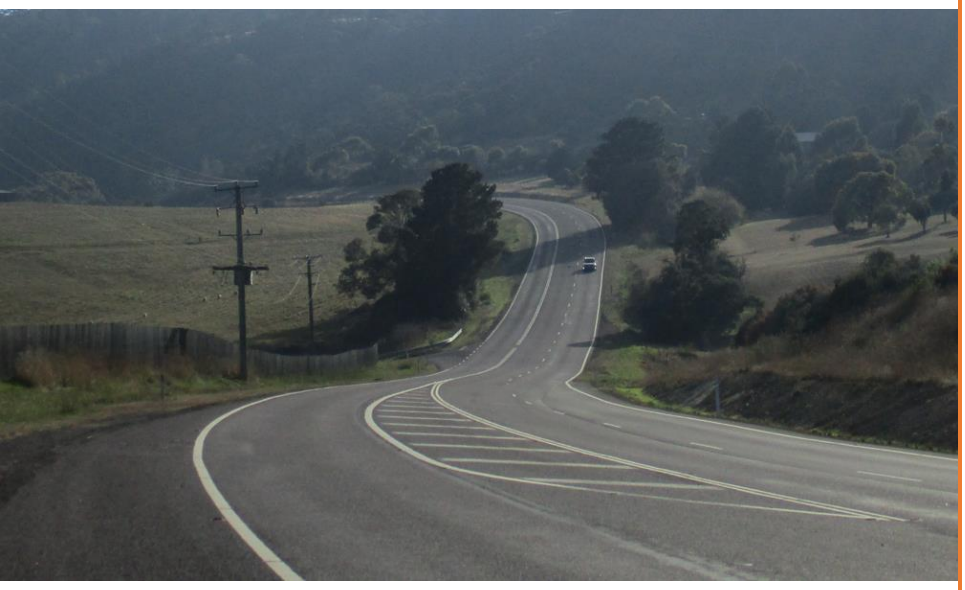

OLD BEACH REZONING

TRAFFIC ASSESSMENT

Hubble Traffic

November 2022

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1. Executive summary

The operational performance of East Derwent Highway (highway), between Old Beach and Bowen Bridge has been assessed using a theoretical capacity methodology, which compares the theoretical lane capacity against the current and predicted peak hour traffic demands. Traffic modelling software has also been used to assess the junctions along the highway, to quantify the level of service for users. The information provided within this assessment is of the predicted outcomes and possible mitigations.

The Tivoli Green residential expansion, which has already been approved, will begin to generate additional traffic movements on the highway over the next few years, intensifying the commuter peak periods. Once this development is completed, the level of service along the highway route would decline, but overall, motorists are expected to continue to receive an appropriate level of traffic performance. The following two locations are to become busier, and will require further investigation and appropriate mitigations to maintain efficient traffic flow:

- In the evening peak, with the additional Tivoli Green traffic returning back to their properties using the Bowen Bridge, the right turn movement from the Bowen Bridge onto the East Derwent Highway will become oversaturated, with long traffic queues. As queued vehicles extend beyond the length of the dedicated right turn lane, it has the potential to create an unwarranted safety risk to through traffic users. Traffic modelling indicates that changing traffic control at this junction to traffic signals, could be a suitable mitigation, and would accommodate future traffic growth.

- The highway link between the southern junction at Otago Bay and the Bowen Bridge (approximately 400 metres) is shown to reach lane capacity in the morning peak hour, making it difficult for motorists turning right out of Otago Bay Road, as they must select a suitable gap in the two-way traffic stream. A possible mitigation would be an additional southbound traffic lane, to segregate southbound highway traffic with right turning traffic.

This assessment predicts that the additional traffic generated on the highway by the rezoning of some rural properties within Old Beach, could be accommodated by implementing appropriate mitigation measures at these two locations.

An additional 580 residential lots in addition to the Tivoli Green development are expected to be accommodated by the highway. There is one location at the Clives and Fouche Avenues roundabout, which is shown to have increased traffic delays and queues, with possible mitigations to convert the roundabout to traffic signals or additional localised traffic lanes through the roundabout.

With a modest level of infrastructure investment at key locations, the highway is expected to provide users with an appropriate level of service to support a further 580 residential lots through land rezoning. It is projected that an increase past these additional residential lots, would increase highway commuter traffic demand to a volume that exceeds available lane capacity, causing an unacceptable reduction in traffic performance for highway users, with junctions having insufficient traffic capacity to provide a suitable level of performance. This would require an extensive level of infrastructure investment to provide dual traffic lanes and improvements to all junctions.

This assessment found that the recent extensive residential development at Old Beach, is generating significant commuter peak hour traffic flows, with the function of the highway changing to an urbanised arterial, with peak commuter flows continuing to grow as Tivoli Green develops. As this highway integrates into the Hobart urban arterial network, it is understandable for the level of performance to decline, as the urban arterial network struggles to provide sufficient lane capacity to meet intense commuter peak traffic demands, affecting travel times. This deterioration in the level of service is accepted by users.

When an urban arterial network becomes busier, some motorists with the ability to change their travel patterns, are likely to avoid travelling in the intense commuter peak periods, which is known as peak spreading. This occurs naturally as the pattern of traffic demand changes overtime, it increases the highway traffic capacity, and delays the need for infrastructure improvements. It is not possible to forecast the level of peak spreading that may occur along the highway as the traffic demand increases, but based on other parts of the network, peak spreading is likely to occur.

2. Introduction

ERA Planning have engaged Hubble Traffic Consulting to undertake an independent traffic assessment, to consider the impact of rezoning two parcels of land within Old Beach to higher density residential, to increase the supply of land for residential development.

The two parcels of land under consideration are adjacent to Compton Road, and Old Beach Road, with both relying on the East Derwent Highway (highway) as the main arterial connecting road.

The assessment includes the:

- evaluation of the current traffic conditions on the surrounding State Road network during the peak morning and evening periods,
- evaluation of additional traffic flow generated from the approved Tivoli Green development,
- prediction of the increase in traffic movements generated by each land parcel, based on yields quantified by ERA Planning, and
- consideration of possible infrastructure improvements to accommodate higher traffic demand.

SIDRA Intersection modelling software has been used in this assessment, which uses gap acceptance theory, including traffic flow, delays, and queues, to determine the level of traffic performance. The software predicts the degree of saturation (DOS), level of service (LOS), average delay, and maximum length of traffic queues.

The assessment will refer to Austroads Guide to Road Design and the RTA Guide to Traffic Generating Developments (RTA Guide).

3. Site Description

The two parcels of land under consideration are defined in the diagram below, with Precinct B to have access to Compton Road, and Precinct A to Old Beach Road. The nearest arterial road is the highway, which is part of the State Road network managed by the Department of State Growth (Department).

Diagram 3.0 – Land parcels under consideration for rezoning

4. Existing traffic flows

Traffic performance for links and intersections are primarily determined based on peak hour traffic flows, with peak hour traffic flows from the State Road network obtained for this assessment.

4.1 Link traffic flows

The Department maintains a database of traffic flows for the State Road network, with permanent stations that collect traffic flow data every day of the year, and short-term traffic collection sites that collect data for two to four weeks every few years.

For this assessment, the term link, means a section of roadway between intersections or junctions, and node means an intersection or junction.

Interrogation of the Department's traffic database found the following traffic flows for the surrounding State Road links.

Table 4.1 – Link traffic flows from the Department traffic database

Road	Location	Survey date	ADDT	Morning peak hour		Evening peak hour	
				NB/WB	SB/EB	NB/WB	SB/EB
East Derwent	South of Jordan Bridge	Jun 21	11,700	422	483	766	550
East Derwent	North of Old Beach Rd	Jun 21	9,600	266	494	700	364
East Derwent	West of Bowen Bridge	Jun 21	14,800	310	1,061	1,089	440
East Derwent	West of Grass Tree Roundabout	Nov 18	18,200	972	848	1,053	960
Bowen Bridge	South of East Derwent	Nov 21	21,300	636	1,471	1,433	790

4.2 Link traffic capacity

Section 5.1.1 of the Austroads Guide to Traffic Management Part 3: Transport Study and Analysis Methods, provides guidance on calculating operational lane capacity.

The operational capacity of a single lane for uninterrupted flow (links) is 1,800 passenger cars per hour, with the capacity affected by the pavement width, lateral clearance to roadside features and hazards, and the presence of heavy vehicles and vertical grades.

In respect to pavement width and lateral clearance, the highway has 3.5-metre-wide lanes supported by sealed shoulders and wide verges, with the adjustment factor for pavement width and lateral clearance determined to be 0.97, as per the Austroads Guide.

The highway has one section with steep vertical grades, with climbing lanes provided in each direction to mitigate any decrease in flow caused by slow moving vehicles. The remaining sections of highway have relatively flat vertical grades, and for this capacity analysis are considered as level.

Using the Department traffic database, the average heavy vehicle content for the highway between Bowen Bridge and Compton Road is estimated between 5 and 10 percent.

Having consideration to the road characteristics and applying the relevant adjustment factors, the calculated single lane traffic operational capacity is 1,650 vehicles per hour, per direction, which means vehicles are operating with a headway gap of 2.25 seconds.

4.3 Node traffic flows

Traffic flows at intersections and junctions have been collected using manual traffic surveys, undertaken in the morning and evening weekday peak commuter periods. The surveys were undertaken on Wednesday and Thursday 16 and 17 February 2022, primarily between 7:30am to 9:00am and 4:00pm to 6:00pm.

5. Existing traffic performance for the highway links and nodes

Traffic models of the nodes were developed in SIDRA modelling software to determine the level of traffic performance and were based on the road layout, the number of turning lanes, and the peak hour traffic data collected from the recent manual traffic surveys. The traffic modelling software analysed the traffic flow, junction layout, and traffic control, to determine the Degree of Saturation (DOS) and Level of Service (LOS), to predict average delays, and traffic queues.

The modelling indicates the nodes operating along the highway are operating at LOS C or higher and providing motorists with an appropriate level of service. The modelling also indicates there is spare traffic capacity at most nodes, except for vehicles returning to Old Beach from the Bowen Bridge, turning right onto the East Derwent Highway, where the junction is operating at DOS of 0.825, or 82 percent of the junction capacity. Further traffic growth at this location will intensify the traffic queues, causing the queue to extend beyond the length of the right turn lane into the through lane.

The table below is a summary of the traffic modelling, with the complete analysis of the existing traffic conditions available in appendix A of this assessment.

Table 5.0 – Summary of traffic modelling for existing traffic conditions at highway nodes

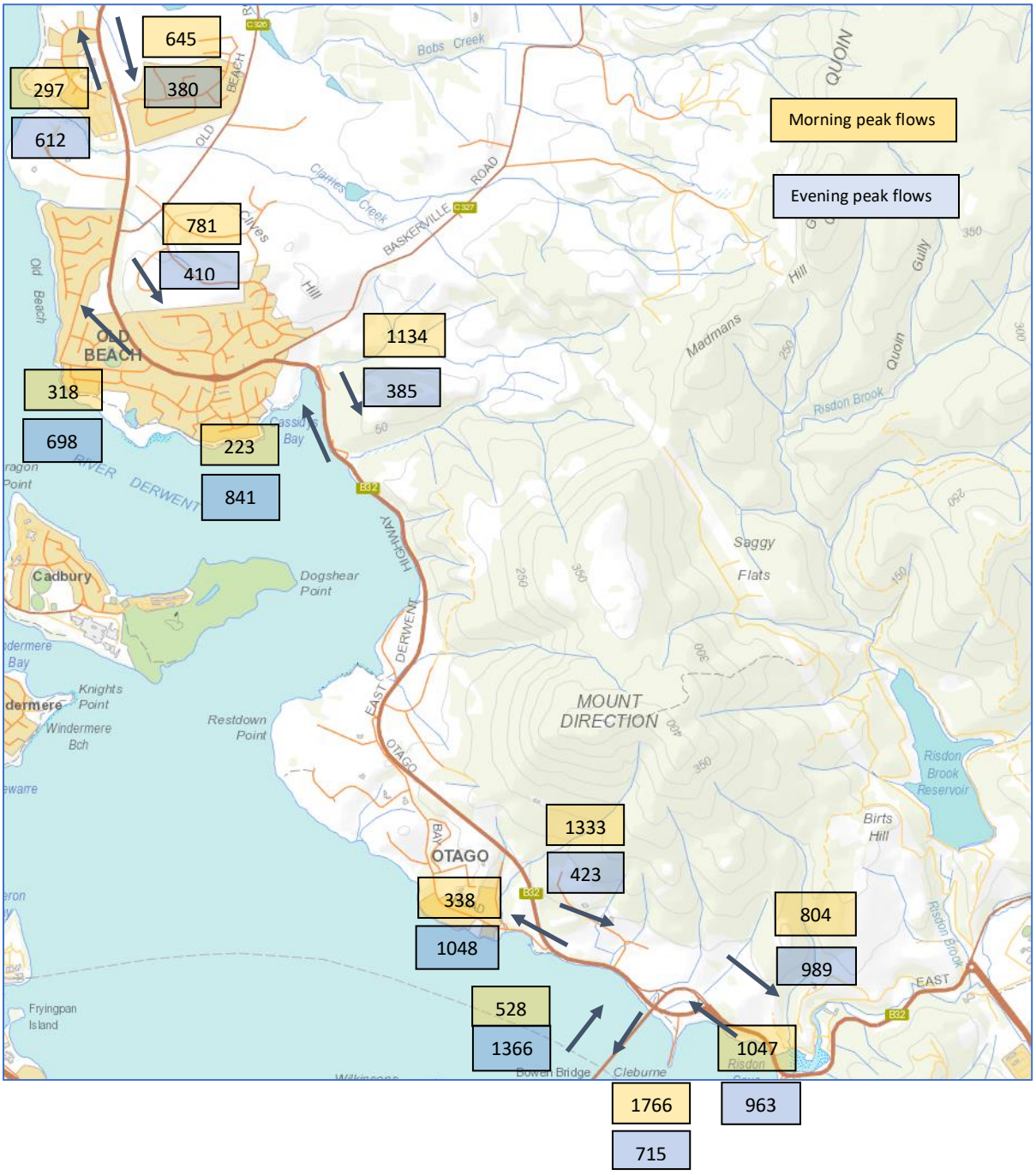
Location	Period	Total Vehicles	DOS	LOS	Worst Ave Delay	Max queue length
Compton Road	Morning	943	0.294	C	15.5 secs	0.6 metres
	Evening	996	0.327	C	16.8 secs	0.6 metres
Old Beach Road	Morning	1106	0.352	C	18.4 sec	5.1 metres
	Evening	1128	0.338	C	19.6 sec	1.5 metres
Clive and Fouche Aves	Morning	1403	0.675	A	6.9 sec	51.5 metres
	Evening	1345	0.571	A	5.3 sec	39 metres
Bowen Bridge junction One	Morning	1103	0.155	A	7 sec	16.3 metres
	Evening	1617	0.350	A	9.6 secs	10.3 metres
Bowen Bridge junction Two	Morning	160	0.327	C	15.5 secs	11.2 metres
	Evening	628	0.825	C	17.8 secs	77.4 metres

5.1 Existing link traffic flows along the highway

It is evident that the highway has a significant peak commuter function, with the morning peak being slightly higher, and traffic flow intensifying around the Bowen Bridge. The highest morning directional peak hour flow of 1,333 vehicles was recorded north of the Bowen Bridge, with 1,048 recorded in the evening peak.

At these traffic flow levels, highway users are receiving an appropriate level of traffic performance, with the existing directional peak hour flows provided in diagram 5.1.

Diagram 5.1 – Existing peak hour traffic flows from the available traffic survey data



6. Traffic generation from Tivoli Green new residential development

Tivoli Green is an approved large residential development located north of Old Beach Road, which will generate additional vehicle trips onto the highway over the next few years. It is important to consider the impact on the highway network from these approved residential properties, to evaluate if spare traffic capacity on the highway is available when this development is completed.

According to a Traffic Impact Assessment prepared by Milan Prodanovic in 2017, the subdivision is expected to yield 577 residential lots, and generate an additional 324 vehicle trips in the peak periods.

These 577 residential lots, are in addition to the existing residential lots, currently operating from Riviera Drive, with new trips from the residential subdivision expected to enter and leave the highway using Old Beach Road, Riviera Drive or Gage Road.

As determined earlier from the manual traffic surveys, during the morning period the majority of trips generated from the residential catchments travel along the highway towards the Bowen Bridge, while in the evening the percentage of trips arriving home from the Bowen Bridge is slightly less.

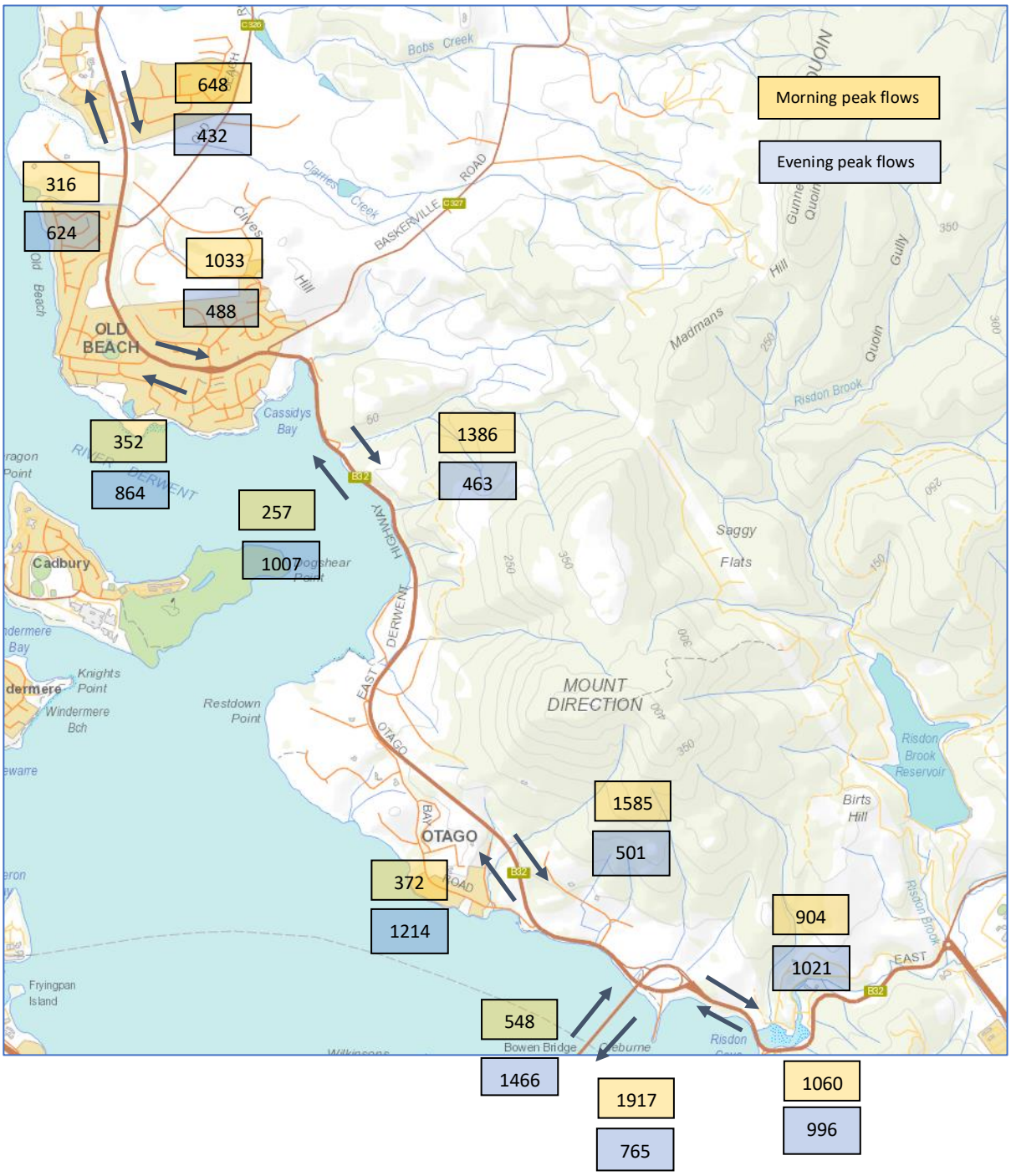
A small portion of up to five percent of the users are expected to use public transport as a transport mode, which equates to 16 trips from the 577 new residential properties.

Future trips from the new Tivoli Green residential development have been assigned to the highway, based on the trip distribution as specified in table 6.0, which is based on current trip distribution from the existing surrounding residential catchment areas, with the assigned traffic flows shown in diagram 6.0 below.

Table 6.0 – Estimation of future trip distribution to be generated by Tivoli Green development

Morning peak	**Trips entering Tivoli Green (12%)**		**Trips leaving Tivoli Green (88%)**		**Total vehicles generated**
	NB (93%)	**SB (7%)**	**NB (7%)**	**SB (93%)**	
	34	3	19	252	308
Evening peak	**Trips entering Tivoli Green (71%)**		**Trips leaving Tivoli Green (29%)**		
	NB (76%)	**SB (24%)**	**NB (13%)**	**SB (87%)**	
	166	52	12	78	308

Diagram 6.0 – Predicted peak hour traffic flows including future trips generated by Tivoli Green



7. Assessment of network performance with Tivoli Green development

The traffic impact of the additional trips generated from Tivoli Green development on the highway has been evaluated by three methods, level of service, lane capacity and node capacity.

7.1 Level of service of additional trips from Tivoli Green

Level of service is a qualitative assessment of the traffic conditions that considers speed, volume of traffic, delays, and freedom to manoeuvre, with six levels of service (LOS) described in the RTA Guide in Extract 7.1 below. Level of service LOS D to E is an acceptable performance level for State Roads operating during the peak periods. Many of the busy arterial highways, such as the Brooker Highway, Tasman Highway, and Southern Outlet, operate adequately at LOS E during peak periods, with users prepared to accept a reduced level of service.

Level of service is based on the two-way peak hour traffic flows and considers the opportunity for opposing vehicles to overtake on a two-way two-lane highway.

Extract 7.1A - RTA Guide for level of service for links

Level of service	
A	Highest level, traffic is free flowing, individual drivers are virtually unaffected by the presence of others in the traffic stream, with high level of comfort and convenience.
B	Traffic flow is stable, drivers have reasonable freedom to select their desired speed, to manoeuvre within the traffic stream, and maintains good level of comfort and convenience.
C	Stable traffic flow, with most drivers restricted to some extent in their freedom to select their desired speed and manoeuvre within the traffic stream, the level of comfort and convenience is declining.
D	The traffic flow is reaching its level of being stable, all driver severely restricted in their freedom to select their desired speed and to manoeuvre, the general level of comfort and convenience is poor.
E	Traffic volumes are nearing the lane capacity, there is no freedom to select desired speeds or manoeuvre within the traffic stream, minor disturbances within the traffic stream have the potential to cause traffic-jams.
F	The traffic is in a forced flow, with the amount of traffic approaching or exceeding saturation levels, operating speeds severely restricted, queuing and delays expected.

The RTA Guide provides the level of service for rural roads based on the terrain, the percent of heavy vehicles, and two-way peak hour traffic flows. For the purpose of this assessment, the terrain is considered level, as climbing lanes operate on vertical grades, and the heavy vehicle content is between 5 and 10 percent.

Extract 7.1B from RTA Guide for level of service for rural roads

Table 4.5
peak hour flow on two-lane rural roads (veh/hr)
(Design speed of 100km/hr)

Terrain	Level of Service	Percent of Heavy Vehicles			
		0	5	10	15
Level	B	630	590	560	530
	C	1030	970	920	870
	D	1630	1550	1480	1410
	E	2630	2500	2390	2290
Rolling	B	500	420	360	310
	C	920	760	650	570
	D	1370	1140	970	700
	E	2420	2000	1720	1510
Mountainous	B	340	230	180	150
	C	600	410	320	260
	D	1050	680	500	400
	E	2160	1400	1040	820

The level of service analysis shown in table 7.1 below indicates during the peak hour periods the opportunity for overtaking will be severely restricted, as some links are predicted to operate at LOS E. As discussed earlier, there are dedicated climbing lanes providing overtaking on the vertical inclines around Otago Bay, to ensure reasonable traffic flow is maintained and slow-moving vehicles can be passed. In an urban arterial environment overtaking is not as essential, as traffic generally moves in platoons.

With the highway already speed limited to 80 km/h, the traffic flow is expected to maintain a reasonable speed, noting the operating speed will be strongly influence by other vehicles in the traffic stream.

Table 7.1 – Level of service for links once Tivoli Green development is completed

Link		Existing traffic flows		Traffic flow including Tivoli Green	
		Morning peak	Evening Peak	Morning peak	Evening peak
Compton to Clive	Two-way Flow	942	992	1385	1352
	LOS	C	C	D	D
Clive to Otago	Two-way flow	1,357	1,226	1,643	1,470
	LOS	D	D	E	D
Otago to Bowen	Two-way flow	1,675	1,471	1,957	1715
	LOS	E	D	E	E
Bowen to Grass Tree	Two-way flow	1,851	1,952	1,964	2,017
	LOS	E	E	E	E
Bowen Bridge (dual lanes)	Two-way flow	2,294	2,231	2,465	2,231
	LOS	D	D	D	C

7.2 Lane capacity assessment from additional Tivoli Green trips

As described earlier, traffic lane efficiency can be measured by comparing the directional peak hour traffic flows against a theoretical operational capacity. The highway has a theoretical operational capacity of 1,650 vehicles per lane, per direction during the peak periods.

The table below provides the predicted directional traffic demand, comparing with the theoretical lane capacity, and indicates the highway will be able to accommodate the increase in demand generated from the Tivoli Green development.

The southbound lane capacity between Otago Bay Road (southern junction) and the Bowen Bridge is predicted to operate around 96 percent, and with this lane reaching capacity it will become difficult for vehicles to enter the traffic stream. Further investigation into providing a suitable mitigation for turning traffic should be considered for this section of the highway.

Table 7.2 – Lane capacity for the existing flows, and additional traffic from Tivoli Green

Link		Existing traffic conditions				Traffic conditions with Tivoli Green			
		Morning peak		Evening peak		Morning peak		Evening peak	
		NB	SB	NB	SB	NB	SB	NB	SB
Compton to Clive	Flow	318	718	698	410	352	1,033	864	488
	Capacity %	19%	47%	42%	25%	21%	62%	52%	30%
Clive to Otago	Flow	223	1,134	841	385	257	1,386	1,007	463
	Capacity %	14%	69%	51%	23%	16%	84%	61%	28%
Otago to Bowen	Flow	338	1333	1048	423	372	1585	1214	501
	Capacity %	20%	81%	64%	26%	23%	96%	74%	31%
Bowen to Grass Tree	Flow	1,047	804	963	989	1,060	904	996	1,021
	Capacity %	63%	49%	58%	60%	64%	55%	60%	72%
Bowen Bridge	Flow	528	1,766	1,366	715	548	1,917	1,466	765
	Capacity %	15%	49%	38%	20%	15%	53%	41%	21%

7.3 Traffic impact from Tivoli Green development

The Prodanovic Traffic Impact Assessment (TIA) indicated additional traffic trips generated from Tivoli Green are expected to enter and leave the highway at three existing junctions, Old Beach Road, Riviera Drive and Gage Road. While the traffic modelling undertaken with the Tivoli Green TIA, determined that each of the above junctions could operate at an appropriate level of traffic performance, the assessment did not consider the downstream impact, particularly around the Bowen Bridge.

The level of service and lane capacity assessment has determined that additional peak hour trips generated from Tivoli Green, is predicted to cause a deterioration in traffic performance along the highway route, where overtaking will not be possible, but sufficient lane capacity will be available to ensure traffic will flow efficiently. It is important to acknowledge that except for the roundabout at the Clive and Fouche intersection, highway motorists have an uninterrupted traffic flow to the Bowen Bridge, with southbound motorists having free flow onto the bridge. While motorists returning to Old Beach in the evening peak are required to give way at the end of the Bowen Bridge.

Traffic modelling of the highway nodes indicates that at the completion of the Tivoli Green development, the nodes will become busier, however motorists continue to receive an appropriate level of service, except for motorists returning in the evening period using the junction at the end of the Bowen Bridge. At this junction, the intensification of right turning traffic returning to Old Beach is predicted to operate at LOS F, and to cause excessive delays and unacceptable traffic queues that would extend back into the through traffic lane, creating an unacceptable crash risk.

Table 7.3A – Traffic Modelling comparison for the morning peak with Tivoli Green development

Location	Existing traffic conditions					Future traffic conditions with Tivoli Green				
	Vehicles	DOS	Highest delay	LOS	Max Queue	Vehicles	DOS	Highest delay	LOS	Max Queue
Old Beach Rd junction	1,106	0.352	18.4 sec	C	5.1m	1,362	0.474	31sec	D	7.9m
Clive/Fouche roundabout	1,403	0.675	17.7 sec	B	51.5m	1,689	0.873	42 sec	D	138m
Bowen Bridge site 1	1,103	0.404	7 sec	A	16.3m	1,224	0.487	7.6sec	A	25.3m
Bowen Bridge site 2	3,048	0.500	15.5sec	C	11.2m	3,082	0.500	16.6sec	C	13.6m

Table 7.3B – Traffic modelling comparison for the evening peak with Tivoli Green development

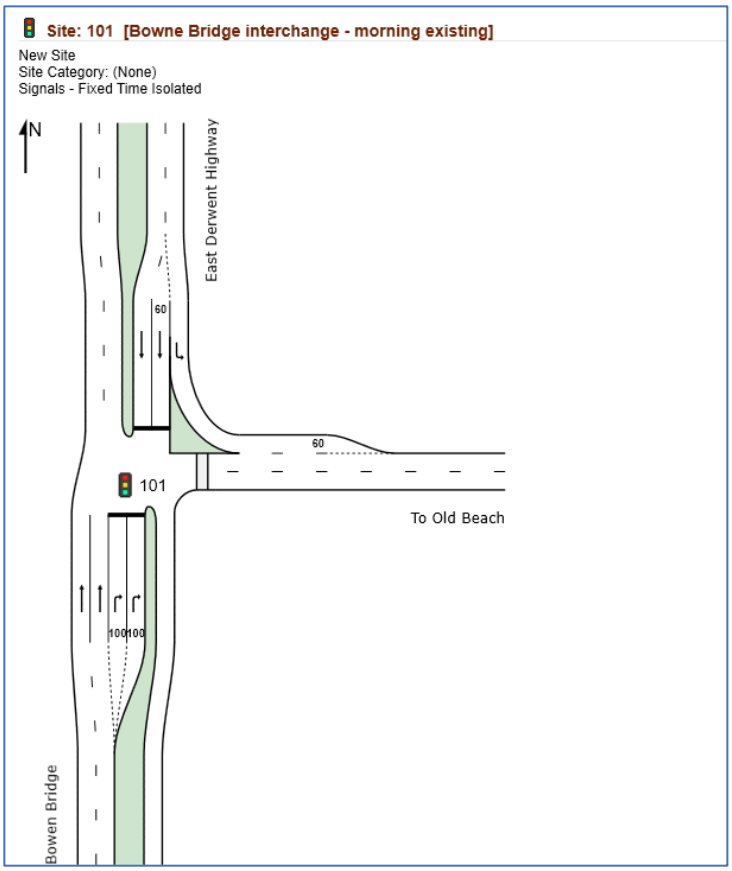
Location	Existing traffic conditions					Future traffic conditions with Tivoli Green				
	Vehicles	DOS	Highest delay	LOS	Max Queue	Vehicles	DOS	Highest delay	LOS	Max Queue
Old Beach Rd junction	1,128	0.38	19.6sec	C	8.1m	1,376	0.421	30.1sec	D	11.9m
Clive/Fouche roundabout	1,345	0.571	13.5sec	B	39m	1,593	0.679	15.7sec	B	57.8m
Bowen Bridge site 1	1,617	0.350	9.6sec	A	10.3m	1,749	0.391	10.6sec	B	13.5m
Bowen Bridge site 2	2,753	0.825	17.8sec	C	11.1m	2,919	1.05	141sec	F	527m

8. Highway mitigations to accommodate Tivoli Green development

Based on this analysis, the highest priority for highway improvements would be to improve the Bowen Bridge access to the East Derwent Highway during the evening peak, where the right turn capacity needs to be increased to address the queue length, which is predicted to extend beyond acceptable levels (500 metres) well back into the through lane, creating an unwarranted crash risk. Increasing traffic capacity at junctions is normally accomplished by providing additional traffic lanes, and in this case a second right turn lane can be achieved with implementing traffic signals.

A possible traffic signals layout is shown below, and traffic modelling of this layout indicates motorists will receive an appropriate level of traffic efficiency. The traffic signals will introduce a traffic delay for motorists travelling from Geilston Bay onto the Bowen Bridge.

Diagram 8.0 – Possible layout for traffic signals at end of the Bowen Bridge



Otago Bay Road (south) junction with the highway is the second priority, as the highway flow reaches lane capacity, it will become increasingly more difficult for vehicles to turn out of Otago Bay Road (southern junction) as they need to select a gap from two traffic streams. A possible improvement could be to commence an additional lane south of the junction, which creates two lanes for the short distance to the existing diverge at the Bowen Bridge, enabling right turning vehicles to turn out into their own traffic lane, then only needing to select a gap in the northbound traffic stream.

9. Traffic impact from rezoning existing rural properties

This section evaluates the highway capacity to absorb an increase in traffic from rezoning the rural residential properties at Old Beach, and assumes that Tivoli Green development is completed, and minor infrastructure improvements as outline in section 8 have been implemented.

Existing rural residential properties have the potential to be rezoned to increase the number of residential lots, with ERA Planning analysing the potential yield based on existing properties, and where each could be subdivided. Three options have been considered:

- Option one - no change in zoning and incremental development to continue to occur on vacant lots at the predicted rate of 4.5 dwellings per year, or total of 114 lots.
- Option two - rezone 25 rural residential lots to general residential to generate a potential yield of an additional 580 lots.
- Option three - rezone all available land identified in the two precincts to generate a potential yield of 1,544 lots.

Table 9.0 – ERA Planning prediction of additional lots

Location	Option One	Option Two	Option three
Precinct B	17	86	256
Precinct A	97	494	1,288
Total	**114**	**580**	**1,544**

As established previously, each dwelling could generate 0.71 peak hour trips, with 88 percent of these trips leaving the dwelling in the morning peak, and 71 percent of the trips returning to the dwelling during the evening peak. Also, in the morning 93 percent of generated trips are likely to travel in a southbound direction towards the Bowen Bridge, with 76 percent of the vehicles arriving from a southbound direction.

From this information the potential increase in highway directional traffic flows, can be predicted based on the potential land yields.

Table 9.0A – Prediction of increase in directional traffic flows based on land yield

Potential Yield (Option)	Morning peak					Evening peak				
	Total	Out	In	SB	NB	Total	Out	IN	SB	NB
	0.71	88%	12%	93%	7%	0.71	29%	71%	24%	76%
114	81	71	10	66	5	81	21	58	14	44
580	412	363	49	334	25	412	119	292	70	222
1,544	1096	965	132	898	67	1096	318	778	187	591

This predicted directional traffic flow data as determined in the above table, has been assigned to the existing State Road network to assess the impact under two methods, lane capacity and node performance.

9.1 Highway lane capacity performance under the different rezoning Options

Based on the directional lane capacity as shown in tables 9.1 below, it is evident that option one (no change in land zoning - incremental growth of 144 lots) can be accommodated without causing any significant decline in level of performance for motorists.

Based on directional lane capacity, option two (rezoning some properties to generate additional 580 lots) appears to be the threshold where highway links commence reaching the theoretical lane capacity. While motorists have limited freedom to select desired speeds or manoeuvre within the traffic stream, traffic is expected to maintain a reasonable flow.

Option three – (rezoning to achieve 1,544 new residential lots), this increase in traffic demand is predicted to cause highway links to exceed the theoretical lane capacity. The traffic is in a forced flow, with the amount of traffic exceeding saturation levels, operating speeds severely restricted, excessive queuing and delays expected, with any minor disturbance having the potential to create excessive delays, and these traffic conditions should be avoided.

The two tables below predict the directional lane flow under each option for the morning and evening peak hour periods, with the traffic flow presented as a percentage of the theoretical lane capacity.

Table 9.1A – Morning peak hour – predicted operational lane capacity (Note: Bowen Bridge has dual traffic lanes)

Link		**Existing flows with Tivoli Green**		**Option One (114)**		**Option Two (580)**		**Option Three (1,544)**	
		NB	**SB**	**NB**	**SB**	**NB**	**SB**	**NB**	**SB**
Compton to Clive	Flows	352	1,033	357	1099	377	1367	427	2023
	%	**21%**	**63%**	**22%**	**67%**	**23%**	**83%**	**29%**	**122%**
Clive to Otago	Flows	257	1,386	262	1452	282	1720	332	2376
	%	**16%**	**84%**	**16%**	**88%**	**17%**	**104%**	**20%**	**144%**
Otago to Bowen	Flows	372	1,585	377	1651	397	1919	447	2575
	%	**23%**	**96%**	**23%**	**100%**	**24%**	**116%**	**27%**	**156%**
Bowen to Grass tree	Flows	1,060	904	1062	925	1072	1011	1097	1221
	%	**64%**	**55%**	**64%**	**56%**	**65%**	**61%**	**66%**	**74%**
Bowen Bridge	Flows	548	1,917	550	1962	560	2144	585	2590
	%	**15%**	**53%**	**17%**	**61%**	**18%**	**67%**	**18%**	**81%**

Table 9.1B – Evening peak hour - existing and predicted operational lane capacity

Link		Existing flows with Tivoli Green		Option One (114)		Option Two (580)		Option Three (1,544)	
		NB	SB	NB	SB	NB	SB	NB	SB
Compton to Clive	Flows	864	488	908	502	1084	558	1517	572
	%	**52%**	**30%**	**55%**	**30%**	**64%**	**34%**	**92%**	**35%**
Clive to Otago	Flows	1,007	463	1051	477	1227	533	1660	547
	%	**61%**	**28%**	**64%**	**29%**	**74%**	**32%**	**100%**	**33%**
Otago to Bowen	Flows	1,214	501	1258	515	1434	571	1867	585
	%	**74%**	**30%**	**76%**	**31%**	**87%**	**35%**	**113%**	**35%**
Bowen to Grass tree	Flows	996	1,021	1014	1028	1084	1056	1282	1063
	%	**60%**	**62%**	**61%**	**62%**	**66%**	**64%**	**78%**	**64%**
Bowen Bridge	Flows	1,466	765	1492	772	1598	800	1857	807
	%	**41%**	**21%**	**47%**	**47%**	**50%**	**25%**	**58%**	**25%**

9.2 Compton Road and East Derwent Highway junction

SIDRA intersection modelling software has been used to evaluate the junctions along the highway, with the base case being the completed Tivoli Green development, then consideration of the rezoning options. As the morning peak generate the highest traffic flows along the highway, the modelling has only considered the morning peak as being the worst-case scenario.

For the Compton Road junction, the modelling predicts that the junction will provide an adequate level of traffic performance under the base case (Tivoli Green), and with options one and two, while option three cannot be tolerated.

Table 9.2 – Modelling comparison for Compton Road junction (morning peak)

Option	Total vehicles	DOS	Max delay	LOS	Max Queue
Tivoli Green	1,230	0.408	25 secs	D	0.1 metres
Option one	1,249	0.409	25.9 secs	D	3.1 metres
Option two	1,283	0.410	29.6 sec	D	7.3 metres
Option three	1,399	0.863	69.3 secs	F	41.4 metres

9.3 Old Beach Road and East Derwent Highway junction

Old Beach Road is expected to be the main route for the majority of the new traffic to enter and leave the highway, in the morning the left turn onto the highway is the predominant vehicle movement, while in the evening the right turn movement into Old Beach Road will intensify.

The current give way junction control is predicted to provide an adequate level of performance for the base case (Tivoli Green) traffic flows, with further intensification of traffic seeing the right turn out movement affect the junction performance. This can be easily alleviated by creating two exit lanes out of Old Beach Road, with one lane dedicated to right turners, allowing left turning traffic unimpeded access.

The following junction modelling is based on two exit lanes out of Old Beach Road and predicts option one and two can be accommodated by the junction, while option three could not be tolerated.

Table 9.3 – Modelling comparison for Old Beach Road junction (morning peak)

Period	Option	Total vehicles	DOS	Max delay	LOS	Max Queue
Morning peak	Tivoli Green	1,365	0.474	12.4 secs	B	7.9 metres
	Option one	1,454	0.475	13.4 secs	B	12.5 metres
	Option two	1,660	0.869	18.2 secs	C	33.1 metres
	Option three	2,376	1.803	1458 secs	F	3882 metres

9.4 Clive/Fouche and East Derwent Highway roundabout

Traffic modelling of the existing roundabout predicts traffic generated from the Tivoli Green development can be adequately managed, with the roundabout operating in the morning peak at level of performance LOS D. However, further traffic growth along the highway is predicted to cause the performance of the roundabout to quickly deteriorate beyond acceptable levels.

To increase capacity at the roundabout the provision of additional traffic lanes should be considered, these additional lanes only need to be localised, say 60 metres on the approach and departure of the roundabout. The following modelling is based on the roundabout having two localised traffic lanes along the highway as shown in diagram 9.4A below.

The modelling demonstrates the modified roundabout is reaching capacity at option two, and an increase in traffic growth beyond the 580 additional lots is expected to cause a deterioration in the level of traffic performance, with option three unable to be accommodated.

Diagram 9.4A – Localised dual lanes at the roundabout

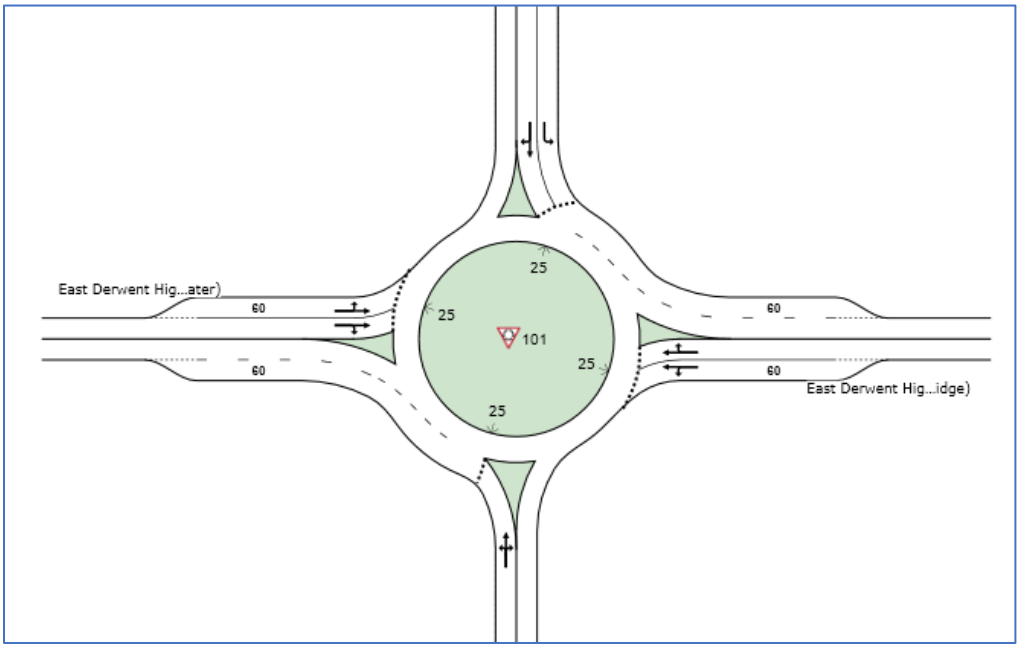


Table 9.4 – Modelling comparison for Clive and Fouche modified roundabout (morning peak)

	Option	Total vehicles	DOS	Max delay	LOS	Max Queue
Morning peak	Tivoli Green	1,689	0.873	42 secs	D	138 metres
	Option one	1,779	0.617	27.6 secs	D	44.3 metres
	Option two	2,026	0.715	65.8 secs	E	59.9 metres
	Option three	2,787	1.078	490 secs	F	1333 metres

Another way to increase traffic capacity, is to replace the roundabout with traffic signals, with a possible layout shown in diagram 9.4B below. The modelling predicts the traffic signals will provide a suitable level of traffic performance for option one and two, while the intensification of traffic from option three would generate significant delays and queues.

Diagram 9.4B – Possible traffic signals replacing the roundabout

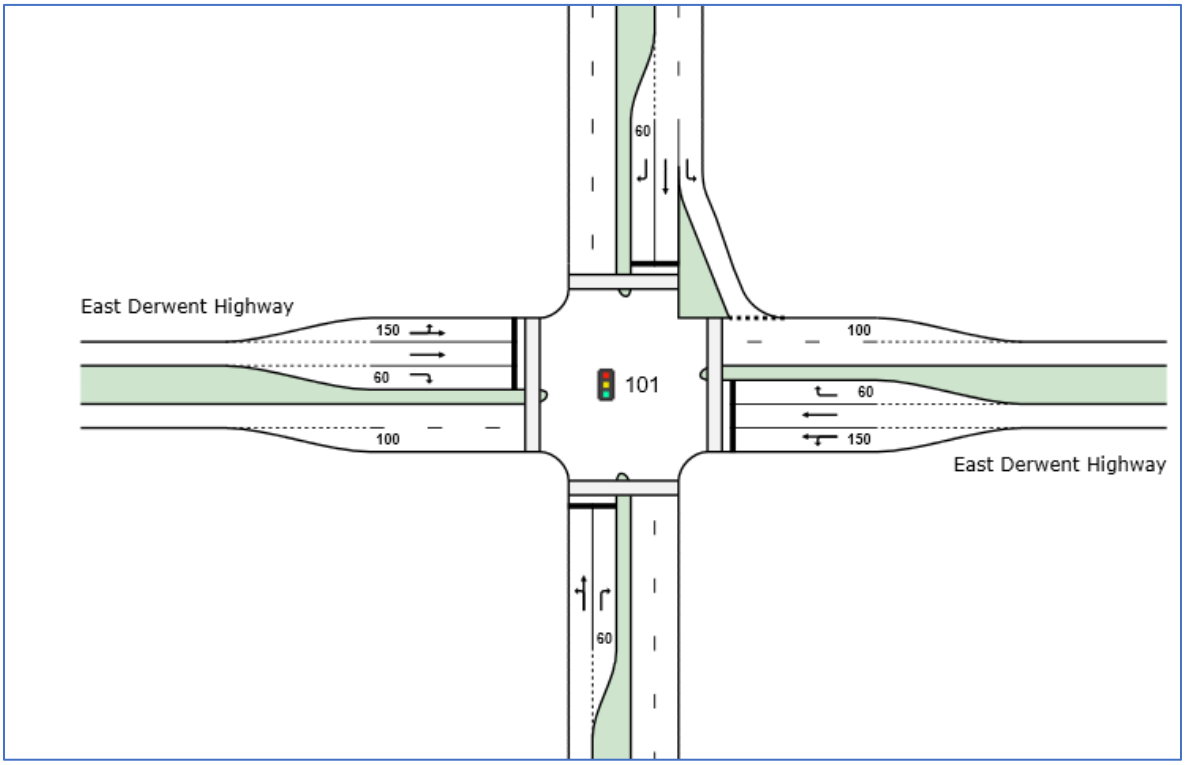


Table 9.4B – Traffic modelling of implementing traffic signals (morning peak)

	Option	Total vehicles	DOS	Max delay	LOS	Max Queue
Morning peak	Tivoli Green	1,689	0.835	31 secs	C	168 metres
	Option one	1,779	0.892	36.1 sec	D	204.6 metres
	Option two	2,026	0.842	32.6 secs	C	248 metres
	Option three	2,787	0.971	66.6 secs	E	752 metres

9.5 Bowen Bridge junction one

Junction one is the left slip lane from the highway onto the Bowen Bridge, on the carriageway leading to Grass Tree Hill Road. The modelling predicts all three options are expected to be accommodated, without causing any adverse traffic impact.

Table 9.5 – Modelling comparison for Bowen Bridge slip lane (morning peak)

Option	Total vehicles	DOS	Max delay	LOS	Max Queue
Tivoli Green	1,224	0.487	7.6 sec	A	25.3 metres
Option one	1,269	0.516	7.8 secs	A	28.8 metres
Option two	1,351	0.572	8.3 secs	A	36.5 metres
Option three	1,619	0.772	11.2 secs	B	83.8 metres

9.6 Bowen Bridge junction two

Junction two is the right turn from Bowen Bridge to the highway, for motorist returning to Old Beach. During the manual traffic surveys for the evening peak, the length of the right turn queue on occasions extended beyond the length of the right turn storage lane, spilling into the inside through lane. The queue was a moving queue, so the impact to through traffic was reasonably low, this indicates the right turn lane has limited spare capacity.

The modelling predicts that the base case (Tivoli Green) traffic loads cannot be accommodated, with the junction causing an adverse impact to Bowen Bridge through traffic, with excessive delays and queues forming, and operating performance at LOS F as detailed in table 7.3B.

Implementing traffic signals to control the right turn lane and the opposing traffic travelling to the Bowen Bridge, can provide a mitigation to achieve an adequate level of performance, but will instigate a delay to motorists traveling from Grass Tree Hill Road to the Bowen Bridge. A possible traffic signal layout is shown in diagram 8.0, which includes dual right turn lanes.

Modelling in table 9.6 indicates that traffic signals are predicted to provide a suitable level of traffic performance of LOS C for all three options.

Table 9.6 – Modelling comparison for Bowen Bridge right turn movement

Period	Option	Total vehicles	DOS	Max delay	LOS	Max Queue
Morning peak	Tivoli Green	2,170	0.675	23.4 secs	C	73.9 metres
	Option one	2,176	0.675	23.4 secs	C	73.9 metres
	Option two	2,213	0.675	23.7 secs	C	73.9 metres
	Option three	2,230	0.675	23.8 sec	C	73.9 metres
Evening peak	Tivoli Green	2,746	0.781	19.1 secs	B	57.5 metres
	Option one	2,784	0.781	20.1 secs	C	57.5 metres
	Option two	2,859	0.849	23.3 secs	C	57.5 metres
	Option three	3,129	0.801	22 secs	C	82 metres

10. Conclusion

Manual traffic survey data has determined that the highway between Compton Road and Grass Hill Road roundabout is busy, but motorists are receiving an appropriate level of service, including at junctions along this highway section.

Residential development within the Old Beach area has created significant commuter traffic peaks in both the morning and evening periods, and the highway is becoming an urban arterial road, and an extension of the greater Hobart urban arterial road network.

Once Tivoli Green development is completed, the increase in traffic along the highway is predicted to cause two sections of the highway to provide a poor level of service. The first section is at the junction of the Bowen Bridge with the highway. In the evening peak as motorists return to Old Beach, the length of the traffic queue is predicted to extend beyond the length of the dedicated right turn lane, and queuing in the through traffic lane is undesirable from a crash risk perspective. Traffic modelling demonstrates that providing traffic signals at this location will alleviate the queueing problem, with the signals having sufficient capacity to cater for future traffic growth.

The second location is at the southern junction of Otago Bay with the highway, the two-way traffic flow in the morning peak is predicted to make it challenging for motorists to turn right out of the junction, and further investigation is required to determine the feasibility of providing a dedicated turning facility, so motorists only need to select a gap in the northbound traffic flow.

For the purpose of this assessment, it is assumed that infrastructure improvements at the above two locations have occurred. On this assumption this assessment predicts the highway has the ability to absorb a moderate increase in traffic, which is achieved under option two, where an additional 580 residential lots could be generated from rezoning.

To achieve this moderate increase, additional infrastructure improvements would be necessary. Firstly, an additional exit lane out of Old Beach Road, and secondly improvements at the roundabout of Clive and Fouche Avenues. The roundabout capacity and performance could be improved, by providing isolated additional traffic lanes on the highway through the roundabout, or alternatively replacing the roundabout with traffic signals.

This assessment concludes that moderate infrastructure improvements should be considered at two locations, to facilitate safe and efficient traffic movements to accommodate the increase in traffic demand, generated by the Tivoli Green development. These improvements should occur over the next few years, to align with the incremental demand from Tivoli Green. On completion of these improvements, the highway is predicted to have sufficient capacity to accommodate further traffic growth, which could be generated from rezoning land in Old Beach to provide an additional 580 lots.

11. Appendix A – Traffic analysis of existing highway conditions

11.1 Compton Downs and East Derwent Highway junction

The morning peak hour occurred between 7:30am and 8:30am, where 644 vehicles were recorded traveling along the highway in a southbound direction towards the Bowen Bridge, with 287 vehicles travelling in the opposite direction. During the evening 589 vehicles were recorded travelling northbound, and 387 travelling southbound.

Compton Road generated a low number of vehicle movements, with 11 vehicles in the morning peak hour and 20 in the evening.

Compton Road intersects the highway at a standard T-Junction, with one traffic lane in each direction along the highway, and a short (50 metres long) dedicated right turn lane into Compton Road.

Table 11.1 – Traffic flows for Compton Road with East Derwent Highway

	Southbound East Derwent Highway	Northbound East Derwent Highway	Right from E/Derwent Hwy into Compton Rd	Left from E/Derwent Hwy into Compton Rd	Left from Compton Rd into E/Derwent Hwy	Right from Compton Rd into E/Derwent Hwy
7:30am to 7:45am	149	74	0	0	0	2
7:45am to 8:00am	180	75	0	0	0	1
8:00am to 8:15am	186	76	1	0	1	3
8:15am to 8:30am	129	62	0	0	1	2
8:30am to 8:45am	93	62	0	3	0	0
8:45am to 9:00am	82	59	0	0	0	1
Peak hour totals	644	287	1	0	2	8
Total Morning Survey	**819**	**408**	**1**	**3**	**2**	**9**
4:00pm to 4:15pm	79	116	0	3	0	1
4:15pm to 4:30pm	88	171	0	1	0	3
4:30pm to 4:45pm	99	155	2	4	0	3
4:45pm to 5:00pm	121	147	0	1	2	0
Total Afternoon Survey	**387**	**589**	**2**	**9**	**2**	**7**

The traffic modelling of the junction indicates the traffic performance for the morning and evening peak hour periods is similar, with highway users receiving a high level of performance with free-flowing conditions and vehicles turning off the highway not impeding the highway traffic flow.

Compton Road motorist must give way to traffic travelling along the highway, with motorists turning right needing to select a gap in both directions of traffic, which can be challenging in peak periods. In both peak periods the level of service is currently operating at level of service LOS C, with acceptable average delays of less than 17 seconds, and no notable traffic queues due to the low number of vehicles leaving the area.

Table 11.1A – Intersection and highway performance

Period	Intersection			Level of service for highway users				
	Total vehicles	DOS	SB	NB	Left off Hwy		Right off Hwy	
					Delay	LOS	Delay	LOS
Morning	943	0.294	A	A	5.6 secs	A	6.9 secs	A
Evening	996	0.327	A	A	5.6 sec	A	8.9 secs	A

Table 11.1B – Compton Road traffic performance

Period	Left out		Right Out		Maximum queue length
	Ave delay	LOS	Ave delay	LOS	
Morning	6.5 secs	A	15.5 secs	C	0.6 metres
Evening	8.1 secs	A	16.8 secs	C	0.6 metres

11.2 Old Beach Road and East Derwent Highway junction

At the junction of Old Beach Road and the highway there is one traffic lane in each direction, with a dedicated right turn lane (55 metres long) into Old Beach Road.

The traffic flows at the junction are detailed in the table below, with Old Beach Road generating 171 vehicle movements in the morning peak hour, and 146 vehicle movements in the evening peak. During the morning peak 96 percent of the vehicles leaving Old Beach Road turned left toward the Bowen Bridge. While in the evening 91 percent of vehicles entering Old Beach Road turned right from Bowen Bridge.

Table 11.2A – Traffic flows for Old Beach Road with East Derwent Highway

Time	Northbound on East Derwent Hwy	Soutbound on East Derwent Hwy	East Derwent Hwy Left into Old Beach Rd	East Derwent Hwy Right into Old Beach Rd	Left from Old Beach Rd into East Derwent Hwy	Right from Old Beach Rd into East Derwent Hwy
7:30am to 7:45am	133	73	0	5	27	1
7:45am to 8:00am	181	76	1	9	40	3
8:00am to 8:15am	195	76	1	7	43	1
8:15am to 8:30am	134	67	0	5	28	0
8:30am to 8:45am	91	69	2	10	15	0
8:45am to 9:00am	78	54	1	9	8	1
Peak hour	643	292	2	26	138	5
Total Morning Survey	**812**	**415**	**5**	**45**	**161**	**6**
4:00pm to 4:15pm	130	77	14	5	8	0
4:15pm to 4:30pm	179	92	27	1	6	1
4:30pm to 4:45pm	151	102	17	1	9	0
4:45pm to 5:00pm	147	111	27	4	12	0
5:00pm to 5:15pm	129	71	21	3	12	5
5:15pm to 5:30pm	132	99	37	2	13	1
Peakhour	606	376	92	9	39	6
Total Afternoon Survey	**868**	**552**	**143**	**16**	**60**	**7**

The traffic modelling of the junction indicates the traffic performance for the morning and evening peak hour periods is similar, highway users received a high level of performance with free-flowing conditions, with traffic turning off the highway not impeding the highway traffic flow.

Old Beach Road motorist must give way to traffic travelling along the highway, with the dominant movement in the morning being a left turn, where motorists turning left received a high level of service at LOS A, and five motorists turning right out receiving an acceptable level of service at LOS C, with the average delay for the right turner being 18.4 seconds.

During the evening peak there was a significant right turn movement into Old Beach Road, the right turning vehicles received a high level of service LOS A, as the southbound highway traffic flow was reasonably low providing suitable turning gaps. The maximum queue length of the right turning vehicles is predicted to be 8.1 metres, which creates no adverse impact as the right turn lane is 55 metres long.

Once again, vehicles turning right out of Old Beach Road incur a slight delay of 19 seconds, due to the need to pick a gap in both traffic flows along the highway.

Although Old Beach Road generated a moderate number of vehicle movements, there were no traffic capacity issues, and all motorists received an acceptable level of traffic performance.

Table 11.2B – Intersection and highway performance

Period	Intersection			Level of service for highway users				
	Total vehicles	DOS	SB	NB	Left off Hwy		Right off Hwy	
					Delay	LOS	Delay	LOS
Morning	1,106	0.352	A	A	5.6 secs	A	9.2 secs	A
Evening	1,128	0.338	A	A	6.9 secs	A	7.7 secs	A

Table 11.2C – Old Beach Road traffic performance

Period	Left out		Right Out		Maximum queue length
	Ave delay	LOS	Ave delay	LOS	
Morning	9 secs	A	18.4 secs	C	5.1 metres
Evening	6.9 secs	A	19.6 secs	C	1.5 metres

11.3 East Derwent Highway roundabout with Fouche and Clives Avenues

Either side of the highway there are substantial residential developments, extending from both Fouche and Clives Avenues, with a roundabout provided to manage traffic flows, which interrupts the free-flowing highway conditions.

The roundabout has one traffic lane on each approach, and an inner core traffic island diameter of 25 metres, with side roads intersecting at approximately ninety degrees, which provides a reasonably efficient roundabout.

The roundabout is located south of both Compton and Old Beach Road, in between these nodes there is two side roads that service the Old Beach water side residential catchment.

Table 11.3A – Traffic flows for roundabout at Clives and Fouche Avenues

Time	Southbound on East Derwent Hwy	Northbound on East Derwent Hwy	East Derwent Hwy Right into Clives Ave	East Derwent Hwy Left into Clives Ave	East Derwent Hwy Right into Fouche Ave	East Derwent Hwy Left into Fouche Ave	Clives Ave Right into East Derwent Hwy	Clives Ave Left into East Derwent Hwy	Clives Ave straight into Fouche Ave	Fouche Ave Right into East Derwent Hwy	Fouche Ave Left into East Derwent Hwy	Fouche Ave straight into Clives Ave
7:30am to 7:45am	144	42	1	2	1	3	9	33	0	37	2	2
7:45am to 8:00am	210	49	2	3	0	6	5	32	1	51	1	0
8:00am to 8:15am	279	60	4	2	1	0	2	51	1	60	4	0
8:15am to 8:30am	176	50	5	2	0	1	3	22	2	39	3	0
8:30am to 8:45am	109	60	3	1	7	5	3	17	1	17	6	0
8:45am to 9:00am	82	50	11	2	1	9	3	10	1	13	2	1
peak hour	809	201	12	9	2	10	19	138	4	187	10	2
Total Morning Survey	**1000**	**311**	**26**	**12**	**10**	**24**	**25**	**165**	**6**	**217**	**18**	**3**
4:00pm to 4:15pm	77	186	17	3	2	21	6	9	0	2	2	1
4:15pm to 4:30pm	73	202	21	5	5	19	7	8	3	6	3	2
4:30pm to 4:45pm	88	160	17	10	8	17	6	8	0	3	4	0
4:45pm to 5:00pm	86	172	18	6	10	27	6	10	1	11	4	3
5:00pm to 5:15pm	72	140	23	3	8	26	6	0	1	9	5	2
5:15pm to 5:30pm	80	180	31	15	12	30	4	9	2	9	2	1
Peak hour	326	652	89	34	38	100	22	27	4	32	15	6
Total Afternoon Survey	**476**	**1040**	**127**	**42**	**45**	**140**	**35**	**44**	**7**	**40**	**20**	**9**

Traffic modelling indicates that during the morning, the roundabout caters for 1,403 vehicle movements, operating at a Degree of Saturation of 0.67. Overall, motorists are receiving an acceptable level of traffic performance ranging between LOS A and B.

With highway motorists requiring to give way to side traffic, they incur a slight traffic delay, with the average delay being 6.8 seconds for southbound through motorists travelling towards the Bowen Bridge. Because of the traffic demand, the maximum queue length for this southbound approach is estimated at 51 metres or 6.8 vehicles.

The roundabout is achieving its desirable outcome of sharing delays to all approaches, and there is sufficient traffic flow on all legs to provide efficient roundabout outcomes.

In the evening peak hour, the roundabout is also providing all motorists will an acceptable level of traffic performance ranging between LOS A and B. The roundabout is operating with no significant delays or excessive traffic queues.

Table 11.3B – Summary of roundabout traffic modelling

Period	Total vehicles	DOS	Average delay	LOS	Maximum queue length
Morning	1403	0.675	6.9 secs	A	51.5 metres
Evening	1345	0.571	5.3 secs	A	39 metres

11.4 East Derwent Highway and Bowen Bridge interchange

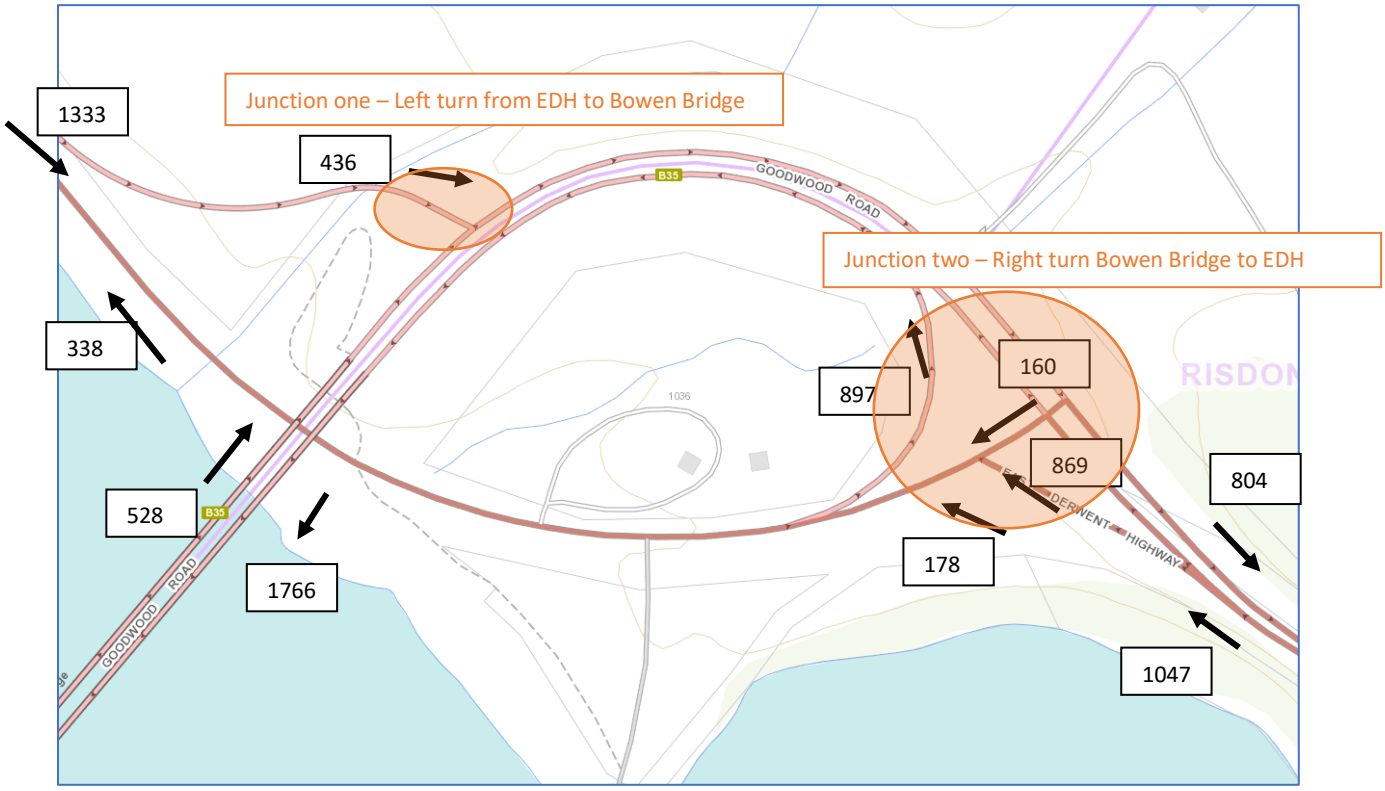
The interchange is quite large, with two separate junctions to be analysed, the left turn from the highway onto Bowen Bridge (junction one), and the right turn from Bowen Bridge to the highway (junction two).

Southbound traffic on the highway proceeding across the river, are provided with a high-level traffic arrangement, where vehicles loop underneath the bridge, and then onto the Bowen Bridge through an added lane, with no need to give way to any other traffic flow.

Southbound traffic proceeding to Geilston Bay, need to exit left from the highway, then turn left onto the Bowen Bridge through a give way junction.

Vehicles travelling from the Bowen Bridge to the highway towards Old Beach, are required to undertake a right turn and give way to traffic travelling onto the Bowen Bridge.

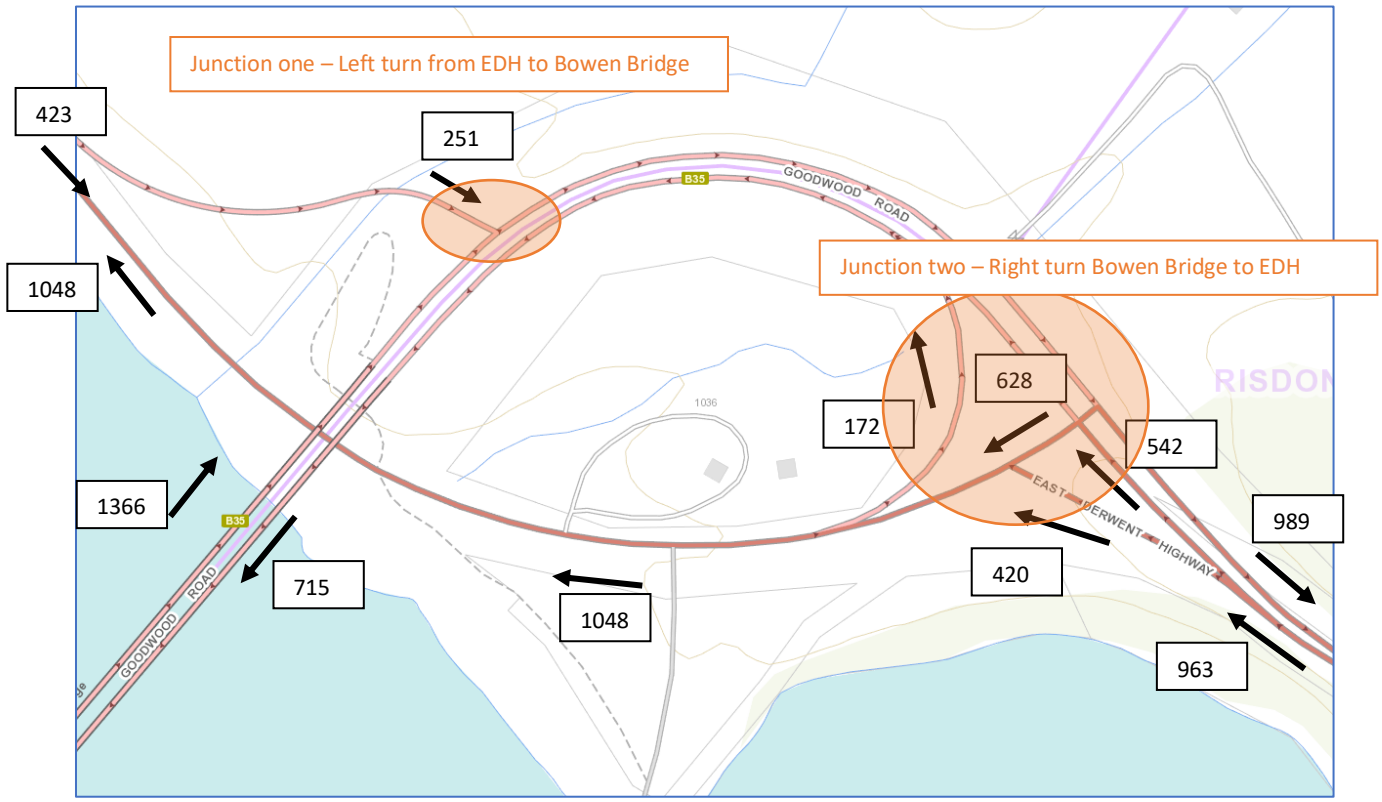
Diagram 11.4A - Morning peak hour flows at East Derwent Highway and Bowen Bridge interchange



In the morning peak, 68 percent of the southbound highway traffic proceeds across the Bowen Bridge, while the other 32 percent travels towards Geilston Bay. In the opposite direction (northbound), there is 338 vehicles heading towards Old Beach.

At this interchange, there is a significant traffic flow of 869 vehicles travelling onto the Bowen Bridge from Geilston Bay, with the two westbound lanes on the Bowen Bridge carrying 1,766 vehicles towards the Brooker Highway.

Diagram 11.4B - Evening peak hour flows at East Derwent Highway and Bowen Bridge interchange



In the evening peak, vehicles travelling to Old Beach from the Bowen Bridge, must undertake a right turn on the highway and loop underneath the bridge. A moderate number of vehicles undertook this turn and were delayed by Geilston Bay traffic proceeding onto the Bowen Bridge, causing queues. The right turn lane for this manoeuvre is 100 metres long and occurs on a sweeping curve, with site observations finding that the queue occasionally extends beyond the length of the right turn lane, spilling into the through traffic lane.

Traffic performance at junction one

Traffic modelling of junction one, indicates that all motorists receive the highest level of performance at LOS A, for both the morning and evening peak. Although the interchange is busy, there is sufficient gaps to facilitate efficient traffic flow, mainly due to two traffic lanes operating on the Bowen Bridge.

Table 11.4A – Traffic modelling for junction one

Period	Intersection			Left turn onto Bowen Bridge				
	Vehicles	DOS	LOS	Vehicles	DOS	Ave delay	LOS	Max queue
Morning	1,103	0.155	A	499	0.401	7 secs	A	16.3m
Evening	1,617	0.350	A	251	0.321	9.6 secs	A	10.3m

Traffic performance at junction two

At the second junction, there are two give way controls, the right turn from the Bowen Bridge onto the highway (from Brooker Highway to Old Beach), and the left turn from the highway (from Geilston Bay to Old Beach). The other movements are free flowing, and because they are unimpeded, they operate at LOS A.

The traffic modelling analysed the two give way controls, and during the morning and evening peaks the right turn movement operates at an appropriate level of service of LOS C. During the morning peak the average delay is 15.5 seconds, with the maximum queue being 11.2 metres.

During the evening peak the delay extends to 17.8 seconds, with a maximum queue length of 77.8 metres, this right turn is operating at a high degree of saturation at 0.825, which indicates limited spare capacity.

Overall, the interchange is busy, but motorists are receiving an appropriate level of performance

Table 11.4B – Traffic modelling for junction two

Period	Right turn from Bowen Bridge to EDH					Left turn from EDH to EDH				
	Veh	DOS	Delay	LOS	Queue	Veh	DOS	Delay	LOS	Queue
Morning	160	0.327	15.5sec	C	11.2m	178	0.128	6.2sec	A	4.0m
Evening	628	0.825	17.8sec	C	77.4m	420	0.519	11.2sec	B	24.2m

11.5 Distribution of trips arriving or leaving the residential catchments

Each developed property generates traffic movements, and the RTA Guide specifies on average each rural dwelling could generate 0.7 trips in the peak hour periods. In the morning period the collected traffic survey data indicates, 88 percent of these trips are leaving the property, with 12 percent arriving.

In the evening peak the collected survey data indicates 71 percent of the trips are arriving to the properties, with 29 percent of the trips leaving.

Table 11.5 – Trip distribution of side roads (in or out)

Road	Morning peak hour			Evening peak hour		
	In	Out	Total	In	Out	Total
Compton Rd	2	10	12	11	9	20
Old Beach Rd	28	143	171	101	45	146
Fouche Ave	16	199	215	129	53	182
Clives Ave	23	161	184	142	53	195
Total	**69**	**513**	**582**	**383**	**160**	**543**
Percentage	**12%**	**88%**		**71%**	**29%**	

11.6 Trip distribution – generating southbound or northbound vehicle movements

From the survey data it was established that during the morning peak period, 93 percent of all vehicles leaving the side roads travelled in a southerly direction towards the Bowen Bridge.

While in the evening peak period, 76 percent of vehicles arrived from the Bowen Bridge direction.

Table 11.6 – Trip distribution of side streets (southbound or northbound)

Road	Morning peak			Evening peak		
	Bridgewater	Bowen Bridge	Total	Bridgewater	Bowen Bridge	Total
Compton Rd	2	8	10	2	9	11
Old Beach Rd	5	138	143	9	92	101
Fouche Ave	10	187	197	38	100	142
Clives Ave	19	138	157	34	89	129
Total	**36**	**471**	**507**	**83**	**290**	**383**
Percentage	**7%**	**93%**		**24%**	**76%**	