gyratory itself, Westbound traffic on Maisondieu Road increased by 80% whilst traffic on Station Road Northbound increased by 57%. Traffic on the A96 between High Street and Cumming Street increased by 40% whilst traffic between Cumming Street and Pansport Place increased 94%.

Travel times through Elgin showed a 5% decrease Eastbound (via the A96) and also decreased by approximately 14% Westbound (via Maisondieu Road and

Station Road). Northbound and Southbound routes were faster by approximately 13% and 7% respectively. It should be noted that whilst these seem very encouraging they represent the key benefits of the scheme since users of the gyratory system will by definition have a route that has less conflict points on it. However, those who are forced to use alternative routes to complete their journey will suffer far slower journeys than in the reference case scenario.

It was not possible to complete the gyratory option model simulation in the Saturday peak as the model would gridlock during the first full iteration. Large volumes of traffic wish to travel between the Edgar Road area (and other areas South of the rail line) towards the industrial estates on the A96 to the East of Elgin, the A96 itself and also residential areas off Pansport Road and Lesmurdie Road. This traffic might previously have used the railway bridge, Maisondieu Road and Pansport Place to access these areas but in the gyratory option this route is not available. This caused them to reroute, primarily via Linkwood Road, Reiket Lane and also Ashgrove Road. This led to significant problems at the roundabout of Edgar Road due to the redistribution of traffic here. This intersection was already overcapacity in the reference case scenario and hence the problems here cause large queues on all arms. In addition this option caused very large queues at the intersection of Ashgrove Road and the A96. These issues caused the model to gridlock in spite of a number of various tests that were undertaken in order to achieve a workable result.. These included upgrading the roundabout at Edgar Road / A941 and also signalising the same intersection.

In addition to these problems it was noted that there was significant rat-running through Elgin town centre in order to avoid taking long routes around the gyratory. This had knock-on effects on intersections around the gyratory itself., causing significant queuing problems.

3.4 Option 2 – HGV Routing

This option assessed the impact of creating an alternative route for HGV's to the A96 trunk road avoiding the town centre of Elgin. The option would see HGV vehicles travelling through Elgin from routed via Morriston Road, and Lossiemouth Road to the Cumming Street/A96 roundabout, or Lossiemouth Road then Lesmurdie Road to reach the A96 at Pansport Road.

This option was considered inappropriate for traffic modelling due to the relatively low traffic flow data and HGV flow data extracted from the 2012 Reference Case

model. As an example, flows extracted for the modelled link adjacent to the bus station are shown in Table 3-1 below.

Table 3-1: HGVs as a Percentage of Through Traffic on A96 at Bus Station

Peak / Flow	Through Traffic - All Vehicles on A96	Through HGVs on A96	Through HGVs as % of Through Traffic
AM – west to east	1,234	23	2%
PM – west to east	1,669	32	2%
Sat – west to east	1,515	12	1%
AM – east to west	1,577	40	3%
PM – east to west	1,996	44	2%
Sat – east to west	2,007	5	0%

The table shows that on a typical A96 link, through HGV represents a small percentage of the total volume of traffic using this route. Testing this option with the traffic model is likely to show very little overall difference in traffic impact and thus the results would be only marginally different. Hence it would be difficult to quantify any discernible impact of this option.

Besides the quantification of traffic impacts, it may also considered inappropriate to route HGV vehicles along this route on road safety grounds. This route features a mix of residential frontage with on street parking, mixed business use and two schools (Elgin Academy and Bishopmill Primary) front onto one section of the route on Morriston Road. There is also a part-time 20mph zone in operation along this particular section of the route.

Additionally, it is generally considered that vehicles, particularly HGVs should use the most appropriate (i.e.: highest) level of road available in any local hierarchy, and by proposing this alternative route, HGV vehicles would be removed from the Trunk Road network and placed onto less suitable local distributor roads. It is likely that if the HGV component of vehicles on this alternative route were increased, there could be a requirement for increased maintenance costs, due to the higher number of heavy vehicles using it.

Another factor considered in the appraisal is that the several of the route's junctions may be unsuitable for the movement of HGV vehicles. At some junction locations there may be few suitable gaps in traffic flows to allow a safe right turn by HGV vehicles. The likely delay caused by such hindrance to movement would also impact on general traffic.

It is apparent that this Option does not address in any respect the key transport planning objective to *Provide a quicker, safer and more reliable transport system in and around Elgin while accommodating future development.*

In summary, this option is not suited to modelling, and other impacts (safety, junction performance and enforcement/compliance) of this option do not justify taking the HGV routing forward.

3.5 Option 3 – Traffic Signals at A96 / Blackfriars Road

This option assesses the impact of signalising the roundabout at Tesco on the A96. The key features of this option are shown in Figure 3-2 and as follows:

- Signalise intersection of A96, Haugh Road and retail store access.
- Tesco access to have three lane approach consisting Left (L), Ahead (A) and Ahead/Right (AR) lanes.
- Haugh Road access to have three lane approach consisting of L, A and R lanes.
- A96 (South) arm to have a three lane approach composed of L, AR and R lanes.
- A96 (East) arm to have a three lane approach composed of L, L and AR lanes.
- Flare lengths are shown in Figure 3-2 and land take has been kept to the minimum possible.
- The signals run on a four stage sequence with cycle times varying from 100 to 120 seconds.
- A pedestrian stage is not included. Pedestrian facilities for crossing the A96 are already located on both A96 approach arms within 150m of this intersection.

3.6 Option 3 – Results

This option has the impact of regulating traffic flow in this area of the model. The introduction of signals has the benefit of allowing all approaches to access the intersection over the course of a signal cycle. Previously, access was dependent

upon gaps being available in traffic at the roundabout. Hence the signals have the effect of providing greater delay in a low flow environment since traffic may now be stopped at a red light when previously it could have entered the intersection. However, in a higher flow environment it allows traffic from all arms to access the junction and as such we would expect to see significant benefits on these arms.

The AM peak hour LoS diagram shows that the overall LoS provided by the signals is significantly lower than the reference case scenario. In the reference case the whole intersection worked at a LoS A, suggesting that the average wait-time at this intersection was less than ten seconds. When the signals are introduced the average wait time increases as drivers may frequently be stopped by a red light. The junction is operating under capacity in this peak hour and as such the levels of service on each arm are proportional to the duration of green time per cycle on that arm. Haugh Road has a very limited green stage and a LoS D. The A96 (East) has the highest green time duration and a LoS B. Operationally, the intersection works well during this peak and an improvement in performance may be possible by shortening the 100s cycle time..

The PM peak shows a more confused situation. In the reference case scenario traffic queues from the downstream Cumming Street roundabout through the Tesco junction. This situation obscures the true performance of the intersection as stopline capacities on some arms are significantly reduced when traffic is blocking back to this junction. The benefit of the signals in this situation is shown in a slight improvement in the level of service of the Tesco access arm. Previously these vehicles would not be able to access the A96 (East) as they had to cede priority to traffic circulating the roundabout. With signals installed they have an allotted green time and as such a number of vehicles can access the intersection during each cycle. The disbenefit affects the A96 (South). These vehicles previously had little trouble accessing the roundabout. However, queuing now extends back to the High Street roundabout and beyond when the signals are impacted by the blocking back. In isolation it is likely that the signals would work to a reasonable level of performance. However, when they are affected by the blocking back from the Cumming Street roundabout they actually exacerbate the problem on the A96 whilst slightly improving it on the Tesco access.

The Saturday peak has similar issues to the PM peak. Traffic can block back from the Cumming Street roundabout and impact on the operational capacity of the Tesco access junction. In addition there can be occasional impacts upon the High Street junction.

The layout of this intersection would benefit from longer stacking lanes on both A96 approaches. Traffic tends to queue to significant lengths along the A96 as these are the approaches with the heaviest flows. However, the largest single benefit to this intersection would be to remove the problems associated with the Cumming Street roundabout as these have the greatest impact upon the performance of the signalised intersection.

3.7 Conclusions

After analysis of the Traffic Management Options, none of the options were found to be effective in traffic terms of improving conditions within Elgin. Option 1 proved to be unworkable in the model due to the severe pressure of traffic placed at various parts of the road network. Option 2 was not considered suitable for modelling and other qualitative impacts would preclude this option, and Option 3 cannot be undertaken in isolation.

Figure 3-2: Layout of Tesco Access Intersection in Option 3

4 Link Options

4.1 Scheme Descriptions

The following three options test different methods of linking the Edgar Road retail area and surrounding residential areas with the A96 to the West of Elgin. Each option is described below and subsequently results from the options are compared with the reference case scenario.

4.2 Option 4– Wittet Drive Link (TSP 10-12)

This option links Edgar Road to the A96 near Wittet Drive as shown in Figure 4-1. The key features of this network are as follows:

- Extend Edgar Road to a new roundabout approximately 185m beyond the entrance to the primary school. This roundabout to provide access to zones 129 and 130.
- Create a new link from the roundabout to run Northbound, parallel with The Wards. This new link to provide access to zones 129 and 127 to the West via priority junctions with ghost islands.
- A new railway bridge to be constructed where the link crosses the rail line and a subsequent priority junction to be designed where this meets Wards Road, Wittet Drive and Fleurs Road.
- Wittet Drive to realigned to join the A96 at a new roundabout adjacent to Sheriffmill Road and a new junction at Edgar Road.
- The previous alignment of Wittet Drive to be stopped up short of the A96 and signals to be removed.
- Speed limit on new link to be set at 30mph.

All links in this option are single carriageway and both roundabouts flare to two lane approaches on all arms from 15-20m back. Roundabouts have two lane circulation.

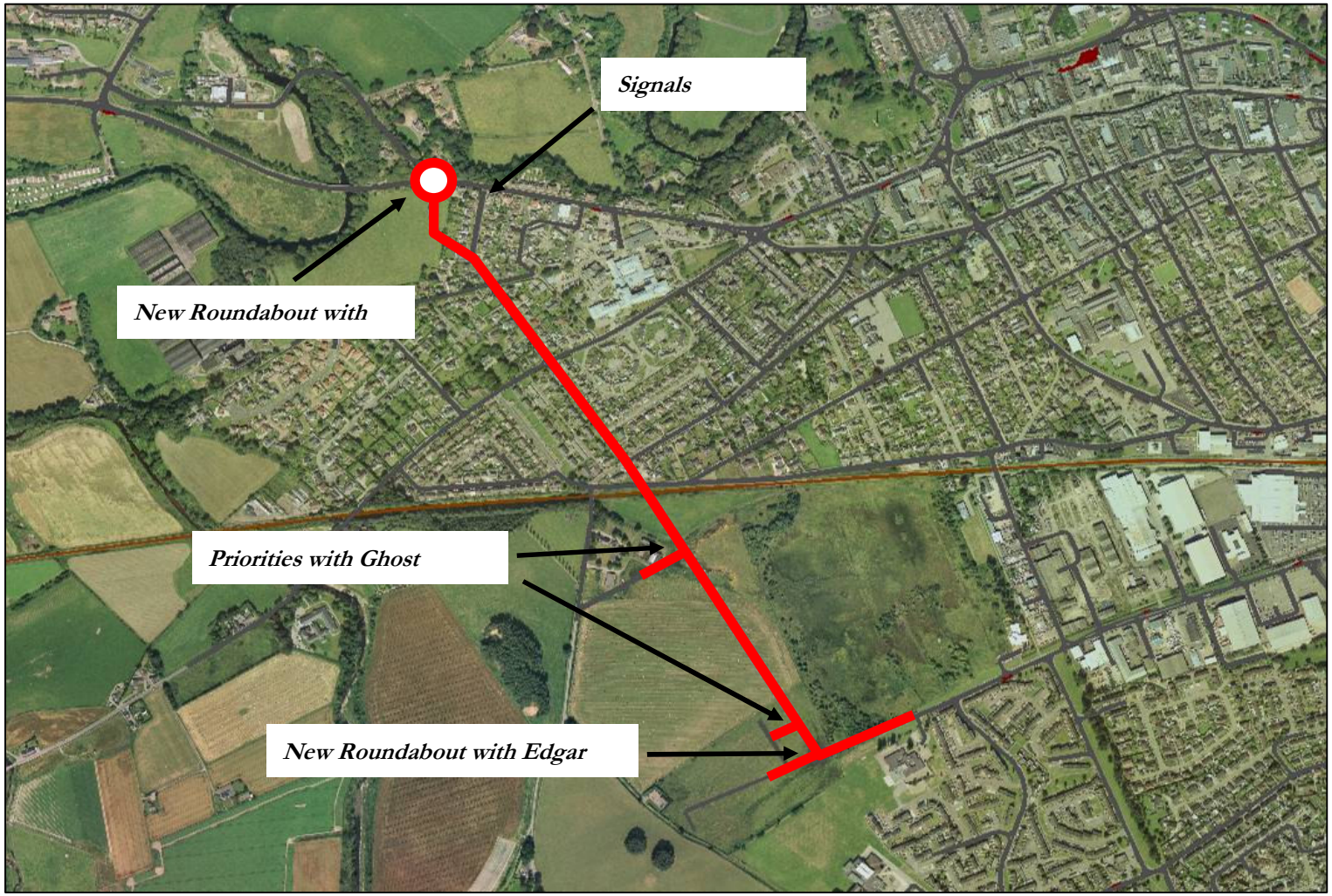


Figure 4-1: Layout of Option 4

4.3 Option 4 Results

The addition of a high quality link between Edgar Road and the A96 at Wittet Drive has the immediate effect of creating a new attractive alternative to the existing routes. In this case the directly competing North-South route running from Edgar Road to and from the A96 West of Elgin is The Wards/Wards Road.

The Wards sees a significant reduction in traffic in all three periods. In the Northbound direction traffic is reduced by 20% in the AM, 19% in the PM and 23% in the Saturday period. Southbound traffic is reduced by 41% in the AM, 35% in the PM and 24% in the Saturday period. Hay Street and South Street form a further competing route, albeit to a lesser extent. These see reductions in traffic in some periods in the order of up to 30%.

A further impact of this option is to replace the signals at Wittet Drive. The removal means that the A96 becomes a more attractive route to some movements in Option 4. In some periods there is a reduction in traffic using Morriston Road Southbound. This is as a result of traffic from the North of Elgin using the A941/A96 route to access the Western part of the model rather than the previous Morriston Road/A96 route.

Table 4-1 shows the traffic levels by the various sections of the new link over each two hour time period, these flows include existing traffic plus new diversionary trips.

Table 4-1: Traffic Volumes on New Link in Option 4 Scenario

Link	Direction	AM Flow	PM Flow	Saturday Flow
New Link (between The Wards and Edgar Road	Southbound	299	333	305
	Northbound	321	263	373
New Link (between Wittet Drive and The Wards	Southbound	520	548	553
	Northbound	721	684	867
New Link (between A96 and Wittet Drive	Southbound	551	715	579
	Northbound	568	804	915

Time savings are provided on the eight travel time routes assessed in the AM, PM and Saturday periods. Westbound routes along the A96 see significantly reduced travel times in all periods whilst large time savings are also made on the Northbound A941 routes in the Saturday period also, primarily as a result of congestion relief at the Edgar Road/Main Street roundabout.

Levels of service at the newly created roundabouts on the A96 and the Edgar Road extension are excellent.

4.4 Option 5 – The Wards Link

This option upgrades the existing layout associated with The Wards/Wards Road. The junction of The Wards and Edgar Road has already been upgraded as part of the reference case scenario. The key features of this network are as follows:

- Widen The Wards to 7.3m carriageway.
- Create a roundabout at the junction of The Wards and Wards Road. This will have single lane approaches on Wards Road and a two lane approach on The Wards approach.
- Speed limit on Edgar Road to remain at 30mph.

The layout of Option 5 is shown in Figure 4-2.

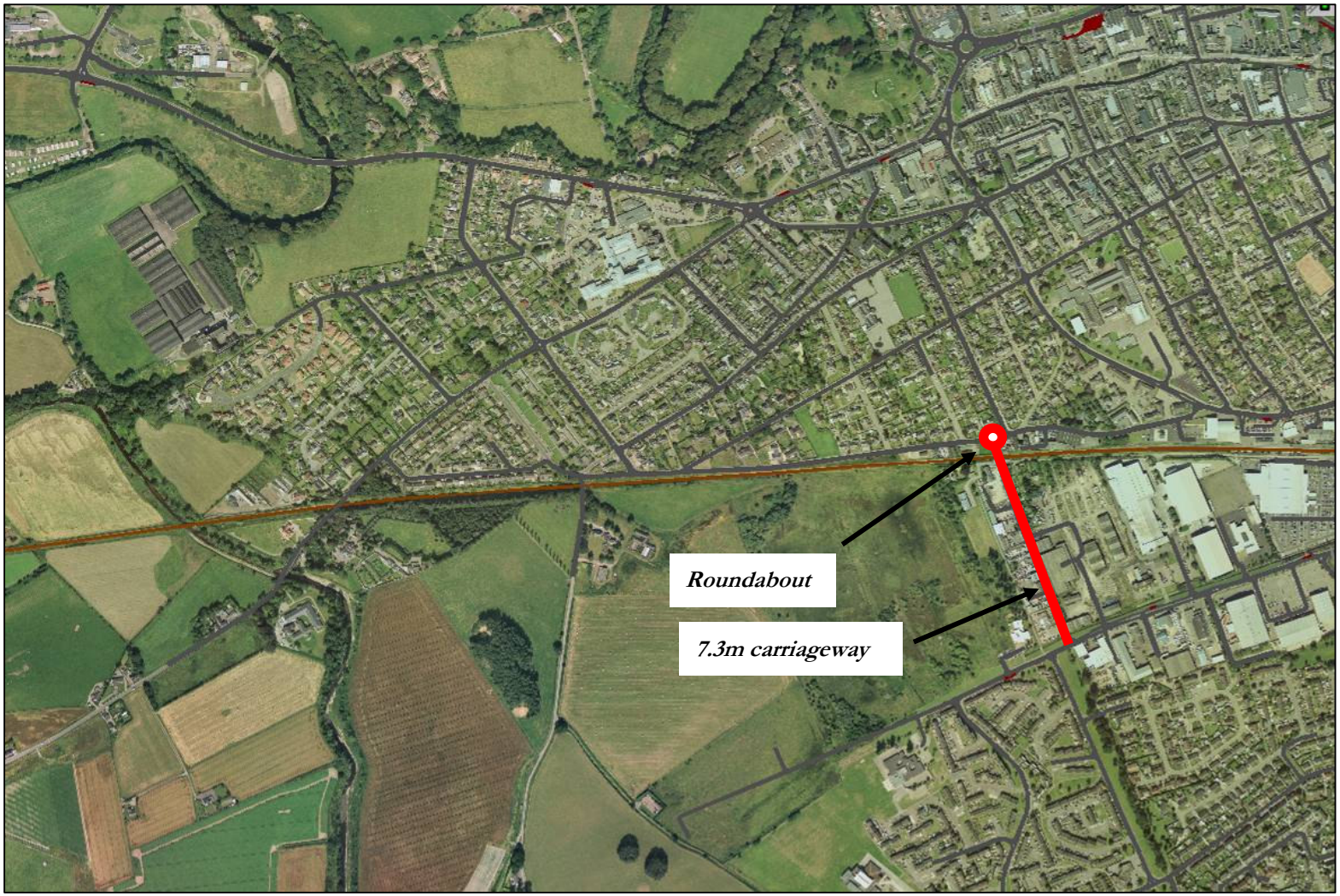


Figure 4-2: Layout for Option 5

4.5 Option 5 Results

This option upgrades the North-South route along The Wards that links Edgar Road with Wards Road. It would be expected that traffic would increase along The Wards for this option and traffic might decrease on the railway bridge on the A941. Table 4-2 below show the changes in traffic volumes on these two links for each two hour time period in the Option 5 scenario.

Table 4-2: Changes In Traffic Volumes On The Wards And Railway Bridge In Option 5

Link	Direction	AM	PM	Saturday
The Wards	Southbound	+88	+144	+170
	Northbound	+75	+110	+100
A941 Railway Bridge	Southbound	-57	-147	-169
	Northbound	-78	-96	+2

As would be expected there is a good correlation between the reduction in traffic on the A941 railway bridge and the increase in traffic on The Wards. In the AM peak between 57 and 88 vehicles in each direction switch from the A941 to The Wards whilst in the PM peak the range is from 96 to 147. The Saturday peak shows that in the Southbound direction around 170 vehicles switch to The Wards. However, in the Northbound direction there is an increase on The Wards of 100 vehicles but no significant change on the railway bridge. This is because the junction upstream of the railway bridge (ie the roundabout with Edgar Road) is highly congested and hence the vehicles that switch to The Wards are simply replaced on the railway bridge by vehicles that were previously held in queues on approach to the Edgar Road roundabout.

Travel times on the specified journey time routes show little significant variability generally. The exception to this is on the Northbound routes on the A941 where the reduction in vehicles using the railway bridge has a beneficial effect on travel times. These benefits are of the order of 5% in the AM and PM peak time periods and 20% in the Saturday peak.

Levels of service at relevant intersections are generally unchanged for Option 5. In all three periods the intersection of The Wards with Wards Road remains at LoS A overall when compared with the reference case scenario. However, in each period the approach arm from The Wards to this intersection improves from a LoS B to

LoS A. There are also slight improvements at the Edgar Road / Main Street roundabout in the AM and Saturday peaks due to the switching of traffic to The Wards lessening congestion at this location.

4.6 Option 6 – Morriston Road Link (Part TSP 2)

This option links Edgar Road with the A96 at Morriston Road by partially following the alignment of the proposed Southern Bypass Route. The key features of this network are:

- Extend Edgar Road approximately 650m to the West of the primary school access. Link this extension with Pluscarden Road and on to the A96 at Morriston Road.
- Access to zones 129 and 130 to be provided by priority junctions from Edgar Road extension.
- Access to zone 131 to be provided by priority junction approximately 60m South of the A96.
- A new roundabout to be constructed at the junction of the A96, Morriston Road and the new link.
- A new roundabout to be constructed at the junction of Pluscarden Road and the new link.
- Speed limit for new link to be set at 40mph.

The layout for Option 6 is shown in Figure 4-3.

All links in this option are single carriageway and both roundabouts flare to two lane approaches from 15-20m back. The exception is the A96 approaches to the Morriston Road roundabout which have longer flares due to the existing infrastructure being utilised. Roundabouts have two lane circulation.

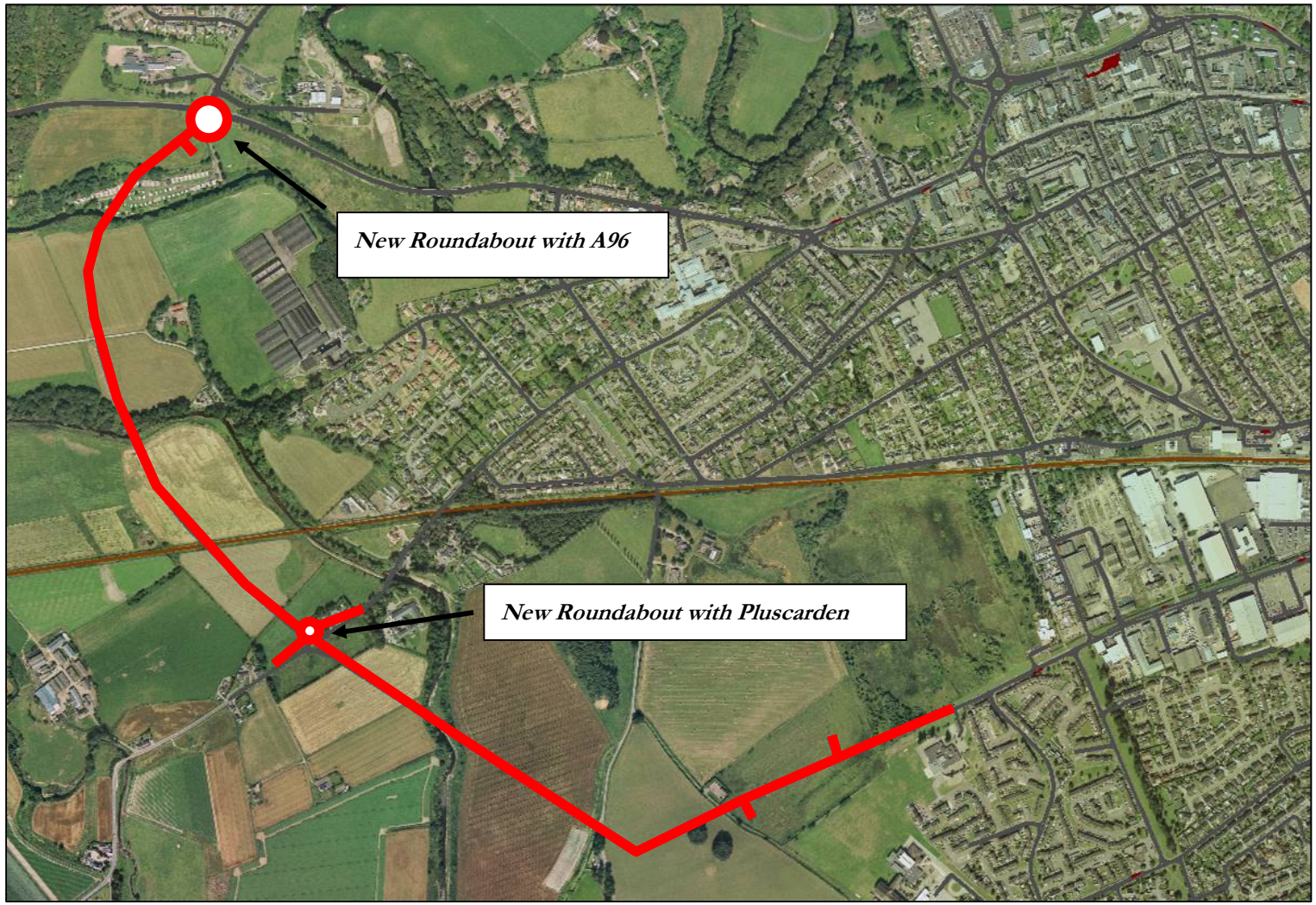


Figure 4-3: Layout for Option 6 (Part TSP 2)

4.7 Option 6 Results

This option links Edgar Road with Morriston Road via a new link Road. It would be expected that this option would draw traffic from the Wittet Drive / Edgar Road route. The traffic volumes using the new link over the two separate sections are shown in Table 4-3 below:

Table 4-3: Traffic Volumes Using New Link In Option 6

Link	Direction	AM Flow	PM Flow	Saturday Flow
New Link (A96 to Pluscarden Road)	Southbound	269	299	315
	Northbound	227	281	161
New Link (Pluscarden Road to Edgar Road)	Southbound	256	320	238
	Northbound	254	281	205

Traffic on Wittet Drive and The Wards is reduced significantly in all three time periods suggesting that these vehicles are switching to use the new link. In addition there are moderate reductions on the A941 railway bridge in both directions.

Travel times along the eight specified routes improve marginally in almost every instance during all time periods. During the Saturday period Northbound routes on the A941 see a significant improvement in travel time as reduced traffic on the A941 railway bridge allows faster journeys in this vicinity.

The new roundabout at the junction of the A96, the link road and Morriston Road operates at a LoS B in the AM and PM peak and a LoS A in the Saturday period. This junction significantly benefits the Morriston Road arm of the intersection which had previously been a LoS E in the AM and PM periods but improves to a LoS B in both periods once the scheme is implemented. The scheme also has a marginally positive impact upon the ASDA and Edgar Road / Main Street roundabouts.

4.8 Global Statistics Comparison of Link Option Results

The data in Table 4-4 to Table 4-6 outline the overall performance of the three link options when compared with the reference case scenario. This information provides a measure of network congestion based on the total number of hours that vehicles spend in the model over the two hour modelled period and the average

speed of vehicles over this time period. Summaries of Vehicle Hours and Average Vehicle Speed are shown in Figure 4-4 and Figure 4-5.

Table 4-4: Global Statistics For AM Peak Link Options

Scenario – AM Peak	Total Vehicle Hours	Average Vehicle Speed (mph)
Reference Case	1385	23.1
Option 4 – Wittet Drive link	1312	24.4
Option 5 – The Wards Link	1377	23.3
Option 6 – Morriston Road Link	1338	24.0

Table 4-4 shows that Option 4 provides a more than 5% decrease in total travel time across the network and a corresponding 5% increase in average journey speed. Option 5 decreases total travel time by just 0.5% and increases average speeds by the same margin. Option 6 decreases travel time by approximately 3.5% and increases average travel speed by 4%.

Table 4-5: Global Statistics For PM Peak Link Options

Scenario – PM Peak	Total Vehicle Hours	Average Vehicle Speed (mph)
Reference Case	1782	21.1
Option 4 – Wittet Drive link	1669	22.5
Option 5 – The Wards Link	1773	21.2
Option 6 – Morriston Road Link	1732	21.8

In the PM peak, Table 4-5 shows that Option 4 reduces travel time by 5.4% and increases the average vehicle speed in the network by 6.7%. Option 5 again provides minimal significant change, altering the total vehicle hours by 0.5% and increasing travel speeds by 0.6%. Option 6 reduces travel time by 2.8% and increases average journey speed by 3.5%.

Table 4-6: Global Statistics For Saturday Peak Link Options

Scenario – Saturday Peak	Total Vehicle Hours	Average Vehicle Speed (mph)
Reference Case	2240	17.0
Option 4 – Wittet Drive link	1987	19.3
Option 5 – The Wards Link	2135	17.9
Option 6 – Morriston Road Link	2089	18.4

The Saturday peak results in Table 4-6 show the greatest level of impact for each link option. This is not surprising as trip activity is heavily focused on the Edgar Road area during this time period. Option 4 decreases travel time across the network by 11.3% and increases average travel speeds by 13.3%. Option 5 has a more significant impact in the Saturday time period than other periods, reducing total travel hours by 4.7% and increasing the average vehicle speeds by 5.4%. Option 6 reduces travel time by 6.8% and increases average journey speed by 8.1%.

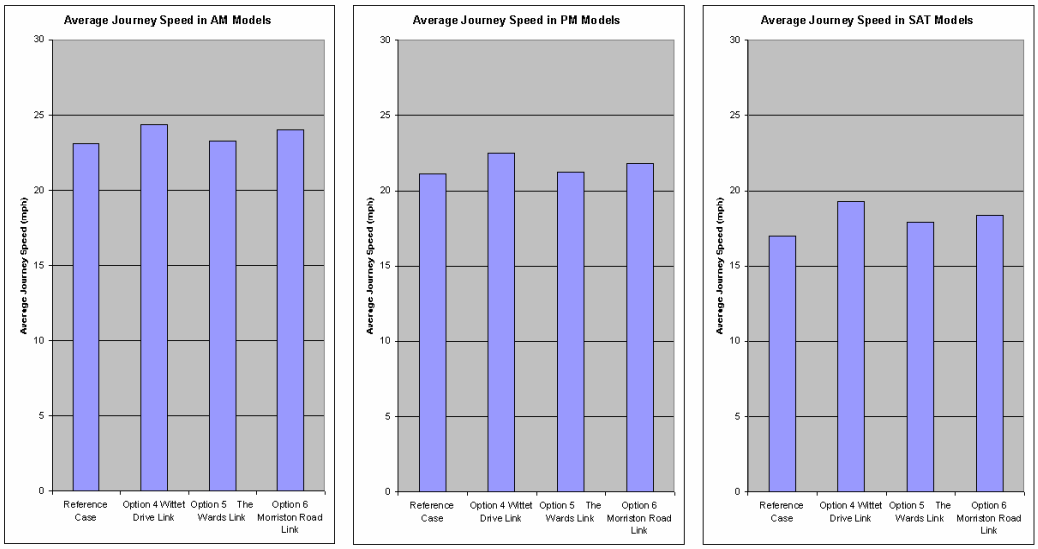


Figure 4-4: Summary of Average Vehicle Speeds – Link Options

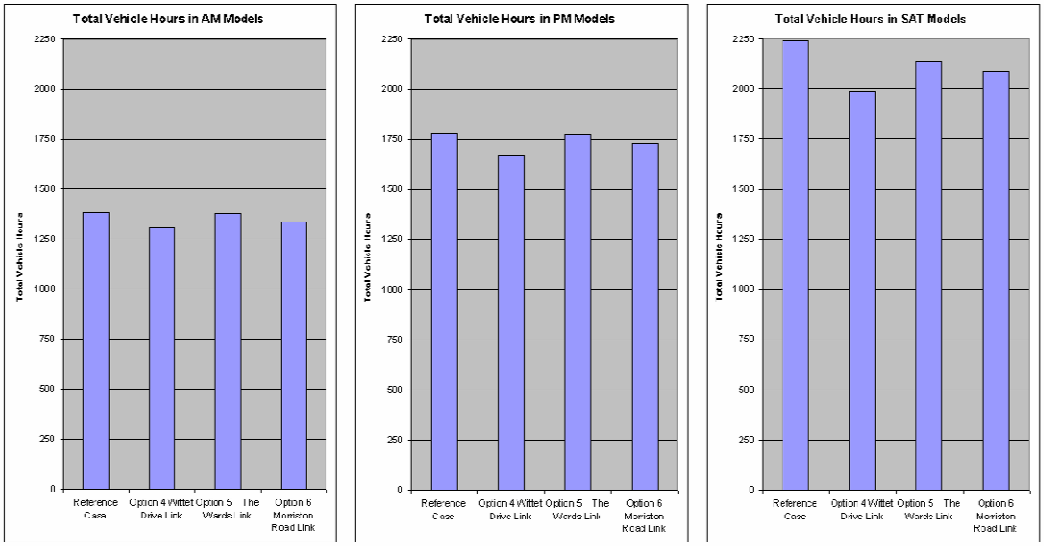


Figure 4-5: Summary of Total Vehicle Hours – Link Options

4.9 Conclusions

It is immediately obvious from the analysis of the global statistics above that Option 4 outperforms the other scenarios in every time period. Significant overall time savings can be noted, particularly in the Saturday peak model whilst average speeds are faster in all three periods.

Option 6 shows a significant improvement when compared with the reference case although not of the same magnitude as Option 4. Option 5 shows no significant difference from the reference case scenario in the AM and PM time periods. It does however provide more substantial improvements in the Saturday period.

Options 4 and 6 would both be acceptable solutions that could be taken forward for further analysis. It should be noted that a proportion of the benefits shown by Option 4 are due to the removal of the signals at Wittet Drive. These cause significant delay in all time periods in 2012 and their subsequent removal for this option and replacement with a roundabout have removed much of this impact. In addition, it is probable that the smaller impact of Option 6 is at least in part a result of the capacity restraints imposed by these signals.

Of the Link options, Options 4 and 6 show positive results, while Option 5 does not display such benefits.

5 A96 Improvements

5.1 *Scheme Descriptions*

The following three options test different methods of upgrading intersections and links along the A96 corridor in Elgin. Each option is described and analysed below and subsequently results from the options are compared with the reference case scenario. It would not be expected that improvements to individual intersections would necessarily have a significant impact on global travel times and vehicle speeds. As such, the performance of the individual intersections is analysed in greater detail whilst the global figures are included in Appendix B..

5.2 *Option 7 – Pansport Road Junction Upgrade*

The roundabout is at the confluence of Pansport Place, Maisondieu Road and the A96. This option increases the capacity of the roundabout by altering flare lengths, exit arms and lane allocations. The scheme details are as follows, and as shown in Figure 5-1;

- Flare on approach from A96 (East) is increased to 65 metres. Lanes are allocated as Ahead/Left and Ahead/Right.
- Flare on approach from A96 (West) is increased to 70 metres. Lanes are allocated as Ahead/Left and Ahead/Right.
- Exit arm to A96 (East) widened to two lanes for 40 metres with subsequent merge.
- Exit arm to A96 (West) widened to two lanes for 40 metres with subsequent merge.
- Flare on approach from Pansport Place to be lengthened to 15 metres. Lane allocation remains unaltered.
- Maisondieu Road approach to remain unaltered.

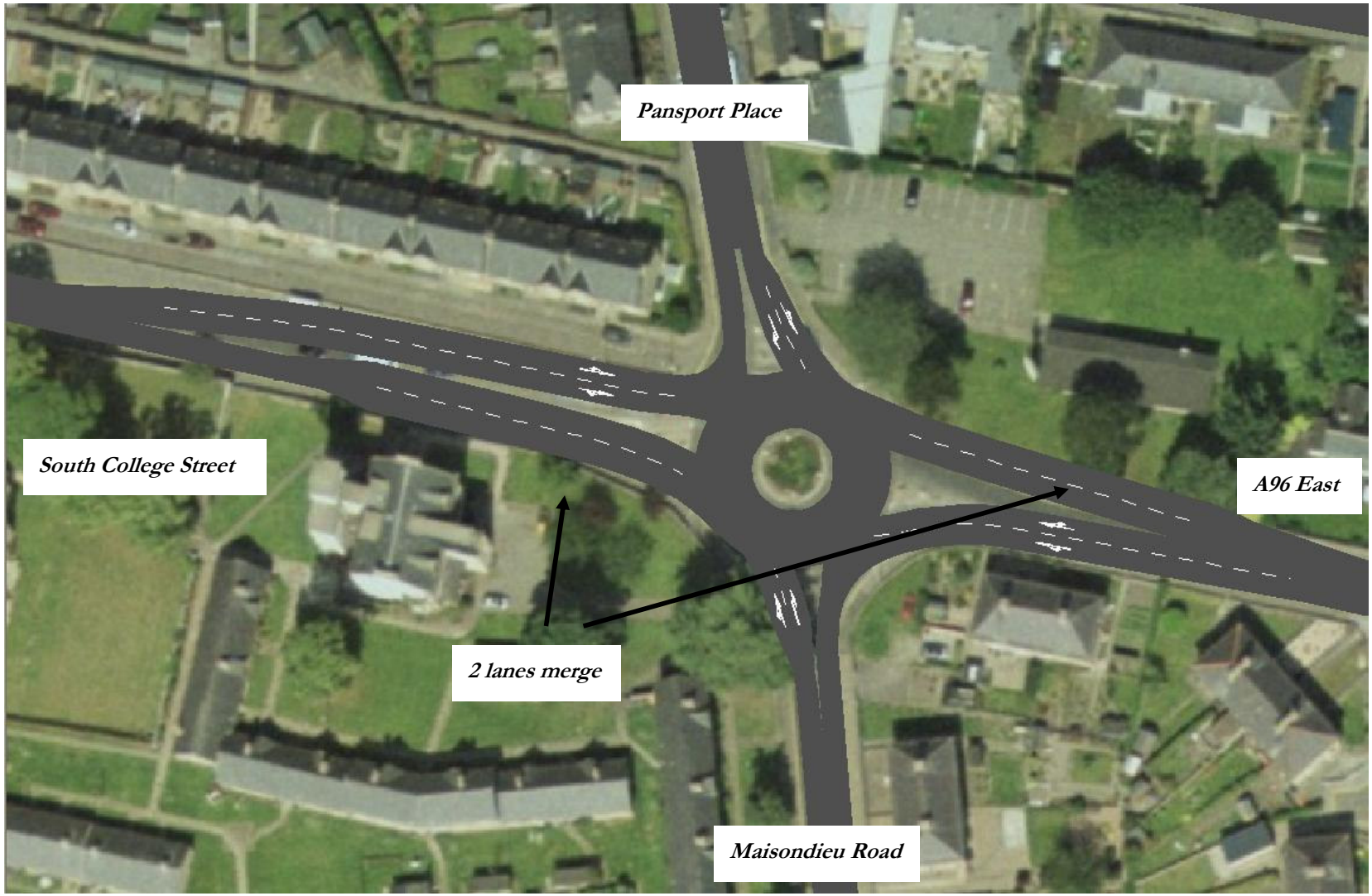


Figure 5-1: Layout for Option 7

5.3 *Option 7 Results*

Improving the capacity of the roundabout at Pansport Place has a significant impact on the level of service provided by this intersection. The key network changes are made to the Western and Eastern approach arms (ie the A96) and as such it is these arms that benefit the most in this option. However, as a result of this improvement there is some disbenefit to traffic arriving from Pansport Road.

In the AM peak hour the intersection improves from a LoS B to LoS A. The increased capacity available on both the Western and Eastern approaches improve these arms to Los A from B and C respectively. Maisondieu Road also improves from B to A. However, Pansport Road is penalised by the increased movements from other arms and becomes a C rather than a B.

In the PM peak hour the overall improvement is from LoS C to LoS B. There is a significant improvement in the operation of the Western and Eastern arms which both jump from C to A in the option scheme. Maisondieu Road also improves from a B to an A. Pansport Road is again penalised due to the increase in circulating traffic and drops from a C to a D.

In the Saturday peak hour the junction shows an overall improvement from a B to an A. Both the Western and Eastern approach arms operate at LoS A which is a significant improvement. Both Maisondieu Road and Pansport Road retain the same level of performance in this time period as in the reference case.

Journey times along the A96 from the Eight Acres Hotel to the Moycroft roundabout improve slightly in both directions in all peaks. Improvements are of the order of a 5% improvement over the length of this journey. These figures do not represent a significant enough change to suggest that improvements to this intersection alone might be responsible for a major improvement in the functionality of the A96 through the centre of Elgin.

Overall, the performance of the A96 arms at this intersection is significantly improved when this scheme is implemented. However, traffic on Pansport Road can be disadvantaged by this and journey time data suggests that the overall impact on the Elgin traffic network is not significant.

Diagrams of the Level of Service for all intersections in the reference case and Option 7 can be found in Appendix A.

5.4 *Option 8 – Pansport Road & Cumming Street Junction Upgrades*

Two of the key focal points for congestion in the Elgin network are the Pansport Place roundabout and the roundabout in front of Cumming Street and the St Giles Centre. This option explores upgrading these intersections to try and improve the traffic flow through the town. The key features of this option are as follows, and are shown in Figure 5-1 and Figure 5-2.

- Pansport roundabout layout to be as Option 7.
- Cumming Street roundabout to be upgraded to three lane approaches on all arms.
- North Street approach to consist of Left, Ahead and Ahead lanes.
- A96 (East) approach to consist of Left, Ahead and Ahead lanes.
- A96 (West) approach to remain Ahead, Ahead and Right lanes.

5.5 *Option 8 - Results*

Option 8 increases the capacity of the Pansport Place roundabout and the Cumming Street Roundabout. The impact of this option on the levels of service provided by the affected A96 intersections can be found in Appendix A. The key changes are described below.

In the AM peak there is a significant improvement in the operation of the Pansport roundabout. However, the Cumming Street roundabout shows no significant change overall.

In the PM peak the Pansport roundabout is once again significantly improved. In this period the overall LoS improves from a C to an A and both approaches from the A96 are also operating at this high level. The Cumming Street roundabout improves from LoS E to LoS D although there are still significant queues on the A96 (West) approach. However, these queues do not now block back to affect the Tesco roundabout which sees improvements to the Tesco access and Haugh Road arms.

In the Saturday peak there is a marginal improvement at the Pansport roundabout and a marginal disbenefit at Greyfriars roundabout. However, the Cumming Street roundabout shows a significant improvement, particularly on the Western approach of the A96. This has a beneficial knock-on effect on the Tesco roundabout by removing the problem of blocking-back across this intersection.

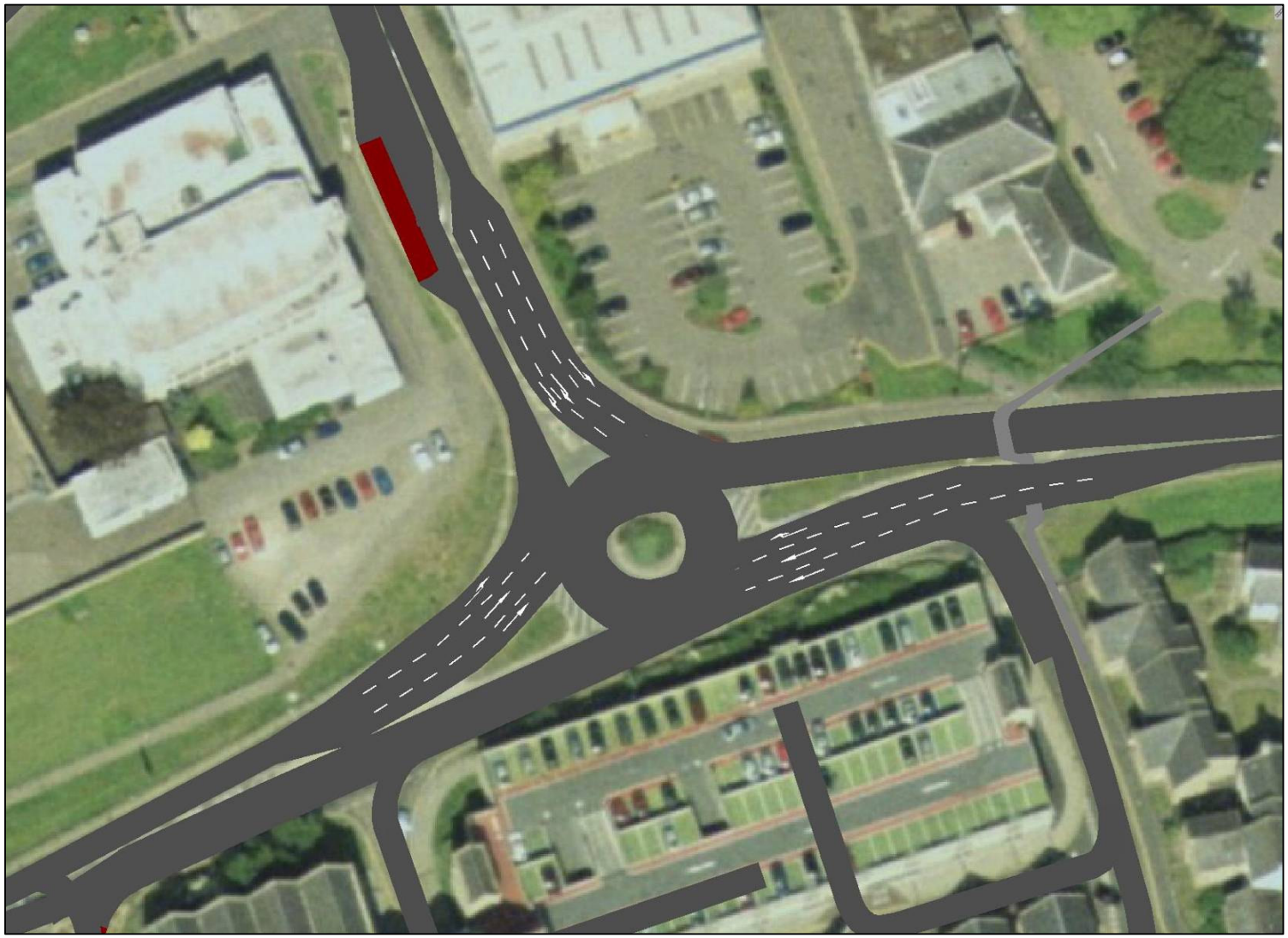


Figure 5-2: Layout of Option 8 at Cumming Street Roundabout

5.6 *Option 9 – Partial Dualling of Alexandra Road*

The sections of the A96 between the Greyfriars roundabout and Tesco roundabout are upgraded to two lanes in each direction for this option. The purpose of the option was to attempt to improve the flow along this heavily congested section of the main strategic route through Elgin. The details of this option are outlined below and in Figure 5-3;

- Dual section of A96 in both directions between Tesco roundabout and Cumming Street roundabout.
- Allocate two lanes on Western approach to Cumming Street roundabout for through movement (ie left hand lane becomes a shared ahead/right allocation).
- Dual section of A96 in both directions between Cumming Street roundabout and Greyfriars roundabout.

5.7 *Option 9 – Results*

Sections of the A96 between Greyfriars roundabout and Tesco roundabout are heavily congested during the PM and Saturday peaks.

A level of service analysis has been undertaken for the three roundabouts that are linked by this scheme. It is notable from the 08:00-09:00 diagrams that there is no significant change at any of the intersections when the scheme is implemented. There is no major delay associated with the reference case scenario and as such the scheme has little impact in this period.

In the 1630-1730 reference case scenario the queuing on the Western approach to Cumming Street roundabout was severe and was blocking back onto the Tesco roundabout and causing significant delays to traffic from Tesco and Borough Briggs Road. There is a notable improvement in the operation of the Cumming Street roundabout once the scheme is implemented and the knock-on effect of this is to significantly improve the capacity of the Tesco roundabout in this time period. However, the LoS for traffic approaching Cumming Street from the East remains at F due to the heavy congestion at this intersection.

It is worth noting that traffic travelling East along the A96 between Tesco and Cumming Street increases by 15% when the scheme is in place. This is a combination of traffic that can now be released from Tesco and Borough Briggs Road and some trip draw from other routes. The level of service at the Greyfriars

roundabout remains unchanged from the reference case to the scheme implementation.

In the Saturday peak hour period there is a similar pattern. There is a significant benefit to traffic approaching the Cumming Street roundabout from the West and the knock-on effect is to again improve capacity at the Tesco roundabout by preventing the blocking back that occurred previously. The LoS at these intersections increases from B and D to A and C over this one hour period. There is again a significant increase in traffic using the Eastbound A96 through this section of the model and this has the effect of marginally reducing the level of service at the Greyfriars roundabout to a LoS B.

5.8 Conclusions

Of the A96 Improvement Options tested above, all of the options were found to be highly localised in terms of the benefits provided, and none were particularly successful on a global basis.

With Option 7 the intersection is significantly improved when this scheme is implemented, however journey time data suggests that the overall impact on the Elgin traffic network is not significant. In Options 8 & 9 some junctions improve slightly although the overall improvement along the A96 corridor is marginal.

Figure 5-3: Layout of Option 9

6 A941 Improvements

6.1 Scheme Descriptions

These options attempt to improve intersections along the A941 to the North of the town centre. North Street / Lossiemouth Road is a single lane road and at peak times provides few gaps for joining traffic. As a consequence large queues can build up on sideroads in the 2012 reference case model. These options attempt to improve traffic flows for all movements at the A941 intersections..

6.2 Option 10 – Morriston Road Junction Upgrade

The intersection is at the confluence of Morriston Road, North Street and Lossiemouth Road. This option replaces the current priority intersection with a roundabout in order to enable traffic from Morriston Road to access the A941 more easily. The scheme details shown in Figure 6-1 are as follows:

- Replace current priority intersection with a roundabout
- Roundabout to have two lane gyratory and two lane approaches
- Approaches to flare from a single lane for 10-15m
- Roundabout to have a total diameter of 30 metres

6.3 Option 10 – Results

The key aim of this option is to improve the access for traffic on Morriston Road to the A941. The impact of replacing a priority intersection with a roundabout is generally to spread the delay across the three arms of the junction rather than penalising just one. As such it is important to look at both the improvement in performance of Morriston Road and also the impact on the North and South arms from the A941.

In the AM peak hour there is a clear improvement in the functionality of this intersection when the scheme is put in place. The overall LoS of the intersection improves from a C to a B. However it is worth noting that the average level of delay in Option 10 is 10.5 seconds and hence this is just half of one second from being classified as a LoS A. This significant improvement is driven by the change in level of service of the approach arm from Morriston Road. In the reference case scenario this difficult priority turn was classified as LoS F with significant delays and queues in this period. With Option 10 implemented this arm attains a LoS B with queuing drastically reduced. In addition it should be noted that both arms of

the A941 remain at a LoS A in this time period (although a very slight disbenefit can be seen by closer examination of the raw data).

In the PM peak hour the level of service data suggests that the intersection improves from LoS B to LoS A. The reasons are similar to those identified in the AM peak whereby the Morriston Road approach gains significant benefits in this scheme whilst the A941 approaches suffer only minor disbenefit. Morriston Road improves from LoS E to LoS B whilst the A941 arms remain at LoS A.

The reference case scenario model showed that the greatest level of congestion of any time period at this intersection was in the Saturday peak hour. However, upon implementation of the roundabout the LoS improves from a D to an A. There is a significant improvement in the operation of the Morriston Road arm which improves from a LoS F to A. However it is important to note that there is a slight disbenefit to traffic approaching the junction from Lossiemouth Road. The LoS for these vehicles drops from A to B as a result of the right turning traffic from Morriston Road that can now access the junction more easily.

Overall it is clear that this option shows a high level of benefit to the junction as a whole in all time periods. However there is clearly a slight disbenefit to traffic on the A941 that previously had right of way at this intersection and must now on occasion cede priority.

Figure 6-1: Layout For Option 10

6.4 *Option 11 – Borough Briggs Road Junction Upgrade*

The intersection is at the confluence of Borough Briggs Road and North Street. This option replaces the current priority intersection with a roundabout in order to enable traffic from Borough Briggs Road to access the A941 more easily. The scheme details shown in Figure 6-2 are as follows:

- Replace current priority intersection with a roundabout
- Roundabout to have two lane gyratory and two lane approaches
- Approaches to flare from a single lane for 15-20m
- Roundabout to have a total diameter of 30 metres

6.5 *Option 11 – Results*

During the reference case scenarios this intersection has been subject to severe queuing from the Borough Briggs Road arm. Traffic on North Street is heavy and gaps for traffic to join the mainline from Borough Briggs Road are infrequent.

The benefit of this scheme is to allow the traffic from Borough Briggs Road to access the A941 more easily. The obvious disbenefit is that traffic on the mainline is often now interrupted by this intersection whereas it was previously free flow. The level of service diagrams for this option can be found in Appendix A.

The AM peak hour diagram shows the LoS of the intersection to be A with both the A941 South and Borough Briggs approaches also attaining this high level of classification. The A941 North arm is a LoS B as traffic now has to give way to right turners from Borough Briggs Road.

In the PM peak hour the intersection operates at a LoS B. The A941 South approach is provides LoS A whilst both Borough Briggs Road and the A941 North have LoS C.

In the Saturday peak hour the roundabout provides a LoS B overall. Both the A941 South and Borough Briggs Road have LoS A whilst the A941 North has LoS C.

Travel times are not significantly affected in this option. However a small journey time increase in all Southbound trips is notable due to the impact of the roundabout on this approach.

Figure 6-2: Layout For Option 11

6.6 *Option 12 – Edgar Road Junction Update*

This option assesses the impact of upgrading the roundabout at the junction of Edgar Road and Main Street. The proposed layout is shown in Figure 6-3 and the key features of this network are as follows:

- Add a third approach lane along Main Street; and
- Add a third approach lane along Linkwood Road.

6.7 *Option 12 – Results*

This option has some local impacts in the AM and PM peaks, improving the level of service of some approaches on the Edgar Road \ Main Street roundabout when compared to the reference case. The most significant impact is to improve the operation of the Main Street approach in the AM peak period. This significantly reduces queuing on this arm during this period.

There are few local impacts in the Saturday peak period. This is because the junction remains at capacity for the critical movements and these movements are not significantly addressed by the addition of the extra lanes on Linkwood Road and Main Street. The approach from Main Street remains a LoS F although queues are reduced as a result of a slightly higher capacity on this arm.

This option has a small impact on the overall network statistics in the AM, PM and Saturday modelled periods. In the AM and PM peak periods the total travel hours actually increase slightly whilst in the Saturday peak there is a slight reduction in overall travel time.

Journey times through the network show little change in the AM peak period whilst the PM peak period sees a slight increase in journey time on journeys heading Southbound through the junction. Significant savings are made in the Saturday peak for vehicles heading Northbound through the roundabout. Whilst the queuing remains extensive it is significantly shorter than in the reference case scenario.

6.8 *Conclusions*

Of the options tested under A941 Improvements, none were found to be particularly successful on a global basis, but each provided benefits which were highly localised in nature.

Option 10 shows a high level of benefit to the junction as a whole in all time periods. However there is clearly a slight disbenefit to traffic on the A941 that previously had right of way at this intersection and must now on occasion cede priority. With Option 11 travel times are not significantly affected and benefits accrued are mainly on the side arms.

With Option 12 the most significant impact is to improve the operation of the Main Street approach in the AM peak period. This significantly reduces queuing on this arm during this period. However it has a small impact on the overall network statistics in the AM, PM and Saturday modelled periods

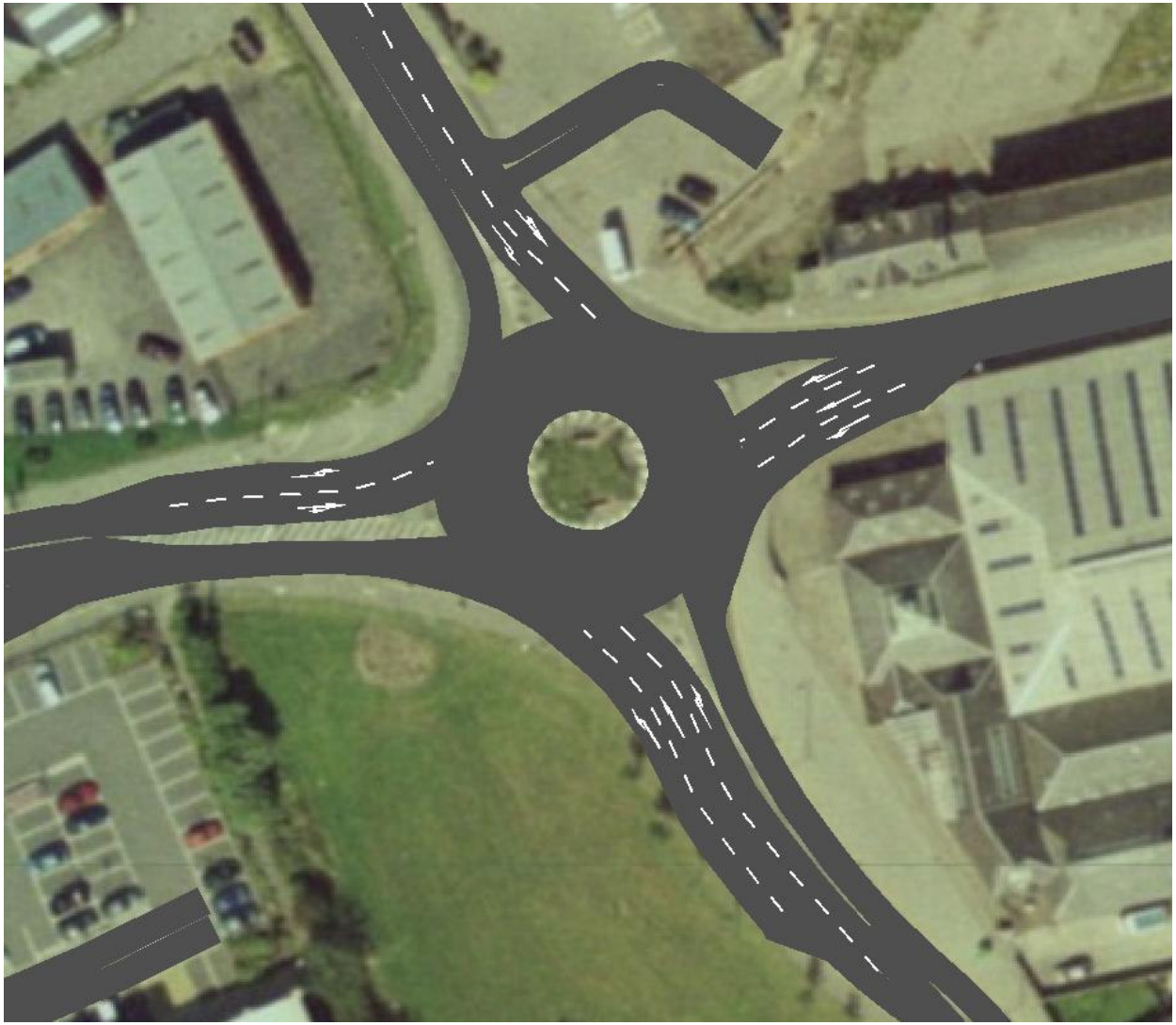


Figure 6-3: Layout for Option 12, Edgar Road Junction Upgrade

7 Bypass Options

7.1 *Scheme Descriptions*

The following five options test different methods of enhancing the road network by the provision of a bypass road around, or partly around Elgin. Each option is described below and subsequent results from the options are compared with the reference case scenario. It is assumed in these options that the bypass will be the signposted through-route for the A96 and that all A96 through traffic will utilise this route.

7.2 *Option 13 – Bypass North Alignment (TSP 1)*

This option implements a bypass to the North of Elgin with intersections at Duffus Road and the A941 North of Bishopmill. The key features of this network (Figure 7-1) are as follows:

- New roundabout on A96 West of Elgin to allow traffic to access bypass.
- No connection at crossing of Brumley Brae.
- New roundabout at Duffus Road to allow access to bypass in both directions.
- No connection at crossing of Covesea Road.
- New roundabout at A941 North of Bishopmill to allow access to bypass in both directions.
- No connection at crossing of Linksfield Road.
- No connection at crossing of Pitcaveny Road.
- No connection at crossing of Calcots Road.
- New roundabout on A96 East of Elgin to allow traffic to access bypass.
- Bypass modelled as a single 3.65m lane in each direction.
- Roundabouts modelled with two lane flares of 25-30m on all approaches

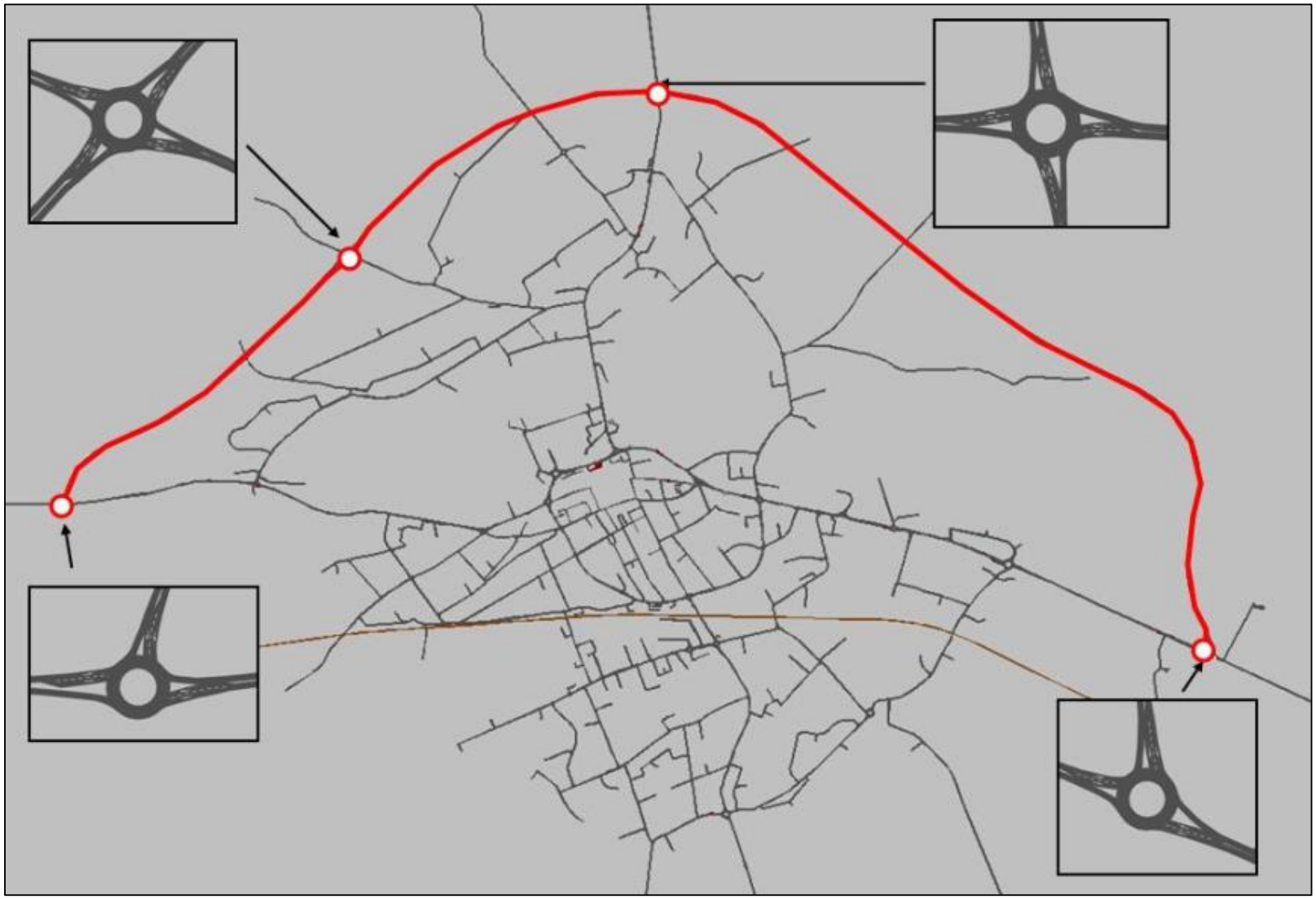


Figure 7-1: Layout For Option 13 (TSP 1)

7.3 Option 13 Results

This option provides a bypass around Elgin's Northern periphery. It would be expected to carry A96 through traffic and traffic going to and from Lossiemouth and surrounding areas.

The traffic volumes using the three sections of the bypass over the two hour modelled periods are shown in Table 7-1 below.

Table 7-1: Traffic Volumes Using Option 13 Bypass Links

Link	Direction	AM Flow	PM Flow	Saturday Flow
Bypass (A96 East to A941)	Eastbound	481	441	429
	Westbound	458	588	391
Bypass (A941 to B9012)	Eastbound	375	532	393
	Westbound	418	446	428
Bypass (B9012 to A96 West)	Eastbound	385	406	366
	Westbound	363	476	350

It would be expected that there would be a decrease in traffic using the A96 when compared with the reference case scenario. In the AM peak period, traffic decreases along the length of the A96 through Elgin town centre by between 15% and 25%. In the PM peak this decrease is approximately 10% to 20%. For the Saturday peak period there is a decrease of approximately 30% to the West of Elgin, 20% to the East of Elgin and between 10% and 25% within Elgin itself. The reduction in traffic is not consistent along the length of the A96 since other traffic re-routes to use this route when traffic that now uses the bypass is removed.

There are general reductions in traffic across all other links in the network within the range of 0-10% for the AM and PM peaks and 0-15% for the Saturday peak. This represents traffic that is now either using the bypass for part or all of its journey or is rerouting onto the A96.

Travel times on Westbound routes through Elgin improve by 15% to 20% for journeys using South College Street and Maisondieu Road in the AM and PM peaks. In the Saturday peak the reduction is between 10% and 15%.

Eastbound journey times are improved by approximately 7% in the AM peak. In the PM peak and Saturday peak the Eastbound route via Maisondieu Road improves by around 10% whilst the route via South College Street improves by approximately 20%.

Northbound journey times in the AM peak improve by approximately 7%. In the PM peak the route via Hay Street improves by 15% whilst the route via Maisondieu Road improves by 7%. In the Saturday peak the improvements are 23% and 17% respectively.

Southbound journey times improve by 3%, 10% and 7% in the AM, PM and Saturday peaks respectively.

The AM peak shows significant improvement along the A96 where queuing on the Eastern approach to the town was previously problematic. In addition the intersection of Morriston Road and the A96 is improved as less traffic now uses the A96 itself providing more gaps for entering traffic. The Southern approach to the Edgar Road roundabout continues to be problematic as no relief is provided at this location by the Northern alignment of the bypass.

The PM peak shows similar improvements at the intersection of Morriston Road and the A96 whilst the Cumming Street and Pansport roundabouts also get significant benefits. In addition, the roundabout of Moss Street with the A941 and Maisondieu Road improves whilst the signals at Wittet Drive perform better due to lower traffic volumes.

The Saturday peak shows some improvements but remains heavily congested in places. The Cumming Street roundabout improves from LoS D to LoS C and the ASDA roundabout from a D to a B. However, the Moss Street roundabout and the Edgar Road roundabout with the A941 remain unchanged and suffers from heavy congestion at times. The A96 to the East of Elgin sees significant improvements to flow due to the reduced traffic volumes.

7.4 *Option 14 – Bypass South (short) Alignment (TSP 2)*

This option implements a bypass to the South of Elgin with intersections at the A941 South of Elgin, the Edgar Road extension and the A96 at Morriston Road. The key features of this network are as follows: and as shown in Figure 7-2.

- New roundabout on A96 West of Elgin at junction with Morriston Road to allow traffic to access bypass.
- No connection at crossing of Pluscarden Road.
- New roundabout at Edgar Road extension to allow access to bypass in both directions.
- New roundabout at A941 South of Elgin to allow access to bypass in both directions.
- No connection at crossing of Linkwood Road.
- New roundabout on A96 East of Elgin to allow traffic to access bypass and Business Park.
- Bypass modelled as a single 3.65m lane in each direction.
- Roundabouts modelled with two lane flares of 25-30m on most approaches.

Figure 7-2: Layout for Option 14 Bypass Links (TSP 2)

7.5 Option 14 Results

This option provides a bypass around Elgin's Southern periphery. It would be expected to carry A96 through traffic, a proportion of traffic going to and from the Edgar Road retail area, traffic for the A941 heading Southbound and vehicles destined for the Southern residential areas of Elgin.

The traffic volumes using the three sections of the bypass over the two hour modelled periods are shown in Table 7-2 below.

Table 7-2: Traffic Volumes Using Option 14 Bypass Links

Link	Direction	AM Flow	PM Flow	Saturday Flow
Bypass (A96 East to A941)	Eastbound	390	603	744
	Westbound	589	753	705
Bypass (A941 to Edgar Road Extension)	Eastbound	338	500	375
	Westbound	460	435	422
Bypass (Edgar Road Extension to A96 West)	Eastbound	411	592	446
	Westbound	451	556	565

In the AM peak there is a significant reduction in traffic using the A96 to the East and West of Elgin. This reduction is approximately 30% to 40%. In the town centre there is a reduction in traffic on the A96 of between 15% and 20%.

In the PM peak traffic on the A96 to the West and East of Elgin drops by approximately 40%. Traffic in the town centre decreases by between 15% and 25% dependent upon location. In the Saturday peak period traffic is reduced by just over 30% to the West of Elgin and by 40% to 45% to the East of Elgin. Traffic volumes on the A96 in the town centre are reduced by around 10% to 20%.

All three periods show significant reductions in traffic on Wittet Drive, South Street and Reiket Lane. Traffic volumes on Main Street increase due to changed routing to provide access to Edgar Road and the surrounding residential zones from the A96. This is since the new roundabouts on the bypass allow traffic to access these areas via the bypass and subsequently via Edgar Road or Main Street as opposed to using the town centre.

Westbound travel times in the AM peak period drop by approximately 20%. In the PM peak there is a reduction of 18% travelling Westbound via South College Street and 24% travelling via Maisondieu Road. In the Saturday peak period the figures are 11% and 20% respectively.

Eastbound travel times are reduced by 7% in the AM peak and by approximately 15% in the PM peak. The Saturday peak shows a reduction of 19% via South College Street and 13% via Maisondieu Road.

Northbound travel times in the AM peak are reduced by around 10%. In the PM peak this reduction is between 7% and 10%. In the Saturday peak there are significant savings due to the reduction in queuing on Main Street and on Alexandra Road. The route via Hay Street shows a reduction in travel time of over 36% whilst the Maisondieu Road route shows a reduction of 32%.

The Southbound travel times reduce by approximately 2% to 3% in the AM peak. In the PM peak this reduction is of the order of 11% to 13% whilst in the Saturday peak period a reduction of 8% to 10% is evident.

The AM peak model shows significant improvements when compared with the reference case model. The Eastern approach to Elgin along the A96 shows a reduction in queuing and a significant improvement at Pansport Place roundabout. The signals at Wittet Drive function far better with the reduced traffic volumes on the A96 in this option and the roundabout at Edgar Road / Main Street receives significant benefits due to the redistribution of traffic via the bypass.

The PM peak model shows improvements to many junctions on the A96 corridor. This is particularly the case at the Pansport Place roundabout. The Cumming Street roundabout improves slightly although this intersection is still heavily congested. There are also improvements in performance at the roundabouts of the A941 with Moss Street and Edgar Road and an improvement in performance of the intersection of Hay Street and Wards Road. In addition the Wittet Drive signals perform significantly better as a result of the reduced traffic flows. The Morriston Road arm of the junction with the A96 shows significant improvement.

The Saturday peak period provides some significant benefits along the A96 corridor. The Cumming Street roundabout remains congested although it performs better than the reference case scenario and does not impact the operation of the Tesco roundabout. The roundabouts at Pansport Place and to the East of Elgin

along the A96 improve in performance. Improvements are also noticeable at Edgar Road and at the ASDA and Moss Street roundabouts. The Wards Road / Hay Street intersection also improves. Queues along Main Street are significantly reduced although the roundabout at Edgar Road / Main Street remains extremely busy. The Morriston Road arm of the junction with the A96 shows significant improvement.

7.6 Option 15 – Bypass South (long) Alignment (TSP 2)

This option implements a bypass to the South of Elgin with intersections at the A941 South of Elgin, the Edgar Road extension and the A96 to the East and West of Elgin. This network differs from Option 14 since there is no connection to Morriston Road, the A96 connection is a further to the West. The key features of this network are as follows: and as shown in Figure 7-3.

- New roundabout on A96 West of Elgin xkm West of Morriston Road to allow traffic to access bypass.
- No connection at crossing of Pluscarden Road.
- New roundabout at Edgar Road extension to allow access to bypass in both directions.
- New roundabout at A941 South of Elgin to allow access to bypass in both directions.
- No connection at crossing of Linkwood Road.
- New roundabout on A96 East of Elgin to allow traffic to access bypass and Business Park.
- Bypass modelled as a single 3.65m lane in each direction.
- Roundabouts modelled with two lane flares of 25-30m on most approaches.

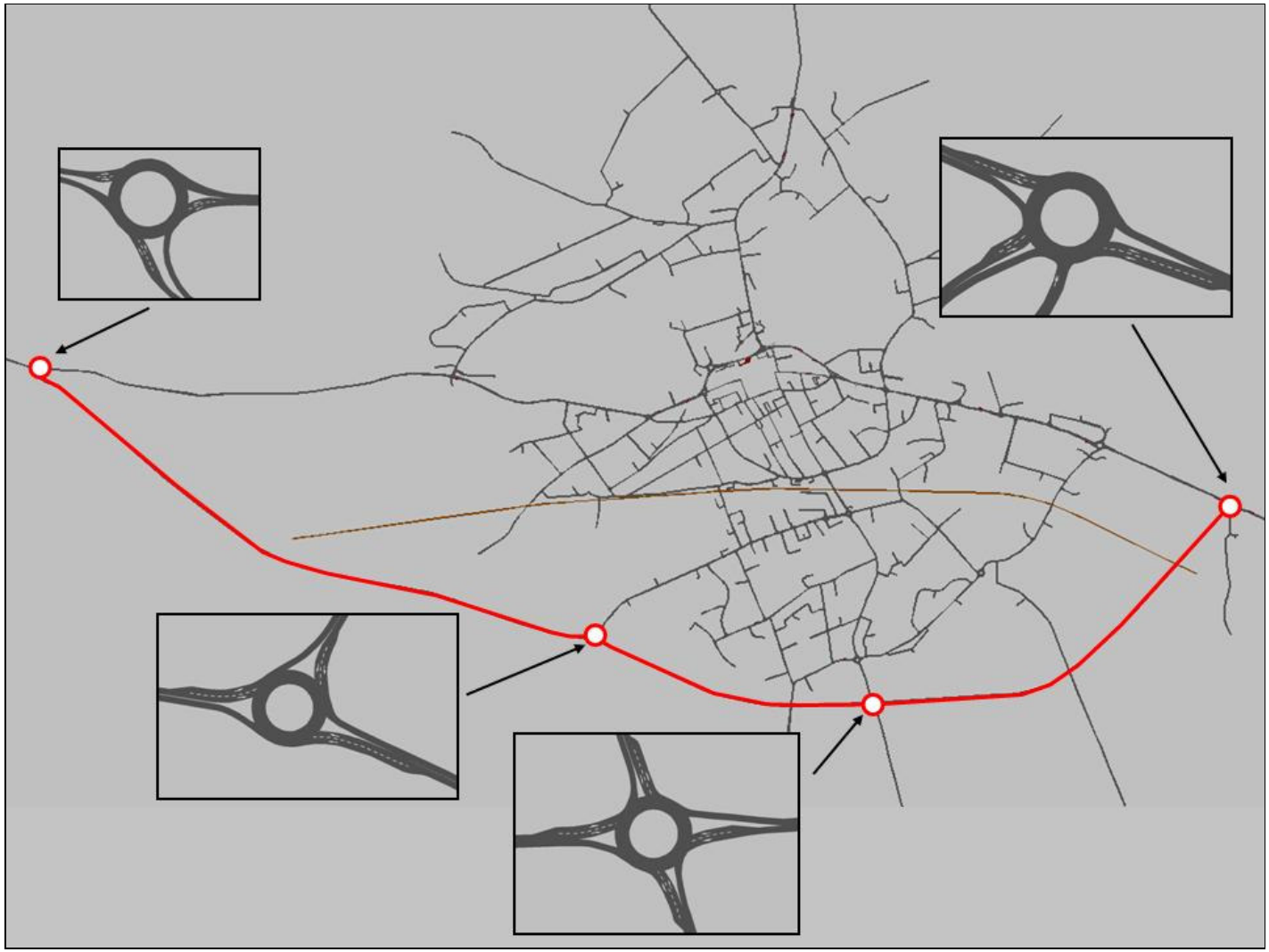


Figure 7-3: Layout for Option 15 Bypass Links (TSP 2)

7.7 Option 15 Results

This option provides an extended bypass around Elgin's Southern periphery. It would be expected to carry A96 through traffic, a proportion of traffic going to and from the Edgar Road retail area, traffic for the A941 heading Southbound and vehicles destined for the Southern residential areas of Elgin.

The traffic volumes using the three sections of the bypass over the two hour modelled periods are shown in Table 7-3 below:

Table 7-3: Traffic Volumes Using Option 15 Bypass Links

Link	Direction	AM Flow	PM Flow	Saturday Flow
Bypass (A96 East to A941)	Eastbound	566	609	537
	Westbound	373	764	564
Bypass (A941 to Edgar Road Extension)	Eastbound	339	518	339
	Westbound	439	434	372
Bypass (Edgar Road Extension to A96 West)	Eastbound	524	668	411
	Westbound	571	633	473

In the AM peak period there is a substantial decrease in traffic using the A96. To the East of Elgin there is a 30% to 35% reduction in traffic whilst to the West there is a larger reduction of 35% to 45%. In the town centre there is a 15% to 25% reduction in traffic. In the PM peak period the reduction to the East of Elgin is approximately 40% whilst the decrease in traffic to the West is between 40% and 50%. Town centre volumes decrease by 15% to 30% dependent upon the count location. The Saturday peak shows an approximate reduction of 35% to the East and West of the town and a decrease of between 5% and 15% within the town centre itself.

All three periods show significant reductions in traffic on Wittet Drive, South Street and Reiket Lane. However traffic on Main Street increases. These changes are primarily due to changing travel patterns for accessing Edgar Road and the surrounding residential zones from the A96. The new roundabouts on the bypass allow traffic to access these areas via the bypass and then Edgar Road or Main Street rather than going through the town centre.

Travel times on Westbound routes through Elgin are reduced by between 15% and 20% in the majority of cases due to the reduction in traffic volume on these routes.

Journey times on Eastbound routes are reduced by approximately 8% in the AM peak. In the PM peak the reductions are 20% for the South College Street route and 14% via Maisondieu Road. Saturday travel times are reduced by 12% and 14% respectively.

Travel times on Northbound routes decrease by approximately 10% in the AM peak period. In the PM peak they are reduced 13% on the route via Hay Street and 6% on the route via Maisondieu Road. In the Saturday period the journey times are reduced by between 25% and 30%. This is primarily as a result of a significant reduction in queuing on the Main Street approach to the Edgar Road roundabout due to the redistribution of local traffic via the bypass to the Edgar Road extension.

Travel times on Southbound routes are reduced by 3% to 4% in the AM peak, 7% to 8% in the PM peak and 8% to 10% in the Saturday peak.

The AM peak model shows significant improvements at key intersections when compared with the reference case model. The Eastern approach to Elgin along the A96 shows a sizeable reduction in queuing and a significant improvement in the performance of the Pansport Place roundabout. The signals at Wittet Drive function far better with the reduced traffic volumes on the A96 in this option and the roundabout at Edgar Road / Main Street receives significant benefits due to the redistribution of traffic via the bypass.

The PM peak model shows benefits along the A96 corridor, particularly at the Pansport Place roundabout which was one of the key problem intersections in the reference case model. The Cumming Street roundabout improves slightly although this intersection is still heavily congested and the Wittet Drive signals perform better. There are also improvements in performance at the roundabouts of the A941 with Moss Street and Edgar Road and an improvement in performance of the intersection of Hay Street and Wards Road.

The Saturday peak period provides benefits along the A96 corridor although the Cumming Street roundabout remains somewhat congested at times. The Tesco roundabout functions very well in this scenario whilst the roundabouts at Pansport Place and to the East of Elgin along the A96 improve performance. Improvements

are also noticeable at Edgar Road and at the Moss Street roundabout and Wards Road / Hay Street intersection. Queues along Main Street are significantly reduced although the roundabout at Edgar Road / Main Street remains extremely busy.

7.8 Global Statistics Comparison of Bypass Option Results

All bypass options show general performance improvements across the network. This section of the report analyses which options perform best from a global perspective.

Figure 7-4 below shows the total vehicle hours in the network for each option. Given that the matrix is identical for all models this statistic provides a good comparative measure of which networks are reducing congestion more than others.

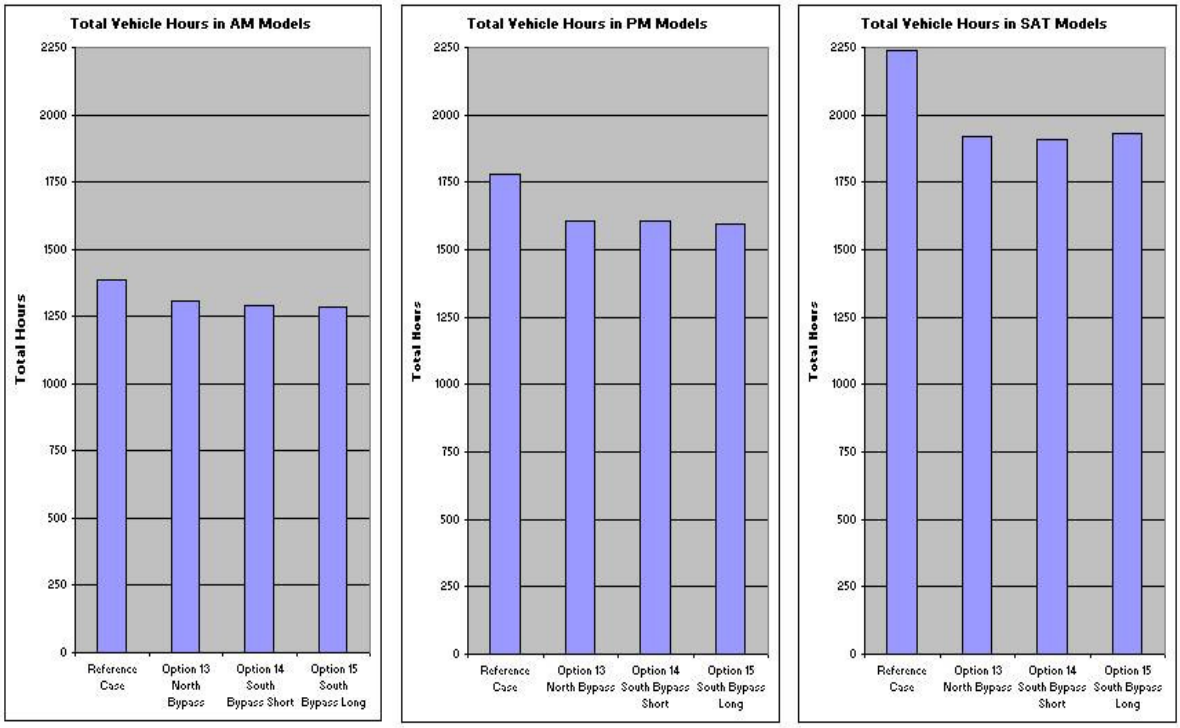


Figure 7-4: Total Vehicle Hours For Bypass Options

It is clear from the graphs that the implementation of any of these schemes would have a large beneficial effect upon the wider Elgin Network. The key problem areas within the model are the A96 route through the town and the Edgar Road roundabout with the A941. When either of these issues is addressed appropriately (ie by use of a bypass) we are seeing overall travel time savings in the order of 10% to 20% dependent upon peak and option across the network.

Figure 7-5 shows the average vehicle speed for each option.

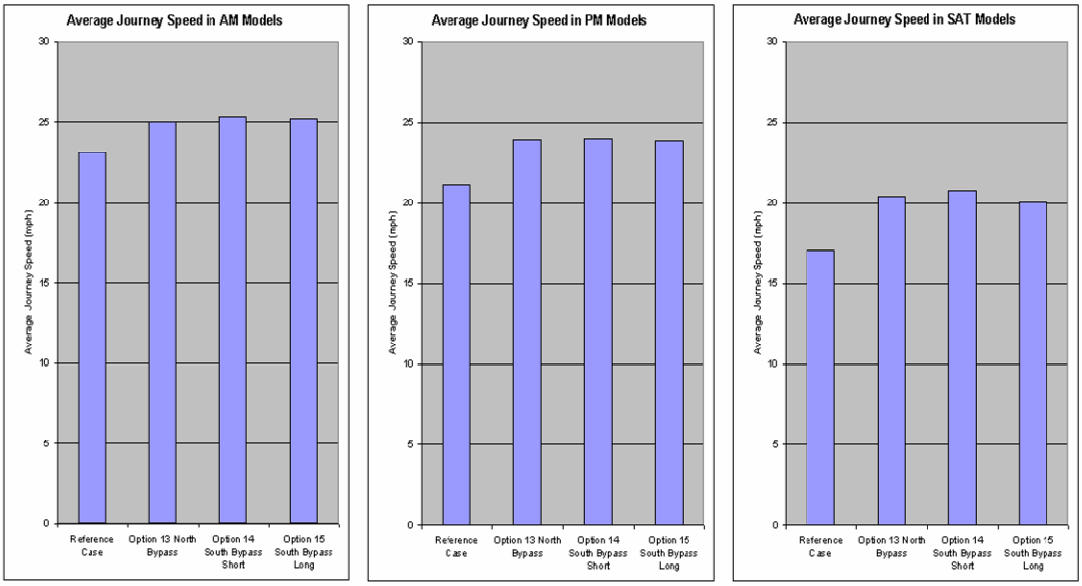


Figure 7-5: Total Vehicle Hours For Bypass Options

These graphs show a similar trend to the total vehicle hours. They identify that any of the options provide a significant level of benefit to the Elgin network when compared with the reference case scenario.

7.9 Conclusions

All bypass options provide significant benefits to the wider Elgin network. Whilst options 14 and 15 (the Southern bypass alignments) slightly outperform Option 13 (the Northern bypass alignment), the reverse appears true in the Saturday peak. The additional benefit of the Southern alignment is the link with Edgar Road which is an area likely to increase significantly as a trip generator in the future. In addition, Option 14 provides a significant benefit to Morriston Road by improving access from that route to the A96 and the South of Elgin from a strategic point of view.

8 Combination Options

8.1 *Scheme Descriptions*

These schemes combine a number of options that have been tested as standalone schemes up until this point. Each option is described below and subsequently results from the options are compared with the reference case scenario.

8.2 *Option 16 – Southern Distributor & Wittet Drive Link*

Option 16 essentially combines the Option 4 link road with upgrading a route following Reiket Lane through to Glen Moray Drive to form a Southern distributor route. The key features of this network are shown in Figure 8-1 and are as follows:

- Option 4 as described previously
- Upgrade length of Reiket Lane
- Upgrade length of Thornhill Road
- Upgrade Birnie Road from A941 to Sandy Road
- Upgrade Sandy Road from Birnie Road to Springfield Road
- Upgrade Glen Moray Drive from Springfield Road to Edgar Road.

Figure 8-1: Layout for Option 16 Southern Distributor

8.3 Option 16 Results

Table 8-1 below shows the volumes of traffic using the new link road in Option 16.

Table 8-1: Traffic Volumes on New Link in Option 16 Scenario

Link	Direction	AM Flow	PM Flow	Saturday Flow
New Link (between The Wards and Edgar Road	Southbound	305	432	441
	Northbound	421	340	476
New Link (between Wittet Drive and The Wards	Southbound	507	680	674
	Northbound	754	730	917
New Link (between A96 and Wittet Drive	Southbound	678	797	625
	Northbound	595	856	876

Generally these volumes are higher in all time periods than the volumes recorded in Option 4.

In all models there is a noticeable reduction in traffic using Main Street, Maisondieu Road and the A941 railway bridge. Conversely traffic levels on Reiket Lane, Thornhill Road and other upgraded sections of the distributor route increase significantly.

Travel times on Westbound routes are reduced by 20% in the AM peak period, 15% to 20% in the PM peak period and between 10% and 25% in the Saturday peak period.

Travel times on Eastbound routes are reduced by 3% to 4% in the AM peak period, 8% to 14% in the PM period and by 12% to 18% in the Saturday period.

Northbound travel times are reduced by 8% to 15% in both the AM and Pm peak periods. In the Saturday periods the reductions are significantly greater at approximately 45%. This is due to a significant reduction in the queue on Main Street to access the Edgar Road roundabout. The distributor route is carrying

some of this traffic to the Western end of Edgar Road which has a beneficial effect upon this problem area.

Southbound travel times are reduced by 3% to 4% in the AM peak and 5% to 9% in the PM peak. Saturday peak reductions are closer to 10%.

8.4 Option 17 – Southern Distributor & Morriston Road Link

Option 17 essentially combines the Option 6 link road with upgrading a route following Reiket Lane through to Glen Moray Drive to form a Southern distributor route. The key features of this network are shown in Figure 8-2 are as follows:

- Option 6 as described previously
- Upgrade length of Reiket Lane
- Upgrade length of Thornhill Road
- Upgrade Birnie Road from A941 to Sandy Road
- Upgrade Sandy Road from Birnie Road to Springfield Road
- Upgrade Glen Moray Drive from Springfield Road to Edgar Road.

Figure 8-2: Layout for Option 17 Southern Distributor

8.5 Option 17 Results

Table 8-2 below shows the volumes of traffic using the new link road in Option 17.

Table 8-2: Traffic Volumes Using New Link in Option 17

Link	Direction	AM Flow	PM Flow	Saturday Flow
New Link (A96 to Pluscarden Road)	Southbound	288	330	384
	Northbound	238	307	246
New Link (Pluscarden Road to Edgar Road)	Southbound	281	350	387
	Northbound	276	310	324

Generally these volumes are higher in all time periods than the volumes recorded in Option 6.

Traffic levels on Reiket Lane, Thornhill Road and other upgraded sections of the distributor route increase significantly in al periods. In all three peak periods the traffic increase is of the order of 15% to 30%. Traffic levels in other areas tend to decrease. Wittet Drive and Wards Road see 30% to 40% decreases in traffic due to the utilisation of the new link road whilst there are modest decreases on the A96, Station Road, the A941 Railway Bridge and Main Street.

Travel times on Westbound routes are reduced by up to 10% in the AM and PM peak periods, and up to 15% in the Saturday period..

Travel times on Eastbound routes are reduced by up to 11% dependent upon time period and route..

Modest improvements in travel time are noticeable for Northbound journeys in the AM and PM peak periods. A reduction of up to 12% is noted in the AM peak whilst 5% is the maximum time saving in the PM peak. Much more significant savings can be seen in the Saturday peak model since the redistribution of traffic by the distributor route significantly reduces traffic on Main Street approaching the Edgar Road roundabout. This in turn reduces the level of queuing on this route by a large factor and has a positive impact on Northbound journeys. Reductions in this time period are of the order of 45%.

Southbound travel times are reduced by 3% in the AM peak and 6% in the PM peak. Saturday peak reductions are closer to 10%.

8.6 Option 18 - Pansport Road and Cumming Street Upgrades & Partial Dualling of Alexandra Road

This option looks at a combined package of measures to improve the flow along the A96 corridor through Elgin town centre. The key features of this option are shown in Figure 8-3 and are as follows:

- Pansport Roundabout layout to be as Option 7;
- Cumming Street Roundabout layout to be as Option 8; and
- A96 to be partially dualled in town centre as Option 9.

8.7 Option 18 - Results

The impact of upgrading the A96 in Elgin town centre is to draw slightly more traffic onto this route in all three modelled periods. The functionality of the intersections affected improves when extra lanes are added and journey times along the A96 generally improve.

Globally, there is an insignificant impact upon the total travel hours on the network in the AM and PM peaks. There are reductions in travel time when compared with the reference case scenario but these are not statistically significant. However, in the PM peak there is a reduction in travel time of 4.3% which is slightly more significant.

Traffic volumes on the improved sections of the A96 increase by up to 5% in the AM peak, up to 15% in the PM peak and up to 10% in the Saturday peak.

Travel times along the A96 improve significantly in the Eastbound direction in all three peaks. Reductions in journey times of 5% in the AM period, 23% in the PM period and 20% in the Saturday period reflect the benefits of improving the Pansport and Cumming Street roundabouts. Westbound travel times along the A96 are reduced by 4% in the AM peak, 7% in the PM peak and 9% in the Saturday peak. In addition, the Saturday peak shows significant benefits to Northbound and Southbound traffic due to the improvements at the Cumming Street roundabout.

Levels of service show that the Pansport and Cumming Street roundabouts have improved functionality under this scenario in all periods. In the AM peak hour the

levels of service of the Cumming Street and Pansport roundabouts improve from B to A.

In the PM peak hour the Cumming Street roundabout improves from a LoS E to B whilst the Haugh Street roundabout also improves. Pansport roundabout improves from B to C whilst Greyfrairs roundabout improves from B to A.

In the Saturday peak hour the Cumming Street roundabout improves from a LoS D to B, the Haugh Street roundabout improves from B to A and the Pansport roundabout improves from B to A.

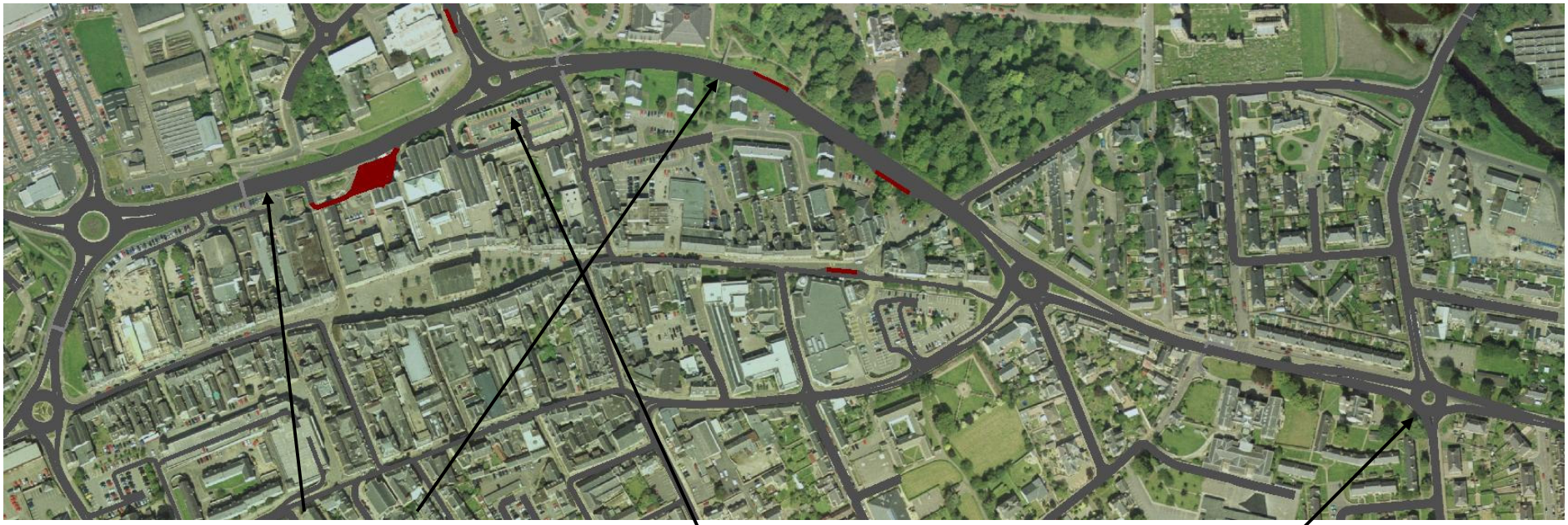


Figure 8-3: Layout for Option 18 Pansport Road and Cumming Street Upgrades & Partial Dualling of Alexandra Road -

8.8 *Option 19 - Edgar Road Junction Upgrade & Wittet Drive Link*

This combined option considers the impact of adding extra lanes to the Edgar Road roundabout whilst also incorporating the Wittet Drive Link into the network. The key features of this network are shown in Figure 8-4 and are as follows:

- Edgar Road \ Main Street roundabout as Option 12; and
- Wittet Drive Link as Option 4.

8.9 *Option 19 Results*

The implementation of this scheme shows significant positive local benefits in the AM, PM and Saturday peaks. One of the most significant local benefit is from the removal of the signals at Wittet Drive. In the AM and PM peak reference case scenarios significant queuing occurred at this site. The signals are replaced with a roundabout in option 19 and this operates far more efficiently and with significantly reduced delays. In addition there are benefits in the AM and Saturday peaks for traffic on Main Street approaching the Edgar Road roundabout.

In addition to the local benefits there are also benefits to the wider network. Traffic redistribution allows the Cumming Street roundabout to operate significantly better in the PM and Saturday peak models than it did in the reference case scenarios. There is also an improvement in the Tesco roundabout in these two peak periods.

These wider benefits can be quantified since the total travel hours on the AM, PM and Saturday networks reduce by 6%, 7% and more than 11% respectively when compared to the reference case models.

Journey times through the network on the eight specified routes are also reduced. The greatest reductions are seen on Northbound routes which benefit from the significant reduction in delay on Main Street at Edgar Road, particularly in the Saturday model.

8.10 *Conclusions*

All of the Combination Options (Options 16 – 19) benefits to traffic in the wider Elgin network; however most of the improvements can be attributed to the previously reported Link Options which are part of the Combination Options. Nevertheless these options per se do provide overall traffic improvements to Elgin.

Figure 8-4: Layout for Option 19

9 A941 Railway Bridge Closure

9.1 Option 20 – A941 Railway Bridge Closure

This option would consider the closure of the A941 to traffic at the bridge over the railway. This represents the impact of a bridge failure on the Elgin network in the three modelled periods.

Removing a critical link from the model places extreme pressures on the remaining links during some periods of the simulation. As such it was not possible to complete all iterations of the model assignment. However, where this was the case observations were made during the iterations that preceded gridlock to assess the location of the problems caused in this option.

9.2 AM Peak Results

The key traffic flow affected by the closure of the A941 at the railway bridge in the AM peak is the Northbound flow heading towards the town centre. This traffic is re-routed via several alternative routes. The primary route is to use The Wards and Wards Road to access Hay Street. Other routes include Linkwood Road / Ashgrove Road and Reiket Lane.

The Wards becomes extremely congested during the peak period as large volumes of traffic wish to turn right into Wards Road and subsequently left into Hay Street. This creates a large queue that can extend beyond Edgar Road and cause significant problems. In addition there are large queues on Ashgrove Road and Reiket Lane where diverted traffic attempts to access the A96.

9.3 PM Peak Results

Traffic heading Eastbound along Wards Road queues back to The Wards and blocks back onto Edgar Road in both directions. This is caused primarily by the intersection of Wards Road and Hay Street and also The Wards and Wards Road being over capacity.

9.4 Saturday Peak Results

In the Saturday peak traffic is extremely heavy on The Wards and Wards Road. Northbound traffic on The Wards quickly queues back to Edgar Road and blocks back along Edgar Road in both directions. The cause of the delay is that traffic heading North along The Wards must cede priority to traffic on Wards Road.

Whilst traffic on Wards Road is quite light, the traffic diverted onto The Wards from the railway bridge is very heavy and pushes this intersection significantly over capacity.

Traffic on Ashgrove Road and Reiket Lane also increases and leads to the formation of some large queues on the former route at its intersection with the A96.

10 Summary

10.1 *Introduction*

This document has reported the findings of a series of traffic modelling options undertaken on the Elgin VISSIM Model. The options being tested were derived from the STAG 1 appraisal process, and forms part of the "sifting process" to identify options which merit further analysis in STAG 2.

10.2 *Options Tested*

The options which have been tested fall into six categories, all of which were compared against a Reference Case. These categories were:

- Traffic Management Options;
- Link Options;
- A96 Improvement Options;
- A941 Improvement Options;
- Bypass Options; and
- Combination Options.

10.3 *Conclusion*

For the traffic management options none of the options were found to be effective in traffic terms of improving conditions within Elgin.

Modelling the link options, Option 4 (Wittet drive) & Option 6 (Morriston Road Link) all improved traffic conditions for Elgin as a whole. Option 5 (Wards Road) did little to alleviate traffic conditions in Elgin.

None of the A96 and A941 improvement options were found to be particularly successful on a global basis and all benefits were highly localised in nature.

In traffic terms all of the potential bypass options had global benefits by reducing overall travel times within Elgin and increasing overall average speeds on the network.

Of the combination options, all saw marginal increases in benefits although most of these could be attributed to the link options (4&6) that they were associated with..

This report sets out a description of the options tested through the traffic model and provides the quantitative results obtained from the option tests. It makes no explicit recommendations on what options should be carried forward but simply states the facts based on analysis.

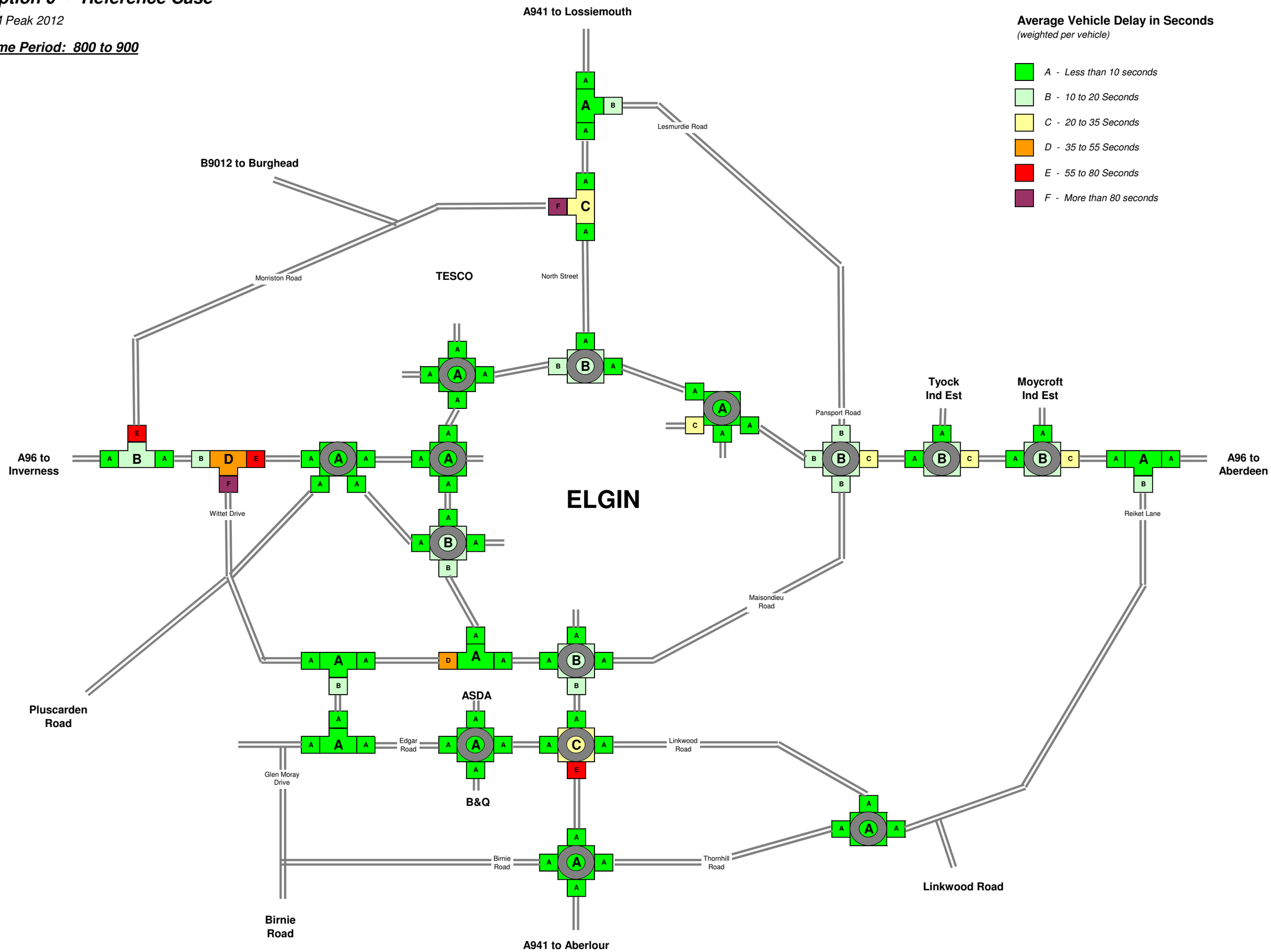
A Appendix A

A.1 Level of Service Diagrams

Option 0 - Reference Case

AM Peak 2012

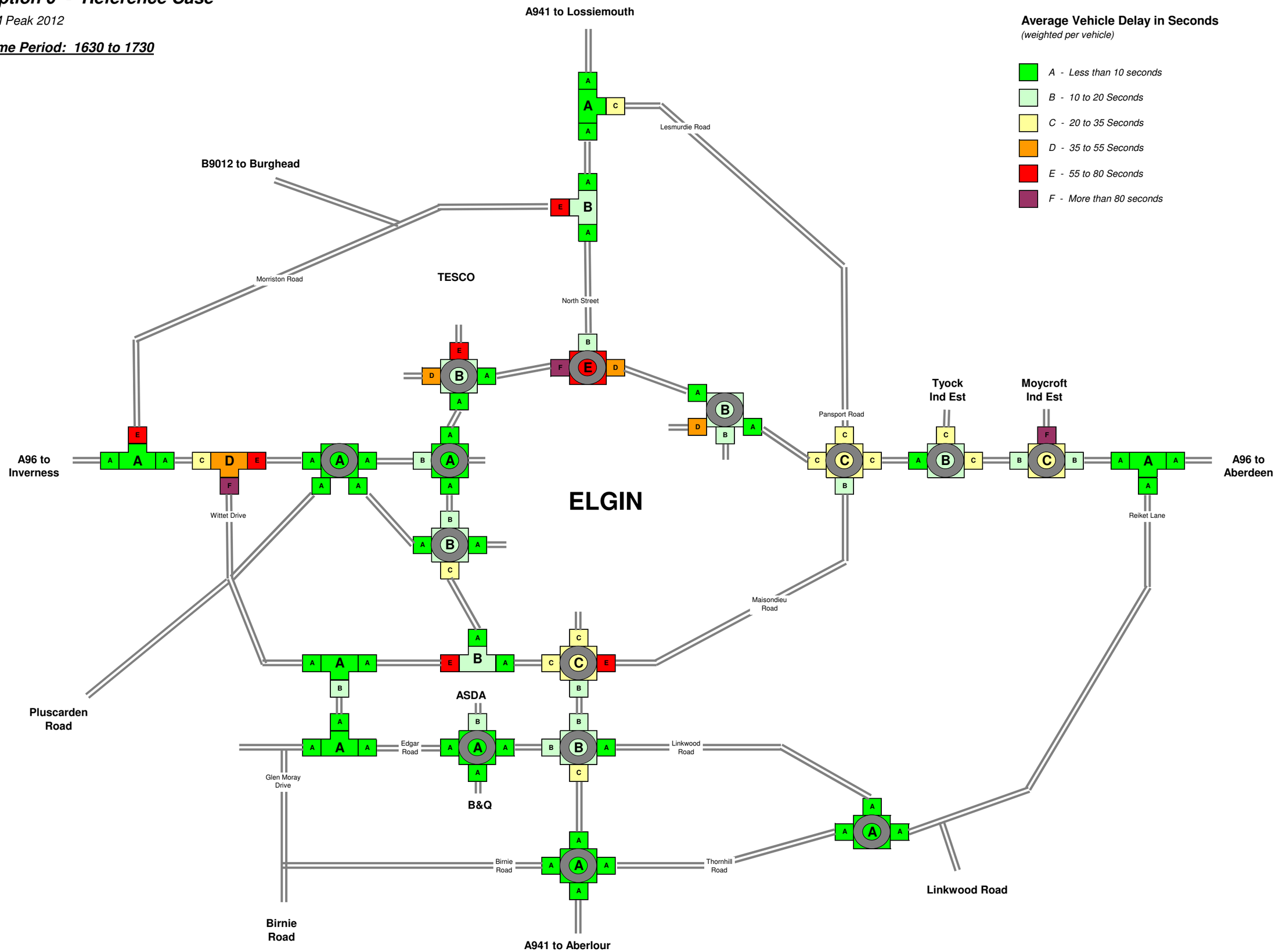
Time Period: 800 to 900



Option 0 - Reference Case

PM Peak 2012

Time Period: 1630 to 1730



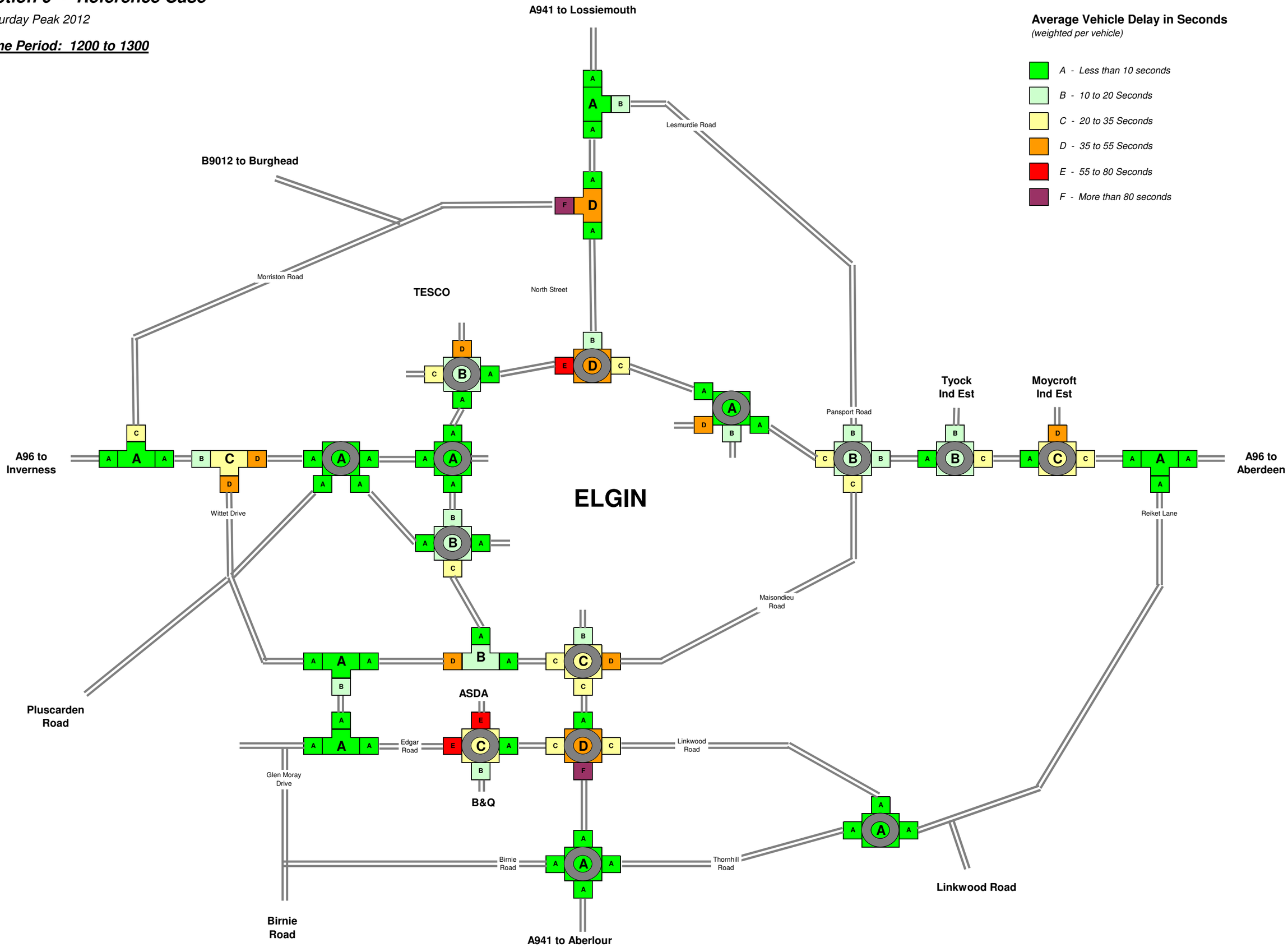
Option 0 - Reference Case

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

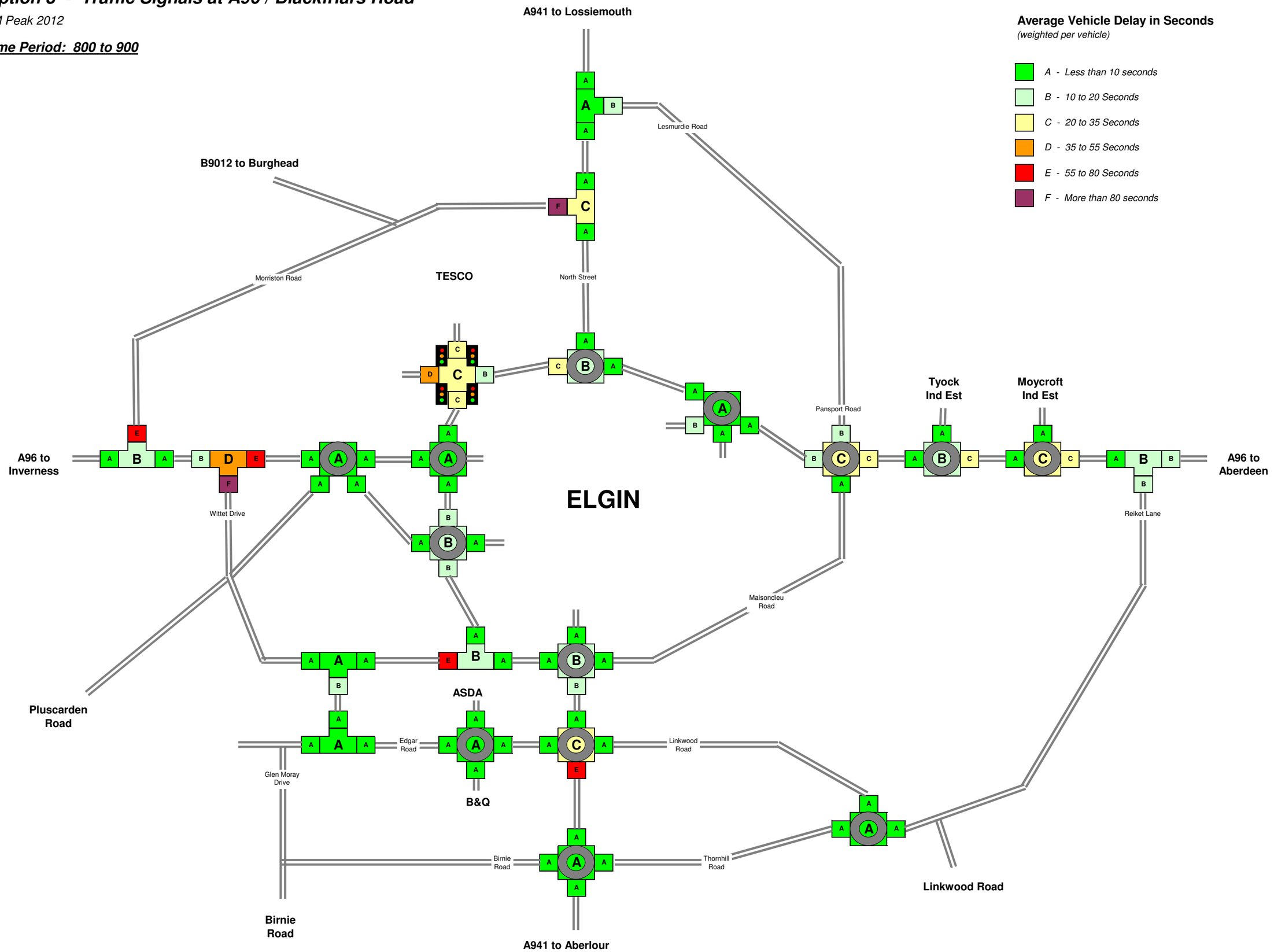
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 3 - Traffic Signals at A96 / Blackfriars Road

AM Peak 2012

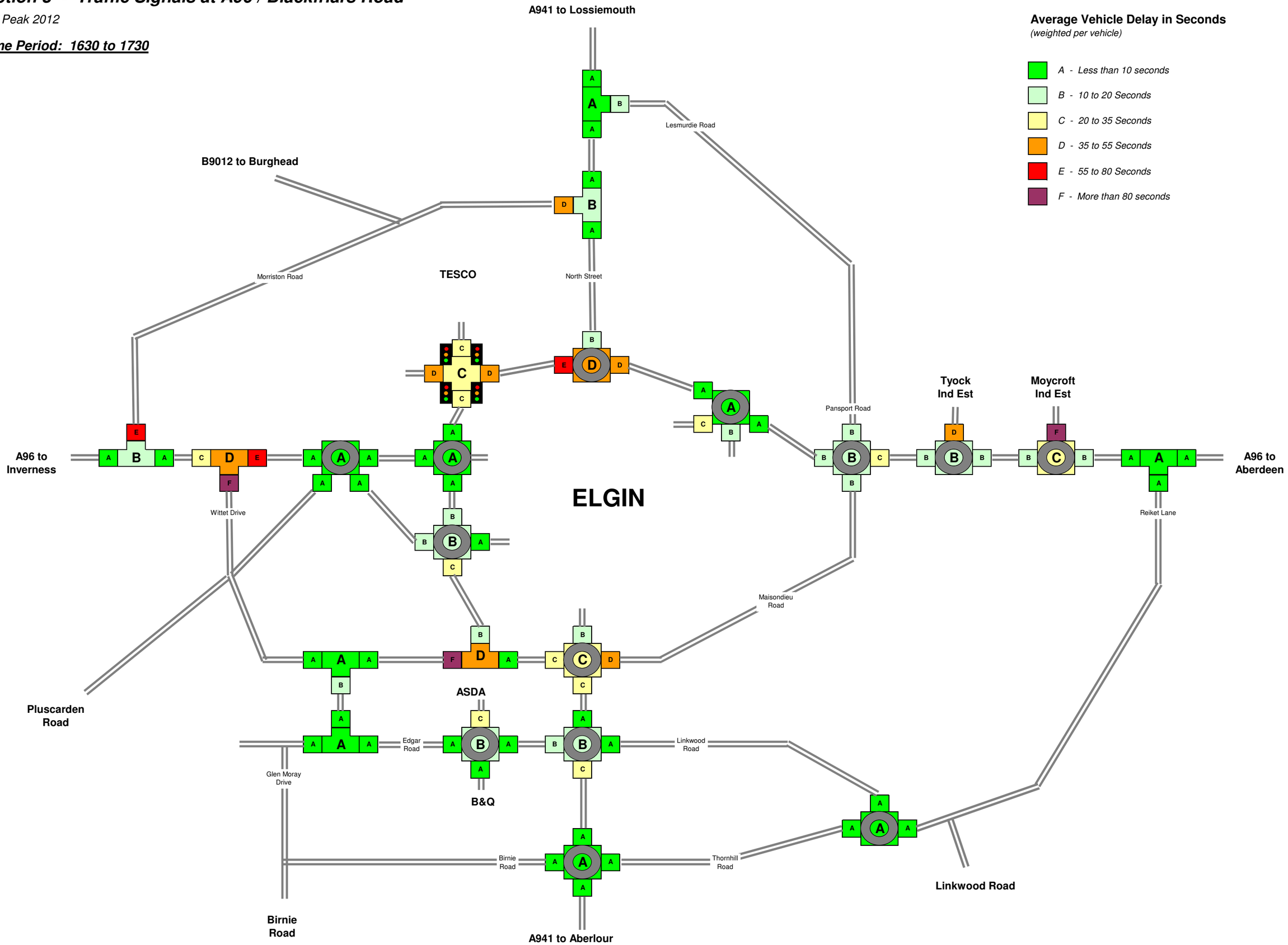
Time Period: 800 to 900



Option 3 - Traffic Signals at A96 / Blackfriars Road

PM Peak 2012

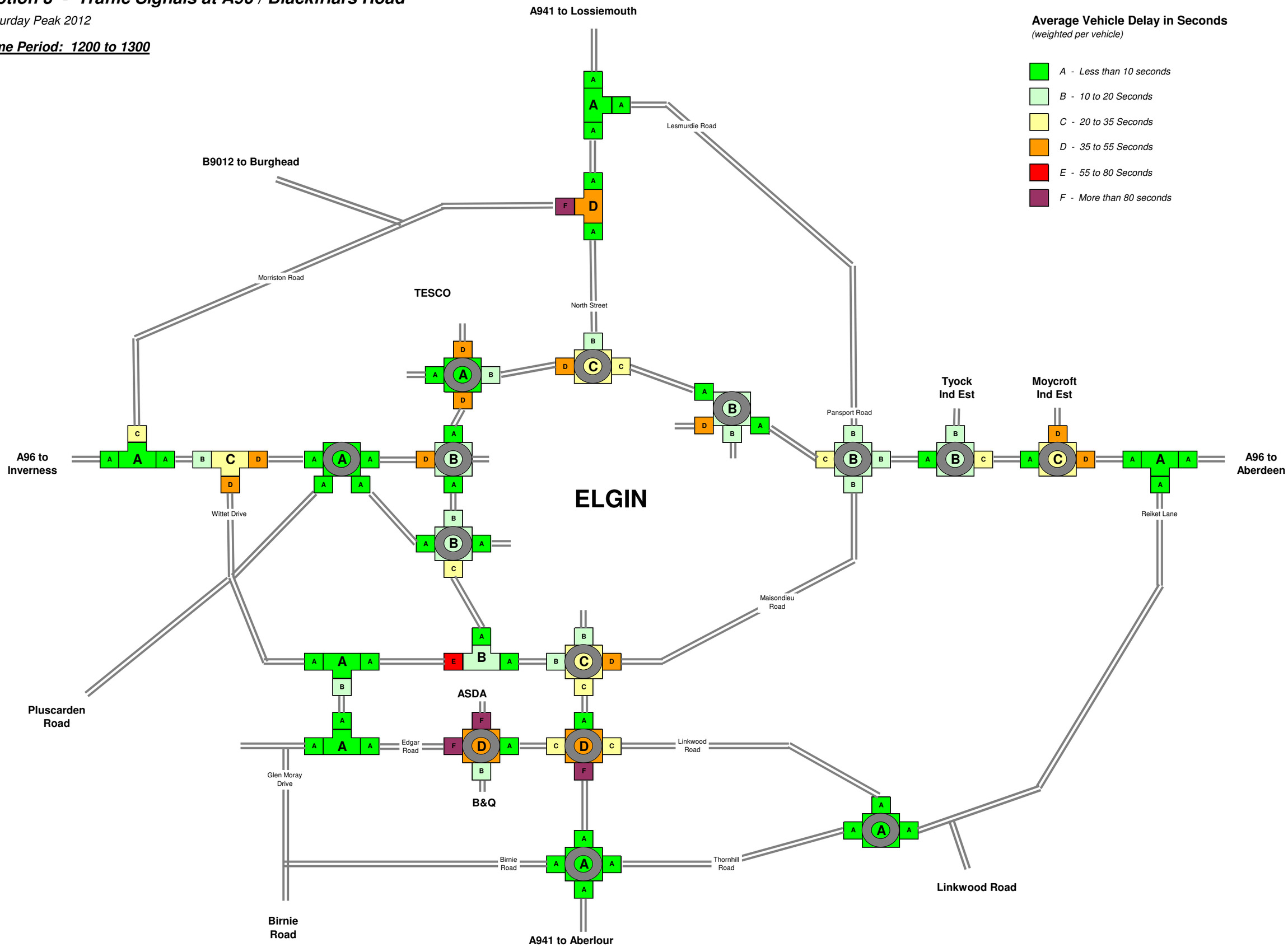
Time Period: 1630 to 1730



Option 3 - Traffic Signals at A96 / Blackfriars Road

Saturday Peak 2012

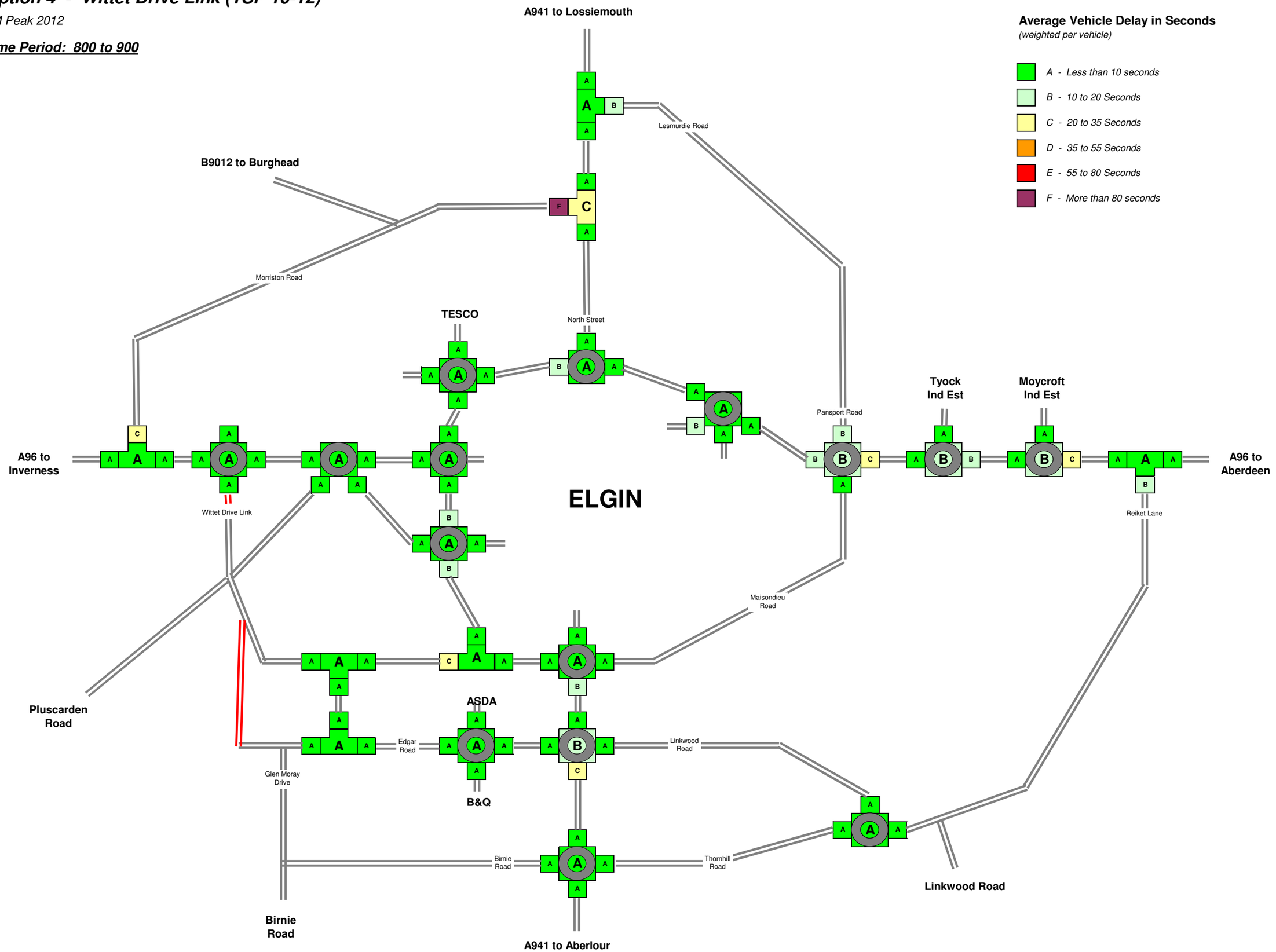
Time Period: 1200 to 1300



Option 4 - Wittet Drive Link (TSP 10-12)

AM Peak 2012

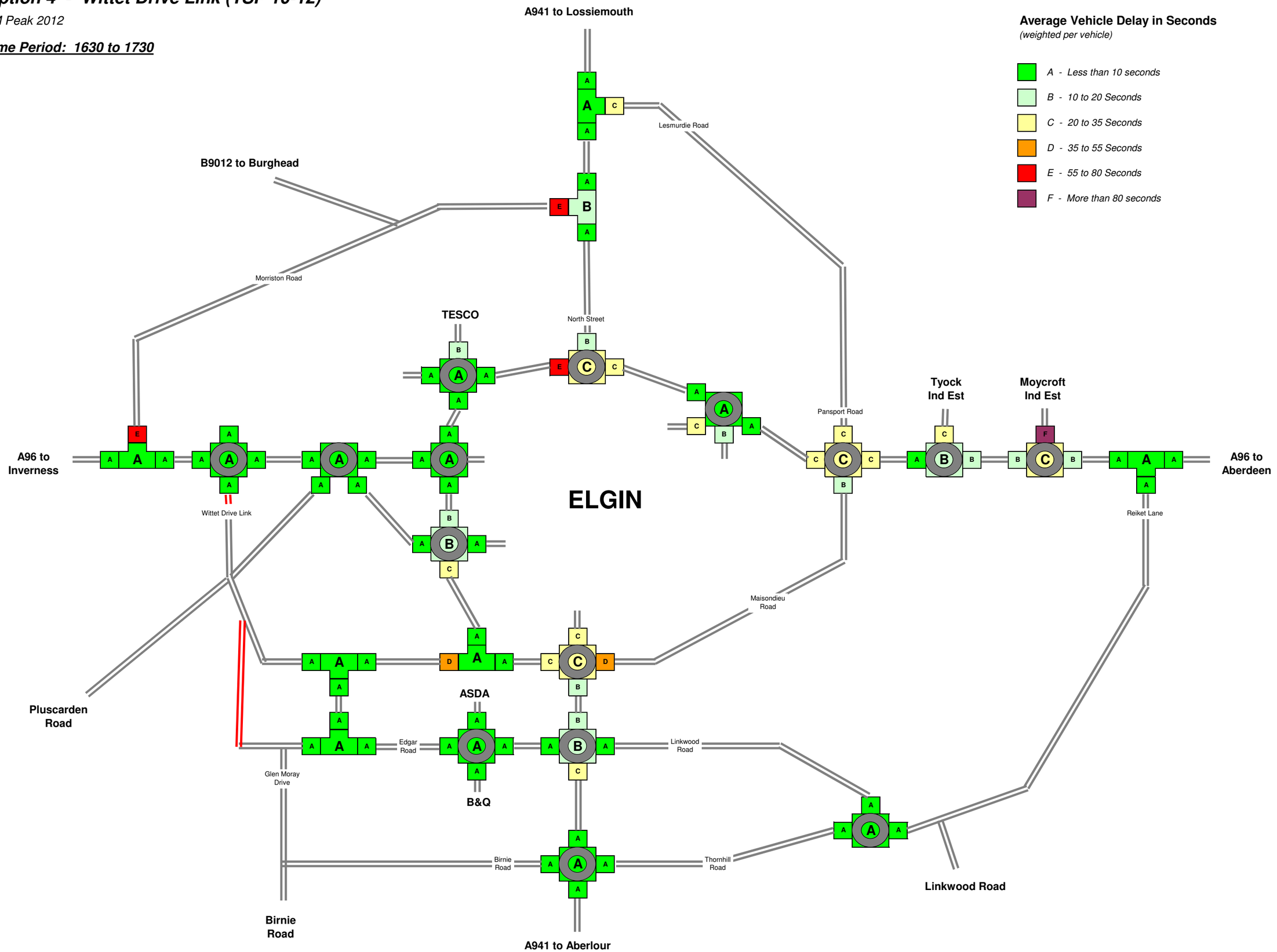
Time Period: 800 to 900



Option 4 - Wittet Drive Link (TSP 10-12)

PM Peak 2012

Time Period: 1630 to 1730



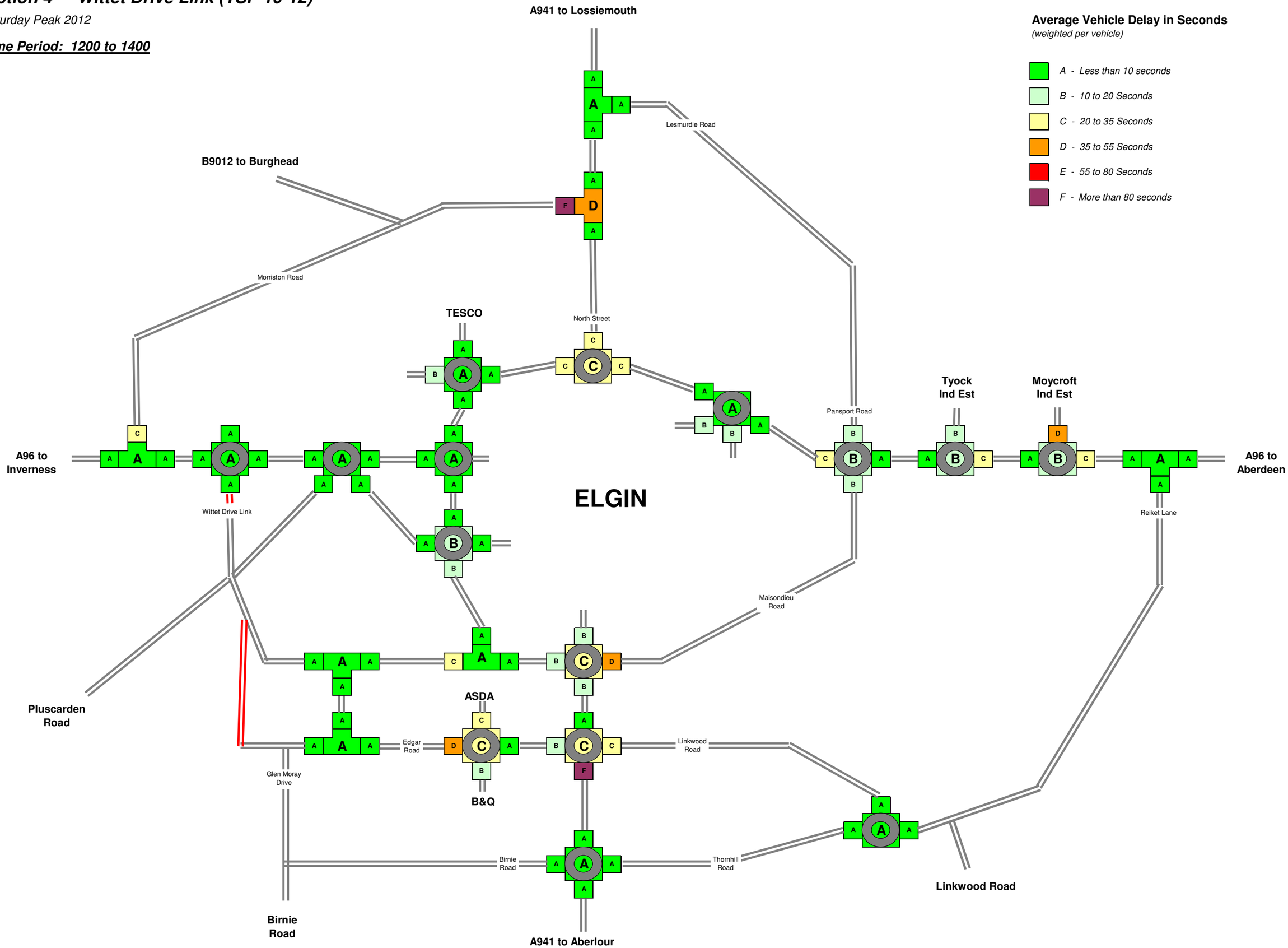
Option 4 - Wittet Drive Link (TSP 10-12)

Saturday Peak 2012

Time Period: 1200 to 1400

Average Vehicle Delay in Seconds
(weighted per vehicle)

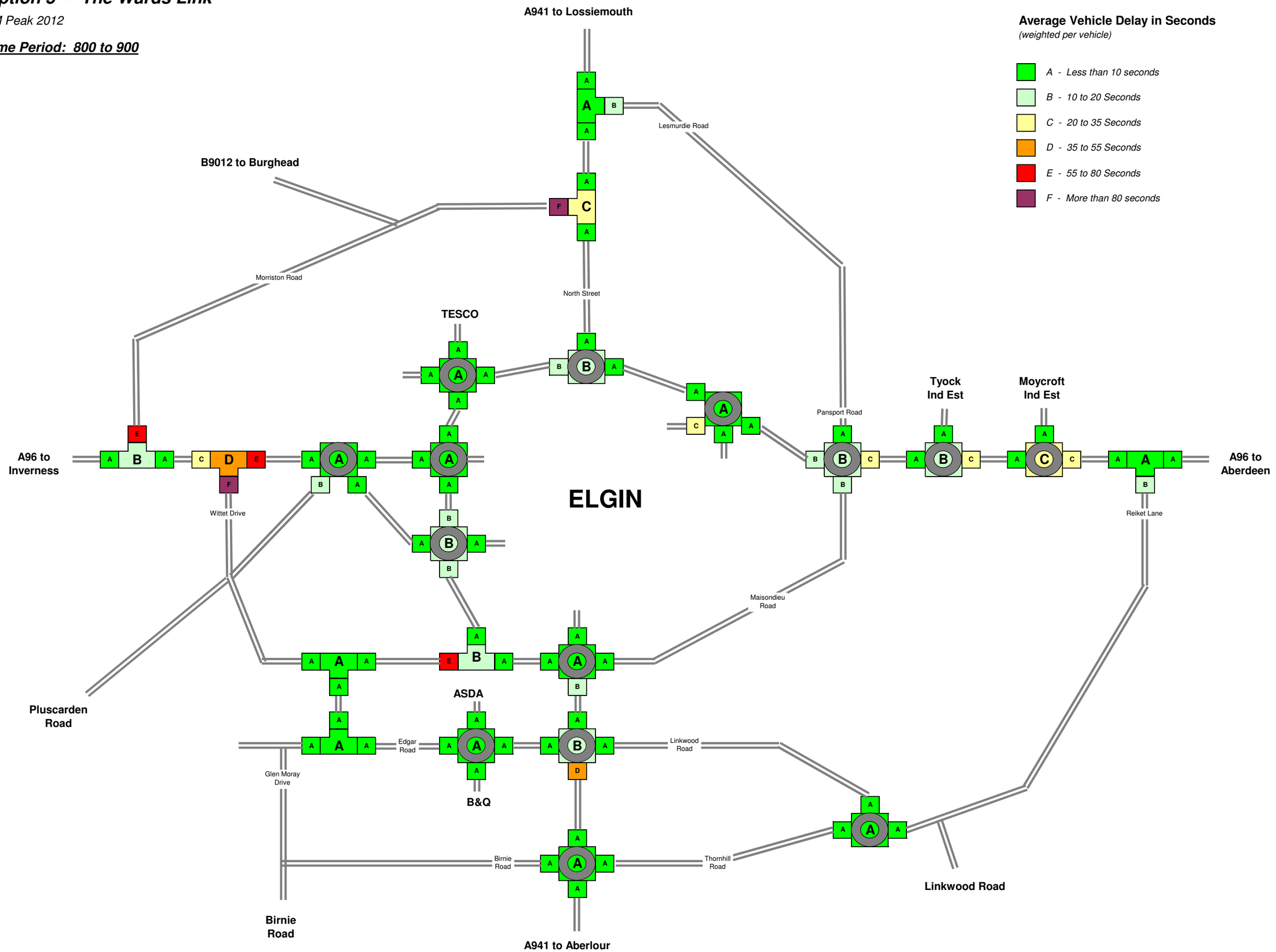
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 5 - The Wards Link

AM Peak 2012

Time Period: 800 to 900



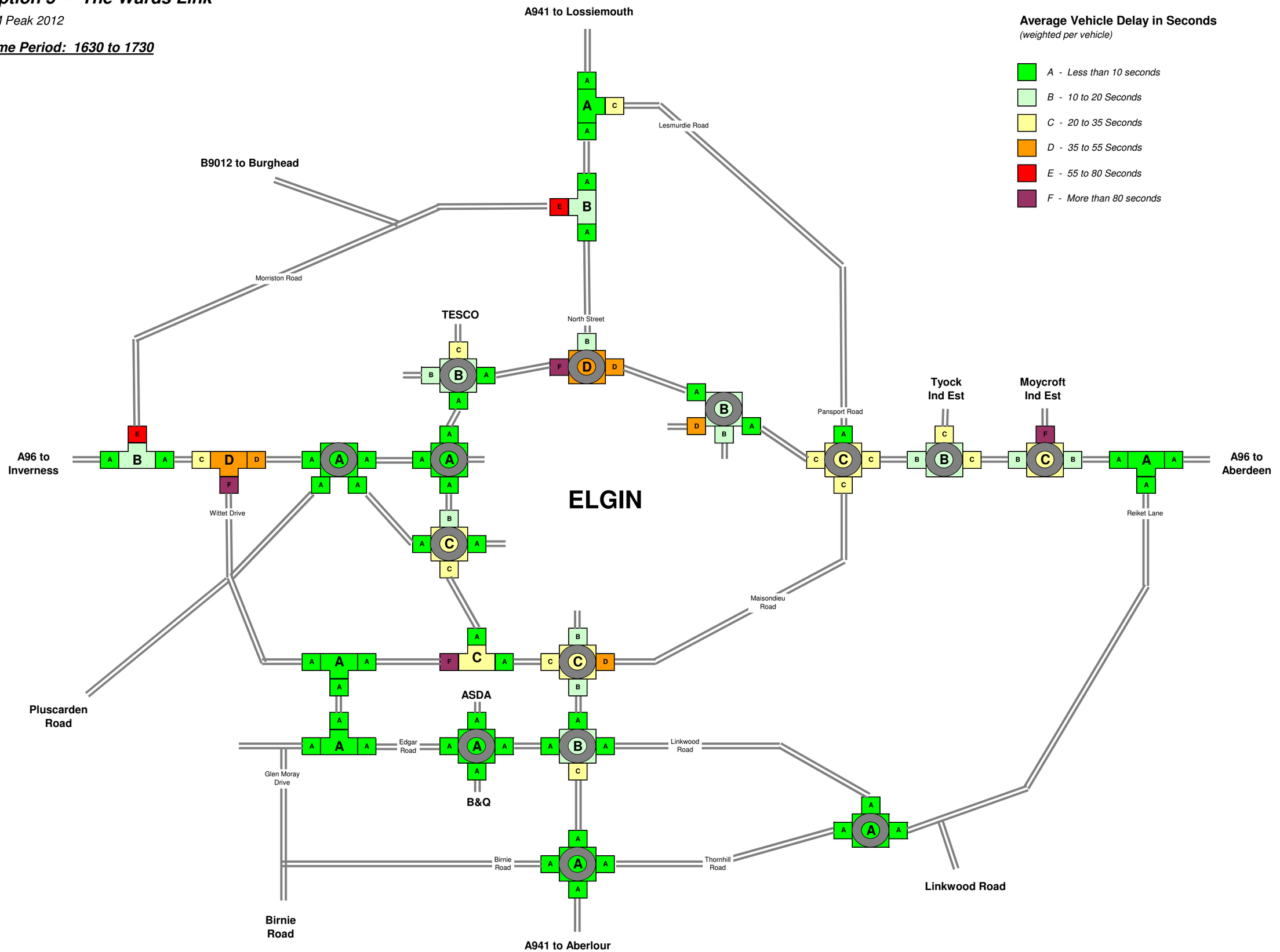
Option 5 - The Wards Link

PM Peak 2012

Time Period: 1630 to 1730

Average Vehicle Delay in Seconds
(weighted per vehicle)

- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 5 - The Wards Link

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*

A941 to Lossiemouth

Lesmurdie Road

B9012 to Burghead

Morriston Road

TESCO

North Street

A96 to Inverness

Wittet Drive

ELGIN

Pansport Road

Tyock Ind Est

Moycroft Ind Est

A96 to Aberdeen

Reiket Lane

Maisondieu Road

Pluscarden Road

ASDA

Edgar Road

Linkwood Road

Glen Moray Drive

B&Q

Birnie Road

Thornhill Road

Linkwood Road

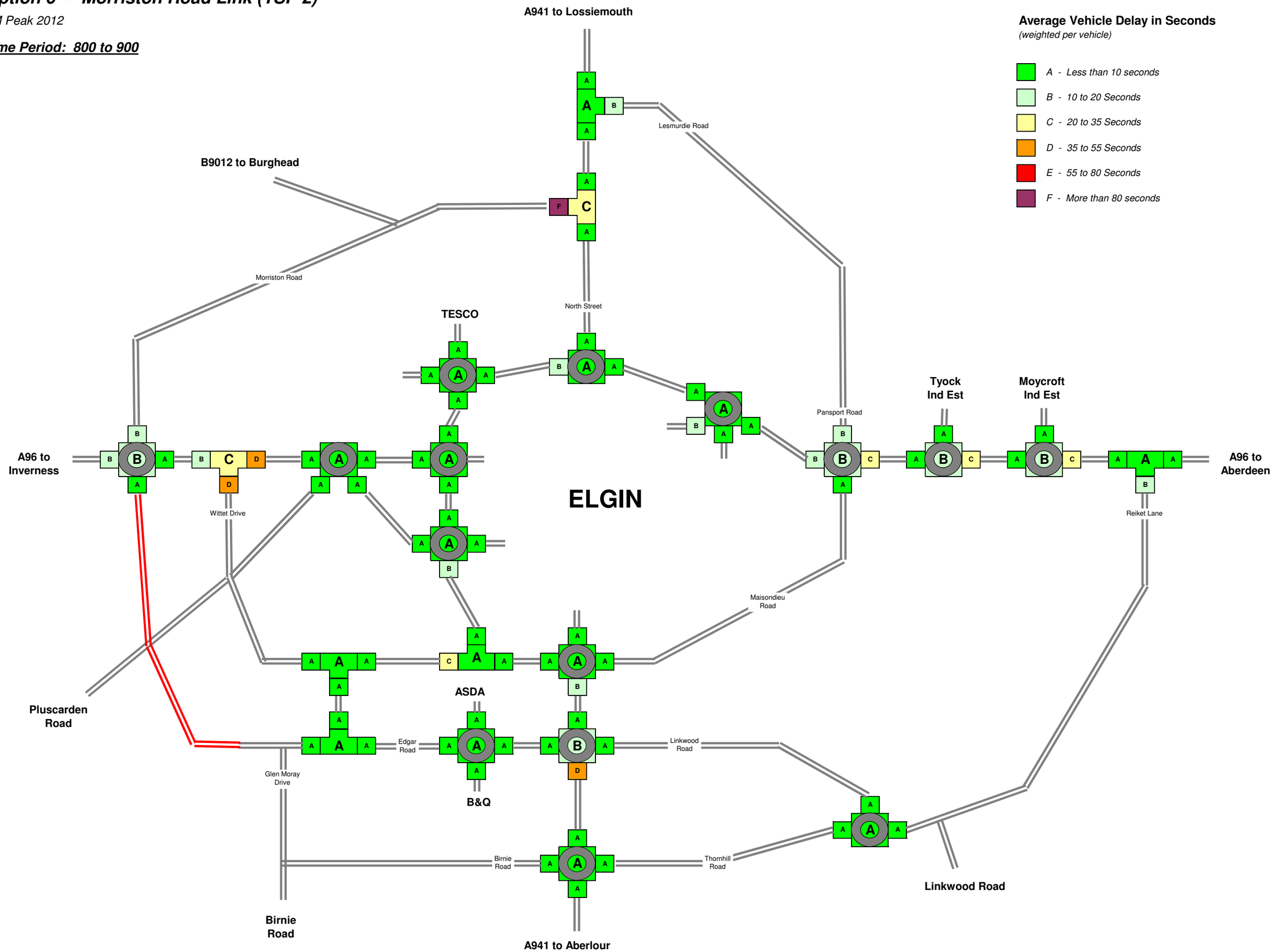
Birnie Road

A941 to Aberlour

Option 6 - Morriston Road Link (TSP 2)

AM Peak 2012

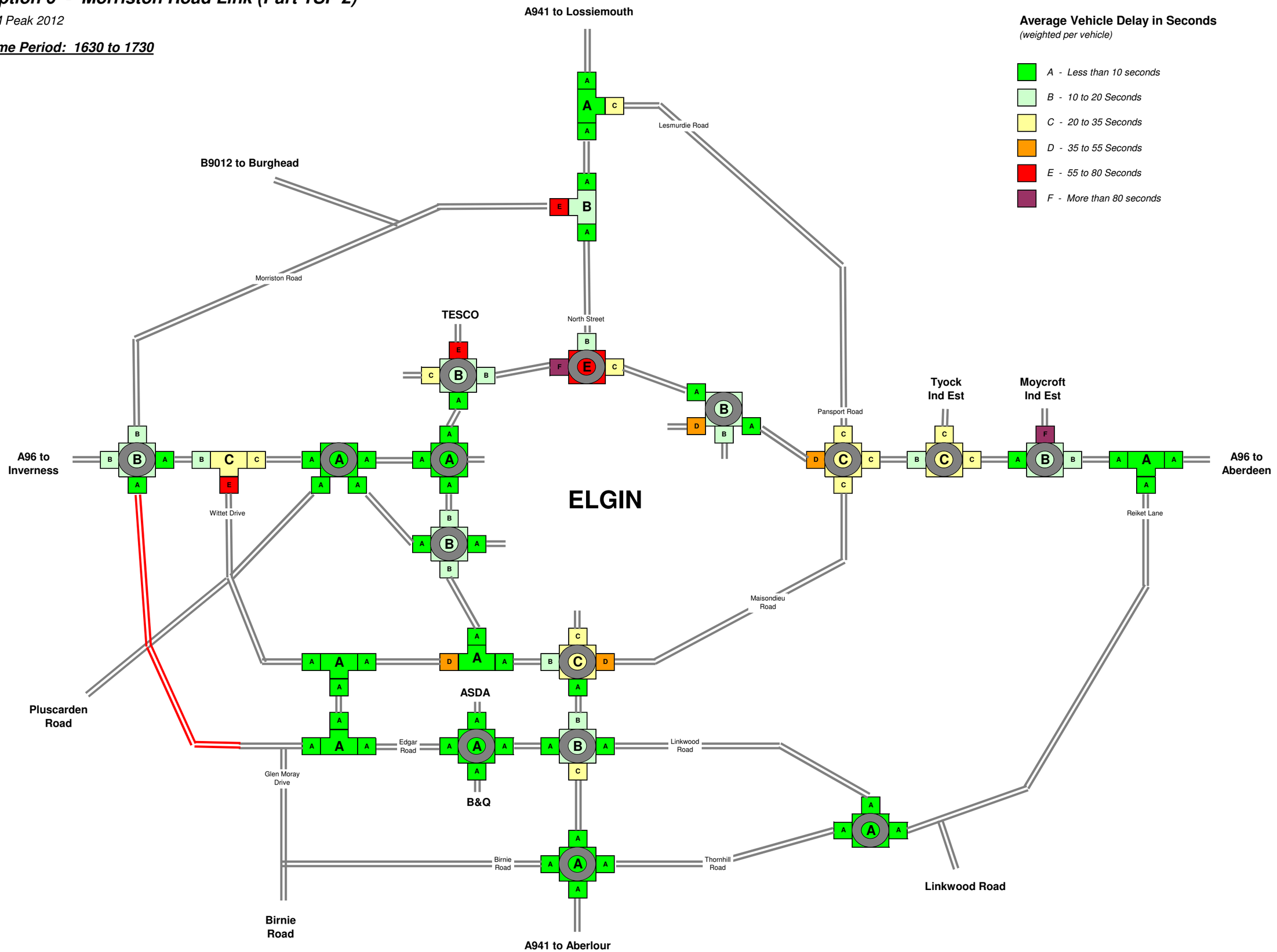
Time Period: 800 to 900



Option 6 - Morriston Road Link (Part TSP 2)

PM Peak 2012

Time Period: 1630 to 1730



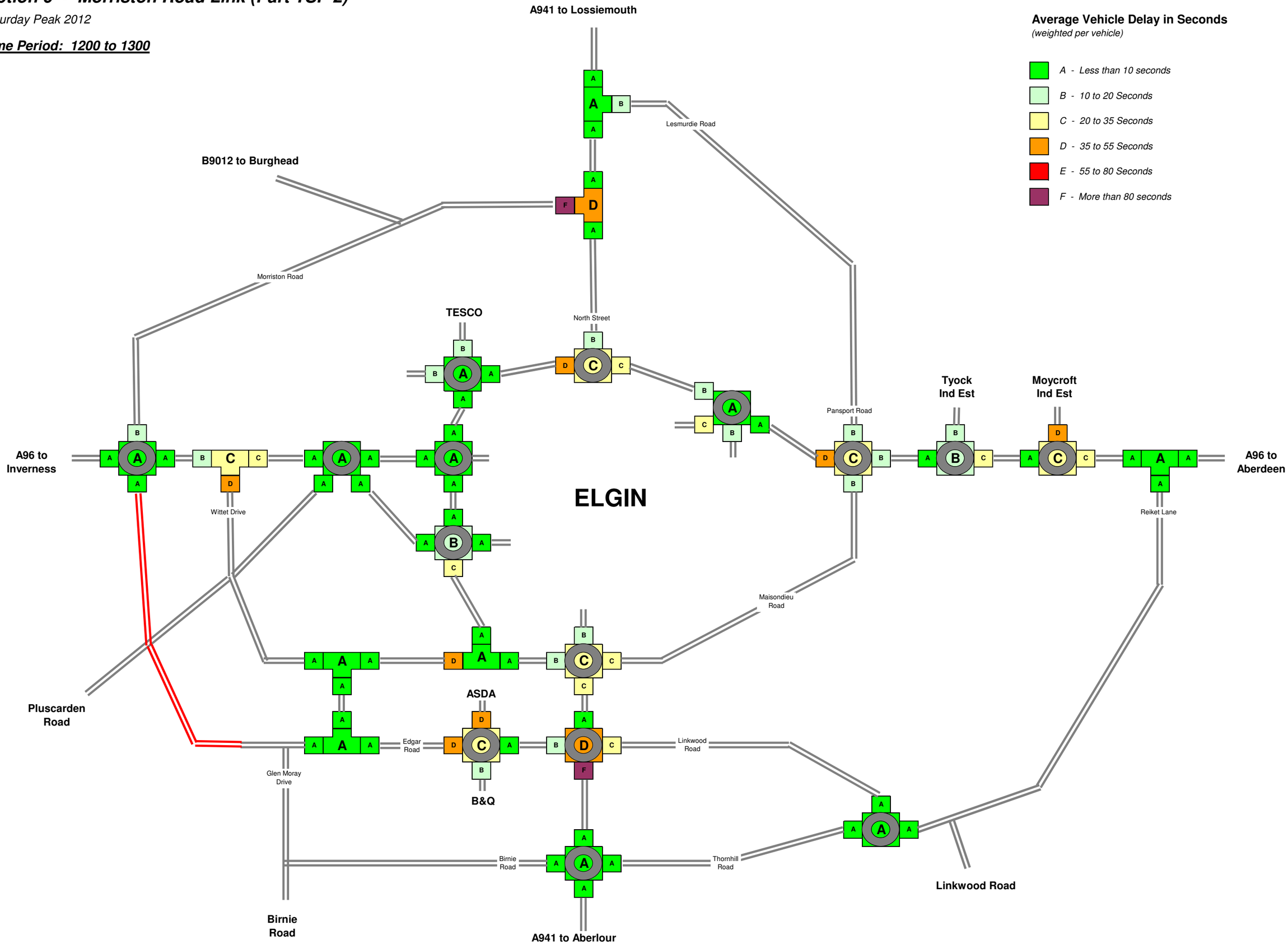
Option 6 - Morriston Road Link (Part TSP 2)

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

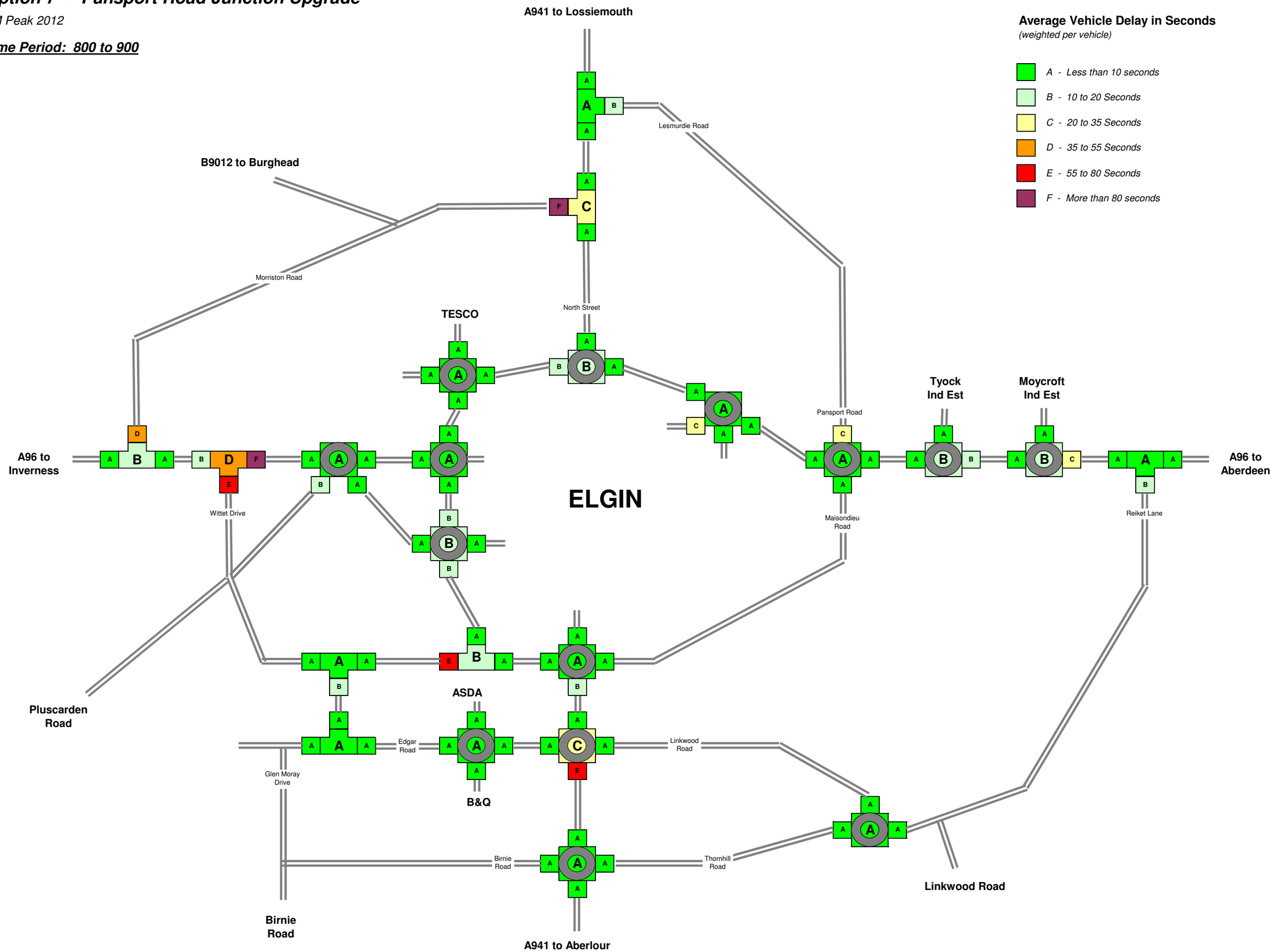
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 7 - Pansport Road Junction Upgrade

AM Peak 2012

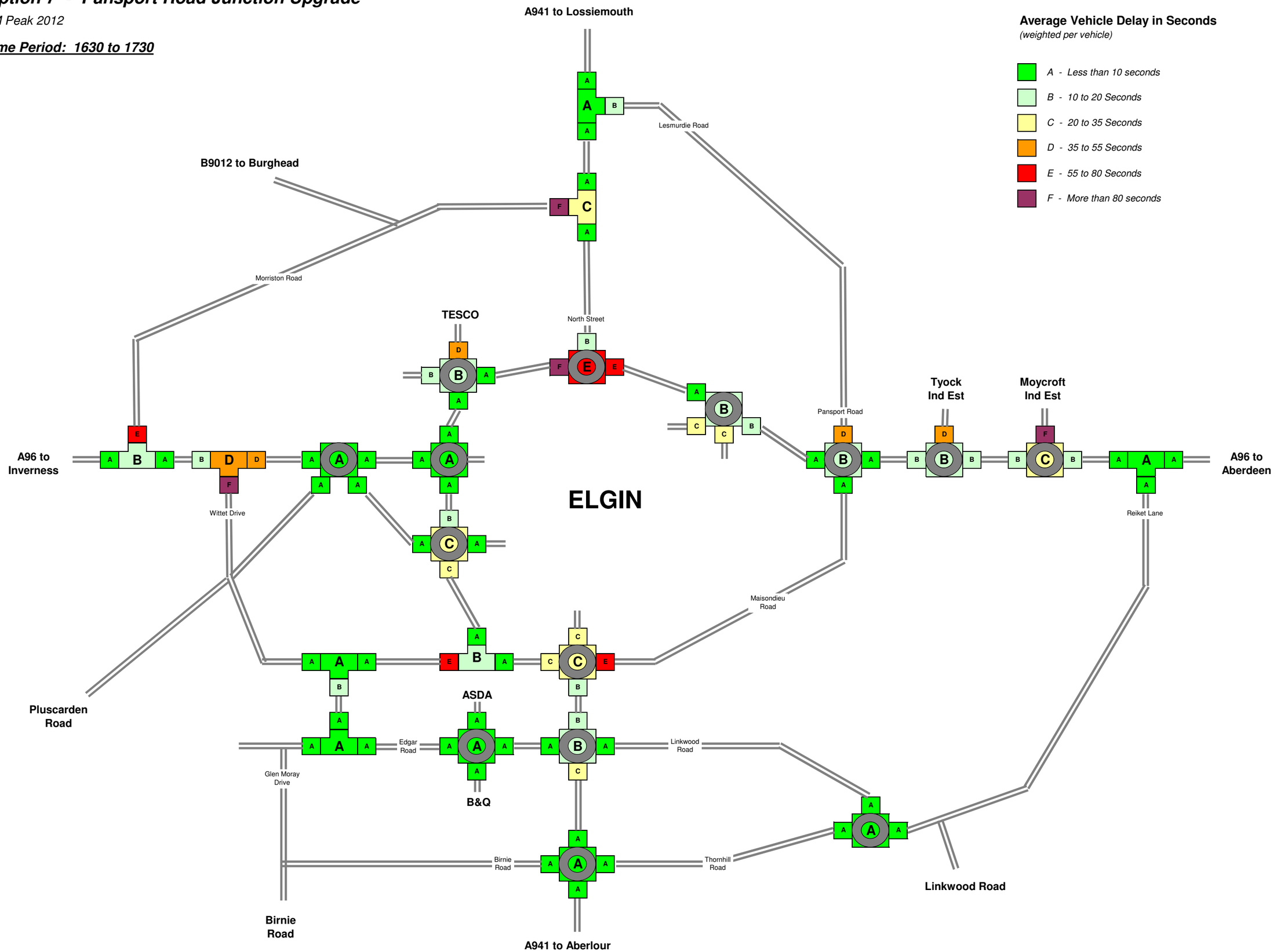
Time Period: 800 to 900



Option 7 - Pansport Road Junction Upgrade

PM Peak 2012

Time Period: 1630 to 1730



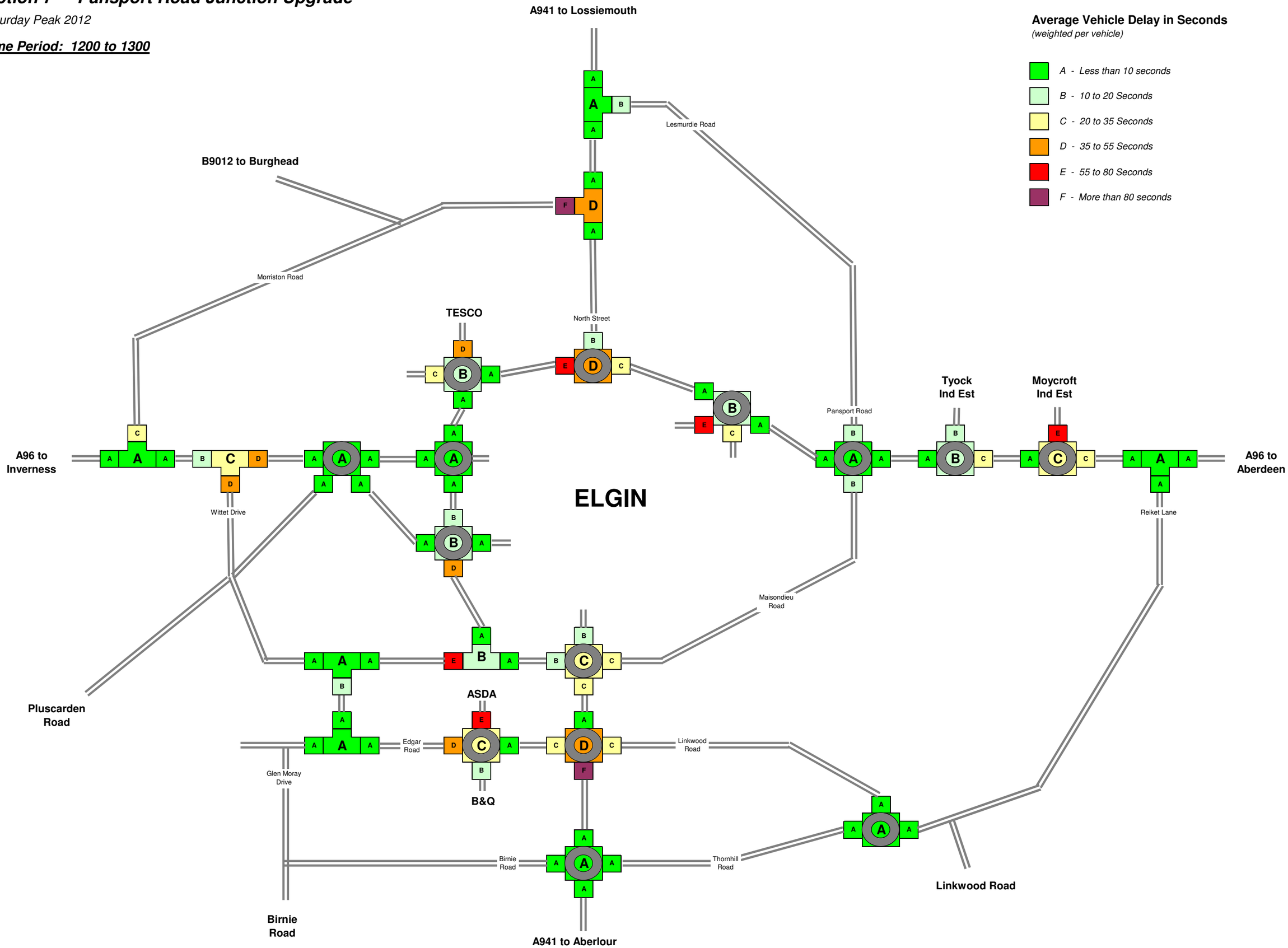
Option 7 - Pansport Road Junction Upgrade

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

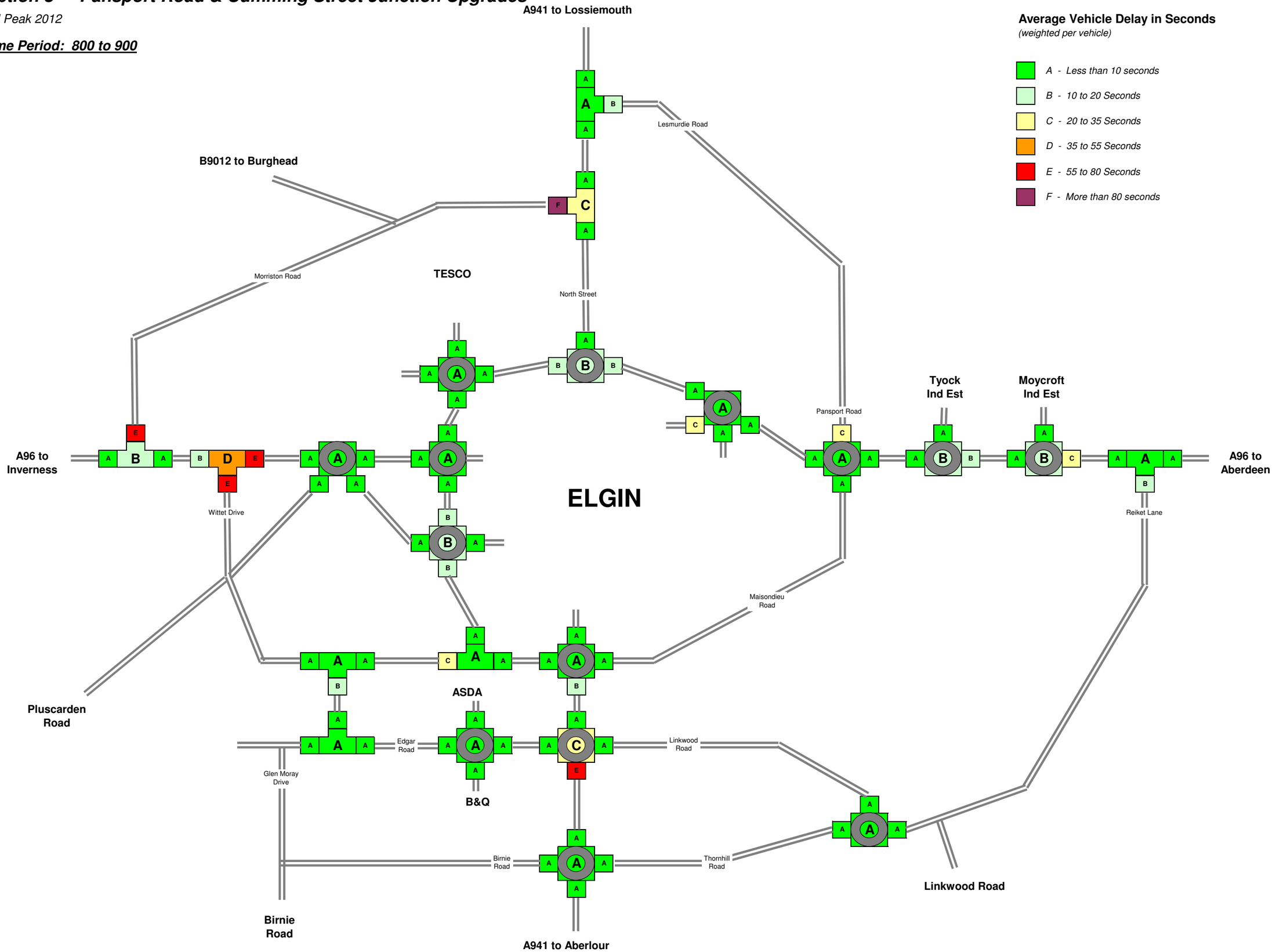
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 8 - Pansport Road & Cumming Street Junction Upgrades

AM Peak 2012

Time Period: 800 to 900



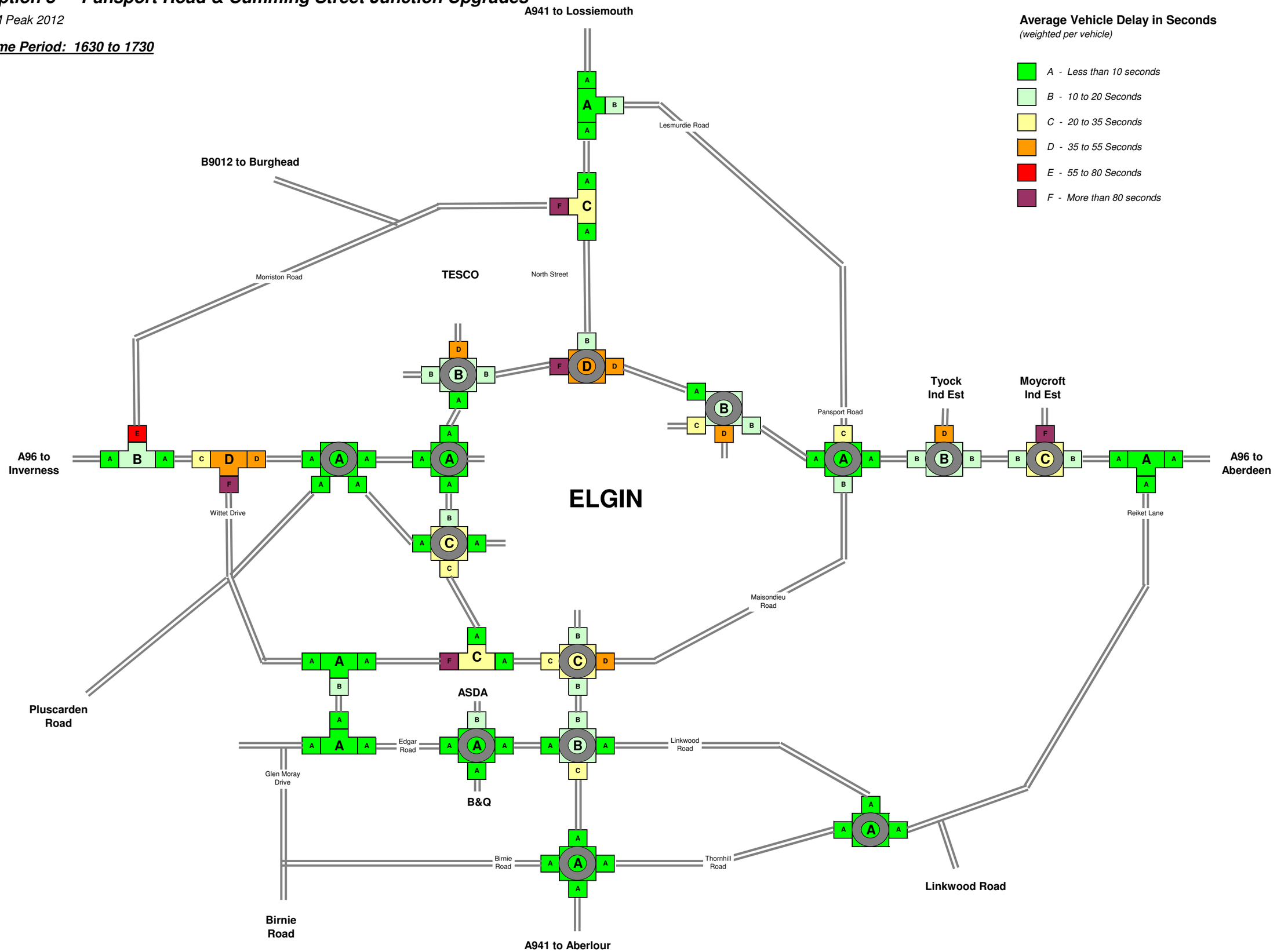
Option 8 - Pansport Road & Cumming Street Junction Upgrades

PM Peak 2012

Time Period: 1630 to 1730

Average Vehicle Delay in Seconds
(weighted per vehicle)

- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



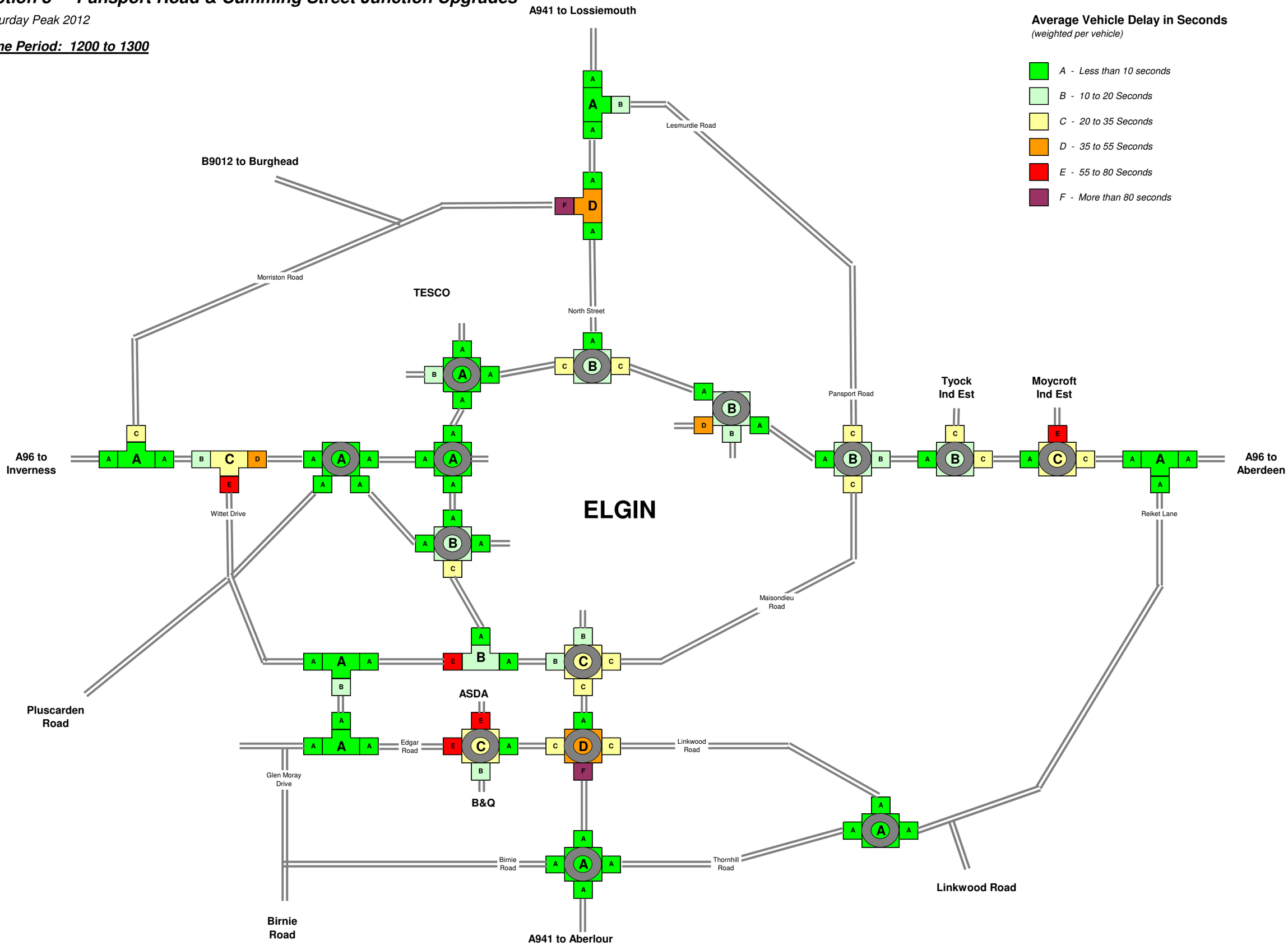
Option 8 - Pansport Road & Cumming Street Junction Upgrades

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

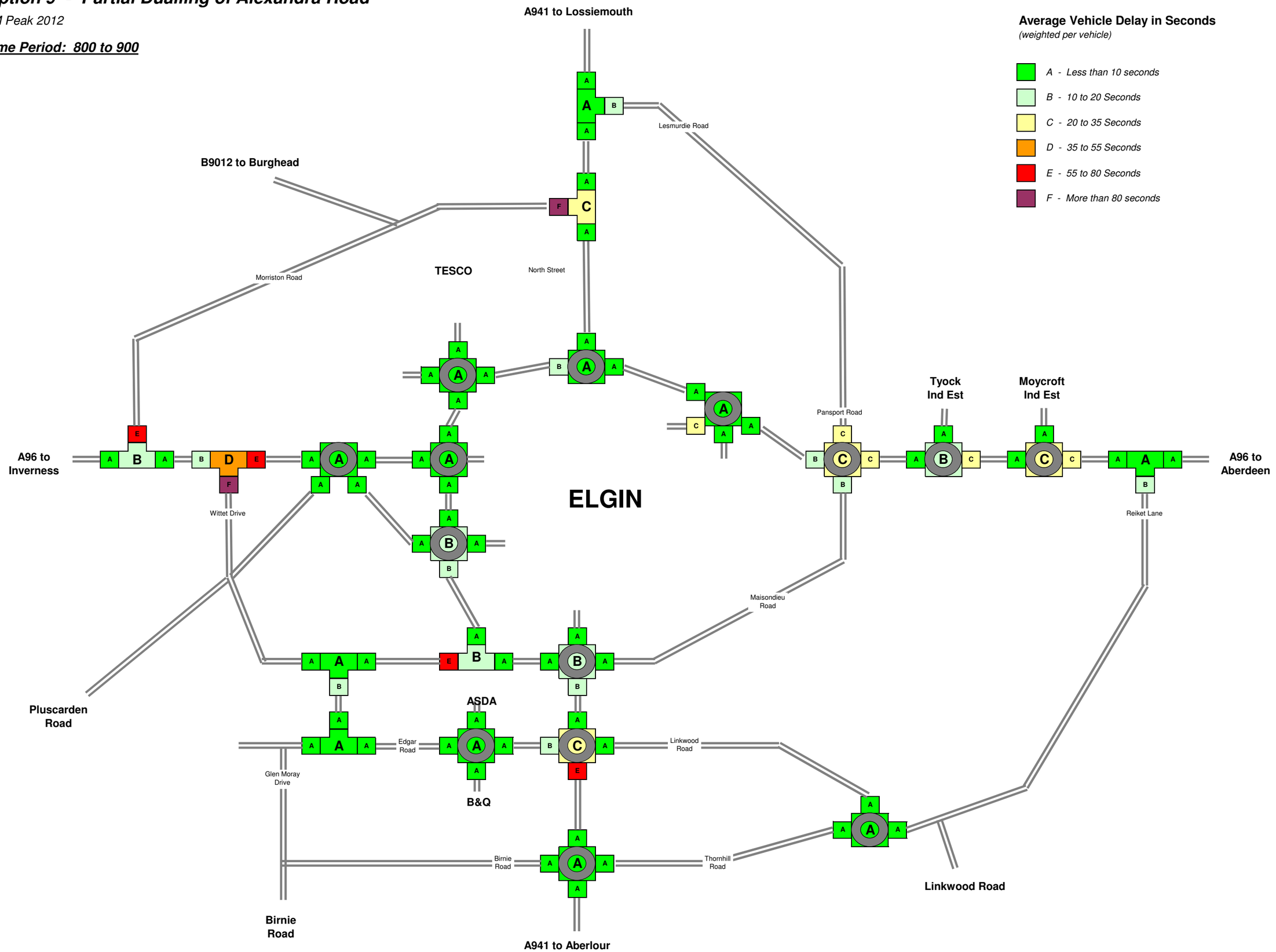
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 9 - Partial Dualling of Alexandra Road

AM Peak 2012

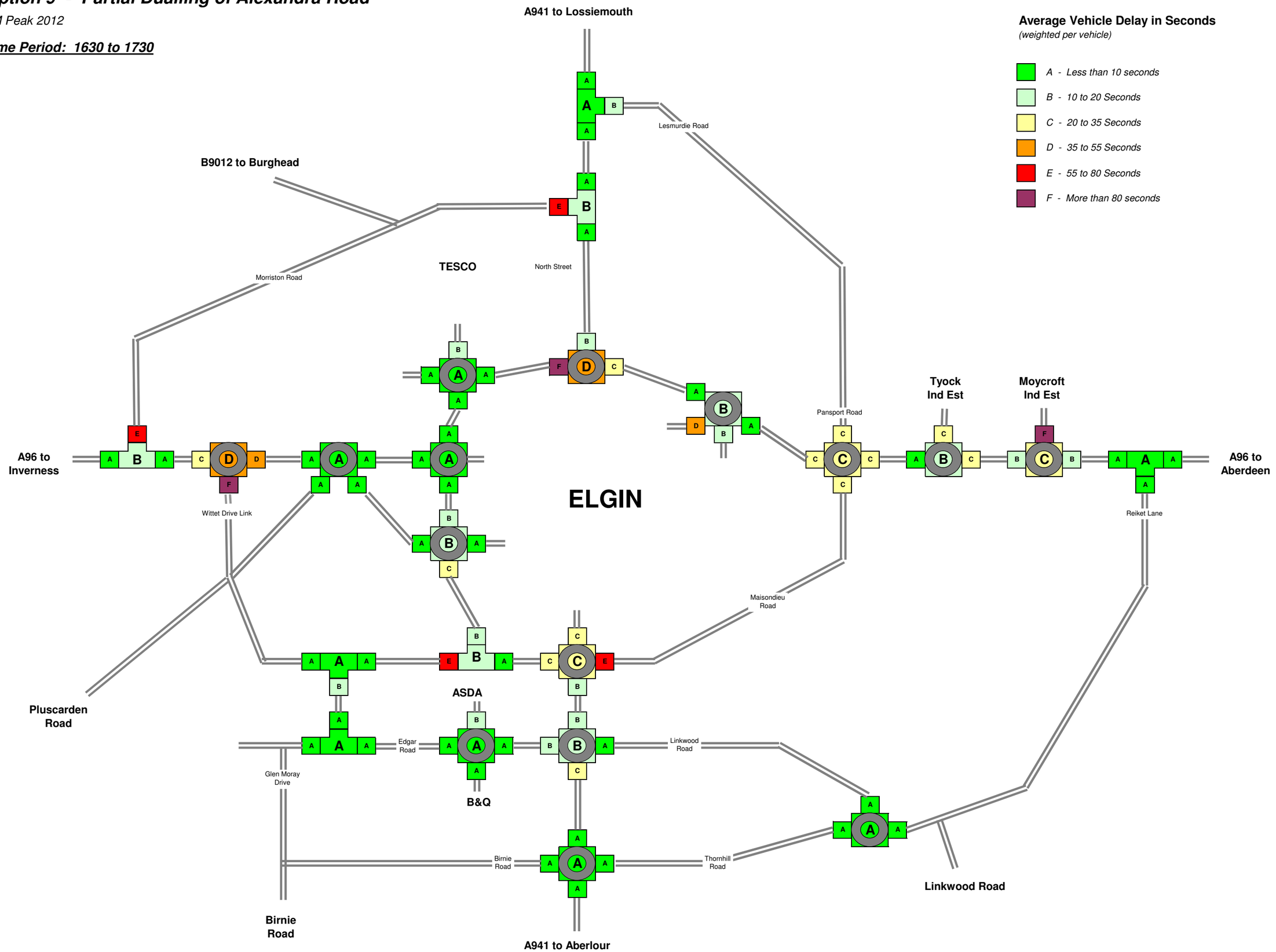
Time Period: 800 to 900



Option 9 - Partial Dualling of Alexandra Road

PM Peak 2012

Time Period: 1630 to 1730



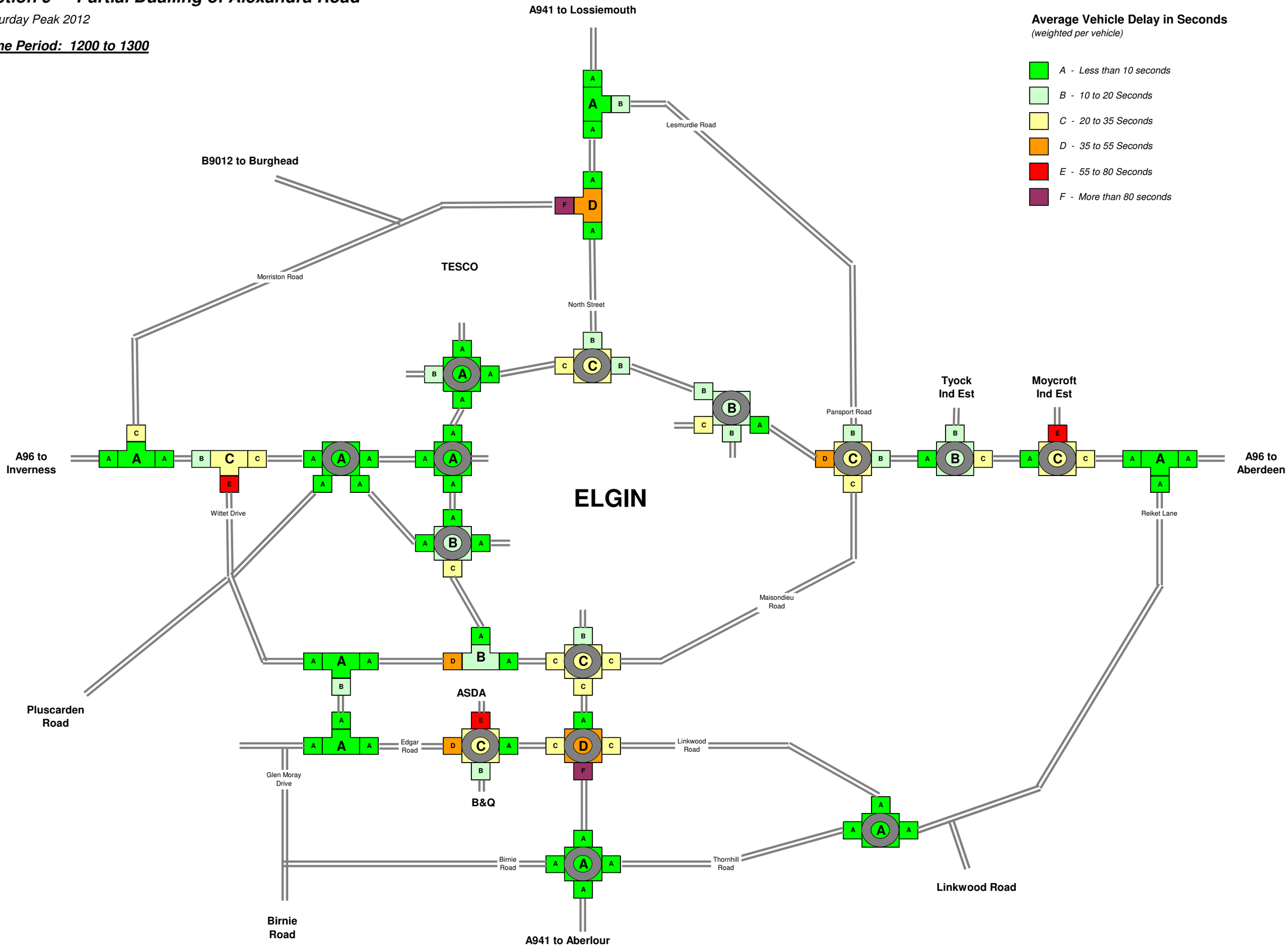
Option 9 - Partial Dualling of Alexandra Road

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

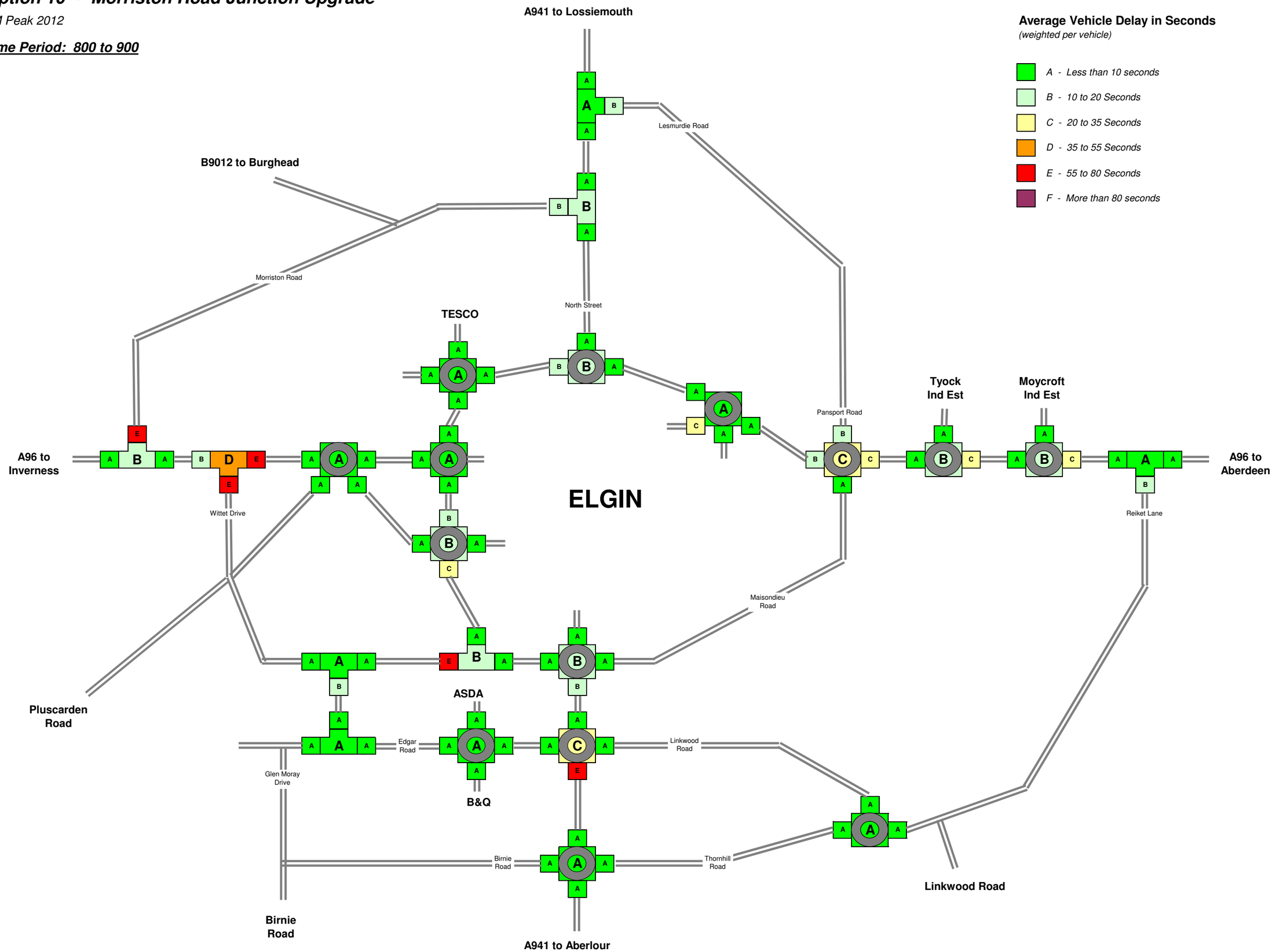
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 10 - Morriston Road Junction Upgrade

AM Peak 2012

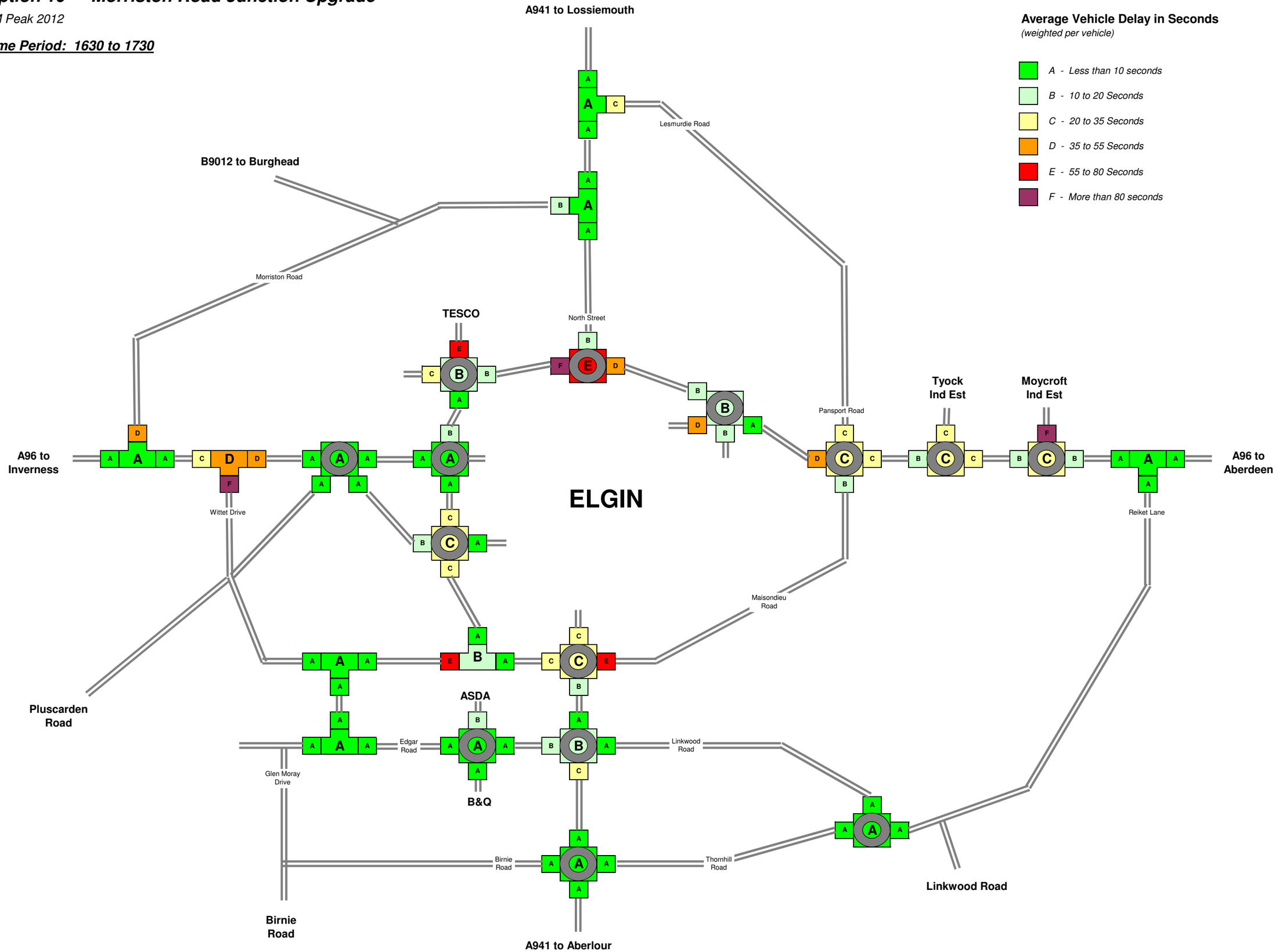
Time Period: 800 to 900



Option 10 - Morriston Road Junction Upgrade

PM Peak 2012

Time Period: 1630 to 1730



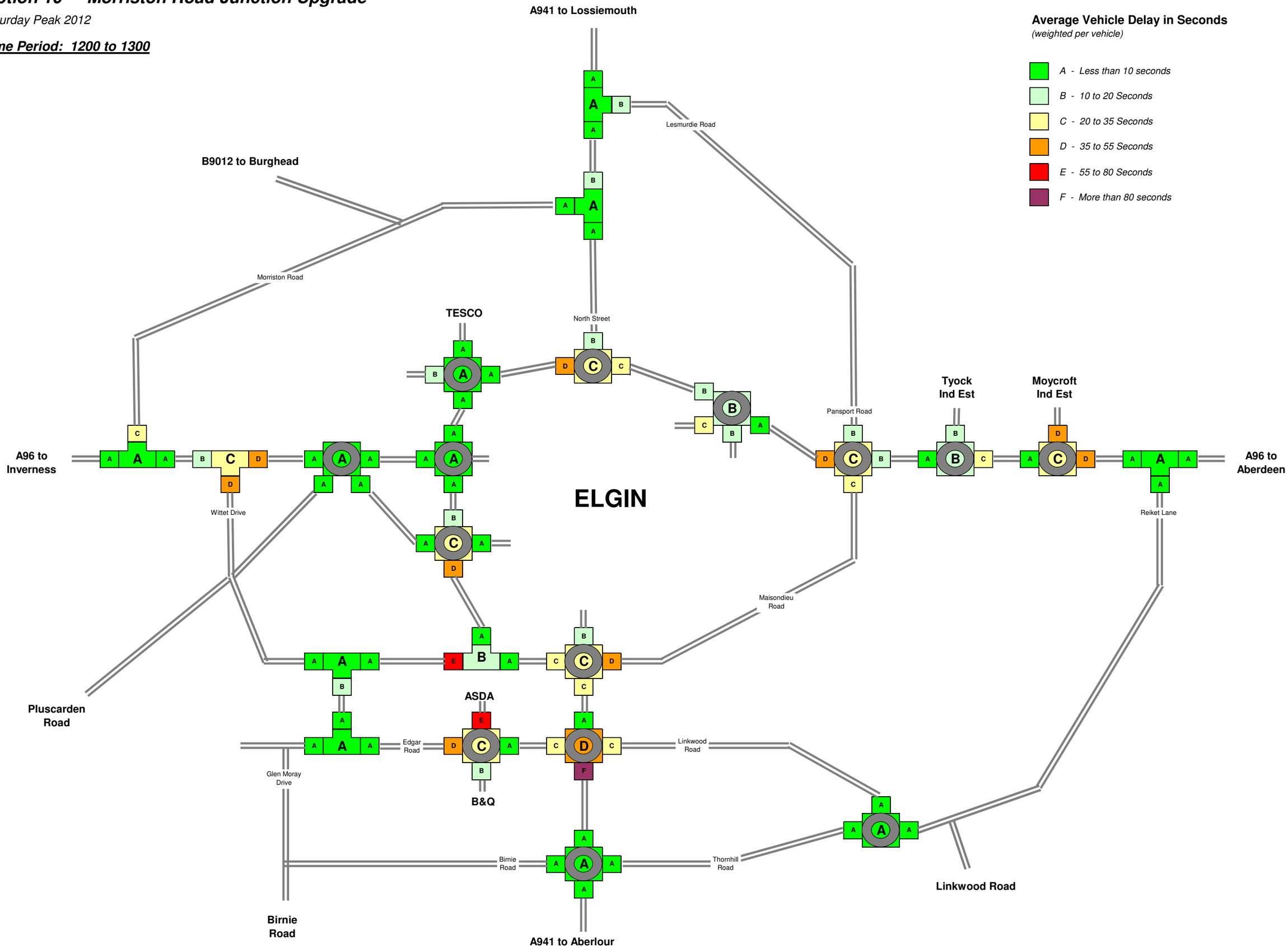
Option 10 - Morriston Road Junction Upgrade

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

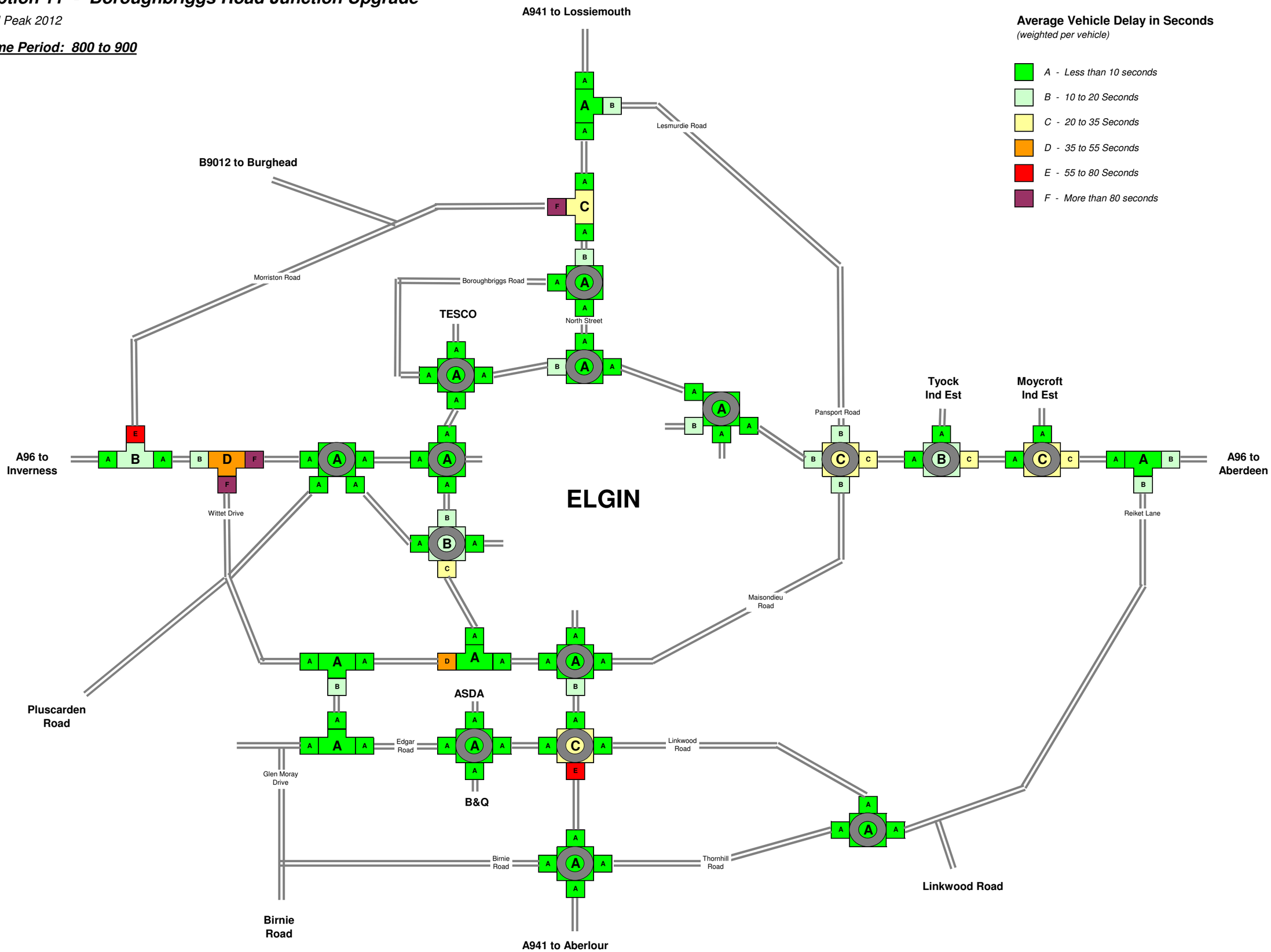
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 11 - Boroughbriggs Road Junction Upgrade

AM Peak 2012

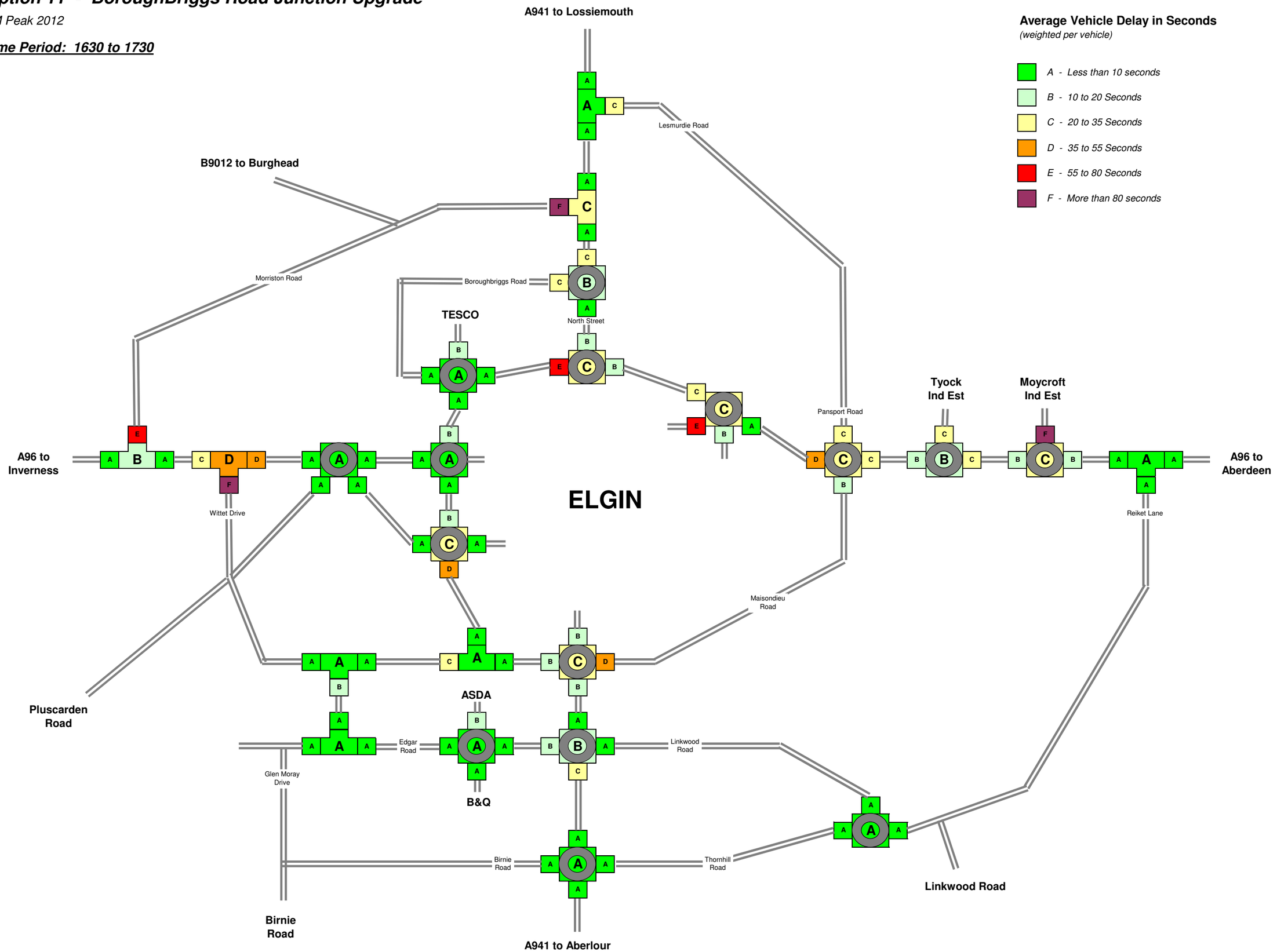
Time Period: 800 to 900



Option 11 - BoroughBriggs Road Junction Upgrade

PM Peak 2012

Time Period: 1630 to 1730



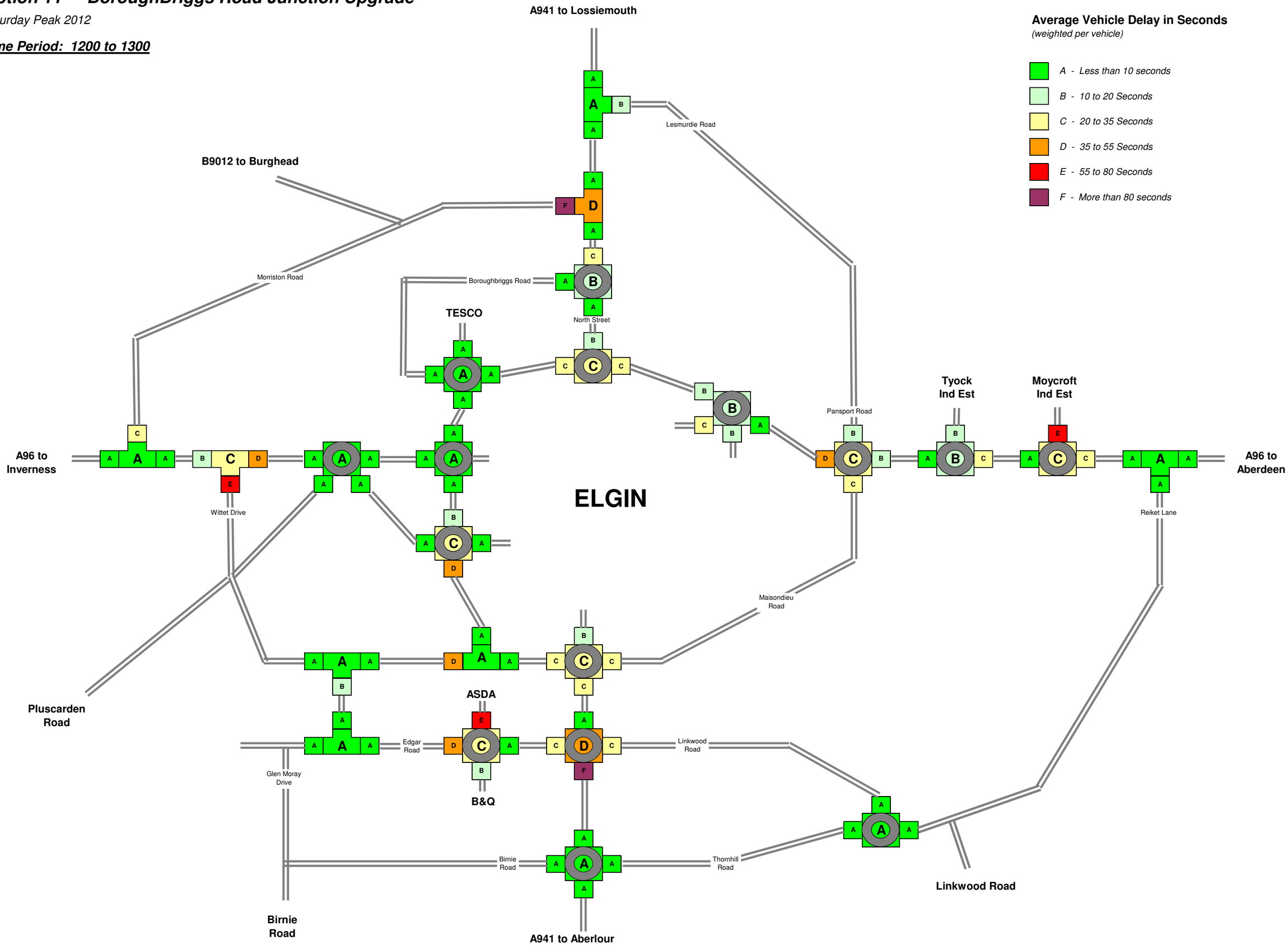
Option 11 - BoroughBriggs Road Junction Upgrade

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

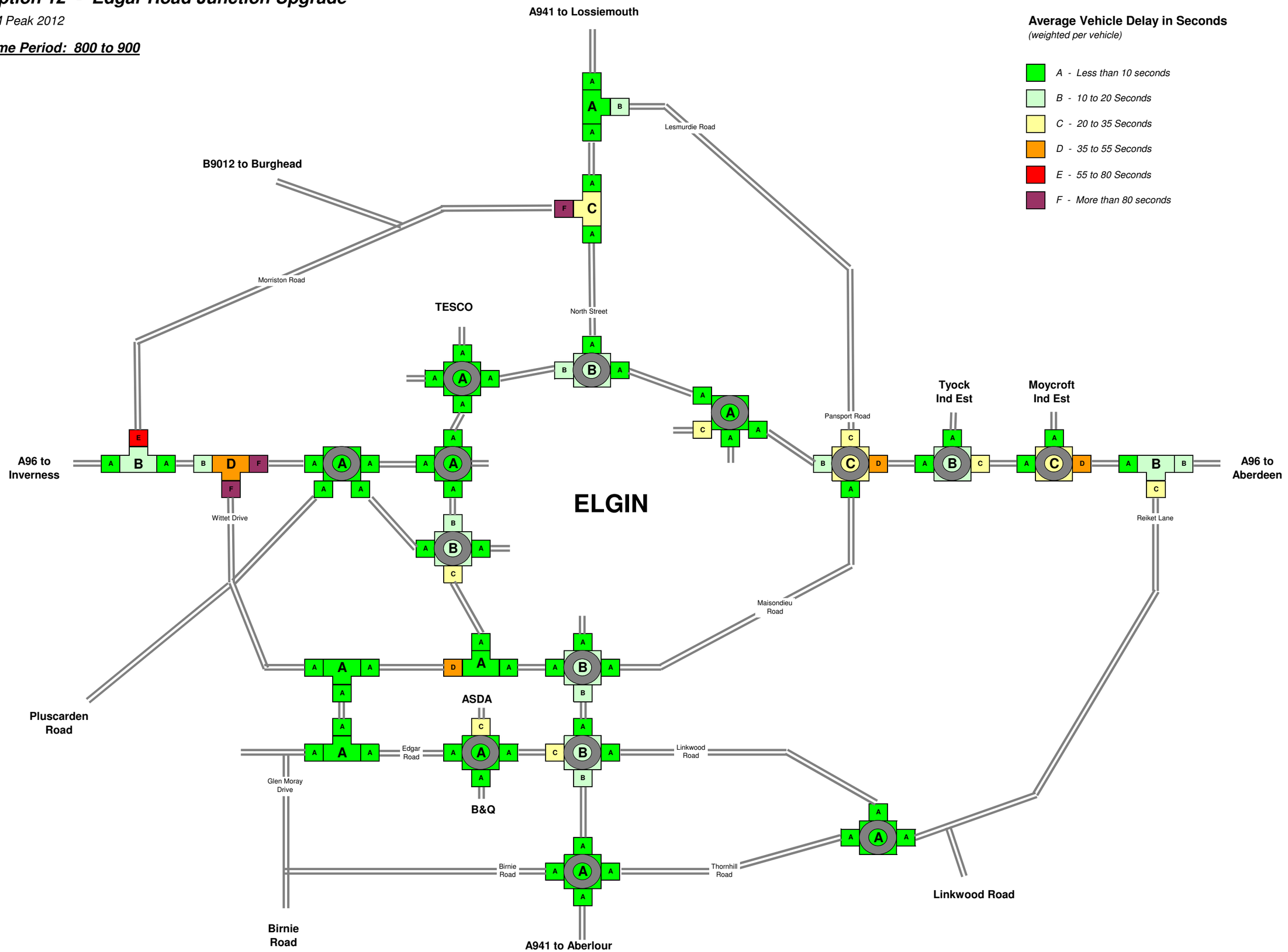
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 12 - Edgar Road Junction Upgrade

AM Peak 2012

Time Period: 800 to 900



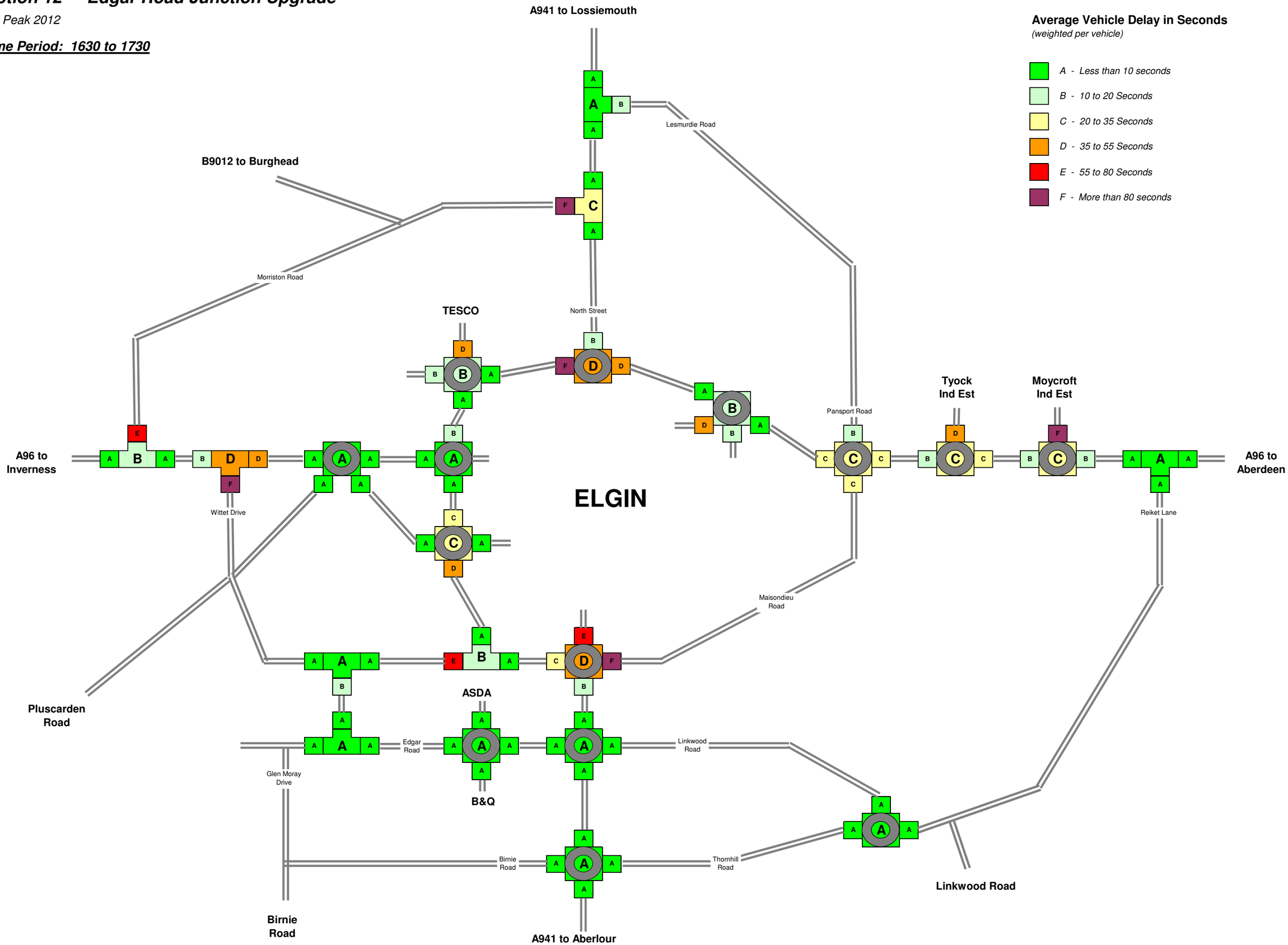
Option 12 - Edgar Road Junction Upgrade

PM Peak 2012

Time Period: 1630 to 1730

Average Vehicle Delay in Seconds
(weighted per vehicle)

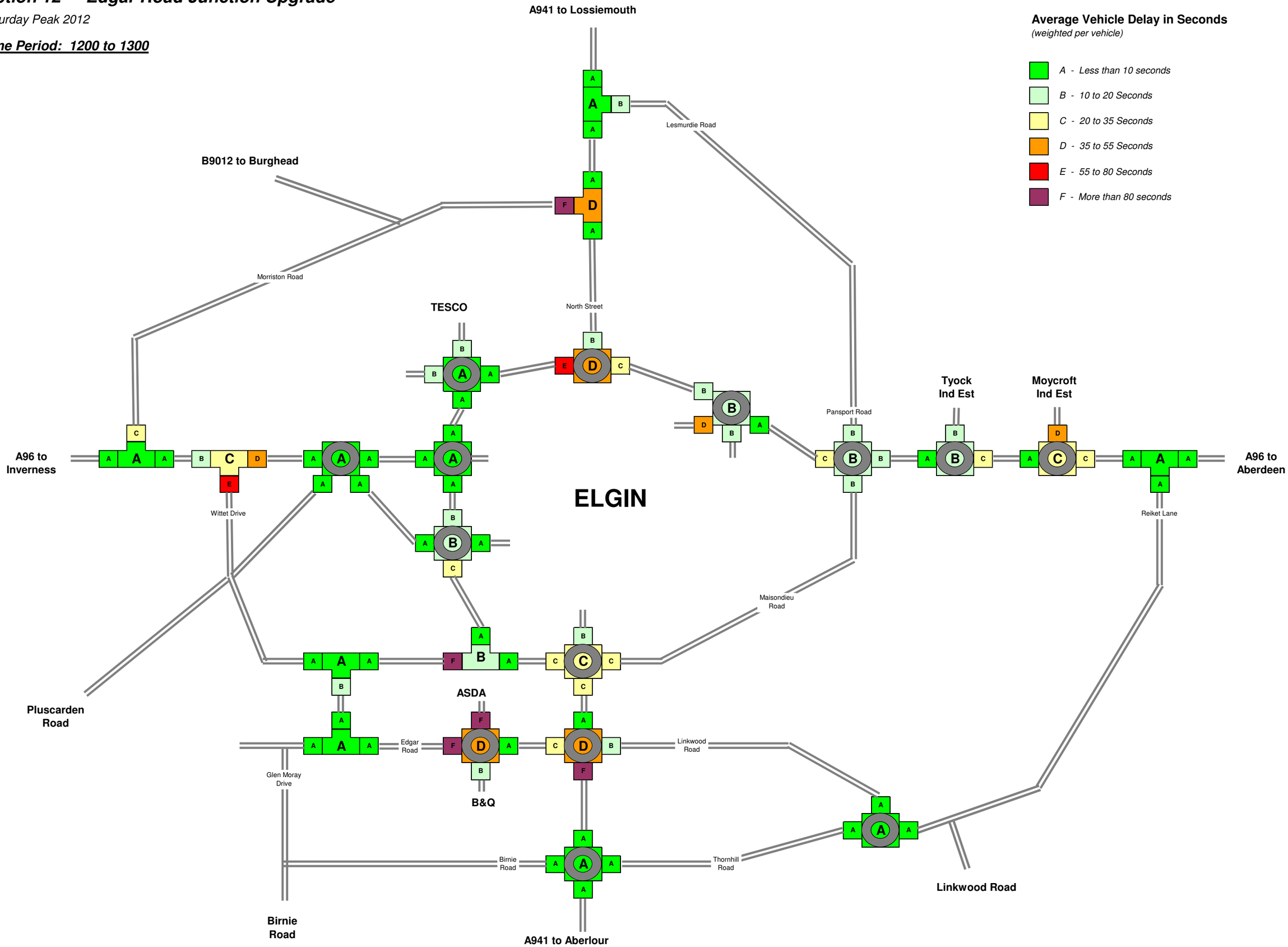
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 12 - Edgar Road Junction Upgrade

Saturday Peak 2012

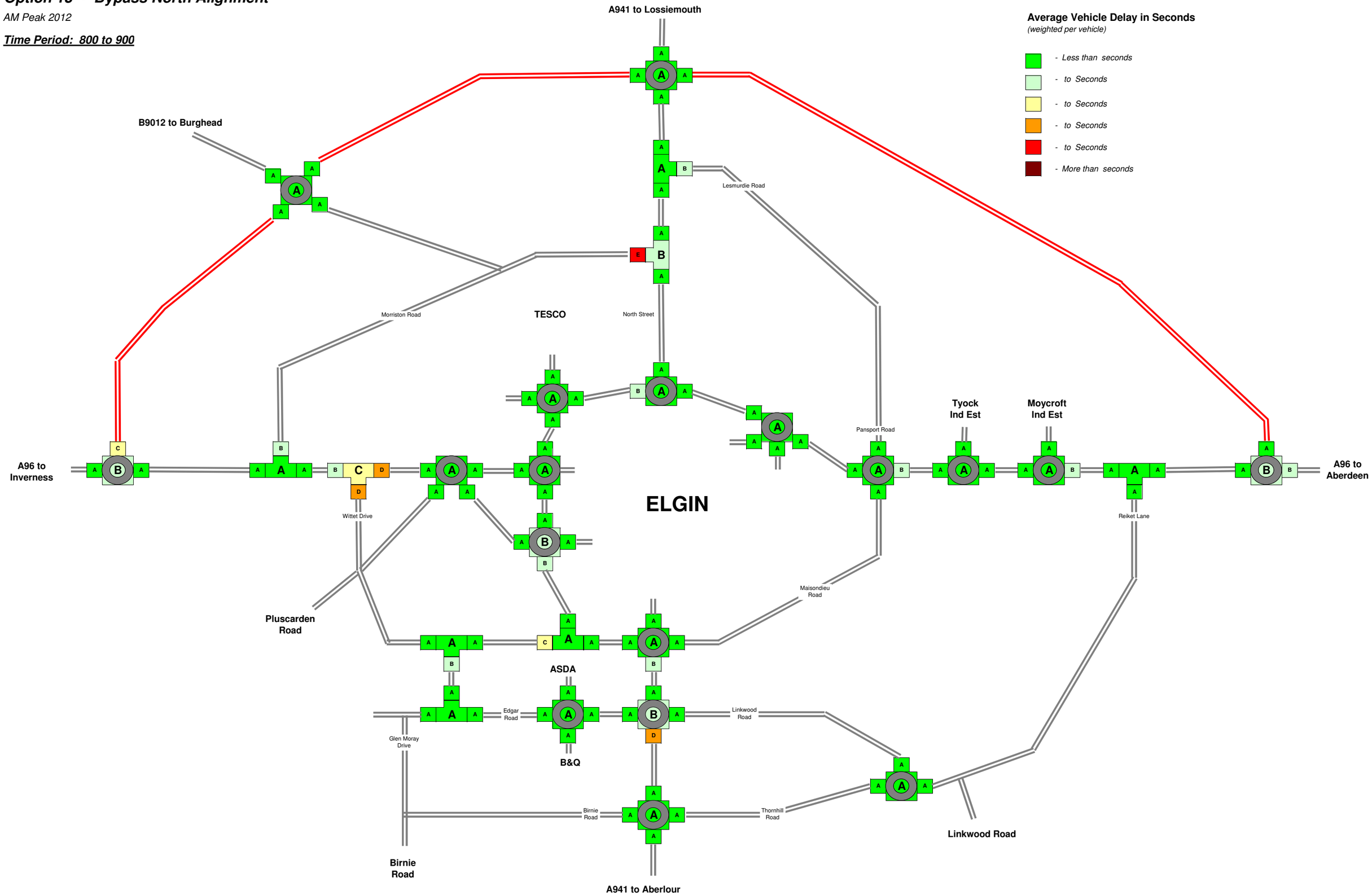
Time Period: 1200 to 1300



Option 13 - Bypass North Alignment

AM Peak 2012

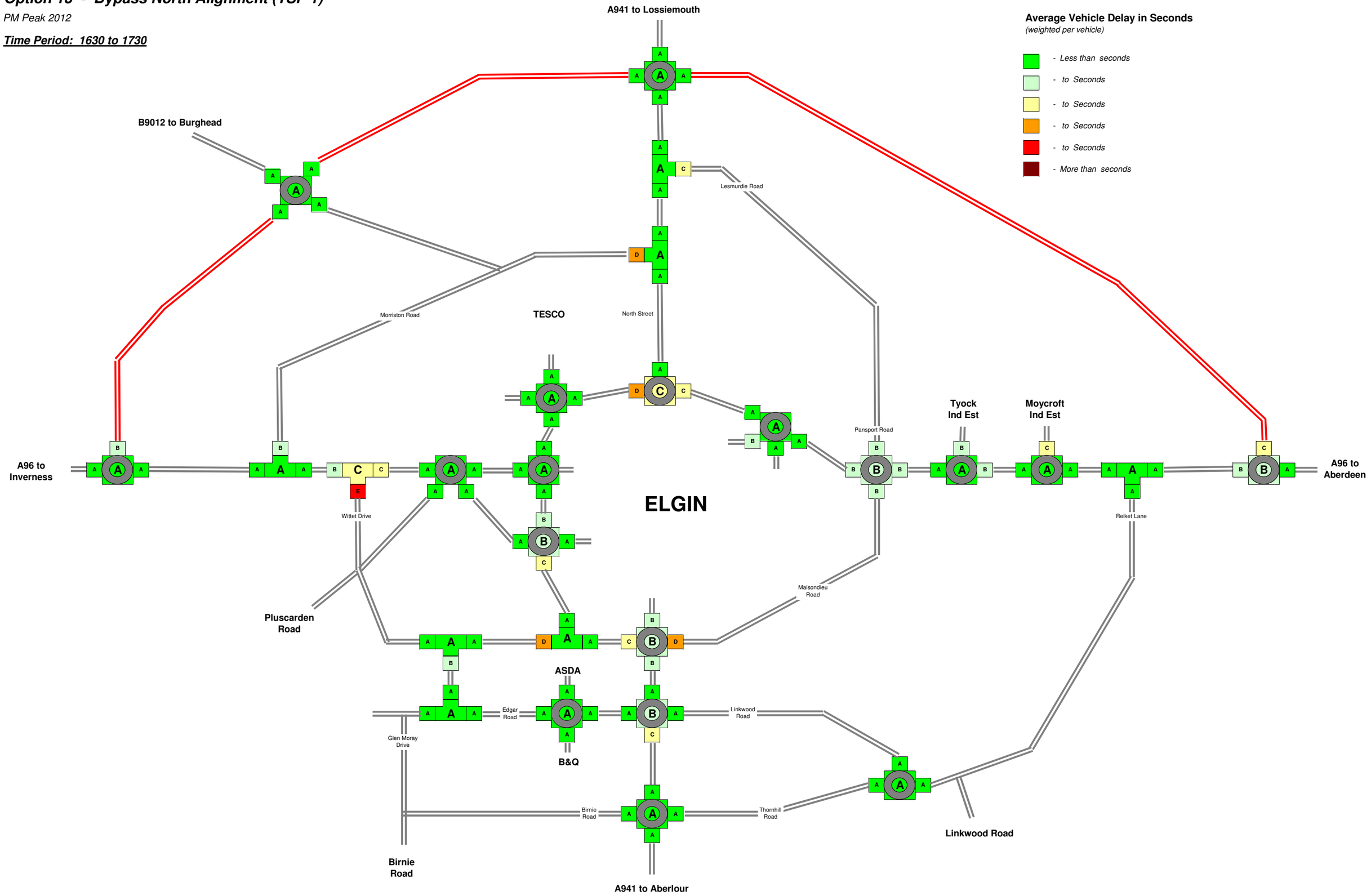
Time Period: 800 to 900



Option 13 - Bypass North Alignment (TSP 1)

PM Peak 2012

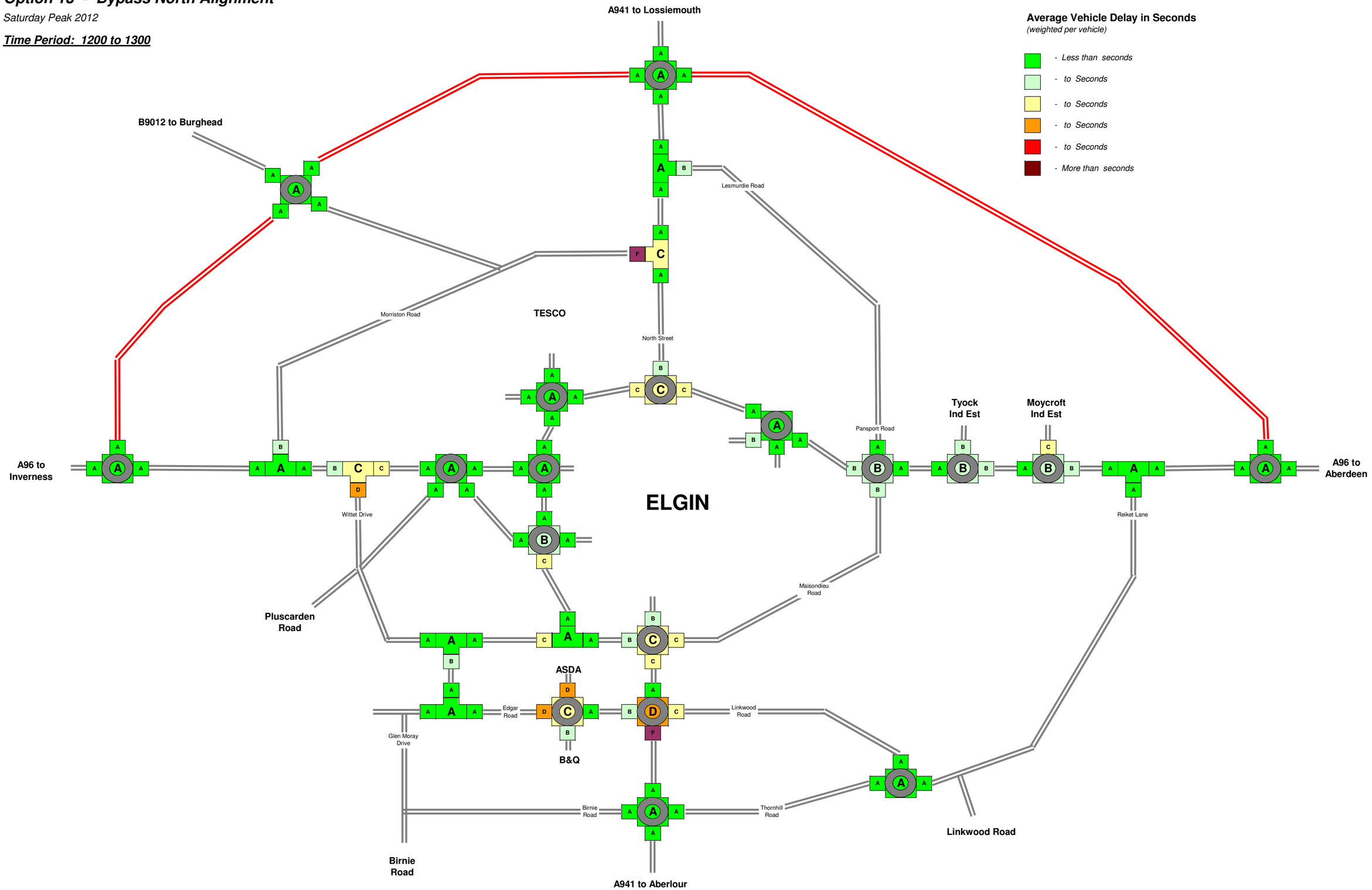
Time Period: 1630 to 1730



Option 13 - Bypass North Alignment

Saturday Peak 2012

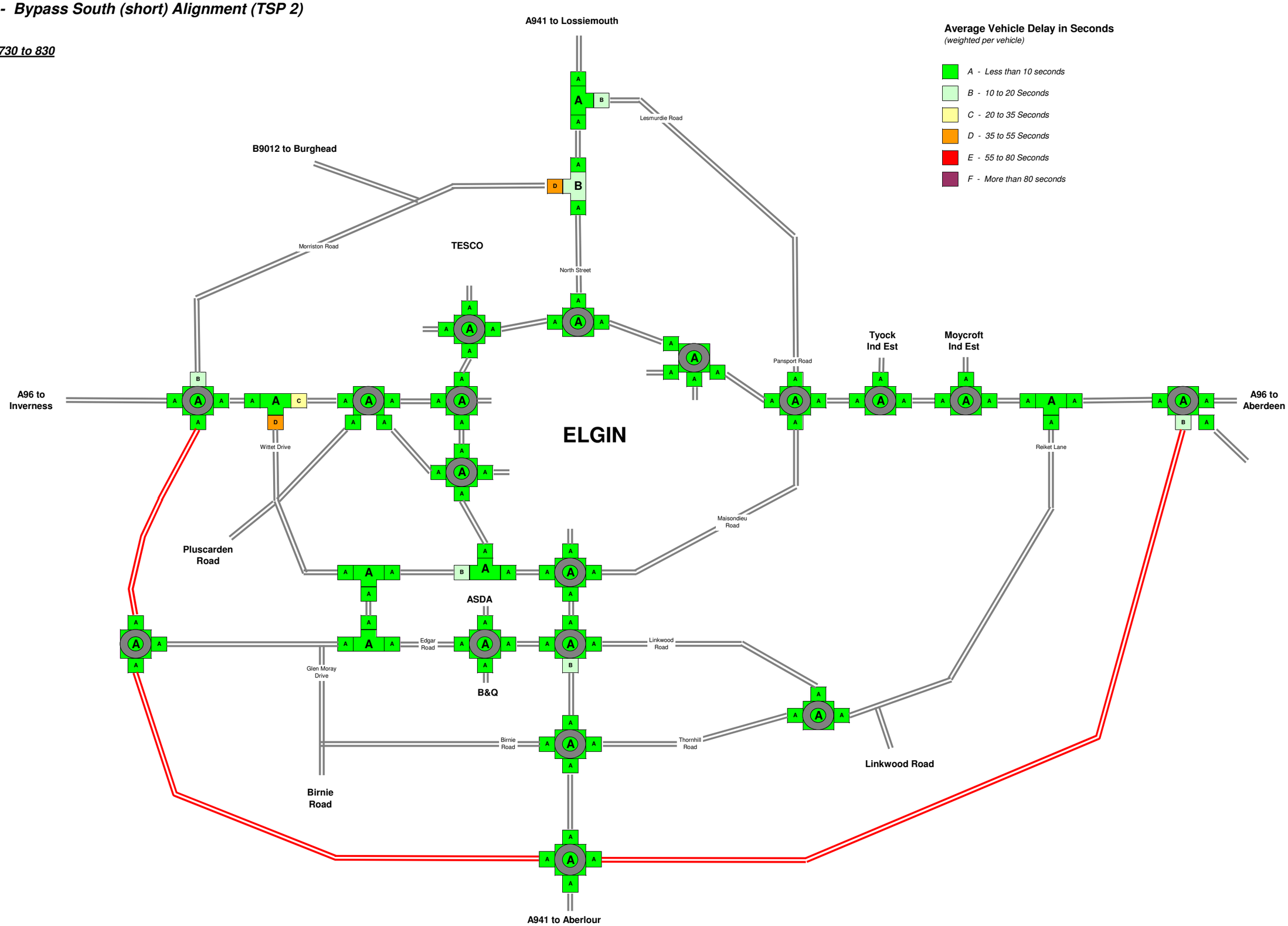
Time Period: 1200 to 1300



Option 14 - Bypass South (short) Alignment (TSP 2)

AM Peak 2012

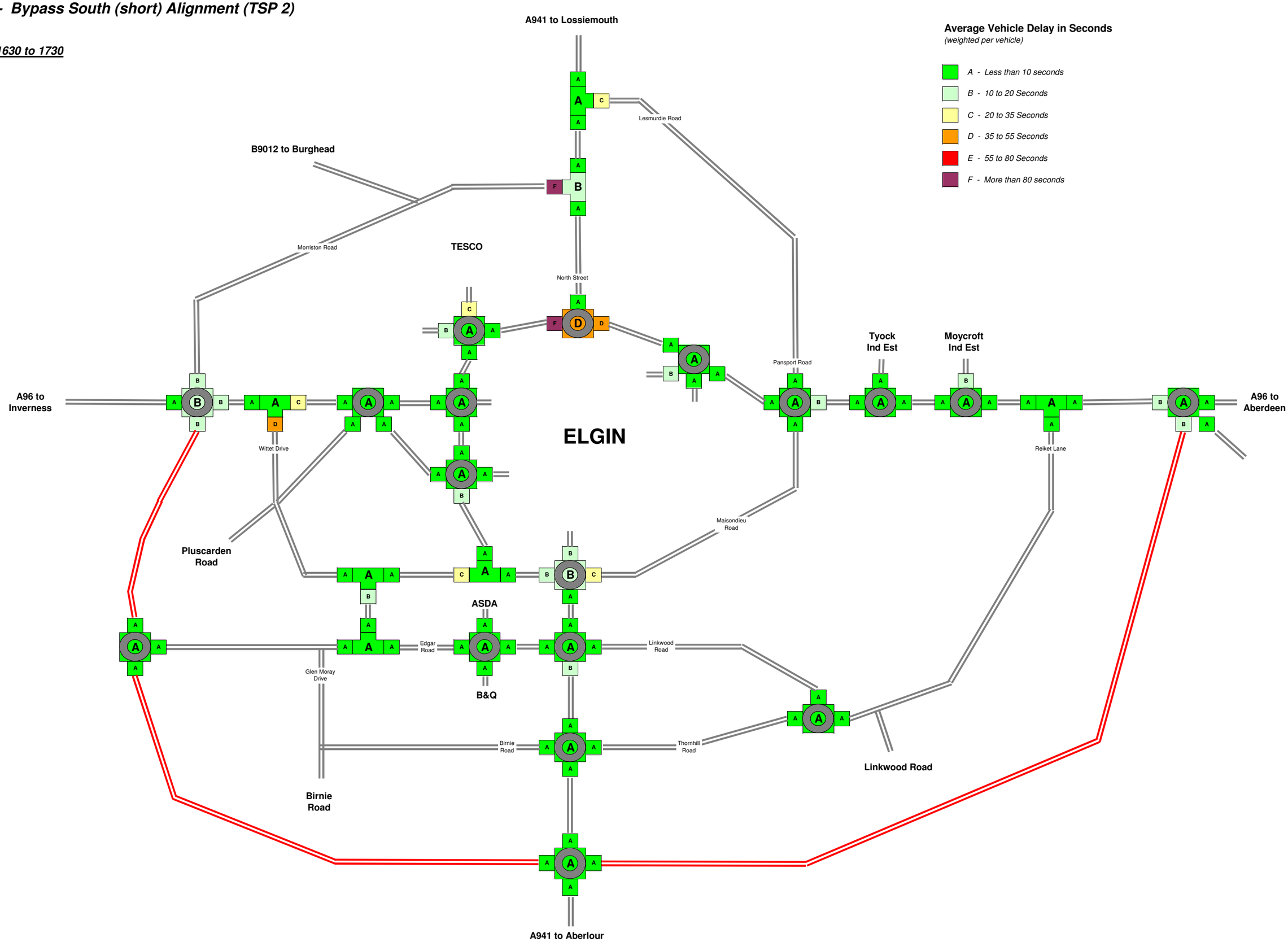
Time Period: 730 to 830



Option 14 - Bypass South (short) Alignment (TSP 2)

PM Peak 2012

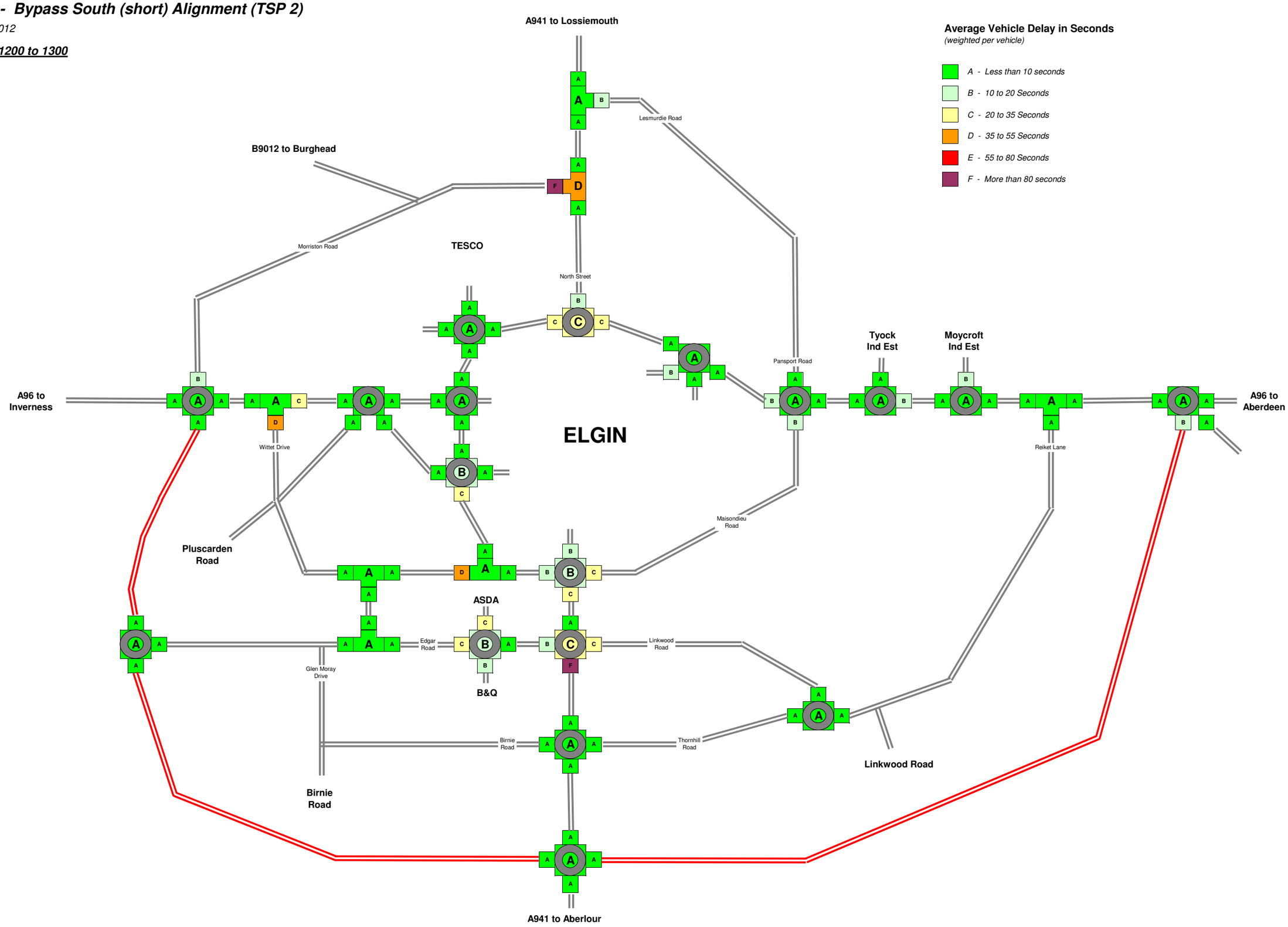
Time Period: 1630 to 1730



Option 14 - Bypass South (short) Alignment (TSP 2)

Saturday Peak 2012

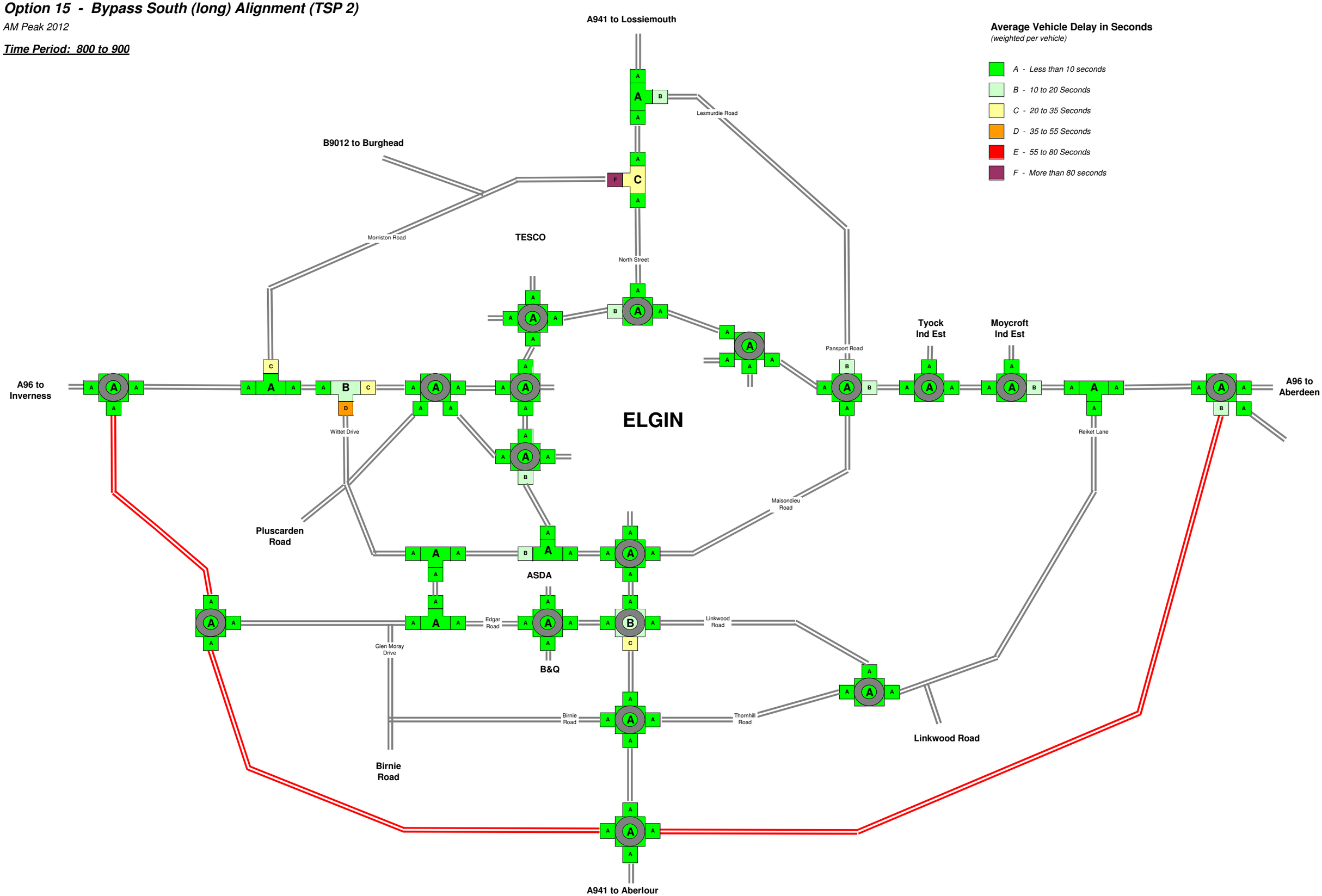
Time Period: 1200 to 1300



Option 15 - Bypass South (long) Alignment (TSP 2)

AM Peak 2012

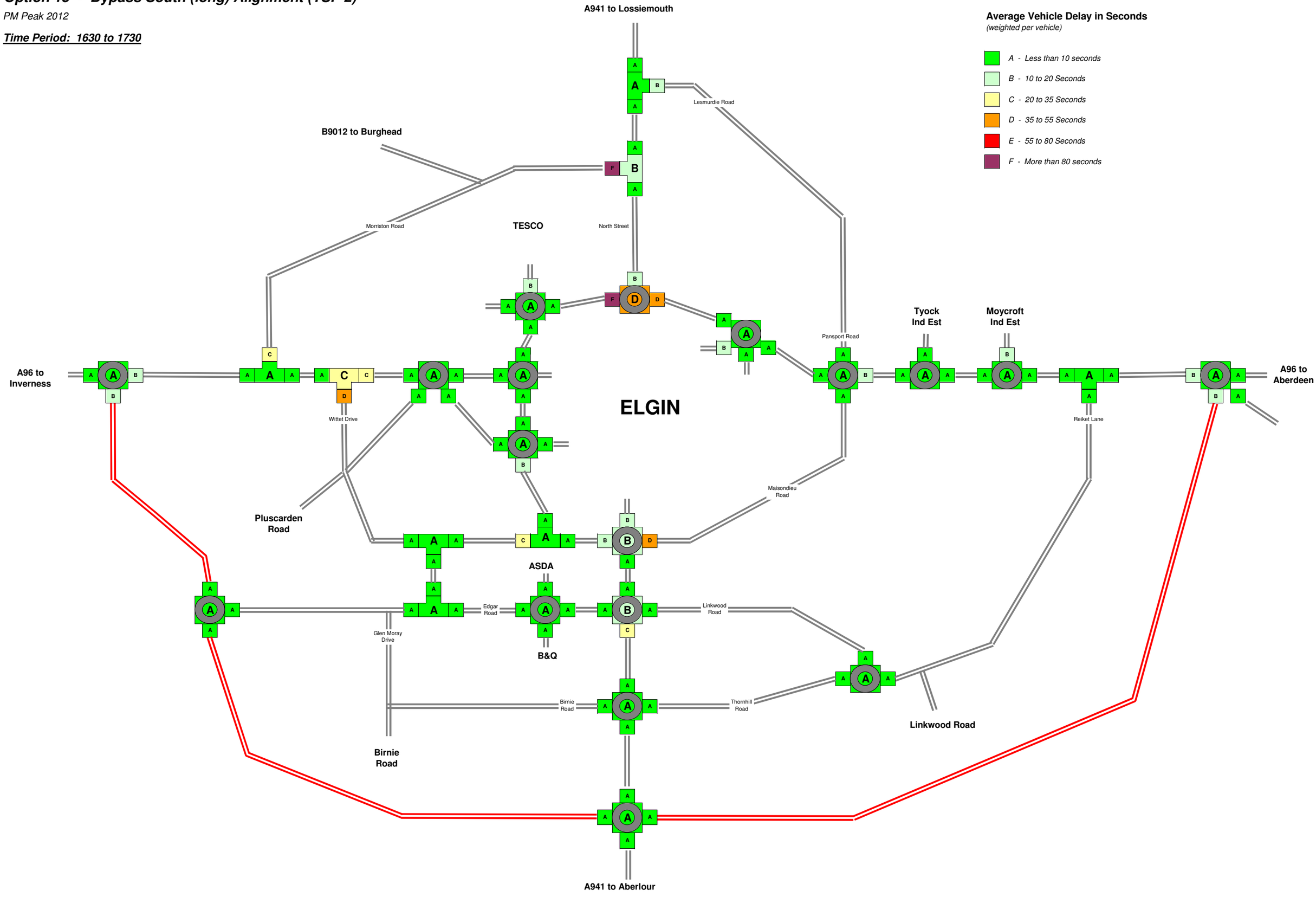
Time Period: 800 to 900



Option 15 - Bypass South (long) Alignment (TSP 2)

PM Peak 2012

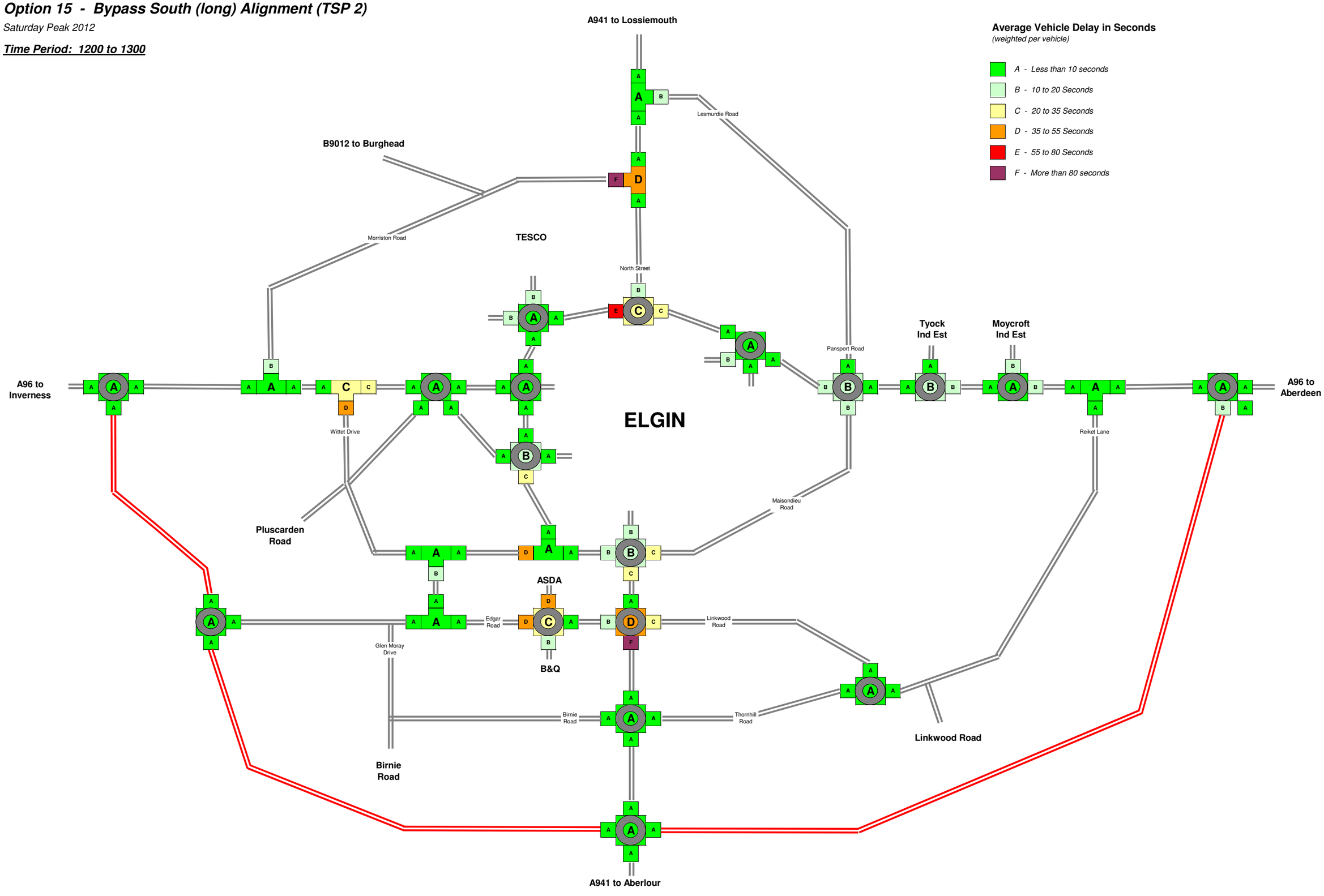
Time Period: 1630 to 1730



Option 15 - Bypass South (long) Alignment (TSP 2)

Saturday Peak 2012

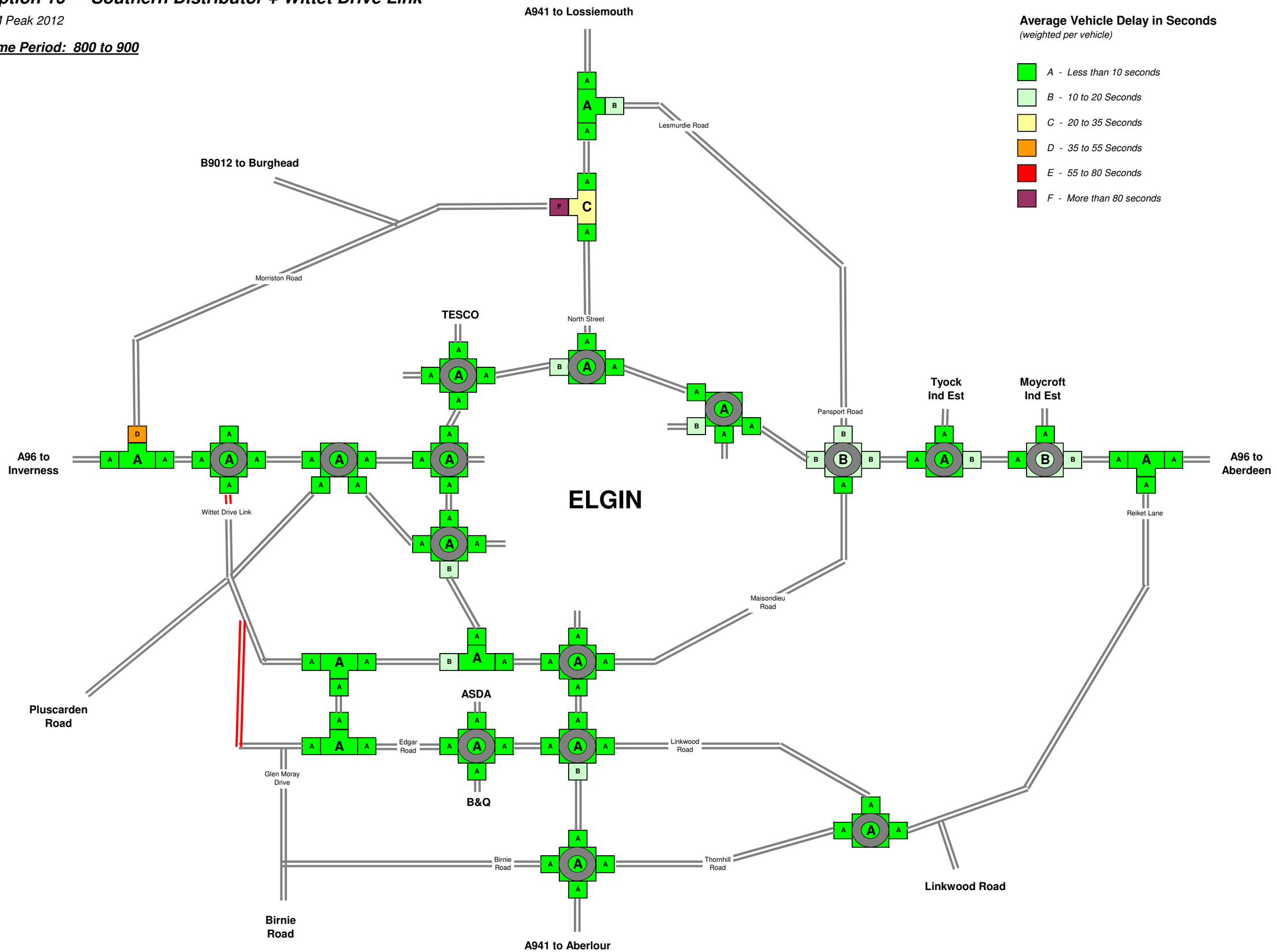
Time Period: 1200 to 1300



Option 16 - Southern Distributor + Wittet Drive Link

AM Peak 2012

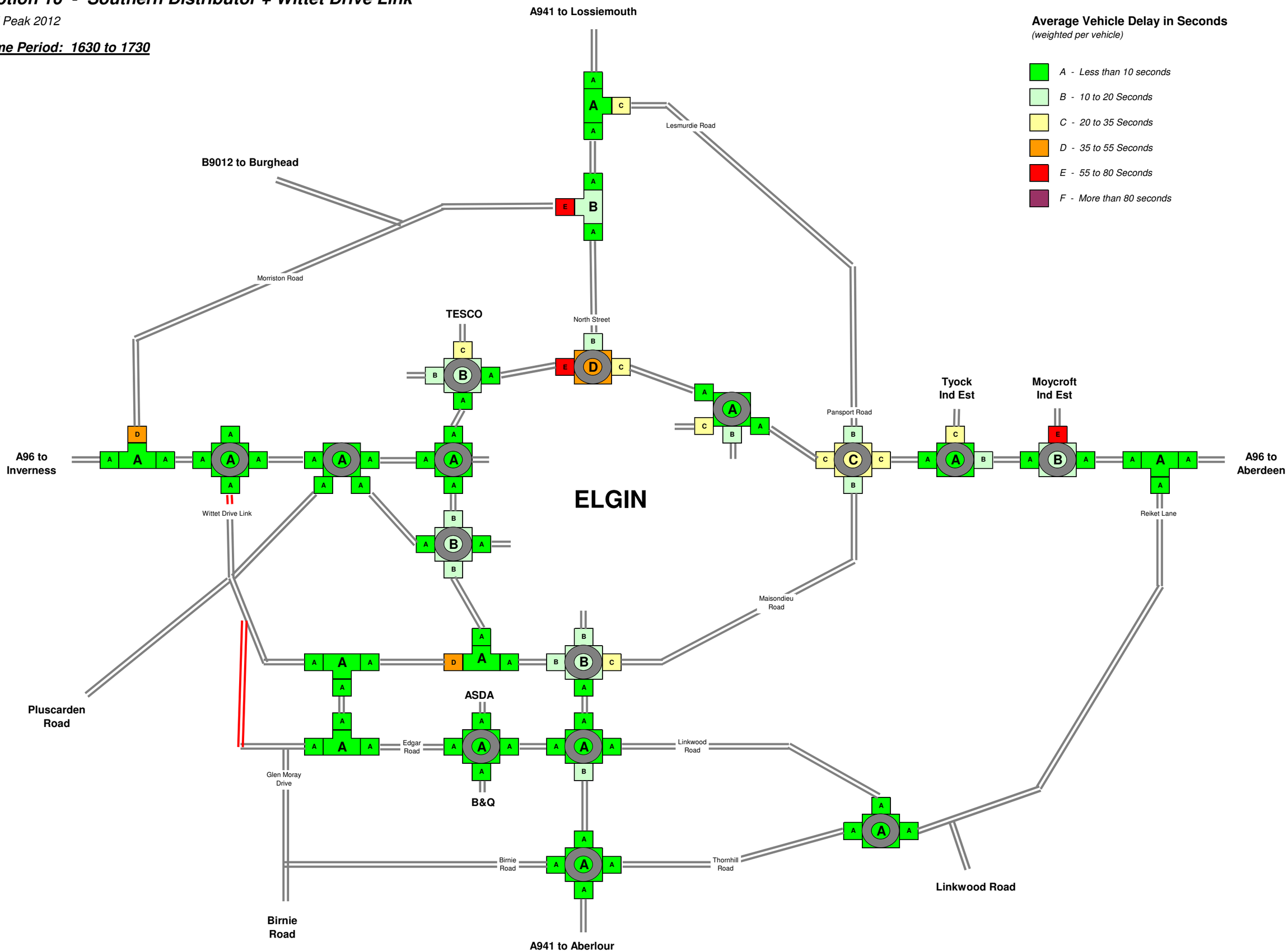
Time Period: 800 to 900



Option 16 - Southern Distributor + Wittet Drive Link

PM Peak 2012

Time Period: 1630 to 1730



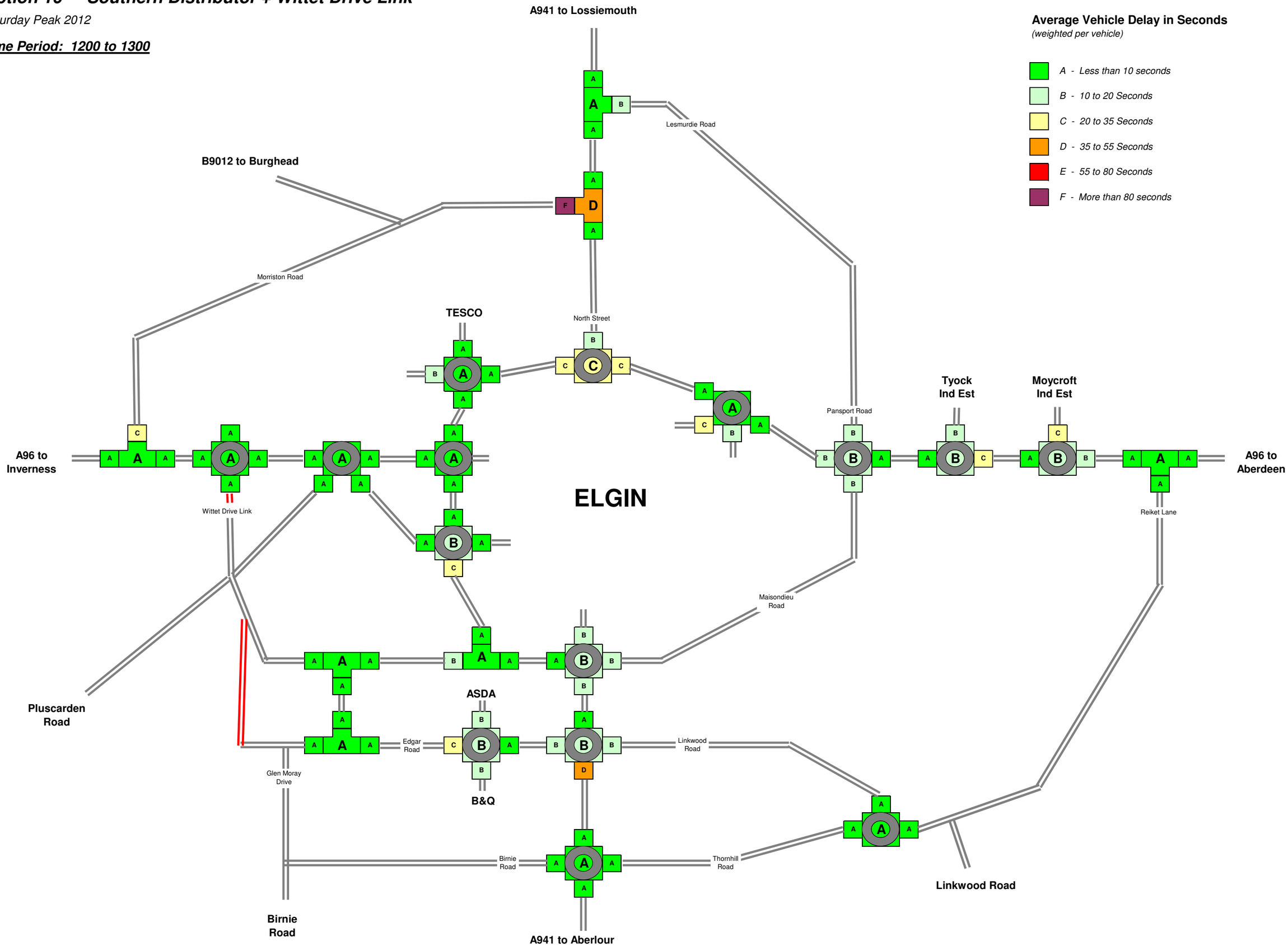
Option 16 - Southern Distributor + Wittet Drive Link

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

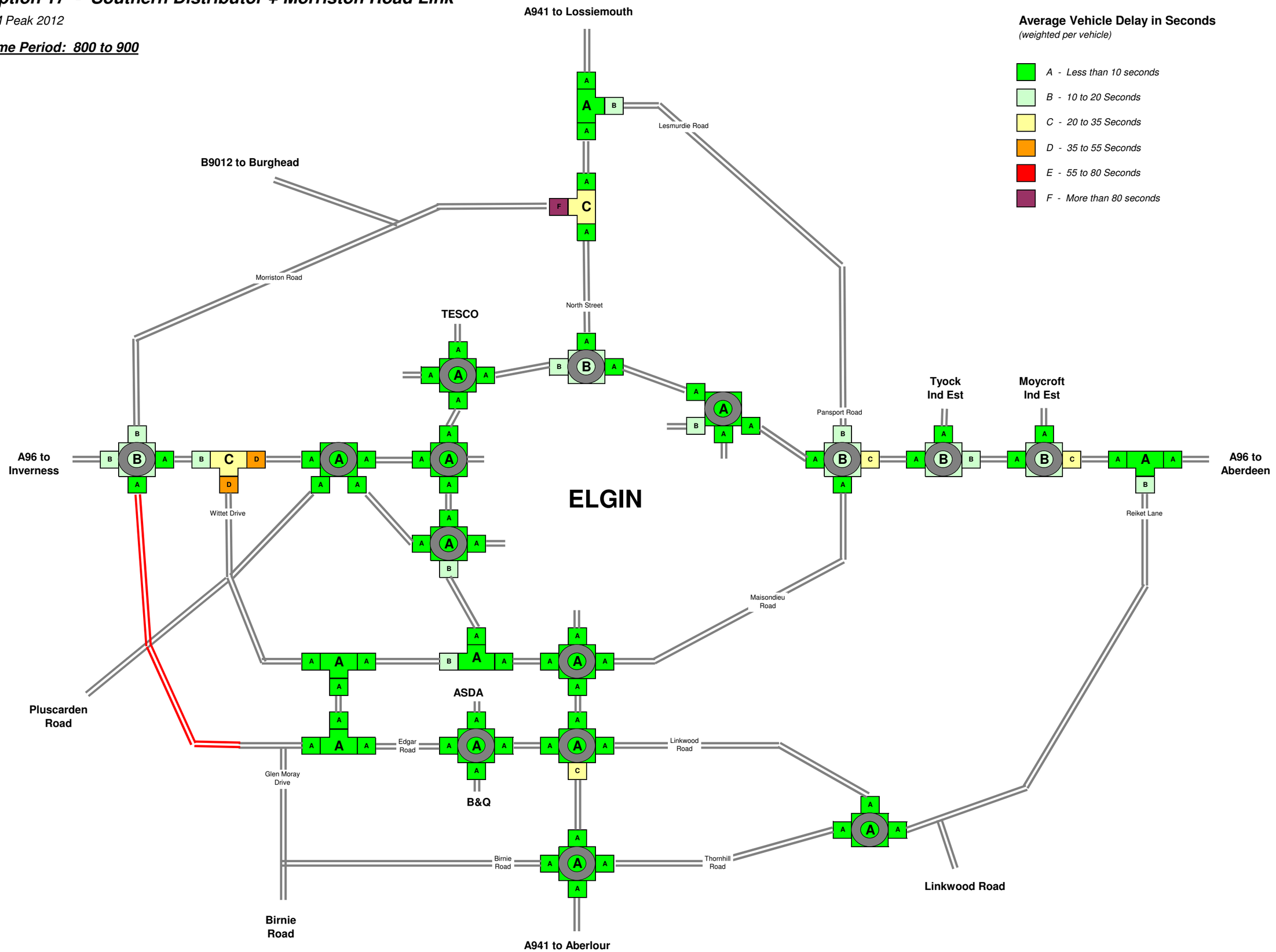
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 17 - Southern Distributor + Morriston Road Link

AM Peak 2012

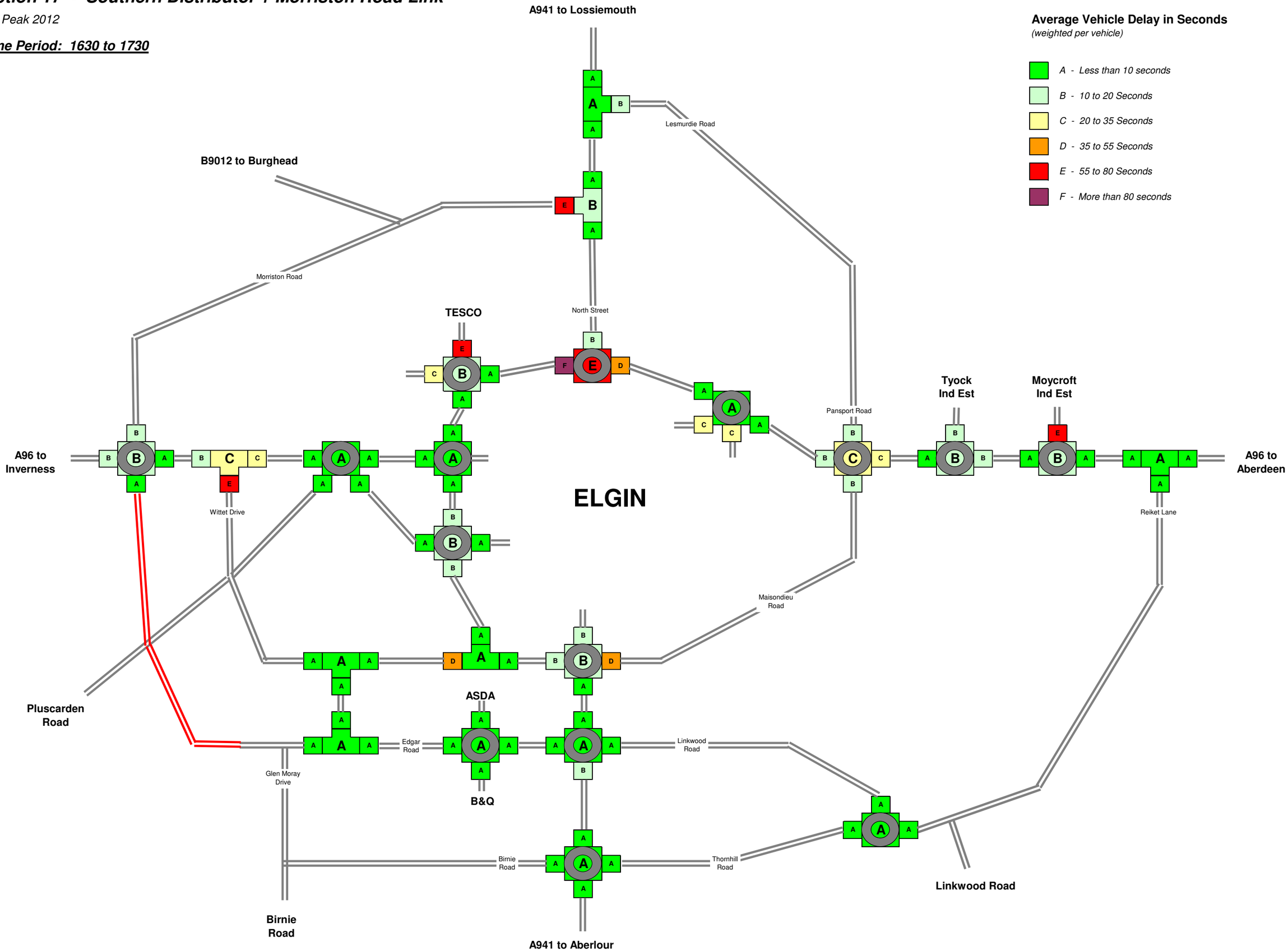
Time Period: 800 to 900



Option 17 - Southern Distributor + Morriston Road Link

PM Peak 2012

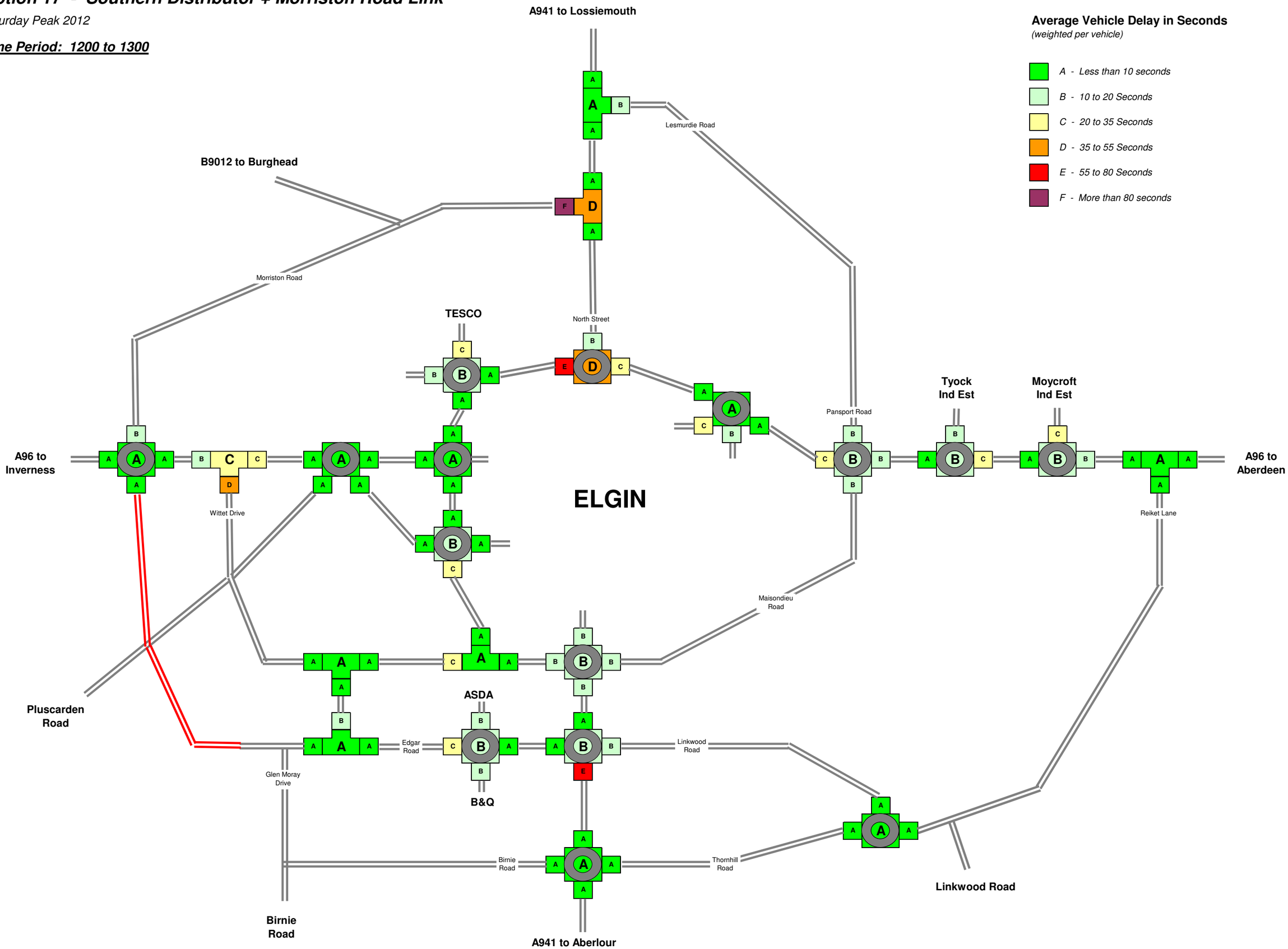
Time Period: 1630 to 1730



Option 17 - Southern Distributor + Morriston Road Link

Saturday Peak 2012

Time Period: 1200 to 1300



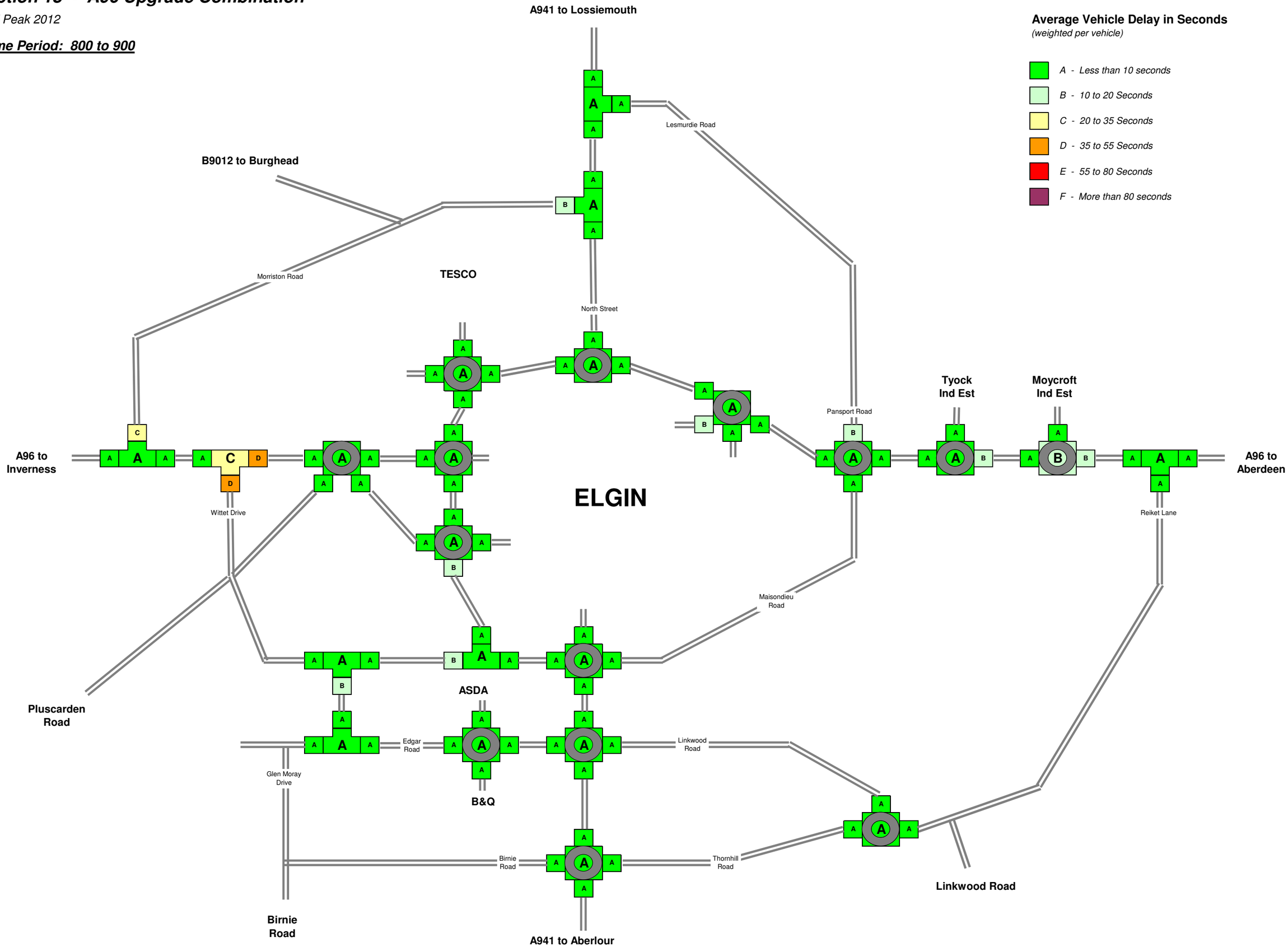
Option 18 - A96 Upgrade Combination

AM Peak 2012

Time Period: 800 to 900

Average Vehicle Delay in Seconds
(weighted per vehicle)

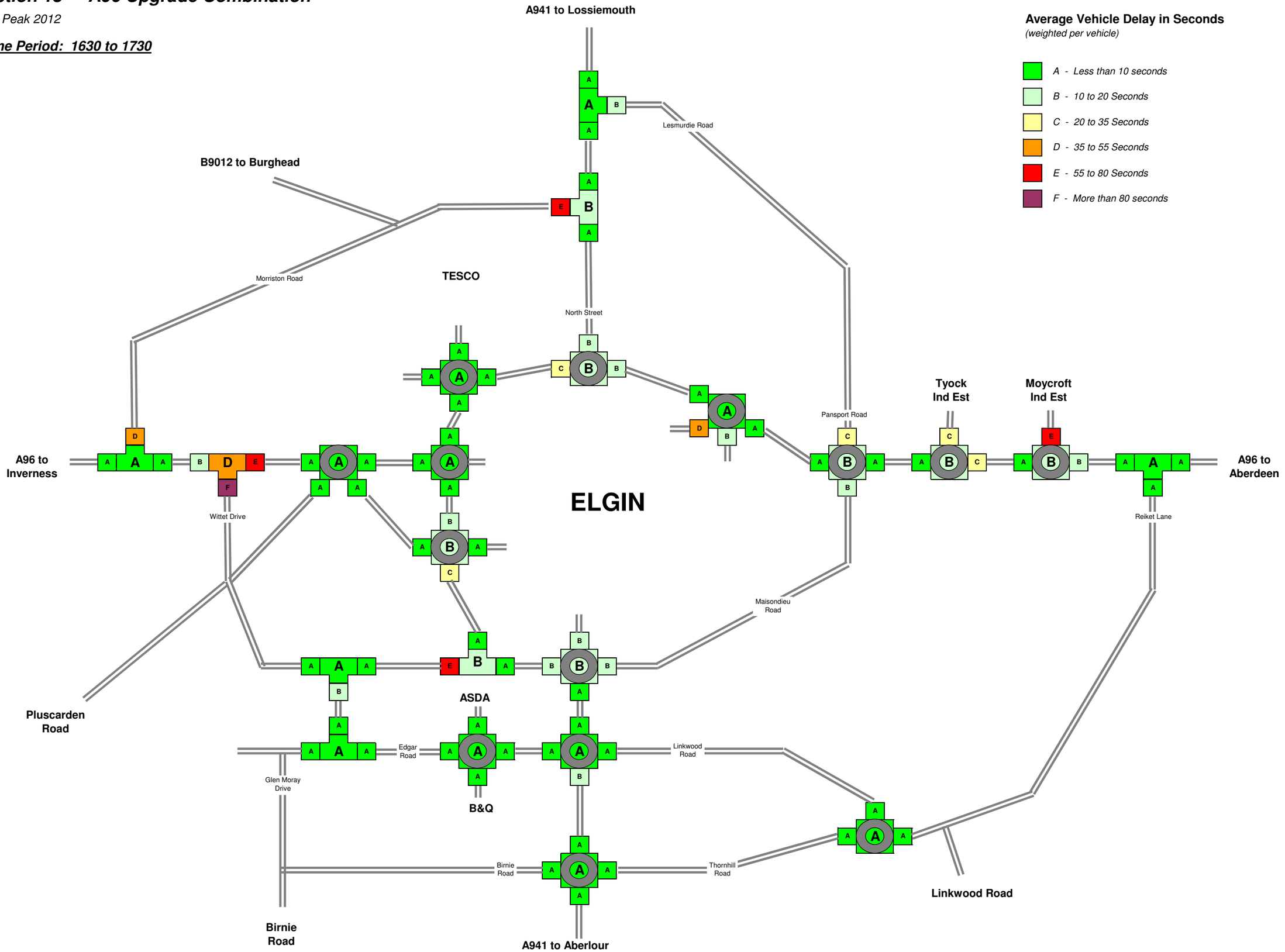
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 18 - A96 Upgrade Combination

PM Peak 2012

Time Period: 1630 to 1730



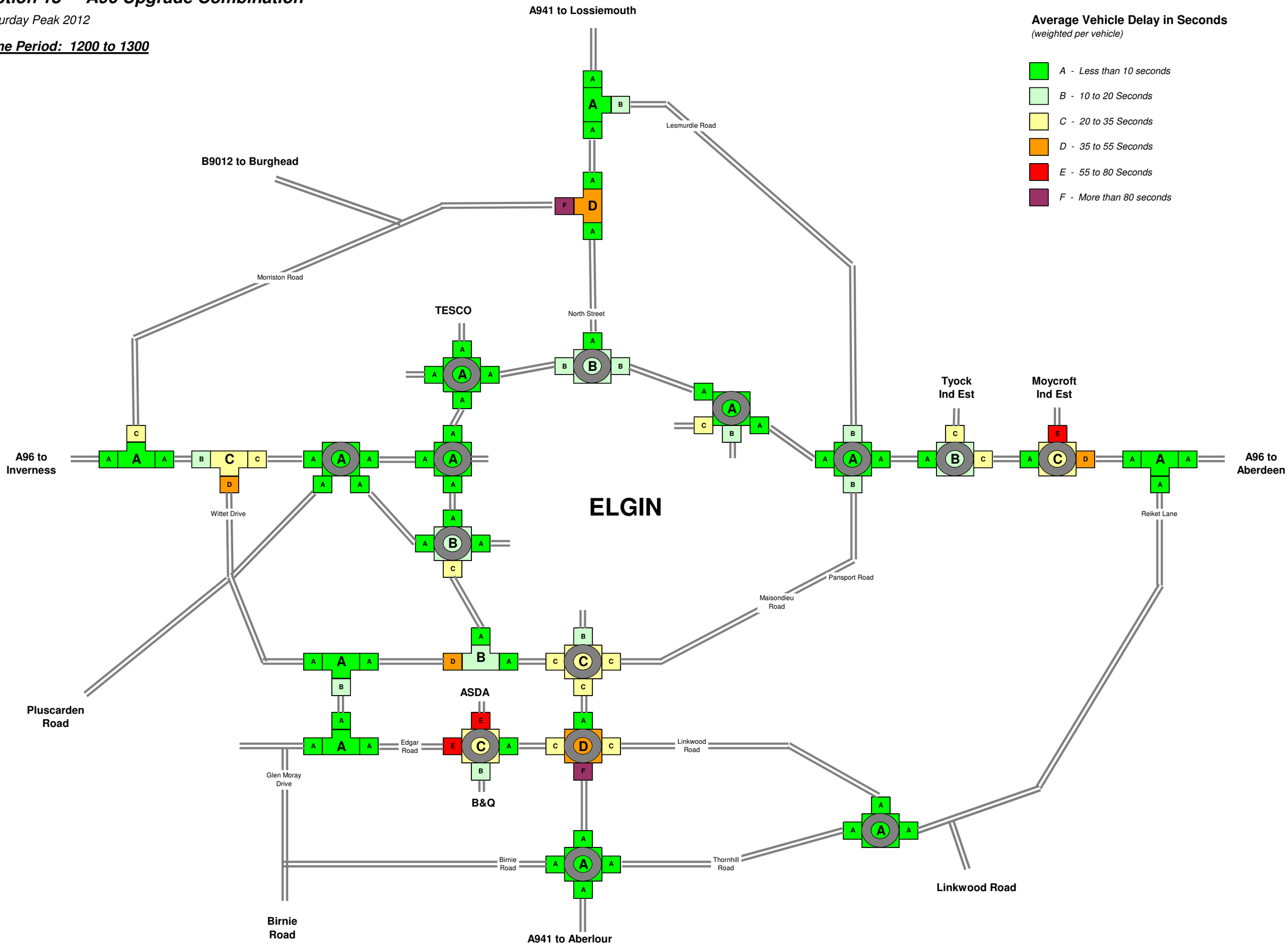
Option 18 - A96 Upgrade Combination

Saturday Peak 2012

Time Period: 1200 to 1300

Average Vehicle Delay in Seconds
(weighted per vehicle)

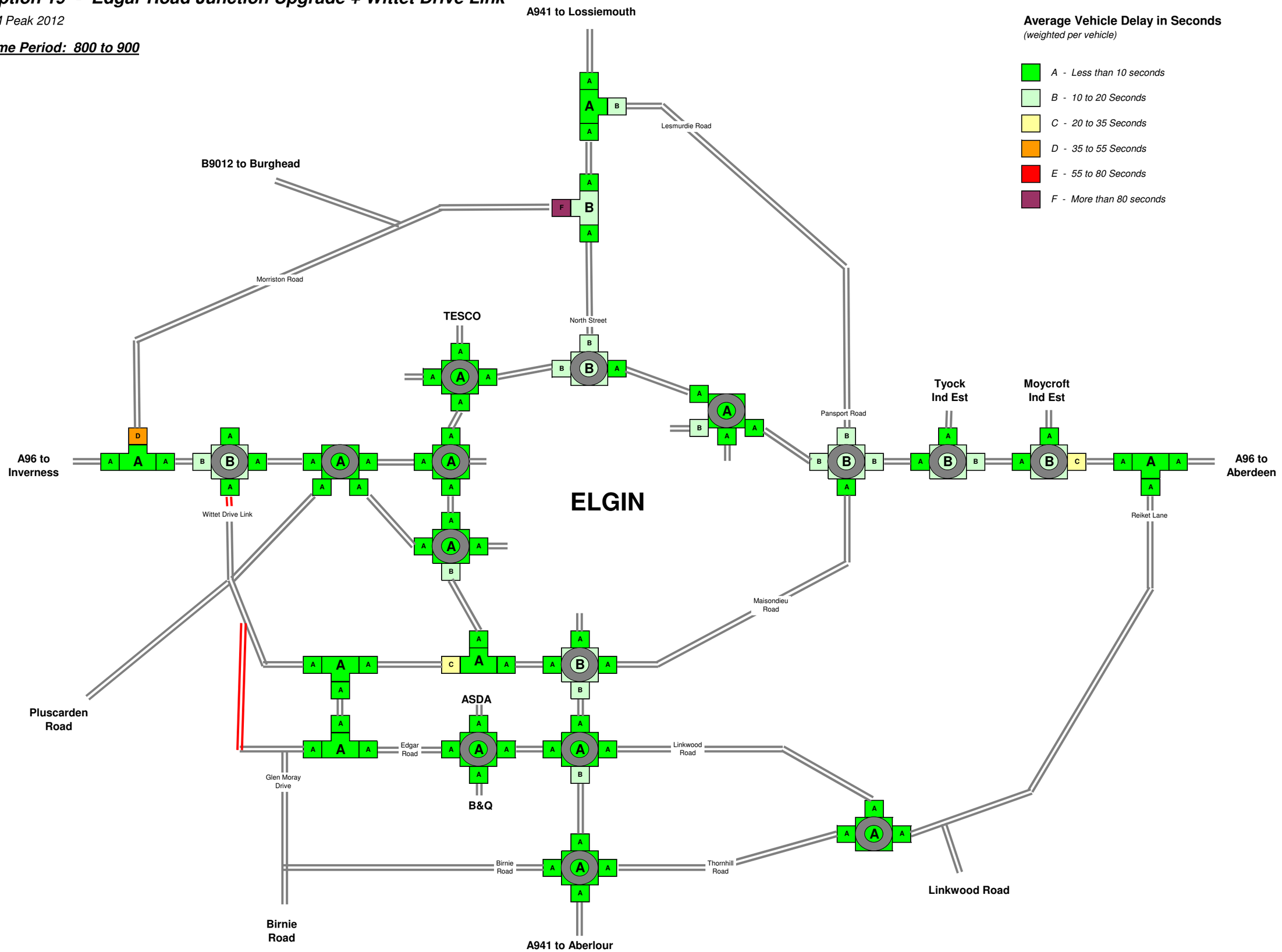
- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



Option 19 - Edgar Road Junction Upgrade + Wittet Drive Link

AM Peak 2012

Time Period: 800 to 900



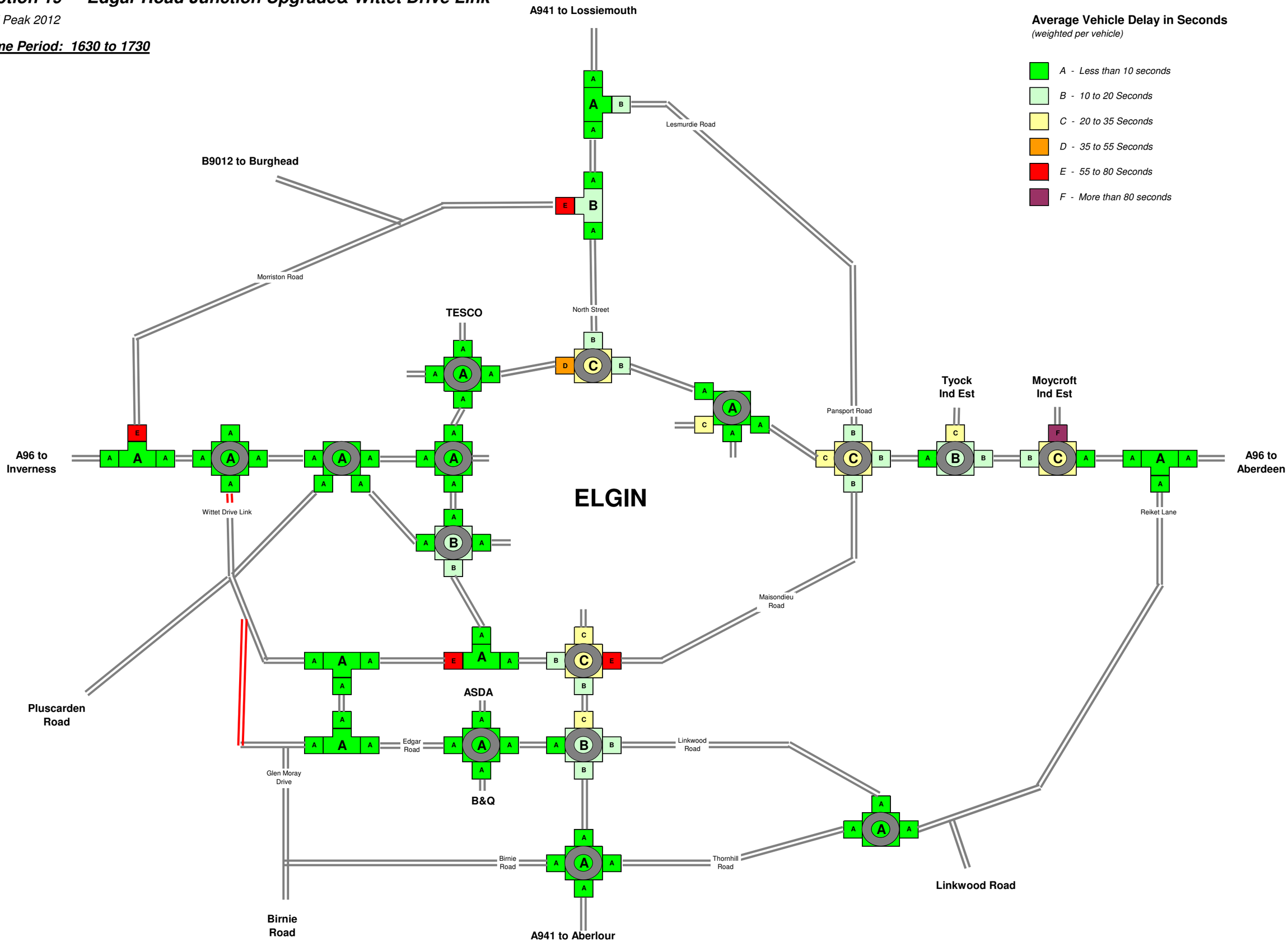
Option 19 - Edgar Road Junction Upgrade& Wittet Drive Link

PM Peak 2012

Time Period: 1630 to 1730

Average Vehicle Delay in Seconds
(weighted per vehicle)

- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



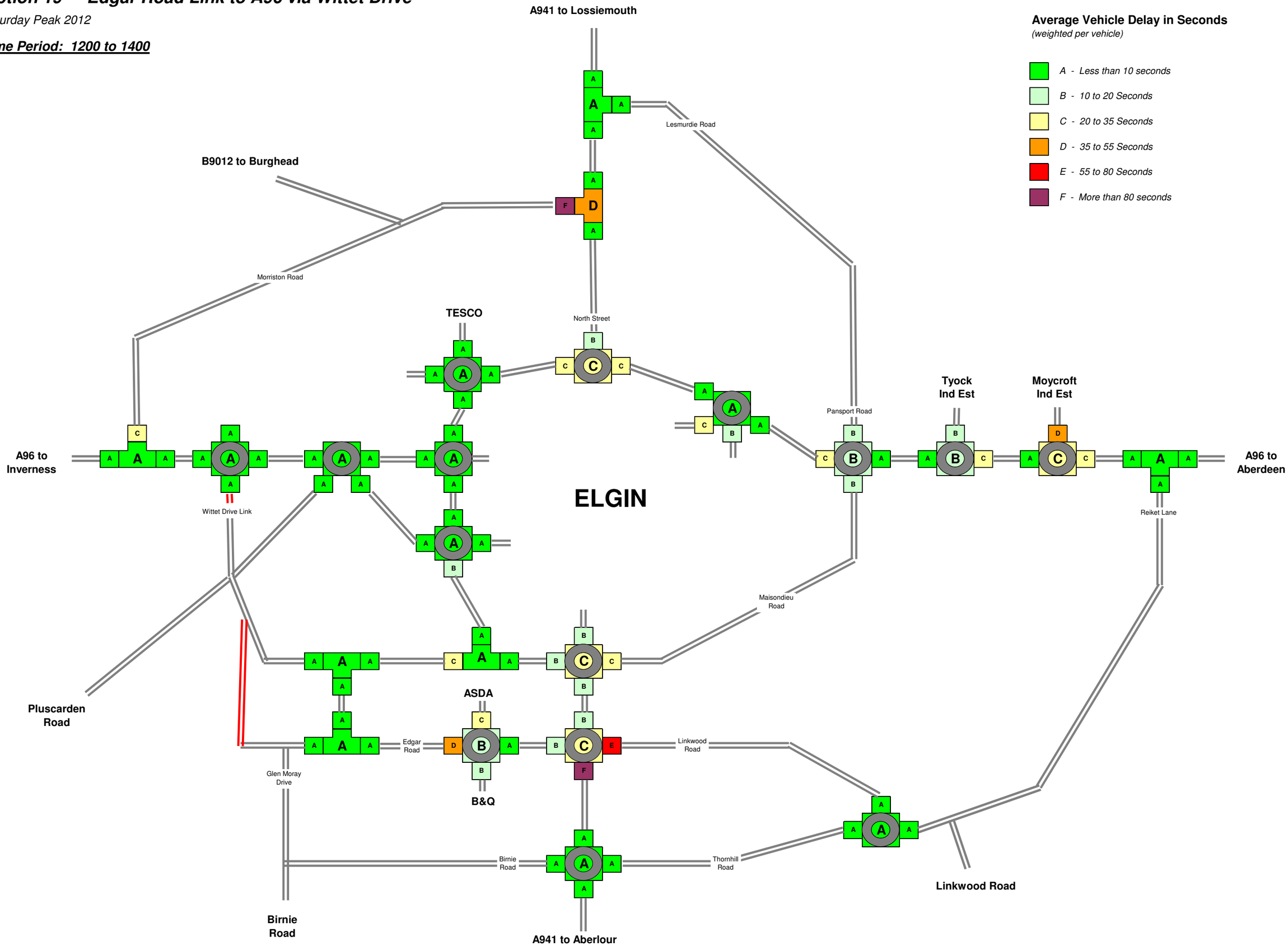
Option 19 - Edgar Road Link to A96 via Wittet Drive

Saturday Peak 2012

Time Period: 1200 to 1400

Average Vehicle Delay in Seconds
(weighted per vehicle)

- *A - Less than 10 seconds*
- *B - 10 to 20 Seconds*
- *C - 20 to 35 Seconds*
- *D - 35 to 55 Seconds*
- *E - 55 to 80 Seconds*
- *F - More than 80 seconds*



B Appendix B

B.1 Global Network Statistics

AM Peak	Total Travel Hours	Average Vehicle Speed (mph)
Reference Case	1,385	23.1
Option 1	1,449	22.7
Option 2	n/a	n/a
Option 3	1,424	22.5
Option 4	1,312	24.4
Option 5	1,377	23.3
Option 6	1,338	24.0
Option 7	1,380	23.2
Option 8	1,374	23.3
Option 9	1,396	22.9
Option 10	1,381	23.2
Option 11	1,408	22.8
Option 12	1,406	22.8
Option 13	1,306	25.1
Option 14	1,293	25.4
Option 15	1,283	25.2
Option 16	1,322	24.4
Option 17	1,329	24.2
Option 18	1,373	23.3
Option 19	1,300	24.6
Option 20	#N/A	#N/A

PM Peak	Total Travel Hours	Average Vehicle Speed (mph)
Reference Case	1,782	21.1
Option 1	1,918	20.2
Option 2	n/a	n/a
Option 3	1,799	20.9
Option 4	1,669	22.5
Option 5	1,773	21.2
Option 6	1,732	21.8
Option 7	1,781	21.1
Option 8	1,775	21.2
Option 9	1,756	21.4
Option 10	1,807	20.9
Option 11	1,803	20.7
Option 12	1,831	20.6
Option 13	1,609	23.9
Option 14	1,605	24.0
Option 15	1,596	23.9
Option 16	1,621	23.2
Option 17	1,684	22.5
Option 18	1,761	21.4
Option 19	1,656	22.7
Option 20	n/a	n/a

SATURDAY	Total Travel Hours	Average Vehicle Speed (mph)
Reference Case	2,240	17.0
Option 1	n/a	n/a
Option 2	n/a	n/a
Option 3	2,324	16.4
Option 4	1,987	19.3
Option 5	2,135	17.9
Option 6	2,089	18.4
Option 7	2,289	16.6
Option 8	2,248	17.0
Option 9	2,204	17.4
Option 10	2,193	17.4
Option 11	2,141	17.9
Option 12	2,165	17.5
Option 13	1,922	20.4
Option 14	1,908	20.7
Option 15	1,932	20.1
Option 16	1,805	21.3
Option 17	1,882	20.5
Option 18	2,145	17.8
Option 19	1,986	19.3
Option 20	n/a	n/a

C Appendix C

C.1 Journey Time Routes


Routes 1 &2:
A96 via South College Street
Routes 3 & 4:
A96 via Hay Street
Routes 5 & 6:
A941 via Hay Street
Routes 7 & 8:
A941 via Maisondieu Road

Halcrow Group Limited
16 Abercromby Place Edinburgh EH3 6LB
Tel +44 (0)131 272 3300 Fax +44 (0)131 272 3301
www.halcrow.com