

Darwin City Waterfront Redevelopment

TRAFFIC IMPACT ASSESSMENT

Technical Assessment for the Draft Environmental Impact Statement

13 April 2004

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Objectives and Scope

1.1 Objectives

The objectives of the traffic impact assessment are to:

- Assess the existing road and traffic conditions in and around the Darwin City Waterfront Precinct;
- Identify potential traffic-related issues that may arise as a consequence of proposed development within the precinct; and
- Suggest measures to mitigate these issues.

1.2 Scope

The scope of this assessment is limited because the details of the Master Plan for the Darwin City Waterfront Precinct have yet to be finalised and endorsed by the Northern Territory Government. Accordingly assumptions have been made regarding the extent and type of traffic generating developments that may ultimately occur and of the staging of development.

It has also been acknowledged that further development and redevelopment of land in the immediate vicinity of the precinct may occur. These may not only influence the timing of development within the precinct but may also contribute to the impacts on traffic conditions on the main access roads to and at key intersections.

The traffic related issues and suggested mitigating strategies identified in this assessment are therefore provided as a guide only. These should be reviewed once details of the Master Plan are known.

2. Description of the Existing Environment

2.1 Development and Land Use

The Darwin City Waterfront precinct is located immediately below and adjacent to the escarpment at the south east end of the CBD. The precinct comprises two distinct and physically separated components:

- The southern end of the precinct includes the land abutting both sides of McMinn Street and east of the escarpment and forms the majority of the land; and
- The northern end which is the former Stokes Hill Power Station

The precinct comprises a small number of disparate land uses serviced by a moderate but low standard road network (refer section 2.2). These existing land uses are described elsewhere in this report but are summarised here to provide an appreciation of the activities that contribute to the existing traffic volumes and patterns into, out of and within the precinct.

The Stokes Hill Wharf and the Fort Hill Wharf are operational wharves. These are used periodically by naval and passenger cruise vessels both of which may generate significant vehicle and pedestrian activity. Naval vessels are occasionally open for public inspection, attract a significant number of visitors to the wharves and generate loading and unloading activities. Passenger cruise-ships also attract large numbers of visitors including passengers and observers.

There are a number of eateries on the Stokes Hill Wharf including restaurants and cafes and these operate throughout the week. Car parking is permitted on the wharf but this is restricted at some times when the passenger ships are loading and unloading. The wharf is also used for recreational activities including fishing.

Along McMinn Street there is a small number of abutting developments with accompanying car parks including:

- Tram Eatery;
- Australian Pearling Exhibition and Aquaculture Centre; and

- Indo Pacific Marine tourist facility

These do not generate significant volumes of vehicle or pedestrian traffic.

The Shell Bitumen Plant which is still operational is located further south of McMinn Street. This will be de-commissioned at some stage as part of the general redevelopment of the area. Nearby, there is a hardstand area used by helicopters which provide scenic tours for tourists. The remainder of the land to the east of the escarpment is disused industrial land which may require remediation before it could be re-developed (depending on the nature of the intended use).

The disused Stokes Hill Power Station is located to the north of McMinn Street.

The following developments are located outside of but in the general vicinity of the precinct and are of interest because they generate traffic movements into and out of the precinct and along main access roads.

The Deck Chair Cinema has recently been relocated to just outside of the south western end of the precinct. It is provided with its own car park and operates in the evenings during the dry season. Vehicle and pedestrian access to this site is via the precinct.

There are four developments abutting Leydin Court located immediately west of the precinct and north of McMinn Street. These are:

- A six storey commercial office building (Harbour View Plaza); and
- Three townhouse complexes comprising 15-16 apartments each (one under construction)

Multi-story residential developments are presently being constructed within the immediate proximity of the precinct and its main access roads. Other land nearby which is either vacant or suitable for re-development also has the potential to be similarly developed in the foreseeable future.

The majority of the existing land uses and operation of the wharves are expected to be retained at least in the short to medium term and will continue therefore to generate vehicle and pedestrian activity.

2.2 Road Network and Traffic Access

Roads

Road access into the precinct is restricted to its northern end because it is located on the southern tip of the peninsula and is bounded on its eastern edge by the escarpment. Access is further restricted because of the physical separation of the two components of the area.

McMinn Street and to a much lesser extent, Hughes Avenue provide access to the southern section of the precinct. Mavie Street (via Frances Bay Drive) provides access to the northern section.

McMinn Street links the precinct with Tiger Brennan Drive and the Stuart Highway. North of Tiger Brennan Drive, McMinn Street is a two-lane undivided road. This section of road may be progressively upgraded to form a duplicated road as traffic demands warrant it, although there is no commitment to the timing (refer section 3.2). The road narrows as it extends southwards into the precinct and terminates at Stokes Hill Wharf. It provides direct access to a small number of abutting developments.

Hughes Avenue provides a very low standard access into the southern end of the precinct. It connects with The Esplanade and Kitchener Drive and is steep and narrow.

Mavie Street is a sealed undivided road. It connects with Frances Bay Drive which is a two lane undivided road and which in turn links to McMinn Street and Tiger Brennan Drive. Tiger Brennan Drive is a major 3-lane arterial road (2 lanes inbound, 1 lane outbound) which supplements the Stuart Highway in connecting the CBD to outer suburbs and regional centres including Palmerston. It is a controlled access road.

Within the precinct there is an internal network of sealed and undivided roads. These are generally on level grade but are generally in poor condition. These have also been designed and constructed to a low geometric standard with little or no provision for drainage.

Kitchener Drive extends south-westwards from its junction with McMinn Street along the base of the escarpment and into Fort Hill. It serves as a collector road for the few remaining developments and together with other connecting local roads provides access to the abutting land.

Pedestrians

Pedestrian access to the precinct is also limited and is not generally conducive to use by mobility-impaired persons. Access is possible via any of the approach roads mentioned above or via a stepped walkway linking The Esplanade with Kitchener Drive.

A footpath is provided along part of McMinn Street south of the intersection with Bennett Street. The approach to the intersection is reasonably steep. There are no footpaths along either of Frances Bay Drive or Hughes Street and pedestrians have to walk on the road pavement.

The stepped walkway is the most direct link between the CBD and the precinct. It is quite steep and is not appropriate for use by mobility-impaired pedestrians. There are no clearly delineated pedestrian crossings at either end of the walkway where pedestrians are required to cross roads.

Cyclists

There are no dedicated facilities for cyclists to access or circulate within the precinct. There are no marked bicycle lanes on the access or internal circulation roads. Hughes Avenue is the most direct route between the CBD and the precinct but the road is steep and narrow and visibility at the junctions with end is restricted.

Buses

There are no public passenger bus services operating within the precinct. The bus terminus in Harry Chan Avenue is the closest facility to the precinct. Passengers wishing to access the precinct must either walk or take a taxi.

Buses access the CBD via either the Stuart Highway or Tiger Brennan Drive and travel to and terminate at the Harry Chan Avenue facility via Mitchell Street, Cavenagh Street or Bennet Street.

2.3 Intersections

There are a number of key intersections in the vicinity of the precinct. These are described briefly below with specific reference to any key features which may be of relevance to traffic movements which may be generated by future developments within the precinct.

McMinn Street – Tiger Brennan Drive – Bennett Street

The intersection of McMinn Street and Tiger Brennan Drive is a major intersection controlled by traffic signals. It is one of the two major entry points to the CBD from the northeast.

The majority of traffic travels through the intersection between Tiger Brennan Drive and Bennett Street and there are only moderate volumes of conflicting traffic movements travelling along McMinn Street during peak periods. There is a dedicated lane and signal phase for traffic turning into the precinct from Bennett Street but there are no specific provisions for left turns from Tiger Brennan Drive. There is only a single lane provided for through and right turn movements from each of the McMinn Street approaches and these are controlled by a single phase of the traffic signals. Right turns from these approaches must filter through the opposing traffic. There is a long left turn slip lane on the south eastern approach which reduces delays to traffic travelling into Bennett Street.

The level of service provided at the intersection during peak periods is good and the intersection has capacity to cater for additional traffic volumes. However, the opposed filter turn movements from the single lane McMinn Street approaches could potentially reduce capacity significantly with only moderate increases in traffic volumes or could introduce safety concerns.

Frances Bay Drive – Tiger Brennan Drive – Dinah Beach Road

The intersection of Frances Bay Drive with Tiger Brennan Drive is also signalized. It provides convenient access to the Stuart Highway at Stuart Park via Dinah Beach Road and Duke Street.

Frances Bay Drive follows the approximate alignment of Tiger Brennan Drive for most of its length and the intersection of the two is via a short connecting road. Frances Bay Drive continues northwards past this point towards Gonzales Road which also forms a junction with Tiger Brennan Drive.

The unusual approach of Frances Bay Drive to the intersection with Tiger Brennan Drive restricts the capacity to some extent although this is not presently evident with its current level of traffic usage. The approach consists of two lanes including a separate right turn lane. Separate phases are provided for the Frances Bay Drive and Dinah Beach Road approaches.

Frances Bay Drive – McMinn Street

Frances Bay Drive forms a priority controlled T-junction with and on the northern side of McMinn Street about 300 metres south east of Tiger Brennan Drive. All approaches to the junction comprise single traffic lanes and there is a splitter island on Frances Bay Drive at the mouth of the junction to delineate turning traffic movements. McMinn Street follows a slight horizontal curve through the junction and Frances Bay Drive connects on the outside of the curve. There is no separation of through and turning traffic on the McMinn Street approaches to the junction.

Kitchener Drive – McMinn Street

Kitchener Drive also forms a priority controlled T-junction with McMinn Street about 200 metres south of and on the opposite side of the junction with Frances Bay Drive. McMinn Street follows a similar horizontal curve through the junction with Frances Bay Drive located on the outside of the curve.

McMinn Street – Leydin Court

Leydin Court forms a priority-controlled T-junction with and on the northern side of McMinn Street about 130 metres south of the intersection of McMinn Street with Tiger Brennan Drive. Leydin Court is a no-through road and its approach to the junction is on a moderate incline. The junction is not well delineated. There is no separate provision for turning traffic at the junction.

Hughes Avenue

The T-junctions at each end of Hughes Avenue with Kitchener Drive and The Esplanade are both problematic. The Hughes Street approaches are on moderately steep grades and form acute angle junctions. Visibility from and of the junction is restricted.

2.4 Traffic Volumes

Surveys of traffic volumes on roads in the CBD and the general vicinity of it indicate seasonal variations with higher volumes being recorded during the dry season in the middle of the year.

The estimated AADT (2003) for McMinn Street (west of Bennett Street) was 5,900vpd but the daily volumes varied between 6,500 in July/August and 5,000 in January. Similarly the estimated AADT (2003) for Tiger Brennan Drive was 16,100 vpd varying between 17,000 in August to 13,300 in January. Records indicate that over the last few years, the volume of traffic using McMinn Street (and Stuart Highway) has reduced while the traffic volume using Tiger Brennan Drive has increased.

Surveys of traffic volumes at the intersections of these two main roads Tiger Brennan Drive/Bennett Street and Frances Bay Drive/Dinah Beach Road indicate the following two-way demands on the access roads into the precinct:

- McMinn Street (west) - 570 vehicles in the morning peak hour and 290 in the evening peak hour (excluding the left turn into Tiger Brennan Drive);
- McMinn Street (east) - 358 vehicles in the morning peak hour and 411 in the evening peak hour
- Frances Bay Drive - 363 vehicles in the morning peak hour and 374 in the evening peak hour

These volumes are not high and provide an indication of the present levels of traffic generating activities being undertaken in the precinct.

2.5 Car Parking

There are locations within the precinct where provision is made for formalised car parking. These include parking on the Stokes Hill Wharf and off-street facilities at each of the developments abutting McMinn Street. Parking here is provided free of charge although it is occasionally restricted at the wharf during times when ships are loading and unloading. Parking on-street within the precinct is generally permitted but is not prominent.

Public car parking outside of the precinct is provided largely within the CBD. There is a range of parking opportunities including paid off-street car parks (such as Cavenagh Street and Mott Court) as well as paid and free of charge timed on-street parking. Many of these facilities are considered to be too far from the precinct unless some form of improved public transport link is provided.

“All-day” parking is permitted on the northern side of McMinn Street, between Bennett Street and Stuart Highway. The allocated areas are actually within the McMinn Street road reserve and will be eliminated when the road is eventually duplicated.

3. Future Conditions

3.1 Introduction

Traffic conditions on the approach roads and intersections in the vicinity of the precinct will change as a consequence of numerous factors, irrespective of any development with the Darwin City Waterfront precinct. These include further residential and commercial traffic generating developments within and on the outskirts of the CBD, traffic growth resulting from growth in population and employment and improvements to the road network.

These are discussed briefly below.

3.2 Road Improvements

The Northern Territory Government (through DIPE) has investigated and periodically reviewed the development of the arterial road network with specific regard to improving road access into the CBD. These investigations have been undertaken as part of the development of the Government's planning strategy for improving access and road capacity across the urban area.

The specific road improvements described below are relevant to this traffic impact assessment in that the timing for their implementation and their ultimate form may be influenced by traffic generated by development within the precinct. There has been no Government commitment to the implementation of any of these projects.

McMinn Street duplication

The section of McMinn Street between Bennett Street/Tiger Brennan Drive and Daly Street/Stuart Highway is a two lane undivided road. This duplication of this road to provide a four lane divided road may be required when

traffic volumes warrant it. The road reserve is sufficiently wide to accommodate the widened road without the need to purchase land. Should the road be widened, then the parking of cars that is presently permitted in the road reserve would be eliminated. Widening of the road would also include improvements at the intersection with Bennett Street/Tiger Brennan Drive.

Barneson Street extension

The extension of Barneson Street would link Tiger Brennan Drive with Cavenagh Street. This link would reduce the volume of traffic entering the CBD via Bennett Street and direct traffic into the centre of the CBD. The link would reduce traffic demands on the intersection of McMinn Street and Tiger Brennan Drive adjacent to the precinct.

Tiger Brennan Drive - widening

Tiger Brennan Drive is presently a three-lane road for part of its length- providing two lanes for inbound traffic and one lane for outbound traffic. The widening of this section to provide a more traditional four-lane road is dependent on traffic growth and the possible construction of the Barneson Street extension.

3.3 Traffic Growth

Traffic volumes on the main approach and circulating roads in the CBD are expected to grow generally as a consequence of increased population, new commercial and retail development, employment opportunities and growth in tourism. The changes in traffic volumes on individual streets will also be influenced by improvements to the layout of the road network.

In 1999/2000 the then Department of Transport and Works (now DIPE) reviewed forecasts of future traffic volumes on roads in the CBD. The review was based on traffic modelling undertaken in 1998 which included consideration of various road network improvements and 150,000 population levels.

Many changes have occurred in the CBD area since the modelling was initially undertaken which may invalidate the model outputs. However, the review provides an appreciation of the range of traffic volumes that may occur on key road links as indicated in table below.

**Existing and Indicative Future Traffic Volumes
Two-way Peak Hour Flows
(Vehicles per Hour)**

Location	Existing Peak	Traffic Growth Only No Road Improvements 150,000 Population	Traffic Growth and Road Network Improvements 150,000 Population
McMinn Street (W)	290-570	970-980	460-690
Tiger Brennan Drive	1270-1820	1890-2910	1070-1490
Bennett Street	1470-1510	1470-1510	1170-2710

As can be deduced from the table, without selective road improvements in the vicinity of the CBD, traffic volumes using roads adjacent to the precinct will increase significantly as a consequence of population growth. These forecasts do not take into consideration any development within the precinct.

3.4 Land Use

As has already been noted, there exists potential for development of vacant land and redevelopment of under-utilised land in the vicinity of the precinct (including the railway yards land located between Tiger Brennan Drive

and Frances Bay Drive). Medium density residential housing is currently being developed close to the main road access into the area.

These developments will generate traffic movements that will contribute to increased traffic volumes and congestion on the road network and could potentially exacerbate the traffic impacts that might occur as a consequence of development of the precinct alone. On the other hand though, the rate and extent of any residential development outside of the precinct will affect the rate and extent of development within the precinct and the traffic impacts may be countered to some extent.

4. Description of the Proposed Environment

4.1 Introduction

Details of the Master Plan for the Darwin City Waterfront Precinct have yet to be finalised and endorsed by the Northern Territory Government. However some key principles and objectives have been formulated to provide a framework for its development and some essential components have been specified.

The most significant feature will be the Darwin Convention and Exhibition Centre (DCEC) which will comprise a 1500-seat convention centre, 4000 m² of exhibition space and provision for parking for 1000 cars. The exact location and layout of the facility including access and circulation roadways have yet to be determined.

The Master Plan will aim to integrate the existing commercial, entertainment, tourist and wharf activities. There will be a promenade along the waterfront linking the Fort Hill and Stokes Hill Wharves with additional entertainment, tourism and community use facilities. The form and layout of the remainder of the precinct is flexible and could include a range of compatible land uses such as residential, tourist, entertainment or recreational but would exclude industrial. Extensive commercial activity outside of the CBD is possible but not a preferred use. Hotel accommodation and serviced apartments may possibly be included but these would have to compete with existing and more central facilities in the CBD which have been expanded in recent years.

Re-development of the site (with the exception of the DCEC) will likely be funded on a private commercial basis and the rate and type of development will therefore be dependent on economic drivers. It is likely then that some form of accommodation, either short term (hotels or serviced apartments) or long term (residential) will form a significant component of the site. Based on the current rate of sales of residential dwellings in and around the CBD, it is likely that full development of the site may occur over a 10-15 year period.

Given the industrial nature of previous uses of the land and the likely inclusion of at least some residential and recreational activities in the Master Plan, remediation of large parts of the site will be likely. This could involve excavation and removal of soil and importation of fill which would have to be undertaken by road haulage.

The significant level difference between the precinct and the CBD at the top of the escarpment will pose a challenge to provide effective pedestrian and cycle links to the CBD and the existing public transport terminal in Harry Chan Avenue.

4.2 Possible Development Scenario

In order to identify any possible traffic-related impacts associated with the re-development of the precinct, a possible development scenario is postulated. The key components of the development scenario are those that are considered likely to generate significant traffic movements into out of and within the precinct at various times of the day and week. This traffic will be additional to the traffic generated by the present land use activities that are likely to be retained. The most significant impacts arising out of development of the precinct are most likely to occur during the peak week-day commuter periods when peak hour traffic will interact with the additional traffic generated by the new developments.

It is possible that any issues that arise out of this assessment will be valid for other development scenarios but may differ in extent or timing only. A review of these will be necessary when details of the Master Plan are known.

The Master Plan for the site will include the development of the DCEC as described above.

Residential development within the precinct is most likely to occur at the former Stokes Hill Power Station and to a lesser extent at Fort Hill. Strong preference was given to these sites during the community consultation phase of the study. Hotel accommodation may be possible in the southern part of the precinct but residential development is more likely to generate higher peak hour traffic volumes and therefore have greater impact on the road network.

For the purpose of this assessment it has been assumed that 500 residential dwellings would be developed in each of Fort Hill and Stokes Hill. Higher densities may be possible but it is recognised that there are likely to be restrictions on the height of the buildings.

Other compatible development may also be incorporated at other locations in the precinct including recreational, entertainment and tourist facilities. However, the traffic movements generated by these are not expected to be significant in the peak commuter periods and are accordingly disregarded in this assessment.

4.3 Staging of Development

It was commented earlier that the full re-development of the precinct may not be realised for 10-15 years because of the requirement to remediate some of the land, the economic and commercial viability of private developments compared with competing developments outside of the precinct and the demand for such development.

The precinct will therefore likely be developed in stages.

The first stage which will be initiated almost immediately through government funding will be the DCEC. The second stage might include residential development at Stokes Hill and the third stage being the residential development at Fort Hill.

5. Assessment of Potential Impacts

5.1 General

As has already been mentioned, this assessment of impacts is based on an assumed development scenario which may vary from the actual Master Plan. The assessment though will identify potential traffic related issues which will need to be reviewed once the details of the Master Plan are known. The assessment focuses on the key traffic generating components of the development and on the impacts on the road network that may be eventuate in the peak commuter periods.

5.2 Traffic Generation and Movement Patterns

General

Each of the individual land use activities associated with the redevelopment of the precinct will generate demands for traffic movements into and out of the precinct as well as within the precinct. The volume and rate of vehicle trips will depend on the nature of the activity. These trips will be additional to the trips generated by existing developments within the precinct.

The daily and peak hour volumes of traffic likely to be generated by the key components of the development scenario are estimated below. The impacts of this generated traffic on the existing adjacent road network are most likely to be evident during the peak commuter period and not necessarily during the peak time for the entire development. Other traffic generating developments associated with the Master Plan may have their peak activity at times that do not coincide with the peak commuter period and have therefore been disregarded in this assessment. (These should nonetheless be considered in a review of the traffic impact assessment when details of the Master Plan are known).

Generated peak hour traffic demands have been estimated for each of the three key components of the assumed development scenario and for the fully developed site. Comments are also made on the volume and type of traffic that will be associated with the preparation of the site and construction activities during the staged development of the precinct.

Convention and Exhibition Centres

There are no published Australian guidelines on the trip generation rates for these types of facilities. Estimates of traffic volumes are best determined on the basis of first principles or comparisons with other similar developments. Events at the convention and exhibition centres may occur separately or coincident with each other. Each component is considered in turn.

The convention centre may be utilised for a wide range of events and the nature of these events will influence the volume and temporal patterns of trip making associated with them. In terms of determining the impacts of this traffic generation on the adjacent road network, the worst case scenario would involve an all-day function in which delegates arrive in the morning and depart in the afternoon.

Assuming that the 1500-seat convention centre is fully occupied for a full day function, then it can be assumed that it would generate at least 3000 person trips in the day (that is each delegate arrives in the morning and departs in the evening). This estimate makes no allowance for trips by the staff required to service the function or of the possibility of individual delegates making additional trips into and out of the precinct during the course of the day.

The mode of travel selected by individuals to travel to the site will influence the number of vehicle trips made and the possibilities may be wide ranging. However it can be expected that such a significant event would be attended by delegates from interstate or overseas and who would stay in hotels in the CBD. It is likely then that some of the trips will be undertaken by walking or by taxi. Accordingly, the following assumptions are made:

- 10% (300) of person trips will be undertaken by foot;
- 10% (300) of person trips will be undertaken by taxis having an average vehicle passenger occupancy of 1.5 (i.e. 400 taxi trips – two trips per fare);
- 10% (300) of trips will be undertaken by public transport; and
- The remaining 70% (2100) of trips will be undertaken by private car having an average occupancy of 2.0 (i.e. 1050 private car trips).

It would be unlikely that all 1500 delegates would arrive and depart the convention centre in the peak commuter hours. So if it is further assumed that 80% of delegates would travel in these time periods, then the numbers of peak hour passenger car trips generated by the centre would be:

- 500 arrive and 80 (taxis) depart in the morning peak; and
- 80 (taxis) arrive and 500 depart in the evening peak.

The number of daily trips is estimated at 1450 (in and out).

The total number of passenger car trips attracted to the convention centre event in this scenario is 525 and these would presumably park in the 1000 space car park provided as part of the development. This suggests that providing the car park is to be reserved only for this event, additional car trips (having lower average occupancies) could be accommodated.

The Exhibition Centre is likely to generate a much different pattern of travel to the convention centre because of the nature of the events held. Visitors to the Exhibition centre are more likely to attend for much shorter periods and at varied times throughout the day. This distribution of trips throughout the day will place less pressure on the roads network during peak times.

It has been suggested elsewhere that the Exhibition Centre could attract about 3000 visitors in a single 8 hour day. If visitors arrive at a uniform rate over the day then there will be 375 visitors arriving every hour. If the same mode split is assumed as for the convention centre the following peak hour car trips may be generated:

- 160 arrive and 25 depart in the morning peak; and
- 50 arrive and 320 depart in the evening peak.

The number of daily trips is estimated at 2900

When the Convention Centre and Exhibition Centre conduct coincident events then it is likely that delegates to the Convention Centre will also visit the Exhibition Centre. However it is also likely that these would visit during breaks in the Convention Centre event program during the day time and between the peak periods. Accordingly the total number of vehicle trips generated in the peak periods would be very similar to the combination of the two estimates above;

- 660 arrive and 105 depart in the morning peak; and
- 130 arrive and 820 depart in the afternoon peak.

The number of daily trips is conservatively estimated at 4350 when there are coincident events.

Residential

The vehicle trip generation rate for units and townhouses varies from 4-6 trips per dwelling per day (depending on the number of bedrooms and other factors). It may be more appropriate to apply the higher end of the range for this proposed development because it is likely that the dwellings will be occupied by more affluent people having a higher car ownership. On the other hand, residents may work in the CBD and walk to work. For the sake of this assessment, the conservative higher value is adopted. The vehicle trip generation rate for the peak hour is 0.65 trips per hour.

This rate suggests that each of the two residential developments would generate 3000 vehicle trips per day and 325 vehicle trips in the peak hour. Some of these trips may occur wholly within the precinct but the majority would travel through one or both of the signalised intersections on Tiger Brennan Drive (via McMinn or Frances Bay Drive).

In the morning peak period it is assumed that 80% (260) of these trips would depart the locality and 20% (65) would enter it. In the evening peak hour, 65% (210) are assumed to enter 35% (105) to depart the locality.

Construction Traffic

The development of the precinct will take place in a staged manner over a number of years and will involve site preparation and construction activities.

In view of the previous industrial uses and the consequent contamination of the land, it is likely that selective remediation of the site will be required prior to its development. This may involve in some cases removal of soil and possibly the importation of replacement fill materials. Details of the remediation activities have yet to be determined and will depend to some extent on the nature of the developments proposed. However, it is very likely that these will occur in the very early stages of the site preparation. The general clean up of the site to remove disused infrastructure (including buildings and services) will also be a major activity. The removal of contaminated material, the general clean up of the site and the importation of fill materials will be undertaken by large commercial vehicles using existing road access into the precinct.

The provision of new infrastructure including new or upgraded internal roads and services will also represent a significant activity and will generate traffic movements into and out of the precinct at various stages of its development.

The construction of buildings associated with individual developments will generate both commercial and private vehicle traffic involved in the delivery of materials, provision of labour and other associated activities.

The volume and type of vehicle trips generated by these activities and their timing is difficult to estimate without further details of the nature and quantity of remediation required.

Over the duration of the staged development, the volume of traffic generated will be significant but most of this will occur during weekday business hours.

5.3 Traffic Distribution

General

The majority of the estimated traffic volumes likely to be generated by the proposed re-development of the precinct will access the external road network via McMinn Street (southern part of the precinct) or Frances Bay Drive (northern part of the precinct). A minority of vehicle trips may use Hughes Street (if it remains open to traffic) and a small proportion of trips will be undertaken wholly within the precinct.

It is presumed that apart from taxis, very little traffic will travel into or out of the CBD during peak periods and will be more likely destined for areas north and east of the city.

The most likely routes to be used then would be:

- McMinn Street and then Stuart Highway (40% of trips to and from the southern part of the precinct);
- McMinn Street and then Tiger Brennan Drive (60% of trips to and from the southern part of the precinct);
- Frances Bay Drive and then Tiger Brennan Drive (70% of trips to and from the northern part of the precinct) or Dinah Beach Drive (30% of trips)

Traffic entering or leaving the southern part of the precinct may choose to use Frances Bay Drive and Tiger Brennan Drive if there was congestion evident at the intersection of McMinn Street and Tiger Brennan Drive.

The estimated traffic volumes associated with the individual and combined developments have been assigned to the road network for each of the three stages of development:

- Stage 1 – Convention Centre and Exhibition Centre (separate and combined events);
- Stage 2 – Stage 1 plus 500 dwellings at Stokes Hill Wharf
- Stage 3 – Stage 1 and 2 plus 500 dwellings at Fort Hill Wharf.

The volumes indicated below are additional to the existing traffic volumes using the roads.

Stage 1

The Convention Centre and Exhibition Centre activities will generate additional traffic volumes as follows:

- McMinn Street (east of Tiger Brennan Drive) could attract between 185-765 vehicles in the morning peak, 370-950 vehicles in the evening peak and 1450-4350 vehicles per day
- McMinn Street (west of Tiger Brennan Drive) could attract between 75-306 vehicles in the morning peak, 148-380 vehicles in the evening peak and 580-1740 vehicles per day
- Tiger Brennan Drive could attract between 110-459 vehicles in the morning peak, 222-390 vehicles in the evening peak and 870-2610 vehicles per day

Stage 2

The residential development at Stokes Hill will generate additional traffic volumes as follows. These volumes do not include additional traffic volumes using these roads as a consequence of normal traffic growth:

- Frances Bay Drive could attract about 325 vehicles in the morning and evening peaks and 3000 vehicles per day
- Tiger Brennan Drive could attract 228 vehicles in each peak hour and 2100 vehicles per day
- Dinah Beach Road could attract 97 vehicles in each peak and 900 vehicles per day

When the Convention Centre and Exhibition Centre are holding events, the volume of traffic using Tiger Brennan Drive could increase further to an extra 338-687 in the morning peak, 450-618 in the evening peak and 2970-4710 vehicles per day.

Stage 3

The residential development at Fort Hill will generate additional traffic volumes as follows. These volumes do not include additional traffic volumes using these roads as a consequence of normal traffic growth:

- McMinn Street (east of Tiger Brennan Drive) could attract 325 vehicles in the morning and evening peaks and 3000 vehicles per day
- McMinn Street (west of Tiger Brennan Drive) could attract 130 vehicles in the morning and evening peaks and 1200 vehicles per day
- Tiger Brennan Drive could attract 195 vehicles in the morning and evening peaks and 1800 vehicles per day

When the Convention Centre and Exhibition Centre are holding events, the volume of traffic using these roads could increase further as follows:

- McMinn Street (east of Tiger Brennan Drive) could attract between 510-1090 vehicles in the morning peak, 695-1275 vehicles in the evening peak and 4450-7350 vehicles per day
- McMinn Street (west of Tiger Brennan Drive) could attract between 205-436 vehicles in the morning peak, 278-510 vehicles in the evening peak and 1780-2940 vehicles per day
- Tiger Brennan Drive could attract between 533-882 vehicles in the morning peak 645-813 vehicles in the evening peak and 2670-4410 vehicles per day

Construction Traffic

Large commercial vehicles deployed in the site remediation and construction activities will access the two areas of the precinct via McMinn Street or Frances Bay Drive.

The route adopted by vehicles external to the precinct will depend on the locations of the sources of construction materials and equipment and the disposal sites for the contaminated soil deposits. These are not known but are likely to be located north of the city. Accordingly, it is most likely that large commercial vehicles would use Tiger Brennan Drive (where appropriate) rather than McMinn Street/Stuart Highway because it is a controlled access road and would avoid passing through developed areas abutting the road. Over-dimension vehicles would have to use Tiger Brennan Drive.

5.4 Traffic Impacts

The impacts of the estimated traffic volumes assigned to various roads are discussed in the following sections. These impacts will be most evident at locations closest to the precinct and will diminish further away from the site. Traffic volumes will be concentrated at the major road access points at McMinn Street and to a lesser extent Frances Bay Drive and at the intersections of these roads with Tiger Brennan Drive.

Internal Road Network

It will not be known until the Master Plan has been completed whether the existing internal road network will remain or whether an entirely new road network will be constructed to service the development. If the existing roads are retained then these will need to be upgraded to current design standards and they would need to be reviewed to ensure that they cater for both moving traffic and access.

In the first stage of development, the internal road network will be required to cater for traffic volumes generated by the convention and exhibition centres (estimated maximum of 4350 vpd). This volume can be accommodated by a two lane road however, if Kitchener Drive is to be retained to provide this function then it would need to be widened and upgraded to also make provision for buses, cyclists and pedestrians.

In its present layout, Kitchener Drive also provides access to the Fort Hill Wharf area which occasionally attracts visitors to inspect vessels. It would be rare though for such an event to coincide with concurrent events at the DCEC and unlikely therefore that traffic demands would exceed the capacity of the two lane road.

The junction of Kitchener Drive with McMinn Street would need to be upgraded to cater for the additional traffic. This may require a review of the alignment of the junction to alter the priority control (it may be preferable to provide priority to traffic on Kitchener Drive over McMinn Street) and to improve delineation of traffic movements through the junction.

When stage 3 of the development is complete, it is possible that traffic generated by the residential development (3000 vehicles) will also use Kitchener Drive to access site. On normal weekdays when there are no events at the DCEC then the capacity of the road will be sufficient to cater for the demands. However, on days when the DCEC is operating at capacity, then the volume of traffic using Kitchener Drive may increase to as much as 8400 vehicles per day. The conflicts between residential traffic moving through the area with traffic entering and leaving the DCEC will need to be managed by the provision of turning lanes and other traffic management initiatives. The conflicts in the immediate vicinity of the DCEC could be eliminated if an alternative access road was provided. The layout and capacity of the junction of Kitchener Drive with McMinn Street would need to be reviewed to ensure safe and efficient traffic movements under these circumstances.

McMinn Street

The additional traffic volumes using McMinn Street (east of Tiger Brennan Drive) as a consequence of the development will vary from between 1450 and 4350 vehicles per day (Stage 1 only) to between 4450 and 7350 when the site is fully developed in 10-15 years time (Stage 3).

On days when there are no events at the DCEC, there will be little additional traffic using McMinn Street during Stage 1 of the development. Any additional traffic will be attributed to the day to day operations of the centre and on-going pre-development activities elsewhere in the site.

The traffic attributed to the DCEC is significant but any adverse impacts on the operation of McMinn Street are likely to be infrequent and short lived. There would appear to be sufficient capacity at the intersection of McMinn Street to cater for the additional peak hour trips, albeit average delays to all traffic would increase. If the impacts of increased delays to other traffic using the intersection are to be minimised then there may be just cause to provide capacity improvements. In time and as traffic volumes grow on Tiger Brennan Drive and Bennett Street, then there may be increased justification to review the layout and operation of this intersection. The safety performance of the filter right turns put of McMinn Street would need to be monitored.

Traffic queues on the single lane McMinn Street approach to the signals may occasionally extend to the junction with Leydin Court and restrict access and egress at the junction. Again, this would occur infrequently.

When Stage 3 is completed and there are no events at the DCEC, the additional traffic volume using McMinn Street would be about 3,000 vehicles per day. This volume by itself would likely be accommodated by the existing intersection layout, but the increase in traffic volumes on the other roads over the 10-15 year period may warrant improvements to the intersection. It is possible that the intersection improvements as part of the duplication of McMinn Street (west) may well have been completed at this stage.

In the period between the completion of the DCEC and the full redevelopment of the precinct, traffic volumes on McMinn Street and through the intersection at Tiger Brennan Drive will increase progressively as development proceeds. At some stage, traffic volumes will reach a level which will warrant the duplication of McMinn Street between Tiger Brennan Drive and Kitchener Drive and capacity improvements at the major intersection. The improvements at the intersection could be introduced incrementally but these would need to be consistent with the ultimate layout for the intersection.

The additional traffic volumes on McMinn Street (east) will emphasise the lack of delineation and turning lanes at the T-junctions with Leydin Court, Frances Bay Drive and Kitchener Drive. Localised widening at the junctions to provide separate right turn lanes could be considered as an interim improvement pending the duplication of the whole road.

The traffic using McMinn Street to access the Stuart Highway or the CBD will increase by about 1200 vehicles per day on a normal day (Stage 3) but could reach as high as 1780-2940 with events at the DCEC. By the time stage 3 is complete the duplication of this section of McMinn Street may already have been justified on the basis of increased traffic volumes generally. The traffic generated by the stage 3 development of the site though may bring forward the requirement to duplicate the road.

Frances Bay Drive

The additional traffic volumes using Frances Bay Drive (between Mavie Street and Tiger Brennan Drive) as a consequence of the development will be about 300 vehicles in the peak hours and 3000 vehicle per day.

Frances Bay Drive will need to be upgraded to an acceptable standard two-lane road with upgraded junction to cater for turning traffic. The approach to the major intersection with Tiger Brennan Drive may need to be reviewed to maximise the capacity of the approach and to ensure access to the northern end of the road is not unduly restricted.

The intersection at Tiger Brennan Drive will be subjected to significant and progressively increasing traffic volumes as development of the precinct proceeds. During the preparation stages of Stage 1, heavy vehicles are likely to use this intersection to gain access to the site. The DCEC will generate between 870-2610 vehicles per day through the intersection. The Stage 2 development will generate a further 3000 vehicles per day through the intersection and Stage 3 will contribute a further 1800 vehicles per day. When the precinct is fully developed, as many as 7400 vehicles per day will pass through the intersection over and above the existing traffic volumes and in addition to any traffic growth generally.

Accordingly, capacity improvements to the intersection will be required. The form and timing of the development of the intersection though will need to be considered in light of other road improvements in the general vicinity that may be scheduled and which may influence traffic volumes at this intersection.

Construction Traffic

Heavy commercial vehicles involved in the haulage of construction materials and the removal of contaminated and demolition materials will lead to increased rates of deterioration of road pavements. The roads that will be subjected to the most frequent use by heavy vehicles include McMinn Street and Frances Bay Drive.

These and other potentially affected roads may need to be strengthened and maintained regularly to ensure that the roads do not become safety concerns for other road users. Localised widening of key intersections may also assist in reducing the damaging impacts of heavy vehicles.

5.5 Provision for Parking

It is assumed that each of the components of the redevelopment of the precinct will comply with the provisions for parking as required by the Darwin City Council. That is that adequate off-street parking will be provided to cater for the parking demands generated by the development.

There is however some scope for shared use of parking between complementary land-use activities that generate peak parking demands at different times. For example, the DCEC could use parking normally set aside for recreational purposes. This would reduce the amount of land required for car parking within the precinct. This would need to be reviewed as part of a more detailed Master Plan.

There may also be opportunities to reduce the level of parking provided within the precinct by providing parking facilities elsewhere through the Darwin City Council parking contribution fund. This would not apply to residential dwellings. To be effective, strong links would need to be developed between these external parking facilities and the precinct including for example shuttle bus services. Parking external to the precinct would reduce traffic demands at key intersections and perhaps eliminate or defer the need for costly capacity improvements that may be required to meet infrequent traffic demands.

5.6 Pedestrian and Bicycle Movement Patterns

Redevelopment of the precinct will generate increased demands for the movement of pedestrians and cyclist into, out of and around the area. These will most likely be concentrated on the routes between the CBD and the precinct.

The pedestrian walkway between the CBD and Kitchener Street will need to be supplemented or upgraded with a more effective pathway that complies with the requirements for disabled access. Pedestrian footpaths and provisions for cyclists will need to be provided and upgraded along Frances Bay Drive and McMinn Street. Pedestrian crossings will need to be identified and formalised.

Within the precinct, pedestrian and cycle paths will need to be integral features of the layout of the road system.

Consideration may be given to closing Hughes Avenue to road traffic and developing it as a shared path for pedestrians and cyclists which also meets the requirements for disabled access. The path could also be used as an emergency vehicle access.

5.7 Public Transport

The use of taxis and buses to provide public passenger transport to the precinct offers an opportunity to reduce the demands for passenger car traffic to enter the precinct and to generate additional visitation to the precinct generally.

The upgraded internal road network will need to incorporate appropriate provisions for buses include appropriate width lanes, indented bus stops and areas for buses to lay-over and turn around. Intersections and junctions may need to be widened to accommodate bus turning. These considerations should be integral to the design and layout of the DCEC.

The bus services might consist of extensions of existing bus services connecting with the terminus at Harry Chan Avenue and new shuttle services between the CBD and the precinct. Bus priority may be considered as part of the eventual upgrade of the McMinn Street/Bennett Street intersection. The shuttle bus route could include Hughes Avenue which would provide a more direct route between the CBD and the precinct.

6. Mitigation Strategies

6.1 Introduction

The traffic impacts identified in the foregoing section may be mitigated by improvements in road capacity and changes to the layout of various parts of the road network. These are summarised below.

The strategies are indicative only and need to be reviewed once details of the form and staging of the development of the Master Plan are known. These are broadly categorised as short, medium and long term and

correspond approximately to the three stages of development described earlier. However, any of the strategies can be implemented earlier if justification can be shown to do so.

6.2 *Short Term*

- Upgrade Frances Bay Drive and McMinn Street to enable these to carry heavy vehicle loads during the preparation stages of the precinct. This might include strengthening of the road pavements and widening at junctions to cater for large turning circles.
- Upgrade the internal road network to conform to current design standards and to include footpaths and cycle lanes.
- Review the layout and priority at the junction of Kitchener Drive and McMinn Street
- Provide local flaring of the junctions of (1) Frances Bay Drive and (2) Leydin Court to develop separate right turn lanes
- Provide a separate right turn lane on McMinn Street approach to the intersection with Tiger Brennan Drive.
- Assess the need to widen McMinn Street from Kitchener Drive to Tiger Brennan Drive (and in which case incorporate the right turn lanes at junctions and intersections as well as bicycle lanes).
- Upgrade Kitchener Drive (if retained) to cater for vehicle access, bus stops and turning traffic in the vicinity of the DCEC
- Investigate the possibility of developing Hughes Avenue as a shared pedestrian-cycle path and /or shuttle bus route

6.3 *Medium Term*

- Widen and upgrade Mavie Street and upgrade the junction with Frances Bay Drive
- Widen Frances Bay Drive and upgrade junctions along its length
- Review the layout and operation of the intersection of Tiger Brennan Drive with Frances Bay Drive and upgrade if required.

6.4 *Longer Term*

- Duplicate McMinn Street between Stuart Highway and Bennett Street
- Duplicate McMinn Street between Kitchener Drive and Bennett Street if not already done so
- Upgrade the intersection of Tiger Brennan Drive and McMinn Street. Review the signal phasing and provide controlled right turns from McMinn Street.
- Investigate the need to widen Tiger Brennan Drive to 4 lanes in conjunction with reviews of other road improvement strategies.

