services, proposed access and internal layout and traffic generation and associated effects as a result of the development.

Proposed traffic generation figures and intersection operations analyses were based on RTA standards and modelled using the SIDRA program.

5.3.3 Existing Conditions

Road Network

The site is located to the west of Nowra and the road network in the immediate vicinity of the site servicing Mundamia includes Albatross Road, Yalwal Road, George Evans Road, Jonsson Road and Stonegarth Road.

Albatross Road provides Nowra with access to the Flinders Industrial Estate and this also forms part of a network that ultimately connects Nowra with Braidwood via Main Road 92.

Yalwal Road connects with Albatross Road at West Nowra to the east of the subject site, with Burrier and Yalwal in the west. Yalwal Road is provided with a sealed surface, and to the west of Mundamia, Yalwal Road has a 100 km per hour speed limit, whilst to the east, a 60 km per hour speed limit prevails. Yalwal Road intersects with Albatross Road with an unsignalised t-intersection, with Albatross Road having priority.

George Evans Road extends off Yalwal Road to the north via an unsignalised t-intersection, where give way signs provide Yalwal Road with priority. At this intersection, turning via Yalwal Road into George Evans Road, there are two marked westbound lanes, enabling westbound traffic to pass a vehicle turning right into George Evans Road. George Evans Road provides one traffic lane in each direction, with a sealed surface to the south of the University of Wollongong campus, and beyond this complex (to the north) the road is unsealed.

Both Jonsson and Stonegarth Roads are unsealed, and connect surrounding rural properties with George Evans Road.

A plan prepared by CBHK showing the existing road network is reproduced as **Figure 12** below.

8351 - Mundamia Subdivision

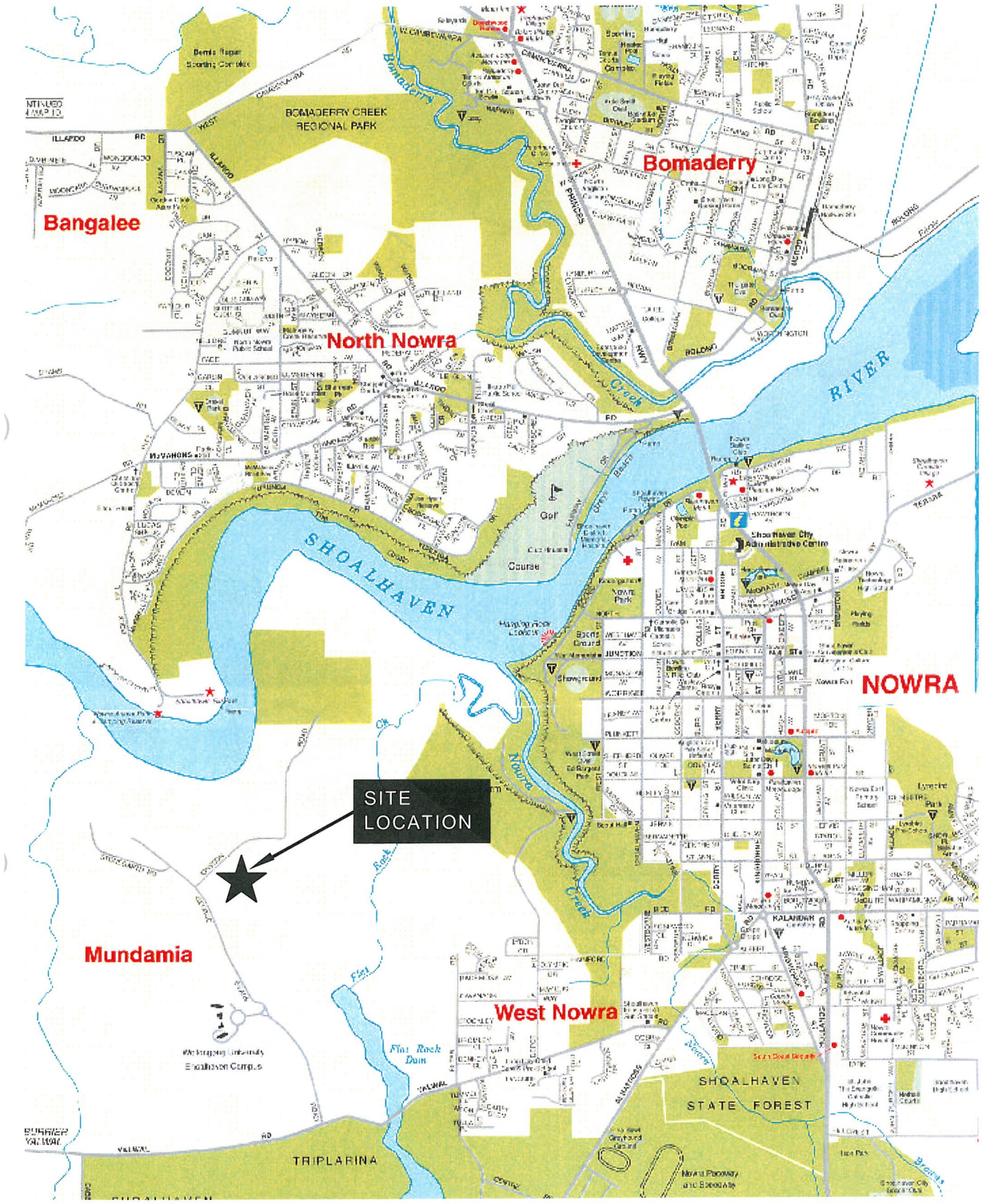

Figure 12: Existing road network. (Plan prepared by CBHK Pty Ltd)

Traffic Flow Counts

According to CBHK, traffic generated by the proposed subdivision will have the greatest impacts during weekday morning and afternoon peak periods. In order to assess these impacts, traffic counts were undertaken at various intersections during these periods to establish existing traffic movements. The intersections included:

- Albatross Road/Yalwal Road;
- Yalwal Road/George Evans Road;
- George Evans Road/university access.

The results of these surveys are summarised in **Table 6** below and show the greatest traffic flows occurring along Albatross Road, with some 1050 to 1150 vehicles per hour two-way during the morning and afternoon peak periods. Significantly lower flows were recorded on Yalwal Road, George Evans Road, and the University access.

Table 6
Existing Two-Way (sum of both directions) Peak Hour Traffic Flows

Road	*Location*	*AM Peak Hour*	*PM Peak Hour*
Albatross Road	North of Yalwal Road	1050	1130
	South of Yalwal Road	595	710
Yalwal Road	West of Albatross Road	605	630
	East of George Evans Road	275	280
	West of George Evans Road	175	155
George Evans Road	North of Yalwal Road	120	145
	North of University access	15	15
University Access	West of George Evans Road	105	130

Intersection Operations Analysis

The capacity of the existing intersections around the site were analysed using the SIDRA program in order to ascertain the ability of the intersections and road networks to cater for peak period traffic flows. SIDRA is an analytical tool to evaluate alternative intersection designs in terms of capacity, level of service, a wide range of performance measures including delay, queue length and the like. A useful measure is the average delay per vehicle which results in the allocation of a level of service (LOS), ranging from A to F with A representing a good LOS, and F indicating an unsatisfactory LOS that requires additional capacity.

Based upon the above modelling, the analysis undertaken by CBHK indicates that all existing intersection currently operate with an average delay of less than 15 seconds per

vehicle on both the morning and afternoon peaks periods, which represents a LOS of A/B, which is a good LOS.

Public Transport

A bus service is currently provided in the area by Nowra Coaches which services the University of Wollongong Campus, and connects with the Bomaderry Railway Station via the Nowra town centre.

5.3.4 Assessment of Proposal

Access and Internal Layout

Vehicular access to the site will be provided via George Evans Road which will require some realignment to the south of the site, and extension to the north to service the proposed subdivision. In addition, a new roundabout will be provided to facilitate access to the University of Wollongong Campus, and other properties to the west.

According to CBHK, the new roundabout will function with average delays of less than 15 seconds per vehicle during peak periods, which represents a LOS of A/B which is good.

The proposed subdivision is to be provided with a collector road (major spine road) which is to have a reserve width of 20 metres, with a nine metre constructed carriageway to accommodate buses, and 5.5 m verges on both sides. Local streets are provided with an 18 m wide reserve, with nine metre wide carriageways, and 4.5 metre verges. Access streets are to have a 16 m reserve, with four metre verges and eight (8) metre constructed carriageways. Access places are to have a 13 m wide reserve, with four metre verges on each side, and therefore a 5 m wide carriageway.

Internal road layout and access provisions will be designed in accordance with Council's DCP 100 - Subdivision Code, a document which is based on AMCORD requirements. AMCORD identifies two levels of streets, being local streets and collector streets.

- Local streets are those where the residential environment dominates. Traffic volumes and speeds are low and pedestrian and cycle movements are encouraged, with cycle movements on street. According to AMCORD, vehicle speeds should be restricted by street length, parked cars, landscape design, built form and activity along the frontage.
- Collector streets carry higher traffic volumes as they collect traffic from access streets. Residential amenity and safety is to be maintained to a good standard by restricting traffic volumes and vehicular speeds. Speeds are to be controlled through street alignment, parked cars, street length, intersection design and built form.

CBHK consider that use of Council's Subdivision Code and AMCORD guidelines provides an appropriate assessment base in order to promote alternative travel modes to private vehicle trips such as cycling and pedestrian movements.

Traffic Generation Impacts

According to CBHK, traffic generation will have its greatest effect during the morning and afternoon peak periods. According to surveys carried out by the RTA, residential subdivisions generate approximately 0.85 two-way vehicular movements per hour per lot during peak hours. On the other hand, Council's Subdivision Code DCP No. 100 calculates traffic generation based on an estimated 10 trips per day, two-way. The assessment undertaken by CBHK has used the higher traffic generation rates utilised in Council's Subdivision Code DCP No. 100.

The application proposes 312 residential allotments, some of which have the potential to be developed to accommodate medium density housing and dual occupancies. According to CBHK, total traffic generated by the project will result in some 310 to 300 two-way vehicle trips in the morning and afternoon peak hours. Approximately 70 percent of traffic generated in the morning peak period would be outbound, and this is expected to be reversed in the afternoon.

CBHK in their assessment have assigned the additional traffic to the road network, and reassessed the existing conditions utilising SIDRA. A summary of proposed traffic generation as produced by CBHK is reproduced below as **Table 7**.

Table 7

Projected Two-Way Peak Hour Traffic Flow (CBHK 2008)

Road	***Location***	***AM Peak Hour Existing***	***AM Peak Hour Plus Development***	***PM Peak Hour Existing***	***PM Peak Hour Plus Development***
Albatross Road	North of Yalwal Road	1050	+ 245	1130	+ 245
	South of Yalwal Road	595	+ 45	710	+ 45
Yalwal Road	West of Albatross Road	605	+ 290	630	+ 290
	East of George Evans Road	275	+ 290	280	+ 290
	West of George Evans Road	175	+ 15	155	+ 15
George Evans Road	North of Yalwal Road	120	+ 305	145	+ 305
	North of University Access	15	+ 330	15	+ 330
University access	West of George Evans Road	105	+ 25	130	+ 25

The analysis undertaken by CBHK demonstrates traffic increases of 245 to 330 two way vehicle trips would occur on Albatross Road (north of Yalwal Road), Yalwal Road (east of George Evans Road) and George Evans Road during peak hours.

Increases on Albatross Road (south of Yalwal Street), Yalwal Road (west of George Evans Road) and the university access are likely to be less than 50 vehicles per hour two-way.

Within the subdivision itself, traffic is expected to carry less than 100 trips per hour two-way, apart from the collector road.

SIDRA analysis of these traffic volumes has determined that the existing unsignalised intersections of Yalwal Road with Albatross Road, and George Evans Road, and the roundabout at the intersection of George Evans Road and the University will operate with average delays of less than 20 seconds, representing a LOS of B, which is a reasonable or better LOS.

In accordance with the DG's EARs, CBHK have also considered 10 year future traffic flows, along with holiday traffic. According to CBHK, accounting for traffic growth requires an increase in traffic of 2% compound over this 10 year period, and then adding the traffic generated by this project. Consideration of the 10 year future growth, plus additional traffic reveals that existing afternoon peak hour traffic flows would increase by some 30% over current volumes. The intersection of Albatross and Yalwal Roads has been reanalysed by CBHK using SIDRA, and this found that the intersection would benefit from an upgrade at some time in the 10 year horizon encompassing the provision of a separate left and right turn lanes from Yalwal Road into Albatross Road. With this treatment, the SIDRA analysis found that the intersection would perform with average delays of some 25 seconds or less per vehicle, which represents a LOS B, which is a reasonable LOS with acceptable delays and spare capacity.

Local surveys undertaken by CBHK during holiday periods indicate that afternoon peaks experience an increase of some 30% over non holiday periods. During morning peaks, holiday flows are less than non-holiday periods and as such, it is not necessary to assess this any further. According to CBHK, SIDRA analysis of the additional traffic generated during holiday periods, coupled with the 10 year growth, results in an average delay of less than 28 seconds at the intersection of Albatross and Yalwal Roads, which represents a LOS of B, which is a reasonable LOS with acceptable delays and spare capacity. Consequently, with the separate left and right turn lanes implemented at some time prior to the ten year horizon at the Yalwal Road/Albatross Road intersection, CBHK consider that the road network will have capacity to accommodate traffic from the

proposed development, future growth over a 10 year period, plus additional flows generated during holiday periods.

Public Transport

The locality is already provided with a bus service which provides public transport to the nearby University of Wollongong campus. The proposed collector road within the proposed subdivision layout will enable access by buses, and the additional residential population will improve overall demand, and therefore the viability of any service, the result being that this new living area will result in an improved public transport service.

5.3.5 Conclusions

CBHK have undertaken a Transport Assessment to assess potential traffic impacts associated with this major project. The analysis undertaken has included an assessment of the existing road network and public transport in the locality, as well as traffic volume counts at relevant intersections, along with surveys and modelling using the specified SIDRA program to evaluate the capacity of intersections to cater for peak period traffic flow. Furthermore, the analysis has included future growth for a 10 year period, and includes an assessment of traffic conditions experienced during holiday periods.

Results of the assessment reveal that the existing road network and intersections currently operate with good LOS, and the addition of traffic expected to be generated by this proposal will not have significant traffic and transport impacts, however provision of separate left and right turn lanes from Yalwal Road into Albatross Road is recommended some time over the ten year horizon to cater for the next ten years growth which is anticipated.

Having regard to the provision of public transport, the report acknowledges the existence of a regular bus route servicing the University, and the viability of and demand for this service is likely to be strengthened by the project. This existing service can readily be extended into the residential subdivision to cater for the new living area and the road network will be designed to cater for this potential bus route.

5.4 HAZARD MANAGEMENT AND MITIGATION

5.4.1 Coastal processes and flooding

This Section of the EA deals with the impacts of coastal processes and flooding and considers the impacts of the proposed subdivision the subject of this EA.

5.4.1.1 Introduction

The subject site is located within the coastal zone due to its proximity to the Shoalhaven River. However, the property is sited well away from the actual coastline being some 16 kilometres (direct line) from the ocean which is to the east of the locality. The site does not form part of the Shoalhaven River floodplain, as it comprises land having an elevation which ranges between RL 36 m and 70 m AHD, separated by a large sandstone cliff face. Developable parts of the property are sited at a minimum level of RL 46 m AHD. The height of the subject site is well above known flood levels identified by SCC. The provisions of Shoalhaven LEP 1985 identify flood affected properties by either applying a specific zone such as Rural 1(g) – Flood Liable in rural areas or Urban Floodways 9(a) in urban areas, or alternatively identifying such lands with a distinctive line. The subject site is not so identified by Shoalhaven LEP 1985 and therefore, is not mapped as being subject to flooding hazards.

5.4.1.2 Coastal Processes

The subject property is sited well away from the actual coastline and is not subject to coastal processes and hazards such as beach erosion, shoreline recession, or coastal inundation. Consequently, these processes are unlikely to have any impact on the site or the proposal.

Having regard to sea level rise, Storm Consulting have advised in their Water Cycle Management Report (**Annexure 7)** that sea level rise has no impact on the development as the lowest portion of the site is at least RL 30 m AHD. This height is well above expected sea level rise predictions that have been forecast due to climate change impacts.

5.4.1.3 Flooding

The proposed developable portions of the subject land have an elevation that ranges between RL 46m AHD to RL 70m AHD. This is well above known flood levels. According to SCC's Flood Mitigation Engineer, the planning level flood (i.e. the 1 in 100 year ARI) at the crossing of the Shoalhaven River at Nowra, has a height of RL 6.5 m AHD, whilst the Probable Maximum Flood (PMF) has a height of RL 9.3 m AHD. The proposed site is clearly well above these levels by at least 36 metres. Although the bridge crossing is downstream from the subject site, it is considered reasonable to utilise this information as flood levels for the Shoalhaven River are not expected to vary significantly and certainly not to the extent that would affect the 36 metre height difference available in this instance.

Given the above, it is reasonable to consider that the subject site is not affected by flooding associated with the Shoalhaven River.

The site is in the vicinity of the Flat Rock Creek dam and Flat Rock Creek watercourse, however mapping prepared by SCC does not identify this as flood prone. Furthermore, perusal of the 1:25000 topographic map for 'Nowra' shows that Flat Rock Dam has a height of approximately RL 40 m AHD, whilst Flat Rock Creek in the vicinity of the subject site, falls from 40 m AHD to below 20 m AHD to the north of the site. Consequently, it is unlikely that the subject site, and therefore the proposal, would be subject to localised flooding from Flat Rock Creek given the developable portion of the subject site (at minimum RL 46 m) is well above these levels.

The site itself is not traversed by any existing watercourses that are likely to lead to flooding of the property.

Localised drainage and stormwater matters are dealt with in Section 5.4.5 of this EA.

5.4.1.4 Conclusion

The subject site is very remote from the actual coastline and is physically separated, and is therefore is unlikely to be affected by coastal processes. Further, the site is of an elevation that is well above known flood levels, or sea level rise predicted by the IPCC, by in excess of 30 metres.

Consequently, it is considered that coastal processes and flooding will not affect the development of the subject site.

5.4.2 Site Contamination

5.4.2.1 Introduction

This section deals with the potential of the subject property to be affected by site contamination and the impacts such may have on the Part 3A Major Project. This section is based on the reports titled Stage 1 Contamination Assessment, Stage 2 Environmental Site Assessment and Remedial Action Plan prepared by Martens Consulting Engineers which forms **Annexure 5** of this EA.

5.4.2.2 Contamination Assessment

Martens Consulting Engineers were engaged to undertake a Stage 1 Assessment in accordance with the requirements of SEPP 55 – Remediation of Land. This assessment included:

- A review of previously existing land uses and site history including a review of development consent history, interview of existing land owners, search of SCC records;
- Search of NSW Environment Protection Authority records; and
- Aerial photograph interpretation.

The research undertaken by Martens Consulting Engineers has revealed that the site has been the subject of predominantly a rural land use with low to medium intensity for approximately 35 years, which is confirmed by both the oral history and aerial photograph interpretation. This rural land use also dominates the use of other local and nearby properties for greater than 50 years and presents a low risk of impacting on the subject site. The subsurface investigations that were undertaken revealed no visual or olfactory (odour) evidence of contamination. The southern portion of the site contains a number of rubbish piles and these contain various materials including chemical drums, fibrous cement sheeting, rusted farm machinery, chain link wire fencing whilst Lot 384 contains a dilapidated building which contains some fibro sheeting. Site inspections undertaken by Martens Consulting Engineers did not detect any evidence of chemical contamination, usually apparent by way of soil staining or plant stress.

The assessment undertaken by Martens Consulting Engineers identified the following potential 'hotspots', shown in tabular form as **Table 8**:

Table 8

Potentially Contaminated Locations, Contaminating Activities and Contaminants

Location	***Activity***	***Potential Contaminants***
Dwellings, livestock yards and sheds, southern portion of the site (Lot 384).	Storage of machinery, fertilisers and other chemicals. Sheds and dwellings possibly containing asbestos materials.	HM Herbicides, OCP/OPP asbestos.
3 dams located on Lot 384.	Accumulation of heavy metals, herbicides and pesticides from various farm activities.	HM, Herbicides, OCP/OPP.
Scattered disused machinery and areas of rubbish fill and soil stockpiling, across the site (see Figures 1 & 2 of that report).	Dumping of old car parts, various pieces of machinery, fibro sheeting and other building products.	HM, TRH, BTEX, PAH's, OCP/OPP and asbestos.
Paddocks of Lot 3 and Lot 384.	Agricultural activity utilising pesticides, herbicides and fungicides.	HM, OCP/OPP.