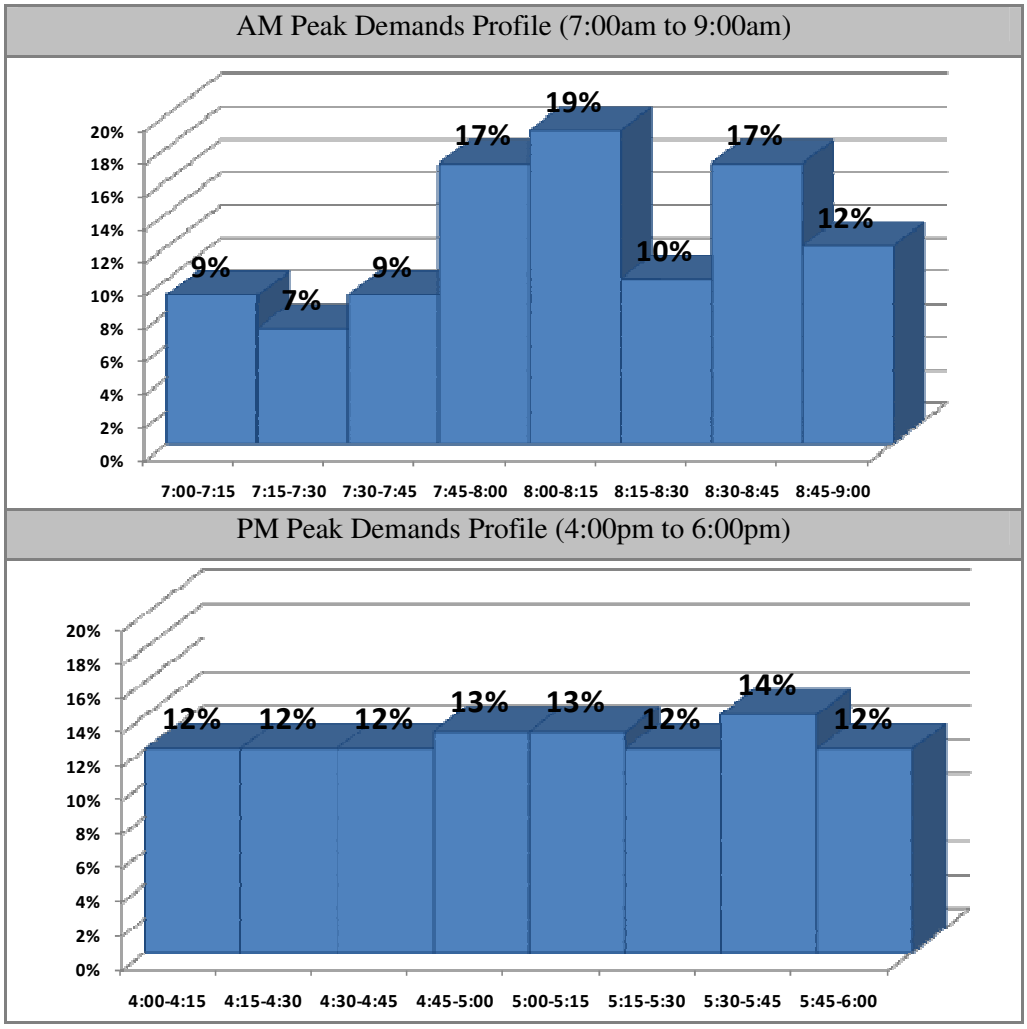


Figure 3.8: Peak hour Profile for Ocean Drive

The AM peak demand profile shows a clear increase in traffic between 7:45am and 8:15am. This can be attributed to tidal flow traffic from Bonny Hills and Laurieton to Port Macquarie. The AM peak is expected to have concentrations over the 2 hour period as worker start times (and subsequent travel patterns) generally coincide. In addition, school traffic also coincides with commuter traffic during the AM peak period.

Alternatively, the PM peak is relatively consistent across the two hour period as worker end times vary during the afternoon and school traffic is not included.

3.2.3 Site Observations

During the AM and PM peak period the following observations were made for the road network and traffic patterns within the study area:

- there is a distinct northbound tidal flow along Ocean Drive in the AM peak and subsequent southbound flow in the PM peak;

- the AM demand profile shows sharp increases between 7:45am - 8:15am as well as 8:30am - 8:45am;
- the PM demand profile is relatively consistent across the 2 hour peak period;
- Houston Mitchell Drive also exhibits a tidal flow (AM westbound and PM eastbound) as vehicles access the Pacific Highway;
- during the PM peak period, turning vehicles from Houston Mitchell Drive to Ocean Drive southbound conflict with southbound traffic (both through and right turns) on Ocean Drive;
- Vehicles were witnessed performing a u-turn at Abel Tasman / Ocean Dr intersection as to access the Medical Centre;
- bus stops along Ocean Drive have issues regarding acceleration and deceleration storage areas as well as pedestrian access particularly near the residential area at Abel Tasman Drive; and
- the 100kph speed limit on Ocean Drive through the Bonny View Drive intersection was perceived to be a safety issue and is exacerbated by the presence of school children boarding and alighting school buses.

4.0 Future Model Development

4.1 Future Growth

Models were developed for future year scenarios of +10years (2019) and +20years (2029). Future growth percentages were developed using The Hastings Road Traffic Study Annual Average Daily Traffic (AADT) produced by SMEC.

The Hastings Road and Traffic Study was undertaken to provide Council with a framework to manage its expanding road infrastructure assets. Projected traffic data for major roads was developed using information such as current jobs data from the Hasting Business Enterprise Centre (BEC), Hasting Urban Growth Strategy (HUGS 2001), population projections and historical traffic count data. Table 4.1 shows the historical and projected AADT volumes for Ocean Drive in proximity to the Area 14 study area.

Table 4.1: Estimated Future Volumes and Growth for Ocean Drive

Location	SMEC AADT's			2001 to 2011 growth (%).p.a	2001 to 2021 growth (%).p.a	2011 to 2021 growth (%).p.a
	2001	2011	2021			
Ocean Dr, north of Lake Cathie	4100	5800	7300	3.5%	2.9%	2.3%
Ocean Dr, south of Bonny Hills	4700	8400	10800	6.0%	4.2%	2.5%

Short term traffic growth (2009 to 2011) is expected to be consistent with recent historical traffic growth (approximately 5%p.a compounding). Interim growth (2011 to 2021) is expected to reduce slightly compared to short term growth as areas become more congested. In the long term, traffic growth is expected to ease or even plateau. This is not expected to occur within at least the next 20 years for areas such as Lake Cathie and Bonny Hills due to the availably of land zoned for development, as well as the envisaged continuation of people being attracted to coastal living along Australia's east coast. Based on historical and future projected volumes along Ocean Drive the following compounding growth rates were applied to calculate future background traffic:

- 2009 to 2011 - 4.8% p.a.;
- 2009 to 2019 – 3.6% p.a.; and
- 2009 to 2029 – 2.4% p.a.

4.2 Proposed Development

4.2.1 Development Details

The study area is likely to include development is proposed to include;

- 780 – 900 residential lots;
- Primary school and High school;
- Playing fields;
- Open space;
- Commercial Precinct providing a retail and business centre;
- Ecotourism site as part of the proposed Hilltop Village; and
- Light Industrial Precinct adjacent to Houston Mitchell Drive.

Figure 4.1 demonstrates the location of land uses within the proposed development.

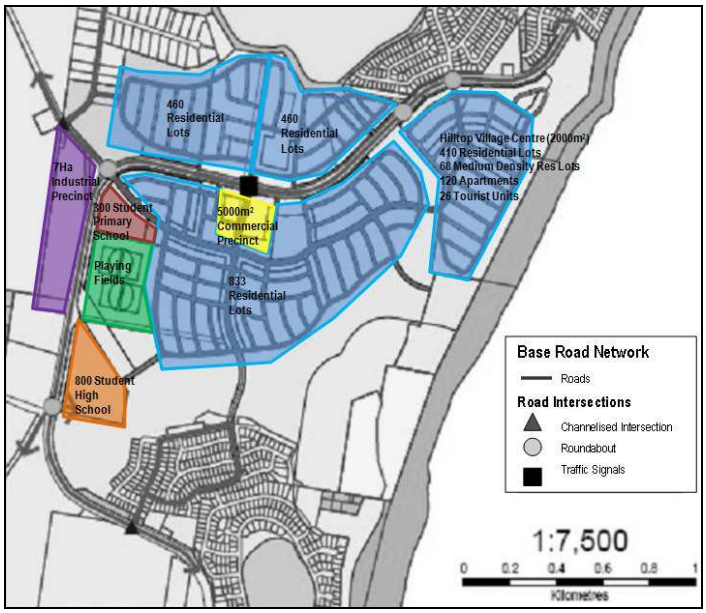


Figure 4.1: Scenario 1 Proposed Development

In addition to the proposed development, an additional residential component has been proposed with a new north-south link road from Forest Parkway to Kenwood Drive (see Figure 4.2). This influence this additional residential development and new link road has on the road network has been assessed as 'Scenario 2' for both 2019 and 2029.

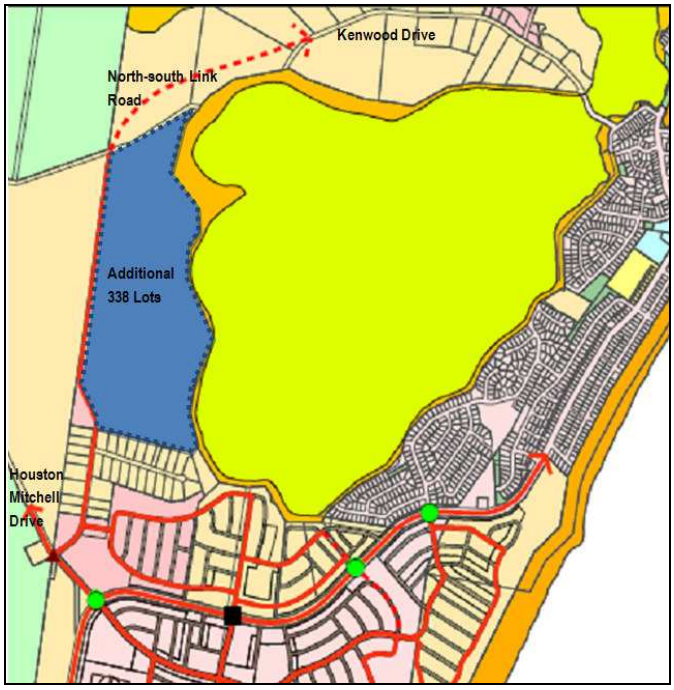


Figure 4.2: Scenario 2 Development

In addition, an assessment was also undertaken on a possible link road between the existing residential area to the south and the proposed residential/commercial area east of Ocean Drive as shown in Figure 4.3.

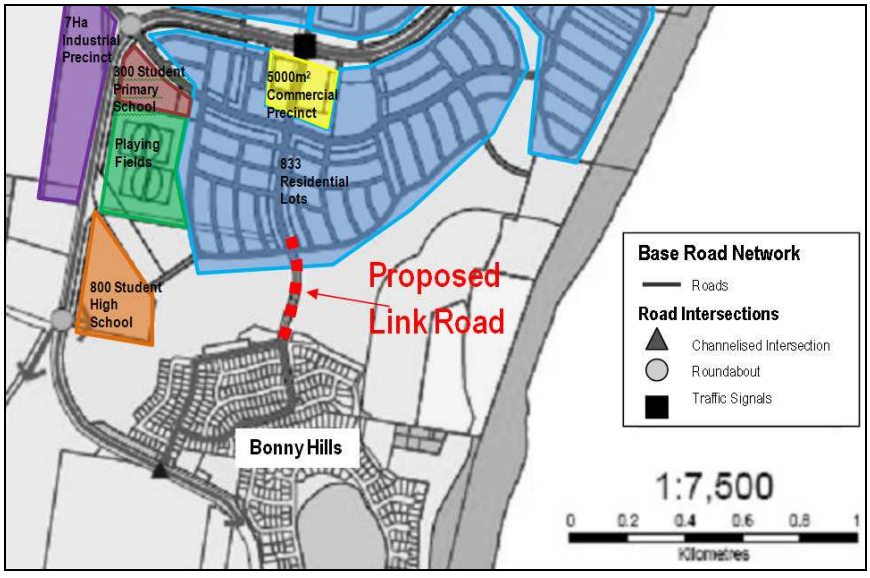


Figure 4.3: Proposed Link Road

4.2.2 Development Traffic Generation

The distribution of traffic to/from development areas was based on relative size (attractiveness) of the other zones in the network as well as considering current travel patterns within the study area.

Route choice within the network is undertaken within Paramics by calculating the perceived quickest time between the origin zone and destination zone through network. Many of the routes through the Area 14 network from zone to zone have only a single path, however some zone to zone movements have various alternate route paths for which the simulation model calculates the optimum path.

4.2.3 Development Staging for Future Years

As the proposed development is not expected to be fully occupied and 'completely developed' at year of opening, staging assumptions needed to be made for the interim year of 2019. These are:

- 2 Primary school sites
- Commercial areas fully developed including the Hilltop Village;
- All Residential areas 50% developed; and
- Industrial areas fully developed.

Scenario 2
2019 will see the inclusion of 50% of the additional residential component located north of Forest Parkway and assess the perceived impact of the connection to Kenwood Drive.

5.0 2019 Base Model

Prior to assessing the requirements of the development in future years it is important to determine the base performance due to background traffic only. By applying growth factors to the 2009 counts Figure 5.1 shows the base traffic volumes for 2019 for major intersections along Ocean Drive within the study area.

Figure 5.1: 2019 2 Hour Peak Intersection Turn Volumes

5.1 2019 Base Model Performance

While traffic increases at intersections within the study area in 2019, the existing pattern of predominately through traffic along Ocean Drive is expected to continue.

However, it is expected that by 2019 the increase in traffic travelling on Ocean Drive and vehicles turning onto/off Ocean Dive is expected to exacerbate the existing safety concerns, due primarily to the existing posted speeds.

During the AM peak, the key issue within the network is that the Houston Mitchell Dr / Ocean Drive intersection suffers from conflicting movements; namely the right turn from Houston Mitchell Drive southbound conflicts with the opposing right turn from Ocean Drive. This results in queues along Houston Mitchell Drive to extend to a maximum of nine vehicles. However, maximum queues only occur during the AM peak period between 8:00am and 8:15am. Figure 5.2 demonstrates maximum queues at Houston Mitchell Drive / Ocean Drive intersection during the 2019 AM peak.

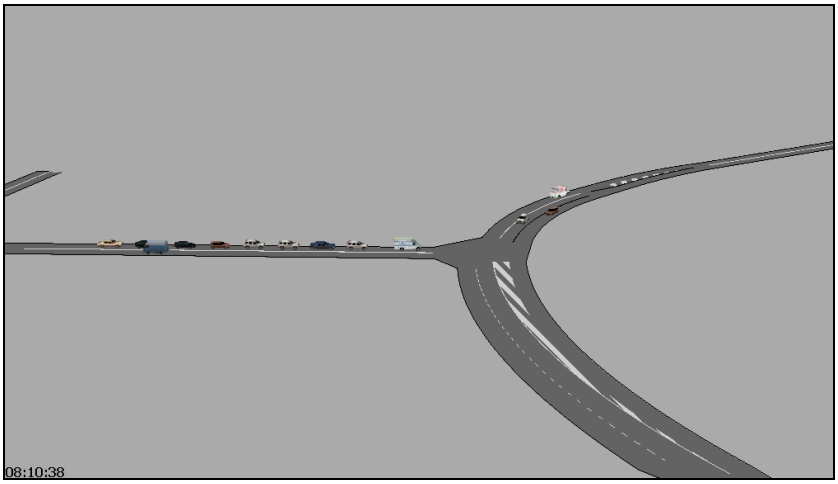


Figure 5.2: 2019 AM Peak Queues – Houston Mitchell Drive / Ocean Drive Intersection

During the PM peak, the southbound flow on Ocean Drive restricts the right turning vehicles from Houston Mitchell Drive. This subsequently restricts the left turns from Houston Mitchell Drive as a result of the single lane approach as shown in Figure 5.3.

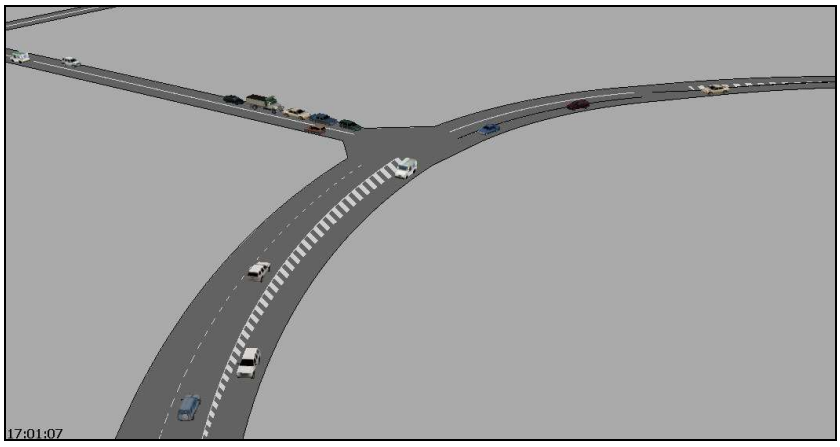


Figure 5.3: 2019 PM Peak Queues – Houston Mitchell Drive / Ocean Drive Intersection

Table 5.1 provides the LOS for 2019 Base Model case.

Intersection	2019 AM	2019 PM
Abel Tasman Dr / Ocean Dr	A	A
Houston Mitchell Dr / Ocean Drive	B	A
Bonny View Dr / Ocean Dr	A	A

Link	2019 AM	2019 PM
Ocean Dr (North of Abel Tasman Dr)	A	A
Ocean Dr (Abel Tasman Dr / Houston Mitchell Dr)	A	A
Ocean Dr (Houston Mitchell Dr / Bonny View Dr)	A	A
Ocean Dr (South of Bonny View Dr)	A	A
Houston Mitchell Dr	A	A

6.0 2019 Partial Development

6.1 Scenario 1 Proposed Development

6.1.1 Preliminary Network

Development in the area by 2019 is expected to generate the need for the addition of two new intersections along Ocean Drive between Houston Mitchell Drive and Abel Tasman Drive.

The new developments and subsequent intersections along Ocean Drive introduce a more local function for this section of Ocean Drive which was originally used for through traffic only. Previously Ocean Drive was a primary north-south connection between south town centres of Bonny Hills and Laurieton to Port Macquarie. With the proposed development, Ocean Drive includes more access points for traffic as well as intersections which now change the function of Ocean Drive from an arterial road to a collector/distributor road. Figure 6.1 demonstrates the initial road network and intersection configuration for 2019 partial development.

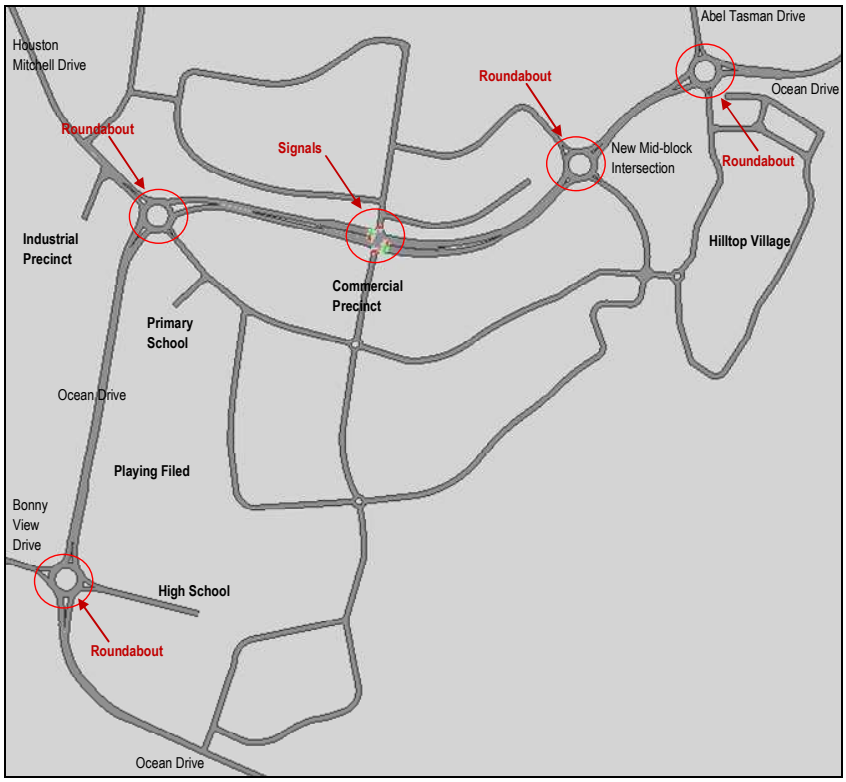


Figure 6.1: Initial Road Network for the 2019 partial development

For the initial study area network, a series of standard intersections were used as a base, with refinements then made at each intersection based on the observed traffic performance two lane roundabouts were required at all Ocean Drive intersections primarily to retain the through traffic level of service (LOS) along Ocean Drive.

In order to maintain travel times and through capacities along Ocean Drive, 80kp/h speeds were retained between Bonny View Drive and Abel Tasman Drive, although speed reductions were required through intersections.

Failure of the intersections in the preliminary network occurred during the AM peak period as a result of the concentrated peak. The following section discusses the specific failure mechanisms and subsequent required improvements for the partial development scenario in 2019.

6.1.2 Ocean Drive

Based on the existing 2019 base road network, Ocean Drive was initially modelled as a single lane in each direction and opening to 2 lane approaches and exits at the intersections. With the addition development traffic, considerable queues developed along Ocean Drive northbound in the AM peak from Houston Mitchell Drive, through the 2 new intersections and north to Abel Tasman Drive. This occurs due to the additional turn movements at each of the intersections along Ocean Drive as a result, reducing the though capacity for the northbound movement. Figure 6.2 demonstrates the queues along Ocean Drive with a single lane northbound, and also demonstrates the need for providing two lanes northbound.

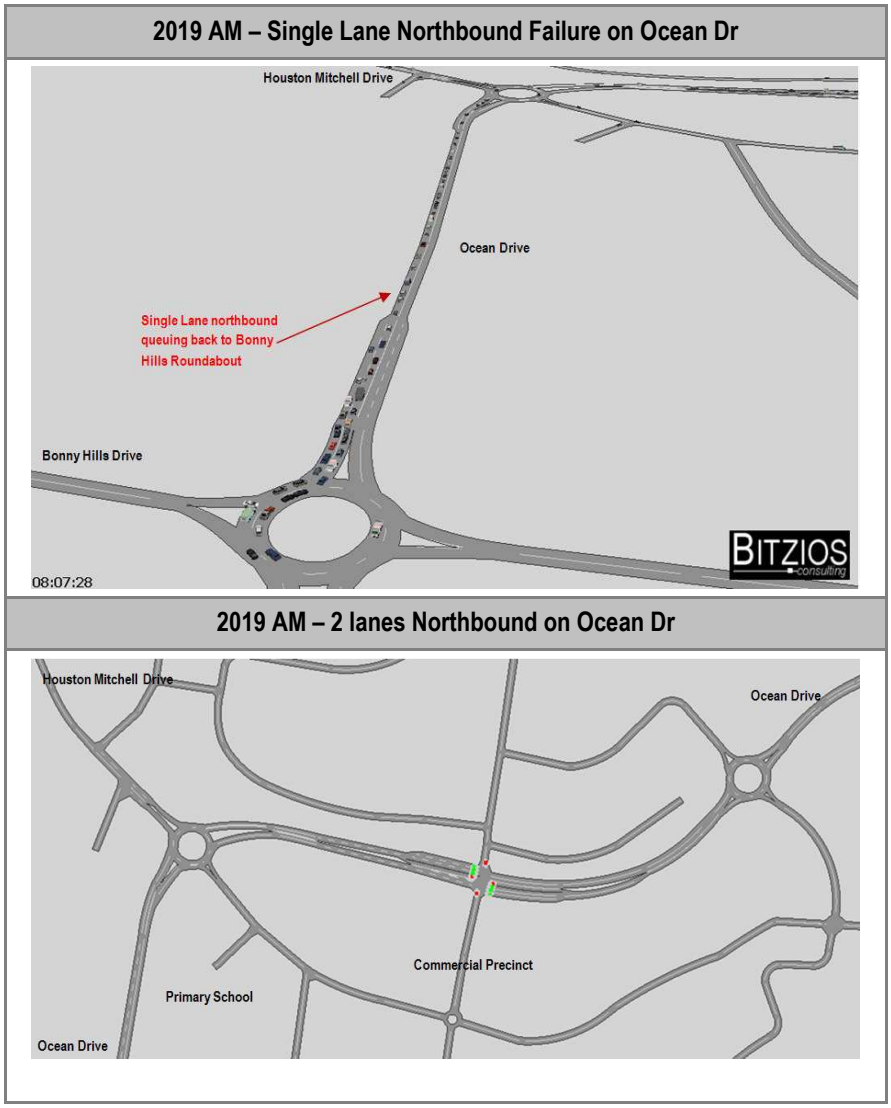


Figure 6.2: Single Lane Failure and Required Improvement

For Ocean Drive southbound, a single lane is still sufficient between intersections for 2019, except between the commercial precinct signalised intersection and Houston Mitchell Drive. This is due to the benefits of platooning of vehicles southbound from the signalised intersection.

6.1.3 Bonny View Drive / Ocean Drive Intersection

The two lane roundabout intersection at Bonny View Drive is observed to be within capacity in 2019 as shown in Figure 6.3. There is an increase in turn volumes as a result of the high school access, however this does not cause excessive delays or queuing for the through movement in either the AM or PM peak period.

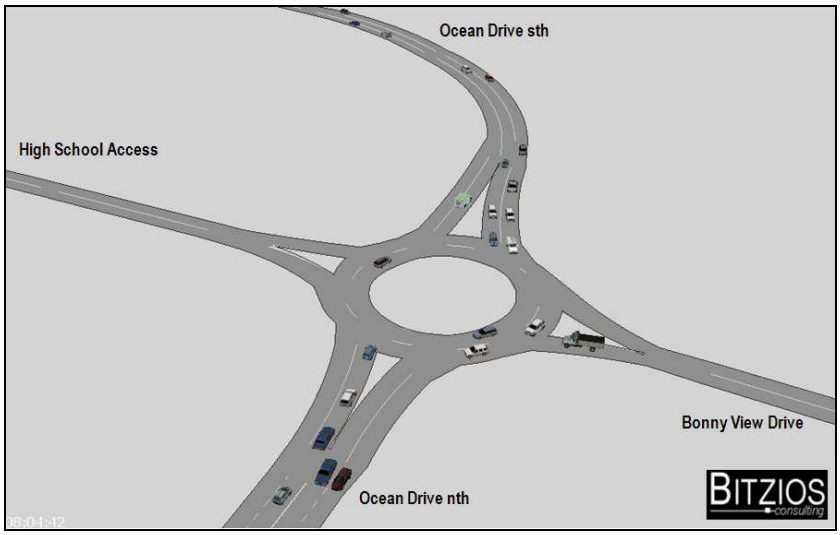


Figure 6.3: 2019 AM Bonny View Drive / Ocean Drive Intersection Performance

6.1.4 Houston Mitchell Drive / Ocean Drive Intersection

The proposed development includes an additional (fourth) approach to Houston Mitchell Drive intersection which results in additional movements to be added to at this intersection. The two lane roundabout was initially proposed for Houston Mitchell Drive / Ocean Drive intersection, however this intersection experiences long queues northbound during the AM peak period as shown in Figure 6.4.

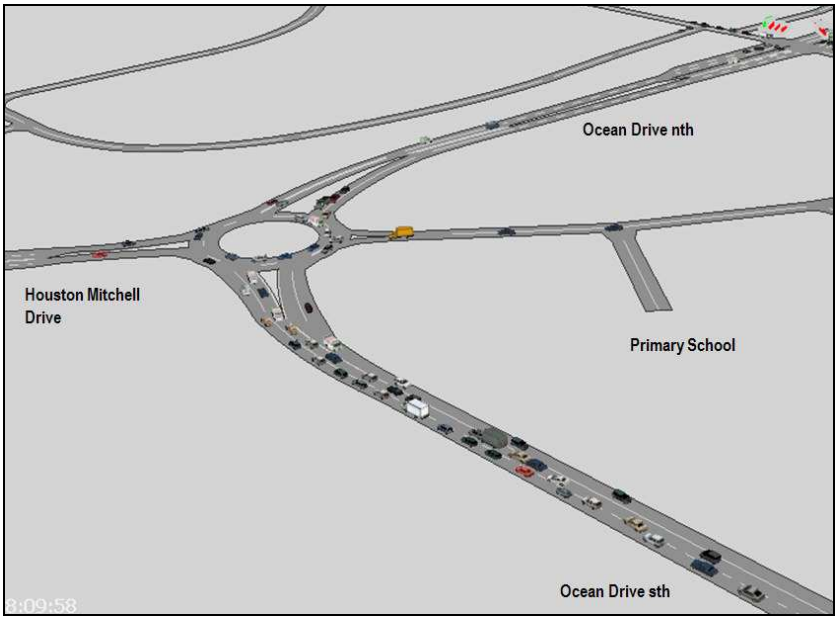


Figure 6.4: Northbound queues at Houston Mitchell Drive Roundabout

During the AM peak, right turning vehicles from Ocean Drive southbound to Houston Mitchell Drive westbound conflict with the northbound through movement along Ocean Drive. The queues northbound along Ocean Drive however only reach considerable lengths and cause long delays during the concentrated peak periods between 7:45 and 8:15. It is not expected that the two lane roundabout will provide sufficient capacity for future traffic volumes to 2029 and beyond.

The new intersection north of Houston Mitchell Drive accessing the commercial precinct is required to be signalised. The interaction between these intersections causes vehicles approaching Houston Mitchell Drive to be 'platooned' into the roundabout intersection. This causes circulating traffic on the roundabout to reduce headways between vehicles and 'bunch', which reduces the allowable acceptance gaps for vehicles entering the roundabout.

Another major concern at Houston Mitchell Drive is the provision for pedestrians, as this intersection is in close proximity to the proposed primary school. With the additional residential developments on both sides of Ocean Drive, it is expected that school children as well as other residents would need a sufficient pedestrian and cycle crossing across Ocean Drive in the vicinity of Houston Mitchell Drive.

The initially proposed roundabout intersection configuration is not expected to provide a sufficiently safe crossing facility for pedestrians. If a marked crossing or 'manned stop' crossing was provided, this would be expected to greatly reduce the through capacity of Ocean Drive.

Based on the initial roundabout configuration performance and need to provide for pedestrians, it is proposed to provide a signalised intersection at the Houston Mitchell Drive / Ocean Drive intersection as shown in Figure 6.5.

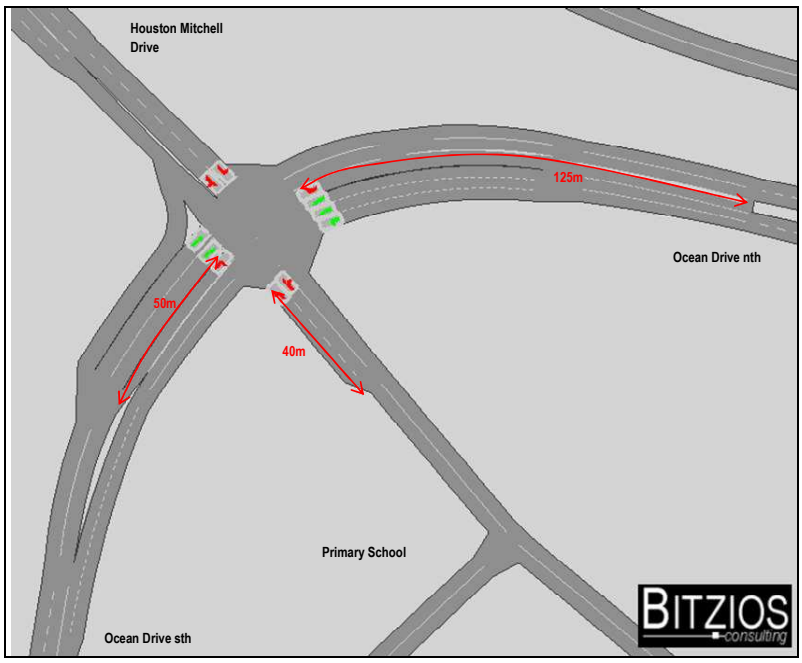


Figure 6.5: Signalised Intersection Configuration Houston Mitchell Drive / Ocean Drive

The signalised intersection requires two lane approaches from Ocean Drive with dedicated turning lanes. The southern approach includes a left turn give-way as this movement is high in the morning peak and runs in conjunction with the northbound through movement.

The southbound right turn is required to be 125 metres long as to provide sufficient storage for turning vehicles.

Houston Mitchell Drive requires two lanes approaching the intersection with the kerbside lane for left turns only and median lane for right and through movements. As the industrial precinct is located off Houston Mitchell Drive and in close proximity to Ocean Drive intersection, it is recommended that a 'keep clear' area be line marked at the give-way intersection to the industrial precinct.

A major benefit to the intersection is the signal coordination potential with the adjacent signalised intersection to the north. As a result, cycle times can be off-set to enable platooning of traffic to arrive at the next intersection with minimal delay. The provision of pedestrian crossings at the intersection will also reduce the allowable green time and subsequent capacity at the intersection. In order to reduce this impact, pedestrian crossings are recommended to be provided across all approaches except the northern approach. In addition, the pedestrian crossing across the southern approach of Ocean Drive is recommended to be staggered due to the number of lanes required to cross. This will also require sufficient pedestrian storage spaces within the median Figure 6.6 demonstrates the propose signal phase times for Houston Mitchell Drive / Ocean Drive intersection.

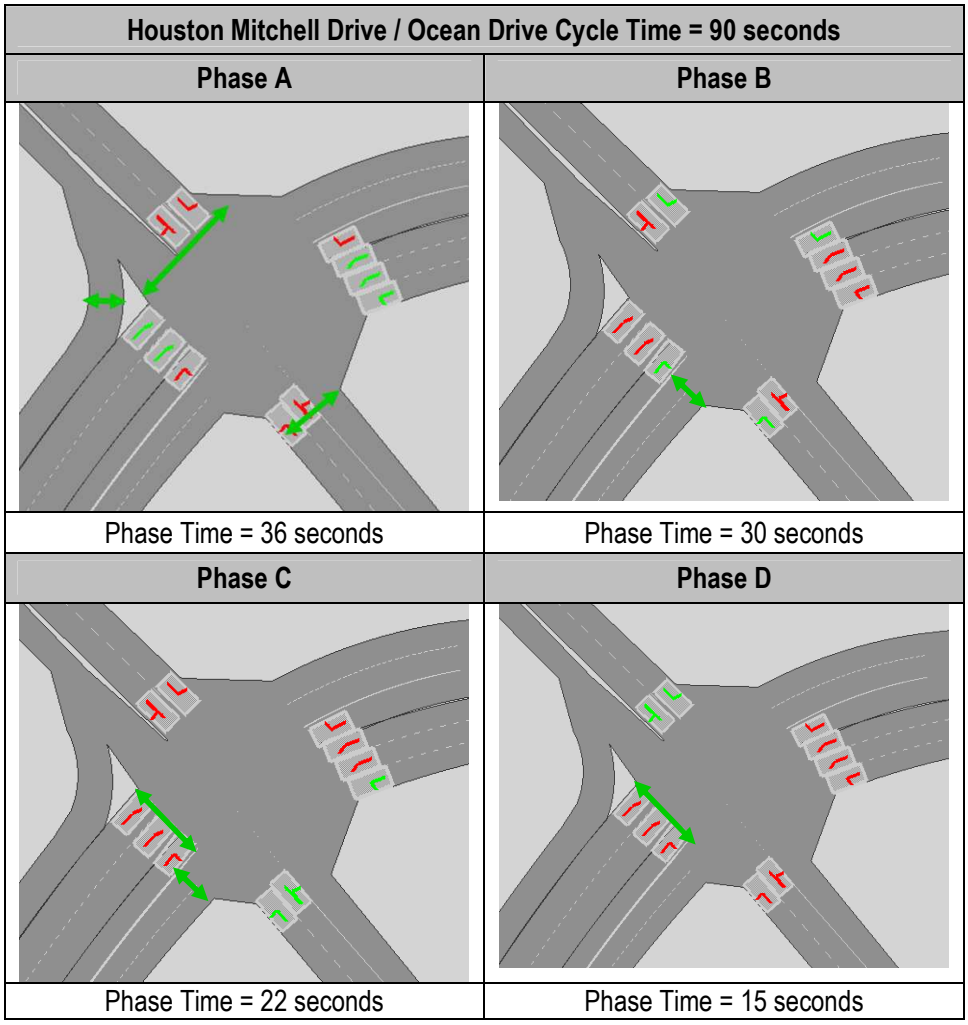


Figure 6.6: Signal Phase Configuration for Houston Mitchell Drive / Ocean Drive

Figure 6.7 demonstrates the performance of the signalised intersection during the AM peak period. Queues for each approach now clear within each and signal coordination between the two signalised intersections facilitates an increase in through capacity. The signalised intersection configuration is also expected to provide an extended life compared to the roundabout option. Any required land for upgrades as part of the 2029 future assessment should be taken into consideration when staging construction of this intersection.

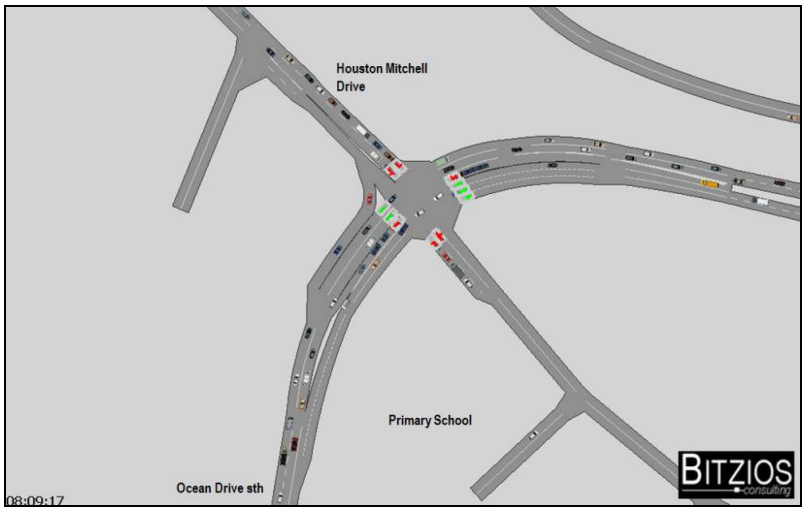


Figure 6.7: Signalised Intersection Performance - Houston Mitchell Drive / Ocean Drive

6.1.5 Commercial Precinct Intersection

The commercial precinct intersection requires a signalised intersection for similar reasons as stipulated for Houston Mitchell Drive / Ocean Drive intersection, namely:

- new turning movements to/from the residential development north of Ocean Drive and commercial precinct to the south;
- pedestrians are expected to be frequently crossing this intersection to access to commercial/retail centre; and
- signal timing will run concurrently between Houston Mitchell Drive intersection and the commercial precinct intersection to retain through movement flow along Ocean Drive.

To provide sufficient through capacity the intersection requires two through lanes with additional turning lanes. In addition it is recommended to construct relatively long turn lanes as to allow turning vehicles to access the lane instead of contributing to the through lane queue lengths. Figure 6.8 demonstrates the required intersection in 2019 including minimum turning lane lengths.

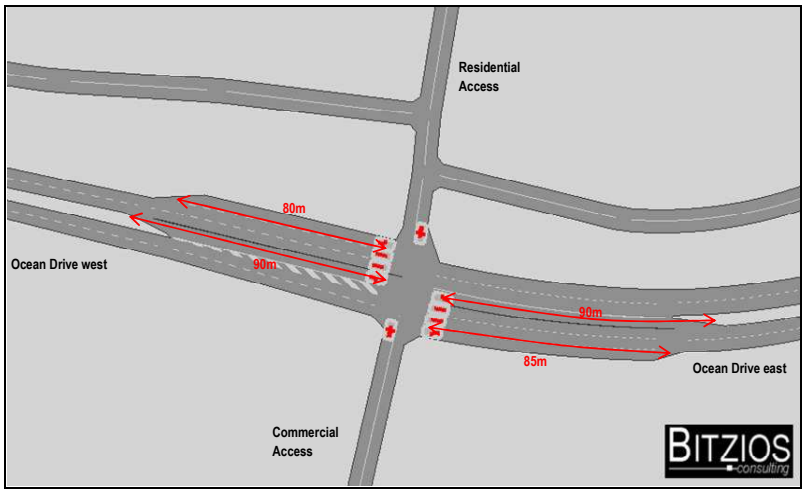


Figure 6.8: Required Commercial Precinct Intersection Configuration for 2019

As the residential component is assumed as only 50% developed by 2019, a single lane approach is all that is required. However, the existing internal road network includes residential side streets in close proximity to the Ocean Drive intersection. As a result queuing at the intersection is expected to impact on access in/out of these side streets. Further refinement is required into the distance between internal roads and intersections.

The commercial precinct has also been provided with only a single land approach and exit lane to the intersection. This forms part of a strategy to reduce the amount of through traffic along the commercial street. The street links have also been give attributes of to high traffic impedance and low vehicle speeds, as to simulate a commercial/retail centre high pedestrian interaction across the street.

This intersection will operate with a Level of Service (LOS) of D with an average delay of 49 seconds out of the commercial precinct.

Figure 6.9 demonstrates the intersection performance in 2019 during the AM peak period.

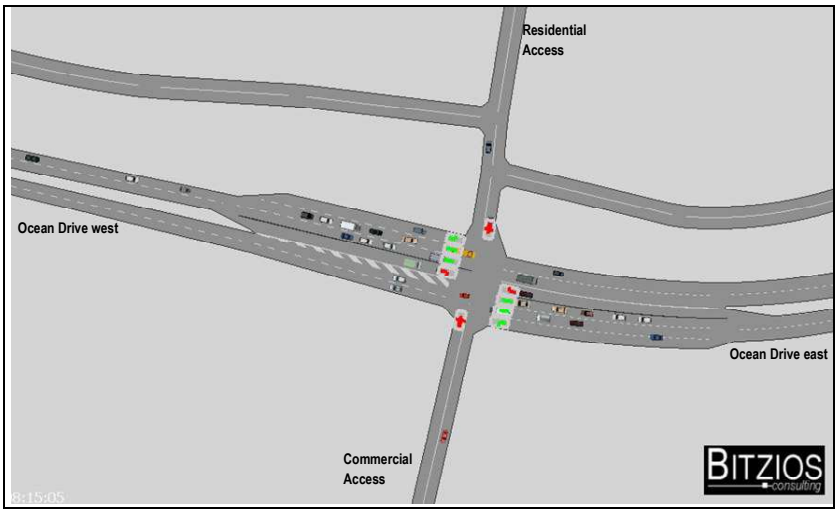


Figure 6.9: Commercial Precinct Intersection Performance - 2019 AM

6.1.6 Abel Tasman Drive and New Residential Mid-block Intersection

Both Abel Tasman Drive and the new mid-block intersection on Ocean Drive have been provided with roundabout intersections for 2019. As these intersections predominately provide access to residential areas turn movement in 2019 perform within capacity, while still maintaining major through movements along Ocean Drive. Figure 6.7 demonstrates the acceptable performance of the roundabout intersections along Ocean Drive.

The southern approach to Abel Tasman / Ocean Drive intersection required refinement due to the proximity of the internal access street as shown in Figure 6.10 (and previously mentioned for the commercial intersection assessment).

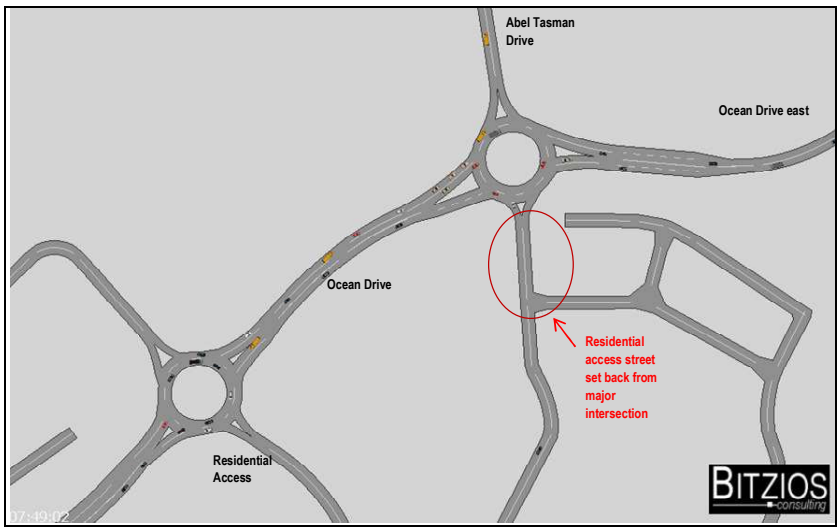


Figure 6.10: Roundabout Intersection Performance - 2019 AM

Whilst the Roundabout at Abel Tasman Drive performs well with development and background traffic at 2019, council have indicated that pedestrian provision across Ocean Drive is currently an area of concern. This can be attributed to residents living off Abel Tasman Drive and associated streets frequently crossing in the vicinity of Abel Tasman Drive to access the beach.

6.1.7 2019 Network Requirements

By 2019 and with partial development of the site, the following road network improvements are required:

- Ocean Drive requires two lanes northbound between Bonny View Drive and Abel Tasman Drive and two lanes southbound between the commercial intersection and Houston Mitchell Drive;

- a roundabout intersections with two lane approaches and circulating lanes is required for Bonny View Drive, Abel Tasman Drive and the new residential access intersection with Ocean Drive;
- Houston Mitchell Drive / Ocean Drive intersection requires a signalised intersection to provide sufficient capacity for vehicles as well as providing pedestrian amenity across Ocean Drive.
- a signalised intersection is required at the commercial precinct access; and
- Houston Mitchell Drive eastbound requires two lanes between Forest Parkway at Ocean Drive, in addition to a 'Clear Zone' within the give-way intersection to the industrial precinct.

Figure 6.11 provides a summary of the required intersection requirements.

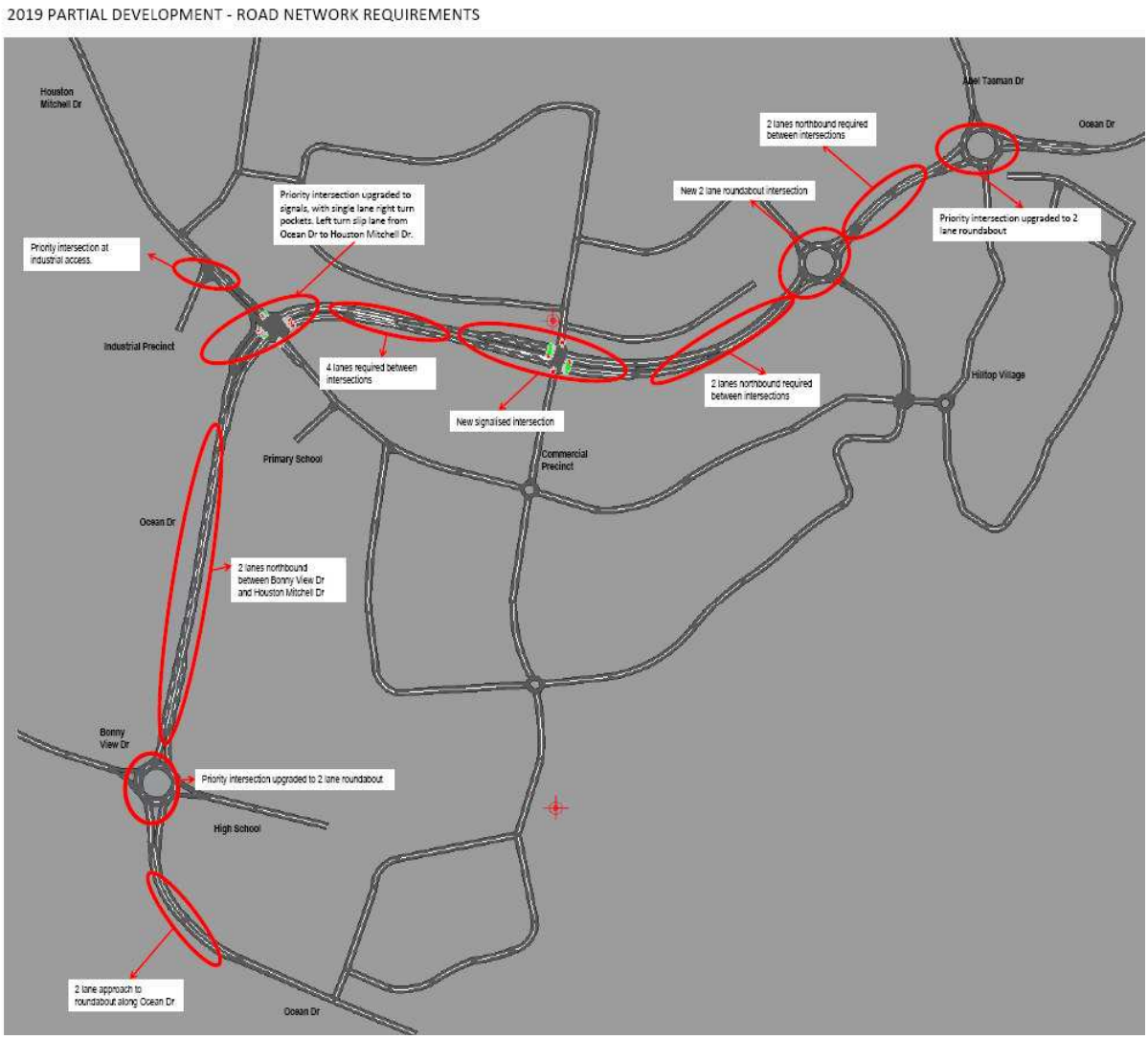


Figure 6.11: Intersection requirements for 2019

Table 6.1 provides the LOS for 2019 Development Model case.

Intersection	2019 AM	2019 PM
Abel Tasman Dr / Ocean Dr	A	A
Houston Mitchell Dr / Ocean Drive	C	C
Bonny View Dr / Ocean Dr	A	A
New Midblock Intersection	A	A
Commercial Precinct	D	C

Link	2019 AM	2019 PM
Ocean Dr (North of Abel Tasman Dr)	A	A
Ocean Dr (Abel Tasman Dr / Houston Mitchell Dr)	A	A
Ocean Dr (Houston Mitchell Dr / Bonny View Dr)	A	A
Ocean Dr (South of Bonny View Dr)	A	A
Houston Mitchell Dr	A	A

6.2 Scenario 2 Performance

6.2.1 Proposed Additional Residential Component

A future investigation area has been identified to the north of the existing 2(a4) zone off Forest Parkway which could cater for up to 221 additional residential lots

Based on the 2019 assumption of the 50% development within residential developments, the inclusion of additional residential developments on the north-west corner of the site in 2019 does not require any additional road network requirements. Traffic from the residential area enters the network from either Forest Parkway or via the additional intersections on Ocean Drive at the commercial precinct.

The directional split of traffic from this development has been based on the internal road network layout north of Ocean Drive. During 2019 the primary route is along Forest Parkway to access Ocean Road via Houston Mitchell Drive. These intersections can adequately cater the additional traffic based the proposed development extension.

6.2.2 Influence of Additional North-South Connection Road

In 2019, the amount of traffic using the north-south connection road around Lake Innes and connection to Kenwood Road would depend greatly on the design of the proposed link road. The link road is expected to carry a percentage of the residential traffic from Forest Parkway in order to access Lake Cathie and Port Macquarie. But exact traffic volumes would depend

on the travel time savings in compared to using Ocean Drive is it becomes more congested in future years.

It is not expected that the proposed road will divert traffic from using Ocean Drive to travel north or south by 2019, as long as proposed intersections along Ocean Drive cater for expected traffic volumes.

Further analysis is required on the impact of this proposed road to the road network and intersections within Lake Cathie to the north.

6.3 Residential Link Road – 2019

The proposed link road between the existing residential development at Bonny Hills and the proposed residential and commercial area has the ability to greatly impact on the through traffic along Ocean Drive as well as the function and success of the residential and commercial areas of the proposed development.

In order to limit through traffic using the link road instead of Ocean Drive, it is recommended to include local area traffic management schemes (LATM) to reduce the attractiveness of this route. If intersection improvements along Ocean Drive are not in place to allow free flowing through movements and the link road is not supplied with adequate LATM measures, then travel times for through movements will be perceived to be quicker along the proposed link road. In addition, the link road is proposed provide a relatively direct connection to the commercial precinct. This may be seen as an easier or even less stressful route when compared to turning right off Ocean Drive at signals further north.

Figure 6.12 demonstrates the queues through the commercial precinct if no LATM measure were undertaken along the north south road with the inclusion of the internal link road.

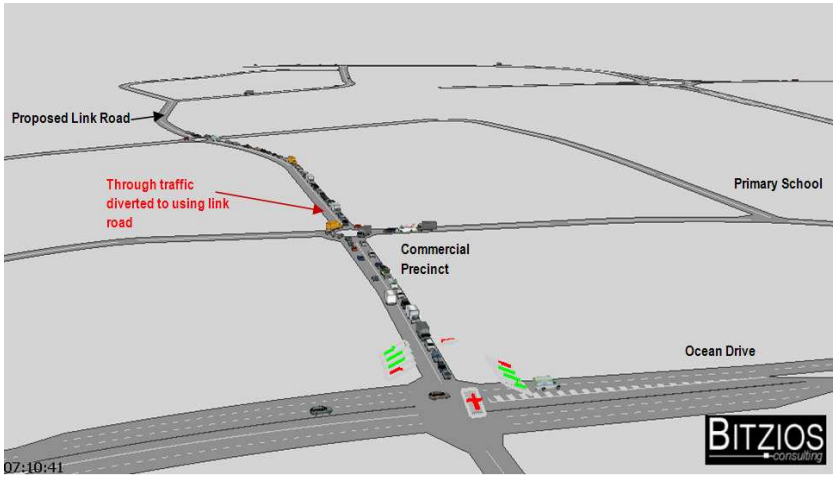


Figure 6.12: Queues due to No LATM along Internal Link Road

7.0 2029 Full Development

By 2029, it is expected that the site will be fully developed and background traffic will continue to grow as a result of continuous growth at nearby local centres such as Bonny Hills and Laurieton. As a result, the recommended network will require refinements to cater for the projected future traffic volumes. This section details the specific issues and requirements for Ocean Drive and each of the intersections within the study area for 2029. In addition, recommendations and areas of concern are also included to provide more information how the proposed site layout and internal road network function as a whole.

Table 7.1 provides the LOS for 2029 Development (No Improvements in the network between 2019 and 2029) Model case.

Intersection	2029 AM	2029 PM
Abel Tasman Dr / Ocean Dr	F	A
Houston Mitchell Dr / Ocean Drive	F	E
Bonny View Dr / Ocean Dr	D	A
New Midblock Intersection	D	A
Commercial Precinct	F	D

Link	2029 AM	2029 PM
Ocean Dr (North of Abel Tasman Dr)	A	A
Ocean Dr (Abel Tasman Dr / Houston Mitchell Dr)	E	C
Ocean Dr (Houston Mitchell Dr / Bonny View Dr)	C	A
Ocean Dr (South of Bonny View Dr)	B	A
Houston Mitchell Dr	A	A

7.1 Ocean Drive

With the inclusion of 'double' the residential traffic compared to 2019, turning movements in and out of the intersections have increased as have through volumes along Ocean Drive. This puts added pressure on Ocean Drive as the main arterial route through the study area. By 2029, Ocean Drive requires two lanes in each direction between Bonny View Drive and Abel Tasman Drive. Figure 7.1 demonstrates the queues along Ocean Drive southbound as the single lane configuration does not provide enough capacity between intersections.

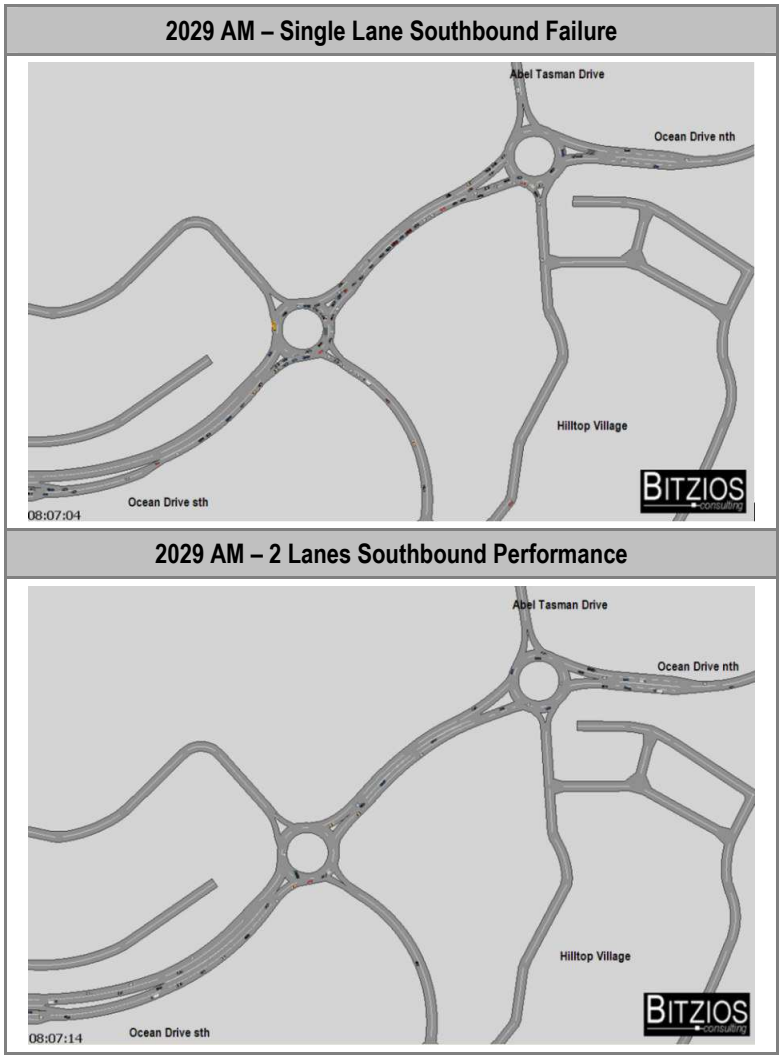


Figure 7.1: 2 Lane Southbound on Ocean Drive

7.2 Houston Mitchell Drive

Houston Mitchell Drive is the primary intersection for development traffic to/from the south via Ocean Drive and the west via Houston Mitchell Drive. With the proposed development increasing in size and expected increase in background traffic, the right turn from Ocean Drive to Houston Mitchell Drive experiences long queues which extend beyond the storage lane length and back into the previous intersection as shown in Figure 7.2.

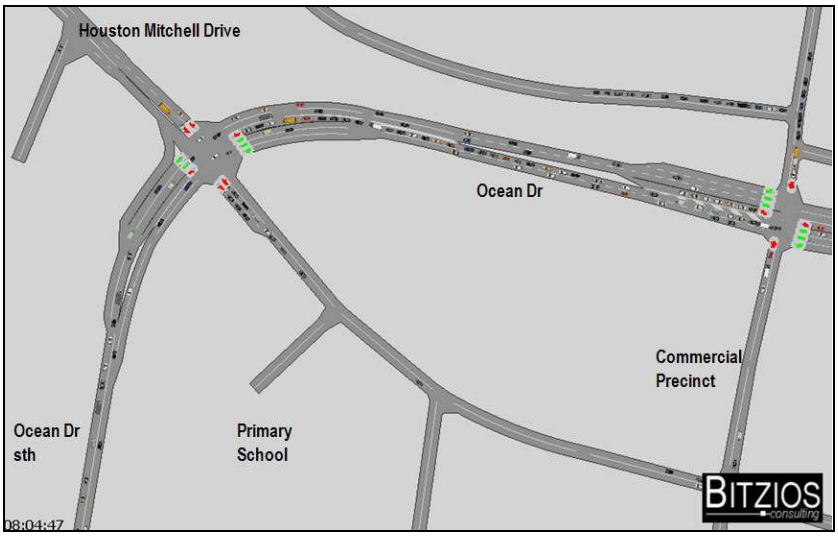


Figure 7.2: Right Turn Lane failure - 2029 AM Peak

Additional right turn lane length is required and can be provided by either extending the right turn pocket or by providing a second turning lane. If the single right turn lane is extended the signal timing will also be refined to provide more green time as to allow the stored vehicles clear. This would however require a large percentage of green time in order to clear the single lane queues.

A double right turn movement would not require additional green time, however would require re-alignment of the road to cater for the additional lane. The double right-turn would also provide additional spare capacity for future years. It is recommended to provide a double right turn as shown in Figure 7.3, as this is a more efficient solution in the long term. In order to provide adequate exit lanes, Houston Mitchell Drive westbound requires extension of the deceleration lane onto the industrial precinct to provide two lanes westbound.

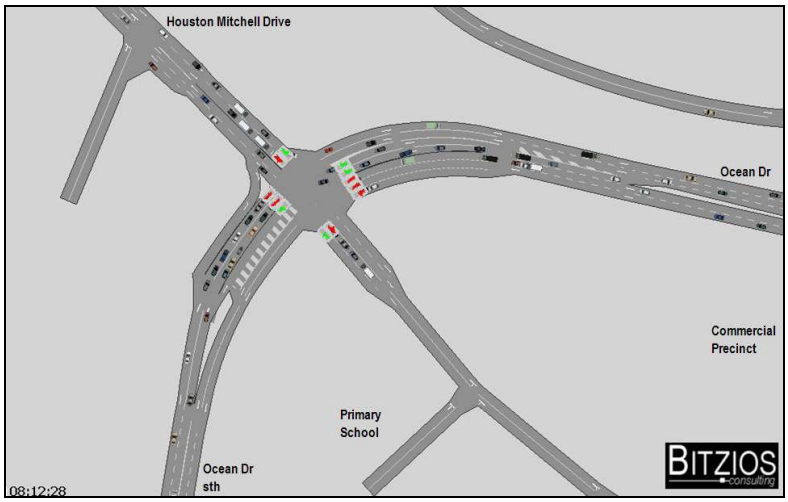


Figure 7.3: Double Right Turn Performance - 2029 AM Peak

The northbound right turn from Ocean Drive to the primary school also exhibits long queues, however these queues do not warrant the need for an additional turning lane. Instead, width required within the central median as a result of the southbound double right turn is recommended to be utilised as pedestrian refuge for the proposed staggered crossing.

It should be noted that the right turns from Ocean Drive at the primary school access and commercial precinct access work concurrently to provide access form Ocean Drive south. The length of the turn lanes is recommended not to be based only on the maximum turning queues as the through traffic queues will extend beyond the turning lane length and limit the ability to access the lane for turning vehicles.

7.3 Commercial Precinct Intersection

Figure 7.4 shows the performance of the commercial precinct intersection in 2029 without any improvements. The side street approaches from the northern residential area and the southern commercial precinct exhibit queues as a result of the single lane approach. As previously mentioned for 2019 assessment, the residential access queues extend beyond the internal intersections.

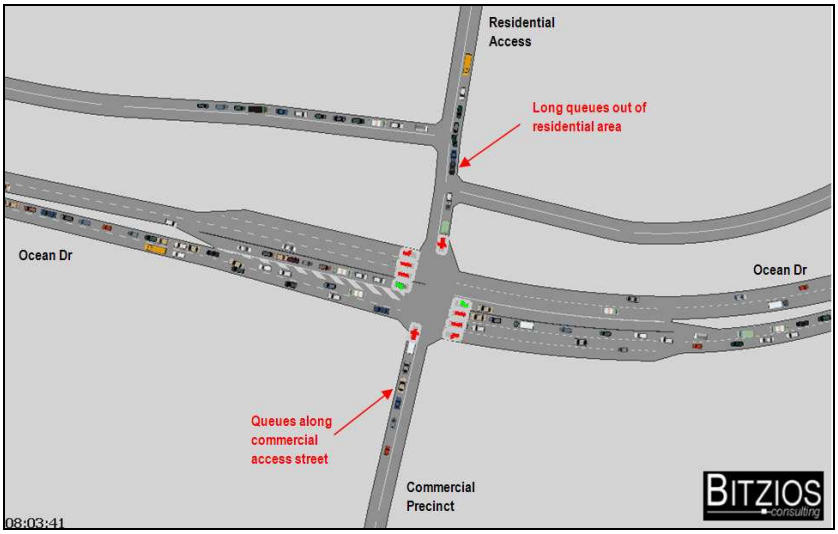


Figure 7.4: Commercial Precinct Intersection - 2029 AM Peak

The southern approach from the commercial precinct requires a two lane approach, comprising of a left turn lane and a shared right/through lane.

It is envisaged that extensive traffic queues along the commercial precinct 'promenade' would be detrimental to the function of the road and commercial centre success.

Currently traffic to/from the commercial precinct access Ocean Road via a single intersection.

Design studies into physical framework planning of the commercial precinct were undertaken by Design Collaborative in 2008. This report detailed the proposed design option of a north-south road through the commercial precinct which connects Ocean Drive to an internal east-west collector/distributor road. The report also details the option of a possible left in/left out road to the east of the commercial precinct to the possible location of an off-street car park.

The northern access from the residential area requires two approach lanes, with the kerbside lane extending 45metres from the stop line. This additional lane is required to both provide storage and also to allow left turning vehicles to access the left turn. As previously mentioned within the 2019 assessment, further investigation is required into the internal road layouts in reducing the influence of queuing traffic at Ocean Drive intersections.

The maximum right turn queues into the commercial precinct from Ocean Drive extend to approximately 10 vehicles per cycle, however these queues do not extent beyond the lane length as vehicles are unable to access the right turn lane due to the queues from through traffic as shown in Figure 7.5.

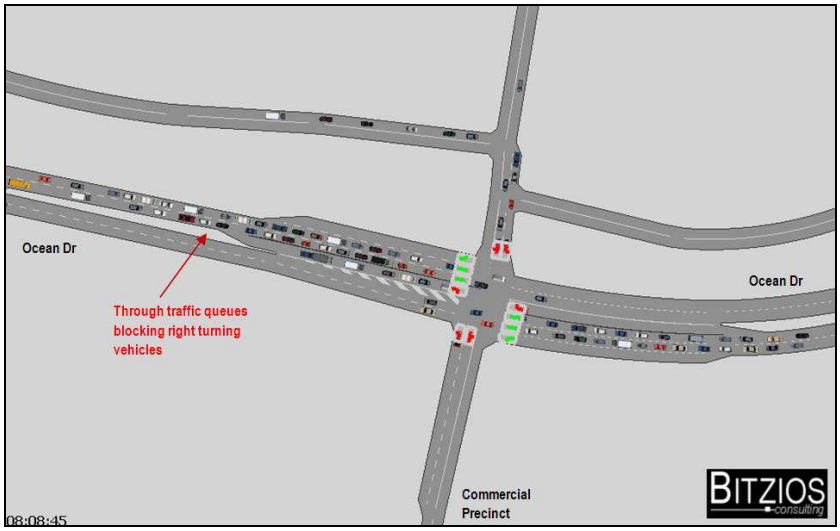


Figure 7.5: Commercial Precinct Intersection – Right Turn Queues Blocked

By extending the length of the right turn lane, through traffic queues would be reduced as right turn vehicles would be able to access the turning lane. Figure 7.6 demonstrated the required improvements to the intersection in addition to demonstrating the performance of the intersection during the AM peak period in 2029.

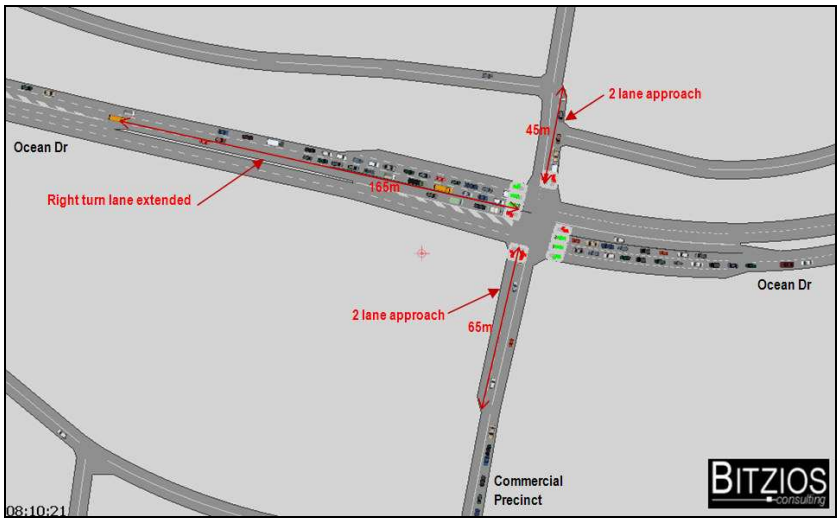


Figure 7.6: Commercial Precinct Intersection Improvements – 2029 AM Peak

7.3.1 Bonny View Drive Intersection

The roundabout intersection at Bonny View Drive continues to perform within capacity at 2029.

7.4 Variation in Peak Demand by 2029

Whilst the recommended intersection configurations perform within capacity at 2029, Ocean Drive continues to show residual queues at the two signalised intersection between 8:00am and 8:15am. This can be attributed to the peak demand profile which has been adopted from the exiting peak hour traffic patterns.

For the previous future year assessment at 2019 it is expected that the through movements along Ocean Drive (AM peak in the northbound direction and PM peak in southbound direction) will continue to be the major movements through the network. Therefore the existing demand profile should be adopted.

However, by 2029 the traffic patterns within the study area are driven more by the surrounding land uses as oppose to the through traffic commuting to Port Macquarie. Therefore the demand profile for the AM peak period is expected to be distributed more evenly across the two hour peak period as shown in Fig 7.7

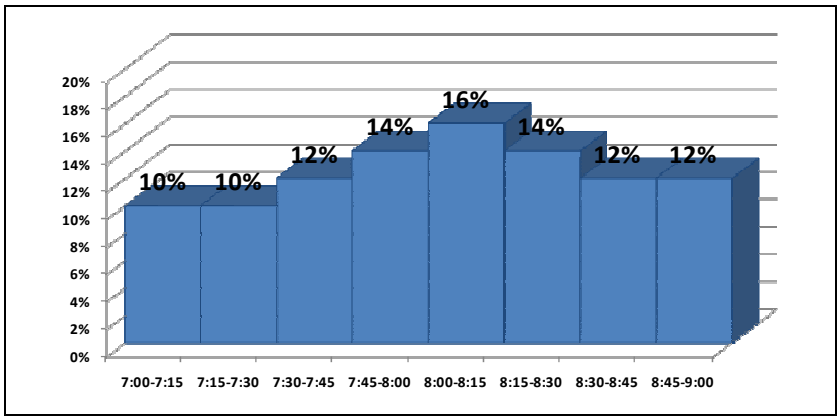


Figure 7.7: Refined AM Peak Demand Profile

Table 7.2 provides the LOS for 2029 Full Development (with Upgrades) Model case.

Intersection	2029 AM	2029 PM
Abel Tasman Dr / Ocean Dr	A	A
Houston Mitchell Dr / Ocean Drive	D	D
Bonny View Dr / Ocean Dr	A	A
New Midblock Intersection	A	A
Commercial Precinct	D	C

Link	2029 AM	2029 PM
Ocean Dr (North of Abel Tasman Dr)	A	A
Ocean Dr (Abel Tasman Dr / Houston Mitchell Dr)	B	A
Ocean Dr (Houston Mitchell Dr / Bonny View Dr)	A	A
Ocean Dr (South of Bonny View Dr)	B	A
Houston Mitchell Dr	A	A

When running the 2029 AM models with the updated demand profile, the concentration of AM peak traffic between 7:45 and 8:15 is reduced and traffic flow is more consistent across the two hour period. This in turn reduces the maximum queues, and subsequent delay for vehicles at the signalised intersections located at Houston Mitchell Drive and the commercial precinct compared to applying the existing peak demand profile.

Figure 7.8 shows the improved performance and reduced queues at Houston Mitchell Drive intersection when applying a refined AM peak demand profile. The queues along Ocean Drive clear with each cycle as traffic volumes are not concentrated at specific times.

Table 7.3 provides the LOS for 2029 Full Development (Updated Profile) Model case.

Intersection	2029 AM
Abel Tasman Dr / Ocean Dr	A
Houston Mitchell Dr / Ocean Drive	D
Bonny View Dr / Ocean Dr	A
New Midblock Intersection	A
Commercial Precinct	C

Link	2029 AM
Ocean Dr (North of Abel Tasman Dr)	A
Ocean Dr (Abel Tasman Dr / Houston Mitchell Dr)	A
Ocean Dr (Houston Mitchell Dr / Bonny View Dr)	A
Ocean Dr (South of Bonny View Dr)	A
Houston Mitchell Dr	A

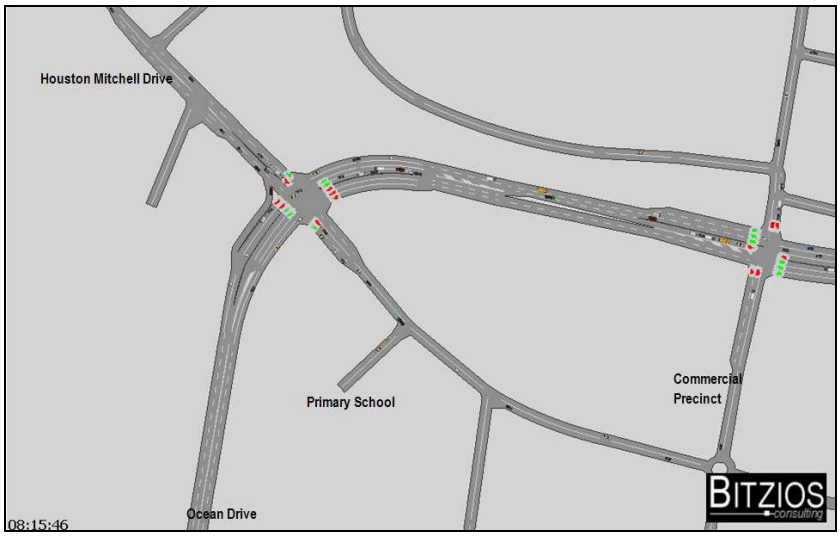


Figure 7.8: Reduced Queues and Congestions with Refined AM Profile

Figure 7.9 provides a summary of the road network and intersection improvements that are required by 2029.

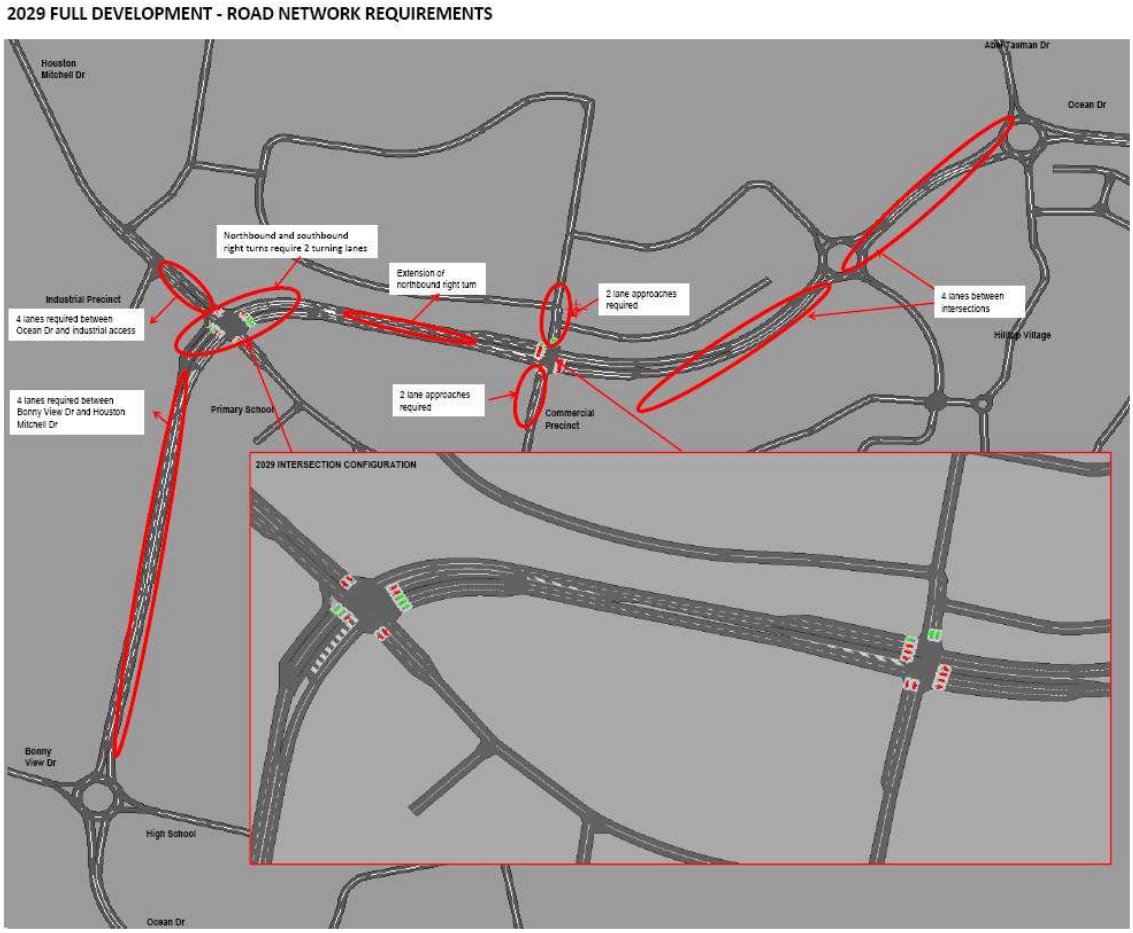


Figure 7.9: Road Network and improvements 2029

7.5 Scenario 2 Performance in 2029

By 2029, residential development traffic as part of Scenario 2 will require the two lanes westbound along Houston Mitchell Drive to be extended past Forest Parkway. Additional turning vehicles at Houston Mitchell Drive and the Commercial Precinct intersection from the north are increased, however no intersection improvements are required. Figure 7.10 shows the performance of the signalised intersections along Ocean Drive with the inclusion of additional residential traffic.

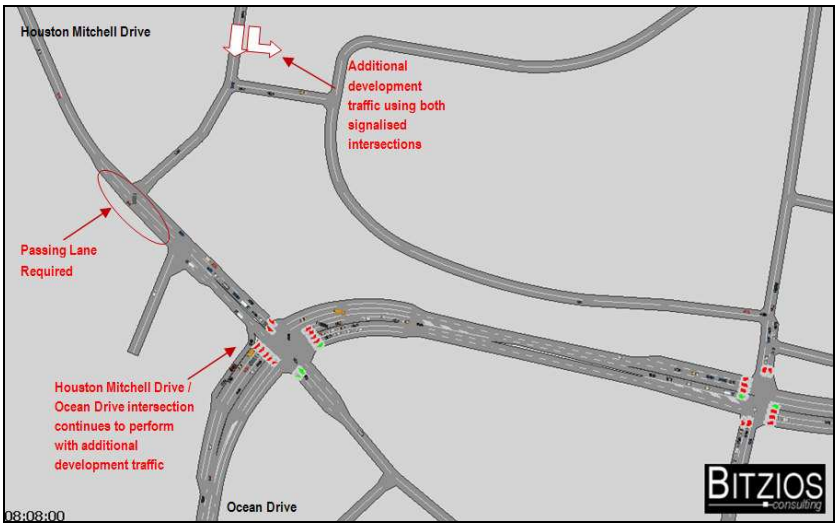


Figure 7.10: Road Network Performance with Addition Development Traffic

The Scenario 2 north-south link road to Kenwood Drive is not expected to attract vehicles from Ocean Drive or Houston Mitchell Drive as long as intersections along Ocean Drive include the recommended configurations. However, it is envisaged that traffic as part of the Scenario 2 residential development will use the connection as to access Lake Cathie and Port Macquarie to the north. In addition, existing traffic from Kenwood Drive and the adjacent areas of North Lake Cathie could also use the proposed north-south link road to access Houston Mitchell Drive towards the Pacific Highway. Therefore, further consideration should be made into using LATM schemes along the proposed link in order to reduce the attractiveness of this route for future through traffic.

8.0 Residential Link to Bonny Hills in 2029

By 2029, LATM schemes along the proposed link road between the commercial precinct and existing residential area at Bonny Hills is essential as to reduce the attractiveness for through traffic shifting from Ocean Drive.

As traffic increases along Ocean Drive and intersection delays become longer, other available routes will become more attractive.

It is important however to allow some usage of the proposed link road as it allow local traffic movements to use the residential access street instead of increasing queues to access and use Ocean Drive.

A concern however is the link road connecting directly into the collector road towards the commercial precinct. This area will be a primary generator of traffic once fully developed. Therefore it is proposed to direct traffic using the proposed link further east of the commercial centre and into the residential road network. This would improve access for residential areas and reduce through traffic along the commercial precinct access.

9.0 Sensitivity Test - Commercial Precinct Access

The initial proposed network distributes traffic to/from the commercial precinct access at Ocean Road via a single intersection. It is envisaged that extensive traffic queues along the commercial precinct 'promenade' would be detrimental to the function of the road and commercial centre success.

Design studies into the physical framework planning of the commercial precinct were undertaken by Design Collaborative in 2008. This report detailed the proposed design option of a north-south road through the commercial precinct which connects Ocean Drive to the residential east-west collector/distributor road. The report also details the option of a possible left in/left out road from Ocean Drive to the east of the commercial precinct and connecting the possible location of an off-street car park.

In order to test the impacts of applying additional access/egress points for commercial traffic, a Paramics model was created which simulates a central car park located to the east of the commercial precinct. The car park was provided with additional access points directly onto Ocean Drive, the commercial precinct promenade and also the residential east-west collector/distributor to the south. Figure 9.1 demonstrates the proposed access configuration.

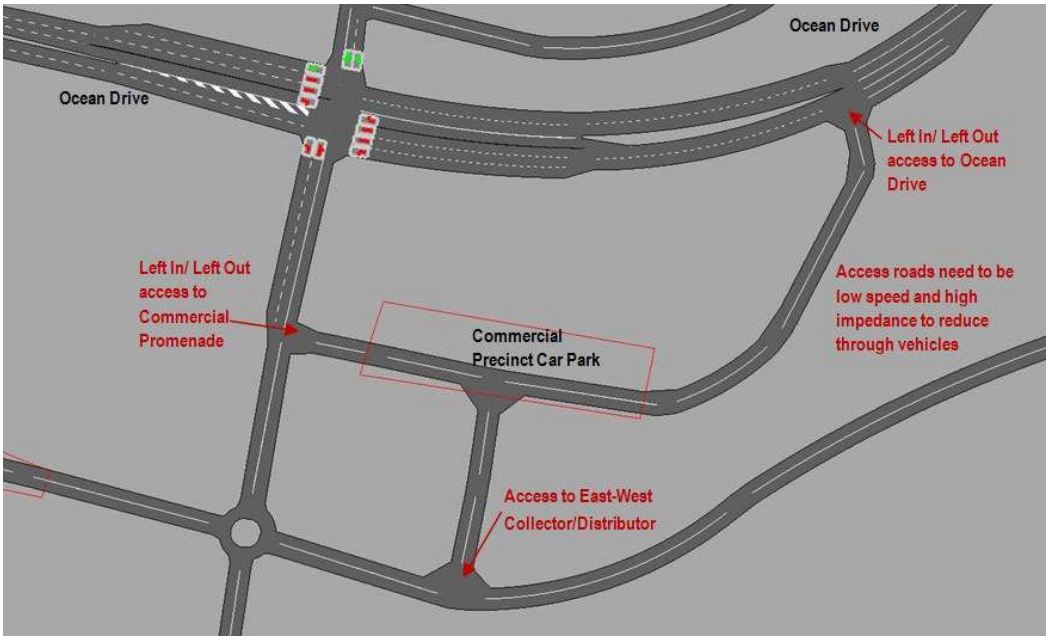
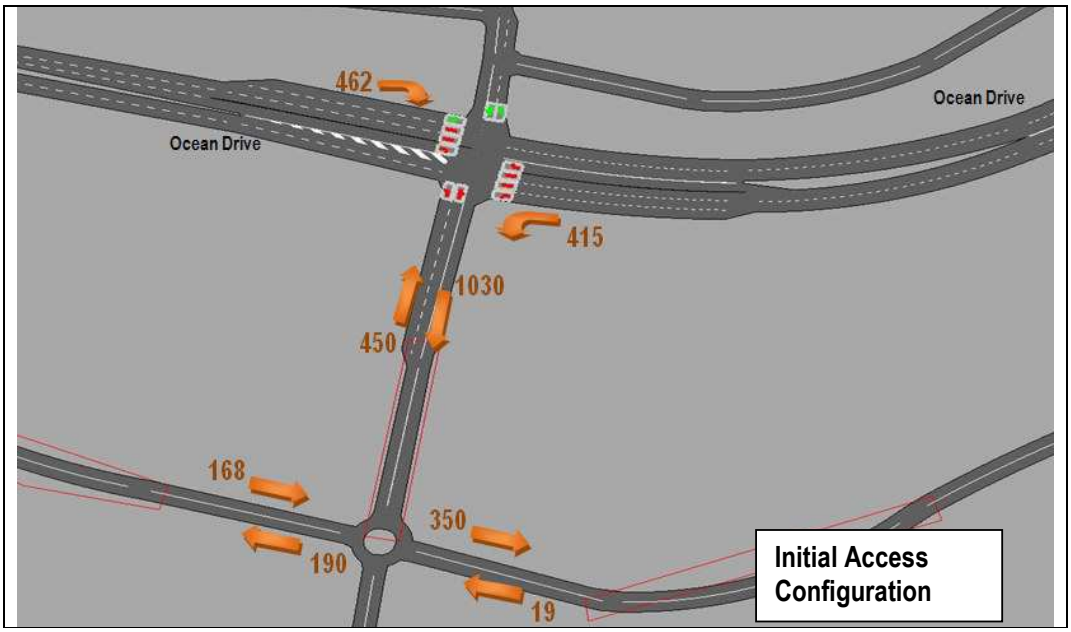


Figure 9.1: 2019 2 Hour Peak Intersection Turn Volumes

A left in/ left out access has been provided from the commercial precinct car park to Ocean Drive southbound and commercial access road southbound only. An additional 'T' intersection has been provided onto the east-west collector/distributor. Figure 9.2 shows the comparison of two hour traffic volumes between a single commercial access and multiple commercial accesses during the AM peak in 2029.



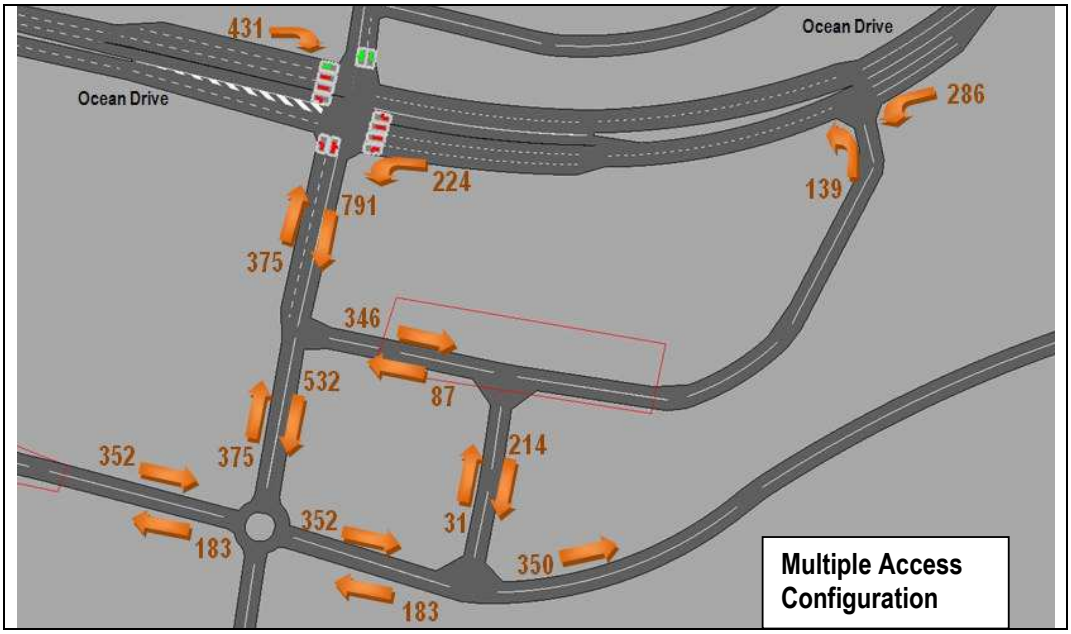


Figure 9.2: Commercial Access Volume Comparison – 2029 AM Peak

The additional points of access/egress for commercial traffic greatly reduce the volumes of vehicles along the commercial precinct access road. This is due to the new links improving the distribution of traffic via Ocean Drive to the north as well as the east-west distributor/collector road to the south. It is important that vehicle impedance is high along these access roads to remove the attractiveness of these linkages as through routes to residential areas.

Figure 9.3 demonstrates the improvements to queues through the commercial precinct as a result of the improved access linkages.

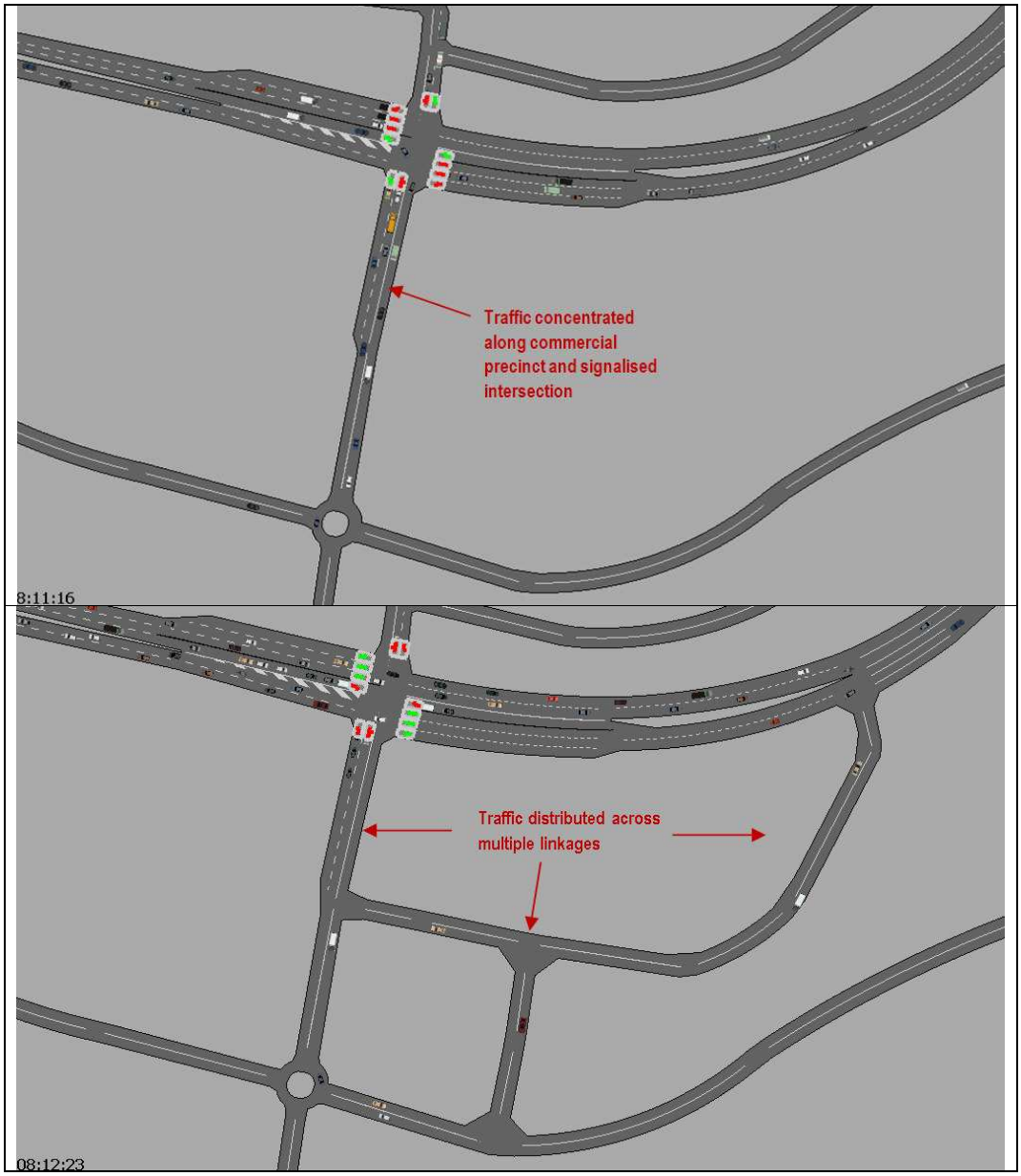


Figure 9.3: Queue improvements due to improved linkages – 2029 AM Peak

10.0 Sensitivity Test – Signals at Abel Tasman Drive

Whilst the roundabout intersection configuration at Abel Tasman Drive is expected to perform well within capacity beyond 2029, Council has identified the need for a pedestrian crossing across Ocean Drive in the vicinity of Abel Tasman Drive. Therefore, a signalised intersection has been modelled to investigate the signalised intersection configuration performance.

Roundabouts generally provide shorter queues than signals as queuing traffic is filtered into the roundabout by gaps generated by conflicting movements. The downside is that the capacity of an approach is reliant on the volumes from the other approaches and priority cannot be given to a specific movement, for example through movements on Ocean Drive.

Signalised intersections however generally produce longer queues but provide designated 'green time' for the movement to clear the intersection. The capacity of the movement through signals is determined by the number of available lanes and multiplied by the percentage of green time compared to the total cycle time. Therefore, capacity for a specific movement can be controlled and refined by the signal operator. Adequate storage area for signals must be taken into account when designing signals and queues should not extend back to influence previous intersections.

Figure 10.1 demonstrates the signalised intersection configuration and performance during the AM Peak in 2029.

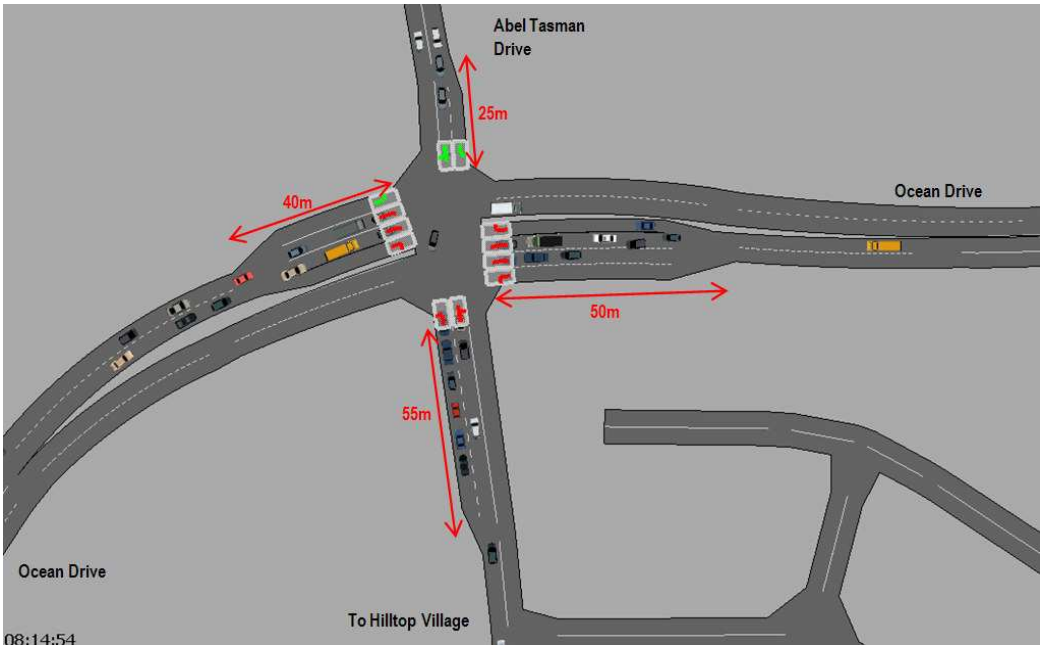


Figure 10.1: Abel Tasman Drive Signalised Intersection Configuration- 2029 AM Peak

The southern approach requires an additional approach lane when compared to the original proposed roundabout configuration.

A major benefit to the intersection is the signal coordination potential with the adjacent signalised intersection to the north. As a result, cycle times can be off-set to enable platooning of traffic to arrive at the next intersection with minimal delay. Figure 10.2 demonstrates the proposed signal phase timing for the intersection.

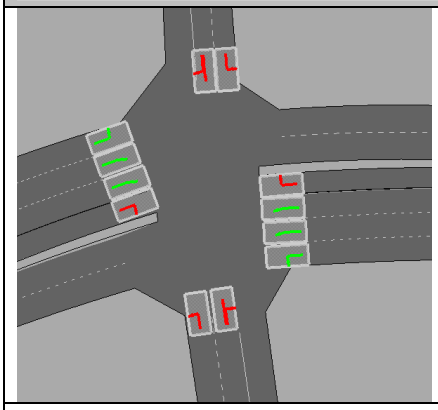
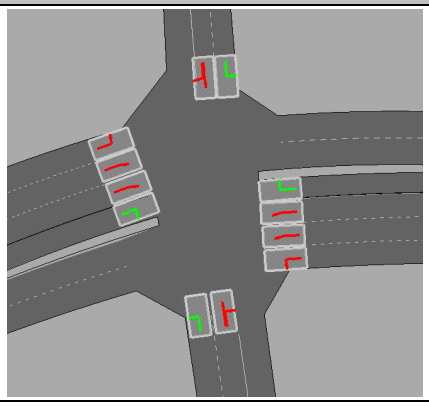
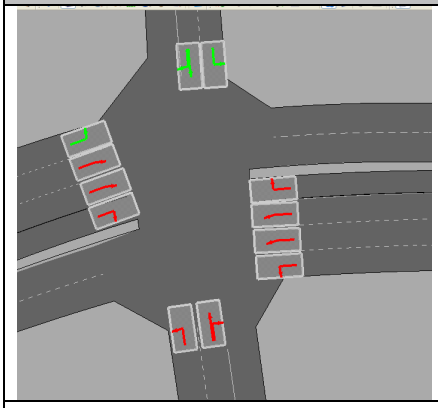
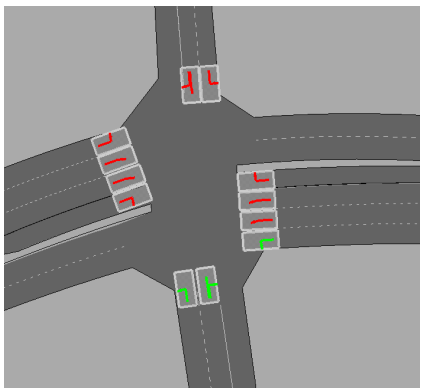
Abel Tasman Drive / Ocean Drive Cycle Time = 100 seconds	
Phase A	Phase B
	
Phase Time = 40 seconds	Phase Time = 12 seconds
Phase C	Phase D
	
Phase Time = 13 seconds	Phase Time = 15 seconds

Figure 10.2: Signal Phase Configuration for Houston Mitchell Drive/Ocean Drive

Similar to Houston Mitchell Drive, pedestrian amenity is required to be provided in the future at Abel Tasman Drive. Pedestrian crossings at side streets will run during phase A, which provide a total crossing time of 43 seconds, including amber times. However, it is recommended to provide a refuge island within the median on both Abel Tasman Drive and the access road to the Hilltop Village for stranded or delayed pedestrians.

Pedestrian crossing across Ocean Drive will run during phases C and D which provide a total of 34 seconds, including amber times. Ocean Drive pedestrian crossings are also recommended to provide a pedestrian refuge within the central medium including a pedestrian button and appropriate guard railing.

11.0 Intersection Footprint Requirements

The intersection configurations and footprints will need to be assessed against the current road reserves along Ocean Drive and adjacent land ownership boundaries. Paramics intersection configurations have been superimposed over the land ownership boundaries to highlight the required land and any associated land acquisition, which will need to be further assessed. It should be noted that widths from Paramics are not to scale and this assessment is only an indication of strategic fit of the proposed intersections. Further analysis involving surveying is required to determine more accurate boundary requirements.

11.1 Houston Mitchell Drive / Ocean Drive Intersection

The required intersection configuration for Houston Mitchell Drive / Ocean Drive intersection (see Figure 11.1) demonstrates that left turn lane from Ocean Drive to Houston Mitchell Drive would encroach outside the current road reserve of Ocean Drive to the west.

It should be noted that there is an additional parcel of land linking Ocean Drive and Houston Mitchell Drive which could be utilised for the left turn. If this land was used for the left turn lane it would reduce pedestrian crossing distances across Ocean Drive. However, this would also reduce the amount of available land for development on the western side of Ocean Drive.

Relocating the left turn would also require the need to provide the access to the industrial precinct further west, as a four-way intersection with Forest Road.

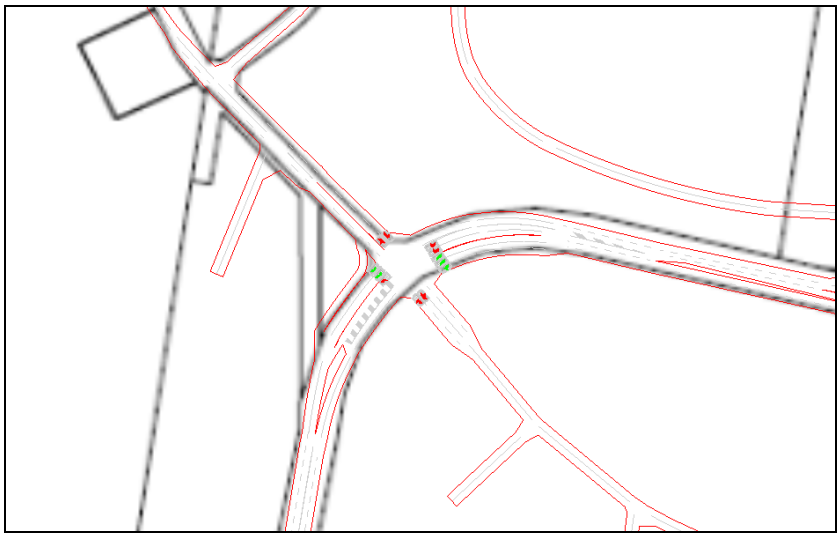


Figure 11.1: Houston Mitchell Drive / Ocean Drive Intersection

11.2 Abel Tasman Drive / Ocean Drive Intersection

Due to existing dwellings on the northern side of the intersection, the proposed roundabout configuration requires the alignment of Ocean Drive to be moved further south in order to allow two circulating lanes on the roundabout as shown in Figure 11.2. The proposed roundabout encroaches approximately 27 metres onto the southern side of Ocean Drive.

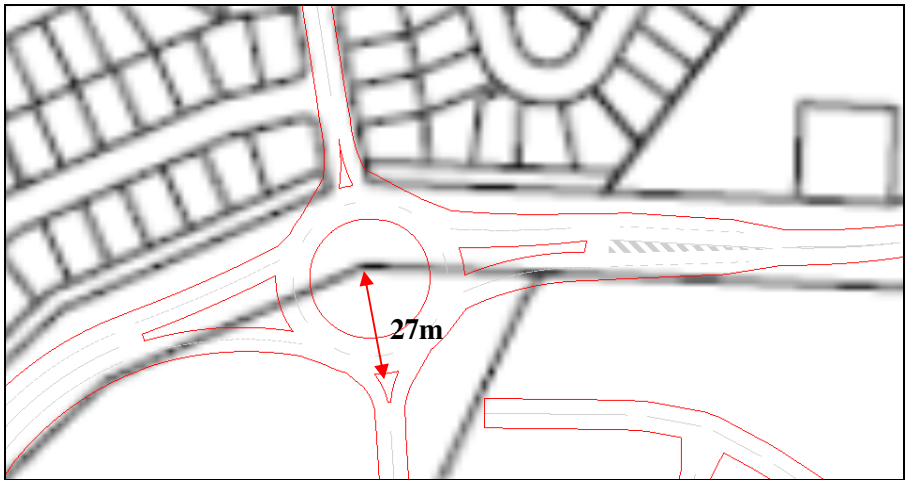


Figure 11.2: Abel Tasman Drive / Ocean Drive Roundabout Intersection

Council has indicated a need to provide pedestrian amenity across Ocean Drive in the vicinity of Abel Tasman Drive. As a result, Abel Tasman Drive / Ocean Drive intersection has been tested with the inclusion of a signalised intersection as shown in Figure 11.3. The benefit of signals at this location is the reduction in land requirements when compared to the initial proposed roundabout intersection.

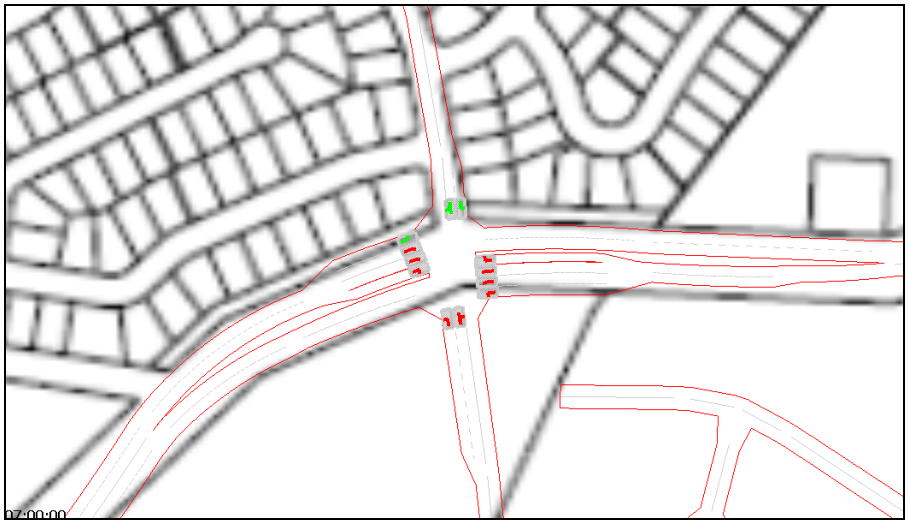


Figure 11.3: Abel Tasman Drive / Ocean Drive Signalised Intersection

The implementation of signals requires more storage capacity for approaches when compared to approaches to roundabouts. As a result, Abel Tasman Drive approach requires two approach lanes for the signalised intersection configuration up to Explorers Way.

The existing configuration comprises of only a single lane in each direction with a central median. The width of the road reserve is 11 metres north of the median, therefore three lanes (two approach lanes and one exit lane) should be able to be provided along Abel Tasman Drive between Ocean Drive and Explorers Way.

11.3 Bonny View Drive / Ocean Drive Intersection

Similar to the roundabout intersection for Abel Tasman Drive, the alignment of Ocean Drive approaching the proposed roundabout at Bonny View Drive is required to shift east in order to reduce the impact on the existing Bonny View Drive approach from the west. Pursuant to this alignment, sections of land on the eastern side of Ocean Drive will still be required with the roundabout intersection configuration (see Figure 11.4). The roundabout intersection requires lane to the east of Ocean Drive to a width of approximately 20metres east.

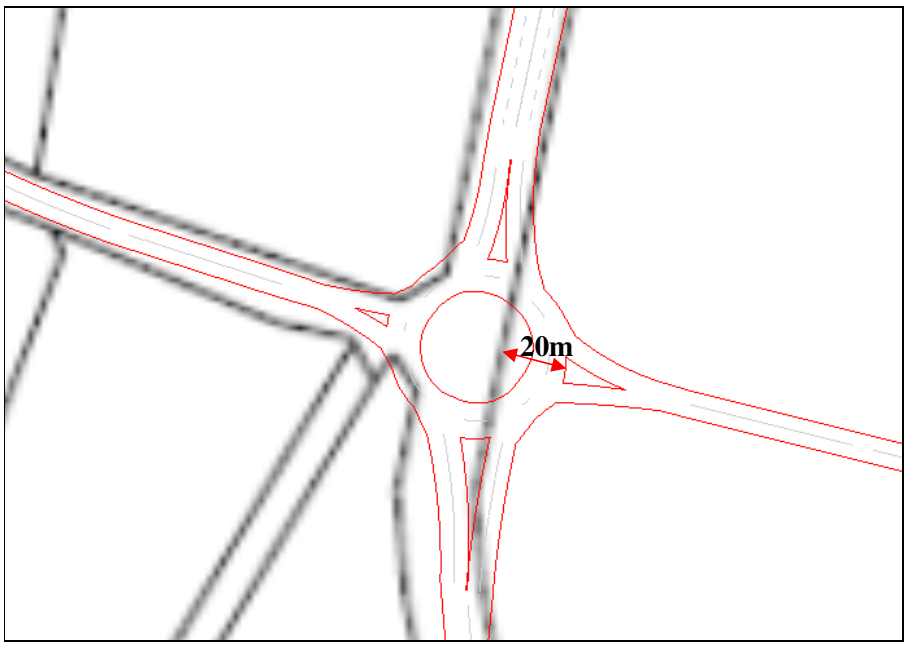


Figure 11.4: Bonny View Drive / Ocean Drive Intersection

12.0 Key Conclusions and Recommendations

Ocean Drive and associated roads within the study area are currently operating well within capacity. However, safety concerns due to speeds through intersections, turning vehicles and poor bus stop and pedestrian facilities will limit the ability if intersections to cater for expected traffic growth in future years.

The proposed development requires additional intersections as well as new approaches into existing intersections along Ocean Drive in order to provide sufficient access to the development sites. By 2019 under a partial development scenario, the following road network improvements are required:

- Ocean Drive requires two lanes northbound between Bonny View Drive and Abel Tasman Drive;
- Houston Mitchell Drive / Ocean Drive requires upgrading to a signalised intersection, which provides two through lanes along Ocean Drive. Pedestrian crossings are recommended across the Houston Mitchell Drive, Primary School Access and the southern approach of Ocean Drive;
- Houston Mitchell Drive requires two lanes eastbound between Forest Parkway and Ocean Drive with a 'clear way' to be line marked at the give way intersection at the Industrial Precinct access;
- a signalised intersection is required on Ocean Drive at the proposed Commercial Precinct which provide two through lanes along Ocean Drive;
- Bonny View Drive / Ocean Drive is required to be upgrade to a roundabout intersection with two lane approaches and circulating lanes;
- Abel Tasman Drive / Ocean Drive intersection is required to be upgraded to a signalised intersection with two lane approaches as it will provide the following benefits:
  - i) requires a smaller intersection footprint compared to a roundabout;
  - ii) provides pedestrian crossing amenity across Ocean Drive;
  - iii) allows signal timing to be optimise depending on the demand flows for both through traffic on Ocean Drive as well as turning movements from the proposed development and Abel Tasman Drive; and
  - iv) provides greater capacity for future traffic growth than a roundabout intersection.
- a new roundabout intersection is required along Ocean Drive between Abel Tasman Drive and the Commercial Precinct. This roundabout requires two lane approaches and circulating lanes; and
- four lanes (two lanes in each direction) are required along Ocean Drive between the Houston Mitchell Drive and the Commercial Precinct.

The inclusion of additional residential development (Scenario 2) and a new north-south link road from Forest Parkway to Kenwood Drive is not expected to require any additional road network improvements. The proposed link road is not expected to change traffic patterns along Ocean Drive as long as recommended improvements are made along Ocean Drive and at associated intersections.

The proposal to include a link road between the existing residential development at Bonny Hills and the proposed residential/commercial area would greatly depend on the design of the proposed link road. In order to limit through traffic using the link road instead of Ocean Drive, it is recommended to include Local Area Traffic Management Schemes (LATM) to reduce the attractiveness of this route. The function and amount of traffic using this proposed road also greatly depends on the intersection configuration and performance along Ocean Drive.

By 2029, the following road network improvements are required:

- Ocean Drive requires four lanes (two lanes in each direction) between Bonny View Drive and Abel Tasman Drive;
- Houston Mitchell Drive / Ocean Drive intersection requires two right turn lanes from Ocean Drive north to Houston Mitchell Drive;
- Houston Mitchell Drive requires four lanes (two lanes in each direction) between Forest Parkway and Ocean Drive;
- The signalised intersection fronting the commercial precinct requires two lane approaches from both the commercial precinct in the south and residential area in the north. The right turn lane from Ocean Drive to the Commercial Precinct requires extension to 165 metres.

By 2029, the traffic patterns within the study area are driven more by the surrounding land uses as opposed to the through traffic commuting to Port Macquarie. Therefore, the demand profile for the AM peak period is expected to be distributed more evenly across the two hour peak period.

By 2029, additional development north of Forest Parkway (Scenario 2) requires the two lanes westbound along Houston Mitchell Drive to be extended past Forest Parkway. Additional turning vehicles at Houston Mitchell Drive and the Commercial Precinct intersection from the north also increase, however no intersection improvements are required.

The Scenario 2 north-south link road to Kenwood Drive is not expected to attract vehicles from Ocean Drive or Houston Mitchell Drive as long as intersections along Ocean Drive include the recommended configurations to provide sufficient through movements. Further assessment is required into the detailed impact of this road to the north along Kenwood Drive and Lake Cathie.

By 2029, LATM schemes along the proposed link road between the commercial precinct and existing residential area at Bonny Hills are essential as to reduce the attractiveness for through traffic shifting from Ocean Drive.

It is recommended to connect the proposed link road further east of the commercial centre and into the residential road network. This would improve access for residential areas and reduce through traffic along the commercial precinct access.

Houston Mitchell Drive is mostly a narrow, hilly and winding road that connects Ocean Drive with the Pacific Highway. Houston Mitchell Drive through to the Pacific Highway will need upgrading to accommodate the additional traffic generated by the proposed development. In addition, consideration of how that traffic would safely enter and exit the Pacific Highway will need to be resolved with the RTA.

This page left intentionally blank