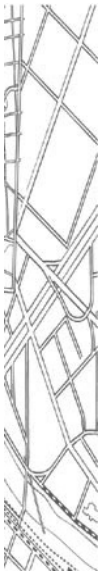

Traffic Report

Kingscliff Resort - Casuarina Way, South Kingscliff (New South Wales)

10 December 2009

Prepared for

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Executive Summary

The Traffic Impact Assessment for the proposed Kingscliff Resort, located along Casuarina Way in South Kingscliff has adhered to the prescribed procedures outlined in the Road and Traffic Authority of NSW *Guide to Traffic Generating Developments*. The scope and objective of the Traffic Impact Assessment are as follows:

- Quantify traffic impacts along Casuarina Way adjacent to the proposed development and in particular, at the proposed access locations;
- Quantify the traffic impacts on Cudgen Creek Bridge; and
- Ensure that from a traffic and transport perspective, the Resort complies with relevant standards and planning guidelines.

The subject site is currently undeveloped and has a total area of 43.4 hectares. The resort site is anticipated to encompass an area of 11.67 hectares and is proposed to include four vehicular access points along Casuarina Way. Details of the vehicle access points are as follows:

- The primary access to the proposed development will be located on Casuarina Way at the north eastern boundary of Lot 490. This intersection is proposed to be a roundabout arrangement and will provide vehicular access to the Resort facilities and accommodation uses as well as the public beach car parking area. SIDRA analyses of the intersection for the day of opening and a 10-year design horizon indicate that there is considerable spare capacity provided within the proposed intersection form and a LOS A is provided on all approaches for all analysis scenarios;
- A Maintenance Area access point, which will be a dedicated vehicular access for the Resort's employee car parking area and the Resort's Maintenance Area is to be located on Casuarina Way on the southern boundary of Lot 490. This access is proposed to be a basic priority-controlled intersection configuration. The SIDRA analyses supported the appropriateness of the intersection form in terms of its operational requirements as all approaches were shown to perform at a LOS C or better for all approaches and all design scenarios;
- An access will be provided for the public parking facilities which support the recreational uses between the Primary and Maintenance Area accesses, on the northern side of Casuarina Way. Due to the relatively small vehicle volumes

anticipated to utilise this access, a basic priority controlled intersection arrangement is deemed to be suitable; and

- A formalised intersection and parking arrangement will be provided to the north of the primary resort access. This is to replace the informal beach access which currently exists. Similar to the recreational parking access discussed above, a basic priority controlled intersection arrangement is deemed to be adequate. For the purposes of this analysis and this phase of the masterplanning, it has been assumed that this intersection will cater for all movements. It is possible that some turn movement restrictions could be required due to its proposed location on a bend and its proximity to Cudgen Creek Bridge. However, this will be determined during the detailed design phase when detailed road survey information becomes available.

The proposed development is to comprise a number of land uses, but the primary intention is to provide resort style accommodation. The development description is as follows:

- The resort will provide a combination of accommodation types, ranging from 2 bedroom units to 3 bedroom bungalows;
- The 2 bedroom units and 2 bedroom bungalows are to be equipped with a dual key, allowing for two separate tenancies of 1 bedroom each;
- Resort facilities will include restaurant, bar, conference facilities, administration/office and some retail space;
- An interpretive centre will also be provided on site;
- Formalised public beach access to Bogangar Beach will be provided; and
- Formalised public parking will be provided for the recreational facilities located to the north of Casuarina Way and beach access located to the south of Cudgen Creek Bridge.

The anticipated traffic generation for the proposed development is summarised in the following table.

Table 1-1 Trip Generation – The Resort

Land Use	Quantity	Trip Generation (vehicles per day)	Trip Generation (vehicles per hour)
Resort Accommodation[(a)]			
• 2-Bedroom Units	143 units	429	57

Land Use	Quantity	Trip Generation (vehicles per day)	Trip Generation (vehicles per hour)
(dual key assumed) • 2-Bedroom Bungalows	65 units	195	26
(dual key assumed) • 3-Bedroom Bungalows	37 units	111	15
• Beach Side Bungalow	12 units	36	5
Resort Accommodation • Journey to Work (employees)	40 car parking spaces	160	AM Peak: 40 PM Peak: 80
Retail[(b)]	75 m² GFA	60	6
Restaurant/Bar[(b)]	256 m² dining area	115	10
Conference Facility[(b)]	250 m² GFA/ 214 seats	19	4
Administration/Office Space	90 m² GFA	7	1
Interpretive Centre[(b)]	150 m² floor area	11	2
TOTAL TRIPS		**1,143**	**166 (AM Peak)** **206 (PM Peak)**

(a) Assumes 85% occupancy of available unit keys as per RTA Guide to Traffic Generating Developments.

(b) Reduced by 25% to account for assumed custom of persons staying within resort.

Vehicle movements to and from the public beach accesses and the recreational area to the north of Lot 490 have been determined through statistical analysis, as trip generation rates were not available at the time of this report. The anticipated trip generation resulting from the proposed parking supply are indicated in the following table.

Table 1-2 Trip Generation – Public Carparking Area

	Trip Generation (vehicles per day)	Trip Generation - AM Peak (vehicles per hour)	Trip Generation PM Peak (vehicles per hour)
Main Beach Access	177	14	20
Rec Area	31	2	4
North of Development	31	2	4

Given the expected trip generation for the proposed development and the current and future levels of background traffic, it was determined that both Casuarina Way and the Cudgen Creek Bridge would be able to cater for the anticipated increases in traffic. Typically, a road forming the function to that of Casuarina Way and Cudgen Creek Bridge would be expected to cater for daily traffic volumes in the range of 7,000-10,000 vehicles. The results presented in the following tables indicate that the daily traffic volumes are at the lower end of this traffic capacity range, even at the 2022 design horizon. Therefore, the two-lane two-way cross-section of Casuarina Way

and Cudgen Creek Bridge are expected to support daily traffic volumes both without and with the additional traffic generated by the Resort and the public beach access parking area during the 2012 and 2022 future years.

As part of the Traffic Impact Assessment, a number of recommended works for transport infrastructure have been detailed. These include:

- Provision of a roundabout at the intersection of the main access with Casuarina Way;
- Provision of a basic priority-controlled access driveway at the Maintenance Area access (ie. utility facility and employee car park access) with Casuarina Way;
- Provision of basic priority controlled access intersections at the public beach and recreational parking areas;
- Provision of connections into the existing pedestrian/cycleway network and the provision of additional pedestrian/cycleway facilities within land between Cudgen Creek and Casuarina Way and connections to the public beach to the east of the site;
- Provision of indented bus bays on each side of Casuarina Way adjacent to the Resort; and
- Provision of a pedestrian refuge island in Casuarina Way central to the aforementioned bus bays.

In terms of the adequacy of internal circulation roads, it has been determined at this stage in the master planning that the proposed cross sections and manoeuvring areas are adequate for the expected uses and traffic demands. Further design and refinement of the internal circulation roads will be developed in accordance with Australian Standard *AS 2890.1:2004 – Parking Facilities Part 1: Off-Street Car Parking.*

Parking supply (both vehicle and cycle) has also been cross checked against Tweed Shire Council requirements, and these have also been deemed adequate. Servicing arrangements have also been considered and provision supplied in accordance with the relevant standards.

Council's *Section 94 Plan04 – Tweed Road Contribution Plan* provides a financial strategy for the provision of roads in the Tweed Shire to satisfy travel growth demands. Given the requirements of this plan, a Standard Contribution shall apply to the

proposed development. The Standard Contribution is determined from the product of a sector-based unit rate and the estimated traffic generation of the development. The proposed Resort development is located within *Sector 7 – Duranbah / Cabarita*. For this sector, the sector-based unit rate is $868 per daily vehicle trip-end. As detailed in Table 1-3, the estimated cost contribution for roads in Tweed Shire has been calculated to be $771,444.

Council's *Section 94 Plan 22 – Cycleways* explains the levying of contributions for new development towards the cost of cycleway infrastructure within Tweed Shire. This plan refers specifically to new development of residential and tourist accommodation uses. The contribution applicable to the Resort development is based on the total number of tourist accommodation beds at a cost of $136 per bed. The estimated cycleway contribution costs attributable to the proposed Resort development under Council' s *Section 94 Plan 22 – Cycleways* is estimated to be $56,848.

The proposed development is to include the provision of pedestrian and cycle paths on the northern portion of the site adjacent to Cudgen Creek. It is understood that Leighton Properties would enter into discussions with Council in relation to the possibility of obtaining credit for these additional community facilities against the estimated cycleway contribution costs.

Table 1-3 Road Contribution Costs

Land Use	Daily Trip Rate[(a)]	Trip Generation (vehicles per day)	Road Contribution Costs
Resort Accommodation[(b)]			
• 143 x 2-Bedroom Units (dual key assumed)	2.48 trips per key	354.6	$307,828
• 65 x 2-Bedroom Bungalows (dual key assumed)	2.48 trips per key	161.2	$139,922
• 37 x 3-Bedroom Bungalows	2.48 trips per unit	91.8	$79,648
• 12 x Beach Side Bungalow	2.48 trips per unit	29.8	$25,832
Resort Facilities			
• 75 m² GFA of shop	60 trips per 100 m² GFA	45.0	$39,060
• 256 m² GFA of restaurant/bar[(c)]	50 trips per 100m² GFA	128.0	$111,104
• 250 m² GFA of conference[(d)]	16 trips per 100m² GFA	40.0	$34,720
• 90 m² GFA administration/office[(d)]	16 trips per 100m² GFA	14.4	$12,499
Interpretive Centre			
• 150 m² floor area[(d)]	16 trips per 100 m² GFA	24.0	$20,832

TOTAL TRIPS	**888.8**	**$771,444**

(a) Source: Section 94 Plan 04 – Tweed Road Contribution Plan (Tweed Shire Council, 2007)
(b) Assumes 85% occupancy of available unit keys as per RTA Guide to Traffic Generating Developments.
(c) Assumes hospitality facility use equivalent trip generation
(d) Assumes commercial premises equivalent trip generation

Table 1-4 Cycleways Contribution Costs

Tourist Accommodation	Total Beds	Cycleway Contribution Costs
84 x 2-bedroom Units	168	$22,848
38 x 2-bedroom Bungalows	76	$10,336
44 x 3-bedroom Bungalows	132	$17,952
14 x 3-bedroom Beach Side Bungalows	42	$5,712
Totals	418	$56,848

Contents

List of Figures

List of Tables

1. Introduction

1.1 Background

Halcrow Pacific Pty Ltd (trading as Halcrow MWT) was commissioned by Leighton Properties Pty Ltd (Leighton Properties) to undertake a Traffic Impact Assessment for the development of a tourist resort (the Resort), to be located on Casuarina Way, Kingscliff.

This report will accompany the development application for this site.

1.2 Scope of Report

The scope of this report is to assess the traffic and transport related impacts of the proposed development on the external Tweed Shire Council owned network. Where adverse impacts are identified, mitigation strategies will be recommended. Internal access provision will also form part of this traffic investigation.

The assessment is presented in this report through the following chapters:

Chapter 2 - describes the subject site in terms of its locality, existing landform and vehicle access arrangements;

Chapter 3 - is a description of the existing transport situation in the vicinity of the proposed development;

Chapter 4 - describes the proposed development in terms of its anticipated land uses, proposed vehicle access and circulation characteristics, parking provision and service vehicle arrangements;

Chapter 5 - presents the results of the traffic generation, traffic distribution and resultant impact analysis. Mitigation strategies for the management of identified impacts will also be discussed in this chapter;

Chapter 6 - outlines the development contributions; and

Chapter 7 - is a summary of conclusions and recommendations.

1.3 Reference Resources

The assessment of the proposed development's traffic and transport elements considers the requirements of the following planning documents and standards:

- *Guide to Traffic Generating Developments* (Road and Traffic Authority of NSW (RTA), 2002);
- *Tweed Shire Development Control Plan: Section A2 – Site Access and Parking Code (*Tweed Shire Council, 2007);
- *Tweed Shire Development Control Plan: Section A5 – Subdivision Manual (*Tweed Shire Council, 2008); and
- *AS2890.1:2004 – Parking Facilities Part 1: Off-Street Car Parking* (Australian Standards, 2004).

1.4 Key Issues & Objectives

The RTA *Guide to Traffic Generating Developments* provides the following definition for Traffic Impact Assessments:

"A traffic impact study is a simplified technical appraisal of the traffic and safety implications relating to a specific development. The information provided in the study should enable the relevant authorities to assess the traffic impact of a development."

The translation of this definition into the context of the Resort yields the following objectives for the study:

- Quantify traffic impacts along Casuarina Way adjacent to the proposed development and in particular, at the proposed access locations;
- Quantify the traffic impacts on Cudgen Creek Bridge; and
- Ensure that from a traffic and transport perspective, the Resort complies with relevant standards and planning guidelines.

2. Subject Site

2.1 Site Locality

The subject site is described as Lot 490 DP1095234, South Kingscliff in New South Wales as shown in Appendix A. It also comprises part of Lot 489 DP47021 and Lot 500 DP1095234.

The subject site has frontage to Bogangar Beach to the east and is bounded by Cudgen Creek along its northern and western boundaries. The site adjoins the *Salt* development on the southern boundary. Casuarina Way dissects the subject site.

2.2 Site Description

The subject site is currently undeveloped and has a total area of 43.4 hectares. The Resort site, which is located on the eastern portion of Lot 490 DP1095234, encompasses an area of 11.67 hectares. The majority of the site is zoned as 2(f) Tourism Zone with potions of the riparian creek edge being within the 7(a) Environmental Protection (Wetlands and Littoral Rainforests) Zone and part of Lot 500 DP1095234 is within the 7(f) Environmental Protection (Coastal Lands) Zone.

2.3 Vehicular Access

Given the undeveloped nature of the site, there is currently no formal vehicular access. However, site investigations have revealed that there are some instances of informal access relating to Bogangar Beach.

3. Existing Traffic & Transport Conditions

3.1 Road Network

3.1.1 Casuarina Way

Casuarina Way is a two lane Council owned road which is classified as an Urban Collector. It spans from the Cudgen Creek Bridge though to Dianella Drive, situated off Tweed Coast Road, Casuarina.

3.1.2 Cudgen Creek Bridge

Cudgen Creek Bridge has undergone upgrade works for the provision of a dedicated pedestrian/cycleway. It has also been upgraded to provide for two lanes of traffic, where previously it operated as a single lane two-way bridge.

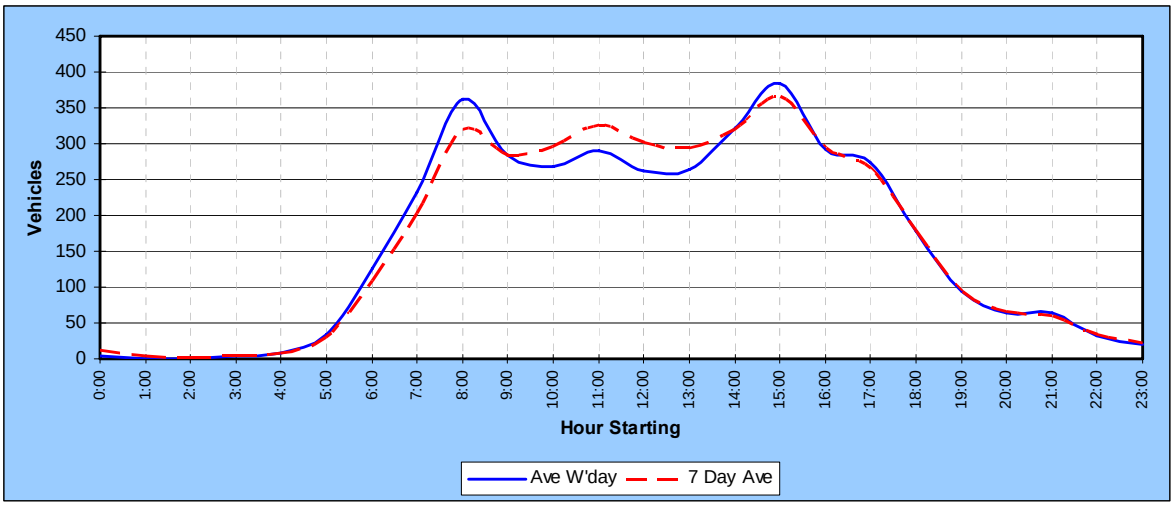
3.2 Traffic Flows

AusTraffic was commissioned to undertake weekly classified counts for Casuarina Way between Viking Street and Elliston Street, Kingscliff. The daily traffic profile is shown in Figure 3-1 and a summary of traffic count information is provided in Table 3-1.

Table 3-1 Traffic Count Summary (2008) – Casuarina Way

Time Period	Traffic Volume / % HV
AM Peak (8:00 AM – 9:00 AM)	320 / 5%
PM Peak (3:00 PM – 4:00 PM)	370 / 5%
Average Weekday Traffic (Monday – Friday)	3860 / 5%
Average Daily Traffic (Monday – Sunday)	3890 / 5%

Full reporting of results for the traffic survey is included in Appendix B.



Source: AusTraffic Data Report (Appendix B)

Figure 3-1 Daily Traffic Profile – Casuarina Way

3.3 Parking Supply & Demand

The subject site does not currently provide any formal car parking. There is currently a small demand for parking associated with the beach, and this is largely located off street, south of the Cudgen Creek Bridge on the eastern side of Casuarina Way.

3.4 Public Transport

3.4.1 Bus

Currently, there is only one scheduled local bus service proximate to the subject site, namely Surfside Buslines *Route 603*. This service operates between Tweed Heads and Pottsville with the frequencies presented in Table 3-2.

Table 3-2 Surfside Buslines 'Route 603' – Service Frequencies

Direction	Day of Week		
	Monday to Friday	Saturday	Sunday
Tweed Heads To Pottsville	Hourly (7:30am – 6:30pm) 12 services daily	Hourly (7:30am – 6:30pm) 12 services daily	Hourly (7:30am – 5:30pm) 11 services daily
Pottsville to Tweed Heads	Hourly (7:20am – 7:20pm) 13 services daily	Hourly (7:20am – 6:20pm) 12 services daily	Hourly (8:20am – 6:20pm) 11 services daily

3.4.2 Rail

The nearest New South Wales-based passenger rail service to the subject site is CountryLink's *North Coast Train Service* which provides an interstate rail connection between Sydney in New South Wales and Brisbane in Queensland. The nearest station on this rail service is Kyogle some 90km (by road) to the west of the subject site. It should also be noted that the nearest Queensland-based rail station is the Robina Station on Queensland Rail's *CityTrain* network. The Robina Station is the southern-most station on *CityTrain's* Brisbane-Gold Coast Line and is approximately 40km (by road) to the north of the subject site.

3.5 Non-Motorised Mode Networks

3.5.1 Pedestrians

The pedestrian movement network in the vicinity of the proposed development largely coincides with the cycleway. Further comment is provided in the following section.

3.5.2 Bicycle

Tweed Shire currently has an extensive cycleway network. In the vicinity of the site, an off-road cycleway runs parallel to the coastline on the western potion of Lot 500. The cycleway connects with the pedestrian/cycle crossing over Cudgen Creek and runs as far north as Tweed Heads. The cycleway to the south is currently incomplete. The existing connection terminates at Avoca Street.

3.6 Current / Proposed Traffic & Transport Upgrades (Tweed Shire Council)

3.6.1 Road Improvements

Other than the Cudgen Creek Bridge upgrade (see Section 3.1.2), no other significant road improvements have been identified at the time of this report.

3.6.2 Cycleway Improvements

As mentioned in Section 3.5.2, the cycleway network to the south of the proposed development is currently incomplete. The Tweed Shire Council Cycleway Network map indicates that there is a plan to construct a cycleway between Avoca Street and Coogera Lane. Once this connection is constructed, the cycleway will run continuously from Tweed Heads in the north through to Pottsville in the south.

3.7 Current / Proposed Developments in the Vicinity

To the north of the site and Cudgen Creek Bridge, development is largely residential. To the south of the site is the *Salt* development.

4. Proposed Development

4.1 The Development

4.1.1 Land-Uses

The proposed development is to comprise the following:

- A combination of accommodation types, ranging from 2 bedroom units to 3 bedroom bungalows;
- The 2 bedroom units and 2 bedroom bungalows are to be equipped with a dual key, allowing for two separate tenancies of 1 bedroom each;
- Resort facilities are to incorporate restaurant, bar, conference facilities, administration/office and some retail space;
- An interpretive centre. It will be a primarily external place celebrating the local culture. It has been assumed for the purposes of this report that the interpretive centre will operate similar to a public art gallery;
- Formalised public beach access to Bogangar Beach; and
- Formalised public parking for the proposed recreational facilities to the north of Casuarina Way (between the resorts primary and Maintenance Area accesses) and the currently temporary beach access located directly south of Cudgen Creek Bridge.

Quantification of each land use type is provided in Table 4-1. A site layout plan is provided in Appendix C.

Table 4-1 Development Details

Land Use Description	Quantity/Floor Space
Resort Accommodation	
• 2-Bedroom Units	84 units and up to 168 keys
• 2-Bedroom Bungalow	38 units and up to 76 keys
• 3-Bedroom Bungalow	44 units
• Beach side Bungalow	14 units
Resort Facilities	
• Resort Reception	75 m^2 floor area
• Administration/Office Space	90 m^2 floor area
• Retail Space	75 m^2 floor area
• Restaurant	156 m^2 dining area
• Bar	100 m^2 floor area
• Conference Facilities	250 m^2 floor area & 214 seats

Interpretive Centre	150 m^2 floor area
Beach Access	Approximately 400 m active frontage

**Note: only trip generating components have been included in this table*

The 2 bedroom units and bungalows can be equipped with a dual key. This means that the accommodation has the capacity to cater for either 1 or 2 tenants. In the event that the accommodation is split and 2 keys are let, the 2 bedrooms will essentially become an individual unit or bungalow with only 1 bedroom each. At present, the number of dual key units is subject to change. Therefore, all calculations presented in this report are based on an 85% occupancy, which follows the suggestion presented in Section 3.4.1 of the RTA *Guide to Traffic Generating Developments*.

4.1.2 Operational Characteristics

The Resort will be open to all members of the public all year round.

4.1.3 Staging & Timing

The Resort is expected to be constructed and fully operational by 2012.

4.1.4 Design Vehicles

From time to time, large vehicles will require access to the Resort. These would typically include:

- Buses/Coaches;
- Refuse collection vehicles (RCV); and
- Delivery vans.

Provision for these vehicles has been considered and is discussed further in Section 4.3.

4.2 Vehicular Access

4.2.1 Locations & Form

Vehicle access to the site is proposed at four locations:

- The primary access to the proposed development will be located on Casuarina Way at the north eastern boundary of Lot 490. This intersection is proposed to be a roundabout arrangement and will provide vehicular access to the Resort facilities and accommodation uses as well as the public beach car parking area;
- A maintenance area access point, which will be a dedicated vehicular access for the Resort's employee car parking area and the Resort's service yard is to be located on Casuarina Way on the southern boundary of Lot 490. This access is proposed to be a basic priority-controlled intersection configuration;
- An access will be provided for the public parking facilities which support the recreational uses between the Primary and Maintenance Area accesses, on the northern side of Casuarina Way. Due to the relatively small vehicle volumes anticipated to utilise this access, a basic priority controlled intersection arrangement is proposed at this location; and

- A formalised intersection and parking arrangement will be provided to the north of the primary resort access. This is to replace the informal beach access which currently exists. Similar to the recreational parking access discussed above, a basic priority controlled intersection arrangement is proposed at this location. For the purposes of this analysis and this phase of the masterplanning, it has been assumed that this intersection will cater for all movements. It is possible that some turn movement restrictions could be required due to its proposed location on a bend and its proximity to Cudgen Creek Bridge. However, this will be determined during the detailed design phase when detailed road survey information becomes available.

The location and form of the vehicle access points are shown diagrammatically in the site layout plan provided in Appendix C.

It should be highlighted that the general public and Resort guests will not be permitted to access the Resort facilities and accommodation uses nor the public beach car parking area via the maintenance area access point in the south west corner of the site. All traffic associated with these uses will gain access via the primary access. Conversely, employee private vehicles will not be permitted to access the maintenance area parking via the primary access. The Resort's internal circulation road link between the maintenance area and the remainder of the Resort will serve only internal traffic movements associated with the Resort's day-to-day operations (eg. housekeeping, maintenance etc).

4.2.2 Sight Distance

A site investigation revealed that adequate sight distance is available at the following access locations:

- Primary roundabout access to the north of lot 490 as discussed in Section 4.2.1;
- Maintenance Area access to the south of lot 490 as discussed in Section 4.2.1; and
- Carpark access for the proposed recreational facilities located on the northern side of Casuarina Way, between the primary and Maintenance Area access locations, as discussed in Section 4.2.1.

Sight distance verification has not been undertaken for the proposed beach carpark access located between the primary resort access and Cudgen Creek Bridge. This will be undertaken during the detailed design phase when detailed road survey information becomes available.

4.3 Vehicular Circulation

4.3.1 Internal Circulation Roads – Resort

The width of vehicular circulation roads internal to the Resort have been designed to cater for expected users (ie. employee, guests) and traffic demands.

The vehicle circulation areas at the Resort facilities and maintenance parking areas are to be designed in accordance with Australian Standard *AS 2890.1:2004 – Parking Facilities Part 1: Off-Street Car Parking*. The internal circulation roads which will cater for the two-way movement of traffic will be designed with a minimum width of 6.2m.

The circulation roads within the Resort providing access to the accommodation uses and associated car parking areas will vary in width as follows:

- Sections of internal circulation roads adjacent to car parking areas will be designed with a minimum pavement width of 6.0m. This will cater for the manoeuvring of vehicles to and from adjacent car parking spaces.
- Internal circulation roads not immediately adjacent to car parking spaces will be designed with a minimum pavement width of 4.0m and 1.0m wide shoulders. While these sections of road do not have pavement widths typical of two-way circulation roads, the provision of trafficable shoulders will allow for vehicles travelling in opposing directions to pass. The widths of these circulation roads are expected to adequately cater for the low traffic demands associated with internal vehicular traffic generated by the Resort's accommodation uses.

4.3.2 Internal Circulation Roads – Beach Access

The vehicle circulation areas at the proposed public beach car parking area are to be designed in accordance with Australian Standard *AS2890.1:2004 – Parking Facilities Part 1: Off-Street Car Parking*. The internal circulation roads which will cater for the two-way movement of traffic will be designed with a minimum width of 6.2m.

4.3.3 Servicing Arrangements - Resort

Within the Resort a number of locations are to be provided to cater for service vehicles. These include:

- A service area and loading bay at the rear of the Resort facilities building for use by vehicles up to and including a heavy rigid vehicle (HRV) and refuse collection vehicle (RCV);
- A service area and loading bay within the Maintenance Area for use by vehicles up to and including an HRV and RCV; and
- A lay-by area adjacent to the western side of the Resort facilities building for use by tourist coaches / buses; and
- A turn around and manoeuvring area located to the rear of the Resort facilities building will be available for use by coaches/buses, HRVs and RCVs.

Given the proposed operations and the integrated nature of the Resort, these facilities are considered to be sufficient for expected service vehicle demands. These facilities are to be designed in accordance with Australian Standard *AS2890.2:2002 – Parking Facilities Part 2: Off-Street Commercial Vehicle Facilities*.

4.4 Car Parking

4.4.1 Planning Recommendations

Section A2 of the *Tweed Shire Council Development Control Plan* specifies varying parking rates for a number of land uses. Table 4-2 is a summary of parking requirements relevant to the development proposal.

Table 4-2 Tweed Shire Council – Parking Requirements

Item	Development Type	Parking Requirement	
		Staff Parking	Customer Parking
B7	Tourist Resort	1 per employee	1 per unit
C18	Shop (Retail)	1 per 100 m2 GFA	4.4 per 100 m^2
D15	Restaurant/Bar	1 per employee at the peak operating time	1 per 7 m^2 dining area
D20	Tourist Facilities (Conference Centre)	0.5 per employee	0.3 per 1 seat*
F2	Art Gallery (Interpretive Centre)	0.5 per employee	2 per 100 m^2 floor area
N/A	Beach Access	None	300 spaces per kilometre of beach frontage on a pro rata basis

**May be reduced for a hotel component, if applicable*

4.4.2 Proposed Supply

Presented in Table 4-3 is the proposed parking supply for customer parking. As shown in the table, the proposed development generally complies with the parking requirements set by Tweed Shire Council.

Parking Provision for "Conference Centre"

In terms of the parking requirement for the conference centre, TSC's DCP states that the parking rate for "conference centre" may be reduced if part of a hotel component. It would therefore be reasonable to assume that the rate of 0.3 spaces per 1 seat would apply to a stand-alone "conference centre". From our understanding of how parking rates are formulated, it would be reasonable to assume that TSC's parking rate for "conference centre" is based on a number of factors including:

- Vehicle occupancy rate;
- Mode share (ie. motor vehicle, walk, cycle, PT); and
- Some level of typical occupancy of the conference facility (ie. should not design for 100% capacity, but some level of typical capacity such as 80%)

However, if this rate is for a stand-alone "conference centre" then it does not include allowances for persons attending the conference that may be staying at the Resort. Considering this component, a "model" for determining a reasonable supply of parking for this Resort's "conference" centre would be:

$N \times (1 - P) \times 0.3$; where

- N = total number of seats in "conference centre"
- P = Percentage of conference attendees staying at resort (expressed as a decimal)
- 0.3 = the application of TSC's "conference centre" parking rate

For example if 50% of the conference attendees stay within the resort, then the "model" would be:

214 x (1 - 0.5) x 0.3 = 32 car parking spaces

Parking Provision for Beach Access

The TSC DCP states that "Developments associated with beach frontages may be required to provide adequate beach parking in addition to that required for nominated uses within the proposed development. Beach parking shall be assessed generally at 300 spaces per kilometre of beach frontage".

Given that the Resort will include approximately 400m of active beach frontage, the general requirement would be 120 spaces. However, it is also stated in the *Lot 490 Draft Plan of Management* (Department of Lands, 2005) that limited parking is to be provided along Tweed Coast Way. It also requests that car parking be located to minimise environmental and visual impacts.

It is important to consider that the active beach frontage for the Resort will not include a surf life saving tower and will therefore be an unpatrolled beach. It is therefore reasonable to assume that the use of the beach would decline and parking demand would decrease. Reducing the number of spaces from the general requirement of 120 spaces satisfies the *Lot 490 Draft Plan of Management* in that parking is minimised and visual/environmental impacts are lessened through a smaller footprint. It is also understood that Leighton Properties have undergone preliminary consultation with the Department of Lands in respect to this matter.

Table 4-3 Resort – Customer Parking Provision

Development Type	Required Number of Spaces[a]	Provision
Resort Accommodation: 2-Bedroom Unit • 84 units • Up to 168 keys	84	145[b]
Resort Accommodation: 2-Bedroom Bungalow • 38 units • Up to 76 keys	38	76
Resort Accommodation: 3-Bedroom Bungalow • 44 units	44	44
Resort Accommodation: Beach Side Bungalow • 14 units	14	28
Shop (Retail) • 75 m^2 GFA	4	4
Restaurant/Bar • 156 m^2 dining area (Restaurant)	23	23

Development Type	Required Number of Spaces[a]	Provision
• 100 m² bar area (Bar)	14	14
Resort Facilities • 214 seats (Conference Centre) Assumes at least 17% of conference centre attendees are staying within the resort	Dependant upon hotel occupancy	53
Interpretive Centre/Art Gallery • 150 m² floor area	3	3
Beach Access • Approx 400 m active beach frontage	120	60
Public Parking located to the east of the Recreational Area on the northern side of Lot 490, adjacent to Casuarina Way	Not specified	12[c]
Public Parking located to the north of the primary Resort access and south of Cudgen Creek Bridge	Not specified	10[d]

(a) Calculated from Tweed Shire Council Site Access and Parking Code (Table 4-2)

(b) As the number of dual key units is subject to change, parking provision has been provided based on an approximate 85% occupancy of 2 bedroom units and bungalows.

(c) The demand for uses in this area is currently unknown as demand could be generated from a range of users (e.g. walkers, cyclists, families, fishing etc). The 12 spaces is a starting point and could be extended should future observed demands warrant it.

(d) On site observations indicated that the approximate demand in this area was 10 vehicles.

Parking Provision for Employees

At the time of this report, employee requirements have not fully been determined, however, 40 employee dedicated parking spaces will be provided on the south-western corner of the site (ie. Maintenance area). Motorised buggies will be provided for internal travel around the site and 5 additional spaces for the use of these vehicles will be situated within the Resort's service yard.

4.4.3 Layout

The proposed layout for customer and employee parking is indicated in the site layout plan, included in Appendix C.

4.5 Service Vehicle Arrangements

4.5.1 Planning Requirements

Planning requirements for service vehicle provisions for the development are provided in the *Tweed Shire Council Development Control Plan*. Table 4-4 is a summary of the parking requirements relevant to the Resort development proposal.

Table 4-4 Tweed Shire Council – Service Vehicle Parking Requirements

Item	Development Type	Parking Requirement
B7	Tourist Resort	1 HRV
D15	Restaurant/Bar	1 HRV
C18	Shop (Retail)	1 HRV per 1500 m² GFA Minimum 1 HRV Minimum 2 HRV for supermarkets
D20	Tourist Facilities (Conference Facilities)	1 bus parking for every 200 m² GFA
F2	Art Gallery (Interpretive Centre)	1 SRV

4.5.2 *Proposed Supply*

Within the Resort a number of locations are to be provided to cater for service vehicles. These include:

- A service area and loading bay at the rear of the Resort Facilities building for use by vehicles up to and including a heavy rigid vehicle (HRV) and refuse collection vehicle (RCV);
- A service area and loading bay within the Maintenance Area for use by vehicles up to and including an HRV and RCV;
- A lay-by area adjacent to the western side of the Resort Facilities building for use by tourist coaches / buses; and
- A turn around and manoeuvring area located to the rear of the Resort facilities building will be available for use by coaches/buses, HRVs and RCVs.

Given the proposed operations and the integrated nature of the Resort, these facilities are considered to be sufficient for expected service vehicle demands.

4.5.3 *Layout*

Service vehicle parking and its associated turn-around and manoeuvring areas are indicated in the site layout plan, included in Appendix C. Given that the development is at the master planning stage it is deemed appropriate that all on-site vehicle manoeuvring will be designed in accordance with relevant Australian Standards (ie. AS 2890 series) and local planning requirements.

4.6 Bicycle Parking

4.6.1 *Planning Recommendations*

Section A2 of the *Tweed Shire Council Development Control Plan* also specifies various bicycle parking rates. A summary of bicycle parking requirements relevant to the development proposal is presented in Table 4-5.

Table 4-5 Tweed Shire Council – Bicycle Parking Requirements

Item	Development Type	Parking Requirement
B7	Tourist Resort	None
D15	Restaurant/Bar	1 for every 5 car-parking spaces
C18	Shop (Retail)	2 per 100 m^2 GFA for shop area up to 100 m^2 1 per 200 m^2 GFA for shop area greater than 100 m^2
D20	Tourist Facilities (Conference Facilities & Beach Access)	1 for every 5 car-parking spaces
F2	Art Gallery (Interpretive Centre)	1 per 100 m^2 display area

4.6.2 *Proposed Supply*

The Resort

As shown in Table 4-5, Tweed Shire Council does not have bicycle parking requirements for tourist resort development. However, given that there is currently a good level of bicycle connectivity between the site and surrounding residential areas (eg. within Kingscliff) it would be highly reasonable to assume that a proportion of the

Resort's employees would travel to and from work by way of bicycle. Therefore, it is proposed to provide bicycle parking and end-of-trip facilities at the Resort's Maintenance Area. These facilities will include:

- Bicycle rack/storage facilities for the parking of 10 bicycles; and
- End-of-trip facilities including separate male and female change rooms each with a shower cubicle.

The provision of these bicycle facilities for the Resort's employees will provide opportunities for reducing the demand for work-based private vehicle travel to and from the Resort. This will also add to the enhancement of Council's strategies for the reduction in work-based private vehicle travel.

For the Resort's non-tourist resort facilities the following provision of bicycle parking is proposed in the form of bicycle racks:

- Parking for a minimum of 17 bicycles at the Resort's facilities to cater for bicycle demands associated with the retail, restaurant/bar and tourist facilities (ie. conference centre);
- Parking for a minimum of 3 bicycles at the interpretive centre; and
- Parking for a minimum of 5 bicycles at the recreation courts.

The provision of these facilities is considered to be sufficient to cater for expected bicycle parking demands associated with the Resort.

Beach Access

As shown in Table 4-5, Tweed Shire Council does not have bicycle parking requirements for beaches. However, there is a need to cater for persons travelling by bicycle to and from the beach for recreation purposes. It is proposed to provide a minimum of 10 bicycle parking spaces in close proximity to the public amenities building in the centre of the beach frontage. This combined with the 17 spaces provided within the resort, 3 provided at the interpretive centre and 5 provided at the recreation courts will provide a total of 35 spaces (minimum) throughout the resort. This is considered to be adequate for the proposed development.

5. Traffic Impact Assessment

5.1 Traffic Generation

The estimated typical weekday daily and peak hour traffic generation of the Resort and the public beach access parking area is summarised below.

5.1.1 The Resort

Traffic generation rates for each of the Resort's land uses described in Section 4.1.1 are detailed in Table 5-1. Generation rates have been sourced from the RTA *Guide to Traffic Generating Developments* and have been matched based on the closest available land use.

Table 5-1 Trip Generation Rates – The Resort

Land Use	Daily Trip Generation Rate	Peak Hour Trip Generation Rate
Resort Accommodation • 2-Bedroom Units (dual key assumed) • 2-Bedroom Bungalows (dual key assumed) • 3-Bedroom Bungalows • Beach side Bungalow	3 trips per occupied unit	0.4 trips per occupied unit
	(As per *RTA Guide to Traffic Generating Developments*, 85% occupancy is assumed)	
Resort Accommodation • Journey to Work (employees)	Trip rates have been calculated based on first principles	
Retail	1,070 trips per 1000 m² GFA	107 trips per 1000 m² GFA
	(based on classification of speciality shops A(SS))	
Restaurant/Bar	60 trips per 100 m² GFA	5 trips per 100 m² GFA
Conference Facilities	10 trips per 100 m² GFA	2 trips per 100 m² GFA
	(in lieu of relevant trip generation rates, calculations will be based on the closest match i.e. classification of "office/commercial")	
Administration/Office Space	10 trips per 100 m² GFA	2 trips per 100 m² GFA
Interpretive Centre/Art Gallery	10 trips per 100 m² GFA	2 trips per 100 m² GFA
	(in lieu of relevant trip generation rates, calculations will be based on the closest match i.e. classification of "office/commercial")	

**Note: Trip rates are sourced from RTA Guide to Traffic Generating Developments unless otherwise stated*

It should be highlighted that the rates for non-accommodation uses in Table 5-1 do not account for the expected likelihood that persons staying within the resort will utilise these uses. As such, it is reasonable to assume that a reduction in vehicle trips generated by the retail, restaurant/bar, conference hall and interpretive centre (ie. art gallery) would be exhibited from the applied rates. For the purpose of this assessment, traffic generated by these non-accommodation uses has been reduced by 25%. This is considered to be a conservative estimate of vehicle trip reduction and assumes that 25% of custom for the non-accommodation uses would be attributable to persons staying within the Resort.

The application of these trip generation rates against the proposed configuration for the Resort are summarised in Table 5-2.

Table 5-2 Trip Generation – The Resort

Land Use	Quantity	Trip Generation (vehicles per day)	Trip Generation (vehicles per hour)
Resort Accommodation[(a)]			
• 2-Bedroom Units (dual key assumed)	143 units	429	57
• 2-Bedroom Bungalows (dual key assumed)	65 units	195	26
• 3-Bedroom Bungalows	37 units	111	15
• Beach Side Bungalow	12 units	36	5
Resort Accommodation[(b)] • Journey to Work (employees)	40 car parking spaces	160	AM Peak: 40 PM Peak: 80
Retail[(c)]	75 m² GFA	60	6
Restaurant/Bar[(c)]	256 m² dining area	115	10
Conference Facility[(c)]	250 m² GFA/ 214 seats	19	4
Administration/Office Space	90 m² GFA	7	1
Interpretive Centre / Art Gallery[(c)]	150 m² floor area	11	2
TOTAL TRIPS		**1,143**	**166 (AM Peak) 205 (PM Peak)**

(a) Assumes 85% occupancy of available unit keys as per RTA Guide to Traffic Generating Developments.
(b) Based on first principles – see text above
(c) Reduced by 25% to account for assumed custom of persons staying within resort.

As stated in Table 5-1 and Table 5-2, trip generation for employees have been based upon first principles. General assumptions made with respect to employee related work patterns are as follows:

- There are two working shifts for employees. To be conservative, it has been assumed that the changeover times for the two working shifts coincide with the commuter peak of the road network;
- It is assumed that during the morning peak (8:00 AM - 9:00 AM) the employee car park fills and reaches its capacity of 40 cars; and
- For the afternoon shift changeover (3:00 PM – 4:00 PM), the employee car park fully empties and subsequently fills again.

It should be noted that the trip generation rates supplied in the *RTA Guide to Traffic Generating Developments* do not specify whether the daily and peak rates are inclusive of employee related 'journey to work' trips. Therefore, it is possible that some degree of double counting has occurred and the development generated trips contained in Table 5-2 therefore represents a conservative and worst case scenario in terms of employee vehicle trips.

5.1.2 Public Beach Access Parking Area

Vehicular movements to and from the public beach access parking area, the carpark near the recreation area, and the carpark to the north of the development have been determined through statistical analysis and the relationship between parking supply and anticipated arrival rates. Based on the guidelines presented in the AUSTROADS *Guide to Traffic Engineering Practice – Part 1: Traffic Flow*, the Poisson distribution has been utilised in the analysis, and the assumptions made with respect to public beach usage are as follows:

- The arrival rate for beach visitors will follow a similar trend to the Sunday traffic profile along Casuarina Way. This is considered to be the critical operating time for the beach;
- The average length of stay is approximately 2 hours;
- When vehicles arrive during the morning peak, the car park is assumed to be approximately 20% full. This percentage has been chosen as the statistical distribution shows that this has the greatest likelihood of occurring;
- The distribution for the afternoon peak indicates that the car park has the greatest chance of being approximately 35% full; and
- Based on the traffic counts along Casuarina Way, the peak conversion factor was calculated to be 5.2.

Detailed explanation of the analysis procedure is provided in Appendix D. The resultant beach generation rates are provided in Table 5-3.

Table 5-3 Trip Generation – Public Carparking Areas

Location	Trip Generation* (vehicles per day)	Trip Generation - AM Peak (vehicles per hour)	Trip Generation PM Peak (vehicles per hour)
Main Beach Access	177	14	20
Rec Area	31	2	4
North of Development	31	2	4

**Daily generation has been calculated by summing the total trips for the AM and PM Peak, and then multiplying the value by the peak conversion factor (i.e. 5.2)*

5.2 Trip Distribution

Trip distribution has been estimated based upon the existing travel demands on Casuarina Way (see Section 3.2). Based on the results of the traffic survey, the trip distributions shown in Table 5-4 will apply to the traffic analyses. The adopted in:out directional splits are presented in Table 5-5.

Table 5-4 Trip Distribution – Casuarina Way

Time Period	Northbound	Southbound
AM Peak	60 %	40 %
PM Peak	50 %	50 %
Daily	50 %	50 %

Table 5-5 Adopted IN:OUT Splits

Land Use	Daily (IN:OUT)	AM Peak (IN:OUT)	PM Peak (IN:OUT)
Resort Accommodation – guests	50:50	80:20	20:80
Resort Accommodation – employees	50:50	100:0	50:50
Retail	50:50	60:40	40:60
Restaurant/Bar	50:50	60:40	40:60
Conference Facilities	50:50	60:40	40:60
Administration/Office Space	50:50	60:40	40:60
Interpretive Centre/Art Gallery	50:50	60:40	40:60
Beach Access	50:50	50:50	50:50

5.3 Design Horizon

Given that the Resort development is expected to be fully operational in 2012, the design horizons for assessment are as follows:

- Year of Opening – 2012
- 10-Year Design Horizon – 2022.

5.4 Background Traffic Growth

Based on discussions with Tweed Shire Council, a background traffic growth of 4% compounding annually has been adopted for the analyses. Given the nature of the surrounding development (existing and proposed), it is considered that the adopted growth rate would yield a conservative result. The application of this rate to the background traffic volumes equates to the following increases:

- 2008 to 2012: 17%
- 2008 to 2022: 73%
- 2012 to 2022: 48%

5.5 Impact of Generated Traffic

The impact of the development proposal is presented in the following sections. Development generated traffic (see Section 5.1) has been distributed to the external road network based on the assumptions presented in Section 5.2. Resultant traffic flow diagrams are presented in Appendix E.

5.5.1 Casuarina Way

Future year traffic volumes expected on Casuarina Way (ie. adjacent to the Resort) both without and with the additional traffic generated by the Resort and public beach parking area are presented in Table 5-6 and Table 5-7.

Table 5-6 Casuarina Way – Link Flows 2012

Scenario	Period	Two-Way Traffic Volume		
		North of Primary Access (taken at northern beach parking access, south of Cudgen Creek Bridge)	**Between Primary & Maintenance Accesses** (taken at recreational parking access)	**South of Maintenance Access**
Without Development*	AM Peak Hour	420 vph	420 vph	420 vph
	PM Peak Hour	440 vph	440 vph	440 vph
	Daily (AWDT)	4520 vpd	4520 vpd	4520 vpd
Development Generated	AM Peak Hour	86 vph	99 vph	107 vph
	PM Peak Hour	118 vph	118 vph	118 vph
	Daily (AWDT)	**696 vpd**	**696 vpd**	**696 vpd**
With Development	AM Peak Hour	506 vph	519 vph	527 vph
	PM Peak Hour	558 vph	558 vph	558 vph
	Daily (AWDT)	**5216 vpd**	**5216 vpd**	**5216 vpd**

Without development volumes are calculated from the Average Weekday Traffic (AWDT)

Table 5-7 Casuarina Way – Link Flows 2022

Scenario	Period	Two-Way Traffic Volume		
		North of Primary Access (taken at northern beach parking access, south of Cudgen Creek Bridge)	**Between Primary & Maintenance Accesses** (taken at recreational parking access)	**South of Maintenance Access**
Without Development	AM Peak Hour	630 vph	630 vph	630 vph
	PM Peak Hour	660 vph	660 vph	660 vph
	Daily (AWDT)	6680 vpd	6680 vpd	6680 vpd
Development Generated	AM Peak Hour	86 vph	99 vph	107 vph
	PM Peak Hour	118 vph	118 vph	118 vph
	Daily (AWDT)	**696 vpd**	**696 vpd**	**696 vpd**
With Development	AM Peak Hour	716 vph	729 vph	737 vph
	PM Peak Hour	778 vph	778 vph	778 vph
	Daily (AWDT)	**7376 vpd**	**7376 vpd**	**7376 vpd**

**Without development volumes are calculated from the Average Weekday Traffic (AWDT)*

Typically, a road forming the function to that of Casuarina Way would be expected to cater for daily traffic volumes in the range of 7,000-10,000 vehicles. The results presented in Table 5-6 and Table 5-7 suggest that even with the additional traffic generated by the Resort and public beach access parking area, the daily traffic volumes during the:

- 2012 future year (ie. "year of opening") are well below the lower limit of this traffic capacity range; and

- 2022 future year (ie. 10-year design horizon) are at the lower end of this traffic capacity range.

It should also be highlighted that the adoption of Tweed Shire Council's background traffic growth of 4% (nb. compounding annually) yields a conservative future year base traffic volume. Therefore, the two-lane two-way cross-section of Casuarina Way and its traffic carrying capacity are expected to support daily traffic volumes both without and with the additional traffic generated by the Resort and the public beach access parking area during the 2012 and 2022 future years.

5.5.2 Cudgen Creek Bridge

Future year traffic volumes expected on the Cudgen Creek Bridge both without and with the additional traffic generated by the Resort and public beach parking area are presented in Table 5-8.

Table 5-8 Cudgen Creek Bridge – Link Flows 2012 and 2022

Scenario	Period	Two-Way Traffic Volume	
		2012	2022
Without Development	AM Peak Hour	420 vph	630 vph
	PM Peak Hour	440 vph	660 vph
	Daily (AWDT)	4520 vpd	6680 vpd
Development Generated	AM Peak Hour	86 vph	86 vph
	PM Peak Hour	118 vph	118 vph
	Daily (AWDT)	**696 vpd**	**696 vpd**
With Development	AM Peak Hour	506 vph	716 vph
	PM Peak Hour	558 vph	778 vph
	Daily (AWDT)	**5216 vpd**	**7376 vpd**

**Without development volumes are calculated from the Average Weekday Traffic (AWDT)*

The results presented in Table 5-8 indicate the same outcome as those presented in Section 5.5.1. Therefore, the two-lane two-way cross-section of the Cudgen Creek Bridge and its traffic carrying capacity are expected to support daily traffic volumes both without and with the additional traffic generated by the Resort and the public beach access parking area during the 2012 and 2022 future years. Therefore it is concluded that no further upgrading of the bridge will be required as a result of the proposed development.

5.5.3 Primary Vehicular Access at Casuarina Way (Roundabout)

The proposed configuration for the primary access point is shown in Figure 5-1. A summary of the SIDRA analyses are presented in Table 5-9. The results indicate that the proposed intersection is expected to exhibit acceptable operations beyond the 10 year design horizon. The degree of saturation at 2022 is well below the practical absorption capacity for roundabouts (i.e. 0.8) and the anticipated Level of Service (LOS) is a minimum B for all approaches. It should be noted that while the proposed development's site layout plan (see Appendix C) includes an indicative layout for the roundabout, the ultimate configuration of the roundabout (ie. island diameter,

circulating carriageway width) will be fully addressed in accordance with AUSTROADS requirements at the detailed design phase of the project.

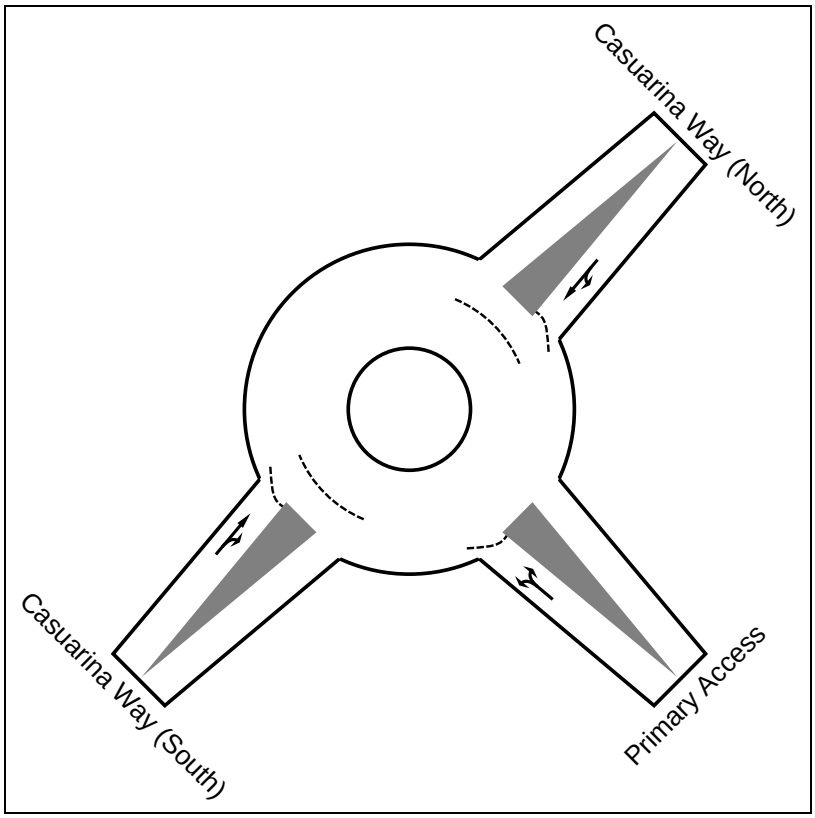


Figure 5-1 Primary Access Location – Intersection Layout

Table 5-9 Main Access Location – SIDRA Summary

Reference Year	Approach	Demand Flow (veh/hr)	Degree of Saturation (V/C)	Level of Service (LOS)
2012 AM Peak	Primary Access	38	0.035	B
	Casuarina Way (North App)	218	0.164	A
	Casuarina Way (South App)	357	0.238	A
2012 PM Peak	Primary Access	114	0.114	B
	Casuarina Way (North App)	286	0.191	A
	Casuarina Way (South App)	265	0.195	A
2022 AM Peak	Site Access	38	0.038	B
	Casuarina Way (North App)	302	0.223	A
	Casuarina Way (South App)	493	0.322	A
2022 PM Peak	Primary Access	114	0.126	B
	Casuarina Way (North App)	413	0.271	A
	Casuarina Way (South App)	370	0.268	A

**Results are based on peak flow factor of 0.95 and a peak flow period of 30 minutes.*

5.5.4 Maintenance Area Access at Casuarina Way

The proposed configuration for the maintenance area access point is shown in Figure 5-2. The summary of the SIDRA reporting presented in Table 5-10 indicates that the proposed intersection configuration operates well at the year of opening and at the 10 year design horizon. Similar to the primary access location, the degrees of saturation indicates that there is considerable spare capacity to cater for increase in

volumes beyond 2022. In addition to this, anticipated LOS for the intersection complies with the minimum desirable LOS C for the 10 year design horizon.

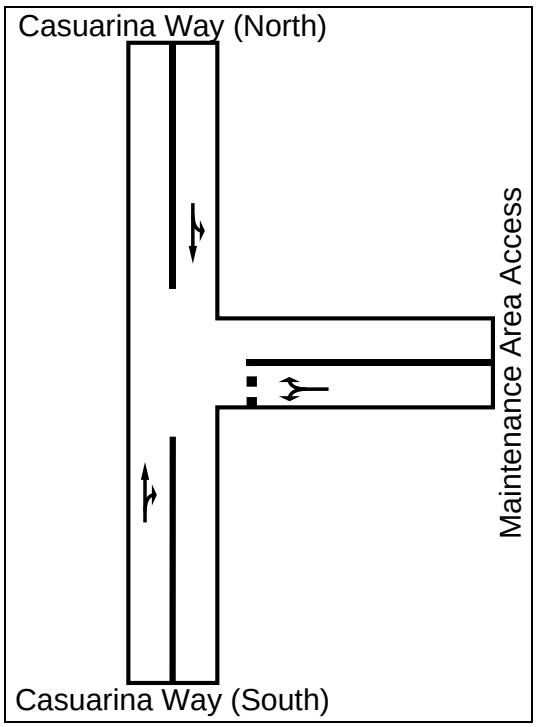


Figure 5-2 Maintenance Area Access Location – Intersection Layout

Table 5-10 Secondary Access Location – SIDRA Summary

Reference Year	Approach	Demand Flow (veh/hr)	Degree of Saturation (V/C)	Level of Service (LOS)
2012 AM Peak	Casuarina Way (South)	377	0.207	A
	Site Access	12	0.028	B
	Casuarina Way (North)	190	0.101	A
2012 PM Peak	Casuarina Way (South)	265	0.150	A
	Site Access	42	0.086	B
	Casuarina Way (North)	322	0.171	A
2022 AM Peak	Casuarina Way (South)	513	0.281	A
	Site Access	12	0.043	C
	Casuarina Way (North)	274	0.146	A
2022 PM Peak	Casuarina Way (South)	370	0.209	A
	Site Access	42	0.128	B
	Casuarina Way (North)	448	0.238	A

**Results are based on peak flow factor of 0.95 and a peak flow period of 30 minutes.*

5.5.5 Other Access Locations

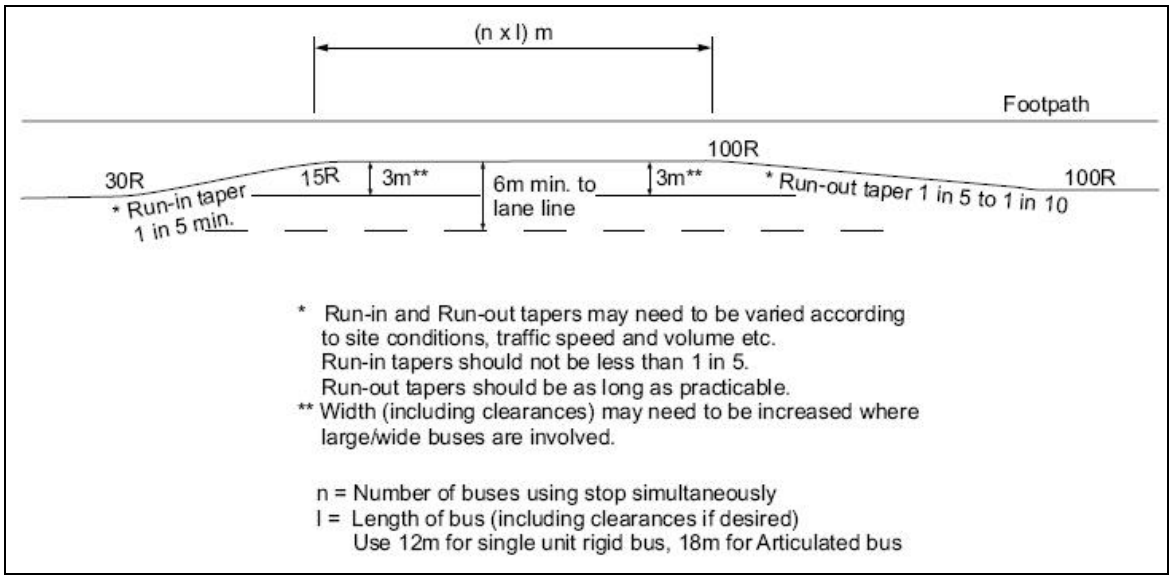
Anticipated development generated traffic volumes which are expected to pass through the public parking intersections located at the recreational area and beach access to the north are very minor. Development generated traffic volumes at these access locations are anticipated to be in the order of 4 vehicles per hour in the afternoon peak, and only 31 vehicles over the whole day. Given the small traffic volumes, SIDRA analysis was not undertaken and a basic priority controlled intersection is deemed to be adequate.

5.6 Public Transport

5.6.1 Bus

Given that Route 603 currently passes the development along Casuarina Way, modifications to the route alignment are not required. However, given that the Resort is likely to produce demands for public bus usage (eg. employees, guests, beach-goers) it is proposed to provide indented bus bays on both sides of Casuarina Way adjacent to the Resort. The proposed location of these facilities is shown in the site layout plan attached in Appendix C.

It is recommended that the bus bay be detailed as shown in Figure 5-3.



Source: Department of Main Roads" Road Planning and Design Manual – Chapter 20: Roadside Amenities"

Figure 5-3 Bus Bay Detail

5.6.2 Rail

Given that the existing passenger rail network is extremely remote to the Resort (see Section 3.4.2), impacts to rail operations are not expected.

5.7 Non-Motorised Mode Networks

5.7.1 Pedestrian

To provide for pedestrian connectivity between the Resort and the pedestrian (and bicycle) network proposed on the northern portion of the site adjacent to Cudgen Creek, a pedestrian refuge island is to be provided within Casuarina Way. The proposed location, as shown on the site layout plan provided in Appendix C, will be central to the proposed indented bus bays described in Section 5.6.1.

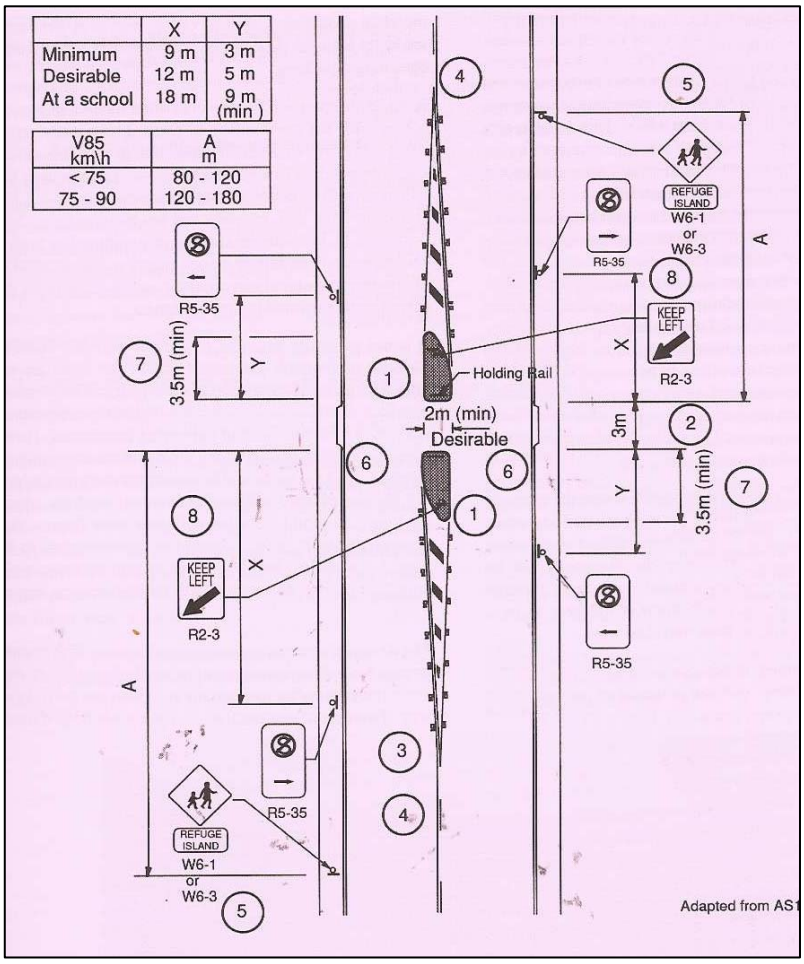
The recommended dimensions (as per Figure 5-4) are as follows:

- Island length: 3.5 m
- Island width: 2 m
- Width of refuge gap: 3 m
- X: 12 m

- Y: 5 m
- A: 80 m

5.7.2 Bicycle

As the proposed cycle network will be integrated with the pedestrian network, bicycle requirements are as detailed in Section 5.7.1.



Source: AUSTROADS" Guide to Traffic Engineering Practice – Part 13: Pedestrians"

Figure 5-4 Pedestrian Refuge Detail

5.8 Recommended Works

Based on the analysis presented above, the recommended works for transport infrastructure are to include:

- Provision of a roundabout at the intersection of the primary access with Casuarina Way;
- Provision of a basic priority-controlled access driveway at the Maintenance Area (ie. utility facility and employee car park access) with Casuarina Way;
- Provision of basic priority controlled access intersections at the public beach and recreational parking areas;

- Provision of connections into the existing pedestrian/cycleway network and the provision of additional pedestrian/cycleway facilities within land between Cudgen Creek and Casuarina Way and connections to the public beach to the east of the site;
- Provision of indented bus bays on each side of Casuarina Way adjacent to the Resort; and
- Provision of a pedestrian refuge island in Casuarina Way central to the aforementioned bus bays.

6. Development Contributions

6.1 Section 94 Plan No 04 – Tweed Road Contribution Plan

Council's *Section 94 Plan04 – Tweed Road Contribution Plan* provides a financial strategy for the provision of roads in the Tweed Shire to satisfy travel growth demands. This plan levies all traffic generating developments within the Tweed Shire using a two-tier system to determine the overall contribution. These two tiers are a Standard Contribution and a Local Area Contribution. For the proposed Resort development only a Standard Contribution shall apply given that it does not fall within an area where a specific Local Area Contribution would apply.

The Standard Contribution is determined from the product of a sector-based unit rate and the estimated traffic generation of the development. The proposed Resort development is located within *Sector 7 – Duranbah / Cabarita*. For this sector, the sector-based unit rate is $868 per daily vehicle trip-end. The estimated road contribution applicable to the Resort development is presented in Table 6-1.

The estimated cost contribution for roads in Tweed Shire attributable to the proposed Resort development under Council's *Section 94 Plan 04 – Tweed Road Contribution Plan* is estimated to be $771,444.

6.2 Section 94 Plan No 22 - Cycleways

Council's *Section 94 Plan 22 – Cycleways* explains the levying of contributions for new development towards the cost of cycleway infrastructure within Tweed Shire. This plan refers specifically to new development of residential and tourist accommodation uses. The contribution applicable to the Resort development is based on the total number of tourist accommodation beds at a cost of $136 per bed as presented in Table 6-2.

The estimated cycleway contribution costs attributable to the proposed Resort development under Council' s *Section 94 Plan 22 – Cycleways* is estimated to be $56,848.

As previously discussed, the proposed development is to include the provision of pedestrian and cycle paths on the northern portion of the site adjacent to Cudgen Creek. It is understood that Leighton Properties would enter into discussions with

Council in relation to the possibility of obtaining credit for these additional community facilities against the estimated cycleway contribution costs.

Table 6-1 Road Contribution Costs

Land Use	Daily Trip Rate[(a)]	Trip Generation (vehicles per day)	Road Contribution Costs
Resort Accommodation[(b)]			
• 143 x 2-Bedroom Units	2.48 trips per key	354.6	$307,828
• 65 x 2-Bedroom Bungalows	2.48 trips per key	161.2	$139,922
• 37 x 3-Bedroom Bungalows	2.48 trips per unit	91.8	$79,648
• 12 x Beach Side Bungalow	2.48 trips per unit	29.8	$25,832
Resort Facilities			
• 75 m² GFA of shop	60 trips per 100 m² GFA	45.0	$39,060
• 256 m² GFA of restaurant/bar[(c)]	50 trips per 100m² GFA	128.0	$111,104
• 250 m² GFA of conference[(d)]	16 trips per 100m² GFA	40.0	$34,720
• 90 m² GFA administration/office[(d)]	16 trips per 100m² GFA	14.4	$12,499
Interpretive Centre			
• 150 m² floor area[(d)]	16 trips per 100 m² GFA	24.0	$20,832
TOTAL TRIPS		**888.8**	**$771,444**

(a) Source: Section 94 Plan 04 – Tweed Road Contribution Plan (Tweed Shire Council, 2007)
(b) Assumes 85% occupancy of available unit keys as per RTA Guide to Traffic Generating Developments.
(c) Assumes hospitality facility use equivalent trip generation
(d) Assumes commercial premises equivalent trip generation

Table 6-2 Cycleways Contribution Costs

Tourist Accommodation	Total Beds	Cycleway Contribution Costs
84 x 2-bedroom Units	168	$22,848
38 x 2-bedroom Bungalows	76	$10,336
44 x 3-bedroom Bungalows	132	$17,952
14 x 3-bedroom Beach Side Bungalows	42	$5,712
Totals	418	$56,848

7. Summary & Conclusions

The Traffic Impact Assessment for the proposed Kingscliff Resort, located along Casuarina Way in South Kingscliff has been completed. Through the traffic analysis presented in the preceding chapters, it has been demonstrated that the proposed development complies with relevant planning documents and standards. Further to this, it is expected that the surrounding road network would be able to cater for an increase in traffic volumes and the resultant impact on the Tweed Shire Council network would be relatively minor. The proposed access locations along Casuarina Way have also been shown to operate adequately and will continue to do so, well beyond the 10 year design horizon.

Based upon the findings, a number of recommended works for transport infrastructure have been detailed. These include:

- Provision of a roundabout at the intersection of the main access with Casuarina Way;
- Provision of a basic priority-controlled access driveway at the Maintenance Area (ie. utility facility and employee car park access) with Casuarina Way;
- Provision of basic priority controlled access intersections at the public beach and recreational parking areas;
- Provision of connections into the existing pedestrian/cycleway network and the provision of additional pedestrian/cycleway facilities within land between Cudgen Creek and Casuarina Way and connections to the public beach to the east of the site;
- Provision of indented bus bays on each side of Casuarina Way adjacent to the Resort; and
- Provision of a pedestrian refuge island in Casuarina Way central to the aforementioned bus bays.

In addition to the abovementioned works, development contributions have been estimated. Based on the requirements of Tweed Shire Council's *Section 94 Plan04 – Tweed Road Contribution Plan* and *Section 94 Plan 22 – Cycleways* the estimated development contributions are $771,444 and $56,848, respectively. It is understood that Leighton Properties would enter into discussions with Council in relation to the

possibility of obtaining credit for the additional pedestrian and bicycle paths facilities against the estimated cycleway contribution costs.

Appendix A - Site Locality

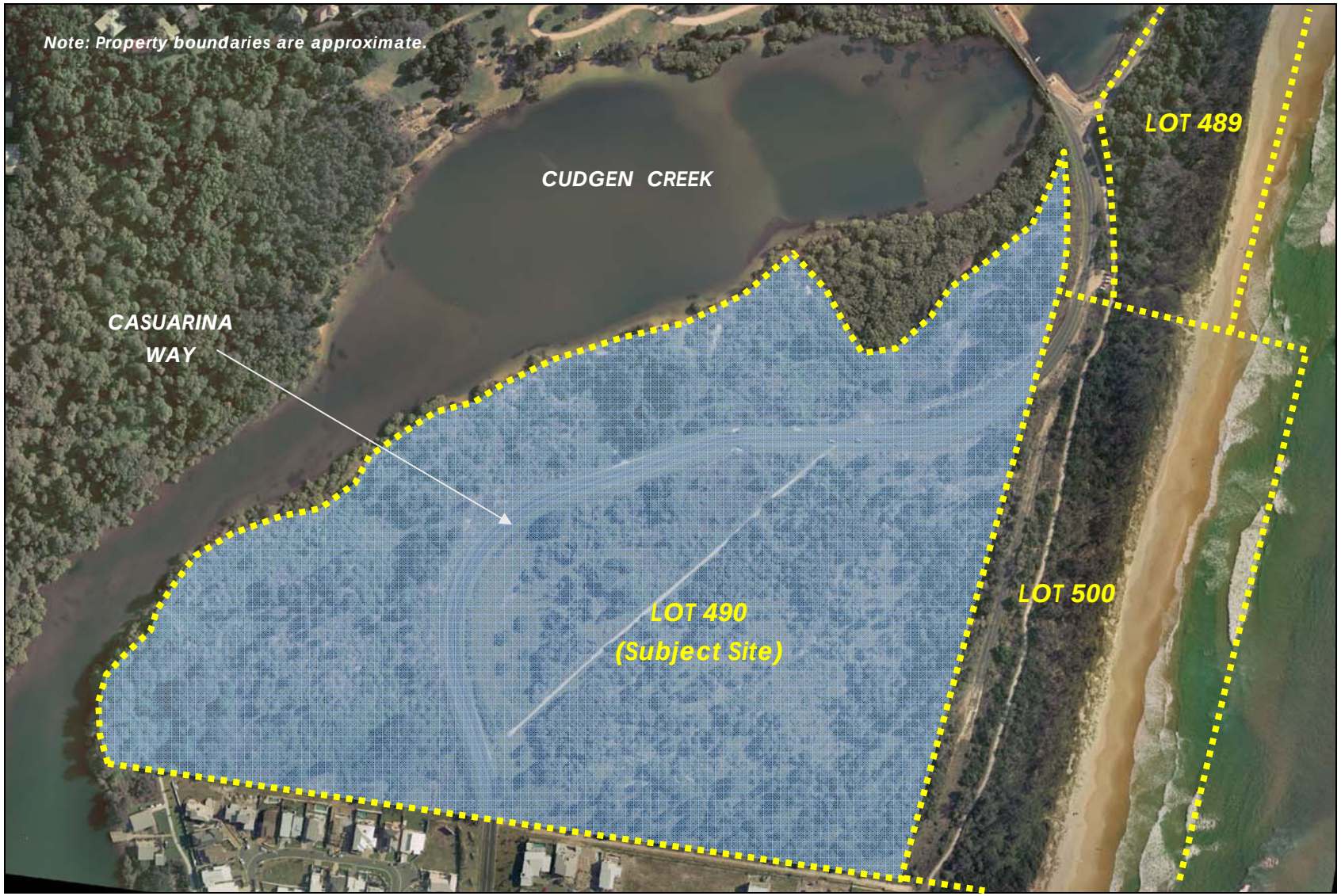


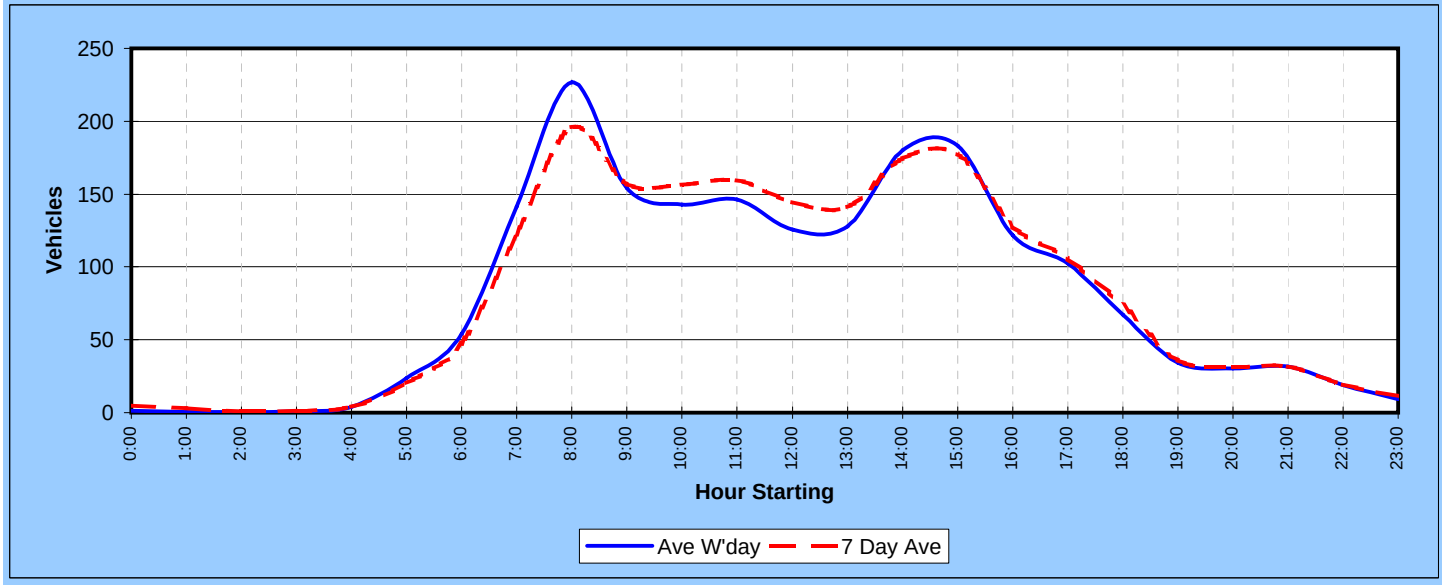
Figure A1 Site Locality

Appendix B - Traffic Survey Information

Road	Casuarina Way
Location	between Viking Street and Elliston Street
Site No.	1
Start Date	Thursday 4-Sep-08
Direction	Northbound

Average Weekday	1930
7 Day Average	1947
Weekday Heavy's	5.5%
7 Day Heavy's	4.8%

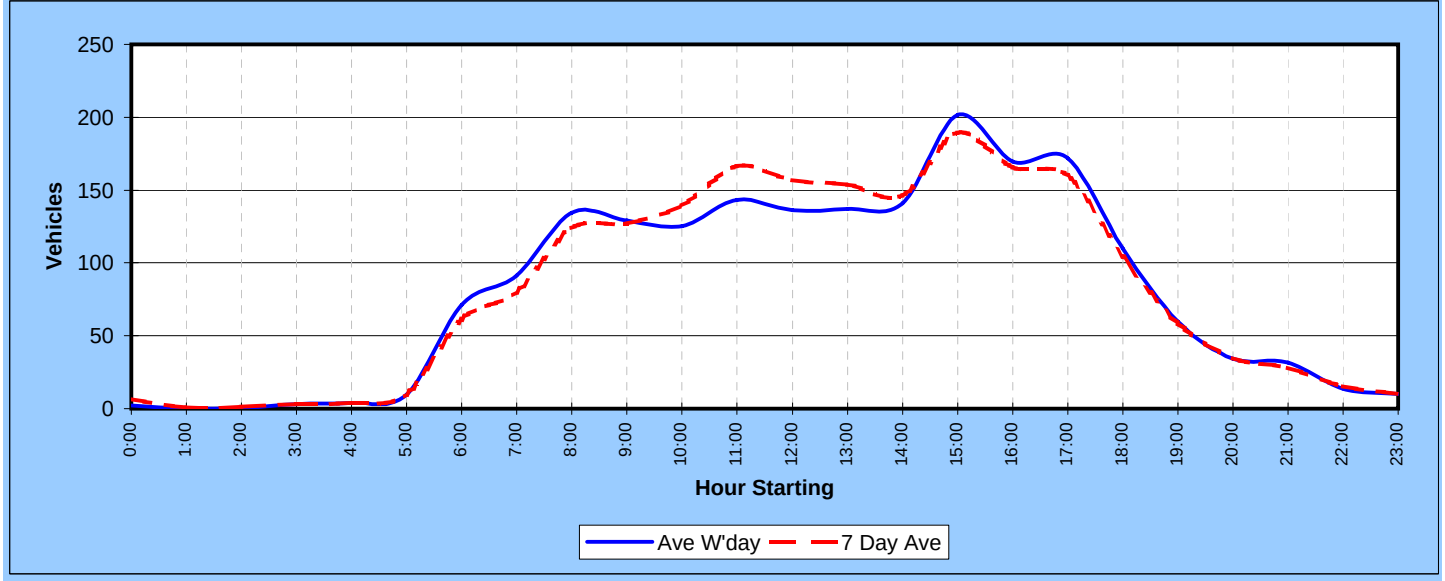
	Day of Week								
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	7 Day
Time	8-Sep	9-Sep	10-Sep	4-Sep	5-Sep	6-Sep	7-Sep	W'day	Ave
AM Peak	233	218	228	224	231	182	226		
PM Peak	208	220	202	161	179	166	224		
0:00	1	0	2	2	2	11	17	1	5
1:00	1	0	1	1	0	8	9	1	3
2:00	1	0	0	0	1	4	0	0	1
3:00	1	1	2	0	0	1	4	1	1
4:00	4	5	5	3	3	5	3	4	4
5:00	23	27	29	23	16	14	11	24	20
6:00	55	56	49	55	56	42	19	54	47
7:00	149	159	138	136	126	82	65	142	122
8:00	233	218	228	224	231	116	121	227	196
9:00	164	152	163	144	147	182	146	154	157
10:00	157	145	145	129	139	155	226	143	157
11:00	148	140	158	135	151	169	214	146	159
12:00	133	129	128	118	120	159	224	126	144
13:00	130	120	131	106	152	166	183	128	141
14:00	175	184	202	161	179	153	168	180	175
15:00	208	220	184	146	159	153	173	183	178
16:00	121	130	133	90	135	134	153	122	128
17:00	91	97	103	89	132	127	101	102	106
18:00	55	64	77	50	91	110	69	67	74
19:00	32	20	31	39	49	46	36	34	36
20:00	30	21	25	26	49	34	32	30	31
21:00	23	29	44	14	48	40	23	32	32
22:00	13	12	30	14	26	37	4	19	19
23:00	3	4	11	11	18	29	3	9	11
Total	1951	1933	2019	1716	2030	1977	2004	1930	1947
% Heavies	5.7%	6.2%	5.5%	4.4%	5.3%	3.3%	3.3%	5.5%	4.8%



Road	Casuarina Way
Location	between Viking Street and Elliston Street
Site No.	1
Start Date	Thursday 4-Sep-08
Direction	Southbound

Average Weekday	1932
7 Day Average	1946
Weekday Heavy's	6.2%
7 Day Heavy's	5.4%

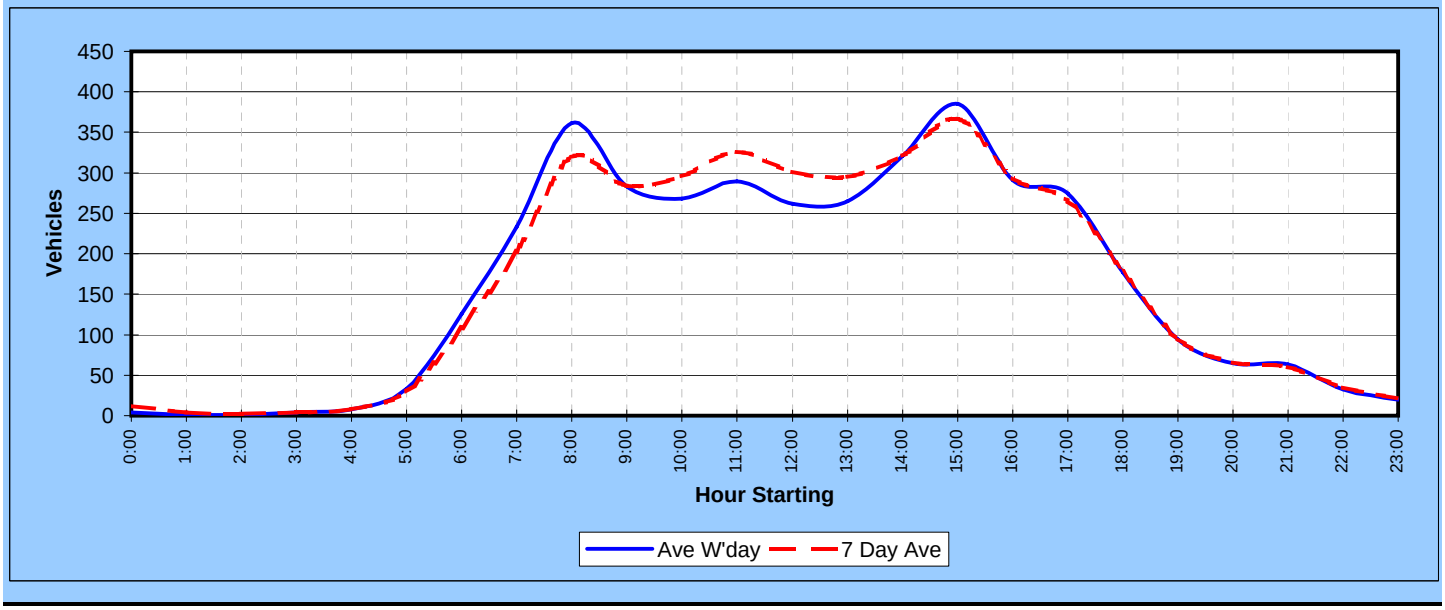
	Day of Week							Ave	7 Day
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	W'day	Ave
Time	8-Sep	9-Sep	10-Sep	4-Sep	5-Sep	6-Sep	7-Sep		
AM Peak	150	142	155	129	150	211	240		
PM Peak	220	195	188	185	230	217	242		
0:00	0	1	2	2	7	16	19	2	7
1:00	0	0	1	0	0	3	2	0	1
2:00	0	0	0	2	1	3	2	1	1
3:00	2	2	4	3	4	3	2	3	3
4:00	5	3	6	2	3	3	7	4	4
5:00	10	7	17	10	5	11	7	10	10
6:00	79	76	87	60	54	44	29	71	61
7:00	102	92	101	81	81	66	38	91	80
8:00	132	138	150	122	130	108	86	134	124
9:00	137	131	123	129	126	107	136	129	127
10:00	147	129	146	87	118	154	193	125	139
11:00	150	142	155	119	150	211	240	143	167
12:00	137	130	143	117	155	174	242	136	157
13:00	128	144	129	125	160	217	173	137	154
14:00	140	140	154	122	149	186	132	141	146
15:00	220	195	178	185	230	168	149	202	189
16:00	168	169	180	138	193	197	113	170	165
17:00	154	176	188	166	176	154	106	172	160
18:00	94	110	120	88	137	113	67	110	104
19:00	43	54	64	52	85	75	38	60	59
20:00	27	28	26	44	47	44	28	34	35
21:00	27	20	36	30	45	25	14	32	28
22:00	9	14	17	10	19	27	12	14	15
23:00	3	4	9	6	28	17	3	10	10
Total	1914	1905	2036	1700	2103	2126	1838	1932	1946
% Heavies	6.9%	6.5%	6.4%	5.4%	5.6%	3.6%	3.4%	6.2%	5.4%



Road	Casuarina Way
Location	between Viking Street and Elliston Street
Site No.	1
Start Date	Thursday 4-Sep-08
Direction	Combined

Average Weekday	3861
7 Day Average	3893
Weekday Heavy's	5.8%
7 Day Heavy's	5.1%

	Day of Week								
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	7 Day
Time	8-Sep	9-Sep	10-Sep	4-Sep	5-Sep	6-Sep	7-Sep	W'day	Ave
AM Peak	365	356	378	346	361	380	454		
PM Peak	428	415	362	331	389	383	466		
0:00	1	1	4	4	9	27	36	4	12
1:00	1	0	2	1	0	11	11	1	4
2:00	1	0	0	2	2	7	2	1	2
3:00	3	3	6	3	4	4	6	4	4
4:00	9	8	11	5	6	8	10	8	8
5:00	33	34	46	33	21	25	18	33	30
6:00	134	132	136	115	110	86	48	125	109
7:00	251	251	239	217	207	148	103	233	202
8:00	365	356	378	346	361	224	207	361	320
9:00	301	283	286	273	273	289	282	283	284
10:00	304	274	291	216	257	309	419	268	296
11:00	298	282	313	254	301	380	454	290	326
12:00	270	259	271	235	275	333	466	262	301
13:00	258	264	260	231	312	383	356	265	295
14:00	315	324	356	283	328	339	300	321	321
15:00	428	415	362	331	389	321	322	385	367
16:00	289	299	313	228	328	331	266	291	293
17:00	245	273	291	255	308	281	207	274	266
18:00	149	174	197	138	228	223	136	177	178
19:00	75	74	95	91	134	121	74	94	95
20:00	57	49	51	70	96	78	60	65	66
21:00	50	49	80	44	93	65	37	63	60
22:00	22	26	47	24	45	64	16	33	35
23:00	6	8	20	17	46	46	6	19	21
Total	3865	3838	4055	3416	4133	4103	3842	3861	3893
% Heavies	6.3%	6.3%	6.0%	4.9%	5.4%	3.5%	3.4%	5.8%	5.1%



Appendix C - Site Layout Plan

LEGEND

	Resort internal circulation lanes	B2	2 Bedroom Bungalow
	On ground pedestrian and ciclyng pathways	B2A	2 Bedroom Fully Accessible Bungalow
	Suspended walkways	B3	3 Bedroom Bungalow
	Fully accessible bungalows	BSB	Beach Side Bungalow
	Asset Protection Zone	MA	Maintenance Area
UP	Unit Pod		
UPA	Fully Accessible Unit Pod		

Supply 10 upgraded car parks See Dwg MP 01-2

CUDGEN CREEK REHAB PRECINCT

LOT 490

LOT 500

Pontoon

Shelter

CREEKSIDE PATHWAY AS IDENTIFIED BY ECOLOGIST

Large Picnic Shelter

Car park

Tennis Court

1/2 Basket Ball Court

BOUNDARY LINE

APZ LINE

Bus Stop

Pedestrian crossing

Proposed Interpretive Centre

New roundabout

Primary access

Existing Conc. Bike Path

Signage

Wet Land

Retention Basin

Resort Facilities

Loading

Pool Area

Drop-off

Service / Loading

BBQ Area

Childrens Play Area

Maintenance Area

Maintenance area parking

Visual buffer

LANDSCAPED VISUAL BUFFER AREA

Fire Access

Existing Fire fighting track

Path to link with existing path to south

Beach side public parking

Play ground 500 m²

Community Amenities

Circuit Training Stations

Revegetation and Public Park

6.5m wide grassed path for Rural Fire Brigade Access

Existing Conc. Bike Path

0 50M 75M 100M 125M

AMENDMENTS

REV:	DATE:	DESCRIPTION:	ISSUED BY:
A	02.04.09	NSW DEPT OF PLANNING - DA	NK
B	25.08.09	RE LOCATE PONTOON	TK
C	07.10.09	ADJ. MAIN ROAD TO TRAFFIC ENG. REQ	TK
D	16.10.09	ADJ. ROAD TO MAINTENANCE AREA	TK
E	15.03.10	MP - UPDATE	PL

NOTES:
Verify all dimensions on site before the commencement of any new construction work, alterations or shop drawings - take measured dimensions in preference to any scaled dimensions

Comply to the following or any other relevant codes:
- Building Code of Australia
- Local Authorities Rules and Guidelines
- covenants manual
- Apply all applicable AUSTRALIAN STANDARDS where relevant, including:
- Termite Barrier AS 3660.1
- Access and Mobility Codes AS 1428.1 & 1428.2
Larger Scale Drawings Take Precedence to smaller scale

Kingscliff Resort DEVELOPMENT

LEIGHTON PROPERTIES

J M A
ARCHITECTS
QUEENSLAND PTY LTD

Level 1 36 Wyandra St, Newstead, Qld 4006

P.O.Box 2716 Fortitude Valley BC, 4006 QLD
Email: jma@jma-arch.com
ACN: 101 165 271 ABN: 48 101 165 271
TEL: 07 3252 4400 FAX: 07 3252 2911

CLIENT.	LEIGHTON PROPERTIES
JOB	THE KINGSCLIFF RESORT
LOCATION	CASUARINA WAY KINGSCLIFF 2487
PROPERTY DESCRIPTION	

JOB No.	1040
DATE.	OCT 09
SCALE.	1:1000@A1 50%@A3
DRAWN.	NK
CHECKED	JMA Architects

DRAWING SET	MASTER PLAN
DRAWING TITLE	SITE PLAN
DRAWING No:	1040 MP-01-3
ISSUE	E
PRINT DATE	16/03/2010

FOR SUBMISSION

0 50M 75M 100M 125M

AMENDMENTS

REV:	DATE:	DESCRIPTION:	ISSUED BY:
A	01.04.09	NSW DEPT OF PLANNING - DA	NK

NOTES:
Verify all dimensions on site before the commencement of any new construction work, alterations or shop drawings - take measured dimensions in preference to any scaled dimensions

Comply to the following or any other relevant codes:
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- Local Authorities Rules and Guidelines
- covenants manual
- Apply all applicable AUSTRALIAN STANDARDS where relevant, including:
- Termite Barrier AS 3660.1
- Access and Mobility Codes AS 1428.1 & 1428.2
Larger Scale Drawings Take Precedence to smaller scale

Kingscliff Resort DEVELOPMENT

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ACN: 101 165 271 ABN: 48 101 165 271
TEL: 07 3252 4400 FAX: 07 3252 2911

CLIENT. LEIGHTON PROPERTIES

JOB THE KINGSCLIFF RESORT

LOCATION CASUARINA WAY
KINGSCLIFF 2487

PROPERTY DESCRIPTION

JOB No. 1040

DATE. APR 09

SCALE. 1:2000@A1
50%@A3

DRAWN. NK

CHECKED JMA Architects

DRAWING SET MASTER PLAN

DRAWING TITLE EXISTING SITE PLAN

DRAWING No: 1040 MP-01-2

ISSUE A

PRINT DATE 21/04/2009

FOR SUBMISSION

Appendix D - Trip Generation for Beach Access

The number of car parks is 60, and it has been assumed that the average duration of stay in the beach car park is 2 hours per vehicle, throughout the day. The arrival rate of vehicles changes depending on the time of day. To obtain a reasonable assumption of these figures, the hourly number of vehicles using a nearby section of Casuarina Way on a Sunday was scaled down by a factor of 30. This gave an idea of the spread of the number of vehicles that may arrive to use the beach car park, across the day.

Sunday Two-way Movements on Casuarina Way

Time (beginning)	No. of trips	Divisor	Adjusted trips (λ)
0:00	36	30	1
1:00	11		0
2:00	2		0
3:00	6		0
4:00	10		0
5:00	18		1
6:00	**48**		**2**
7:00	**103**		**3**
8:00	**207**		**7**
9:00	**282**		**9**
10:00	**419**		**14**
11:00	**454**		**15**
12:00	**466**		**16**
13:00	**356**		**12**
14:00	**300**		**10**
15:00	**322**		**11**
16:00	**266**		**9**
17:00	**207**		**7**
18:00	**136**		**5**
19:00	74		2
20:00	60		2
21:00	37		1
22:00	16		1
23:00	6		0

Weekday morning peak hour for Casuarina Way is from 8am to 9am, and afternoon peak hour is from 3pm to 4pm. Using the table above, it is therefore assumed that the morning peak hour arrival rate for the car park is 7 cars per hour, and the afternoon peak hour arrival rate is 11 cars per hour. It is also assumed that the arrival and departure rates are Poisson distributed, and that if the car park is full, arriving cars will leave and not queue.

AM Peak Hour Parameters

Parameter description	Value
s – no. of carparks	60
μ – departures per hour (inverse of average length of stay)	0.5
λ_{AM} – arrivals per hour	7
ρ – traffic intensity (= λ/(sμ))	0.2

The table below gives morning peak hour arrival and departure rates for every possible state (number of cars using the car park), along with the probability of being in that state. From the table it can be seen that in the AM peak hour, there are more likely to be around 14 cars using the car park (approximately 23% of capacity). This results in an arrival rate of 7 cars per hour, and a likely departure rate of 7 cars per hour, for the morning peak hour.

AM Peak Hour Arrival/Departure Rates and Probabilities for No. of Cars in Car Park

State (no. of cars in car park)	Arrival rate if in state j	Departure rate if in state j	Probability of being in state j
j	λ_j	μ_j	π_j
0	7	0	8.31529E-07
1	7	0.5	1.16414E-05
2	7	1	8.14898E-05
3	7	1.5	0.000380286
4	7	2	0.001331
5	7	2.5	0.003726801
6	7	3	0.008695869
7	7	3.5	0.017391737
8	7	4	0.03043554
9	7	4.5	0.047344174
10	7	5	0.066281843
11	7	5.5	0.08435871
12	7	6	0.098418495
13	7	6.5	0.105989148
14	7	7	0.105989148
15	7	7.5	0.098923205
16	7	8	0.086557804
17	7	8.5	0.071282898
18	7	9	0.055442254

State (no. of cars in car park)	Arrival rate if in state j	Departure rate if in state j	Probability of being in state j
j	λ_j	μ_j	π_j
19	7	9.5	0.040852187
20	7	10	0.028596531
21	7	10.5	0.019064354
22	7	11	0.012131862
23	7	11.5	0.007384611
24	7	12	0.00430769
25	7	12.5	0.002412306
26	7	13	0.001298934
27	7	13.5	0.000673521
28	7	14	0.000336761
29	7	14.5	0.000162574
30	7	15	7.58679E-05
31	7	15.5	3.42629E-05
32	7	16	1.499E-05
33	7	16.5	6.35941E-06
34	7	17	2.61858E-06
35	7	17.5	1.04743E-06
36	7	18	4.07335E-07
37	7	18.5	1.54127E-07
38	7	19	5.67835E-08
39	7	19.5	2.03838E-08
40	7	20	7.13434E-09
41	7	20.5	2.43612E-09
42	7	21	8.12038E-10
43	7	21.5	2.64385E-10
44	7	22	8.41224E-11
45	7	22.5	2.61714E-11
46	7	23	7.96521E-12
47	7	23.5	2.37262E-12
48	7	24	6.92013E-13
49	7	24.5	1.97718E-13
50	7	25	5.5361E-14
51	7	25.5	1.51971E-14
52	7	26	4.09154E-15
53	7	26.5	1.08078E-15
54	7	27	2.80203E-16
55	7	27.5	7.13245E-17
56	7	28	1.78311E-17
57	7	28.5	4.37957E-18
58	7	29	1.05714E-18
59	7	29.5	2.50846E-19
60	0	30	5.85308E-20

PM Peak Hour Parameters

Parameter description	Value
s – no. of carparks	60
μ – departures per hour (inverse of average	0.5

length of stay)	
λ_{PM} – arrivals per hour	11
ρ – traffic intensity (= $\lambda/(s\mu)$)	0.4

The table below gives afternoon peak arrival and departure rates for every possible state (number of cars using the car park), along with the probability of being in that state. From the table it can be seen that in the PM peak hour, there are more likely to be around 22 cars using the car park (approximately 37% of capacity). This results in an arrival rate of 11 cars per hour, and a likely departure rate of 11 cars per hour, for the afternoon peak hour.

PM Peak Hour Arrival/Departure Rates and Probabilities for No. of Cars in Car Park

State (no. of cars in car park)	Arrival rate if in state j	Departure rate if in state j	Probability of being in state j
j	λ_j	μ_j	π_j
0	11	0	2.78947E-10
1	11	0.5	6.13683E-09
2	11	1	6.75051E-08
3	11	1.5	4.95038E-07
4	11	2	2.72271E-06
5	11	2.5	1.19799E-05
6	11	3	4.39263E-05
7	11	3.5	0.000138054
8	11	4	0.000379649
9	11	4.5	0.000928031
10	11	5	0.002041668
11	11	5.5	0.004083336
12	11	6	0.007486117
13	11	6.5	0.012668813
14	11	7	0.019908135
15	11	7.5	0.029198598
16	11	8	0.040148072
17	11	8.5	0.051956329
18	11	9	0.06350218
19	11	9.5	0.07352884
20	11	10	0.080881724
21	11	10.5	0.084733234
22	11	11	0.084733234
23	11	11.5	0.081049181
24	11	12	0.074295082
25	11	12.5	0.065379672
26	11	13	0.055321261
27	11	13.5	0.045076583
28	11	14	0.035417315
29	11	14.5	0.026868308
30	11	15	0.019703426
31	11	15.5	0.013983077
32	11	16	0.009613365
33	11	16.5	0.00640891

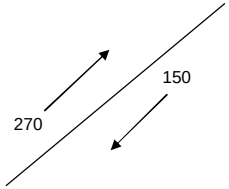
State (no. of cars in car park)	Arrival rate if in state j	Departure rate if in state j	Probability of being in state j
j	λ_j	μ_j	π_j
34	11	17	0.004146942
35	11	17.5	0.002606649
36	11	18	0.001592952
37	11	18.5	0.000947161
38	11	19	0.000548356
39	11	19.5	0.000309329
40	11	20	0.000170131
41	11	20.5	9.12898E-05
42	11	21	4.78185E-05
43	11	21.5	2.44653E-05
44	11	22	1.22326E-05
45	11	22.5	5.9804E-06
46	11	23	2.86019E-06
47	11	23.5	1.33881E-06
48	11	24	6.13623E-07
49	11	24.5	2.75504E-07
50	11	25	1.21222E-07
51	11	25.5	5.22917E-08
52	11	26	2.21234E-08
53	11	26.5	9.18331E-09
54	11	27	3.74135E-09
55	11	27.5	1.49654E-09
56	11	28	5.87926E-10
57	11	28.5	2.26919E-10
58	11	29	8.60727E-11
59	11	29.5	3.20949E-11
60	0	30	1.17681E-11

Appendix E - Traffic Flow Diagrams

2012 CASUARINA WAY/PRIMARY ACCESS LOCATION

Without Development

AM



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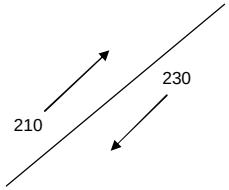
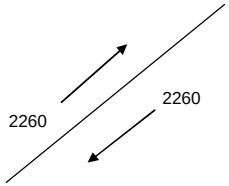
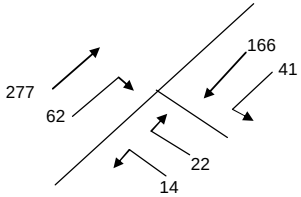


Daily



With Development

AM



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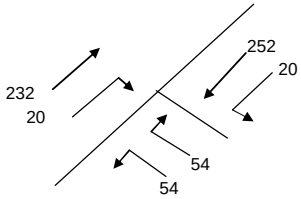
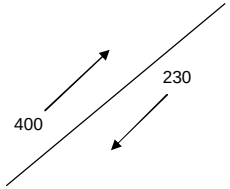


2022 CASUARINA WAY/PRIMARY ACCESS LOCATION

Without Development

AM



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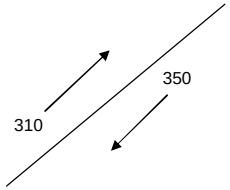

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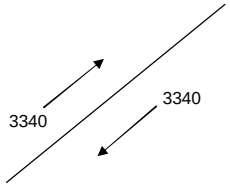

With Development

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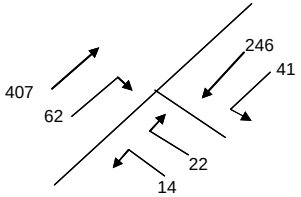

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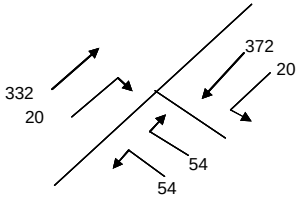
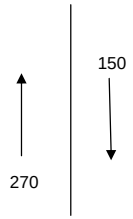


2012 CASUARINA WAY/MAINTENANCE AREA ACCESS LOCATION

Without Development

AM



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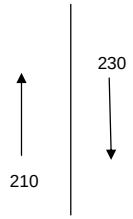
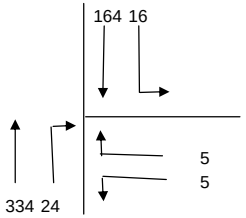


With Development

AM



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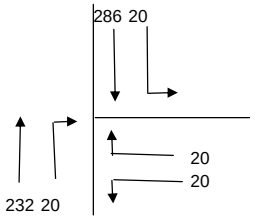
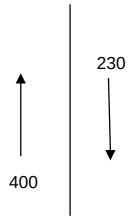


2022 CASUARINA WAY/MAINTENANCE AREA ACCESS LOCATION

Without Development

AM



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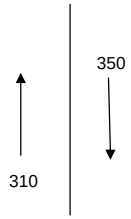
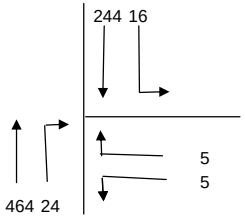


With Development

AM



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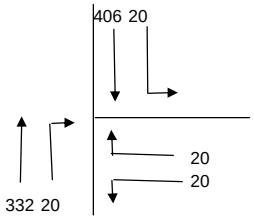
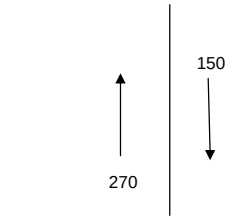


2012 CASUARINA WAY/CARPARK NORTH OF ROUNDABOUT

Without Development

AM



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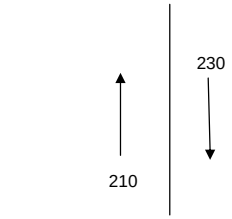

With Development

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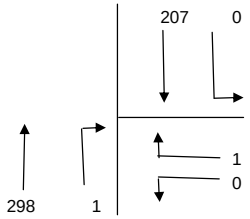

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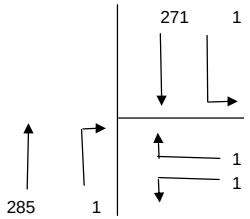
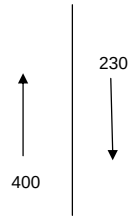


2022 CASUARINA WAY/CARPARK NORTH OF ROUNDABOUT

Without Development

AM



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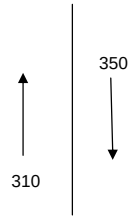

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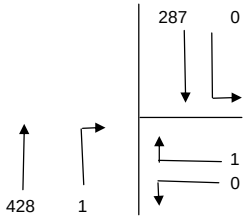

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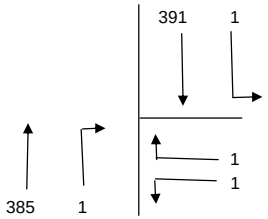
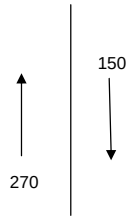


2012 CASUARINA WAY/CARPARK NEAR TENNIS COURT LOCATION

Without Development

AM



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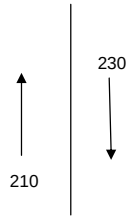

With Development

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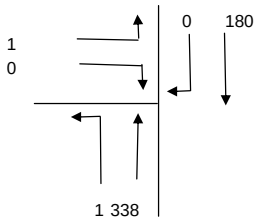

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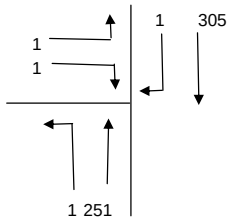
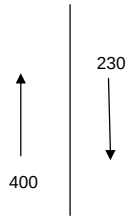


2022 CASUARINA WAY/CARPARK NEAR TENNIS COURT LOCATION

Without Development

AM



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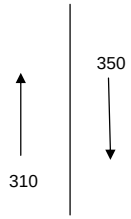

With Development

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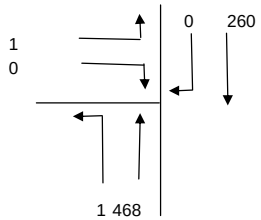

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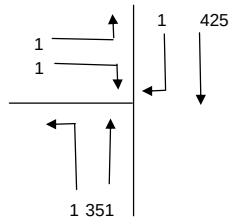
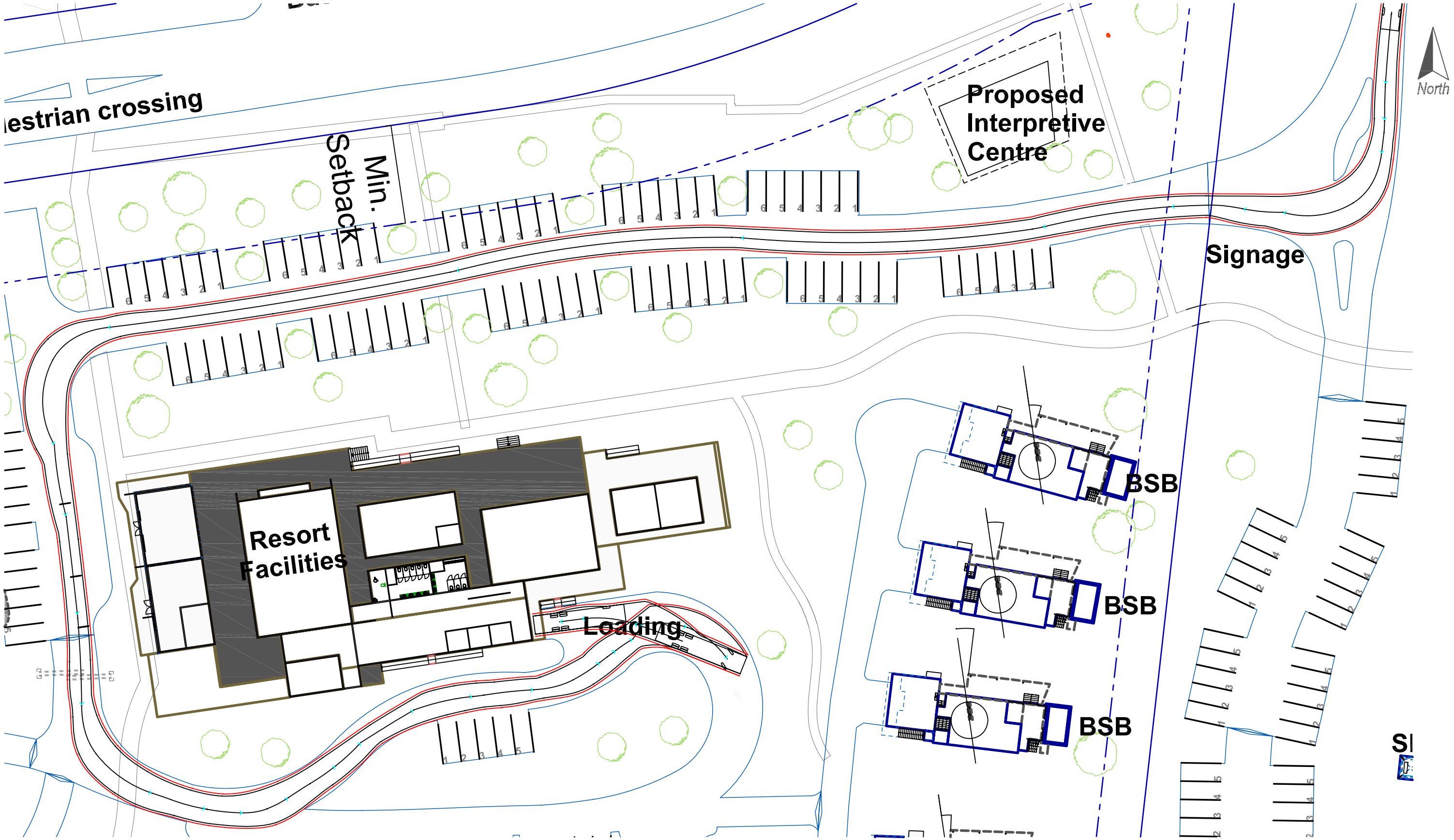


Appendix F - Turning Path Diagrams

12.5M HRV IN

KINGSCLIFF RESORT - SWEPT PATH ANALYSIS



Scale: 1:500@A3

Halcrow MWT

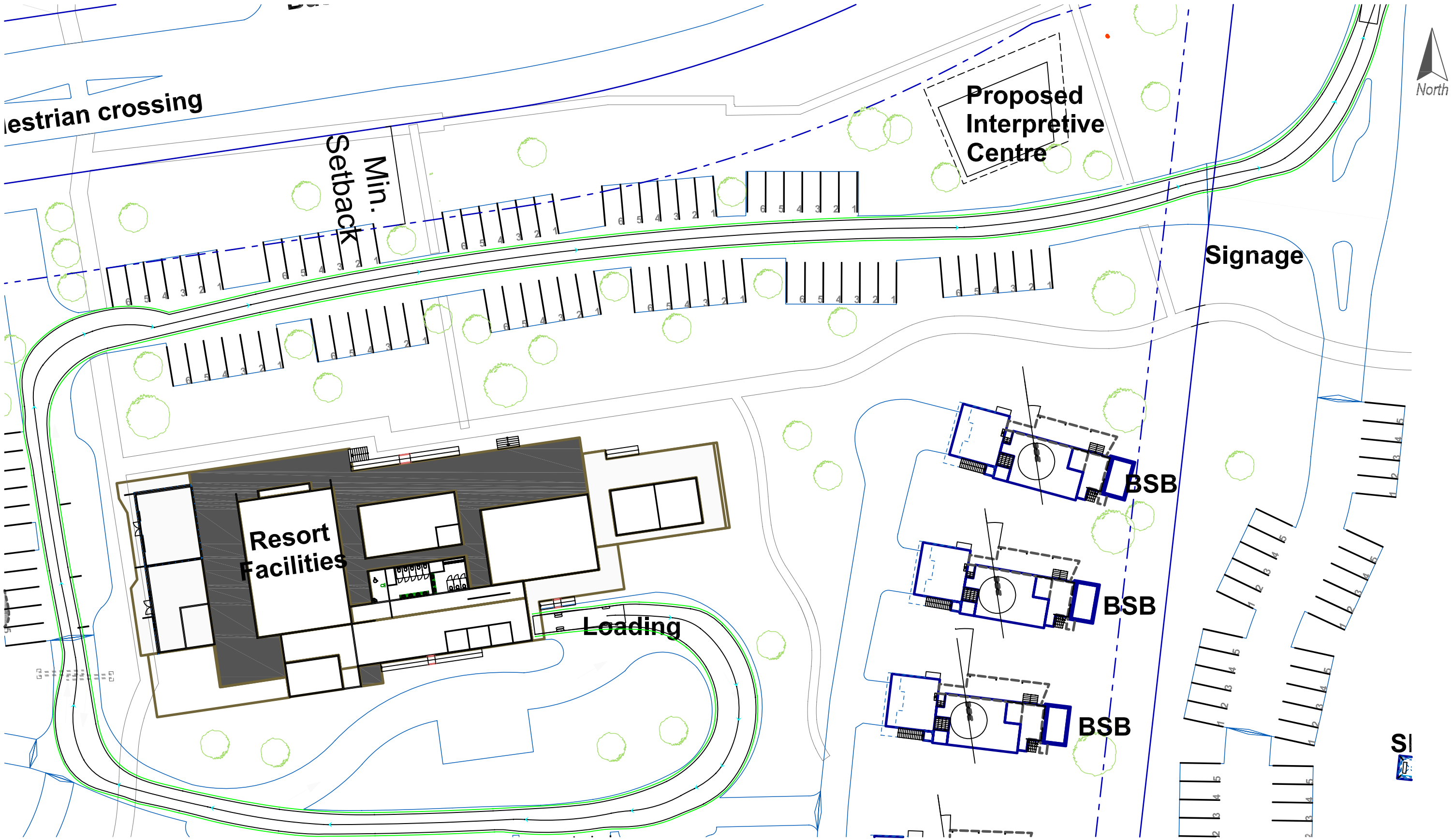
Filename: CTLCLR003DA03

Figure 1

Date: 22 October 2009

12.5M HRV OUT

KINGSCLIFF RESORT - SWEPT PATH ANALYSIS



Scale: 1:500@A3

Halcrow MWT

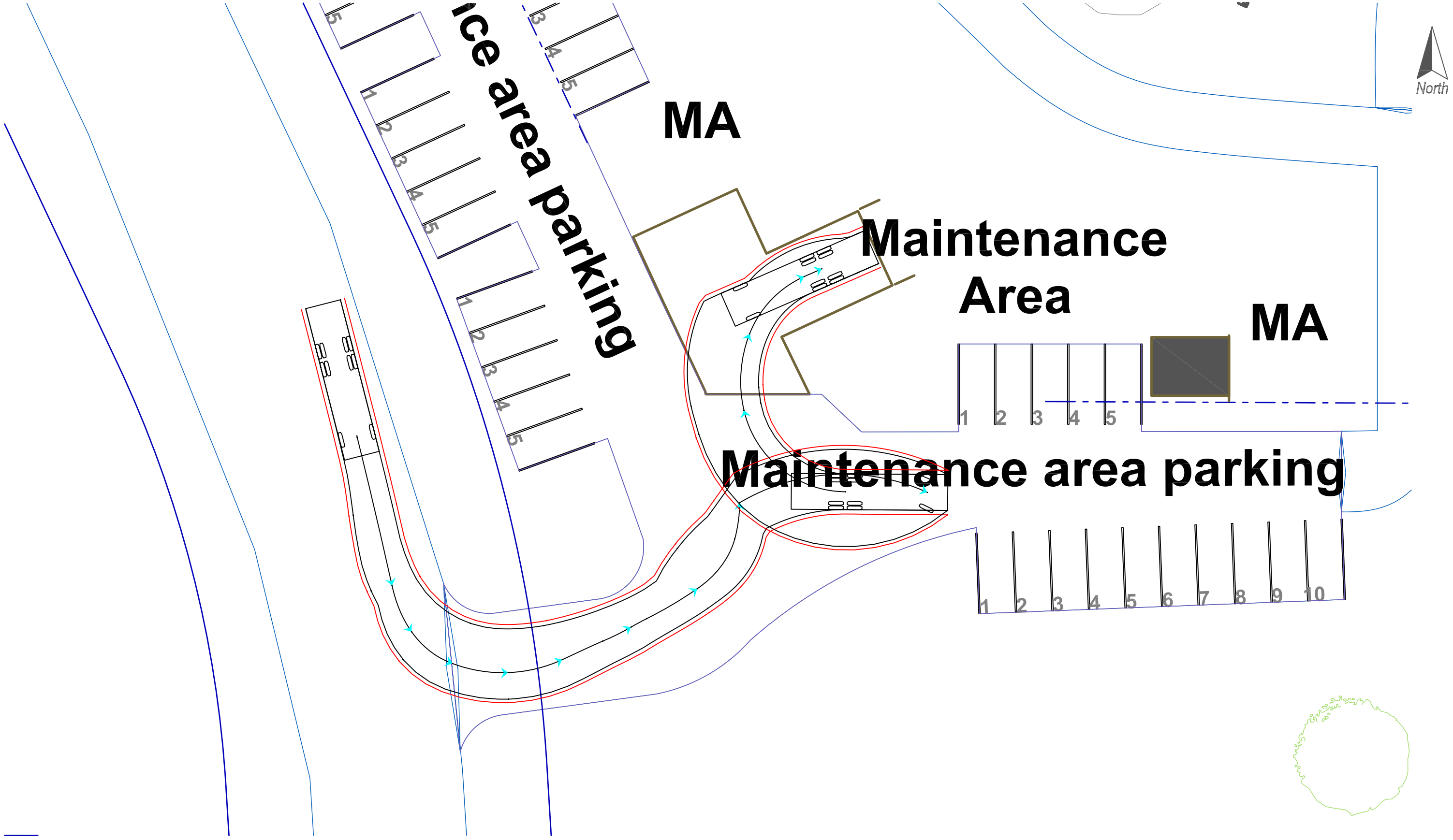
Filename: CTLCLR003DA03

Figure 2

Date: 22 October 2009

10.7M RCV IN

KINGSCLIFF RESORT - SWEPT PATH ANALYSIS



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Halcrow MWT

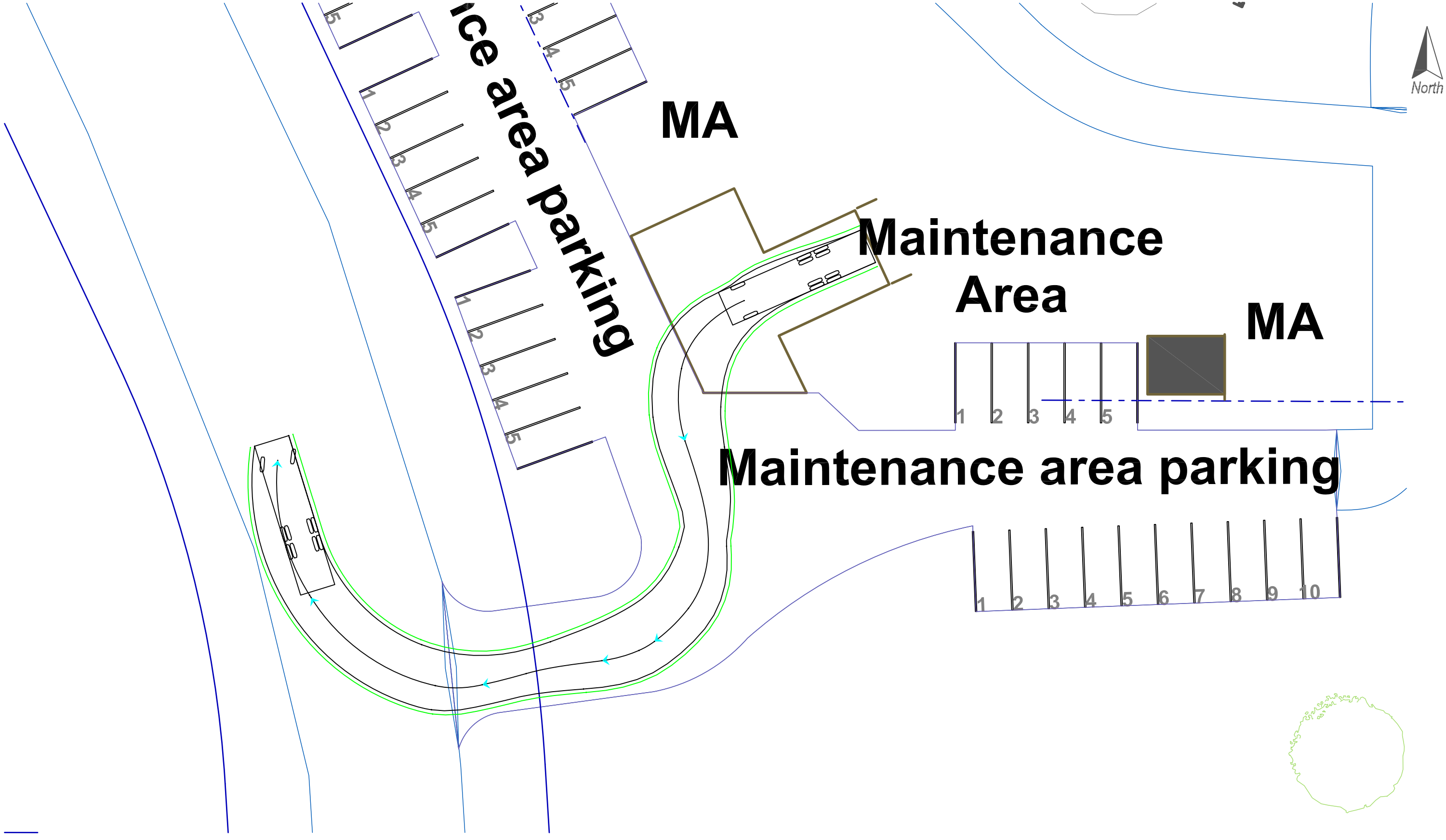
Filename: CTLCLR003DA03

Figure 3

Date: 22 October 2009

10.7M RCV OUT

KINGSCLIFF RESORT - SWEPT PATH ANALYSIS



Scale: 1:250@A3

Halcrow MWT

Filename: CTLCLR003DA03

Figure 4

Date: 22 October 2009