

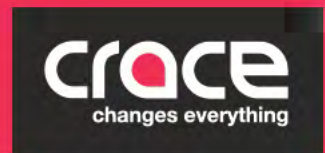
# CRACE



## Estate Development Plan : Stage 3

Development Application : June 2011

A Joint Venture between the Land Development Agency and  
Crace Developments P/L managed by CIC Australia







CIC Crace Pty Ltd

**CRACE RESIDENTIAL ESTATE**  
**STAGE 3**  
**ESTATE DEVELOPMENT PLAN REPORT**  
**FOR DA SUBMISSION**

**June 2011**



In association with  
**J. Easthope & Associates**

A Joint Venture between the Land Development Agency and  
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2	May 2011	Issued to support DA submission – Acoustic Report amended. Appendix H and I added.		
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# 1. Introduction

This Estate Development Plan report outlines the key planning objectives and principles upon which the Crace Stage 3 Residential Estate is planned. The Crace Stage 3 Estate Development Plan provides the important planning requirements as the basis of future detail planning and development of the suburb.

Crace Stage 3 Residential Estate is to be developed by the joint venture between the Land Development Agency and Crace Developments.

This Crace Stage 3 Estate Development Plan covers the area previously delegated as playing field, neighbourhood park and water quality pond. A change in policy initiated by Sport & Recreation Services (SRS), expressed the desire to review the standard requirements for the supply of 'Neighbourhood Ovals' in new residential subdivisions, seeking to develop a more strategic approach to the supply of organised sporting facilities across the ACT by targeting facility development rather than inheriting individual neighbourhood ovals and duplicated facility provision for every new suburb. The new approach identifies the need to provide a Community Recreation Irrigated Parkland (CRIP) for the use of future residents of Crace. The CRIP requires less area than the neighbourhood ovals and accordingly 22 residential blocks have been planned within the residual area.

To facilitate the change from neighbourhood ovals to a CRIP, a Territory Plan Technical Amendment is currently under review. Previous advice from ACTPLA indicated that no Territory Plan variation process was required to facilitate this change. Refer to Appendix F.

Most of the critical criteria associated with an Estate Development Plan have already been satisfied as part of both Crace Stage 1 and Stage 2 Estate Development Plans.

This Estate Development Plan responds to planning concepts expressed in the Crace Concept Plan and the Territory Plan.

The Estate Development Plan is supported by the subject plans listed in Table 1. These drawings meet the requirements of ACTPLA's Guidelines for the Preparation of Estate Development Plans, May 2008.

Where drawings are noted as 'Not Required' it is considered that the EDP does not have elements noted within the EDP guideline for that drawing.

Refer to the following page for the list of supporting drawings.

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

The Estate Development Plan is supported by the subject plans listed below:

DESCRIPTION	SUPPLIED	NOT REQUIRED	OFFICE USE
Drawing List	Yes		
Estate Development Plan	Yes		
Block Details Plan	Yes		
Locality Plan	Yes		
Concept Master Plan	Yes		
Staging Plan	Yes		
Land Use Plan	Yes		
Slope Analysis Plan	Yes		
Stormwater Master Plan	Yes		
Water Sensitive Urban Design Outcomes Plan	Yes		
Sewer Master Plan	Yes		
Water Supply Master Plan	Yes		
Landscape Master Plan	Yes		
Tree Survey and Tree Management Plan		Not required <i>No existing trees in Stage 3</i>	
Energy Audit Plan	Yes		
Road Hierarchy and Traffic Analysis Plan	Yes		
Road Details Plan	Yes		
Typical Cross Sections	Yes		
Chainage Plan	Yes		
Road Longitudinal Sections	Yes		
Public Transport Network and Off Road Movement Systems	Yes		
On-Street Parking Plan		Not required	
Waste Collection Plans		Not required <i>Standard kerb side pick-up at front of blocks</i>	
Building Envelope Plans	Yes		
Development Intentions Plans		Not required	
Bushfire Risk Assessment and Management Plan	Yes		
Fill Plan	Yes		
Environmental Management Concept Plan	Yes		
Planning Control Plan	Yes		
Open Space Concept Plan	Yes		

Table 1: Estate Development Plan Drawing List

Notes:

1. There are no trees within the subject area.
2. All blocks are single dwellings larger than 500m<sup>2</sup> with frontages greater than 12m.

## 1.1 Site Characteristics

### 1.1.1 Location and Views

The overall Crace site is bounded by the Barton Highway, Gundaroo Drive, Nudurr Drive and Canberra Nature Park (Gungahlin Hill Reserve)

The property was leased by CSIRO from 1996 and used as a field research station. The ACT Government acquired the site from the commonwealth Government in 2004.

The site is strategically positioned within 2.5 kilometres from Gungahlin Town Centre. Canberra's highest order commercial centre, Civic is a distance of 9 kilometres from the site. Belconnen Town Centre is at a closer distance of approximately 5.5 kilometres.

The Stage 3 area is situated next to Gundaroo drive and in a low lying area.

### 1.1.2 General Landform and Drainage

The Crace Stage 3 site has general fall to the north overlooking the proposed pond and CRIP area.

### 1.1.3 Existing Vegetation

There are no trees on the site.

## 1.2 Heritage

A cultural heritage report for Crace was completed by Cultural Heritage Management Australia. A number of heritage constraints have been identified and addressed in earlier Stage 1 and Stage 2. There is no Heritage issue in the Stage 3 area. An unanticipated discovery plan has been prepared for the entire Crace Estate and approved by the ACT Heritage Council.

## 1.3 Planning Context

This Estate Development Plan has been prepared to respond to the provisions of the Territory Plan and the Crace Structure Plan and recently released ACT Government "Affordable Housing Action Plan – 2007".

The land is defined as 'Residential'. There are no gazetted or constructed roads on the Crace Stage 3 site.

A Concept Plan (Precinct Code) has not been undertaken specifically for Crace Stage 3. The Estate Development Plan has been prepared to satisfy the requirements of Part B of the "Residential Subdivision Development Code" – ACTPLA 2009. A table addressing each rule and criteria of this Code is included in Appendix A.

Community consultation was carried out in October 2008 in the preparation for the initial Stage 1 Estate Development Plan. Community feedback comments were considered in the final Master plan and acknowledged that the concerns raised during the course of the consultation process have been recognised in planning for the estate.

There is no further community consultation undertaken for Stage 2 and we do not envision that this is required for Stage 3.

Stage 3 is subject to a Territory Plan Technical Amendment to remove the requirement to provide neighbourhood ovals and replace them with an open space area capable of containing local playing for informal recreation and use to the satisfaction of the territory. This area is commonly referred to by Sport & Recreation Services as a Community Recreation Irrigated Park (CRIP).

## 2. Planning Principles and Objectives

The Planning Principles and Objectives are outlined in the attached Sub-division response table included in Appendix A.

## 3. Site Planning Potentials and Constraints

### 3.1 Potentials

- ▶ Develop the Estate Development Plan within the framework of the master plan.
- ▶ Ensure that the planning and design principles of the Crace Concept Plan as amended by the Territory Plan Technical Amendment are incorporated into the EDP.

### 3.2 Constraints

- ▶ Noise from the adjoining Gundaroo Drive.
- ▶ Water course.

## 4. Planning Proposal

The Draft Estate Development Plan responds to the requirements expressed in the Territory Plan – Future Urban Areas Residential Subdivision Development Code and the Crace Concept Plan (19 Dec. 2008)

### 4.1 Urban Design Objectives

The urban design responds to the objectives outlined below:

- ▶ Maximise life style opportunities;
- ▶ Develop an integrated, diverse community with a strong identity and sense of place;
- ▶ Provide a high level of permeability and connectivity with adjoining estates;
- ▶ Provide ease of pedestrian movement from within the Stage 1 to Stage 3 site and allow connectivity to adjoining residential areas.
- ▶ Maximise Investment opportunity through ensuring quality design and delivery;
- ▶ Provide safe, compact and walkable residential precincts with easy access to recreational, retail-commercial and community facilities;
- ▶ Provide high quality, affordable, commercially viable, ecologically sustainable development;
- ▶ Ensure flexibility to meet the changing needs of the market through diverse house designs;
- ▶ Design for efficiency of land use and increased amenities;
- ▶ Complete development of the suburb of Crace;

- ▶ Maximise the opportunity for visual and physical linkages throughout the site;
- ▶ Allow good pedestrian permeability while respecting the need to create safe and secure living environments;
- ▶ Optimise the opportunities for active and passive recreation within the precinct;
- ▶ Provide for a range of dwelling designs which address contemporary lifestyle, economic constraints and current market styles; and
- ▶ Create a unique landscape setting providing an attractive public realm and opportunities for communal/social participation and reinforcement by the future residents.

#### 4.1.1 Urban Design Principles

##### General

- ▶ Planning and development of Crace Stage 3 should incorporate environmental, social, cultural and economic sustainability principles as incorporated into Stage 1 and Stage 2 of Crace development;
- ▶ Detailed planning is to take advantage of the natural, cultural and heritage characteristics of the area to support and strengthen the community's identity; and
- ▶ Deliver high quality, commercially viable, ecologically sustainable development.

##### Vehicular and Pedestrian Networks

- ▶ Provide a legible and connected road layout and pedestrian / cycle network;
- ▶ The local neighbourhood is based on easy walkable distances, and focus on an activity node such as a neighbourhood park or equivalent;
- ▶ The road hierarchy should be legible, connected to the wider network and provide good and safe access for all users and support high levels of public transport usage;
- ▶ Roads include adequate on street parking, wide verges, street trees and pedestrian friendly walkways; and
- ▶ Provide quiet leafy streets.

## 4.2 Compliance with Planning Codes

*The Territory Plan – Estate Development Code* guided the planning and design of the Master plan and Estate Development Plan including neighbourhood planning - street networks, block layout, and open space, physical infrastructure - construction and design of streets and on street parking, utilities, waste management, as well as storm water and integrated catchments management.

A statement of compliance against each of the code rules and criteria is included in Appendix A.

### 4.3 Block Yield

The total number of blocks for Crace Stage 3 is 22 residential sites.

**Table 2: Crace Stage 3 Block Yield**

	BLOCK TYPE	BLOCK WIDTH	BLOCK DEPTH	BLOCK AREA (m)	DESCRIPTION	TOTAL
Standard Block	Standard Block 451-650 m <sup>2</sup>	≥18m	30m	528+m <sup>2</sup>	Detached 1 and 2 storey	22
					STAGE 3	22

### 4.4 Planning Advice Received

#### Crace Native Vegetation

Conservation Planning and Research (TaMS) has assessed the Assessment of Native Vegetation Report prepared by David Hogg Pty Ltd in August 2010 and determined that an EIS for the clearing of native vegetation within Crace Stage 3 is not necessary.

Specifically Conservation Planning and Research found:

*"...the survey effort carried out is adequate.*

*The survey report identified an area of ~0.4ha of YBRG (Area A, Figure 4) and an area of ~0.4ha of secondary grassland (Area B) which had ~60% native cover. Therefore 0.8ha of native vegetation is due to be cleared for the development of Crace Stage 2. The clearing of more than 0.5 ha of vegetation currently triggers the requirement for an EIS under the Planning and Development Act.*

*However, given the management history and extent of degradation across the site, Conservation Planning and Research is of the view that an EIS for the clearing of native vegetation for Crace Stage 2 and 3 is not necessary."*

The Assessment of Native Vegetation Report by David Hogg and the advice provided by Conservation Planning and Research are attached in Appendix F.

#### Environmental Impact Statement Exemption

Crace has been provided an exemption from the requirement to submit an Environmental Impact Statement (EIS) by ACTPLA. The exemption is included in Appendix F.

#### Change from Neighbourhood Oval to Community Recreation Irrigated Park (CRIP)

Early planning advice from ACTPLA indicated that there was no need to submit a Territory Plan variation to enable the change from a Neighbourhood Oval to a CRIP (Refer Appendix F). However subsequent to this advice it was determined by ACTPLA that a Territory Plan Technical Amendment would be required. This amendment is currently under review.

## 5. Traffic Analysis and Road Hierarchy

A traffic study has been prepared by AECOM to assess the internal traffic movements, key internal intersection configuration, the impact on surrounding Crace Stage 1 road network and impact on intersections onto Gundaroo Drive and Nudurr Drive. A copy of the traffic report is included in Appendix B.

The report took into consideration the expected development associated with Crace Stage 3.

A summary of the traffic volumes in Crace Stage 3 are presented on the Road Hierarchy Plan, EDP2-ENG-RHP-17.1, while traffic volumes in the remainder of Crace are presented in the traffic report.

A summary of the findings associated with Stage 3 from the traffic report are as follows:

- ▶ The proposed layout for Crace Stage 3 has 22 dwellings;
- ▶ The additional traffic volumes generated by blocks in Crace Stage 3 does not change the road hierarchy categories in either Stage 1 or Stage 2;
- ▶ The additional traffic volumes generated by Crace Stage 3 does not reduce the operational performance of the intersections onto Gundaroo Drive and Nudurr Drive;
- ▶ All roads in Stage 3 have traffic volumes less than 3,000vpd therefore, permitting direct vehicle frontage to all blocks; and
- ▶ Parking demand generated by the development will be accommodated within the development by onstreet parking satisfying parking requirements within the estate.

### 5.1 Road Hierarchy

The roads within Crace Stage 3 are classified as Access Streets Type A.

### 5.2 Traffic Generation

The following trip rates were used for this assessment, with a summary of trips generated given in Table 2 of the Traffic Report:

- ▶ • Peak hour traffic generation rate = 0.8 trips per dwelling
- ▶ • Daily traffic generation = 8 trips per dwelling

Traffic generation and traffic volumes on each road are shown on the Road Hierarchy Plan (Plan 17) and also in the Traffic Report included in Appendix B.

### 5.3 Traffic distribution

The traffic in Crace Stage 3 is directed to Digby Circuit (Road 22) and Narden Street (Road 6), then connects to Abena Avenue (Road 1), which is the Major Collector road directing traffic to Gundaroo Drive.

## 5.4 Key Internal Intersections

The intersections in the Crace Stage 3 are Local Access streets for which intersections performance assessment is not required due to low traffic volumes.

The performance of key intersections in Crace was modelled by AECOM and the results presented in the Traffic Report (Appendix B). All key intersections in Crace are Level of Service A which is acceptable.

# 6. Roads

## 6.1 Major Collector Roads

No Major Collector Roads are proposed with Crace Stage 3.

## 6.2 Minor Collector Roads

No Minor Collector Roads are proposed with Crace Stage 3.

## 6.3 Access Streets

The road reserve width for Road 101 and 102B is 15.5m, which is formed from 6.5m verge block side, 7m wide pavement and 2.0m verge adjacent open space.

The 2.0m verge has been adopted for the edge road as it is adjacent to open space and is of sufficient space to accommodate the proposed single service of a 100mm diameter water main.

Road 102A has a 21m road reserve width with a 6.5m wide eastside verge, 7m wide pavement and 7.5m wide westside verge. The wider verge to the western side of the road reserve is to accommodate a 2.5m wide path linking the CRIP to the Stage 1 Barton Highway buffer zone.

There are two access streets in Crace Stage 3 which have 1.5m wide paths on the block side, with the exception of Road 102A. It has a 2.5m wide shared path with no block access. Typically the access streets form an edge road and have verge widths of 6.5m and 2m. These typical cross sections are the same as that approved for Crace Stage 1 and Stage 2.

The road configuration of Stage 3 has no direct access from an external road of the Estate and no externally generated traffic can use the roads as through routes.

The edge road allows for a trafficable zone to ensure emergency access is maintained to the area.

## 6.4 Parking

Visitor parking is sufficiently provided along the kerbside edge of all roads.

## 6.5 Street Lighting

ActewAGL will undertake the underground electricity reticulation and street lighting design in accordance with the current Design Standards for Urban Infrastructure, including all paths in and around Stage 3.

All local access roads will be designed to Category P4.

The streetlight poles have been positioned 1.7m behind the kerb line on roads. For consistency throughout the development, a standard distance behind the kerb line has been adopted for all roadways.

The same type of street light pole used in Crace Stages 1 and 2 is proposed for use in Crace Stage 3. Detail design will manage the issue of intrusive lighting.

## 6.6 Traffic Noise

An earthen sound mound is proposed adjacent to Stage 3 along Gundaroo Drive. This sound mound will be approximately 3m higher than the Gundaroo Drive road pavement and approximately 2m higher than the residential block ground level.

Refer to Fill Plan EDP2-ENG-FP-28.1 for indicative sound mound contouring. The acoustic assessment included (in Appendix E) a review of the terrain and block layout for Stage 3. This assessment references ACT Environmental Protection Regulations, ACT Noise Management Guidelines – 1996, and relevant Australian Standards such as AS/NZ 2107-2000 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors

Modelling of traffic noise from Gundaroo Drive has been performed to establish compliance with Noise Management Guideline – 1996. One block at the western side of Stage 3 is predicted to exceed the  $L_{10(18hrs)}$  63 dB(A) criteria due to the road traffic noise from Gundaroo Drive. For these houses, building treatments can ensure that the internal noise levels can conform to AS2107 Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors.

The Planning Control Plans note the requirement for specific fencing on the two western blocks to abate noise levels at ground level. For dwellings affected on first floors the detailed design will incorporate all noise abatement measures as noted in the Planning Control Plans.

## 6.7 Turning movements

Turning movements have been provided for all intersections within Stage 3. Access from Stage 3 meets the Rule 9 requirement by ensuring no more than three turning movements are required to reach a higher order road. The roads in Stage 3 are access roads, which use Narden Street (minor collector) to egress from the Estate.

Turning movement of the waste vehicle have been provided for the hammer head which has been designed in accordance with the Development Control Code for Best Practise Waste Management in the ACT, September 1999. The length of the hammer head allows for the waste truck to undertake a three point turn without encroaching beyond the kerb, in addition to the length provided, the standard 600mm clearance from back of kerb to the footpath is also provided.

# 7. Cycle and Pedestrian Systems

## 7.1 On Road Cycling

On road cycling is not provided in Crace Stage 3.

A major path connection from Crace Stage 3 via Crace Stage 1 to the south will be provided onto Barton Highway in accordance with the requirements of the Concept Plan.

## 7.2 Off Road Cycle Paths/ Major Paths

As part of Stage 1 and Stage 2, an off road recreation path for the joint use of pedestrians and cyclists is provided along the full extent of the open space area surrounding the estate in accordance with the Concept Plan. This path has a 4.0m wide formation for emergency vehicle access and a 2.5m wide asphalt path for pedestrian and cycle use. This path is not part of Stage 3.

A 2.5m wide recreational path will be provided in Stage 3, access to this path from the Estate is from Road 101 via a pram crossing. Fixed and removal bollards will be located in the open space area to restrict vehicle access, this approach has been adopted (and approved) for a park in Stage 1A1.

The path network within Crace has not been identified, in TaMS Design Standard Part 13, to be part of any future community network. The current main route drawing identifies the main route will be on road facilities along Gundaroo Drive and Barton Highway.

## 7.3 Minor Paths

Minor paths are provided in all road reserves in accordance with the ACTPLA Residential Subdivision Development Code requirements. Paths are all 1.5m wide and are located 0.3m offset from the block boundary similar to approved typical cross-sections from Crace Stages 1 and 2. This position for the path places the shared trench on the kerb side of the path similar with Stages 1 and 2 trenching agreement.

## 8. Land Contamination

A site audit of Block 588 was undertaken by JBS Environmental in 2006. The investigations of the site assessed the contamination status of the site as low and the site as suitable for residential land use. The Environmental Protection Authority (EPA) reviewed the Site Audit in 2006 and endorsed the recommendation of the audit. Clearance from ACTPLA and the EPA was provided through the Concept Plan for Block 588.

## 9. Public Transport

There are no proposed bus routes through Crace Stage 3. However, it is within 400m of a proposed bus stop on Abena Avenue within Stage 1, refer to the Public Transport Network and Off Road Movement Systems Plan – 22.1.

## 10. Agency Liaison and Consultation

During the planning process and preliminary engineering design, there has been ongoing liaison and consultation with agency representatives from ActewAGL, ACTPLA, TAMS, Rural Fire Services, Sport & Recreation Services and PCL. Sport & Recreation Services have been actively involved in the design process, along with other agencies of TaMS, to ensure the proposed park facilities, uses and design are in accordance with their requirements. As such Sport & Recreation Services and other agencies have indicated they fully support the concept for the park identified on the Open Space Concept Plan – 31.1.

## 11. Stormwater Concept Plan

### 11.1 Existing Stormwater Infrastructure

Crace Stage 3 consists of two sub catchments:

- Western Catchment drains Section EA; and
- Eastern Catchment draining Section EB.

The surrounding catchments of Stage 1 and parts of Stage 2 are captured in the trunk stormwater mains which convene at two locations within the Stage 3, as shown on the stormwater master plan drawings EDP3-END-SWMP-9.1 and 9.2.

Located west of the site is an existing watercourse adjacent to Gundaroo Drive. South of the site the watercourse heads west under Gundaroo Drive into Ginninderra Creek by way of existing culverts.

### 11.2 Proposed Stormwater Infrastructure

A stormwater master plan has been prepared for Crace Stage 3. The stormwater master plan illustrates the schematic stormwater pipe layout for the development, catchment areas, 5 and 100 year ARI flows and velocity depth safety criteria.

The detailed stormwater design will be in accordance with the TAMS Design Standards. Flows up to and including the 5 year ARI event are generally to be piped whilst the major system comprising roads conveys the 100 year ARI flows.

Servicing of residential blocks will utilise both discharge to kerb (northern blocks) and direct connection to stormwater pipes (southern blocks). Kerb discharge has been utilised throughout earlier stages to promote the Water Sensitive Urban Design principles adopted for the Estate.

Stormwater pipes located at the back blocks will be located in easements 2.5m wide.

Water quantity retardation is provided in the basin to be constructed with Crace Stage 3. This basin will provide retardation of developed runoff to pre-developed 100 year ARI flows leaving the Crace suburb under Gundaroo Drive to Ginninderra Creek.

The runoff captured within the basin will also be used to irrigate the CRIP and other areas within Stage 1 of the Estate. As such a water license application will be requested at detailed design stage to allow draw down from the pond.

The levels of the paths around the site have taken into consideration TaMS design requirement to be above the 2 year ARI level.

The two proposed GPT's will be designed in accordance with TaMS design standards and convey the 1 year ARI flow.

The south western catchment not directed to the GPT and directly discharges to the detention pond as the catchment area is less than 8 hectares.

The proposed works will be seeking the following authorisations:

- Application for an Environmental Authorisation
- Waterway Works Licence

- Water Access Entitlement
- Licence to Take Water

### 11.3 Overland Flow management

When stormwater flows exceed the capacity of the piped system (including an allowance for blockages), stormwater runoff will travel overland along the road network into swales and basins.

Overland flows have been designed to meet the following criteria:

- Prevent flow up to the 100 year ARI from entering leased blocks.
- In road reserves to ensure velocity depth safety criteria is less than 0.4m<sup>2</sup>/s.
- In road reserves to ensure flow does not exceed a depth of 50mm above top of kerb.
- To ensure velocity of flows in swales is less than 2m/s to prevent scour.
- A minimum freeboard of 300mm to leased blocks in basins.

A key component of the Stage 1 design is to limit overland flows to comply with velocity depth criteria during the 100 year ARI storm which requires that additional inlet capacity be provided to capture the higher ARI flows within the trunk stormwater pipes.

The proposed detention basin is required to capture the 100 year ARI piped and overland flows, which is located within Stage 3 and then discharges under Gundaroo Drive which is consistent with the provisions used in the Stage 1 stormwater master plan.

### 11.4 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) for Crace Stage 3 is consistent with the Crace Stage 1 and Stage 2 WSUD strategy.

The bioretention systems proposed in Stage 1 and 2 of Crace in combination with rain gardens in the Stage 1 urban core area and tree pits on the suburban streets provide a treatment train that ensures that the suburb meets the water quality requirements of the ACTPLA Waterways Code. Detention areas ensure the required attenuation of storm flows is achieved. A 40% reduction in potable water usage is achieved through the use of water efficient fixtures and through the provision of rainwater tanks to all blocks exceeding 300m<sup>2</sup>.

The WSUD Checklist for each catchment is provided in Appendix D.

It is noted that all stormwater ties are generally to be discharged to the kerb as per Stage 1 and 2 in order to provide water to passive tree watering systems.

Passive tree watering was provided in Crace via a small diameter inlet pipe cast into the kerb to provide trickle flows to each street tree. This same measure is proposed to all street trees in Stage 3. The passive watering system will ensure that all street trees receive additional watering during rainfall events to aid their initial growth.

### 11.5 Water Quantity and Quality

Water quantity retardation is provided in the basin to be constructed with Crace Stage 3. This basin will provide retardation of developed runoff to pre-developed 100 year ARI flows leaving the Crace suburb under Gundaroo Drive to Ginninderra Creek.

## 12. Sewer Concept Plan

### 12.1 Existing Sewer Infrastructure

Crace Stage 3 consists of two sub catchments:

- ▶ • Northern Catchment drains the north facing blocks of Sections EA and EB; and
- ▶ • Southern Catchment drains the southern blocks of Sections EA and EB.

### 12.2 Proposed Sewer Infrastructure

Both catchments will use the existing main under Gundaroo Drive and connect via the newly constructed sewer mains associated with Stage 1, which have adequate capacity to convey these catchments.

## 13. Water Concept Plan

### 13.1 Existing Water Infrastructure

Crace Stage 3 is located wholly within the low zone of Crace.

### 13.2 Proposed Water Infrastructure

Crace Stage 3 will be connected to the newly constructed water network associated with Crace Stage 1 by 100mm diameter mains.

The flow demand greater than 25l/s has been provided to meet the Type F6 (detached housing) classification of the development.

## 14. Utilities

Utilities for Crace Stage 3 will be provided via shared trenches as an extension from shared trenches in Crace Stage 1.

The developer will fund the excavation and backfill of the shared trenches, and each utility will provide cables/conduits as required. The shared trenching throughout the development will be in accordance with the Service Authorities' shared trench agreement.

Three-way trenching for electricity, gas and telecommunications are proposed and are shown on the typical road cross sections.

ActewAGL will provide underground electricity reticulation and street lighting to TAMS standards. The telecommunications provider, TransACT, will provide telecommunications reticulation to the estate.

## 15. Staging

It is proposed to construct the works in one stage.

The proposed staging is shown in Drawing EDP3-ENG-ST-6.1 - Staging Plan.

## 16. Geotechnical Structure and Site Grading

### 16.1 Geotechnical Investigation

A geotechnical investigation has been undertaken for Crace Stage 1 which included the area associated with Crace Stage 3.

### 16.2 Site Grading

The majority of the natural terrain is generally flat and falls towards the proposed detention basin. However the southern area has an increased fall associated with the existing hill and residential blocks which are under construction to the south of the stage.

The finished site grading of the residential blocks has been developed to tie-in into the existing road alignment of Digby Circuit and the proposed batter of the detention pond, therefore the majority of the residential blocks are in fill. Additional fill occurs for the pond embankment, with minor filling along the northern boundary to ensure tie-ins with the existing Abena Avenue. The remaining area of the site will be in cut, refer to drawing EDP3-ENG-FP-28.1 for an general overview of the fill area.

Road longitudinal grading have been prepared for the two roads in Stage 3. They are constrained by the existing tie-in levels associated with Stage 1 and also take into consideration the servicing requirements of blocks. As such a section of Road 102 has a minimum grade of 0.9%.

## 17. Off Site Works

No off site works are proposed.

## 18. Landscape Master Plan

### 18.1 Character

The landscape design philosophy for Stage 3 continues the theme established for Stage 1 and 2, and is based on the following key principles:

- ▶ The new / future vegetation is the landscape that will sustain the lives of the future residents;
- ▶ The new place is an urban place (not a bush setting), located within an important 'open space corridor';
- ▶ The new landscape must flourish in urban conditions if it is to be environmentally effective, now and into the future;
- ▶ The streetscapes and public domain are the predominant landscape features of urban settings;
- ▶ The design is driven by the requirements of sustaining a large scale urban landscape and streetscape in an urban setting;
- ▶ The design theme is 'Streets Alive'.... alive with people, alive with plants, alive with views;
- ▶ The design maximises the opportunity for people to identify with their home patch, their block, their immediate neighbourhood and to link with their hinterland, adjacent

neighbourhoods and the district networks. Clarity of perception, address, connections, movement, and visual identity underpin the design;

- Effective streetscapes and large scale urban landscapes require space, soils, water to flourish; the design provides enhanced verge growing conditions for large scale trees (space, improved soils, WSUD throughout). The WSUD is integrated with the streetscape of every street, enabling development of a contiguous urban streetscape; and
- Perimeter and large tracts of landscape provide broad scale and plantation landscapes for recreation, habitat, and visual aesthetics.

### 18.1.1 Open Space Elements

The importance of well planned and located open space and recreation facilities is at the heart of delivering sustainable and vibrant communities.

Open spaces play a vital role in the health and well being of communities providing opportunities to participate and connect socially within the community as well as supporting other important environmental and natural systems, the “green lungs” of the development.

### 18.1.2 Open Space and Recreation Vision

#### **Vision:**

*Crace will provide a diverse, interconnected system of parks, open space and recreation facilities that cater for the recreation, leisure and social needs and desires of this new community and that meet the goals of environmental, economic, social and cultural sustainability.*

#### **Goals:**

- Create a sense of place and identity within the open space network.
- Provide community spaces as an extension of people’s homes.
- Encourage and promote health, well being and social cohesion.
- Provide equity and accessibility catering to a diverse range of users.
- Offer diversity of facilities and experiences.
- Provide multi-functional and adaptable spaces and places.
- Integrate environmental sustainability principles.
- Develop economically sustainable facilities.

### 18.1.3 Open Space Framework

A core corridor of parklands made up of the Community Recreation Irrigated Park (CRIP), linear park, central neighbourhood park and hilltop reserve will form the backbone of recreation and leisure activities for the entire Estate. The CRIP is wholly within Stage 3 whilst the other parklands are within stages 1 and 2.

Surrounding this core, a series of Local Neighbourhood Parks form a satellite system aimed at servicing the direct needs of local suburban residents and supporting the main recreation hubs.

Linking the satellite system of parks and focal recreation hubs, the continuous outer loop pedestrian parkland provides recreation and commuter based trails internally linking key

destinations as well as providing external access connections into the greater Gungahlin Trails Network.

Key youth orientated facilities are identified to supply a targeted type of facilities aimed at the independent youth group such as skate facilities and cycle tracks.

#### **18.1.4 Community Recreation Irrigated Park**

The Community Recreation Irrigated Park (CRIP) is located at the estates main entry and provides the main sporting, recreation and leisure facility. This recreation hub is linked by both the wide street tree lined boulevard and linear parkland to the heart of the estates Village Centre and to the broader estate recreation path network.

The CRIP is currently being developed as a pilot model in response to consultation with Sport and Recreation Services (SRS) and Parks Conservation and Land (PCL).

SRS has expressed the desire to review the standard requirements for the supply of 'Neighbourhood Ovals' in new residential subdivisions seeking to develop a more strategic approach to the supply of organised sporting facilities across the ACT by targeting facility development rather than inheriting individual neighbourhood ovals and duplicated facility provision for every new suburb. By strategically targeting the development of new and/or consolidation of existing sporting facilities economies can be achieved in facility provision, management and maintenance.

SRS has identified the opportunity at CRACE to utilise the proposed oval space to create a green open recreation and leisure space for the community that would supply multiple and varied recreation and leisure experiences to a wide range of user groups. The proposed CRIP model seeks to combine structured play / sporting / recreation facilities (e.g. multiuse hard courts, playgrounds, picnic and BBQ areas) as well as unstructured spaces (e.g. garden spaces, irrigated open lawns, native woodland areas, pond and wetland) to provide an attractive and versatile community parkland.

The CRIP and the adjacent Linear Park to the east have been designed to ensure that the recreational needs of a wide range of age groups are satisfied within the one connected parkland thus adding to the diversity of users and ensuring its ongoing use by the community that develops within Crace. In this way the CRIP and Linear Park satisfy the community vision and goals for the open space and recreation of residents at Crace.

The opportunity exists to harvest water for irrigation from the proposed detention pond ensuring the community has usable green open space year round. The original proposed neighbourhood ovals were located adjacent the detention pond taking advantage of the sites flatter topography, providing adjoining space for flood detention and taking advantage opportunities for harvesting water for irrigation purposes. The proposed CRIP model maintains these functions through the open space / kickabout spaces.

SRS has indicated they will maintain an irrigation system covering the open space / kickabout areas and the formal garden in the CRIP extending into the kickabout spaces provided in the adjoining Linear Park with water harvested from the proposed detention pond. It is expected that both the CRIP and Linear Park will function in concert to provide an interconnected series of open space and recreation facilities to the higher density urban core of the estate. The provision of usable open space within 100m of dense urbanised areas (Compact blocks defined as blocks having a site area of 250m<sup>2</sup> or less) is a fundamental

principle set out in the Residential Subdivision Development Code. The provision of irrigation will help to ensure both the CRIP and Linear Park remain usable throughout the year.

## 18.2 Streetscape Character

Streetscapes have been designed to integrate the public and private domain to promote both a sense of privacy as well as passive surveillance around the streets contributing to pleasant walkable streets. These generous streetscapes have been created to be an extension of the open space network integrating and linking key destinations within the estate such as the CRIP, village centre, neighbourhood parks and the hilltop reserve.

Road 102A has been designed to incorporate a section of shared pedestrian / cycle path. This path links into and through the CRIP and into the broader cycle and pedestrian network.

Proposed street tree selection has adopted species approved under Stage 1 and in accordance with DSUI 23. As developed and installed in Stage 1, the street trees are passively irrigated by the stormwater runoff from the impervious surfaces within the catchment for each tree.

## 18.3 Tree Survey and Retention

A detailed tree survey and assessment was undertaken by JEA in June 2010 that identified individual trees and tree groups across the Crace Stages 1 and 2, however there are no trees located within Stage 3.

# 19. Energy Audit

The Energy Audit was completed in accordance with the Residential Subdivision Code October 2009 – Appendix C – Energy Audits of Subdivisions – Detached residential Blocks.

All blocks were assessed under Table 9 Criteria for Determining Block Rating. Those blocks that did not comply with the criteria a or b were assessed under criteria c.

Each of the block ratings had further rating applied due to slope of land and aspect of block. Ratings are identified in Table 3.

## 19.1 Zero Setbacks

In determining blocks which should have a zero setback used the following principles have been adopted:

- Zero setbacks on blocks on N-S streets are located on the southern boundary only (unless a corner block). Zero setbacks on the northern boundary are generally avoided.
- Zero setbacks on blocks on E-W streets are located on the western side (unless a corner block).

If there is no advantage in terms of energy performance then zero setbacks are avoided to allow for greater flexibility for housing product choice.

There are no zero setbacks proposed within Stage 3.

### 19.1.1 Results

**Table 3: Energy Ratings for Crace Stage 3**

Rating	Blocks	%
1	0	0%
2	0	0%
3	3	13.6%
4	16	72.8%
5	3	13.6%
TOTALS	22	100%

The results of the Energy Audit indicate that 100% of the blocks in the Estate obtained a rating of 3 stars or greater. The composite results are shown in a table on the Energy Audit. The block-by-block ratings are shown on EDP3-PL-EAP-16.1.

## 20. Capital Works

No capital works are required in association with Crace Stage 3 project.

## 21. Bushfire Protection Measures

A Bushfire Risk Assessment Review was prepared by Australian Bushfire Protection Planners Pty Ltd for Crace. The report is attached at Appendix C. A bushfire plan EDP2-LA-BMP-27.1 presents the proposed bushfire protection measures for this estate.

Any proposed dwellings requiring specific controls are noted on the Planning Control Plans – 31.1.

The edge road allows for a trafficable zone to ensure emergency access is maintained to the area.

## 22. Waste Collection Plan

All blocks have direct frontage access therefore standard kerb side collection will be provided.

Road 101 has been designed and includes the standard hammer head arrangement as outlined in the Development Control Code for best practise waste management in the ACT, September 1999. The length of the hammer head allows for the waste truck to undertake a three point turn without encroaching beyond the kerb, in addition to the length provided, the standard 600mm clearance from back of kerb to the footpath is also provided.

## 23. Land Use Plan

A Land Use Plan (EDP3-LA-LUP-7.1) has been prepared to indicate the land use policy applicable to the site – refer also to Section 1.3 'Planning Context'.

## Appendix A

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### Subdivision Code Response Table

# **CRACE STAGE 3 ESTATE DEVELOPMENT PLAN DA SUBMISSION**

## **ATTACHMENT A - COMPLIANCE CHECKLIST**

### **STATEMENT AGAINST RELEVANT CRITERIA AND APPLICABLE RULES OF THE RESIDENTIAL SUBDIVISION DEVELOPMENT CODE**

**June 2011**

## Residential Subdivision Development Code

### Statement against relevant criteria

#### Part B (1) Estate Development Plans supported by a Precinct Code

Code	Rule	Criteria	Statement
	✓		Indicate whether Rule or Criteria has been addressed in the proposed development. ✓
<b>Element 1: Neighbourhood Design</b>			
To provide safe, convenient, accessible and attractive neighbourhoods that meet the diverse and changing needs of the community. This encompasses offering a wide choice in good quality housing and associated community and commercial facilities, providing for local employment opportunities, encouraging walking cycling and use of public transport, minimising energy and water consumption, and promoting a sense of place through neighbourhood focal points and the creation of a distinctive identity which recognises and, where relevant, preserves the natural environment.			
<b>Element 2: Street Works</b>			
<i>To create street networks in which the function of each street is clearly identified, providing acceptable levels of access, safety and convenience of all users.</i>			
<b>2.1 Functions and Structure</b>			
<b>R1</b> Streets links with other streets that are no more than two levels higher or lower in the hierarchy as defined in Tables 2 and 3  Or <b>C1</b> The street network has a clear structure and component streets conform to their function in the network.	✓		Complies. Road Hierarchy Plan (Plan No 17.1) demonstrates compliance with this rule.
<b>R2</b> The street network reflects the characteristics specified in Table 2.  Or <b>C2</b> The street network has clear physical distinctions between each type of street that encourage appropriate driver behaviour. These distinctions are based on function, legibility, convenience, traffic volumes, vehicle speeds, public safety and amenity.	✓		Complies. The street network has been designed to comply with Rule R2.

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
<b>2.2 Corridors and Precincts</b>			
<p><b>R3</b></p> <p>Streets within any neighbourhood do not operate as through routes for externally generated traffic (other than pedestrians, cyclists and public transport)</p> <p>Or</p> <p><b>C3</b></p> <p>Arterial roads are more convenient for through traffic than streets within precincts.</p>	✓		<p>Complies.</p> <p>Crace Stage 3 roads are local access roads. The road configuration of Stage 3 has no direct access from an external road of the Estate and no externally generated traffic can use the roads as through routes.</p>
<p><b>R4</b></p> <p>Connections between residential streets and arterial roads are in accordance with the requirements of table 3.</p> <p>Or</p> <p><b>C4</b></p> <p>Safe and convenient connections between arterial roads and residential neighbourhoods are provided.</p>	NA		<p>Not applicable.</p> <p>The development is situated within the Crace Stage 1 development which has mandatory connections to arterial roads.</p>
<p><b>R5</b></p> <p>Safe pedestrian and cyclist crossings of an arterial road adjacent to residential areas are provided at intervals of not more than 500 m in locations related to movement desire lines and in accordance with Element 3.</p> <p>Or</p> <p><b>C5</b></p> <p>Safe and convenient links are provided for pedestrians and cyclists across transport corridors.</p>	NA		<p>Not applicable.</p> <p>There are no arterial roads included within Stage 3 development.</p>
<p><b>R6</b></p> <p>Junctions between the external roads and the internal street network are located so as to minimise restriction of movement on the roads, and to avoid traffic volumes in excess of 6000 vehicles per day (vpd) on major collector streets and 3000 vpd on minor collector streets.</p> <p>Or</p> <p><b>C6</b></p> <p>The spacing of connections between street networks in precincts or neighbourhoods and road networks in corridors protects the performance of the road corridors and preserves the environmental quality of the street networks in the precincts or neighbourhoods.</p>	✓		<p>Complies.</p> <p>Stage 3 is within Crace Stage 1 development.</p>

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
<b>2.3 Safety, Access and Convenience</b>			
<b>R7</b> Junctions are spaced as set out in table 3. Or <b>C7</b> Junctions along residential streets are spaced to create safe and convenient vehicle movements.	✓		Complies. Junction spacing complies with Table 3.
<b>R8</b> The driving distance from any dwelling to the nearest collector (or higher-order) street or road is a maximum of 700 m, and the distance to the nearest sub arterial or higher order road is no more than 1200 m. Or <b>C8</b> The street network creates convenient movement for residents between their homes and higher order roads.	✓		Complies All dwellings meet the 700m maximum distance to the nearest collector street and 1200m to the arterial road.
<b>R9</b> No more than three turning movements at intersections or junctions are required in order to travel from any home to the most convenient collector street or higher-order road. Or <b>C9</b> Connectivity between the street network and the collector and arterial road hierarchy is optimised.	✓		Complies Access from all dwellings in Stage 3 requires no more than three turning movements to reach a higher order road. The roads in Stage 3 are access roads, which use Narden Street (minor collector) to egress from the Estate.
<b>R10</b> Proposed housing development along a movement corridor does not have direct vehicle access to an arterial road, unless there are no suitable access alternatives, in which case vehicle access on to the corridor must be able to be made in a forward direction. Or Access arrangements for housing along an arterial road do not impede the traffic capacity of the road or risk the safety of residents.	NA		Not Applicable for Stage 3, no arterial roads.
<b>2.4 Traffic Impacts and Residential Amenity</b>			
<b>R11</b> No more than 5% of dwellings have direct access to streets with the long-term maximum desirable traffic volume in excess of 3000 vpd.	✓		Not Applicable for Stage 3, no traffic volume in excess of 3000 vpd.

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
Or <b>C11</b> The street network is designed to reduce traffic speeds and volumes to acceptable levels to maintain appropriate amenity for most dwellings.			
<b>R12</b> An acoustic analysis identifies internal and external noise impacts.	✓		Complies. Sound mounds are provided along the western boundary interface with the Gundaroo Drive. Controls for open space in the adjoining dwellings ensure that there is no noise impact.
<b>2.5 Functions and Width</b>			
<b>R13</b> The road cross-sections and location of utilities and driveways within verges maintain an alignment for the planting of street trees as required by Table 4.	✓		Complies. Typical road cross sections provided demonstrate tree planting alignments as identified in Table 4.
<b>R14</b> The road network caters for the efficient provision of public utility networks including water, sewerage, stormwater, electricity, telecommunications and gas, as demonstrated by certification by relevant authorities.	✓		Complies. Typical road cross sections provided demonstrate that the proposed verge widths allow sufficient space for public utility networks.
<b>R15</b> The following street components for each type of street are as specified in Table 4: a) carriageway widths b) verge widths c) parking within the street reserve d) kerb type e) pedestrian and cyclist facilities f) longitudinal gradients. Or <b>C15</b> Street reserve width is sufficient to cater for all street functions, including: a) safe and efficient movement of all users b) provision for parked vehicles c) location, construction and maintenance of network utilities d) overland flow paths within depth and velocity safety criteria for pedestrians and vehicles e) provision for water sensitive urban design f) carriageway and pedestrian lighting are integrated with a tree management plan that maintains designed lighting levels over time g) street tree planting h) retaining walls i) public lighting j) pedestrian and cycle paths.		✓	Complies. Street reserve width is sufficient to cater for all street functions.  The edge road verge of 2.0m has been adopted as it is adjacent to open space. The verge opposite Section 45 and the eastern blocks of Section 46 have no services proposed. The verge on the northern boundary of Section 46 is of sufficient space to accommodate the single proposed service of a 100mm diameter water main.

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
<p><b>R16</b></p> <p>Speed reduction devices are part of the design for the total street environment which demonstrates that:</p> <p>a) Slow points, including either horizontal or vertical deflection, are designed to slow traffic to design speeds.</p> <p>b) Slow points and carriageway narrowings are designed to take into account the needs of cyclists, by ensuring speed compatibility, adequate space for concurrent passage or off-street diversions.</p> <p>c) Landscape design, on-street parking and streetscape design are used to complement speed restriction measures.</p> <p>d) Speed restriction techniques and devices are not used in isolation and only exist as part of an integrated traffic management solution.</p> <p>e) The verge, when considered in conjunction with the horizontal alignment and permitted fence, wall and other property frontage treatments, provides safe sight distances, taking into account expected vehicle speeds and pedestrian and cyclist movements.</p> <p>f) Traffic control devices are designed in accordance with national standards that take into account the access requirements for emergency vehicles.</p>	✓		<p>Complies.</p> <p>a) No speed reduction devices are proposed due to the low speed and low volumes of vehicles.</p> <p>b) The need of cyclists and pedestrians has been catered for in the development with appropriate carriageway width and off road path.</p> <p>c) No speed reduction devices are proposed.</p> <p>d) No speed reduction devices are proposed.</p> <p>e) Standard block chamfers have been adopted throughout development.</p> <p>f) TCD will be further developed in detailed design phase in accordance with relevant CT and national standards.</p>
<p><b>R17</b></p> <p>The impact of measures intended to restrain traffic speeds and traffic volumes take account of the needs of other road users and adjoining dwellings, by avoiding:</p> <p>a) Unacceptable traffic noise to adjoining dwellings.</p> <p>b) Devices that reduce convenience or safety levels for cyclists and public transport.</p>	✓		<p>Complies.</p> <p>No measures are proposed due to the low speed and low volumes of vehicles.</p>
<p><b>R18</b></p> <p>Shared use zones comply with AUSTRROADS requirements.</p>	NA		<p>Not applicable for Stage 3, there are no shared use zones proposed</p>
<p><b>R19</b></p> <p>Sight distances at pedestrian and cyclist crossings and at junctions and intersections are in accordance with <i>Part 5 Guide to Traffic Engineering Practice</i> or its successor.</p> <p>Or</p> <p><b>C19</b></p> <p>Safe sight distances, based on the speeds at which vehicles may travel in the street, exist at access points to properties, pedestrian and cyclist crossings and at junctions and intersections.</p>	✓		<p>Complies.</p> <p>Sight distance for all intersection has been verified and demonstrated in the EDP for critical intersections. Road vertical alignments have been designed to meet relevant standards for sight distance.</p>

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
<b>2.6 Site Access and Width</b>			
<p><b>R20</b></p> <p>Motorists are able to enter or reverse from a block or site in a single movement.</p> <p>Or</p> <p><b>C20</b></p> <p>The carriageway width, together with the verge width and crossover dimensions, allows for unobstructed and efficient access to individual blocks and sites, even when a car is parked on the opposite side of the street.</p>	✓		<p>Complies.</p> <p>All dwellings can be entered or reversed out in a single movement.</p>
<p><b>R21</b></p> <p>Driveways and direct vehicle access to major collector streets and other streets that carry more than 3000 vpd are designed to require forward entry and exit of vehicles from properties.</p> <p>Or</p> <p><b>C21</b></p> <p>Driveway egress movements do not create a safety hazard.</p>	NA		<p>Not applicable for Stage 3, there are no streets that carry more than 3000vpd</p>
<b>2.7 Geometric Design</b>			
<p><b>R22</b></p> <p>Longitudinal gradient does not exceed the gradients specified in Table 4, and street pavement cross-fall is between 2.5% and 5%.</p> <p>Or</p> <p><b>C22</b></p> <p>Crossfall and horizontal and vertical alignments reflect physical land characteristics and major drainage functions, while satisfying safety criteria.</p>	✓		<p>Complies.</p> <p>All roads have been graded and demonstrated in the EDP that the maximum gradient is not exceeded.</p>
<p><b>R23</b></p> <p>Geometric design for intersections, roundabouts and slow points is consistent with the vehicle speed and maximum design vehicle envelop intended for each street and is consistent with AUSTRROADS Guidelines and in accordance with the <i>Australian Road Rules</i>.</p>	✓		<p>Complies.</p> <p>The drawings included in the EDP demonstrate the design satisfies this rule.</p>
<p><b>R24</b></p> <p>At intersections, turning vehicles are accommodated using AUSTRROADS <i>Design Vehicles and Turning Templates</i> to enable turns to be made in a single forward movement as follows:</p> <p>a) For turns between a major collector and a minor collector or access street, the 'design articulated vehicle' provides a turning path</p>	✓		<p>Complies.</p> <p>Vehicle Turning Plans included in the EDP for critical intersections demonstrate that this rule is satisfied.</p>

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
<p>radius of at least 15 m in accordance with the <i>Australian Road Rules</i>.</p> <p>b) For turns between a minor collector street and access streets, the 'design heavy rigid vehicle' provides a turning path radius of at least 15 m, using any part of the pavement, in accordance with the <i>Australian Road Rules</i>.</p> <p>c) For turns between access streets, the B99 'design car' provides a turning path radius of at least 7.5 m using the correct side of the pavement only.</p>			
<p><b>R25</b></p> <p>Kerb radii do not exceed desirable kerb returns in Table 4, except when required to accommodate larger vehicle turning movements in accordance with the <i>Australian Road Rules</i>.</p>	✓		<p>Complies.</p> <p>Typical curve radii used is 6,0m. Compound curve has been used on Road 102B to accommodate large vehicles.</p>
<b>2.8 Rear Lanes</b>			
<p><b>R26</b></p> <p>Laneways must serve one of the following purposes:</p> <p>a) Run east-west and provide small-lot rear parking access to maximise solar access to habitable areas;</p> <p>b) Access multi-unit housing;</p> <p>c) Rear access to lots fronting busy streets; or</p> <p>d) Service retail and commercial areas.</p> <p>Or</p> <p><b>C26</b></p> <p>Where a proposal involves rear lanes running north-south a building form capable of acceptable orientation is demonstrated.</p>	NA		<p>Not applicable to Stage 3, there are no rear lanes.</p>
<p><b>R27</b></p> <p>Laneways:</p> <p>a) Are no longer than 100 m;</p> <p>b) Do not serve as the primary access route for emergency vehicles;</p> <p>c) Do not create a more direct through route alternative for vehicles, cycles or pedestrians than the adjoining street network;</p> <p>d) Include threshold treatments at either end that discourage 'rat running';</p> <p>e) Incorporate habitable rooms or independently occupiable studio units at entries and at strategic locations to provide surveillance, activity and interest along the lane;</p> <p>f) Connect only to streets with wider reservations;</p> <p>g) Provide splayed corners at intersections to maintain sight lines and provide 6 m block access setbacks from tangent points;</p>	NA		<p>Not applicable to Stage 3, there are no laneways.</p>

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
<p>h) Are not designed as principal overland flow paths;</p> <p>i) Avoid horizontal and vertical curvature that diminishes continuous sight lines and affects grading of access driveways;</p> <p>j) Incorporate articulation of the garage and fence lines, including planting zones within the lease between fences and property boundaries;</p> <p>k) Provide visual connections from the living area or private open space of dwellings to the public realm of the laneway; and</p> <p>l) Include lighting at each end but not continuously along the laneway.</p> <p>Or</p> <p><b>C27</b></p> <p>a) Good passive surveillance into, along and through lanes is provided.</p> <p>b) Continuous lines of garage doors and fences are avoided.</p> <p>c) Opportunities for privately maintained landscape areas are provided.</p> <p>d) Modifications to all code items to the satisfaction of Asset Acceptance at TaMS are addressed.</p> <p>e) Emergency Services Bureau supports the use of the laneway as its primary access.</p>			
<b>2.9 Culs-de-sac</b>			
<p><b>R28</b></p> <p>No more than 15% of lots across the entire sub division are served by cul-de-sac.</p> <p>Or</p> <p><b>C28</b></p> <p>a) Cul-de-sac contribute to the legibility and connectivity of the neighbourhood; and</p> <p>b) Cul-de-sac provide access to blocks where alternate access is not feasible.</p>	✓		<p>Complies.</p> <p>Only one cul-de-sac (hammerhead arrangement) is proposed. Across the entire estate less than 15% of lots are serviced by dead ends or cul-de-sacs.</p>
<p><b>R29</b></p> <p>Cul-de-sacs are no longer than 100m</p> <p>Or</p> <p><b>C29</b></p> <p>The length of the cul-de-sacs has been agreed by asset acceptance in TaMS.</p>	✓		<p>Complies.</p> <p>Road 101 with a hammerhead arrangement is 76m long.</p>
<p><b>R30</b></p> <p>Linking paths to adjoining areas for use by pedestrians and cyclists include lighting and allow for surveillance from the surrounding roads and private properties.</p>	✓		<p>Complies.</p> <p>All paths in and around Stage 3 will have lighting in accordance with current Design Standards for Urban Infrastructure.</p>

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Code	Rule	Criteria	Statement
<b>R31</b> For turning movements at the head of a cul-de-sac, sufficient area is provided for the 'design refuse vehicle' (as advised by the relevant waste collection authority) to make a three-point turn.	✓		Complies. Hammerhead has been provided for Road 101 in accordance with the <i>Development Control Code for Best Practice Waste Management in the ACT, TaMS 1999</i> (note link on TaMS website has 1999 version not 2006).
<b>2.10 On- Street Parking</b>			
<b>R32</b> In streets where visitor parking is not provided on site, one car-parking space is provided for every two dwellings. These are located against the kerb if the carriageway width is sufficient, or in parking bays constructed within the verge and located within 60 m from the frontage of each dwelling.  Or <b>C32</b> Car parking is provided according to projected needs, which are determined by: <ol style="list-style-type: none"> <li>the number and size of dwellings proposed</li> <li>car-parking requirements of people of differing socio-economic status, age, cultural background and stages of family life cycle</li> <li>availability of public transport</li> <li>the provision of onsite car parking</li> <li>locations of non-residential uses such as schools and local shops</li> <li>the occasional need for overflow parking.</li> </ol>	✓		Complies. The parking plan in the EDP demonstrates that this rule is satisfied.
<b>R33</b> The dimensions of car spaces and access comply with the requirements of AS 2890.	NA		Not applicable to Stage 3, only on street parking is provided.
<b>2.11 Water Sensitive Urban Design</b>			
<b>R34</b> Water Sensitive Urban Design treatments are provided in accordance with the <i>Water Ways: Water Sensitive Urban Design General Code</i> .	✓		Complies. WSUD meeting criteria/objectives have been demonstrated during the development of Crace Stage 1 for the entire catchment.
<b>Element 3: Pedestrian and Cyclist Facilities</b>			
<i>To encourage walking and cycling by providing safe, accessible, convenient and legible movement networks to destinations within and beyond the neighbourhood.</i>			
<b>3.1 Location and Design</b>			
<b>R35</b> Footpaths and cycle paths are provided in accordance with Table 4.	✓		Complies. Footpaths and cycle path proposed are in accordance with requirements indicated in Table 4.

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Code	Rule	Criteria	Statement
Or The location of footpaths and cycle paths in a street reservation is supported by Asset Acceptance in TaMS and is determined by: a) potential for vehicle, cycle and pedestrian conflict and safety hazards b) protection to pedestrians and cyclists from parked vehicles and vehicles moving along the street and on driveways c) the location of physical services d) cross falls e) development fronting the street f) cost-effective construction.			
<b>R36</b> a) Lighting is provided to paths in accordance with AS/NZ 1158; and b) A tree management plan is provided demonstrating how required lighting levels can be maintained as tree canopies develop over time	✓		a) Detailed lighting design to be carried out by ActewAGL in accordance with the TAMS design standards. The paths requiring lighting will be confirmed with TAMS at detailed design. b) Landscape design considers the spacing of trees with reference to possible lighting. This will be a further consideration in detail design to ensure minimum spacing of light poles from tree canopies is provided.
<b>R37</b> a) For collector streets on which block access is provided, pedestrian or cycle paths are provided on either side of the street and separated from the carriageway pavement. b) Minor paths, where required, are a minimum width of 1.2 m and do not exceed 10% gradient, or the gradient is no greater than any adjacent street pavement. c) Minor paths are 2.5 m minimum width in the vicinity of meeting points, schools, shops and other activity centres. d) Minimum stopping sight distances at path intersections is in accordance with AUSTROADS Guide to Traffic and Engineering Practice or its successor. Or <b>C37</b> Paths are designed and constructed to appropriate width, longitudinal gradient and sight distance to cater for the number of projected pedestrians and cyclists and user types (e.g. the aged, the very young, people with prams and in wheelchairs, and people with disabilities).	✓		a) Not applicable to Stage 3, there are no collector streets. b) Complies All paths proposed are 1.5m wide minimum. c) Complies All paths proposed at key locations within the CRIP are 2.5m wide. d) Complies.
<b>3.2 Safe Crossings</b>			
<b>R38</b> Where traffic volumes exceed 3000 vpd or speeds exceed 50 km/h, safe crossings are created with the use of pedestrian refuges, slow points,	NA		Not applicable to Stage 3, traffic volumes don't exceed 3000 vpd or speeds exceed 50 km/h.

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Code	Rule	Criteria	Statement
			thresholds or other appropriate mechanism.
<b>R39</b> At potential conflict points or junctions on high use facilities, paths are widened to a minimum width of 2.5 m to allow for passing of pedestrians and cyclists in opposite directions.	✓		Complies A 2.5m wide shared access path is being provided to the western verge of Road 102A to provide a direct connection between the CRIP and the Stage 1 path network.
<b>R40</b> Safe street crossings are provided for all street users with sight distances, pavement markings, warning signs and safety rails (where appropriate for cyclists) in accordance with AUSTRROADS requirements.	✓		Complies. Further treatment may be identified and undertaken during detail design phase
<b>R41</b> Compliant pram and wheelchair crossings are provided where cycle and pedestrian path intersect with kerbs.	✓		Complies
<b>R42</b> Markings and tactile aides are provided in accordance with the relevant Australian Standard to assist sight-impaired people, the elderly and children.	✓		Complies and will be implemented in detail design phase
<b>Element 4: Public Transport</b>			
<i>To increase opportunities for choice in mode of transport, and provide cost effective and energy efficient public transport services that are accessible and convenient to the community.</i>			
<b>4.1 Bus Stop Location and Design</b>			
<b>R43</b> a) At least 90% of dwellings are within 400m safe walking distance from an existing or potential bus route, or 200m safe walking distance from an existing or proposed demand-responsive or community bus service route. In addition, at least 90% of dwellings are within 500m from the nearest existing and proposed bus stop. OR b) At least 90% of dwellings are within 750m of a high frequency trunk service bus stop that has, or is projected to provide, a minimum of eight outbound buses an hour during the morning peak. Or <b>C43</b> A network of public transport routes is provided that takes account of: a) projected travel demand	✓		Complies. The Public Transport & Footpath Network Plan in the approved Stage 1 EDP demonstrates that more than 90% of all Stage 3 dwellings are within 500m walking distance from the proposed bus stop on Road 1B.

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Code	Rule	Criteria	Statement
b) distribution of likely demand c) scale and time of demand d) characteristics of travelers e) travel time f) operating characteristics g) cost of providing the service.			
<b>R44</b> The siting of bus stops is related to the pedestrian path network. Or <b>C44</b> Public transport stops provide for pedestrian safety, security, comfort and convenience.	NA		Not applicable, no bus stops are proposed in Stage 3 as it is within Crace Stage 1 which has provided bus stops for the entire development as identified on the Public Transport Network Plans.
<b>R45</b> Bus stops are located within 400 m of sporting, community, retail and educational facilities. Or <b>C45</b> Public transport stops provide for pedestrian safety, security, comfort and convenience.	✓		Complies. Bus stops are appropriately located and provided within Crace Stage 1 as identified on the Public Transport Network Plans.
<b>R46</b> Bus stops are in accordance with <i>Disability Access Standards for Public Transport</i> . Or <b>C46</b> Public transport stops provide for pedestrian safety, security, comfort and convenience.	NA		Not applicable, no bus stops are proposed in Stage 3 as it is within Crace Stage 1 which has provided bus stops for the entire development as identified on the Public Transport Network Plans.
<b>R47</b> Bus stops are designed in accordance with TaMS Design Guidelines. Or <b>C47</b> a) Bus stops are designed to prevent vehicles from overtaking a stationary bus, or vehicle speeds are reduced to ensure safe pedestrian crossing. b) Bus stops are located and designed to be overlooked from nearby buildings and are located to minimise adverse impact on the amenity of nearby dwellings.	NA		Not applicable, no bus stops are proposed in Stage 3 as it is within Crace Stage 1 which has provided bus stops for the entire development as identified on the Public Transport Network Plans.
<b>R48</b> The geometry of streets identified as bus routes are suitable for turning, stopping sight distance, grade and parking requirements of buses (as determined from appropriate design documents) has a carriageway width of 7.5m or within ranges specified in Tables 4 and 5.	NA		Not applicable, no bus routes are proposed in Stage 3.

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Code	Rule	Criteria	Statement
Or <b>C48</b> Bus routes have a carriageway width to allow for the movement of buses, unimpeded by parked cars, safely accommodate cyclists, and avoid cars overtaking parked buses.			
<b>R49</b> Bus routes linking residential areas across roads that carry in excess of 6000 vpd are designed to enable a left turn into the road from one area followed by a right turn from the road into the adjoining residential area. OR <b>C49</b> a) Convenient connections to adjoining areas and other public transport routes (including future routes), provide for ease of movement of buses between neighbourhoods, and link activity centres within and external to the neighbourhood. b) Buses are able to safely gain access to the neighbourhood and cross arterial roads without complicated turning manoeuvres when travelling between neighbourhoods.	NA		Not applicable, there is no road that carries more than 6,000 vpd. There is no bus route in Stage 3.
<b>Element 5: Public Open Space and Sporting Facilities</b>			
<i>To provide public open space and sporting facilities as formative elements in the neighbourhood layout that meet community requirements for safe and accessible outdoor recreational space and that contribute to the community identity through landscaping, heritage and biodiversity protection.</i>			
<b>5.1 Size and landform</b>			
<b>R50</b> Local neighbourhood parks must have a minimum size of 0.5 ha, unencumbered by utilities infrastructure, to provide sufficient size for amenity, recreation and environmental purposes. OR <b>C50</b> Public open space makes best use of the neighbourhood's natural attributes to provide the community with accessible and functional outdoor recreation space that is consistent with the management purpose.	✓		Complies. The CRIP has an unencumbered area greater than 0.5ha.
<b>R51</b> Pedestrian parkland serving multiple purposes (e.g. for community paths, bikepaths, stormwater, utilities and the like) achieves minimum widths as described in Table 4 and TaMS Design Standards.	✓		Complies. This has been agreed with TAMS.

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Code	Rule	Criteria	Statement
OR <b>C51</b> Safe, compliant and convenient access to and through the open space is provided.			
<b>R52</b> Open space in watercourses and drainage swales are inundated only in a storm event of greater than two-year average recurrence interval and do not present a safety hazard Or <b>C52</b> Open space in watercourses, drainage swales and detention areas are designed as useable parkland.	✓		Complies. Detention areas within the CRIP are designed as useable open parkland. The main circulation path, shared pathway and major facilities (playground, picnic area, hard surface courts, etc.) are designed to be above the 2 year ARI.
<b>R53</b> Drainage swales are contoured, unfenced, grassed, and landscaped. OR <b>C53</b> Safe, compliant and useable linear open space is provided along overland stormwater drainage paths.	✓		Complies.
<b>5.2 Accessibility</b>			
<b>R54</b> Fully compliant pedestrian and cycle paths are provided to be contiguous with the on-road and off-road trunk network and achieve access through and to the open space. Service vehicle access and public parking is provided in accordance with TaMS design standards. OR <b>C54</b> Safe, compliant and convenient access to and through the open space is provided.	✓		Complies. All open space footpaths are fully compliant with TaMS Design Standards and achieved a comprehensive and coordinated pedestrian network throughout the Estate. Maintenance access is provided to all open space areas in accordance with TaMS Design Standards.  There have been sufficient public parking spaces provided as part of Crace Stage 1, situated along Road 6.
<b>R55</b> Barriers and integrated landscape design prevent motor vehicle trespass onto open space in accordance with TaMS design standards OR <b>C55</b> Vehicle trespass onto areas of public open space is provided to the satisfaction of TaMS.	✓		Complies. Vehicle access to all open space areas will be prevented by use of kerb and gutter and bollards. This will be addressed at detailed design in accordance with TaMS standards.

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

Code	Rule	Criteria	Statement
<b>Element 6: Block Layout and Building Envelope Plans</b>			
<i>To ensure the layout and orientation of blocks achieves required energy standards and provides for attractive and safe streets and public open space.</i>			
<b>6.1 Section Size</b>			
<p><b>R56</b> Except for Compact Blocks as described in Clause 6.5, sections defined by road and property boundaries are in the range of 50-80m deep by 120-220m long. Mid-section walkways are provided where sections exceed 200m in length.</p> <p>OR</p> <p><b>C56</b> a) Street and block layouts are pedestrian friendly and provide for perimeter buildings fronting a perimeter street around sections. b) Where section depths are less than 50m, details are provided about housing types, urban design and affordability objectives.</p>	✓		<p>Complies. All section depths comply.</p>
<p><b>R57</b> The estate includes a combination of multi-unit sites and single and two-storey attached and detached residential dwellings.</p> <p>OR</p> <p><b>C57</b> The variety of block sizes and types facilitates housing diversity and choice and meets the projected requirements of people with different housing needs.</p>	✓		<p>Complies. The Estate has a combination of single storey dwellings and two-storey dwellings.</p>
<p><b>R58</b> Smaller blocks and blocks capable of supporting higher density are located in sections adjacent to commercial centres, public transport, or high amenity areas such as parks.</p> <p>OR</p> <p><b>C58</b> The distribution of block sizes and types enhances accessibility to amenities and reduces the need for use of vehicles.</p>	NA		<p>Not applicable for Stage 3 as no small blocks are proposed.</p>

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Code	Rule	Criteria	Statement
<b>6.2 Solar Efficient Subdivisions</b>			
<p><b>R59</b> An energy audit carried out in accordance with <i>Energy Audits of Subdivisions – Detached Residential Blocks</i> (Appendix C) achieves the following:</p> <p>a) A minimum of 75% of blocks have an energy rating of three stars or above. b) All blocks have a minimum rating of one star. OR</p> <p><b>C59</b> Opportunities to achieve solar access requirements as outlined below in R60 a) are demonstrated.</p>	✓		<p>Complies. The energy audit revealed that 100% of dwellings had an energy rating of 3 stars and above.</p>
<p><b>R60</b> By applying building envelopes permitted in the <i>Residential Zones Development Code</i>, demonstrate that all residential allotments in the estate are capable of achieving the following minimum solar access requirements on the winter solstice:</p> <p>a) North-facing, habitable rooms achieve a minimum of three hours of direct sunlight onto the floor or wall of the main daytime living area between 9.00 am and 3.00 pm on 21 June. b) 50% of the private open space achieves at least three hours of direct sunlight between 9.00 am and 3.00pm over private open space. OR</p> <p><b>C60</b> a) Demonstrate that energy efficiency and amenity considerations are achieved. b) Demonstrate that the private open space receives sufficient sunshine to support its intended uses, including outdoor eating, clothes drying, and growth of plants.</p>	✓		<p>Complies. All blocks are in the correct solar orientation to maximize the opportunity to a minimum of 3 hours of sunlight as per rule a). 50% of the private open space receives at least 3 hours of direct sunlight. The Building Envelope Plan shows open space locations for all blocks.</p>
<b>6.3 Multi-unit sites</b>			
<p><b>R61</b> Multi-unit sites are located within 200m of a commercial zone, public transport node, or public open space. OR</p> <p><b>C61</b> Multi unit sites are located within walking distance of key focal areas of the suburb such as commercial areas, open space and public transport.</p>	✓		<p>Complies. Not applicable for Stage 3 as no multi unit sites are proposed.</p>

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Code	Rule	Criteria	Statement
<p><b>R62</b> Sites for multi-unit development sit within a public road layout that provides similar address and frontage opportunities as the urban structure for single residential blocks.</p> <p>OR</p> <p><b>C62</b> Multi unit sites exist within the legible road structure of the neighbourhood.</p>	NA		Not applicable for Stage 3 as no multi unit sites are proposed.
<p><b>R63</b> When providing access to more than four attached dwellings, shared driveways run east-west and maximise solar access to dwellings.</p> <p>OR</p> <p><b>C63</b> Site planning allows living areas and private open space to have good solar access.</p>	✓		Not applicable for Stage 3 as no shared driveways are proposed.
<p><b>R64</b> Units are sited around a central court with individual dwellings facing the surrounding streets or open space as shown in Figure 2.</p> <p>OR</p> <p><b>C64</b> Units address public streets or open space. Continuous rear fencing along public roads is avoided.</p>	NA		Not applicable for Stage 3 as no multi unit sites are proposed.
<p><b>R65</b> Where internal private roads maintained by the body corporate accommodate more than 300 vehicle movements a day, the roads are developed with the same opportunities for on-street parking, pedestrian paths, verge landscaping and Water Sensitive Urban Design as the public roads described in Table 4.</p> <p>OR</p> <p><b>C65</b> The development achieves safety, amenity and functionality through the design of the internal roads.</p>	NA		Not applicable for Stage 3 as no internal private roads are proposed.

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Code	Rule	Criteria	Statement
<b>6.4 Security, Surveillance, Safety and Amenity.</b>			
<p><b>R66</b> Where blocks adjoin streets with traffic volumes in excess of 3000 vpd, the block layout achieves one or more of the following:</p> <ul style="list-style-type: none"> <li>a) Incorporates service roads or rear lane access adjacent to busier arterial roads;</li> <li>b) Uses battle-axe blocks to provide vehicle access from a side or rear street;</li> <li>c) Provides pedestrian access to the busy road where vehicle access is not provided;</li> <li>d) Arranges blocks to side onto busier streets with vehicle access from a side street;</li> <li>e) Where road safety standards are met, on-street parking is provided;</li> <li>f) Provides for forward exit from garages and driveways for larger blocks; or</li> <li>g) Incorporates shared driveways to garages at the rear of the blocks to facilitate exit in a forwards direction.</li> </ul> <p>OR</p> <p><b>C66</b> Block size and layout facilitates safe vehicular access and egress to busy streets. Possible techniques are illustrated in Figure 3.</p>	✓		<p>Complies. Not applicable for Stage 3 as no traffic volumes exceed 3000 vpd.</p>
<p><b>R67</b> a) Blocks front streets or public open space. b) Where blocks abut public open space the principles described in Figure 4 are applied.</p> <p>OR</p> <p><b>C67</b> Blocks are set out so that buildings on them are oriented to front streets or open spaces to contribute to the quality of the public domain, to provide good amenity for residents, and to facilitate personal and property security, deterrence of crime and vandalism of footpaths and public open space.</p>	✓		<p>Complies. All Blocks face public Streets or a public open space.</p>
<p><b>R68</b> Battle-axe blocks are used only where they:</p> <ul style="list-style-type: none"> <li>a) Front parks, natural areas or recreation areas such as golf courses</li> <li>b) Provide frontage to major roads</li> <li>c) Are necessary to provide vehicle access to sloping sites.</li> </ul>	✓		<p>Complies. Not applicable for Stage 3 as no battle-axe blocks are proposed.</p>

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Code	Rule	Criteria	Statement
<b>6.5 Compact Blocks (defined as blocks having a site area of 250m<sup>2</sup> or less)</b>			
<b>R69</b> Compact blocks are located: a) Opposite parkland open space; or b) Within 100m of parkland open space; or c) Adjacent to a minimum 10m wide verge.	NA		Not applicable for Stage 3 as no compact blocks are proposed.
<b>R70</b> a) Where vehicle access is provided to the front of the block the block frontage is to a local road, and not a main collector. b) Where a block has rear laneway access it may front a collector road. OR <b>C 70</b> Safe vehicle access is provided	NA		Not applicable for Stage 3 as no compact blocks are proposed.
<b>R71</b> Compact blocks provide opportunities for north facing living areas that can be achieved through such measures as: a) East – west running ends of sections b) East – west running culs-de-sac or minor access roads. OR <b>C71</b> Acceptable solar orientation is achieved.	✓		Complies. Not applicable for Stage 3 as no compact blocks are proposed.
<b>R72</b> Road and services infrastructure achieves all operational requirements for waste collection, utilities service access and overland flow protection applicable to standard residential blocks.	✓		Complies. Not applicable for Stage 3 as no compact blocks are proposed.

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Code	Rule	Criteria	Statement
<b>Element 7: Utilities, Waste Management and Sediment and Erosion Control</b>			
<i>To ensure that residential areas are adequately services with sewerage, water, stormwater, fire-fighting, electricity, gas, street lighting and communication services in a timely, cost-effective, coordinated and efficient manner that supports sustainable development practices and asset maintenance needs and to promote the use of road verges or other public land for the provision of reticulated services where topography and other site constraints allow.</i>			
<b>7.1 Viability of Services</b>			
<b>R73</b> Land development occurs only where adequate stormwater, sewerage and water supplies for domestic and fire-fighting purposes can be provided and maintained in accordance with utility codes and standards made under or in accordance with ACT law.	✓		Complies. All dwellings are served with stormwater, sewerage and water supply connections. There is sufficient water supply pressure to satisfy the classified fire demands.
<b>7.2 Utility Services Leased and Unleased Land</b>			
<b>R74</b> a) Utility services comply with utility standards. b) Subject to agreement between the land manager and utility provider, water, electricity, gas and communication services are located within road reservations or other Territory Land that is, and is to remain, unleased. c) Subject to agreement between the proponent and the utility provider, and for the purpose of maximising land utilisation, preference is given to locating sewerage and stormwater services within road reservations, or other Territory Land that is, and is to remain, unleased.	✓		Complies. The existing service arrangement is proposed to be consistent with Crace Stage 1.
<b>R75</b> Where utility standards require sewerage and stormwater services to be located within leased blocks, those services: a) Are contained within service reservations and accessed by means of utility, emergency or maintenance access routes complying with Figures 5 and 6 and Table 7. b) Are on a block of sufficient size to accommodate service reservations and utility access routes, whilst providing comparable building footprint area to similar but unencumbered blocks. c) Where possible, are located in service reservations directly accessible from unleased Territory Land. d) Where possible, are co-located with private open space to maximise land utilisation.	✓		Complies. Reservations and appropriate easements have been demonstrated in sewer and stormwater layout plans.

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Code	Rule	Criteria	Statement
<b>7.3 Shared Trenching</b>			
<b>R76</b> Compatible minor service reticulation in the road verge may be located in shared trenching where permitted by utility standards.	✓		Complies. This has been demonstrated in Typical Road Cross section drawings.
<b>R77</b> Written acceptance of service reservation alignments has been provided by Territory and Municipal Services (TaMS) and other relevant utility providers.	✓		Complies. The existing arrangement for minor service reticulation is proposed to be consistent with Crace Stage 1.
<b>7.4 Width of Service Reservations and Service Access Elements</b>			
<b>R78</b> All sewerage and stormwater reticulation on land that is to be leased is located in a service reservation. The widths of service reservations are agreed by the utility provider and comply with the relevant section of Table 6. More than one easement may be required, as is shown in Figure 6.	✓		Complies. Easements indicated on the stormwater and sewer layout plans comply with Table 6.
<b>7.5 Width of Service Reservations and Emergency Access to Minor Service Reticulation</b>			
<b>R79</b> Where service reservations for sewerage reticulation cannot be adequately accessed directly from public land, maintenance and emergency access routes are provided obstruction-free access from public land to the service reservation.	✓		Complies. Block width has been design to allow for the implementation of the service access for affected blocks.
<b>R80</b> The widths of maintenance and access routes are approved by the utility provider and comply with the relevant section of Table 6.	✓		Complies. The service access width has been allowed in accordance with Table 6. This is in accordance with utility provider requirement (TaMS and ACTEW).
<b>R81</b> Where corner blocks require service reservations in the rear corner, the service reservation is extended along a side boundary to link with the road verge as shown in Figure 5 and 6.	✓		Complies.

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Code	Rule	Criteria	Statement
<b>7.6 Separation of Private and Utility Services</b>			
<b>R82</b> Where the permissible footprints of buildings are located adjacent to a service reservation, the relevant service provider determines and provides written approval of the extent and width of a private service zone required for private stormwater and sanitary drains, electricity and communication cables, gas, water and irrigation pipes associated with the development of the lease. This zone is documented in the EDP to provide adequate separation of private services from utility assets, and to prevent damage to private services when the utility is repairing or replacing its assets (see Figure 5). More than one private service zone may be required.	NA		Not applicable there are no private service zones proposed in Stage 3.
<b>7.7 Recording Utility Access Requirements in Leases</b>			
<b>R83</b> Where services are proposed to be included in leased land the proponent: <ol style="list-style-type: none"> <li>Consults with each utility service provider during the preparation of the EDP and obtains written confirmation that the provider's service reservations and maintenance and emergency access route requirements are included.</li> <li>Provides a written undertaking that all designated service reservations, maintenance and emergency access routes, and utility pipe protection envelopes are recorded on the Deposited Plans that will be referred to in the subsequent leases in the manner shown in Appendix B.</li> <li>Includes in the EDP the standard lease clauses applying to service reservations, maintenance and emergency access routes and utility pipe protection envelopes.</li> </ol>	✓		Complies. The proposed service and access easements are demonstrated in the EDP drawings.
<b>7.8 Design and Construction Qualifications</b>			
<b>R84</b> Sewerage facilities, water supply mains, stormwater, electricity, communications services, gas and street lighting are designed by persons who are qualified by reference to codes and standards made under or in accordance with ACT law.	✓		Complies. The detailed design will be undertaken by chartered professional engineer or authorised organisations

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Code	Rule	Criteria	Statement
<b>7.9 Overland Flow Paths for Sewage and Stormwater Spillage</b>			
<b>R85</b> Overland flow paths must be provided to ensure that surcharge of sewage or stormwater from utility network overflow points (such as manholes) or future residential sanitary drain overflow relief gullies, will not be obstructed by proposed building footprints and will comply with utility and residential plumbing standards.	✓		Complies. No Stormwater overland flows are allowed through lease land. All reverse graded sewer connections comply with maximum allowable dwellings.
<b>7.10 Location of Sewage and Stormwater Connections</b>			
<b>R86</b> Unless specifically approved by the utility provider, the sewer and stormwater ties are at the low point of the block in accordance with utility standards.	✓		The Stormwater and Sewer layout Plans adopt this principle. Where departure from this requirement is required due to conflicts with other services, approval will be sought in the detailed design phase
<b>R87</b> a) Subject to agreement between the proponent and the utility provider, the sewer and stormwater ties may be located away from the low point. b) Written approval is provided by TaMS and other utility service providers, and any special requirements imposed by the service authorities are incorporated in the design.	✓		See above  No special requirements currently known.
<b>7.11 Clearance Between Utility Equipment and Landscape Elements</b>			
<b>R88</b> The location of and accessibility to meters, control valves, manholes and utility connections are acceptable to service providers and determined in accordance with utility standards to minimise conflict with driveways, fencing, courtyard walls, or other permanent paving, vegetation or structures mandated by the developer.	✓		Complies. No non conformance items are identified at this stage.

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Code	Rule	Criteria	Statement
<b>7.12 Noise and Odour Buffer Zones</b>			
<b>R89</b> Buffer zones complying with utility requirements are provided between dwellings and utility service equipment such as sewer vents or pump stations to protect residential amenity from odour and noise nuisance. This buffer zone is agreed with the utility provider and documented in the EDP.	✓		No buffer zone is currently identified.
<b>7.13 Waste Management</b>			
<b>R90</b> Waste management is in accordance with the latest version of the <i>Development Control Code for Best Practice Waste Management in the ACT</i> , TaMS 2006.  Or  <b>C90</b> Evidence is provided of industry acceptance of arrangements for the kerbside collection of residential waste from detached dwellings and for the internal collection of waste from multi-unit sites.	✓		Complies. Hammerhead has been provided for Road 101 in accordance with the <i>Development Control Code for Best Practice Waste Management in the ACT</i> , TaMS 1999 (note link on TaMS website has 1999 version not 2006). Standard kerb side collection is proposed.
<b>R91</b> In accordance with the <i>Development Control Code for Best Practice Waste Management in the ACT</i> (TaMS 2006), garbage collection vehicle access is provided as follows:  a) To mobile garbage bins for all single unit dwellings and multi-unit and cluster developments up to and including 10 units. b) To garbage hoppers in an approved structure for multi-unit sites in excess of 10 dwellings.	NA		Not applicable, no multi unit sites are proposed.
<b>R92</b> Demolition waste leaving the site is diverted to a recycling or reprocessing operator for the particular type of waste material. Evidence of proper recycling, reprocessing or disposal is obtained and kept for 12 months after practical completion of the project.	✓		Complies. All construction waste will be subject to a waste management plan to be administered by Civil and landscape contractors.
<b>7.14 Sediment and Erosion Control Plan</b>			
<b>R93</b> A Sediment and Erosion Control Concept Plan satisfies the requirements of the Environment Protection Authority.	✓		An Environmental Management Concept Plan is included in the EDP.

## Appendix B

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Traffic Report – AECOM

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Mitchell Alexander  
Project Manager  
CIC Crace Pty Ltd  
Level 3, 64 Allara St, Canberra ACT 2600

02 November 2010

Dear Mitchell

**Crace Estate Development Plan EDP Variation and Inclusion of Stage 3**

AECOM provided a traffic impact assessment to support the application of the Crace Stage 1 Estate Development Plan (EDP) in June 2008. This was revised by AECOM in June 2010 for the Crace Stage 2 EDP submission. We have been advised that CIC Crace wish to resubmit the Stage 1 EDP and revise the traffic impact assessment with the following changes:

- *Stage 1 addition of new road 30, reduction of 16 blocks and increase of 11 dwellings;*
- *The Stage 2 internal road network modified due to EDP comments for tree retention;*
- *Inclusion of Stage 3 which comprises of 22 blocks*

Our summary comments on the revised report are as follows.

Peak period for the traffic generated by the proposed development in Crace will be predominantly during weekday AM and PM peaks. Traffic analysis of the major intersections was conducted in SIDRA for the previous submission and again with this Stage 1 amendment and it confirms that the change of internal road network and minor dwelling increase does not reduce the intersection performance of any of the key intersections analysed.

It is understood that According to the 'Residential Subdivision Development Code', roads expected to have traffic volumes exceeding 3,000 a day must not have direct property access (unless a two-way drive-way is provided). The proposed Estate layout has taken this restriction into account and located residential property access points on roads with less than 3,000 vehicles per day.

The addition of additional residential blocks in Stage 3 and an increase of 11 dwellings in Stage 1 has negligible effect on traffic flow. The traffic volumes within the Crace with inclusion of Stage 3 and the new internal road network are well within the environmental capacity of the road classification and current ACT Government Codes and guidelines.

We trust that this will provide a reasonable level of confidence in the satisfactory operation of the proposed EDP submission.

Yours sincerely

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## 1.0 Road Hierarchy and Traffic Analysis

### 1.1 Summary

As part of an overall assessment of the development of Crace a thorough investigation of traffic impacts and requirements has been undertaken by AECOM. The following sections detail a summary of the conclusions made from this traffic study.

In order to aid the assessment the traffic distribution and impacts, the suburb was broken up into a number of precincts, including residential areas, commercial, and a local retail centre.

The traffic analysis focused on the following key aspects:

- The generation and distribution of traffic associated with the full development of Crace;
- Peak hour and daily flows on the main Boulevard (Abena Avenue) and collector roads within the suburb;
- Peak hour and daily flows on Gundaroo Drive and Nudurr Drive; and
- The configuration and performance of key internal and external intersections.

In the proposed Estate layout the internal road network has been changed. The numbers of dwellings has increased to approximately 1,800 and the gross floor area (GFA) for shops remains unchanged at 1,800 m<sup>2</sup> (1200m<sup>2</sup> supermarket + 600m<sup>2</sup> other). The area for a commercial facility (offices) and community facilities also remains unchanged at 600 m<sup>2</sup> and 500 m<sup>2</sup> GFA, respectively. The traffic associated with the 'Community Recreational Irrigated Park' (CRIP) was considered in this assessment, with its impacts deemed to be minimal.

The main Boulevard within Crace (Abena Avenue) is expected to accommodate 5,700 to 9,500 vehicles a day, while the main collector is expected to experience up to 2,900 vehicles only near the local retail and community centres.

According to the 'Residential Subdivision Development Code', roads expected to have traffic volumes exceeding 3,000 a day must not have direct property access (unless a two-way driveway is provided). The proposed Estate layout has taken this restriction into account and located residential property access points on roads with less than 3,000 vehicles per day.

An analysis was conducted both with and without Nudurr Drive being extended to Gungahlin Drive. Sensitivity tests identified that a redistribution of traffic would occur in the peak hours due to the improved access options associated with the extension of Nudurr Drive. This would result in a reduction of traffic volumes on Abena Avenue, whilst increasing volumes on the main collector close to Nudurr Drive. A full set of impacts are detailed in Section 1.7.

### 1.2 Road Hierarchy

A road hierarchy has been established through Crace which provides a defined route via Abena Avenue and the main collector road. The road system will promote good road and pedestrian permeability and connectivity through the Estate. The defined Road Hierarchy is shown on the EDP plans. This Road Hierarchy is reinforced through the urban design elements including:

- Built form controls, setbacks and fencing;
- Streetlighting and types;
- Width of road reserves, road pavement, and verges;
- Indented carparking; and
- Tree planting.

Fundamentally, the road network proposed is a 'grid' configuration. Such systems promote accessibility and legibility and provide a multitude of alternate routes through the network. If not designed properly, these can sometimes be used as 'rat-runs' by motorists looking for a more efficient route through the network. The Crace road network will provide a clear definition of hierarchy by the inclusion of appropriate intersection treatments on the main Boulevard and collector road to allow for the priority of major traffic movements.

The proposed road layout for Crace is outlined in Figure 1 Note: this diagram should be used as a guide to the definition of the main road network only.



Note: this diagram should be used as a guide to the definition of the main road network only.

**Figure 1** Crace Road network

### 1.3 Traffic Generation

The traffic generated for this assessment was generated from the trip generation rates as defined in the 'Residential Subdivision Development Code' as shown in Table 1 and Table 2.

**Table 1** Daily traffic generation rates

Generation Group	Rate	Unit
Single Residential	8	trips per dwelling
Multi-unit dwelling	6	trips per dwelling

**Table 2** Peak hour traffic generation rates

Generation Group	Rate	Unit
Single Residential	0.8	trips per dwelling
Multi-unit dwelling	0.6	trips per dwelling

It is a standard rule of thumb to assume that peak traffic generation rates are 10% of the daily rates.

For the proposed local retail area a rate of 2 trips per 100m<sup>2</sup> was used in the AM peak hour. The defined RTA trip rate in the PM peak hour is defined as 12 trips per 100m<sup>2</sup> but a more conservative 6 trips per 100m<sup>2</sup> (GFA) was used. It was assumed that 50% of the trips would be 'linked trips' associated with motorists already coming into Crace from work.

The base 'background' traffic volumes on the external roads (Gundaroo Drive and Nudurr Drive) were extracted from the earlier traffic study undertaken as part of the Crace Masterplan (Irwin consult, October 2005). This earlier study used a strategic transport model, which took into account wider road network upgrades (eg. Gungahlin Drive Extension) and future land releases. As such, it was deemed a more accurate means of estimating external traffic around Crace. These volumes were then adjusted to reflect the change in lot yield and internal road network proposed as part of the Crace EDP.

It should be noted that the external base volumes assumed that Gundaroo Drive had not yet been duplicated.

In the revised submission, the internal road layout has changed from the Stage 1 submission. A summary of the peak hour and daily volumes generated by the Estate are shown in Table 3.

**Table 3 Daily traffic generation rates**

Land Use	Generated Traffic (AM peak)	Generated Traffic (PM peak)	Generated Traffic (Daily)
Residential	1387	1441	14,140
Commercial Facility	12	12	120
Local Retail Centre	36	108	720
<b>TOTAL</b>	<b>1,435</b>	<b>1,561</b>	<b>14,980</b>

#### 1.4 Traffic Distribution

In order to give an accurate representation of Crace, the traffic network was broken down into 16 precincts. Each precinct contained traffic generators with a corresponding traffic generation rate (i.e. Medium density residential, Office, Shops & High Density etc.). Using these rates, trips were distributed based on their proximity to the external road network as well as estimations of trip destinations/origins.

Although the precincts had separate internal distribution routes (assignments), they assumed the same fundamental regional distribution once the traffic reached Gundaroo Dr. This included:

##### AM Peak

- 80% heading south on Gundaroo Drive (towards the City and Belconnen)
- 20% heading north on Gundaroo Drive (towards the Gungahlin Town Centre)

##### PM Peak

- 60% coming from the south on Gundaroo Drive (from the City and Belconnen)
- 40% coming from the north on Gundaroo Drive (from the Gungahlin Town Centre)

(Note: it was assumed that Nudurr Drive is not extended through to Gungahlin Drive)

**When these assumed distributions were combined with the expected traffic from external sources an overall profile of the peak hour and daily traffic volumes within Crace was developed.**

Figure 2 shows the expected future daily traffic volumes on key roads in and around Crace. No traffic volumes are given in the diagrams for the minor internal roads within the estate, however these are shown in more detail in the Estate Development Plan.

For this assessment it was found that 75% of trips generated by the Crace development accessed the external road network directly onto Gundaroo Drive via intersection 14. The remaining 25% is expected to use Nudurr Drive (12% - intersection 13, 13% - intersection 1).

It should be noted that this traffic distribution differs from that identified in the original Masterplan, as the internal road network has been significantly altered. The EDP layout has the central 'core' area of the suburb focused around the main Boulevard, while the earlier Masterplan layout had this central core closer to Nudurr Drive.

For the proposed layout the main Boulevard within Crace (Abena Avenue) is expected to accommodate **5,700 to 9,500 vehicles a day**, while the main collector is expected to experience up to **2,900 vehicles** only near the local retail and community centres.

As outlined in 'Residential Subdivision Development Code', roads that are expected to have traffic volumes exceeding 3,000 a day must not have direct property access (unless a two-way drive-way is provided).

**It should be noted that the proposed Estate layout has taken this restriction into account and located residential property access points on roads with less than 3,000 vehicles per day.**

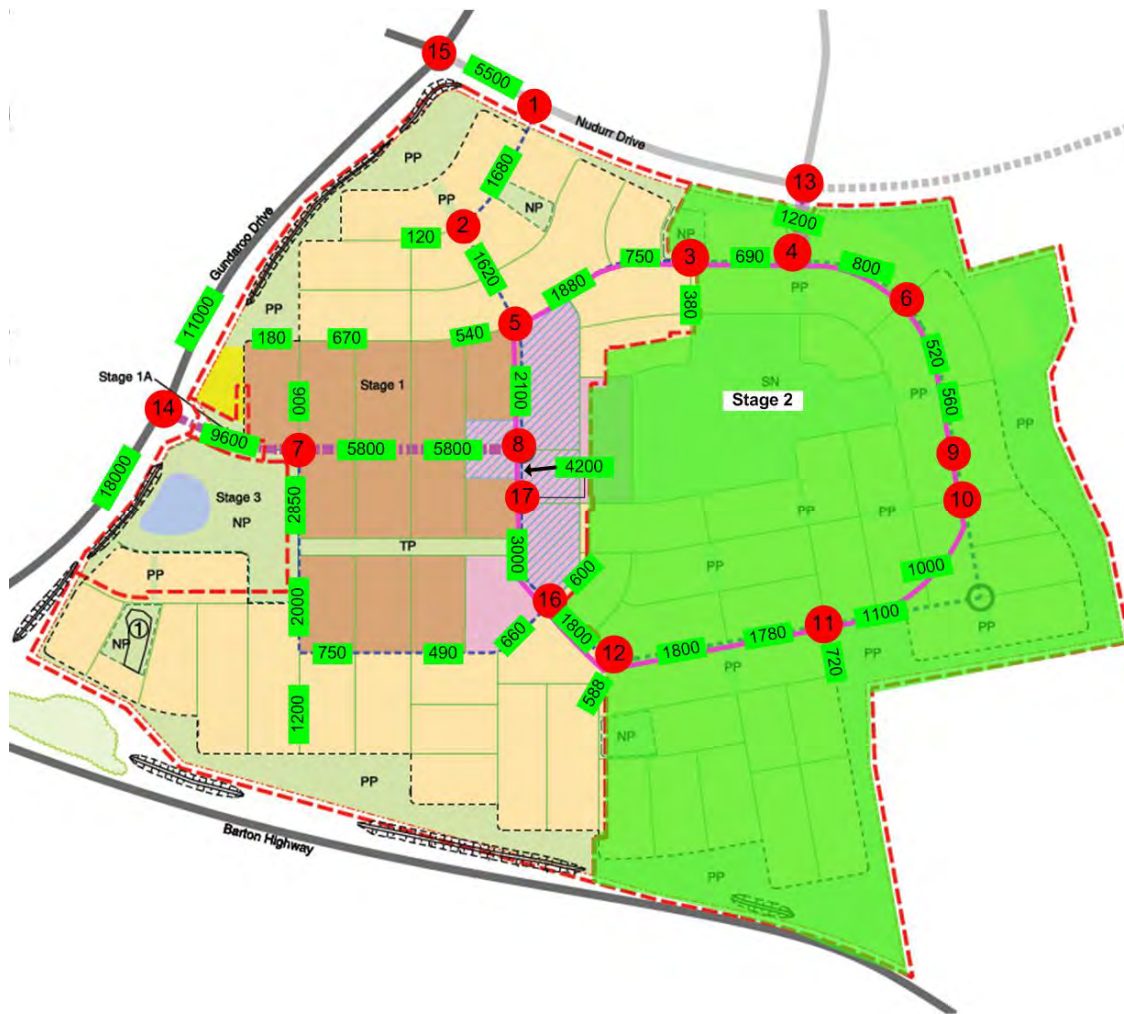


Figure 2 Daily traffic volumes in Crace (without Nudurr Drive extension)

## 1.5 Key Intersections

As part of the traffic modelling and analysis of Crace, seventeen (17) key intersections were assessed for their ability to accommodate peak hour traffic volumes.

Most of the key internal intersections lie on the main collector Road or the Boulevard. The key intersections which provide a link between Crace and the external Road network include 14, 15, 1 and 13. The intersections analysed throughout this report include the following:

1. Nudurr Drive / Chance Street – Give Way
2. Chance Street / Galore Street – Give Way
3. Langtree Crescent / Road 26 – Give Way
4. Langtree Crescent / Road 2 – Give Way
5. Langtree Crescent / Galore Street / Baratta Street – Roundabout
6. Road 04 / Road 45 – Give Way
7. Abena Avenue / Chance Street / Road 6 – Roundabout
8. Abena Avenue / Galore Street – Roundabout
9. Road 44 / Road 4 – Give Way
10. Road 4 / Road 46 – Give Way
11. Road 4 / Road 40 – Give Way
12. Road 4 / Road 34 – Give Way
13. Nudurr Drive / Road 2 / Grampians Street – Roundabout
14. Gundaroo Drive / Road 1 – Roundabout
15. Gundaroo Drive / Nudurr Drive – Roundabout
16. Road 4 / Vandyke Street – Roundabout
17. Galore Street / Road 30 – Give Way

Figure 3 shows the location of all seventeen intersections, with the conceptual layouts of each intersection (as represented in SIDRA) shown in Figure 4.



Figure 3 Key Intersections

### 1.5.1 External Intersections

The proposed layouts of each of the four (4) external intersections are shown in Figure 4. These are not drawn to scale, but simply conceptual layouts as shown in SIDRA.

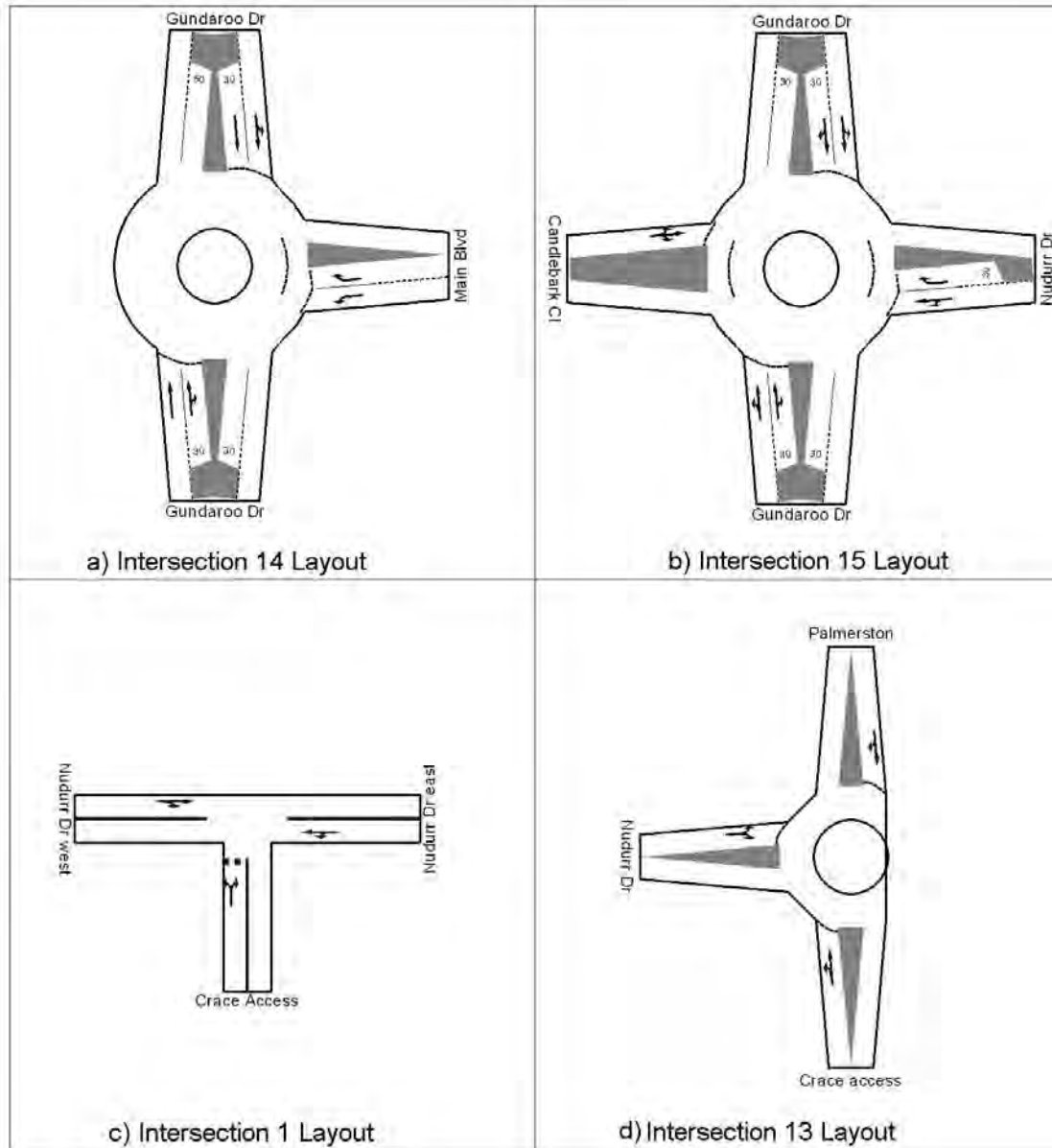


Figure 4 Key External Intersections of Crace (not drawn to scale)

1.5.2 Internal Intersections

The proposed layouts of each of the thirteen (13) internal intersections are shown in Figure 5. These are not drawn to scale, but simply conceptual layouts as shown in SIDRA.

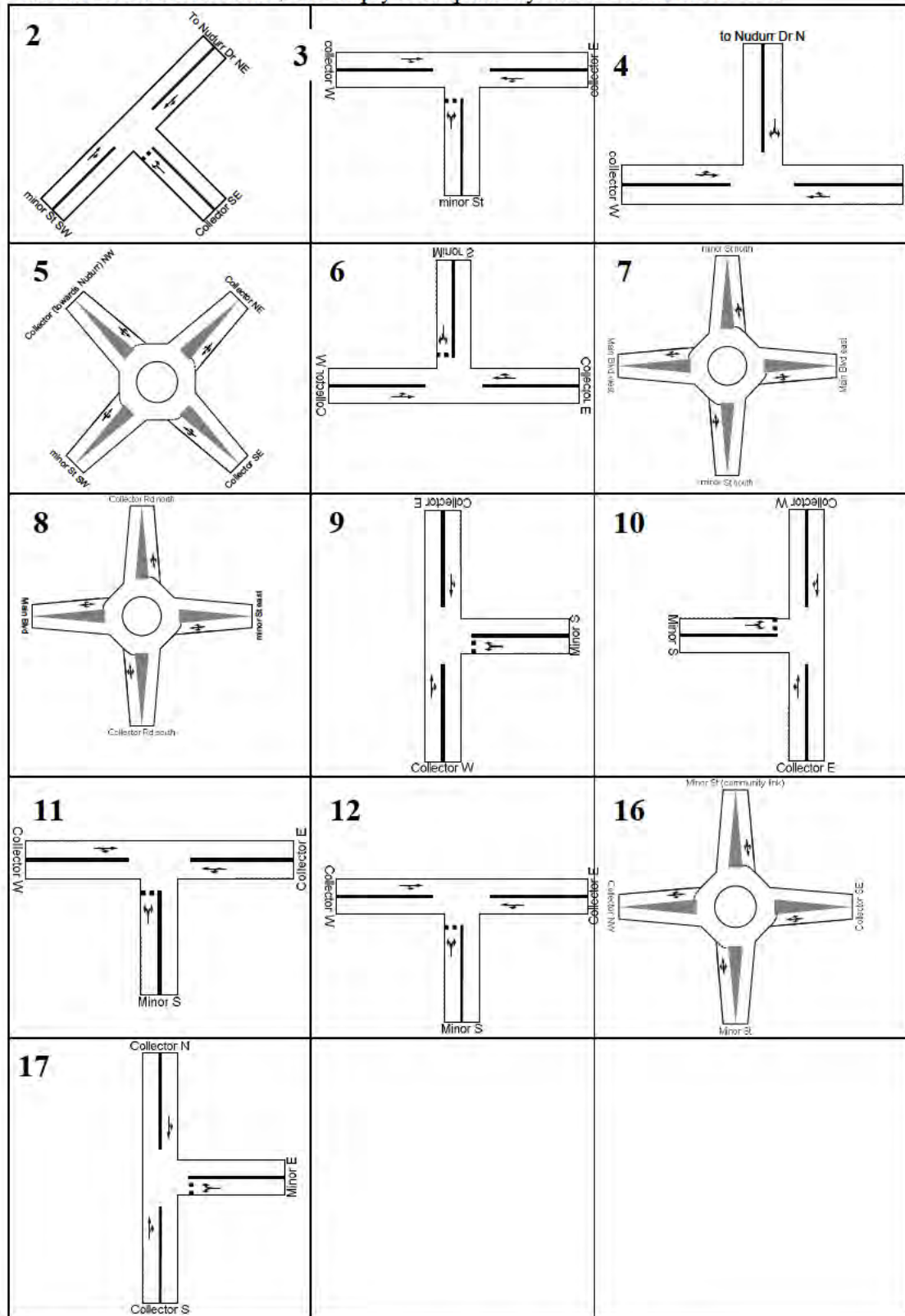


Figure 5 Key Internal Intersections of Crace (Not drawn to scale)

## 1.6 Intersection Performance

The seventeen (17) key intersections within and surrounding Crace were assessed for their AM and PM peak performance to ensure that the proposed configuration and control type proposed is able to accommodate expected peak hour volumes. The intersection analysis software SIDRA3 was used to identify the overall key performance indicators, including:

- Degree of Saturation – a measure of the ratio between traffic volumes and the capacity of the intersection;
- Average Delay – the average vehicle waiting time at the intersection; and
- Level of Service ('LoS') – a measure of the overall performance of the intersection (as shown in Table 4)

**Table 4 Performance Criteria for Intersections**

Level of Service	Average Delay / Vehicle (secs/veh)	Traffic Signals, Roundabouts	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays	At capacity; requires other control mode
F	>70	Roundabouts require other control mode	At capacity; requires other control mode

Source: Guide to Traffic Generation Developments, RTA, 1993

A SIDRA analyses has been done for all key intersections for this revised EDP submission. The work undertaken for the Stage 1 EDP submission identified that all intersections are expected to operate with significant spare capacity (as shown in Table 5).

The results of the analysis are shown in Table 5.

**Table 5 Key performance characteristics of key Crace intersections.**

No.	Description	Overall Level of Service (LoS)	
		AM Peak	PM Peak
<b>External Intersection</b>			
1	Nudurr Drive / Chance street – Give Way	A	A
13	Nudurr Drive / Road 2 / Grampians Street – Roundabout	A	A
14	Gundaroo Drive / Road 1 – Roundabout	A	A
15	Gundaroo Drive / Nudurr Drive – Roundabout	A	A
<b>Internal Intersections</b>			
2	Chance Street / Galore Street – Give Way	A	A
3	Langtree Crescent / Road 26 – Give Way	A	A
4	Langtree Crescent / Road 2 – Give Way	A	A
5	Langtree Crescent / Galore Street / Baratta Street – Roundabout	A	A
6	Road 04 / Road 45 – Give Way	A	A
7	Abena Avenue / Chance Street / Road 6 – Roundabout	A	A
8	Abena Avenue / Galore Street – Roundabout	A	A
9	Road 44 / Road 4 – Give Way	A	A
10	Road 4 / Road 46 – Give Way	A	A
11	Road 4 / Road 40 – Give Way	A	A
12	Road 4 / Road 34 – Give Way	A	A
16	Road 4 / Vandyke Street – Roundabout	A	A
17	Galore Street / Road 30 – Give Way	A	A

As can be seen in Table 5, all intersection configurations are expected to operate well in the AM and PM peak periods, with significant spare operating capacity.

The details of the SIDRA analyses for all the intersections are provided in the following section of the report.

### 1.7 Sensitivity Test - Nudurr Drive Extension

As part of the traffic analysis a scenario was created wherein Nudurr Drive was extended through to Gungahlin Drive. Under this scenario the distribution of trips within the suburb changed, as motorists were more readily able to travel to/from the City via Gungahlin Drive.

As a result of this analysis, the proportion of vehicles preferring to use intersection 14 was found to drop to 62% while the use of Nudurr Drive increased to 32% (intersection 13 - 23% and intersection 1 - 6%).

The expected daily traffic volumes on key roads under this scenario are shown in [Figure 6](#).



**Figure 6 Daily traffic volumes in Crace (with Nudurr Drive extension)**

Figure 6 identifies that if Nudurr Drive is extended there will be a redistribution of traffic within the suburb. Some of the key changes include:

- A reduction in the traffic using the main Boulevard
- A reduction in the traffic using the main collector road in the central 'core' area (near the local retail centre)
- An increase in the traffic using the sections of the main collector road nearest Nudurr Drive
- Traffic volumes on Road 2 (near intersection 13) exceeding 3,000 vehicles per day

In this development scenario Road 2 is the only road to increase above the threshold of 3,000 vehicles per day. Notably, the proposed Estate layout has taken the appropriate access restriction into account and has not located any residential property access points on this road.

No assessment has been made for the traffic volume changes on the minor roads within the estate, however the impact is expected to be minimal, with spare capacity shown to be available in the earlier assessment.

The analysis outlined in Section 1.6 showed that the seventeen (17) key Crace intersections will operate with significant spare capacity; with the ability to accommodate additional traffic volumes. The connection of Nudurr Drive will redistribute traffic within the suburb, most notably during the peak hours. However, this increase will be well within the capacity of each of the roads and intersections.

Although not tested as part of this study, it would therefore be prudent to assume that the intersection configurations recommended will still operate at a satisfactory level of service even if Nudurr Drive is extended and some redistribution of traffic occurs.

# Crace Traffic Distribution

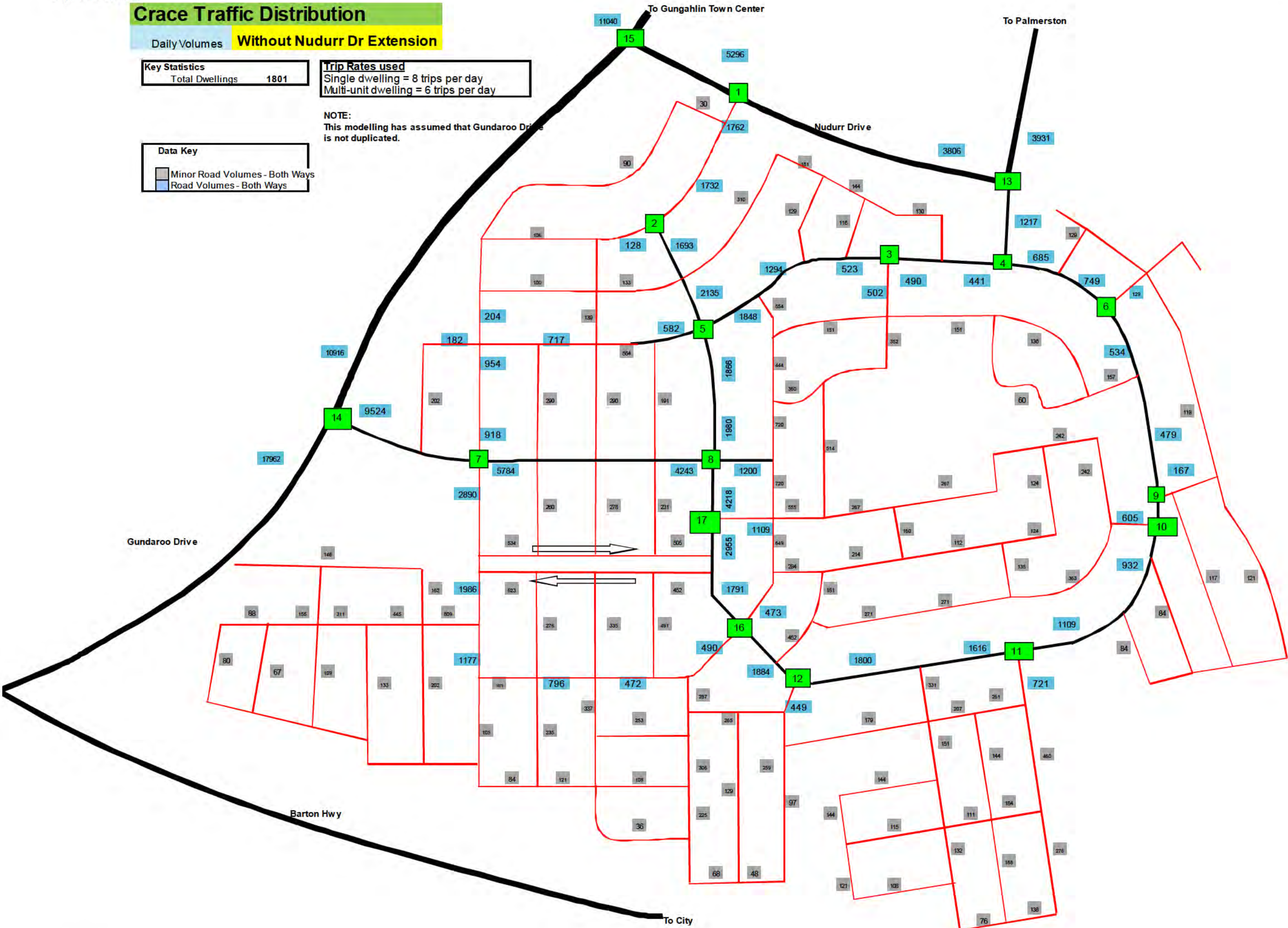
Daily Volumes **Without Nudurr Dr Extension**

**Key Statistics**  
Total Dwellings 1801

**Trip Rates used**  
Single dwelling = 8 trips per day  
Multi-unit dwelling = 6 trips per day

**NOTE:**  
This modelling has assumed that Gundaroo Drive is not duplicated.

**Data Key**  
Minor Road Volumes - Both Ways  
Road Volumes - Both Ways



# Crace Traffic Distribution

## Daily Volumes With Nudurr Dr Extension

**Key Statistics**

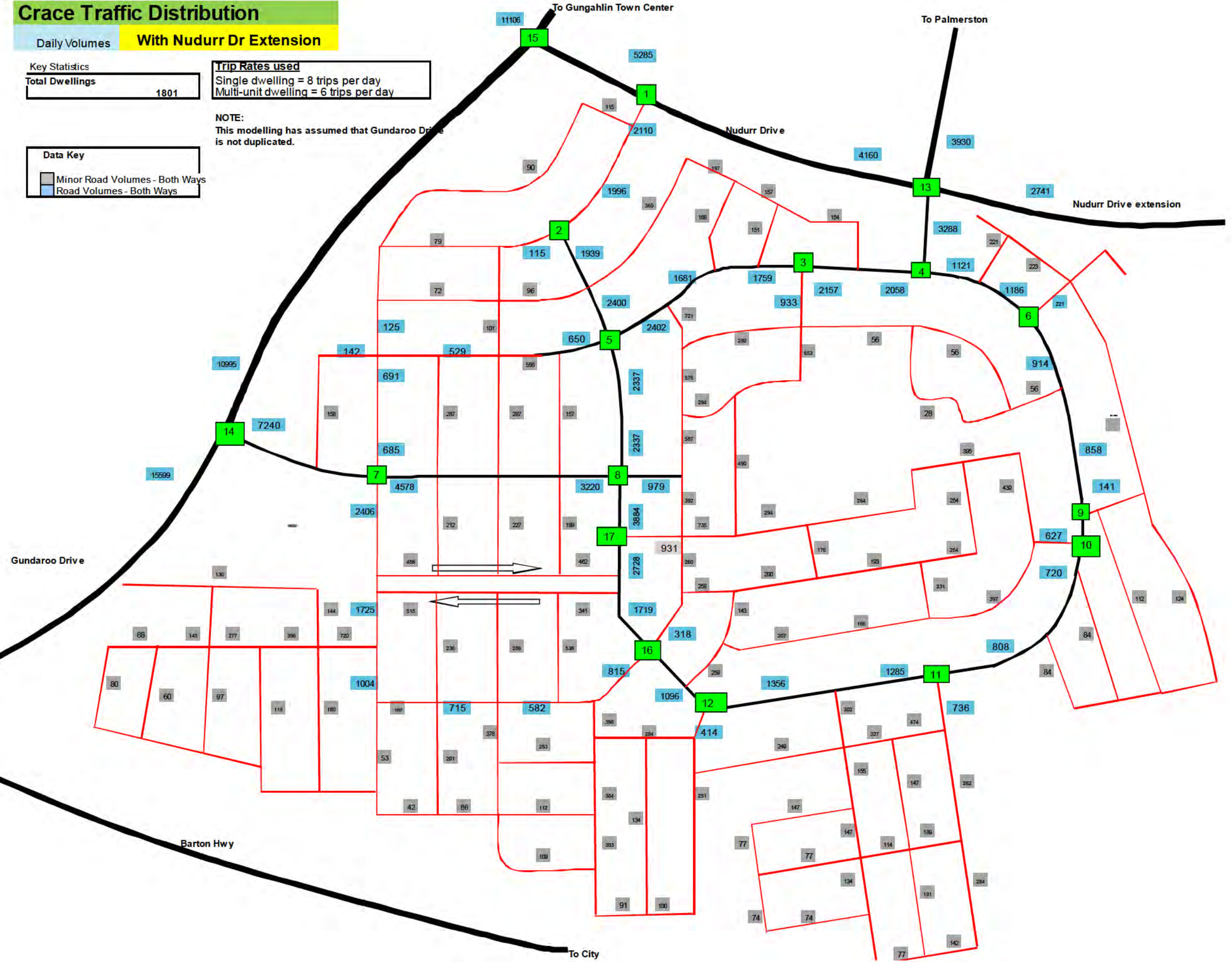
Total Dwellings 1801

**Trip Rates used**  
 Single dwelling = 8 trips per day  
 Multi-unit dwelling = 6 trips per day

**NOTE:**  
 This modelling has assumed that Gundaroo Drive is not duplicated.

**Data Key**

- Minor Road Volumes - Both Ways
- Road Volumes - Both Ways



# SIDRA RESULTS

## Intersection 14 - Gundaroo Dr Roundabout

### AM peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gundaroo Dr										
2	T	526	0.0	0.201	4.6	LOS A	11	0.26	0.40	51.6
3	R	5	0.0	0.200	11.6	LOS A	8	0.26	0.63	45.6
Approach		531	0.0	0.201	4.7	LOS A	11	0.26	0.41	51.5
Main Blvd										
4	L	981	0.0	0.925	19.3	LOS B	133	0.96	1.42	39.2
6	R	88	0.0	0.135	14.6	LOS B	5	0.57	0.85	43.8
Approach		1069	0.0	0.925	18.9	LOS B	133	0.92	1.37	39.6
Gundaroo Dr										
7	L	1	0.0	0.250	5.7	LOS A	15	0.05	0.48	51.6
8	T	780	0.0	0.264	4.4	LOS A	15	0.25	0.33	51.6
Approach		781	0.0	0.264	4.4	LOS A	15	0.25	0.33	51.6
All Vehicles		2381	0.0	0.925	11.0	LOS A	133	0.56	0.81	45.4

### PM peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gundaroo Dr										
2	T	526	0.0	0.338	4.3	LOS A	22	0.06	0.38	53.2
3	R	788	0.0	0.607	12.0	LOS A	30	1.00	0.15	42.6
Approach		1314	0.0	0.607	8.9	LOS A	30	0.62	0.24	46.1
Main Blvd										
4	L	5	0.0	0.005	7.0	LOS A	0	0.58	0.57	48.1
6	R	5	0.0	0.006	12.9	LOS A	0	0.59	0.67	44.2
Approach		10	0.0	0.006	9.9	LOS A	0	0.59	0.62	46.0
Gundaroo Dr										
7	L	196	0.0	0.662	14.7	LOS B	72	1.00	1.04	42.7
8	T	737	0.0	0.662	14.7	LOS B	72	1.00	1.08	42.8
Approach		933	0.0	0.662	14.7	LOS B	72	1.00	1.07	42.8
All Vehicles		2257	0.0	0.662	11.3	LOS A	72	0.78	0.59	44.7

## Intersection 15 - Gundaroo Dr / Nudurr Dr roundabout

### AM peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gundaroo Dr										
1	L	11	0.0	0.275	7.7	LOS A	16	0.48	0.61	48.1
2	T	560	0.0	0.276	6.0	LOS A	16	0.48	0.54	49.4
3	R	53	0.0	0.276	12.6	LOS A	12	0.48	0.69	44.6
Approach		624	0.0	0.276	6.6	LOS A	16	0.48	0.55	48.9
Nudurr Dr										
4	L	274	0.0	0.240	7.1	LOS A	9	0.48	0.62	48.8
5	T	5	0.0	0.238	6.3	LOS A	9	0.48	0.57	49.4
6	R	253	0.0	0.250	13.0	LOS A	10	0.50	0.79	44.5
Approach		532	0.0	0.250	9.9	LOS A	10	0.49	0.70	46.6
Gundaroo Dr										
7	L	2	0.0	0.200	5.9	LOS A	10	0.21	0.47	50.5
8	T	527	0.0	0.197	4.6	LOS A	10	0.21	0.39	51.9
9	R	5	0.0	0.200	11.5	LOS A	7	0.22	0.64	45.7
Approach		534	0.0	0.197	4.6	LOS A	10	0.21	0.40	51.8
Candlebark CI										
10	L	5	0.0	0.027	8.0	LOS A	1	0.58	0.65	48.3
11	T	5	0.0	0.027	7.0	LOS A	1	0.58	0.62	49.1
12	R	11	0.0	0.027	13.9	LOS A	1	0.58	0.71	44.2
Approach		21	0.0	0.027	10.9	LOS A	1	0.58	0.67	46.2
All Vehicles		1711	0.0	0.276	7.1	LOS A	16	0.40	0.55	49.0

### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gundaroo Dr										
1	L	11	0.0	0.204	6.8	LOS A	11	0.22	0.53	49.5
2	T	316	0.0	0.203	5.6	LOS A	11	0.22	0.46	50.7
3	R	211	0.0	0.217	11.4	LOS A	8	0.23	0.64	45.6
Approach		538	0.0	0.217	7.9	LOS A	11	0.22	0.53	48.5
Nudurr Dr										
4	L	105	0.0	0.117	8.3	LOS A	4	0.55	0.72	47.7
5	T	5	0.0	0.116	7.3	LOS A	4	0.55	0.64	48.5
6	R	53	0.0	0.074	13.7	LOS A	3	0.56	0.81	44.2
Approach		163	0.0	0.117	10.1	LOS A	4	0.56	0.75	46.5
Gundaroo Dr										
7	L	285	0.0	0.445	7.7	LOS A	28	0.48	0.60	48.0
8	T	769	0.0	0.445	6.6	LOS A	28	0.48	0.56	49.0
9	R	11	0.0	0.440	12.5	LOS A	20	0.47	0.69	44.6
Approach		1065	0.0	0.445	7.0	LOS A	28	0.48	0.57	48.7
Candlebark CI										
10	L	5	0.0	0.017	8.0	LOS A	1	0.46	0.61	48.5
11	T	5	0.0	0.017	7.2	LOS A	1	0.46	0.58	49.1
12	R	5	0.0	0.017	12.9	LOS A	1	0.46	0.68	44.7
Approach		15	0.0	0.017	9.4	LOS A	1	0.46	0.62	47.3
All Vehicles		1781	0.0	0.445	7.6	LOS A	28	0.41	0.58	48.4

## Intersection 1 - Nudurr Dr access Roundabout

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Crace access										
1	L	92	0.0	0.107	7.8	LOS A	5	0.44	0.60	48.5
2	T	25	0.0	0.107	6.3	LOS A	5	0.44	0.54	49.7
Approach		117	0.0	0.107	7.4	LOS A	5	0.44	0.58	48.7
Palmerston										
8	T	11	0.0	0.193	4.3	LOS A	9	0.07	0.38	53.1
9	R	316	0.0	0.193	11.2	LOS A	9	0.07	0.67	46.3
Approach		327	0.0	0.193	11.0	LOS A	9	0.07	0.66	46.5
Nudurr Dr										
10	L	58	0.0	0.046	5.5	LOS A	2	0.11	0.45	51.4
12	R	11	0.0	0.046	11.3	LOS A	2	0.11	0.65	46.2
Approach		69	0.0	0.046	6.4	LOS A	2	0.11	0.48	50.5
All Vehicles		513	0.0	0.193	9.6	LOS A	9	0.16	0.62	47.5

### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Crace access										
1	L	11	0.0	0.018	6.9	LOS A	1	0.30	0.51	49.3
2	T	11	0.0	0.018	5.4	LOS A	1	0.30	0.44	50.7
Approach		<b>22</b>	<b>0.0</b>	<b>0.018</b>	<b>6.2</b>	<b>LOS A</b>	<b>1</b>	<b>0.30</b>	<b>0.47</b>	<b>50.0</b>
Palmerston										
8	T	58	0.0	0.154	4.7	LOS A	7	0.25	0.41	51.7
9	R	158	0.0	0.154	11.6	LOS A	7	0.25	0.65	45.6
Approach		<b>216</b>	<b>0.0</b>	<b>0.154</b>	<b>9.7</b>	<b>LOS A</b>	<b>7</b>	<b>0.25</b>	<b>0.58</b>	<b>47.0</b>
Nudurr Dr										
10	L	211	0.0	0.185	5.4	LOS A	9	0.07	0.46	51.7
12	R	101	0.0	0.185	11.2	LOS A	9	0.07	0.66	46.4
Approach		<b>312</b>	<b>0.0</b>	<b>0.185</b>	<b>7.3</b>	<b>LOS A</b>	<b>9</b>	<b>0.07</b>	<b>0.52</b>	<b>49.8</b>
All Vehicles		<b>550</b>	<b>0.0</b>	<b>0.185</b>	<b>8.2</b>	<b>LOS A</b>	<b>9</b>	<b>0.15</b>	<b>0.54</b>	<b>48.6</b>

## Nudurr Dr access point (give-way)

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Crace Access										
1	L	119	0.0	0.167	10.9	LOS A	6	0.48	0.77	46.2
3	R	5	0.0	0.167	11.1	LOS A	6	0.48	0.84	45.9
Approach		124	0.0	0.167	10.9	LOS A	6	0.48	0.77	46.2
Nudurr Dr east										
4	L	5	0.0	0.200	8.2	LOS A	0	0.00	0.67	49.0
5	T	386	0.0	0.201	0.0	LOS A	0	0.00	0.00	60.0
Approach		391	0.0	0.201	0.1	LOS A		0.00	0.01	59.8
Nudurr Dr west										
11	T	53	0.0	0.034	1.8	LOS A	2	0.47	0.00	54.0
12	R	6	0.0	0.034	10.2	LOS A	2	0.47	0.70	46.7
Approach		59	0.0	0.033	2.7	LOS A	2	0.47	0.07	53.2
All Vehicles		574	0.0	0.201	2.7	Not Applicable	6	0.15	0.18	55.6

### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Crace Access										
1	L	11	0.0	0.048	13.7	LOS A	1	0.44	0.62	43.5
3	R	11	0.0	0.048	14.0	LOS A	1	0.44	0.83	43.2
Approach		22	0.0	0.048	13.8	LOS A	1	0.44	0.72	43.4
Nudurr Dr east										
4	L	11	0.0	0.087	8.2	LOS A	0	0.00	0.67	49.0
5	T	158	0.0	0.087	0.0	LOS A	0	0.00	0.00	60.0
Approach		169	0.0	0.087	0.5	LOS A		0.00	0.04	59.1
Nudurr Dr west										
11	T	312	0.0	0.310	1.0	LOS A	19	0.38	0.00	55.1
12	R	184	0.0	0.310	9.4	LOS A	19	0.38	0.67	47.2
Approach		496	0.0	0.310	4.1	LOS A	19	0.38	0.25	51.9
All Vehicles		687	0.0	0.310	3.5	Not Applicable	19	0.29	0.21	53.2

## Intersection 2 – give way

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Collector SE										
21	L	11	0.0	0.153	8.6	LOS A	6	0.16	0.60	48.2
23	R	120	0.0	0.152	8.9	LOS A	6	0.16	0.66	48.0
Approach		131	0.0	0.152	8.9	LOS A	6	0.16	0.65	48.0
To Nudurr Dr NE										
24	L	16	0.0	0.014	8.2	LOS A	0	0.00	0.67	49.0
25	T	11	0.0	0.014	0.0	LOS A	0	0.00	0.00	60.0
Approach		27	0.0	0.014	4.8	LOS A		0.00	0.40	52.9
minor St SW										
31	T	11	0.0	0.027	0.3	LOS A	1	0.13	0.00	58.2
32	R	18	0.0	0.027	8.7	LOS A	1	0.13	0.65	48.1
Approach		29	0.0	0.027	5.5	LOS A	1	0.13	0.40	51.5
All Vehicles		187	0.0	0.153	7.8	Not Applicable	6	0.14	0.58	49.2

### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Collector SE										
21	L	21	0.0	0.034	8.9	LOS A	1	0.24	0.62	47.9
23	R	11	0.0	0.034	9.2	LOS A	1	0.24	0.66	47.7
Approach		<b>32</b>	<b>0.0</b>	<b>0.034</b>	<b>9.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.24</b>	<b>0.63</b>	<b>47.8</b>
To Nudurr Dr NE										
24	L	191	0.0	0.110	8.2	LOS A	0	0.00	0.67	49.0
25	T	14	0.0	0.110	0.0	LOS A	0	0.00	0.00	60.0
Approach		<b>205</b>	<b>0.0</b>	<b>0.110</b>	<b>7.6</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.62</b>	<b>49.6</b>
minor St SW										
31	T	11	0.0	0.022	2.1	LOS A	1	0.39	0.00	55.0
32	R	11	0.0	0.022	10.5	LOS A	1	0.39	0.67	46.4
Approach		<b>22</b>	<b>0.0</b>	<b>0.022</b>	<b>6.3</b>	<b>LOS A</b>	<b>1</b>	<b>0.39</b>	<b>0.33</b>	<b>50.4</b>
All Vehicles		<b>259</b>	<b>0.0</b>	<b>0.110</b>	<b>7.7</b>	<b>Not Applicable</b>	<b>1</b>	<b>0.06</b>	<b>0.60</b>	<b>49.4</b>

### Intersection 3 – give way

#### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>minor St</b>										
1	L	39	0.0	0.047	8.4	LOS A	2	0.13	0.62	48.4
3	R	11	0.0	0.047	8.7	LOS A	2	0.13	0.67	48.1
<b>Approach</b>		<b>50</b>	<b>0.0</b>	<b>0.047</b>	<b>8.5</b>	<b>LOS A</b>	<b>2</b>	<b>0.13</b>	<b>0.63</b>	<b>48.3</b>
<b>collector E</b>										
4	L	11	0.0	0.023	8.2	LOS A	0	0.00	0.67	49.0
5	T	33	0.0	0.023	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>44</b>	<b>0.0</b>	<b>0.023</b>	<b>2.0</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.17</b>	<b>56.8</b>
<b>collector W</b>										
11	T	14	0.0	0.015	0.1	LOS A	1	0.13	0.00	58.3
12	R	11	0.0	0.015	8.6	LOS A	1	0.13	0.65	48.1
<b>Approach</b>		<b>25</b>	<b>0.0</b>	<b>0.015</b>	<b>3.9</b>	<b>LOS A</b>	<b>1</b>	<b>0.13</b>	<b>0.28</b>	<b>53.4</b>
<b>All Vehicles</b>		<b>119</b>	<b>0.0</b>	<b>0.047</b>	<b>5.1</b>	<b>Not Applicable</b>	<b>2</b>	<b>0.08</b>	<b>0.39</b>	<b>52.2</b>

#### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>minor St</b>										
1	L	11	0.0	0.023	8.6	LOS A	1	0.15	0.61	48.3
3	R	11	0.0	0.023	8.9	LOS A	1	0.15	0.66	48.0
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.023</b>	<b>8.8</b>	<b>LOS A</b>	<b>1</b>	<b>0.15</b>	<b>0.63</b>	<b>48.1</b>
<b>collector E</b>										
4	L	21	0.0	0.028	8.2	LOS A	0	0.00	0.67	49.0
5	T	32	0.0	0.028	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>53</b>	<b>0.0</b>	<b>0.028</b>	<b>3.2</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.26</b>	<b>55.1</b>
<b>collector W</b>										
11	T	28	0.0	0.022	0.2	LOS A	1	0.14	0.00	58.0
12	R	11	0.0	0.022	8.6	LOS A	1	0.14	0.64	48.0
<b>Approach</b>		<b>39</b>	<b>0.0</b>	<b>0.022</b>	<b>2.6</b>	<b>LOS A</b>	<b>1</b>	<b>0.14</b>	<b>0.18</b>	<b>54.8</b>
<b>All Vehicles</b>		<b>114</b>	<b>0.0</b>	<b>0.028</b>	<b>4.1</b>	<b>Not Applicable</b>	<b>1</b>	<b>0.08</b>	<b>0.31</b>	<b>53.5</b>

## Intersection 4 – give way

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>collector E</b>										
5	T	11	0.0	0.062	0.1	LOS A	2	0.09	0.00	58.7
6	R	80	0.0	0.063	8.5	LOS A	2	0.09	0.66	48.2
<b>Approach</b>		<b>91</b>	<b>0.0</b>	<b>0.063</b>	<b>7.5</b>	<b>LOS A</b>	<b>2</b>	<b>0.09</b>	<b>0.58</b>	<b>49.3</b>
<b>to Nudurr Dr N</b>										
7	L	5	0.0	0.019	8.9	LOS A	1	0.12	0.61	48.2
9	R	11	0.0	0.019	9.1	LOS A	1	0.12	0.67	47.9
<b>Approach</b>		<b>16</b>	<b>0.0</b>	<b>0.019</b>	<b>9.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.12</b>	<b>0.65</b>	<b>48.0</b>
<b>collector W</b>										
10	L	16	0.0	0.014	8.2	LOS A	0	0.00	0.67	49.0
11	T	11	0.0	0.014	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>27</b>	<b>0.0</b>	<b>0.014</b>	<b>4.8</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.40</b>	<b>52.9</b>
<b>All Vehicles</b>		<b>134</b>	<b>0.0</b>	<b>0.063</b>	<b>7.2</b>	<b>Not Applicable</b>	<b>2</b>	<b>0.08</b>	<b>0.55</b>	<b>49.8</b>

### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>collector E</b>										
5	T	11	0.0	0.013	0.1	LOS A	1	0.08	0.00	58.9
6	R	11	0.0	0.013	8.5	LOS A	1	0.08	0.66	48.3
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.013</b>	<b>4.3</b>	<b>LOS A</b>	<b>1</b>	<b>0.08</b>	<b>0.33</b>	<b>53.1</b>
<b>to Nudurr Dr N</b>										
7	L	63	0.0	0.126	8.4	LOS A	5	0.10	0.63	48.5
9	R	62	0.0	0.126	8.7	LOS A	5	0.10	0.67	48.2
<b>Approach</b>		<b>125</b>	<b>0.0</b>	<b>0.126</b>	<b>8.5</b>	<b>LOS A</b>	<b>5</b>	<b>0.10</b>	<b>0.65</b>	<b>48.4</b>
<b>collector W</b>										
10	L	11	0.0	0.012	8.2	LOS A	0	0.00	0.67	49.0
11	T	11	0.0	0.012	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.012</b>	<b>4.1</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.33</b>	<b>53.9</b>
<b>All Vehicles</b>		<b>169</b>	<b>0.0</b>	<b>0.126</b>	<b>7.4</b>	<b>Not Applicable</b>	<b>5</b>	<b>0.08</b>	<b>0.57</b>	<b>49.6</b>

## Intersection 5 – roundabout

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector SE</b>										
21	L	11	0.0	0.046	7.2	LOS A	2	0.24	0.54	49.2
22	T	38	0.0	0.046	6.4	LOS A	2	0.24	0.49	50.0
23	R	8	0.0	0.046	11.5	LOS A	2	0.24	0.65	45.5
<b>Approach</b>		<b>57</b>	<b>0.0</b>	<b>0.046</b>	<b>7.3</b>	<b>LOS A</b>	<b>2</b>	<b>0.24</b>	<b>0.52</b>	<b>49.1</b>
<b>Collector NE</b>										
24	L	82	0.0	0.123	6.9	LOS A	6	0.14	0.54	49.8
25	T	55	0.0	0.123	6.1	LOS A	6	0.14	0.49	50.7
26	R	39	0.0	0.123	11.2	LOS A	6	0.14	0.67	45.9
<b>Approach</b>		<b>176</b>	<b>0.0</b>	<b>0.123</b>	<b>7.6</b>	<b>LOS A</b>	<b>6</b>	<b>0.14</b>	<b>0.55</b>	<b>49.1</b>
<b>Collector (towards Nudurr) NW</b>										
27	L	11	0.0	0.027	6.8	LOS A	1	0.10	0.54	50.0
28	T	20	0.0	0.027	6.0	LOS A	1	0.10	0.49	50.9
29	R	6	0.0	0.027	11.1	LOS A	1	0.10	0.68	46.1
<b>Approach</b>		<b>37</b>	<b>0.0</b>	<b>0.027</b>	<b>7.1</b>	<b>LOS A</b>	<b>1</b>	<b>0.10</b>	<b>0.53</b>	<b>49.8</b>
<b>minor St SW</b>										
30	L	20	0.0	0.027	7.1	LOS A	1	0.22	0.53	49.3
31	T	3	0.0	0.027	6.3	LOS A	1	0.22	0.49	50.1
32	R	11	0.0	0.027	11.4	LOS A	1	0.22	0.65	45.6
<b>Approach</b>		<b>34</b>	<b>0.0</b>	<b>0.027</b>	<b>8.4</b>	<b>LOS A</b>	<b>1</b>	<b>0.22</b>	<b>0.57</b>	<b>48.1</b>
<b>All Vehicles</b>		<b>304</b>	<b>0.0</b>	<b>0.123</b>	<b>7.6</b>	<b>LOS A</b>	<b>6</b>	<b>0.16</b>	<b>0.55</b>	<b>49.1</b>

## PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector SE</b>										
21	L	11	0.0	0.110	6.9	LOS A	5	0.14	0.54	49.8
22	T	26	0.0	0.110	6.1	LOS A	5	0.14	0.49	50.7
23	R	119	0.0	0.110	11.2	LOS A	5	0.14	0.67	45.9
<b>Approach</b>		<b>156</b>	<b>0.0</b>	<b>0.110</b>	<b>10.0</b>	<b>LOS A</b>	<b>5</b>	<b>0.14</b>	<b>0.63</b>	<b>46.9</b>
<b>Collector NE</b>										
24	L	32	0.0	0.045	7.3	LOS A	2	0.28	0.54	49.0
25	T	11	0.0	0.045	6.5	LOS A	2	0.28	0.50	49.7
26	R	11	0.0	0.045	11.6	LOS A	2	0.28	0.64	45.4
<b>Approach</b>		<b>54</b>	<b>0.0</b>	<b>0.045</b>	<b>8.0</b>	<b>LOS A</b>	<b>2</b>	<b>0.28</b>	<b>0.56</b>	<b>48.3</b>
<b>Collector (towards Nudurr) NW</b>										
27	L	67	0.0	0.152	7.5	LOS A	7	0.31	0.56	48.8
28	T	103	0.0	0.152	6.7	LOS A	7	0.31	0.52	49.5
29	R	14	0.0	0.152	11.7	LOS A	7	0.31	0.66	45.3
<b>Approach</b>		<b>184</b>	<b>0.0</b>	<b>0.152</b>	<b>7.3</b>	<b>LOS A</b>	<b>7</b>	<b>0.31</b>	<b>0.55</b>	<b>48.9</b>
<b>minor St SW</b>										
30	L	11	0.0	0.028	7.4	LOS A	1	0.30	0.55	48.9
31	T	11	0.0	0.028	6.6	LOS A	1	0.30	0.50	49.6
32	R	11	0.0	0.028	11.7	LOS A	1	0.30	0.64	45.3
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.028</b>	<b>8.6</b>	<b>LOS A</b>	<b>1</b>	<b>0.30</b>	<b>0.56</b>	<b>47.8</b>
<b>All Vehicles</b>		<b>427</b>	<b>0.0</b>	<b>0.152</b>	<b>8.5</b>	<b>LOS A</b>	<b>7</b>	<b>0.24</b>	<b>0.58</b>	<b>48.0</b>

## Intersection 6 – give way

AM peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector SE</b>										
21	L	11	0.0	0.038	8.4	LOS A	2	0.15	0.57	48.3
22	T	37	0.0	0.038	0.2	LOS A	2	0.15	0.00	57.9
23	R	11	0.0	0.038	8.7	LOS A	2	0.15	0.64	48.0
<b>Approach</b>		<b>59</b>	<b>0.0</b>	<b>0.038</b>	<b>3.3</b>	<b>LOS A</b>	<b>2</b>	<b>0.15</b>	<b>0.22</b>	<b>53.9</b>
<b>minor St NE</b>										
24	L	11	0.0	0.039	8.7	LOS A	1	0.11	0.62	48.3
25	T	11	0.0	0.039	7.5	LOS A	1	0.11	0.57	49.7
26	R	14	0.0	0.039	9.0	LOS A	1	0.11	0.67	48.0
<b>Approach</b>		<b>36</b>	<b>0.0</b>	<b>0.039</b>	<b>8.5</b>	<b>LOS A</b>	<b>1</b>	<b>0.11</b>	<b>0.63</b>	<b>48.6</b>
<b>Collector NW</b>										
27	L	11	0.0	0.025	8.6	LOS A	1	0.22	0.52	48.0
28	T	11	0.0	0.025	0.4	LOS A	1	0.22	0.00	57.0
29	R	11	0.0	0.025	8.9	LOS A	1	0.22	0.62	47.8
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.025</b>	<b>6.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.22</b>	<b>0.38</b>	<b>50.6</b>
<b>minor St SW</b>										
30	L	11	0.0	0.036	8.8	LOS A	1	0.18	0.60	48.2
31	T	11	0.0	0.036	7.5	LOS A	1	0.18	0.56	49.4
32	R	11	0.0	0.036	9.1	LOS A	1	0.18	0.66	47.9
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.036</b>	<b>8.5</b>	<b>LOS A</b>	<b>1</b>	<b>0.18</b>	<b>0.61</b>	<b>48.5</b>
<b>All Vehicles</b>		<b>161</b>	<b>0.0</b>	<b>0.039</b>	<b>6.1</b>	<b>Not Applicable</b>	<b>2</b>	<b>0.16</b>	<b>0.43</b>	<b>50.8</b>

## PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector SE</b>										
21	L	11	0.0	0.025	8.7	LOS A	1	0.23	0.51	47.9
22	T	11	0.0	0.025	0.5	LOS A	1	0.23	0.00	56.9
23	R	11	0.0	0.025	8.9	LOS A	1	0.23	0.62	47.7
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.025</b>	<b>6.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.23</b>	<b>0.38</b>	<b>50.5</b>
<b>minor St NE</b>										
24	L	11	0.0	0.036	8.8	LOS A	1	0.19	0.60	48.1
25	T	11	0.0	0.036	7.6	LOS A	1	0.19	0.56	49.3
26	R	11	0.0	0.036	9.1	LOS A	1	0.19	0.65	47.9
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.036</b>	<b>8.5</b>	<b>LOS A</b>	<b>1</b>	<b>0.19</b>	<b>0.61</b>	<b>48.4</b>
<b>Collector NW</b>										
27	L	11	0.0	0.045	8.4	LOS A	3	0.15	0.57	48.3
28	T	43	0.0	0.045	0.2	LOS A	3	0.15	0.00	58.0
29	R	15	0.0	0.045	8.7	LOS A	3	0.15	0.64	48.0
<b>Approach</b>		<b>69</b>	<b>0.0</b>	<b>0.045</b>	<b>3.4</b>	<b>LOS A</b>	<b>3</b>	<b>0.15</b>	<b>0.23</b>	<b>53.8</b>
<b>minor St SW</b>										
30	L	11	0.0	0.036	8.8	LOS A	1	0.11	0.62	48.3
31	T	11	0.0	0.036	7.5	LOS A	1	0.11	0.58	49.7
32	R	11	0.0	0.036	9.0	LOS A	1	0.11	0.68	48.0
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.036</b>	<b>8.5</b>	<b>LOS A</b>	<b>1</b>	<b>0.11</b>	<b>0.62</b>	<b>48.6</b>
<b>All Vehicles</b>		<b>168</b>	<b>0.0</b>	<b>0.045</b>	<b>5.9</b>	<b>Not Applicable</b>	<b>3</b>	<b>0.17</b>	<b>0.41</b>	<b>51.0</b>

## Intersection 7 – roundabout

AM peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>minor St south</b>										
1	L	305	0.0	0.495	15.8	LOS B	36	0.90	1.02	41.8
2	T	5	0.0	0.500	15.0	LOS B	36	0.90	1.01	42.5
3	R	5	0.0	0.500	20.0	LOS B	36	0.90	0.94	39.2
<b>Approach</b>		<b>315</b>	<b>0.0</b>	<b>0.495</b>	<b>15.8</b>	<b>LOS B</b>	<b>36</b>	<b>0.90</b>	<b>1.02</b>	<b>41.8</b>
<b>Main Blvd east</b>										
4	L	5	0.0	0.556	7.9	LOS A	38	0.46	0.59	48.0
5	T	705	0.0	0.546	7.1	LOS A	38	0.46	0.55	48.6
6	R	5	0.0	0.556	12.1	LOS A	38	0.46	0.66	44.7
<b>Approach</b>		<b>715</b>	<b>0.0</b>	<b>0.546</b>	<b>7.1</b>	<b>LOS A</b>	<b>38</b>	<b>0.46</b>	<b>0.55</b>	<b>48.6</b>
<b>minor St north</b>										
7	L	5	0.0	0.094	6.8	LOS A	4	0.09	0.55	50.1
8	T	5	0.0	0.094	6.0	LOS A	4	0.09	0.49	51.0
9	R	131	0.0	0.094	11.1	LOS A	4	0.09	0.68	46.1
<b>Approach</b>		<b>141</b>	<b>0.0</b>	<b>0.094</b>	<b>10.7</b>	<b>LOS A</b>	<b>4</b>	<b>0.09</b>	<b>0.67</b>	<b>46.4</b>
<b>Main Blvd west</b>										
10	L	5	0.0	0.011	6.8	LOS A	1	0.09	0.54	50.0
11	T	5	0.0	0.011	6.0	LOS A	1	0.09	0.48	51.0
12	R	5	0.0	0.011	11.1	LOS A	1	0.09	0.68	46.1
<b>Approach</b>		<b>15</b>	<b>0.0</b>	<b>0.011</b>	<b>8.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.09</b>	<b>0.57</b>	<b>48.9</b>
<b>All Vehicles</b>		<b>1186</b>	<b>0.0</b>	<b>0.556</b>	<b>9.9</b>	<b>LOS A</b>	<b>38</b>	<b>0.53</b>	<b>0.69</b>	<b>46.3</b>

## PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>minor St south</b>										
1	L	11	0.0	0.025	6.9	LOS A	1	0.13	0.54	49.8
2	T	11	0.0	0.025	6.1	LOS A	1	0.13	0.48	50.7
3	R	11	0.0	0.025	11.1	LOS A	1	0.13	0.66	46.0
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.025</b>	<b>8.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.13</b>	<b>0.56</b>	<b>48.7</b>
<b>Main Blvd east</b>										
4	L	11	0.0	0.032	8.2	LOS A	1	0.45	0.59	48.1
5	T	11	0.0	0.032	7.4	LOS A	1	0.45	0.55	48.7
6	R	11	0.0	0.032	12.5	LOS A	1	0.45	0.65	44.8
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.032</b>	<b>9.4</b>	<b>LOS A</b>	<b>1</b>	<b>0.45</b>	<b>0.60</b>	<b>47.1</b>
<b>minor St north</b>										
7	L	11	0.0	0.057	13.9	LOS A	3	0.80	0.76	43.4
8	T	11	0.0	0.057	13.1	LOS A	3	0.80	0.75	44.2
9	R	11	0.0	0.057	18.1	LOS B	3	0.80	0.72	40.6
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.057</b>	<b>15.0</b>	<b>LOS B</b>	<b>3</b>	<b>0.80</b>	<b>0.75</b>	<b>42.6</b>
<b>Main Blvd west</b>										
10	L	83	0.0	0.659	7.0	LOS A	60	0.25	0.52	49.2
11	T	657	0.0	0.656	6.2	LOS A	60	0.25	0.47	49.9
12	R	303	0.0	0.656	11.3	LOS A	60	0.25	0.63	45.5
<b>Approach</b>		<b>1043</b>	<b>0.0</b>	<b>0.656</b>	<b>7.8</b>	<b>LOS A</b>	<b>60</b>	<b>0.25</b>	<b>0.52</b>	<b>48.5</b>
<b>All Vehicles</b>		<b>1142</b>	<b>0.0</b>	<b>0.659</b>	<b>8.0</b>	<b>LOS A</b>	<b>60</b>	<b>0.27</b>	<b>0.53</b>	<b>48.2</b>

## Intersection 8 – roundabout

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector Rd south</b>										
1	L	397	0.0	0.385	8.2	LOS A	22	0.47	0.62	47.9
2	T	38	0.0	0.384	7.3	LOS A	22	0.47	0.59	48.5
3	R	11	0.0	0.379	12.4	LOS A	22	0.47	0.69	44.7
<b>Approach</b>		<b>446</b>	<b>0.0</b>	<b>0.385</b>	<b>8.2</b>	<b>LOS A</b>	<b>22</b>	<b>0.47</b>	<b>0.62</b>	<b>47.9</b>
<b>minor St east</b>										
4	L	11	0.0	0.103	7.5	LOS A	5	0.29	0.56	48.9
5	T	102	0.0	0.103	6.6	LOS A	5	0.29	0.51	49.7
6	R	11	0.0	0.103	11.6	LOS A	5	0.29	0.66	45.4
<b>Approach</b>		<b>124</b>	<b>0.0</b>	<b>0.103</b>	<b>7.1</b>	<b>LOS A</b>	<b>5</b>	<b>0.29</b>	<b>0.53</b>	<b>49.2</b>
<b>Collector Rd north</b>										
7	L	11	0.0	0.091	6.9	LOS A	4	0.13	0.54	49.8
8	T	18	0.0	0.091	6.1	LOS A	4	0.13	0.49	50.7
9	R	99	0.0	0.091	11.1	LOS A	4	0.13	0.67	46.0
<b>Approach</b>		<b>128</b>	<b>0.0</b>	<b>0.091</b>	<b>10.1</b>	<b>LOS A</b>	<b>4</b>	<b>0.13</b>	<b>0.63</b>	<b>46.9</b>
<b>Main Blvd</b>										
10	L	11	0.0	0.026	7.1	LOS A	1	0.19	0.53	49.4
11	T	11	0.0	0.026	6.2	LOS A	1	0.19	0.48	50.3
12	R	11	0.0	0.026	11.3	LOS A	1	0.19	0.65	45.7
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.026</b>	<b>8.2</b>	<b>LOS A</b>	<b>1</b>	<b>0.19</b>	<b>0.56</b>	<b>48.4</b>
<b>All Vehicles</b>		<b>731</b>	<b>0.0</b>	<b>0.385</b>	<b>8.4</b>	<b>LOS A</b>	<b>22</b>	<b>0.37</b>	<b>0.61</b>	<b>47.9</b>

## PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector Rd south</b>										
1	L	32	0.0	0.042	7.0	LOS A	2	0.15	0.54	49.6
2	T	11	0.0	0.042	6.1	LOS A	2	0.15	0.48	50.5
3	R	11	0.0	0.042	11.2	LOS A	2	0.15	0.66	45.9
<b>Approach</b>		<b>54</b>	<b>0.0</b>	<b>0.042</b>	<b>7.7</b>	<b>LOS A</b>	<b>2</b>	<b>0.15</b>	<b>0.55</b>	<b>49.0</b>
<b>minor St east</b>										
4	L	11	0.0	0.034	8.7	LOS A	2	0.49	0.61	47.8
5	T	11	0.0	0.034	7.9	LOS A	2	0.49	0.58	48.5
6	R	11	0.0	0.034	12.9	LOS A	2	0.49	0.67	44.6
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.034</b>	<b>9.8</b>	<b>LOS A</b>	<b>2</b>	<b>0.49</b>	<b>0.62</b>	<b>46.9</b>
<b>Collector Rd north</b>										
7	L	26	0.0	0.145	9.2	LOS A	7	0.55	0.68	47.5
8	T	89	0.0	0.145	8.4	LOS A	7	0.55	0.65	48.1
9	R	21	0.0	0.145	13.4	LOS A	7	0.55	0.72	44.3
<b>Approach</b>		<b>136</b>	<b>0.0</b>	<b>0.145</b>	<b>9.3</b>	<b>LOS A</b>	<b>7</b>	<b>0.55</b>	<b>0.67</b>	<b>47.3</b>
<b>Main Blvd</b>										
10	L	162	0.0	0.385	7.0	LOS A	23	0.17	0.54	49.6
11	T	139	0.0	0.385	6.1	LOS A	23	0.17	0.48	50.5
12	R	289	0.0	0.385	11.2	LOS A	23	0.17	0.66	45.8
<b>Approach</b>		<b>590</b>	<b>0.0</b>	<b>0.385</b>	<b>8.8</b>	<b>LOS A</b>	<b>23</b>	<b>0.17</b>	<b>0.58</b>	<b>47.8</b>
<b>All Vehicles</b>		<b>813</b>	<b>0.0</b>	<b>0.385</b>	<b>8.9</b>	<b>LOS A</b>	<b>23</b>	<b>0.24</b>	<b>0.60</b>	<b>47.8</b>

## Intersection 9 – give way

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector S</b>										
1	L	11	0.0	0.023	8.3	LOS A	1	0.10	0.60	48.5
2	T	19	0.0	0.023	0.1	LOS A	1	0.10	0.00	58.7
3	R	11	0.0	0.023	8.5	LOS A	1	0.10	0.65	48.2
<b>Approach</b>		<b>41</b>	<b>0.0</b>	<b>0.023</b>	<b>4.5</b>	<b>LOS A</b>	<b>1</b>	<b>0.10</b>	<b>0.34</b>	<b>52.7</b>
<b>Minor St E</b>										
4	L	11	0.0	0.035	8.6	LOS A	1	0.11	0.62	48.5
5	T	11	0.0	0.035	7.4	LOS A	1	0.11	0.57	49.8
6	R	11	0.0	0.035	8.9	LOS A	1	0.11	0.67	48.2
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.035</b>	<b>8.3</b>	<b>LOS A</b>	<b>1</b>	<b>0.11</b>	<b>0.62</b>	<b>48.8</b>
<b>Collector N</b>										
7	L	11	0.0	0.019	8.3	LOS A	1	0.12	0.59	48.4
8	T	11	0.0	0.019	0.1	LOS A	1	0.12	0.00	58.4
9	R	11	0.0	0.019	8.5	LOS A	1	0.12	0.65	48.1
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.019</b>	<b>5.6</b>	<b>LOS A</b>	<b>1</b>	<b>0.12</b>	<b>0.41</b>	<b>51.3</b>
<b>Minor St W</b>										
10	L	11	0.0	0.035	8.6	LOS A	1	0.13	0.61	48.4
11	T	11	0.0	0.035	7.4	LOS A	1	0.13	0.56	49.6
12	R	11	0.0	0.035	8.9	LOS A	1	0.13	0.66	48.1
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.035</b>	<b>8.3</b>	<b>LOS A</b>	<b>1</b>	<b>0.13</b>	<b>0.61</b>	<b>48.7</b>
<b>All Vehicles</b>		<b>140</b>	<b>0.0</b>	<b>0.035</b>	<b>6.6</b>	<b>Not Applicable</b>	<b>1</b>	<b>0.11</b>	<b>0.49</b>	<b>50.4</b>

## PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector S</b>										
1	L	11	0.0	0.020	8.3	LOS A	1	0.16	0.56	48.3
2	T	11	0.0	0.020	0.2	LOS A	1	0.16	0.00	57.9
3	R	11	0.0	0.020	8.6	LOS A	1	0.16	0.64	48.0
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.020</b>	<b>5.7</b>	<b>LOS A</b>	<b>1</b>	<b>0.16</b>	<b>0.40</b>	<b>51.0</b>
<b>Minor St E</b>										
4	L	11	0.0	0.036	8.7	LOS A	1	0.17	0.60	48.2
5	T	11	0.0	0.036	7.5	LOS A	1	0.17	0.56	49.4
6	R	11	0.0	0.036	9.0	LOS A	1	0.17	0.66	47.9
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.036</b>	<b>8.4</b>	<b>LOS A</b>	<b>1</b>	<b>0.17</b>	<b>0.61</b>	<b>48.5</b>
<b>Collector N</b>										
7	L	18	0.0	0.036	8.3	LOS A	2	0.10	0.60	48.5
8	T	31	0.0	0.036	0.1	LOS A	2	0.10	0.00	58.6
9	R	15	0.0	0.036	8.5	LOS A	2	0.10	0.65	48.2
<b>Approach</b>		<b>64</b>	<b>0.0</b>	<b>0.036</b>	<b>4.4</b>	<b>LOS A</b>	<b>2</b>	<b>0.10</b>	<b>0.32</b>	<b>52.9</b>
<b>Minor St W</b>										
10	L	11	0.0	0.035	8.7	LOS A	1	0.11	0.62	48.4
11	T	11	0.0	0.035	7.5	LOS A	1	0.11	0.57	49.7
12	R	11	0.0	0.035	9.0	LOS A	1	0.11	0.67	48.0
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.035</b>	<b>8.4</b>	<b>LOS A</b>	<b>1</b>	<b>0.11</b>	<b>0.62</b>	<b>48.7</b>
<b>All Vehicles</b>		<b>163</b>	<b>0.0</b>	<b>0.036</b>	<b>6.3</b>	<b>Not Applicable</b>	<b>2</b>	<b>0.13</b>	<b>0.46</b>	<b>50.7</b>

## Intersection 10 – give way

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor E</b>										
5	T	16	0.0	0.021	6.2	LOS A	1	0.19	0.47	50.3
6	R	11	0.0	0.021	11.3	LOS A	1	0.19	0.64	45.7
<b>Approach</b>		<b>27</b>	<b>0.0</b>	<b>0.021</b>	<b>8.3</b>	<b>LOS A</b>	<b>1</b>	<b>0.19</b>	<b>0.54</b>	<b>48.3</b>
<b>Collector N</b>										
7	L	11	0.0	0.045	6.7	LOS A	2	0.07	0.54	50.2
9	R	55	0.0	0.045	11.1	LOS A	2	0.07	0.68	46.2
<b>Approach</b>		<b>66</b>	<b>0.0</b>	<b>0.045</b>	<b>10.4</b>	<b>LOS A</b>	<b>2</b>	<b>0.07</b>	<b>0.66</b>	<b>46.8</b>
<b>collector W</b>										
10	L	9	0.0	0.014	6.6	LOS A	1	0.07	0.53	50.4
11	T	11	0.0	0.014	6.0	LOS A	1	0.07	0.49	51.1
<b>Approach</b>		<b>20</b>	<b>0.0</b>	<b>0.014</b>	<b>6.3</b>	<b>LOS A</b>	<b>1</b>	<b>0.07</b>	<b>0.51</b>	<b>50.8</b>
<b>All Vehicles</b>		<b>113</b>	<b>0.0</b>	<b>0.045</b>	<b>9.1</b>	<b>LOS A</b>	<b>2</b>	<b>0.10</b>	<b>0.61</b>	<b>47.8</b>

### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor E</b>										
5	T	11	0.0	0.017	6.0	LOS A	1	0.09	0.48	51.0
6	R	12	0.0	0.017	11.1	LOS A	1	0.09	0.67	46.1
<b>Approach</b>		<b>23</b>	<b>0.0</b>	<b>0.017</b>	<b>8.7</b>	<b>LOS A</b>	<b>1</b>	<b>0.09</b>	<b>0.58</b>	<b>48.3</b>
<b>Collector N</b>										
7	L	4	0.0	0.015	6.7	LOS A	1	0.05	0.55	50.3
9	R	17	0.0	0.015	11.1	LOS A	1	0.05	0.69	46.3
<b>Approach</b>		<b>21</b>	<b>0.0</b>	<b>0.015</b>	<b>10.2</b>	<b>LOS A</b>	<b>1</b>	<b>0.05</b>	<b>0.67</b>	<b>47.0</b>
<b>collector W</b>										
10	L	34	0.0	0.027	6.6	LOS A	1	0.08	0.53	50.3
11	T	6	0.0	0.027	6.0	LOS A	1	0.08	0.49	51.1
<b>Approach</b>		<b>40</b>	<b>0.0</b>	<b>0.027</b>	<b>6.5</b>	<b>LOS A</b>	<b>1</b>	<b>0.08</b>	<b>0.53</b>	<b>50.5</b>
<b>All Vehicles</b>		<b>84</b>	<b>0.0</b>	<b>0.027</b>	<b>8.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.07</b>	<b>0.58</b>	<b>48.9</b>

## Intersection 11 – give way

## AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor S</b>										
1	L	38	0.0	0.048	8.6	LOS A	2	0.18	0.62	48.1
3	R	11	0.0	0.048	8.9	LOS A	2	0.18	0.66	47.9
<b>Approach</b>		<b>49</b>	<b>0.0</b>	<b>0.048</b>	<b>8.7</b>	<b>LOS A</b>	<b>2</b>	<b>0.18</b>	<b>0.63</b>	<b>48.1</b>
<b>Collector E</b>										
4	L	11	0.0	0.040	8.2	LOS A	0	0.00	0.67	49.0
5	T	66	0.0	0.040	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>77</b>	<b>0.0</b>	<b>0.040</b>	<b>1.2</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.10</b>	<b>58.1</b>
<b>Collector W</b>										
11	T	11	0.0	0.014	0.3	LOS A	1	0.17	0.00	57.7
12	R	11	0.0	0.014	8.7	LOS A	1	0.17	0.64	47.9
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.014</b>	<b>4.5</b>	<b>LOS A</b>	<b>1</b>	<b>0.17</b>	<b>0.32</b>	<b>52.4</b>
<b>All Vehicles</b>		<b>148</b>	<b>0.0</b>	<b>0.048</b>	<b>4.1</b>	<b>Not Applicable</b>	<b>2</b>	<b>0.09</b>	<b>0.30</b>	<b>53.6</b>

## PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor S</b>										
1	L	11	0.0	0.024	8.7	LOS A	1	0.08	0.63	48.4
3	R	11	0.0	0.024	9.0	LOS A	1	0.08	0.68	48.1
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.024</b>	<b>8.8</b>	<b>LOS A</b>	<b>1</b>	<b>0.08</b>	<b>0.66</b>	<b>48.2</b>
<b>Collector E</b>										
4	L	11	0.0	0.012	8.2	LOS A	0	0.00	0.67	49.0
5	T	11	0.0	0.012	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.012</b>	<b>4.1</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.33</b>	<b>53.9</b>
<b>Collector W</b>										
11	T	54	0.0	0.055	0.1	LOS A	2	0.09	0.00	58.8
12	R	38	0.0	0.055	8.5	LOS A	2	0.09	0.66	48.3
<b>Approach</b>		<b>92</b>	<b>0.0</b>	<b>0.055</b>	<b>3.6</b>	<b>LOS A</b>	<b>2</b>	<b>0.09</b>	<b>0.27</b>	<b>54.0</b>
<b>All Vehicles</b>		<b>136</b>	<b>0.0</b>	<b>0.055</b>	<b>4.5</b>	<b>Not Applicable</b>	<b>2</b>	<b>0.07</b>	<b>0.34</b>	<b>52.9</b>

## Intersection 12 – give way

## AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor S</b>										
1	L	75	0.0	0.085	8.8	LOS A	3	0.24	0.63	47.9
3	R	11	0.0	0.085	9.1	LOS A	3	0.24	0.68	47.7
<b>Approach</b>		<b>86</b>	<b>0.0</b>	<b>0.085</b>	<b>8.9</b>	<b>LOS A</b>	<b>3</b>	<b>0.24</b>	<b>0.63</b>	<b>47.9</b>
<b>Collector E</b>										
4	L	56	0.0	0.075	8.2	LOS A	0	0.00	0.67	49.0
5	T	87	0.0	0.075	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>143</b>	<b>0.0</b>	<b>0.075</b>	<b>3.2</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.26</b>	<b>55.1</b>
<b>Collector W</b>										
11	T	11	0.0	0.014	0.5	LOS A	1	0.25	0.00	56.7
12	R	11	0.0	0.014	9.0	LOS A	1	0.25	0.63	47.7
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.014</b>	<b>4.7</b>	<b>LOS A</b>	<b>1</b>	<b>0.25</b>	<b>0.32</b>	<b>51.8</b>
<b>All Vehicles</b>		<b>251</b>	<b>0.0</b>	<b>0.085</b>	<b>5.3</b>	<b>Not Applicable</b>	<b>3</b>	<b>0.10</b>	<b>0.39</b>	<b>52.1</b>

## PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor S</b>										
1	L	11	0.0	0.025	9.1	LOS A	1	0.06	0.64	48.0
3	R	11	0.0	0.025	9.3	LOS A	1	0.06	0.69	47.7
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.025</b>	<b>9.2</b>	<b>LOS A</b>	<b>1</b>	<b>0.06</b>	<b>0.67</b>	<b>47.8</b>
<b>Collector E</b>										
4	L	2	0.0	0.007	8.2	LOS A	0	0.00	0.67	49.0
5	T	11	0.0	0.007	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>13</b>	<b>0.0</b>	<b>0.007</b>	<b>1.3</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.10</b>	<b>58.0</b>
<b>Collector W</b>										
11	T	124	0.0	0.097	0.0	LOS A	5	0.07	0.00	59.1
12	R	48	0.0	0.097	8.5	LOS A	5	0.07	0.67	48.3
<b>Approach</b>		<b>172</b>	<b>0.0</b>	<b>0.097</b>	<b>2.4</b>	<b>LOS A</b>	<b>5</b>	<b>0.07</b>	<b>0.19</b>	<b>55.6</b>
<b>All Vehicles</b>		<b>207</b>	<b>0.0</b>	<b>0.097</b>	<b>3.1</b>	<b>Not Applicable</b>	<b>5</b>	<b>0.06</b>	<b>0.23</b>	<b>54.8</b>

## Intersection 16 – roundabout

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor St</b>										
1	L	73	0.0	0.091	8.3	LOS A	4	0.46	0.62	48.0
2	T	11	0.0	0.092	7.5	LOS A	4	0.46	0.58	48.6
3	R	11	0.0	0.092	12.6	LOS A	4	0.46	0.68	44.7
<b>Approach</b>		<b>95</b>	<b>0.0</b>	<b>0.091</b>	<b>8.7</b>	<b>LOS A</b>	<b>4</b>	<b>0.46</b>	<b>0.62</b>	<b>47.7</b>
<b>Collector SE</b>										
4	L	11	0.0	0.186	7.3	LOS A	9	0.29	0.56	49.0
5	T	216	0.0	0.187	6.5	LOS A	9	0.29	0.51	49.7
6	R	11	0.0	0.186	11.6	LOS A	9	0.29	0.66	45.4
<b>Approach</b>		<b>238</b>	<b>0.0</b>	<b>0.187</b>	<b>6.8</b>	<b>LOS A</b>	<b>9</b>	<b>0.29</b>	<b>0.52</b>	<b>49.4</b>
<b>Minor St (community link)</b>										
7	L	11	0.0	0.082	6.9	LOS A	4	0.13	0.54	49.8
8	T	11	0.0	0.082	6.1	LOS A	4	0.13	0.49	50.7
9	R	94	0.0	0.082	11.1	LOS A	4	0.13	0.67	46.0
<b>Approach</b>		<b>116</b>	<b>0.0</b>	<b>0.082</b>	<b>10.3</b>	<b>LOS A</b>	<b>4</b>	<b>0.13</b>	<b>0.64</b>	<b>46.7</b>
<b>Collector NW</b>										
10	L	11	0.0	0.025	6.9	LOS A	1	0.13	0.54	49.8
11	T	11	0.0	0.025	6.1	LOS A	1	0.13	0.48	50.7
12	R	11	0.0	0.025	11.1	LOS A	1	0.13	0.66	46.0
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.025</b>	<b>8.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.13</b>	<b>0.56</b>	<b>48.7</b>
<b>All Vehicles</b>		<b>482</b>	<b>0.0</b>	<b>0.187</b>	<b>8.1</b>	<b>LOS A</b>	<b>9</b>	<b>0.27</b>	<b>0.57</b>	<b>48.3</b>

PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Minor St</b>										
1	L	11	0.0	0.025	6.9	LOS A	1	0.12	0.54	49.9
2	T	11	0.0	0.025	6.1	LOS A	1	0.12	0.48	50.8
3	R	11	0.0	0.025	11.1	LOS A	1	0.12	0.67	46.0
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.025</b>	<b>8.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.12</b>	<b>0.56</b>	<b>48.7</b>
<b>Collector SE</b>										
4	L	11	0.0	0.026	7.1	LOS A	1	0.21	0.53	49.4
5	T	11	0.0	0.026	6.3	LOS A	1	0.21	0.49	50.2
6	R	11	0.0	0.026	11.4	LOS A	1	0.21	0.65	45.6
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.026</b>	<b>8.3</b>	<b>LOS A</b>	<b>1</b>	<b>0.21</b>	<b>0.56</b>	<b>48.3</b>
<b>Minor St (community link)</b>										
7	L	11	0.0	0.031	8.0	LOS A	1	0.40	0.57	48.3
8	T	11	0.0	0.031	7.2	LOS A	1	0.40	0.54	49.0
9	R	11	0.0	0.031	12.3	LOS A	1	0.40	0.65	44.9
<b>Approach</b>		<b>33</b>	<b>0.0</b>	<b>0.031</b>	<b>9.2</b>	<b>LOS A</b>	<b>1</b>	<b>0.40</b>	<b>0.59</b>	<b>47.3</b>
<b>Collector NW</b>										
10	L	27	0.0	0.196	6.9	LOS A	9	0.13	0.54	49.8
11	T	203	0.0	0.196	6.1	LOS A	9	0.13	0.49	50.7
12	R	62	0.0	0.196	11.2	LOS A	9	0.13	0.67	45.9
<b>Approach</b>		<b>292</b>	<b>0.0</b>	<b>0.196</b>	<b>7.2</b>	<b>LOS A</b>	<b>9</b>	<b>0.13</b>	<b>0.53</b>	<b>49.5</b>
<b>All Vehicles</b>		<b>391</b>	<b>0.0</b>	<b>0.196</b>	<b>7.6</b>	<b>LOS A</b>	<b>9</b>	<b>0.16</b>	<b>0.54</b>	<b>49.1</b>

## Intersection 17 – give way

### AM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector S</b>										
2	T	319	0.0	0.171	0.1	LOS A	9	0.10	0.00	58.6
3	R	11	0.0	0.172	8.5	LOS A	9	0.10	0.66	48.2
<b>Approach</b>		<b>330</b>	<b>0.0</b>	<b>0.171</b>	<b>0.4</b>	<b>LOS A</b>	<b>9</b>	<b>0.10</b>	<b>0.02</b>	<b>58.2</b>
<b>Minor E</b>										
4	L	11	0.0	0.076	11.2	LOS A	3	0.14	0.61	45.8
6	R	35	0.0	0.076	11.5	LOS A	3	0.14	0.72	45.5
<b>Approach</b>		<b>46</b>	<b>0.0</b>	<b>0.076</b>	<b>11.4</b>	<b>LOS A</b>	<b>3</b>	<b>0.14</b>	<b>0.69</b>	<b>45.6</b>
<b>Collector N</b>										
7	L	11	0.0	0.012	8.2	LOS A	0	0.00	0.67	49.0
8	T	11	0.0	0.012	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.012</b>	<b>4.1</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.33</b>	<b>53.9</b>
<b>All Vehicles</b>		<b>398</b>	<b>0.0</b>	<b>0.172</b>	<b>1.9</b>	<b>Not Applicable</b>	<b>9</b>	<b>0.10</b>	<b>0.12</b>	<b>56.1</b>

### PM Peak

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
<b>Collector S</b>										
2	T	11	0.0	0.015	0.7	LOS A	1	0.30	0.00	56.1
3	R	11	0.0	0.015	9.2	LOS A	1	0.30	0.64	47.5
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.015</b>	<b>5.0</b>	<b>LOS A</b>	<b>1</b>	<b>0.30</b>	<b>0.32</b>	<b>51.4</b>
<b>Minor E</b>										
4	L	11	0.0	0.027	9.4	LOS A	1	0.31	0.62	47.6
6	R	11	0.0	0.027	9.7	LOS A	1	0.31	0.67	47.3
<b>Approach</b>		<b>22</b>	<b>0.0</b>	<b>0.027</b>	<b>9.6</b>	<b>LOS A</b>	<b>1</b>	<b>0.31</b>	<b>0.65</b>	<b>47.4</b>
<b>Collector N</b>										
7	L	64	0.0	0.103	8.2	LOS A	0	0.00	0.67	49.0
8	T	134	0.0	0.103	0.0	LOS A	0	0.00	0.00	60.0
<b>Approach</b>		<b>198</b>	<b>0.0</b>	<b>0.103</b>	<b>2.6</b>	<b>LOS A</b>		<b>0.00</b>	<b>0.22</b>	<b>55.9</b>
<b>All Vehicles</b>		<b>242</b>	<b>0.0</b>	<b>0.103</b>	<b>3.5</b>	<b>Not Applicable</b>	<b>1</b>	<b>0.06</b>	<b>0.26</b>	<b>54.6</b>



## Appendix C

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Bushfire Report – Australian  
Bushfire Protection Planners

**BUSHFIRE RISK ASSESSMENT REPORT**

**FOR THE**

**CRACE STAGE 3  
ESTATE DEVELOPMENT PLAN**

**AUSTRALIAN CAPITAL TERRITORY**

**PREPARED FOR**

**CIC AUSTRALIA LIMITED.**



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# **BUSHFIRE RISK ASSESSMENT REPORT**

**FOR THE**

**CRACE STAGE 3  
ESTATE DEVELOPMENT PLAN**

**AUSTRALIAN CAPITAL TERRITORY**

**PREPARED FOR**

**CIC AUSTRALIA LIMITED.**

<b>Assessment Number</b>	<b>Document</b>	<b>Preparation Date</b>	<b>Issue Date</b>	<b>Directors Approval</b>
B101385 - 1	Final	29.11.2010	1.12.2010	<i>G.L.Swain</i>

## EXECUTIVE SUMMARY

The ACT Planning & Land Authority (ACTPLA) approved a Concept Plan for the whole of the new suburb known as Crace, which incorporated bushfire risk mitigation measures recommended in a “Bushfire Protection Measures” report undertaken by Conacher Travers Pty Ltd.

The ACT Government sold the holding lease for the Crace Urban Release Area to Crace Developments Pty Ltd/The Land Development Agency Joint Venture.

Canberra Investment Corporation Pty Ltd [CIC], acting as Project Manager to the Joint Venture, prepared the Estate Development Plan for the new suburb and commissioned *Australian Bushfire Protection Planners Pty Limited* to undertake a bushfire risk assessment review of the Conacher Travers Report to confirm that the earlier identified risk mitigation measures were still appropriate or if any extra measures were needed to be implemented in the design of the Crace Estate Development Plan.

The approved Estate Development Plan includes an area of land on the western edge of the Estate which was identified for Community Recreation. The extent of this land use has now been re-examined with the decision taken to reduce the area of land required for Community Recreation with the remaining land developed as residential lots.

This amendment to the original Estate Development Plan has brought about the need to undertake a Bushfire Risk Assessment for what is known as Crace Stage 3 with the modified layout including Community Recreation Irrigated Park; Water Quality Pond/Wetland; Local Playground; Toilets; Multiuse Courts/Plaza; Picnic Area; Cricket Practice Nets; Exercise Stations and a twenty two lot residential precinct which occupies the south-western corner of the Stage 3 precinct, extending to the north from the completed Stage 1 portion of the Estate.

The residential estate of Crace is located approximately 11 kilometres to the north of Canberra, and covers a total area of 146.3 hectares in the north of the Australian Capital Territory, northeast of the existing suburb of Giralang and to the south and southwest of the suburb of Palmerston. The Gungaharra Grasslands Nature Reserve [Canberra Nature Park] bounds the Estate to the east and southeast.

The Barton Highway forms the south-western boundary of the estate with Palmerville Heritage Park and CSIRO lands extending to the northwest in a corridor between the suburbs of Fraser, Spence, Evatt and Giralang to the southwest of the Barton Highway.

Under extreme weather conditions, this land could support a bushfire/grass fire which would burn into the Canberra Nature Park and into the Pine Forest located between the suburb of Giralang and the Barton Highway, to the southwest of the new suburb of Crace.

Nudurr Drive forms the boundary between Crace and the residential development within the suburb of Palmerston to the northeast. The main entry points to the new suburb are from Gundaroo Drive and from two new intersections on Nudurr Drive.

The Special Project Conditions for the Crace Estate, under section A2.2.7 “Fuel Management Zone” states:

*“A Bushfire Risk Assessment is to be undertaken at the preparation of the Estate Development Plan and the outcomes incorporated into the design to the satisfaction of the ACT Planning & Land Authority, the Fire Management Unit of TAMS and the Emergency Services Agency.*

*All Inner Asset Protection Zones [IAPZ] are to be provided inside the Holding Lease Boundary”.*

This report undertakes an assessment of the potential bushfire risks to the Crace Stage 3 development layout, in accordance with the provisions of Australian Standard for Risk Management, AS/NZS 4360:2004 and takes into account the bushfire protection measures required to satisfy the Strategic Bushfire Risk Management Plan for the ACT and the amended *Planning for Bushfire Risk Mitigation [2009]* and the advice provided by ESA.

In the preparation of the Stage 3 EDP layout advice has been sought from the Emergency Services Authority on the adequacy of the bushfire protection measures.



Graham Swain,  
Managing Director  
**Australian Bushfire Protection Planners Pty Limited.**

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## SECTION 1

### INTRODUCTION

#### 1.1 Aim of the Brief.

The aim of this brief is to prepare a bushfire risk assessment for the Crace Stage 3 Estate Development Plan in accordance with Australian Standard for Risk Management, AS/NZS 4360:2004 and the ACTPLA “*Planning for Bushfire Risk Mitigation*” guideline.

#### 1.2 Objective of the Brief.

The objective of the brief is to identify the bushfire constraints on the development of the Crace Stage 3 Estate Development Plan, including any building or landscaping requirements to meet relevant bushfire regulations and guidelines.

#### 1.3 The Project.

The Crace Estate Masterplan provides a residential estate together with a community facility, retail/café, Community Recreation Area and managed open space and parks.

The total area of the Crace Estate is 146.3 hectares with the Stage 3 precinct located in the western portion of the Estate, occupying the area identified in the Concept Plan for Community Recreation/Facilities.

The extent of these community facilities has been reduced to include a Playground; Multiuse Courts, Multiuse Plaza, Toilets, Picnic Area, Cricket Practice Nets, Exercise Stations, Water Quality Pond/Wetland and twenty two residential lots which occupy the south-western section of the Stage 3 precinct.

These lots adjoin existing allotments within the completed Stage 1 precinct with internal connecting roads and an edge road/access link to the perimeter of the additional lots.

Existing Stage 1 forms the adjoining landuse to the south, east and north whilst Gundaroo Drive and Canberra Nature Park Percival Hill extends to the west from Gundaroo Drive. The vegetation within the Nature Park to the northwest/north and within the Barton Highway corridor to the west provides a “wick” for fast moving fires that may ignite and burn towards the north-western edge of the Stage 3 precinct.

**Figure 1 – Aerial Photograph of the Crace Urban Release Area.**



The Crace Stage 3 layout provides a road network with a 6.0 – 7.0 metre wide edge road [with a layback kerb to the outer edge] with an approved access link between edge road 101 and the existing Digby Circuit within the completed Stage 1 precinct.

The edge road No. 101 & 102B connects to Rylstone Crescent and via internal road No. 102A to the existing road network within completed Stage 1 of the Estate.

Figure 2 – Estate Development Plan assessed in the Bushfire Risk Assessment dated 26.6.2008 [ABPP]



Figure 3 – Crace Stage 3 Estate Development Plan



Figure 4 – Crace Stage 3 Open Space Concept Plan



#### **1.4 Scope of Study.**

A Bushfire Risk Assessment is to be prepared, in accordance with Australian Standard for Risk Management (AS 4360:2004). The assessment is to be undertaken with reference to the following methodology:

**(a) Identify the fire scenarios including an assessment of:**

- The exposure to possible ignition/fire sources;
- Vegetation type and likely fuel loads and fire hazards arising using the “Overall Fuel Hazard Guide” – Third edition (NRE May 1999);
- The impact of climate and likely fire runs during severe fire danger periods;

**(b) Identify and describe the surrounding natural environment and the likelihood of each fire scenario identified (before mitigation):**

- The steepness, slope/terrain;
- Define each level of likelihood stating assumed frequency of event assigned to each level of likelihood

**(c) Identify and describe the proposed urban community and consequences of a bushfire (before mitigation):**

- Type of proposed development (density, residential, aged care etc) refer to the *Crace Stage 3 – Estate Development Plan*;
- Identify any “wicks” into the suburb through connected open space with regard to fuel load and likely future maintenance regimes.
- Assumed fire impacts / consequence if exposed to fire events; including during severe fire danger periods.
- Define each level of consequence stating level of impacts.

**(d) Analyse the inherent risk of each identified fire scenario.**

- The best available information and techniques should be used and expressed in the terms of likelihood with all assumptions identified.
- Develop risk statements with assigned risk levels reflecting assigned likelihood and consequence of each fire scenario.

**(e) Risk Mitigation Measures:**

- ***Provide risk mitigation options following consideration of:***

- ❖ The necessary bushfire protection measures in accordance with Australian Standard AS3959-2009 “*Construction of Buildings in Bushfire Prone Areas*” and any addenda or amendments; and
- ❖ The ACT *Planning for Bushfire Risk Mitigation*
- **Evaluate the mitigation measures with consideration of the following:**
  - Protection zone requirements (ember, inner and outer protection zone);
  - Building standards;
  - Access for Emergency Services Vehicles;
  - Engineering infrastructure including water supply, fire trails, edge roads;
- (f) **Evaluate the fire scenarios to establish the residual risk:**
  - Evaluate the residual risk level following mitigation including the vulnerability of the proposed development, and possible consequences of fire during severe fire danger periods;
  - Compare the residual risk level against best practice criteria;
  - Rank the fire scenarios in order of risk level.

## SECTION 2

### DESCRIPTION OF STUDY AREA

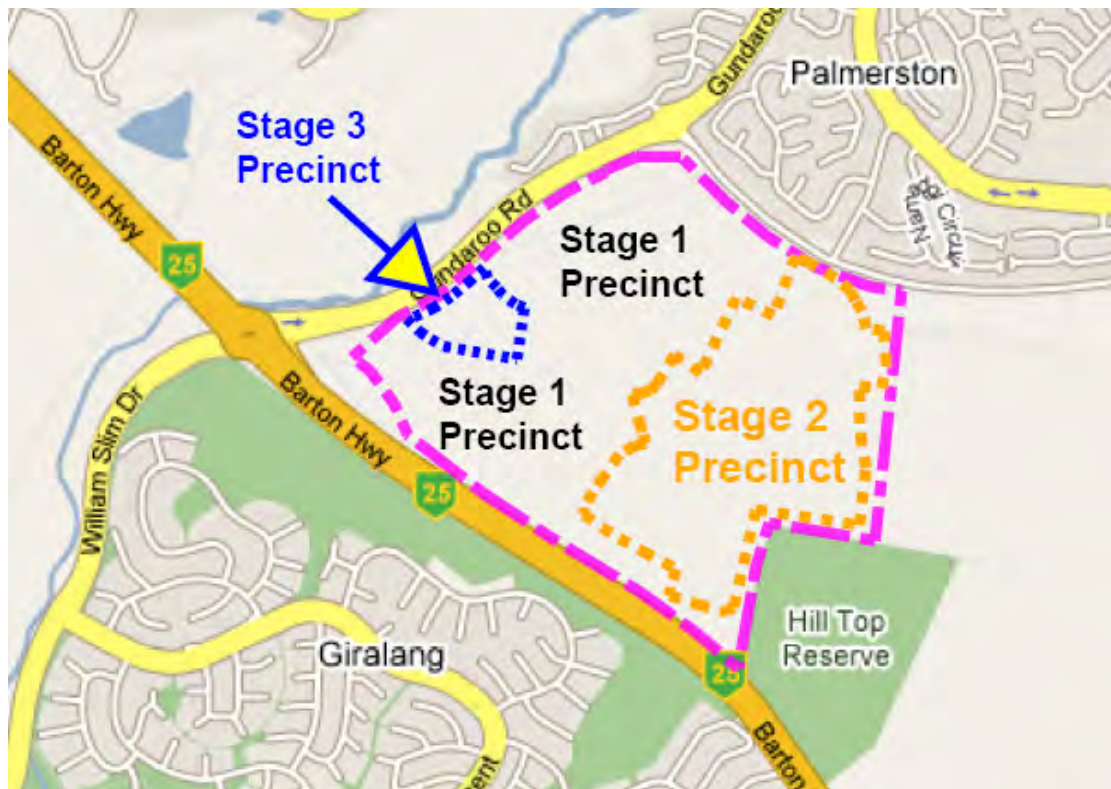
#### 2.1 Site Inspection.

Graham Swain inspected the development precinct on the 18<sup>th</sup> February 2010 to assess the topography, slopes and vegetation classification within and adjoining the development precinct. Adjoining land was also inspected to determine the surrounding landuse / land management, vegetation communities and topography.

#### 2.2 Location.

The Crace Stage 3 precinct is situated within the western portion of the new suburb of Crace, located to the southeast of Gundaroo Drive and adjoined to the southwest, east and northeast by completed Stage 1 of the Estate.

**Figure 5 - Location of the Crace Stage 3 development precinct.**



#### 2.3 Existing Land Use.

The Crace Stage 3 development precinct is currently vacant land.

#### 2.4 Surrounding Land Use.

##### a) Northeast, east & southwest

The land to the northeast, east and southwest of the Crace Stage 3 development precinct forms the completed Crace Stage 1 development precinct.

### **b) West & Northwest**

The land to the west and northwest of the Crace Stage 3 development precinct consists of land within the Gundaroo Drive carriageway beyond which is the Percival Hill Canberra Nature Reserve and the riparian corridor to Ginninderra Creek.

## **2.5 Study Area.**

For the purpose of this report, in order to determine the bushfire risk to the stage precinct, the boundaries of the Crace Stage 3 study area extend to the west and northwest to include the Barton Highway corridor and the Percival Hill Nature Reserve.

## **2.6 Topography.**

### **2.6.1 Within the Development Precinct.**

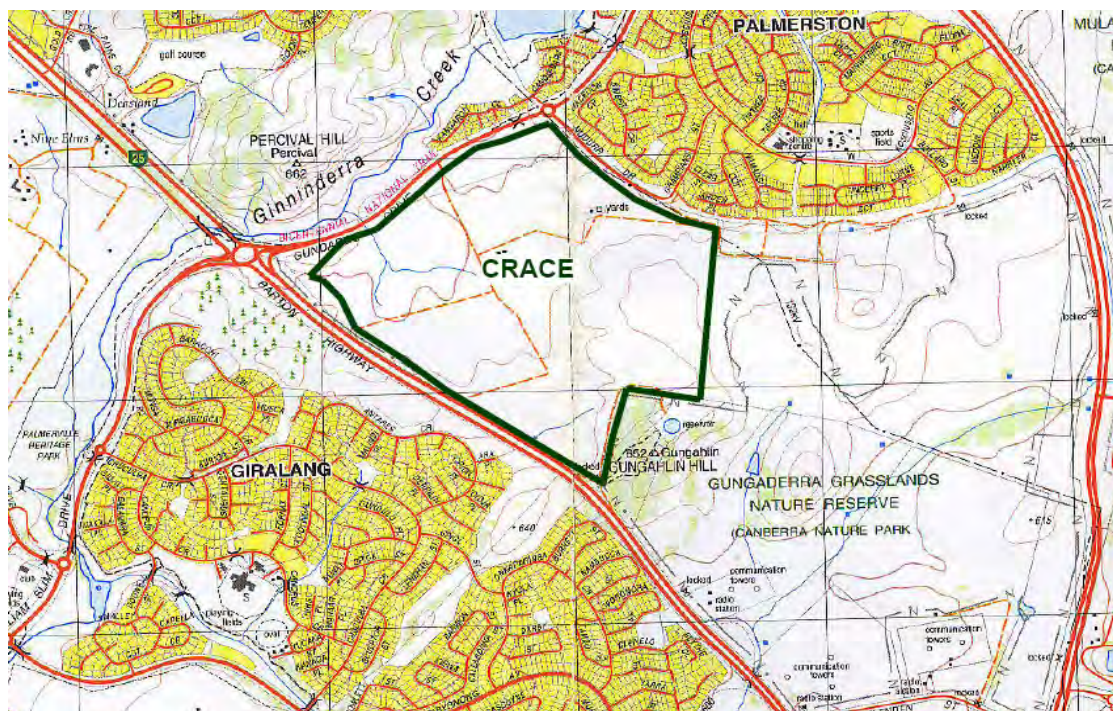
The Crace Stage 3 development precinct contains land which falls gently to the northwest towards Gundaroo Drive.

### **2.6.2 Beyond the Development Precinct.**

The land to the northeast, east and southwest of the Stage 3 development precinct rises to the northeast, east and southwest across the completed Stage 1 development precinct.

The land to the west and northwest, beyond the Gundaroo Drive carriageway, falls into Ginninderra Creek before rising to the west and northwest to Percival Hill.

**Figure 6 – Topographic Map.**



## 2.7 Vegetation within the Development Precinct.

The vegetation within the development precinct consists of grass.

## 2.8 Vegetation on Adjoining Lands.

### (a) Northeast, east and southwest of the Crace Stage 3 Development Precinct

The development of the Crace Stage 1 precinct has removed the vegetation from the land to the northeast, east and southwest of the Crace Stage 3 precinct. The future residential development on this land will create landscaped gardens.

### (b) West and northwest of the Crace Stage 3 Development Precinct.

The vegetation within the adjoining Ginninderra Drive carriageway consists of managed grassland whilst the vegetation within the Ginninderra Creek is unmanaged grassland which develops into grassy Woodland on the eastern face of Percival Hill.

**Figure 7 – Aerial Photograph of Crace Stage 3 development precinct and surrounding lands.**



## SECTION 3

### CONTEXT OF THE BUSHFIRE RISK ASSESSMENT

The Canberra Spatial Plan prepared by the ACT Planning and Land Authority (2004) provides for the future urban development of the Territory in a more sustainable manner. Core values that underpin the spatial planning of Canberra have emerged from consultation with the community and have been translated into a series of goals and objectives that the Spatial Plan is designed to achieve. One such goal is to “*maximise safety and perceptions of safety within the community.*”

Policy Actions stated in the Spatial Plan in response to this goal include:

- *A Bushfire Abatement Zone has been defined and principles for land planning, including land use restrictions and performance measures for fire hazard reduction will be implemented. These will be adopted by ACTPLA and the relevant land managers.*
- *The Bushfire Prone Area will be declared and site specific assessments will be required for proposed residential buildings in accordance with the Building Code of Australia.*
- *The investigations undertaken as a part of the detailed planning for new greenfields residential areas will continue to consider the potential fire, storm and flood hazards.*

The Crace Bushfire Risk Review Assessment prepared by *Australian Bushfire Protection Planners Pty Limited* [26.6.2008] identified that the potential level of risk to the south-western edge of the Estate, from fires that will occur in the woodland vegetation within the Ginninderra Creek/Percival Hill portion of the Canberra Nature Park to the northwest, the Pine Forest to the southwest and grasslands to the west of the Estate, during severe fire weather events similar to that experienced during the 2003, is high to extreme and will depend on the availability of cured fuels and prevailing weather conditions.

Fire behaviour will likely be affected by the turbulence created by the higher ridgeline to the northwest [Percival Hill] and the shape of the valley system to the west, within the CSIRO lands.

Therefore, the following Risk Assessment and resultant recommendations seek to address the protection of the proposed residential development within the Crace Stage 3 precinct from future unplanned fire events that may occur within the surrounding unmanaged grassland/woodland and forest vegetation.

## SECTION 4

# BUSHFIRE RISK

### 4.1 Introduction.

Risk has two elements: Likelihood, the chances of a bushfire occurring and consequence, the impact of a bushfire when it occurs. Risk reduction can be achieved by reducing the likelihood of a bushfire, the opportunity for a bushfire to spread or the consequence of a bushfire (on natural and built assets). Bushfire Management should have a clear objective to reduce both the likelihood of bushfires and reduce the negative impacts of bushfires. It should also consider the costs, inconvenience and dangers of measures taken to reduce the risk of bushfires.

The Australian Standard AS/NZS 4360:2004, the ACT Government Enterprise-wide risk management framework and the Emergency Management Australia (EMA) emergency risk management process provide the framework for establishing the context, analysis, evaluation, treatment, monitoring and communication of risk.

Bushfire risk is defined as the chance of a bushfire occurring that will have harmful consequences to human communities and the environment. Bushfire risk is usually assessed through consideration of the likelihood of ignition and consequences of a bushfire occurring. The consequences of bushfire management activities and the failure to implement programs also need to be considered. A range of factors influence bushfire risk – these include:

- The likelihood of human and natural fire ignitions, as influenced by time, space and demographics;
- The potential spread and severity of a bushfire, as determined by fuel, topography and weather conditions;
- The proximity of assets vulnerable to bushfire fuels, and likely bushfire paths; and,
- The vulnerability of assets including natural assets, or their capacity to cope with, and recover from bushfire.

### 4.2 Management Strategies.

Broad strategies to manage bushfire risk include:

- Eliminate the bushfire risk (make the land-use decision first by asking the question about whether development should or should not proceed in a given area);

- Design or substitution (review boundary locations and shape, change the types of land-use policy);
- Engineering controls (infrastructure, building standards and landscaping) and
- Administration and organisation; (community preparedness measures).

## SECTION 5

### BUSHFIRE RISK ASSESSMENT

#### 5.1 Introduction.

An assessment of bushfire risk must firstly define the problem. This involves the identification of the nature and scope of issues to be addressed and defining the possible boundaries for the assessment (*Emergency Risk Management – Applications Guide*. (EMA Echo Press, 2000), and AS/NZS 4360:2004).

For the purpose of analysing bushfire risks that might emerge in the ACT, a dangerous and damaging fire has the potential to occur when the following conditions prevail:

- Continuous available fuel – fuel at moisture content sufficiently low to enable rapid combustion, arising from drought effects or the maturing and drying, of grasslands.
- Exposure of vulnerable assets. The ‘catchment’ for such fires may be within several hundred metres or many (60-70) kilometres from the asset/s.
- A combination of weather conditions that generate a forest or grass fire danger index of Very High (24) or greater. Typically in the ACT, prevailing adverse fire weather will have a strong northerly, through south westerly wind influence.
- Fire in the landscape not effectively suppressed.

In the case of the Crace Stage 3 development precinct, the problem is the potential exposure of the future residential development to fires that will occur in the vegetation in and adjacent to the Barton Highway, to the southwest; fires that occur in the grassland vegetation in the Ginninderra Creek corridor and the woodland vegetation in the Percival Hill Nature Reserve to the west and northwest of Gundaroo Drive.

The second part of the risk assessment process identifies the potential risk on the development within the Crace Stage 3 precinct by examining:

- Fire History;
- Exposure to possible ignition / fire sources;
- Vegetation type and likely fuel loads and fire hazards arising using the “Overall Fuel Hazard Guide” – Third edition (NRE May 1999);
- The impact of climate and likely fire runs during severe fire danger periods;
- Wind effects;
- The impact of surrounding land uses and fuel loads.

The following sections of this report undertake an assessment of these elements to establish the bushfire risk to the proposed development.

## **5.2 Fire History.**

Natural fires have long been part of the ACT landscape. A combination of inherently inflammable vegetation, dry summers, periodic drought and lightning ignitions, resulted in fires of small and large size, of high and low intensity, with periodic conflagrations that have covered the landscape. Much of the native vegetation in the ACT is subject to periodic fires; particularly the dry forest, woodland and grassland communities, and many are fire-adapted ecosystems. Recurrent bushfires and management burning have shaped the condition of the existing plant communities.

The Strategic Bushfire Management Plan for the ACT [version two] states: *“The ACT has a history of severe damaging bushfires with large areas burnt in the bushfire seasons of 1919/20; 1925/26; 1938/39; 1951/52; 1978/79; 1982/83; 1984/85; 2000/01 and in 2002/03”*.

A review of the large fire history data within the Strategic Fire Management Plan for the ACT, for the northern portion of the ACT, has identified that the area was impacted in the 1979 bushfire season with a fire that started to the south of the Barton Highway, spreading across Ginninderra Creek into the former CSIRO paddocks [Crace] and into what is now the suburb of Palmerston. The potential remains today for this fire path to re-occur, impacting on the south-western and western edge of the Crace Estate and the Crace Stage 3 precinct.

## **5.3 Ignition / Fire Sources.**

Causes of bushfires, including those in the ACT, are natural or human caused. Human causes can be categorised as:

- Malicious – including arson;
- Careless – such as escaped campfires, children and burning off without a permit; and
- Accidental – uncommon but includes motor vehicle and industrial accidents.

The only common natural cause of bushfires in the ACT is lightning. The vast majority of ACT bushfires are human caused with many classified as arson.

Ignition of the grassland / woodland / forest vegetation on the CSIRO land to the southwest of the Barton Highway and the vegetation within the Percival Hill Nature Reserve will present a threat to the south-western, western and north-western edge of the suburb of Crace, including the Stage 3 development precinct.

## **5.4 Climate and Weather.**

### **5.4.1 Temperature/Rainfall & Fire Danger Index:**

The fire season in the ACT corresponds with the summer months' high temperatures and low rainfall, and can occur from September to April with a proclaimed bushfire danger period from October to March. There is significant variability from year to year. Fire seasons may be serious in three out of every 15 years, but this can vary considerably.

Extreme and uncontrollable bushfires typically occur when the fire danger rating is over 50, a rating of Extreme. Many of the major house loss events have occurred at fire danger ratings over 70, on a scale of 0 to 100.

Analysis of 1951 – 2004 meteorological records identified the 105 days of Extreme fire danger from the Forest Fire Index (FFDI) at Canberra airport. These were broken down into the following FFDI ratings:

- [61 days 50 – 59 FFDI;
- 25 days 60 – 69 FFDI;
- 9 days 70 – 79 FFDI;
- 4 days 80 – 89 FFDI; and
- 6 days 90 – 100. *[Source SBMP for the ACT].*

The Very High and Extreme Forest Fire Danger conditions mainly occur between November and March.

### **5.4.2 Wind:**

Wind is an important factor in bushfire behaviour as it influences the rate of spread of the fire front and spreads burning embers / sparks, providing ignition sources for spot fires to distances up to 35 kilometres ahead of the main fire front.

The north-western edge of the suburb of Crace will be exposed to strong, hot and dry north-northwest wind influences. These winds can spread burning embers from both large and small fires over long distances and ignite cured grassland within the woodland/forest vegetation and other combustible fuels.

Fires that occur in the woodland/grassland vegetation in the corridor between the suburbs of Spence and Nicholls have the potential to rapidly burn along the Barton Road corridor, spreading embers into the Pine Forest on the corner of the Barton Highway and Gundaroo Drive, extending through the grassland vegetation on the road verge to the Highway and impacting upon the south-western edge of the suburb of Crace.

Large 'campaign' fires burning across the landscape in New South Wales, to the west of Hall, have the potential to over-run the defenses between the suburbs of Hall and Fraser, progressing to the southeast towards Giralang and Crace.

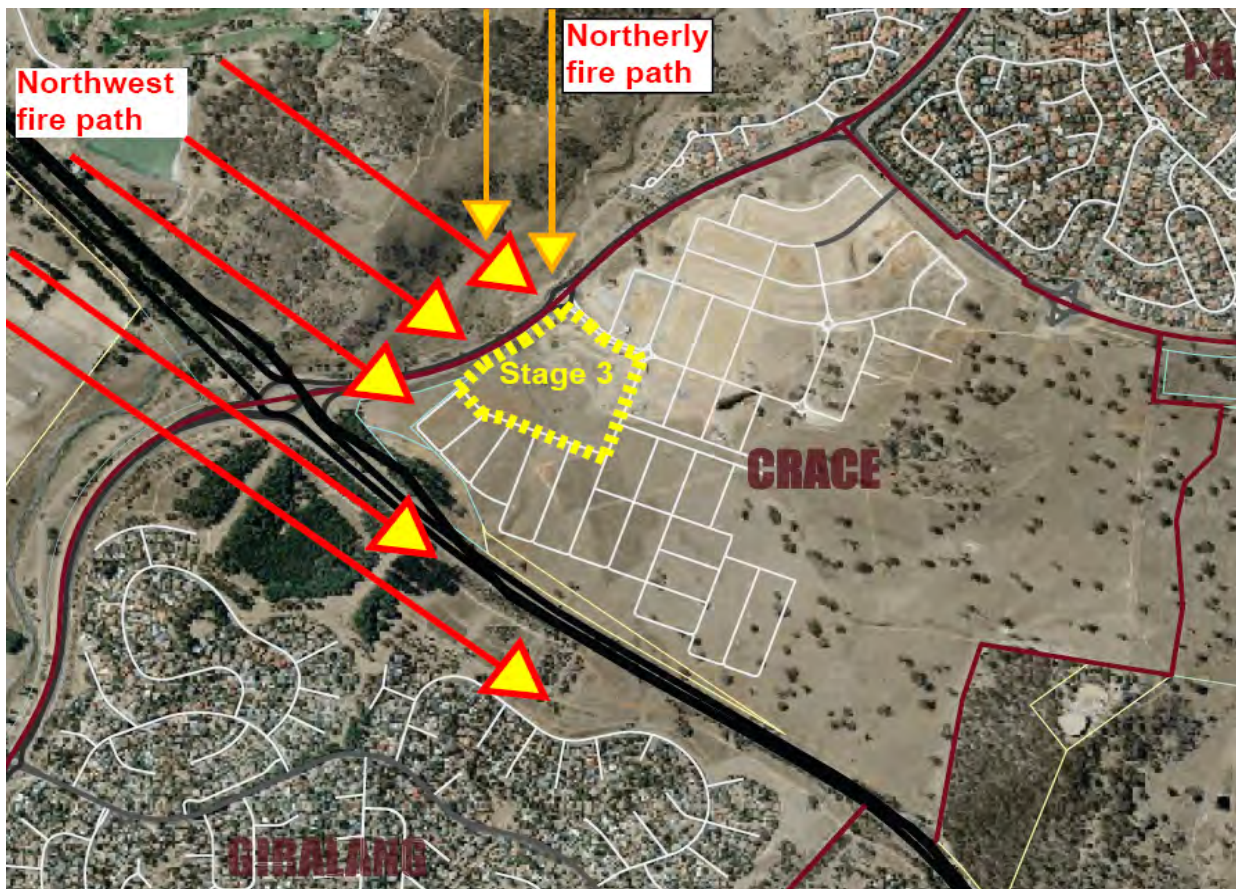
### 5.5 Slope & Fire Paths.

Slope is a critically important factor when assessing fire risk and likely behaviour. The rate of fire propagation doubles up a slope of 10 degrees (18%) and increases almost fourfold up a slope of 20 degrees (40%).

The rate of progress downslope tends to slow at a corresponding rate however wind direction in the lee of hills/ridgelines tends to be unpredictable and can cause fires to change direction unpredictably.

The bushfire risk to the Crace Stage 3 precinct emanates from the bushfire prone vegetation in the Canberra Nature Reserve [Percival Hill] to the west and northwest and from the bushfire prone vegetation along the Barton Highway corridor, both to the southwest of the Stage 3 precinct and as an extension of the fire path through the CSIRO lands further to the north/northwest of the new suburb of Crace.

**Figure 8 – Severe Weather Fire Paths – northwest and east.**



## **5.6 Bushfire Fuels.**

Fuel is a critical element in bushfire risk management, as it is the one factor relating to fire behaviour that can be managed.

There are three 'types' of fuel that contribute to bushfire hazard. They relate to the distribution and nature of combustible material within a vegetated environment and are defined by the NRE Overall Fuel Hazard Guide as:

- Elevated fuel load
- Surface fine fuels; and
- Bark.

Elevated material is defined as shrubs, heath and suspended material greater than 0.5 metres above ground. The level of bushfire hazard depends on fuel continuity, height, amount of dead material, foliage thickness and flammability of live foliage. Flammability of vegetation is at the highest when composition is fine, it contains a lot of dead material, is dense vertically and horizontally and has low moisture content.

Surface fine fuels are defined as the litter bed and vegetation up to 0.5 metres above the ground.

Grasses add to the surface fine fuels and therefore need to be taken into account when assessing the hazard. The risk is higher where greater depth and volume of litter and surface material are present.

Bark has the potential to travel significant distances in a fire situation (spotting) and act as a ladder between surface fuels and the forest crown. Bark contributes to fire hazard when it is loose and fibrous, present in large quantities and in long loose ribbon forms.

## **5.7 Assessment of Fuel Hazard.**

The predominant vegetation that will create the most significant fire impact on the Crace Stage 3 development precinct will be the grassland/woodland and Pine Forest vegetation within the Barton Highway corridor to the southwest and the grassland/woodland vegetation in the Percival Hill Nature Reserve to the northwest and north.

An overall Fuel Hazard can be determined from an assessment of the contributing fuel hazards.

### **5.7.1 Open Grassland Vegetation.**

Using the methodology provided within the NRE Overall Fuel Hazard Guide, the following Fuel Hazard observation was determined for the open grassy vegetation on the land within the Ginninderra Creek corridor to the north and northwest of the Crace Stage 3 precinct.

#### *Surface Fine Fuel Hazard:*

Surface Fine Fuel Hazard is assessed by measuring litter-bed height and can vary, depending on the land management practices.

The estimated litter bed height for unmanaged grassland vegetation is 15 - 25mm and due to the extent of “near-surface fuels” – i.e. grass tussocks or wire grass up to 0.9 – 1.2m high, the Surface Fine Fuel Hazard Rating can increase from High to Very High for unmanaged grassland vegetation.

### **5.7.2 Forest & Grassy Woodland.**

Using the methodology provided within the NRE Overall Fuel Hazard Guide, the following Fuel Hazard observation was determined for the Pine Forest & Grassy Woodland vegetation in the Barton Highway corridor and within the Percival Hill Nature Reserve – based on the assumption that management works do not mitigate the bushfire fuels on this land.

- **Bark Hazard :**

The Grassy Woodland and native forest vegetation includes Eucalypt species, including Yellow Box Red Gum, which has a smooth trunk and long ribbons of bark into the crown of the tree. Therefore this vegetation has a High Bark hazard.

- **Elevated Fuel Hazard :**

Elevated fuel comprises shrub, heath and suspended material. The level of hazard depends on the fuel continuity (horizontal and vertical), height, and proportion of dead material, thickness of the foliage and twigs and flammability of the live foliage.

The flammability of the elevated fuel is highest when:

- The foliage, twigs and other fuel particles are very fine (e.g. maximum thickness 1-2 mm);
- The proportion of dead material is high;
- The fuels are arranged with a high level of density and horizontal and vertical continuity that promotes the spread of flame;
- The live foliage has low, live fuel moisture content.

The vegetation type and time lapse since the most recent fire substantially determines the level of elevated fuel hazard. Due to the extent of the grassy component of the vegetation in the Highway corridor and on Percival Hill an estimated Elevated Fuel Hazard of Very High was determined for this vegetation.

- **Surface Fine Fuel Hazard :**

Surface Fine Fuel Hazard is assessed by measuring litter-bed height. Near surface fuels – i.e. grass tussocks, dead bracken, low shrubs or low wiregrass up to 0.5m high – interact with surface litter to increase fire behaviour and therefore need to be considered when assessing Surface Fine Fuel Hazard and the next highest Surface Fine Fuel Hazard rating.

Due to the extent of the ‘near-surface fuels’ component of this vegetation an estimated Surface Fine Fuel Hazard of High was determined for this vegetation.

**Assessment of Overall Fuel Hazard – Forest/Woodland Vegetation:**

The Overall Fuel Hazard for the Pine Forest/Grassy Woodland vegetation in the Barton Highway corridor and Percival Hill Nature Reserve [without management] is Very High.

**5.8 Asset Interface Classification [AIC].**

The ACT ESA & Rural Fire Service have developed a methodology for determining the classification of potential exposure of the urban edge to severe bushfires and introduces Asset Interface Classification [AIC], which is defined as the boundary between an asset and the bushfire paths that approach it. It is determined by an assessment of:

- The maximum fire size an asset may be subject to;
- The part of the fire [head, flank, back] an asset maybe subject to recognizing the major fire threat from the north and west;
- The fire run length criteria and the length of fire run.

The following table provides an Asset Interface Classification [AIC], at a broader scale for the urban edge of Canberra:

**Table 1: Asset Interface Classification**

Aspect of Fire Run	Length of Fire Run to Asset Interface (through unmanaged vegetation)		
	<100	100 – 350	>350
N	Secondary	Primary	Primary
NW	Secondary	Primary	Primary
W	Secondary	Primary	Primary
SW	Lee	Secondary	Primary
S	Lee	Secondary	Secondary
SE	Lee	Lee	Lee
E	Lee	Lee	Secondary
NE	Lee	Lee	Secondary

An examination of the Asset Interface Classification at a precinct level for the Crace Stage 3 development precinct identifies that the western & north-western aspects to the stage has a primary level of Asset Interface Classification whilst the remaining aspects to this precinct are protected by existing/proposed residential development.

### 5.9 Likely Fire Scenarios.

The following fire scenarios have been identified as a probability for impact on the Crace Stage 3 development precinct:

- (1) Fire in the Pine Forest/grassy woodland vegetation in the Barton Highway corridor to the west of the precinct, burning under north-westerly winds, upslope along the Highway towards the western corner of Crace Stage 1 & 3.

This potential fire impact is likely during any period of hot dry weather when the prevailing wind patterns are from the west/northwest and the management practices in the Highway corridor are insufficient to remove the bushfire hazard and the corridor contains excessive quantities of cured fuels and the Fire Danger Index is Extreme (FDI > 50).

- (2) Fire in the grassland/woodland vegetation in the Ginninderra Creek corridor and the Percival Hill Nature Reserve to the north and northwest of the Crace Stage 3 development precinct, burning initially downslope from the ridgeline and upslope across the creek corridor towards the north-western edge of the Stage 3 precinct.

This potential fire impact is likely during any period of hot dry weather when the prevailing wind patterns are from the north and northwest and the management practices in the Nature Reserve are insufficient to remove the bushfire hazard and the Reserve contains excessive quantities of cured fuels and the Fire Danger Index is Extreme (FDI > 50).

### 5.10 Risk Statement.

Table 5 provides a statement of risk for each fire scenario that may impact the Crace Stage 3 estate [prior to mitigation measures being adopted / implemented] and assigns risk levels reflecting identified levels of likelihood and consequences for a 'worst case' fire occurrence which may occur if the vegetation on the land to the west, northwest and north is not managed to reduce the combustible fuels available to burn during severe fire weather conditions.

Table 2 provides a list of qualitative measures of consequence [or impact] whilst Table 3 provides a list of qualitative measures of likelihood – used to determine the level of risk in Table 5.

Table 4 provides a qualitative risk analysis matrix – used to determine the level of risk in Table 5.

**Table 2 – Qualitative Measures of Consequence or Impact.**

Level	Descriptor	Detail Description
1	Insignificant	No public safety injuries or impact to buildings
2	Minor	No public safety injuries – minor impact to buildings
3	Moderate	Burns and Respiratory Issues – moderate damage to buildings
4	Major	Death of people exposed to radiant heat & major property damage
5	Catastrophic	Death of people exposed to radiant heat and total destruction of buildings

**Table 3 – Qualitative Measures of Likelihood.**

Level	Descriptor	Detail Description
A	Almost Certain	Is expected to occur during severe fire danger periods
B	Likely	Will probably occur during severe fire danger periods
C	Possible	May occur during severe fire danger periods
D	Unlikely	Unlikely to occur during severe fire danger periods
E	Rare	Will rarely occur during severe fire danger periods

**Table 4 – Qualitative Risk Analysis Matrix**

Likelihood	Risk Rating				
	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A – almost certain	High	High	Extreme	Extreme	Extreme
B – likely	Moderate	High	High	Extreme	Extreme
C – possible	Low	Moderate	High	Extreme	Extreme
D – unlikely	Low	Low	Moderate	High	Extreme
E – rare	Low	Low	Moderate	High	High

**Table 5 – Bushfire Risk Register – Severe Bushfire Event – if high levels of combustible fuels/unmanaged vegetation exist in the landscape.**

The Risk – what can happen?	The consequences of an event happening		Adequacy of existing protection measures	Consequence Rating	Likelihood Rating	Level of Risk	Risk Priority
	Consequences	Likelihood					
(1) Fire in the Barton Highway corridor to the west of the Crace Stage 3 development precinct, burning upslope under the influence of west & NW winds	Major – long fire run causing high levels of radiant heat and ember attack on buildings	Possible	Minimal fuel management present at time of site inspection	4	C	Extreme	1
(2) Fire in the grassland / woodland vegetation in the Ginninderra Creek corridor and Percival Hill Nature Reserve to the northwest and north of the Crace Stage 3 development precinct burning upslope under the influence of northerly & north-westerly winds.	Moderate – long fire run however grassland fuels in creek corridor will potentially cause moderate damage to buildings through ember attack	Possible	No fuel management present at time of site inspection	3	C	High	2

### 5.11 Summary of Bushfire Risk.

Fire ignitions that occur within the Barton Highway corridor, between Nicholls and Spence, and within the Percival Hill Nature Reserve have the potential to spread to the east along the highway corridor towards the western corner of the Crace Estate and the north-western edge of the Stage 3 precinct. This fire path will expose the vegetation in the Highway buffer zone and the Percival Hill Nature Reserve to a fire front which could impact directly on the western and north-western edge of the Estate, including Stage 3, especially if inadequate fuel management occurs.

This threat requires that the “semi natural open space” within the Estate lease boundary and the landscaped buffer zone [Open Woodland vegetation] in the Barton Highway and Gungaharra Drive corridor needs to be managed as an Outer Asset Protection Zone in accordance with prescriptions provided by the Strategic Bushfire Management Plan for the ACT and that the landscape planting to the north-western aspect of the Stage 3 precinct shall re-establish an open woodland community with a managed [slashed] grassy understorey.

## SECTION 6

### BUSHFIRE PROTECTION MEASURES.

#### 6.1 Introduction.

On the basis that the vegetation within the Barton Highway corridor and the Percival Hill Nature Reserve to the west and northwest of the Stage 3 precinct is not satisfactorily managed to reduce the bushfire threat during the bushfire danger period the following fire protection measures shall be implemented:

#### 6.2 Fire Protection Zones.

The following Fire Protection Zones shall be applied to the Crace Stage 3 development precinct:

**Table 6. Determination of Fire Protection Zones to the perimeter of the Crace Stage 3 development precinct.**

Aspect	Vegetation Classification	Asset Interface Classification [AIC] [PfBRM 2009]	Outer Asset Protection Zone [OAPZ] [PfBRM 2009]	Inner Asset Protection Zone [IAPZ] [PfBRM 2009]	Ember Asset Protection Zone [EAPZ] [PfBRM 2009]	Bushfire Construction Standards [AS 3959 2009]		
						BAL 29	BAL 19	BAL 12.5
West	Native Grassland & Open Woodland	Primary	100 metres	Minimum 30 metres	200 metres - refer to Note 1	Nil	50	150 m
North West	Native Grassland & Open Woodland	Primary	100 metres	Minimum 30 metres	200 metres - refer to Note 1	Nil	50	150 m
North	Native Grassland & Open Woodland	Primary	100 metres	Minimum 30 metres	200 metres - refer to Note 1	Nil	50	150 m

#### Note 1:

Discussions with the ACT Rural Fire Service/ESA took place during the preparation of the Bushfire Risk Review prepared for the Crace Estate EDP and confirmed that, provided “semi natural open space” within the Estate lease boundary and the landscaped buffer zone in the Barton Highway corridor and the Gundaroo Drive carriageway is managed as an Outer Asset Protection Zone, the dwellings located within an Ember Asset Protection Zone of 100 metres width [from the edge of the Estate] shall be constructed to comply with BAL 12.5 specifications as defined in Australian Standard, A.S. 3959 –2009 “Construction of Buildings in Bushfire Prone Areas”.

### **6.3 Fuel Management Standards.**

#### **(a) Asset Protection Zones:**

The management of the Inner Asset Protection Zones and the Outer Asset Protection Zones recommended in this report shall comply with the management protocols as provided in Schedule C – Fuel Management Standards for Fire Management Zones of the ‘*Strategic Bushfire Management Plan for the ACT – Version 2 – October 2009*’.

#### **(b) Community Recreation Park/Water Quality Pond & Wetland:**

The management of the Community Recreation Park/Water Quality Pond & Wetland within the Crace Stage 3 development precinct shall include the regular maintenance of lawns/grasses to minimize combustible fuels. The maintenance of these areas shall comply with the management protocols as provided in Schedule C – Fuel Management Standards for Fire Management Zones of the ‘*Strategic Bushfire Management Plan for the ACT – Version 2 – October 2009*’.

Landscaping and trees shall be maintained in discrete clumps with limbs to trees under-pruned to provide a 2m clearance to the lower branches.

### **6.4 Access for Fire-fighting Operations – Public Roads.**

Edge roads shall be constructed within the Inner Asset Protection Zone to all bushfire prone interfaces and shall be continuous, except where approved by the ESA, to allow access to the full length of the bushfire prone interface [except as shown on the Estate Development Plan] and constructed to a width of 7.5 metres with corners, intersections and turning heads designed to accommodate both an Urban Pumper and Aerial Appliances [in locations with multi-level development] and Rural Fire Service Tankers (Refer to Access provisions provided by each Service).

Corners and roundabouts shall be constructed to provide access for urban and rural fire service vehicles with a turning circle of 24 metres, with an inner radius of 6 metres and an outer radius of 12 metres for corners. Road surfaces shall be designed to carry a live load of 25 tonnes.

Internal estate roads shall have a minimum width of 5.5 metres with parking/passing bays located clear of the formed road width and a 3 metre verge to each side to allow unencumbered access by emergency crews to all sides of their vehicles.

### **6.5 Access for Fire-fighting Operations – Fire Trails/Access links.**

An access link from the north-western end of the edge road No. 101 to Digby Circuit shall be provided, as approved by the ESA, which enables fire-fighting appliances to access those areas not provided with an edge road.

This access link shall be constructed to a width of 4.0 metres and be capable of carrying a heavy rigid vehicle of 15 tonnes GVM. Locked gates, or similar vehicle restraint, shall be provided at the access points to the edge road. *[Refer to Section 9 – Plan of Bushfire Protection Measures].*

### **6.6 Water Supplies for Fire Fighting Operations.**

A hydrant supply shall be installed to comply with the agreed standards for water supply and 45 l/s single standard hydrants, in accordance with AS 2419.1 – 2005, shall be provided to the edge road network.

Remaining hydrants within the Stage 3 development precinct shall have a 25 l/s output.

## SECTION 7

### RESIDUAL RISK.

#### 7.1 Introduction.

Table 7 evaluates the residual bushfire risk to the future development within Crace Stage 3, during catastrophic fire danger periods, following the implementation of the recommended bushfire protection measures recommended in this report and approved by the ACT ESA/RFS.

**Table 7 – Bushfire Risk Register & Action Treatment Plan – catastrophic bushfire events, post implementation of the recommended protection measures.**

The Risk What can happen?	The consequences of an event happening		Risk before mitigation	Strategy to reduce the risk	Consequences & Likelihood after mitigation measures applied	Residual Level of Risk	Risk Priority
	Consequences	Likelihood					
(1) Fire in the Barton Highway corridor to the west of the Crace Stage 3 development precinct, burning upslope under the influence of west & NW winds	Major – long fire run causing high levels of radiant heat and ember attack on buildings	Possible	Extreme	Revegetation to open woodland standards & provision & management of Asset Protection Zones & construction standards to buildings	High / Possible	High	1
(2) Fire in the grassland / woodland vegetation in the Ginninderra Creek corridor and Percival Hill Nature Reserve to the northwest and north of the Crace Stage 3 development precinct burning upslope under the influence of northerly & north-westerly winds.	Moderate – long fire run however grassland fuels in creek corridor will potentially cause moderate damage to buildings through ember attack	Possible	High	Management of Gundaroo Drive to OAPZ standard 7 provision & management of Asset Protection Zones & construction standards to buildings	Moderate/ Possible	Moderate	2

#### 7.2 Summary of Residual Bushfire Risk.

Table 7 provides a review of the residual level of risk to residents and emergency services personnel and others within Crace Stage 3 and has been determined on the basis that the recommended bushfire mitigation measures are implemented and maintained over the life of the development.

The implementation and permanent management of the Asset Protection Zones, the construction of the buildings to standards [which are aimed at mitigating the potential levels of ember attack] will play an important role in decreasing the bushfire hazards and the level of risk from fire events within Native Grassland/Woodland vegetation in the Percival Hill Reserve to the northwest and west of the precinct and from a fire in the grassy woodland within the Barton Highway corridor/lease boundary along the southwest of the Estate.

## SECTION 8

### CONCLUSION.

The development proposal reviewed in this risk assessment is the Estate Development Plan for Crace Stage 3, which is the third stage in the new suburb of the Crace Urban release area.

The Crace Stage 3 precinct is situated within the western portion of the new suburb of Crace, located to the southeast of Gundaroo Drive and adjoined to the southwest, east and northeast by completed Stage 1 of the Estate.

The development precinct is exposed to the potential threat from a grass/woodland fire in the Percival Hill Nature Reserve, located beyond the north-western edge of the Gundaroo Drive carriageway.

The western edge of the Crace Estate, including the Stage 3 development precinct, is exposed to the threat posed by a fire burning along the Barton Highway under prevailing summer northwest and west winds, necessitating careful consideration to the issue of revegetation of the 'semi-natural' open space corridor between the Barton Highway and the edge road within Stage 1 and the buffer zone to the Barton Highway.

This report concurs with the recommendations of the previous reports and reaffirms the need for the revegetation to replicate an 'open woodland community with a grassy understorey, managed to the prescriptions of an Outer Asset Protection Zone [OAPZ], maintained in accordance with the management protocols as provided in Schedule C – Fuel Management Standards for Fire Management Zones of the *'Strategic Bushfire Management Plan for the ACT – Version 2 – October 2009'*.

This report has examined the likely fire-paths and the resultant bushfire risk to the development within the Crace Stage 3 precinct and has recommended number of protection strategies aimed at reducing the assessed level of risk to the future residents / emergency services personnel if the suburb is exposed to the effects of a future catastrophic fire event.



Graham Swain  
Managing Director,  
**Australian Bushfire Protection Planners Pty Limited**

## **REFERENCES:**

- Strategic Bushfire Management Plan for the ACT – January 2005 & October 2009;
- The Canberra Spatial Plan – ACT Planning & Land Authority – March 2004;
- AS/NZ - 4360 : 2004 Risk Management;
- Emergency Risk Management – Applications Guide. (EMA) 2000);
- Overall Fuel Hazard Guide – NRE. May 1999;
- Planning for Bushfire Risk Mitigation 2006 & Update 2009;

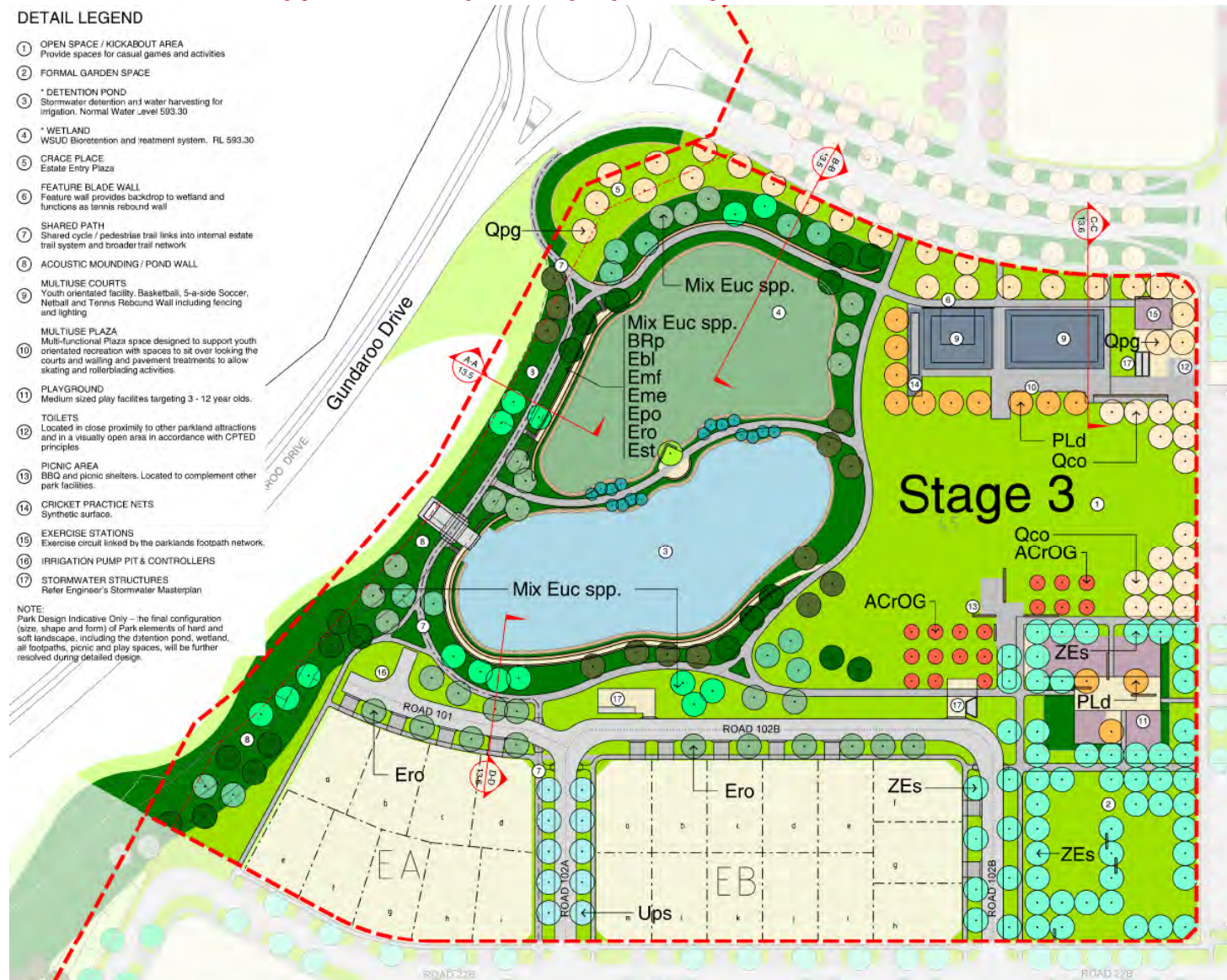


## Attachment A – Copy of Landscape Plan prepared by 'Tract'

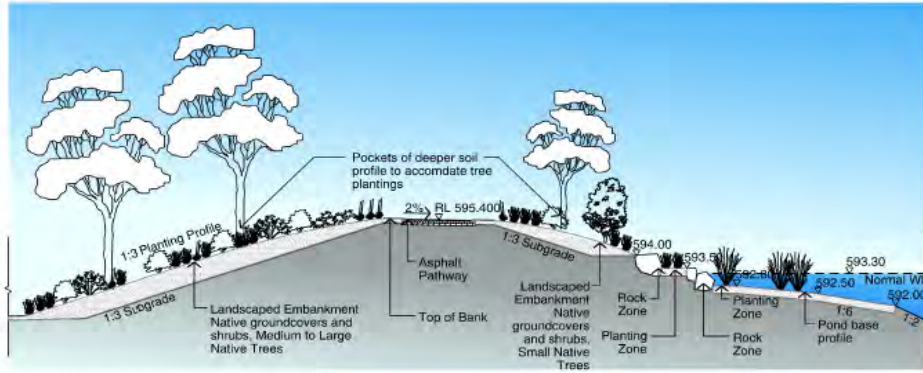
### DETAIL LEGEND

- ① OPEN SPACE / KICKABOUT AREA  
Provide spaces for casual games and activities
- ② FORMAL GARDEN SPACE
- ③ DETENTION POND  
Stormwater detention and water harvesting for irrigation. Normal Water Level 593.30
- ④ WETLAND  
WSUD Bioretention and treatment system. RL 593.30
- ⑤ CRACE PLACE  
Estate Entry Plaza
- ⑥ FEATURE BLADE WALL  
Feature wall provides backdrop to wetland and functions as tennis rebound wall
- ⑦ SHARED PATH  
Shared cycle / pedestrian trail links into internal estate trail system and broader trail network
- ⑧ ACOUSTIC MOUNDING / POND WALL
- ⑨ MULTIUSE COURTS  
Youth orientated facility. Basketball, 5-a-side Soccer, Netball and Tennis Rebound Wall including fencing and lighting
- ⑩ MULTIUSE PLAZA  
Multi-functional Plaza space designed to support youth orientated recreation with spaces to sit over looking the courts and walling and pavement treatments to allow skating and rollerblading activities.
- ⑪ PLAYGROUND  
Medium sized play facilities targeting 3 - 12 year olds.
- ⑫ TOILETS  
Located in close proximity to other parkland attractions and in a visually open area in accordance with CPTED principles
- ⑬ PICNIC AREA  
BBQ and picnic shelters. Located to complement other park facilities.
- ⑭ CRICKET PRACTICE NETS  
Synthetic surface.
- ⑮ EXERCISE STATIONS  
Exercise circuit linked by the parklands footpath network.
- ⑯ IRRIGATION PUMP PIT & CONTROLLERS
- ⑰ STORMWATER STRUCTURES  
Refer Engineer's Stormwater Masterplan

NOTE:  
Park Design Indicative Only – the final configuration (size, shape and form) of Park elements of hard and soft landscape, including the detention pond, wetland, all footpaths, picnic and play spaces, will be further resolved during detailed design.

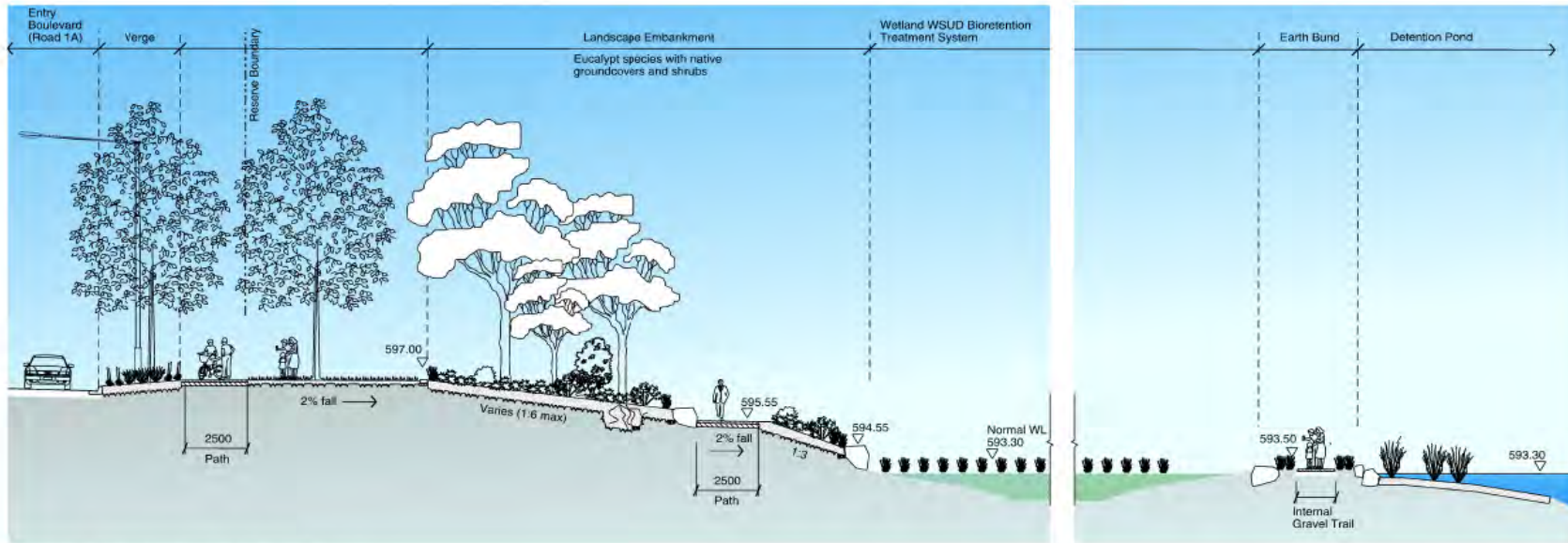


**Attachment B – Landscape Sections [Plan prepared by 'Tract']**



Community Recreation Irrigated Park (CRIP)  
Section A-A

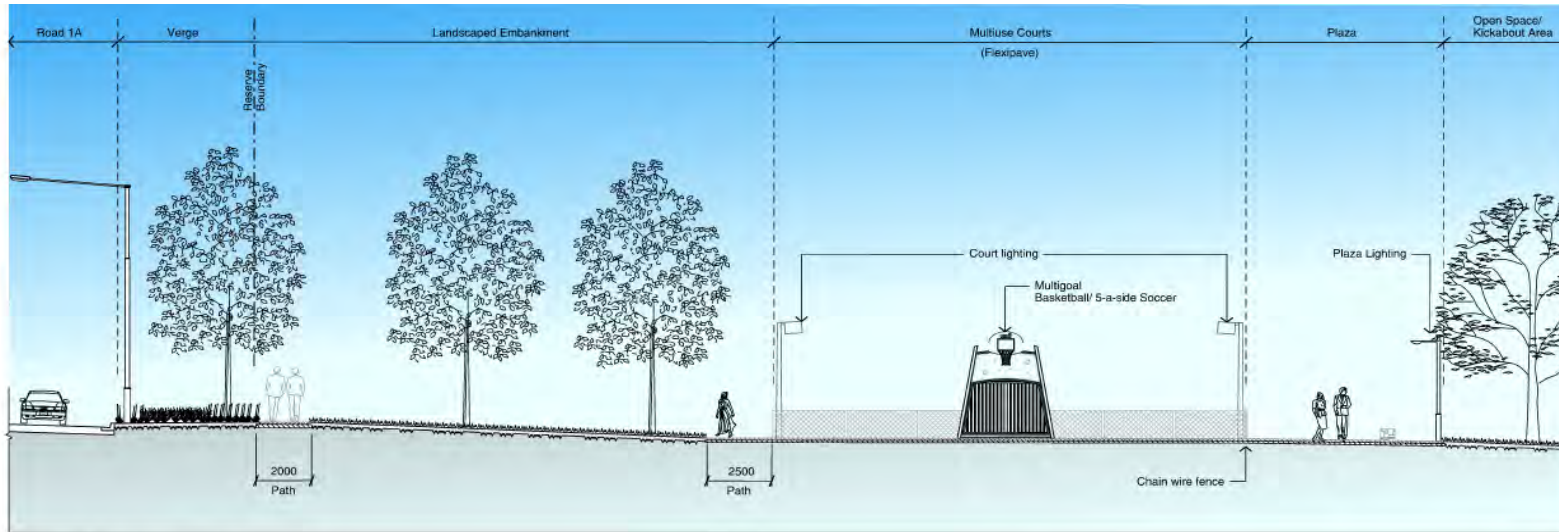
Scale 1:200 @ A3



Community Recreation Irrigated Park (CRIP)  
Section B-B

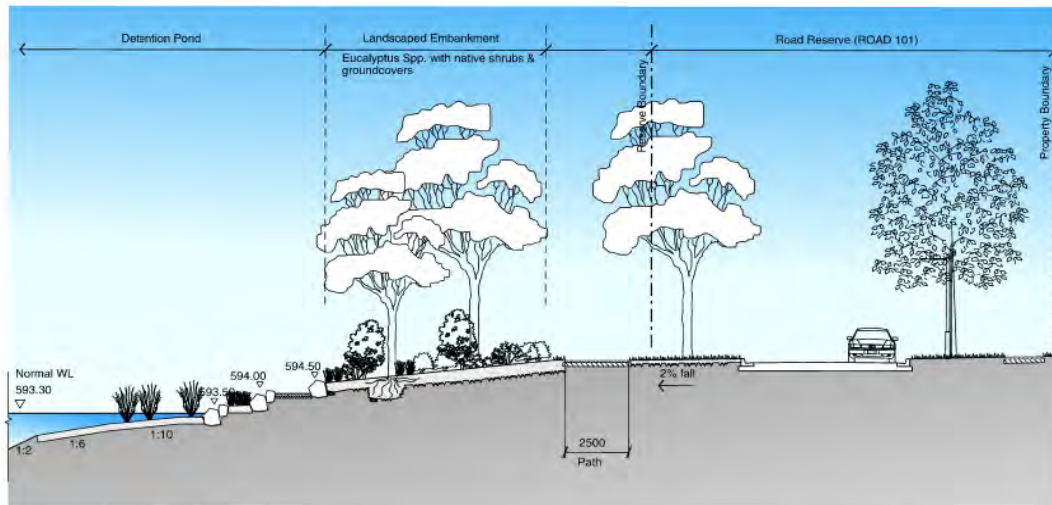
Scale 1:200 @ A3

**Attachment C – Landscape Sections [Plan prepared by 'Tract']**



Community Recreation Irrigated Park (CRIP)  
Section C-C

Scale 1:200 @ A3



Community Recreation Irrigated Park (CRIP)  
Section D-D

Scale 1:200 @ A3

## Appendix D

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### Water Sensitive Urban Design Checklist – AECOM

## Water sensitive urban design estate development checklist

Note: This checklist may be completed for each stage of development as well as for the total development area.

DA No. 200801528 S197H Estate Name Crace

Stage **Total Dev Area** Suburb/District Crace Nearest Streets Barton Highway, Gungahlin Drive and Nudurr Drive

Applicant Name Mitchell Alexander Company CIC Crace Pty Ltd

Developer Name CIC Crace Pty Ltd

WSUD Concept Plan required as 1:1000 scale. Plan No 22.1 in EDP 3, October 2010

### Mains water use

Mandatory provisions for rating plumbing fittings and appliances for individual dwellings, such as in Lease and Development Conditions? Y  N

Estimated mains water use reduction using the Design Response Report, BASiX, Green Star or other assessment tool/spreadsheets: 40 + %

Mains water savings proposed in the design of the public realm?  Y N

Description: Passive irrigation of street trees and landscaped areas, stormwater harvesting for irrigation

### Stormwater management

Development area	<u>140.8 ha</u> .m <sup>2</sup>
Impervious areas – Roof areas	
Roof connected to rainwater storage	<u>14.1 ha</u> .m <sup>2</sup> 150 m <sup>2</sup> per house
Roof area not connected to storage	<u>18.9 ha</u> .m <sup>2</sup>
Total	<u>33.0 ha</u> .m <sup>2</sup> 250 m <sup>2</sup> per house or half lot area
Impervious areas - Paved areas	
Hard paved areas	<u>57.8 ha</u> .m <sup>2</sup>
Permeable / porous paving	<u>0 ha</u> .m <sup>2</sup>
Total	<u>57.8 ha</u> .m <sup>2</sup>
Total impervious areas (with a 50% reduction applied to permeable/porous paving areas)	<u>71.9 ha</u> .m <sup>2</sup>

PLEASE NOTE - Conservative model - only the rainwater tanks, street trees, rain gardens (in the urban core), GPT's, bioretention systems and pond. Additional WQ performance achieved with swales, passively irrigated street trees and recirculation wetland for pond.

#### Analysis / modelling results for sediment, nutrient and runoff volumes

	Existing conditions	Development with no WSUD measures	Development with WSUD measures	% Reduction with WSUD measures
Suspended solids export (kg/yr)	2,410	99,000	16,820	83
Phosphorus export (kg/yr)	10	165	57	66
Nitrogen export (kg/yr)	88	1,393	720	48

#### SITE WIDE MODEL – water quality results

**NOTE: DETAILS FOR SOUTHERN CATCHMENT (for EDP3) on following page**

ARI storm (m <sup>3</sup> /s)				
Peak flow for 100 years ARI storm (m <sup>3</sup> /s)				

#### Pond / Wetland proposals

The following details are to be completed for all proposed pond / wetland designs to allow for the basic elements to be checked for sizing and adequacy.

	RL	Surface area	Volume
Pond invert		0	0
NWL <sup>(1)</sup>			
TWL <sup>(2)</sup> – 3 months ARI storm			
TWL <sup>(2)</sup> – 100 years ARI storm			

(1) NWL = Normal water level prior to storms

(2) TWL = Top water level

	Inflow	Outflow
1 year ARI flow		
5 years ARI flow		
100 years ARI flow		

Catchment area to pond for small storms up to 3 months ARI = .....Ha

Catchment area to pond for large storms up to 100 years ARI = .....Ha

Percentage urbanised = .....%      Percentage impervious = ..... %

Extended detention = Volume at TWL (target 3 months ARI flow) – Volume at NWL

= ..... m<sup>3</sup>

Retardation storage = Volume at TWL (100 years ARI flow) – Volume at TWL (3 months ARI flow)

= ..... m<sup>3</sup>

Macrophyte zone area (less than 600 mm depth at NWL) = .....%

Plant species proposed (list and include % of total planting area):

Authorised by the ACT Parliamentary Counsel—also accessible at [www.legislation.act.gov.au](http://www.legislation.act.gov.au)

## SOUTHERN CATCHMENT – Bioretention Street trees, GPT and POND

### Recirculation wetland provides additional pollutant reduction & water quality management for the pond

#### Analysis / modelling results for sediment, nutrient and runoff volumes

	Existing conditions	Development with no WSUD measures	Development with WSUD measures	% Reduction with WSUD measures
Suspended solids export (kg/yr)	<b>1,420</b>	<b>45,900</b>	<b>5,360</b>	<b>88</b>
Phosphorus export (kg/yr)	<b>6</b>	<b>95</b>	<b>25</b>	<b>74</b>
Nitrogen export (kg/yr)	<b>52</b>	<b>680</b>	<b>304</b>	<b>55</b>
Peak flow for 3 months ARI storm (m <sup>3</sup> /s)	<b>0.45</b>	<b>2.3</b>	<b>1.0</b>	<b>56.5</b>
Peak flow for 5 years ARI storm (m <sup>3</sup> /s)	<b>4.3</b>	<b>9.0</b>	<b>4.4</b>	<b>51.0</b>
Peak flow for 100 years ARI storm (m <sup>3</sup> /s)	<b>11.8</b>	<b>18.6</b>	<b>8.4</b>	<b>54.8</b>

#### Pond / Wetland proposals

The following details are to be completed for all proposed pond / wetland designs to allow for the basic elements to be checked for sizing and adequacy.

	RL	Surface area	Volume
Pond invert	<b>591.8</b>	<b>1,800</b>	<b>0</b>
NWL <sup>(1)</sup>	<b>593.3</b>	<b>9,575</b>	<b>8,531</b>
TWL <sup>(2)</sup> – 3 months ARI storm	<b>593.5</b>	<b>9,840</b>	<b>10,476</b>
TWL <sup>(2)</sup> – 100 years ARI storm	<b>594.5</b>	<b>14,300</b>	<b>22,563</b>

(1) NWL = Normal water level prior to storms

(2) TWL = Top water level

	Inflow	Outflow
1 year ARI flow	<b>4.2</b>	<b>2.0</b>
5 years ARI flow	<b>9.0</b>	<b>4.4</b>
100 years ARI flow	<b>18.6</b>	<b>8.4</b>

Catchment area to pond for small storms up to 3 months ARI = **83**.....Ha

Catchment area to pond for large storms up to 100 years ARI = **83**.....Ha

Percentage urbanised = **83**.....%      Percentage impervious = **56.0**.....% for the 67 ha urban catchment

Extended detention = Volume at TWL (target 3 months ARI flow) – Volume at NWL

$$= \mathbf{1,380} \text{ m}^3$$

Retardation storage = Volume at TWL (100 years ARI flow) – Volume at TWL (3 months ARI flow)

$$= \mathbf{17,950} \text{ m}^3$$

Macrophyte zone area (less than 600 mm depth at NWL) = ..... **~ 50**.....%

**Fringing vegetation surrounding the pond and a separate recirculation wetland of 4,475m<sup>2</sup>.**

Plant species proposed (list and include % of total planting area):

## Wastewater reuse (optional)

Wastewater reuse proposed?	Y <input checked="" type="radio"/> N
Type of reuse	
Untreated greywater (direct use on garden only)	Y / N
Treated greywater	Y / N
Community reuse facility (if available)	Y / N
Uses for wastewater	
Garden use	Y / N
Toilet flushing	Y / N
Laundry use	Y / N
Other	Y / N
Estimated annual reuse	.....m <sup>3</sup> (= kL)

## Summary of WSUD targets and achievements

	Target	Achieved
Mains water use reduction	40%	... <b>40+</b> ...%
Reduction in suspended solids	60%	<b>83</b>
Reduction in total phosphorus	45%	<b>66</b>
Reduction in total nitrogen	40%	<b>48</b>
Effluent reuse	Optional	..... <b>0</b> ..... kL/yr

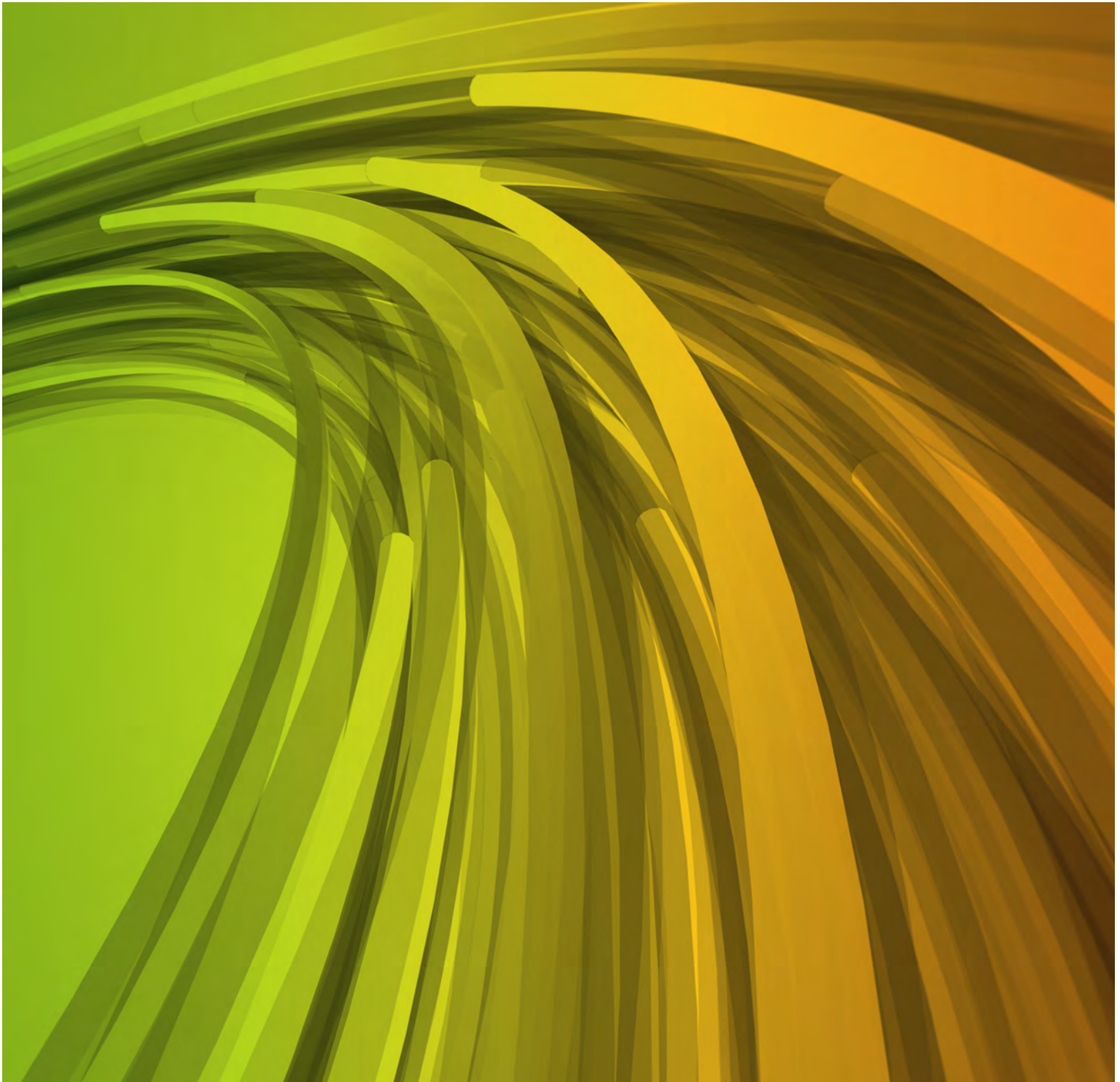
## Appendix E

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Acoustic Report – AECOM

# Crace

## Noise Assessment



## Crace

### Noise Assessment

Prepared for

CIC Crace Pty.Ltd

Prepared by

**AECOM Australia Pty Ltd**

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29 April 2011

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A	06-Sep-2010	Internal review	Alan Subkey Acoustics Manager, Canberra	
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0	21-Sep-2010	Issue to client	Alan Subkey Acoustics Manager, Canberra	
1	13-Oct-2010	Issue to client	James Henriques Buildings Manager, Canberra	
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3	21-Apr-2011	Issue to client	Alan Subkey Associate Director - Acoustics	
4	29-Apr-2011	Issue to client	Alan Subkey Associate Director - Acoustics	

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## Executive Summary

AECOM has assessed the road traffic noise impacts from the Barton Highway, Gundaroo Drive and Nudurr Drive for the new suburb of Crace, within the Australian Capital Territory. This report details the results of computer noise modelling to reflect the current lot layout, site information, and terrain grading provided by the client and urban planners as of November 25, 2010.

To predict external noise levels for future traffic flows, computer modelling has been undertaken with *SoundPLAN* Version 7.0 software with validation from measured data on site. The validation of the noise model was carried out in 2008 in the previous report by Bassett (now part of AECOM), which is attached as Appendix D.

Traffic noise impacts have been assessed for future traffic flows in the year 2021. Traffic flows have been based on information provided by the Client and ACTPLA. For future noise predictions, Gundaroo Drive has been duplicated, on the southern side between the Barton Highway and Nudurr Drive.

Noise receivers have been modelled at ground and first floors of each proposed dwelling on the perimeter of Crace. Residential blocks that have external noise levels that exceed the designated criterion have been identified.

Table 1 – Number of Receivers Exceeding Criteria

Dwelling Levels	Number of Residential Blocks Exceeding Criteria (in the year 2021)
Ground Level	2
First Floor	25

House treatments to achieve an appropriate internal noise level are available and can be designed for dwellings exceeding the external noise criteria.

## 1.0 Introduction

AECOM has been commissioned by CIC Crace Pty. Ltd. to carry out an impact assessment of road traffic noise from the three roads bounding the Crace subdivision development site. The three main roads are Gundaroo Drive, Barton Highway and Nudurr Drive.

Crace subdivision residential development forms the study site of this assessment. The north-western boundary of the study site is Gundaroo Drive and runs for approximately 1300 metres adjacent to the study site. The south-western boundary of the study site is the Barton Highway. Nudurr Drive is located north of the site.

The purpose of this report is to:

- Predict the extent of road traffic noise impact on the study site from Gundaroo Drive, the Barton Highway and Nudurr Drive for future road traffic conditions;
- Assess road traffic noise levels in accordance with the requirements of the ACT Planning Authority's Noise Management Guidelines, 1996 (Draft), and provide indicative noise attenuation measures to reduce noise levels where exceedences are found.

This assessment is based on the following plans and documents:

- Site grading plan for Stage 1 (south) including the noise berm details supplied on 30 Nov 2009 by Indesco Consulting Engineers;
- Site grading plan for Stage 1 (north) including the noise berm details supplied on 15 Sep 2010 by Brown Consulting;
- Site grading plan for Stage 2 including the noise berm details supplied on 22 Nov 2010 by Brown Consulting;
- Allotment layout for Stage 2 supplied on 22 Nov 2010 by Brown Consulting;
- Site grading plan for Stage 3 supplied on 09 Sep 2010 by Indesco Consulting Engineers;
- Existing road alignments supplied on 28 Mar 2008 by Indesco Consulting Engineers;
- Nudurr Drive extension alignment and grading on 22 Nov 2010 by Brown Consulting;
- Future traffic flows for the year 2021 for the Barton Highway, Gundaroo Drive and Nudurr Drive provided by the Client and ACTPLA.

## 2.0 Site Description

The study site is located approximately 8 km north of Canberra CBD, west of where Gundaroo Drive and Barton Highway meet. It is bounded to the north west by Gundaroo Drive, to the south west by Barton Highway and to the north east by Nudurr Drive. The study site will be used primarily for residential use.

Road surface noise corrections have been determined based on the New South Wales RTA Environmental Noise Management Manual. The road surface that was modelled was dense graded asphalt which has a zero correction.

### **Gundaroo Drive**

Gundaroo Drive currently carries one lane of traffic in each direction with a posted speed of 80 km/hr. The existing road surface is Dense Graded Asphalt (DGA). Future predicted traffic flows are based on a duplication of Gundaroo Drive. The predicted noise levels within this report for future traffic flows are based on the current road alignment and can be updated once details of the road duplication are known.

### **Barton Highway**

Barton Highway has two lanes of traffic in each direction. A slip lane exists at the roundabout when travelling from Gundaroo Drive to the Barton Highway. The posted speed is 100 km/hr. The existing road surface is Dense Graded Asphalt (DGA).

### **Nudurr Drive**

Nudurr Drive currently carries one lane of traffic in each direction with posted speed of 80 km/hr. Future traffic volumes within this report are based on the extension of Nudurr Drive to Gungahlin Drive. The existing road surface is Dense Graded Asphalt (DGA).

### 3.0 Road Traffic Noise Criteria

The appropriate criteria for assessing traffic noise for the Crace development is established in the ACT Planning Authority's Noise Management Guidelines (Draft), March 1996. Although the requirement to look at this criterion document has been removed from the 35<sup>th</sup> Revision of the Territory Plan 2008 (22 January 2010), we have been advised<sup>1</sup> that this criterion document is still to be referenced.

The guidelines stipulate that for new developments on existing roads, the maximum noise levels from traffic at a point one metre in front of the façade of the nearest affected residential dwelling should be 63 dB(A)<sub>L<sub>10</sub> (18 hour)</sub>. Within a recreational courtyard of private open space not facing the road source, the noise levels should be 58 dB(A) <sub>L<sub>10</sub> (18 hour)</sub>.

The guidelines also state that: „if this is not achievable through appropriate setback distances from the road, the applicant will be required to demonstrate that, by the use of external noise attenuation features or by appropriate noise attenuation treatments incorporated within the structure, the internal noise levels will meet those in AS/NZS 2107: 2000.“

**Table 2 – Summary of Noise Criteria at Noise Sensitive Places**

Criteria	Description	Criterion dB(A)
Residential Areas	Façade corrected L <sub>10</sub> (18 hour)	63
Private Open Space	External Free-Field L <sub>10</sub> (18 hour)	58
Commercial Facilities	L <sub>10</sub> (18 hour)	75

Residential dwellings adjacent to the roads of this study have been positioned according to the current allotment layouts, with most of the front façade faces the direction of the noise source. The appropriate criterion is therefore a façade corrected L<sub>10</sub> (18 hour) level of 63 dB(A).

AS 3671:1989 *Acoustics - Road traffic noise intrusion - Building siting and construction* also states that: „This Standard concerns the reduction of road traffic noise intrusion in buildings in areas near new or upgraded freeways, tollways, major roads, and national routes or other roads carrying more than 2000 vehicles per day... It provides guidelines for determining the type of building construction necessary to achieve acceptable noise levels indoors, as recommended in AS 2107, for different types of activity.“

<sup>1</sup> Verbal advice received from Paul Isaacs of ACT Territory and Municipal Services (TAMS)

According to the Australian New Zealand Standard AS/NZS 2107 *Acoustics – Recommended design sound levels and reverberation times for building interiors*, the appropriate noise criteria to adopt is residential buildings, which has been reproduced below in Table 3.

**Table 3 – Recommended design sound levels from AS/NZS 2107**

Type of occupancy/activity	Recommended design sound level, $L_{Aeq}$ , dB(A)	
	Satisfactory	Maximum
<b>5 RESIDENTIAL BUILDINGS</b>		
Houses in areas with negligible transportation		
Sleeping areas	25	30
Houses and apartments near minor roads		
Living areas	30	40
Sleeping areas	30	35
Work areas	35	40
Apartment common areas (e.g. foyer, lift lobby)	45	55
Houses and apartments near major roads		
Living areas	35	45
Sleeping areas	30	40
Work areas	35	45
Apartment common areas (e.g. foyer, lift lobby)	45	55

## 4.0 Noise Modelling

This traffic noise impact assessment addresses the expected future noise conditions for traffic volumes in 2021. Modelling has been conducted with the assumption that the dwellings adjacent to the roads of this noise study are likely to be two storeys. In some cases however, planning controls will limit the height of some residences to one level only.

Traffic noise predictions were carried out in accordance with United Kingdom, Department of Environment/Transport (UKDOE), Welsh Office HMSO, „Calculation of Road Traffic Noise“ manual published 1988 (updated from 1975 version) (CoRTN). The CoRTN algorithms are implemented in the *SoundPLAN* Version 7.0 software.

The CoRTN methodology has been verified for Australian conditions in a comprehensive study carried out for the Australian Road Research Board, R Saunders, S Samuels, R Leach and A Hall, “An evaluation of the UK DoE, Traffic Noise Prediction Method”, ARR No. 122. This study was updated in 2002 as summarised in Austroads Publication No. AP–T14/02 “An Approach to the Validation of Road Traffic Noise Models”.

The validation of the CoRTN model suggested that the method generally over predicted noise levels, i.e. it is slightly conservative. There is however some cases where it does under predict noise levels.

The implementation of the CoRTN method in *SoundPLAN* has been verified both by the authors of *SoundPLAN* and by AECOM.

Noise modelling was undertaken at heights of 1.5 metres and 4.2 metres above ground level in order to represent both single and double storey dwellings.

The existing road surface is Dense Graded Asphalt (DGA) and therefore surface correction has not been applied.

### 4.1 Road Traffic Noise Model Parameters

Individual dwellings have been modelled as two storey dwellings with receivers located at the ground and first floor levels relative to the buildings. The exception to this is the multi-unit dwellings located in Section DF. We have been advised that planning controls will limit the heights of these units to one level and have therefore modelled these dwellings as such. The height of each building is relative to the ground based on the current grading plan provided by the client and third party consultants.

It is expected that in the future, Gundaroo Drive will be duplicated on the southern side between Barton Highway and Nudurr Drive. To model this duplication, the existing road alignment has been duplicated to the south with an 8 metre median in the middle. The new duplicated road follows the same terrain height as the existing carriage way.

## 4.2 Road Traffic Data

Future road traffic data for this study has been provided by the Client and ACTPLA and is summarised below in Table 4. This road traffic data is representative of the predicted traffic volumes in the year 2021.

Table 4 - Traffic Flow Data

Road	Future (2021)	
	Annual Average Daily Traffic	Percentage Heavy Vehicles (%)
Barton Highway	22,500	9
Gundaroo Drive	27,500	5
Nudurr Drive	9,500	1

### 4.2.1 Barton Highway

The following design inputs were used in the future prediction model:

- Traffic speed was 100 km/hr, and 40 km/hr through each roundabout.
- The road surface was modelled with Dense Graded Asphalt (DGA), with no road surface correction.
- The 18 hour traffic flow is assumed to be 94% of the Annual Average Daily Traffic (AADT).
- The Ground Absorption Coefficient of the study site close to the road is 0.75.

### 4.2.2 Gundaroo Drive

The following design inputs were used in the future prediction model:

- Traffic speed was 80 km/hr, and 40 km/hr through each roundabout.
- Duplicated carriage way.
- The road surface was modelled with Dense Graded Asphalt (DGA), with no road surface correction.
- The 18 hour traffic flow is assumed to be 94% of the Annual Average Daily Traffic (AADT).
- The Ground Absorption Coefficient of the study site close to the road is 0.75.

### 4.2.3 Nudurr Drive

The following design inputs were used in the future prediction model:

- Traffic speed was 80 km/hr, and 40 km/hr through each roundabout.
- The road surface was modelled with Dense Graded Asphalt (DGA), with no road surface correction.
- The 18 hour traffic flow is assumed to be 94% of the Annual Average Daily Traffic (AADT).
- The Ground Absorption Coefficient of the study site close to the road is 0.75.

## 4.3 Traffic Noise Due to Bus Movements

A future bus route through the streets of Crace is proposed. To impact fewer residences, consideration should be given to the route, such as limiting it past commercial land and parks. Routes should also be confined to collector roads where possible.

At the present time, no information has been published regarding the frequency of any future bus route. It is therefore unknown to what extent bus noise may affect future residents. It is assumed that a maximum frequency of two busses per hour in each direction (total of four busses per hour) would occur. Such an infrequent number of bus passbys would not influence  $L_{10(18 \text{ hour})}$  or  $L_{10(1 \text{ hour})}$  noise levels. It is therefore difficult to assess this type of noise in accordance with any known criterion.

AECOM have carried out attended measurements to determine typical noise emissions from A.C.T. buses. Noise measurements were carried out at the corner of Kate Crace Street and Hibberston Street in Gungahlin. The noise levels were measured at a distance of approximately 15 metres. An average  $L_{Amax}$  noise level of 69 dB(A) was measured for 14 bus movements.

Bus passbys will result in temporary increases in internal noise levels within residences. These temporary increases cannot be feasibly mitigated by building construction elements. Internal noise levels at the time of bus passbys may not meet the criterion described in AS 2107 (see Table 3). However, AS 2107 states that noise levels should be obtained over "an appropriate measurement period" which would typically be 15 minutes. Internal noise levels for residences within Crace and obtained over "an appropriate measurement period" will meet AS 2107.

## 5.0 Road Traffic Noise Modelling Results

The future road traffic noise levels for Crace were predicted using the computer noise model and the traffic data described in Section 4.0 above.

### 5.1 Modelling Process

The computer noise model has been refined over the last 18 months in conjunction with CIC Crace and urban planners. During this time, several noise berms have been designed to reduce the traffic noise impact along Barton Highway and Gundaroo Drive for affected residential sections. Appendix A shows these noise berms in detail.

### 5.2 Results Summary

Table 5 below presents a summary of the modelled results indicating the number of modelled residential blocks exceeding criteria for each scenario defined above.

In several cases (within Section DU and Section EA), we have not counted a block as being affected if the predicted noise contour has minimally encroached upon a block or as is specified in the criteria "Within a recreational courtyard of private open space not facing the road source, the noise levels should be 58 dB(A) L<sub>10</sub>(18 hour)." . In these instances, the minimum setback distances required between the residential block and the front building facade would result in the predicted noise level not exceeding the criterion at the facade.

**Table 5 - Number of Receivers over Criteria**

Dwelling Levels	Number of Residential Blocks Exceeding Criteria (in the year 2021)
Ground Level	2
First Floor	25*

\*At the first floor level, the multi-unit section DF has not been included in this figure as planning controls will limit the height of these dwellings to one storey.

Appendix B graphically presents the façade corrected noise levels along the three roads bounded the Crace Subdivision development. A façade correction of +2.5 dB is used to account for additional reflection of sound from the façade. As such, contours presented within Appendix B display a 60.5 dB contour to account for the 63 dB facade corrected criterion required.

Appendix C presents the detailed results of façade corrected noise levels for specific residential blocks along the perimeter of Crace whose noise level exceeds the criteria.

The results presented in Appendix B and Appendix C shows that the designed noise berms are effective for the adjacent blocks.

## 6.0 Noise Control Discussion

### 6.1 Future External Noise Levels

Within this report, external noise levels due to traffic from the Barton Highway, Gundaroo Drive and Nudurr Drive have been modelled and found to exceed the criterion at various residential blocks within the Crace subdivision.

A total of two blocks within the whole development (stages 1, 2 and 3) will exceed the criteria at ground level, these are shown on page C2. Within Stage 3 there is only one affected block that will exceed external noise criterion with future traffic flows in the year 2021. The multi-unit Section DF in Stage 2 is also predicted to exceed external noise criterion with future traffic flows in the year 2021 at the ground level

Twenty five residential blocks have been shown to exceed external noise criterion with future traffic flows in the year 2021 at the first floor level across Stages 1, 2 and 3.

### 6.2 Treatments to Dwellings

Where the predicted external traffic noise levels do not comply with the criterion established in Section 3.0, additional treatments to the dwellings are available to control the traffic noise intrusion into the building. Treatments are only required for the appropriate level of the dwelling for the affected facade/s.

Potential treatments include:

- Fencing designed as noise barriers;
- Setbacks from noise sources;
- Internal layout of houses;
- Increased glazing requirements.

Upgraded glazing would only be required to habitable rooms and external doors opening onto habitable rooms. Habitable rooms are defined as living, dining, and bedrooms. They exclude bathrooms, laundries and corridors. They may apply to open plan kitchens. These treatments may need to be supplemented with mechanical ventilation and air-conditioning to enable windows to be kept closed during high traffic noise periods.

An indicative 1.8m high fence has been modelled 2 metres in from the western boundary of two residential blocks in Stage 3 (Appendix C) in accordance with The Territory Plan. Only the northern one actually requires noise mitigation as the southern one is not affected under the criteria. This indicative fence has the potential to shield the traffic noise intrusion to the Stage 3 dwellings from Gundaroo Drive traffic noise.

For residential blocks shown to exceed the criterion, treatments need to be designed to achieve internal noise levels in accordance with AS/NZS 2107 (Section 3.0). The noise criteria adopted in AS/NZS 2107 are an  $L_{Aeq}$  criterion, whereas the road traffic noise criteria are in the form of an  $L_{A10}$  criteria. For steady flowing road traffic, it is common to adopt  $L_{Aeq} = L_{A10} - 3 \text{ dB(A)}$ . Therefore an  $L_{A10} 63 \text{ dB(A)}$  is equivalent to  $L_{Aeq} 60 \text{ dB(A)}$ . For sparse traffic or uneven traffic distribution the difference may be greater.

## 7.0 Conclusions

The traffic noise impacts from the Barton Highway, Gundaroo Drive and Nudurr drive have been assessed. This assessment was carried out using the future traffic flows for the year 2021, as provided by the client and ACTPLA.

Predicted external noise levels are expected to exceed the criterion at various residential blocks along the perimeter of Crace. These residential blocks have been identified in Appendix C. Indicative treatments for dwellings located on these residential blocks are provided within Section 6.2.

## Appendix A

# Noise Berms

## Appendix A Noise Berms

Figure 1 Noise berm for Stage 1 and 3 along Gundaroo Drive

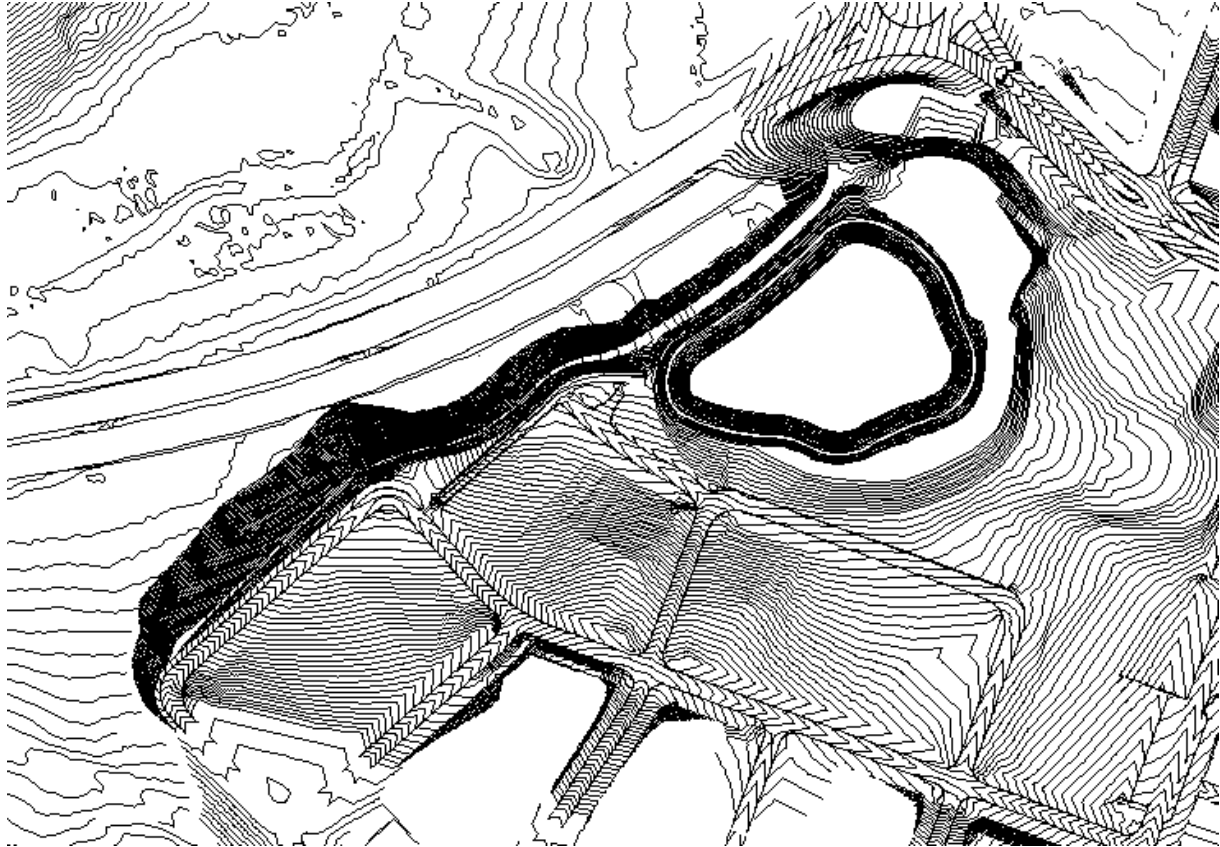


Figure 2 Noise berm for Stage 1 along Gundaroo Drive

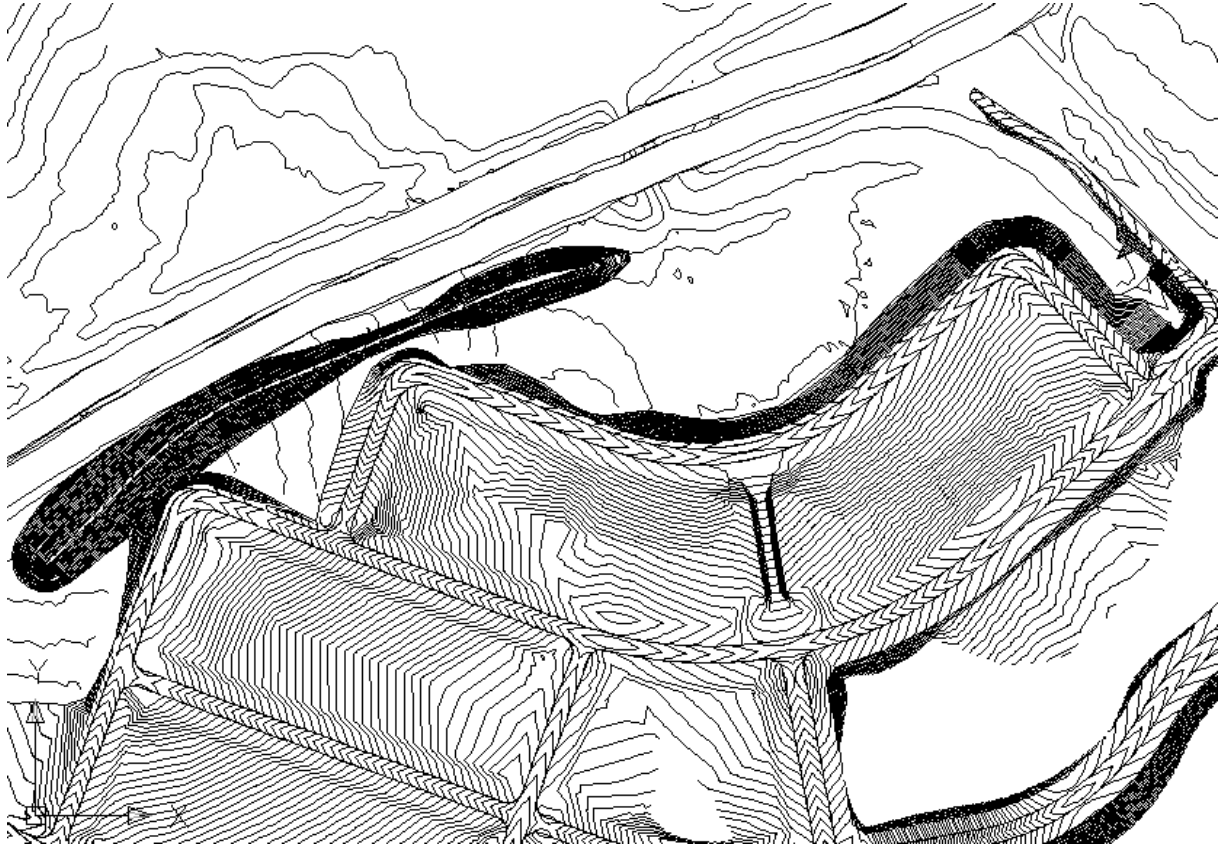


Figure 3 Noise berms for Stage 1 along Barton Highway

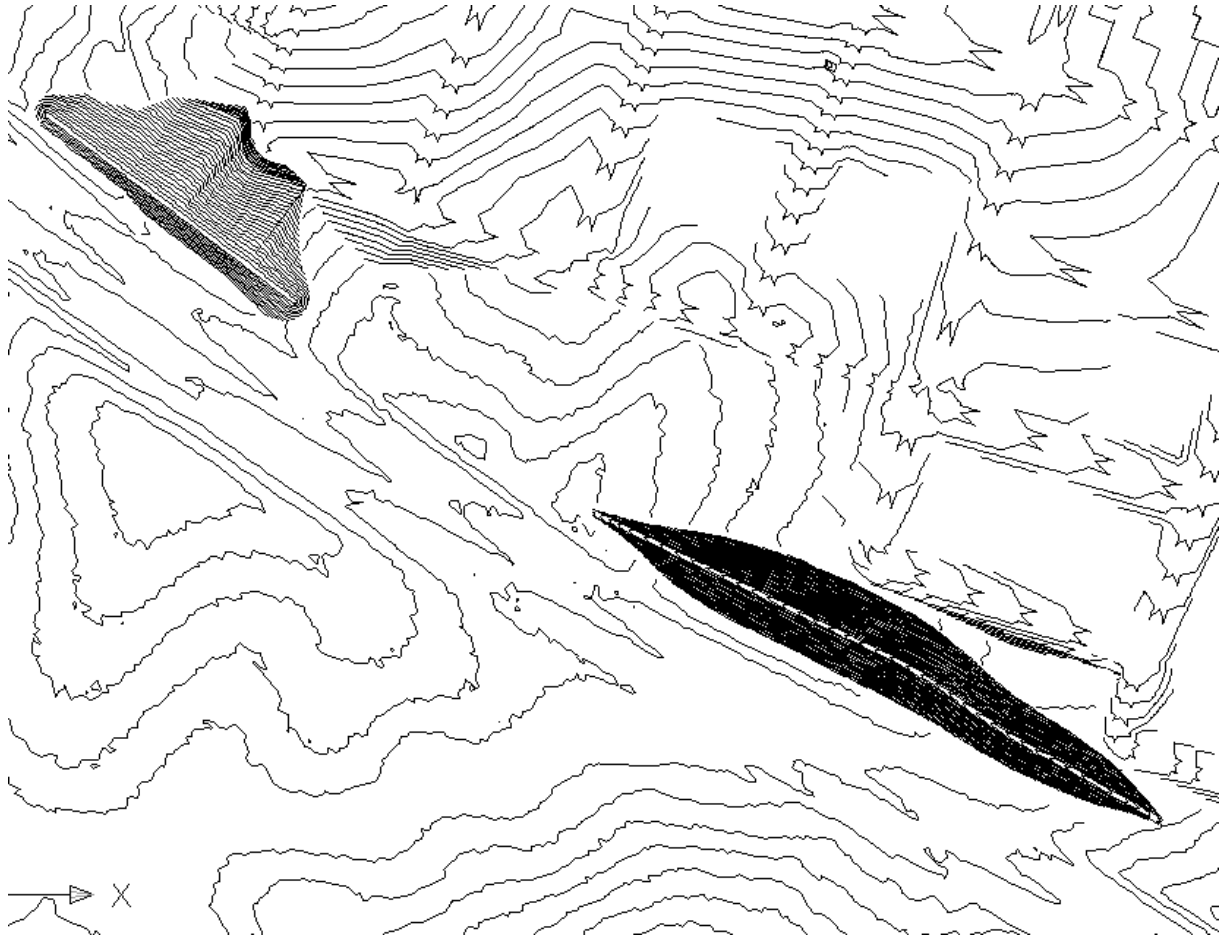


Figure 4 Noise berms for Stage 2 along Barton Highway



Appendix B

# Noise Assessment Results

## Appendix B Noise Assessment Results



Signs and symbols

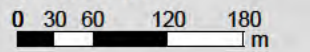
- Road
- House
- Fence

Noise level  
L10(18h)  
in dB(A)

- $\leq 60.5$
- $60.5 <$



A3 SCALE 1:6000



PROJECT:  
Crace, Subdivision

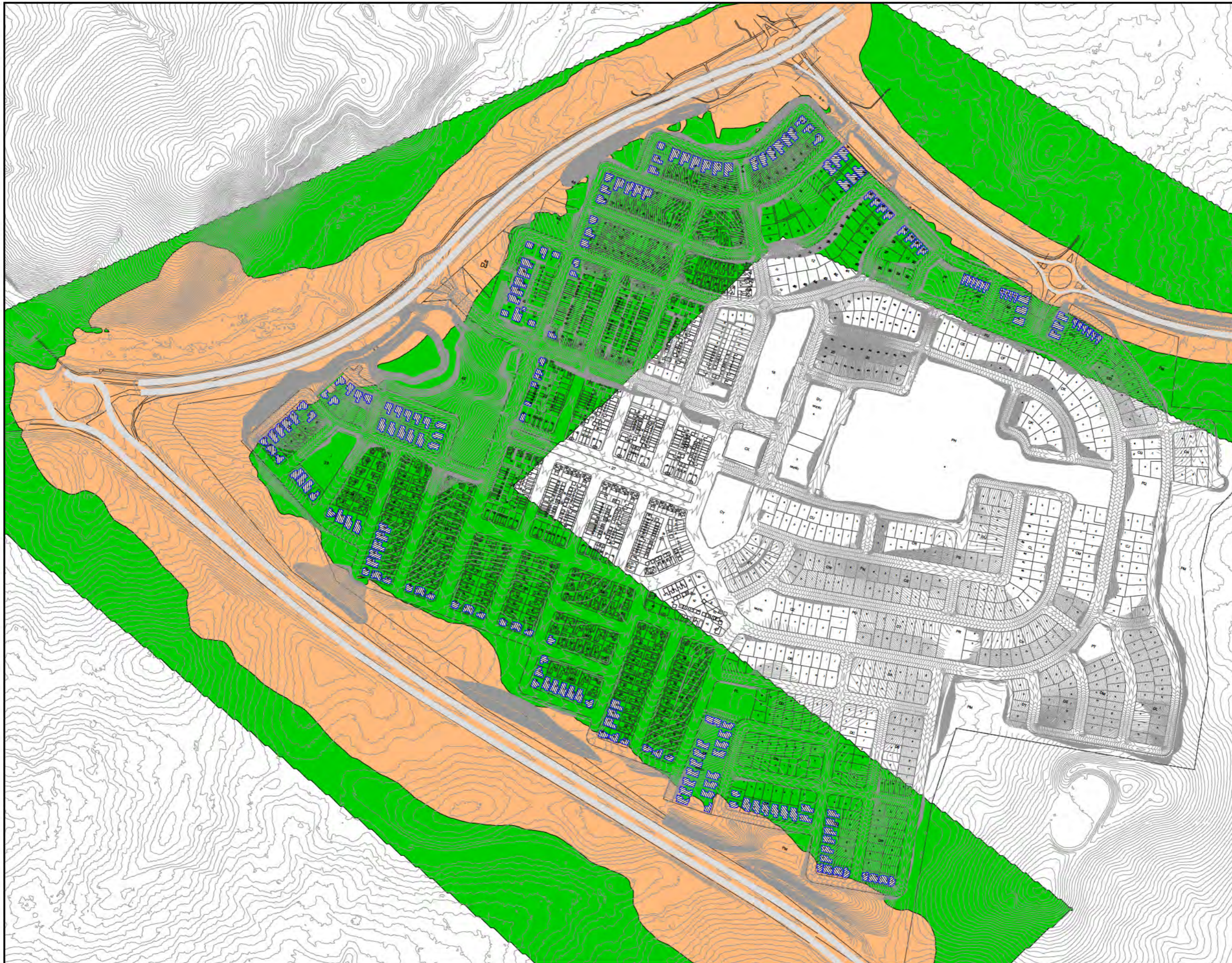
CLIENT:  
CIC Crace Pty. Ltd.

PREDICTED NOISE CONTOURS  
Future Traffic 2021  
Ground Floor (1.5 m)  
Stage 1, 2 & 3  
Nurdurr Drive extended

SHEET: 1 of 1      REVISION: 1

PREPARED:  
CH 21/04/11





Signs and symbols

- Road
- House
- Fence

Noise level  
L10(18h)  
in dB(A)

- $\leq 60.5$
- $60.5 <$



A3 SCALE 1:6000  
0 30 60 120 180  
m

PROJECT:  
Crace, Subdivision

CLIENT:  
CIC Crace Pty. Ltd.

PREDICTED NOISE CONTOURS  
Future Traffic 2021  
First Floor (4.2 m)  
Stage 1, 2 & 3  
Nurdurr Drive Extended

SHEET:  
1 of 1

REVISION:  
1

PREPARED:  
CH 21/04/11



## Appendix C

# Detailed Results of the Residential Blocks Exceeding the Noise Criteria

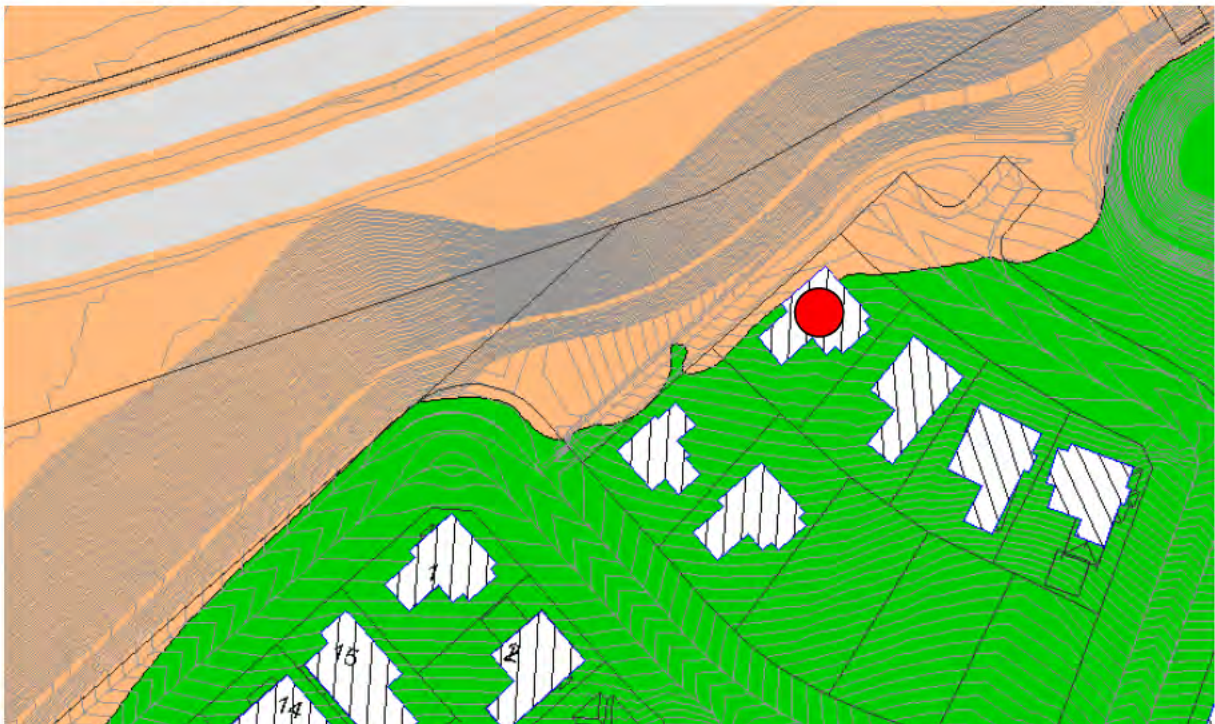
## Appendix C Detailed Results of the Residential Blocks Exceeding the Noise Criteria

**Ground Floor**

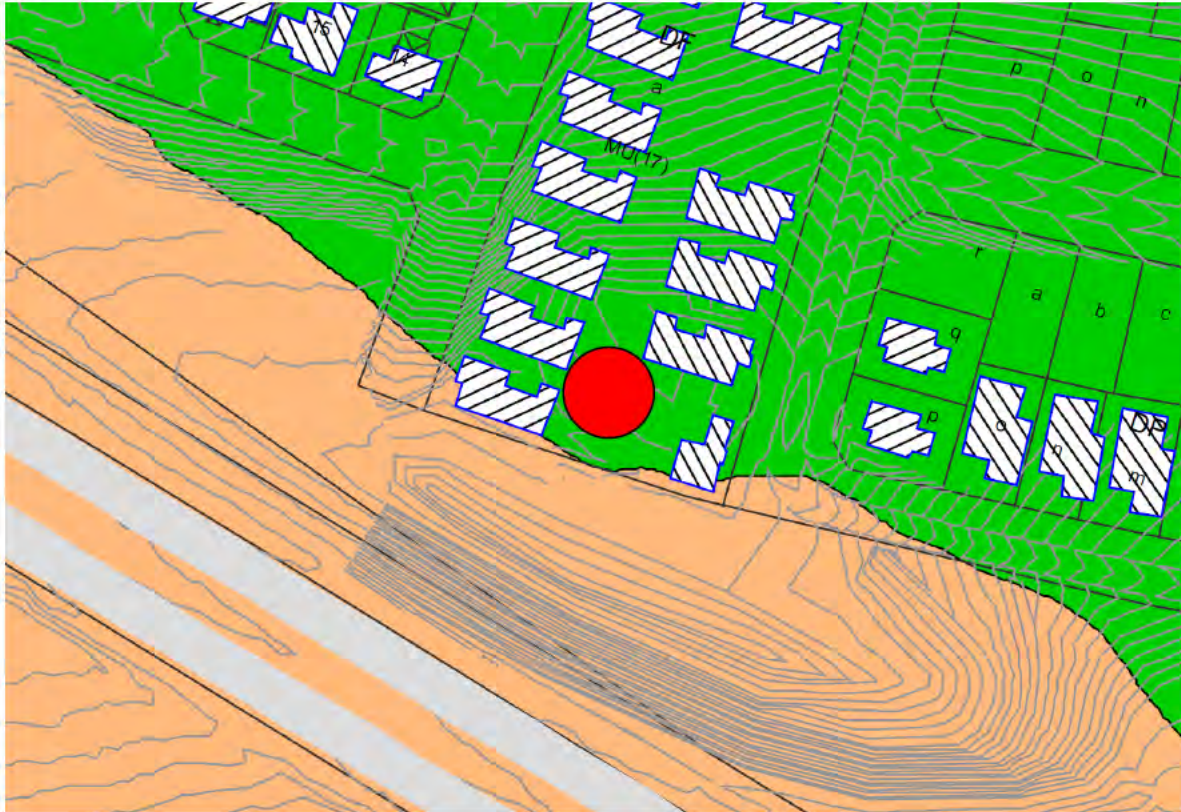
**Showing the location of one property within Stage 3 affected at ground level (with fence)**



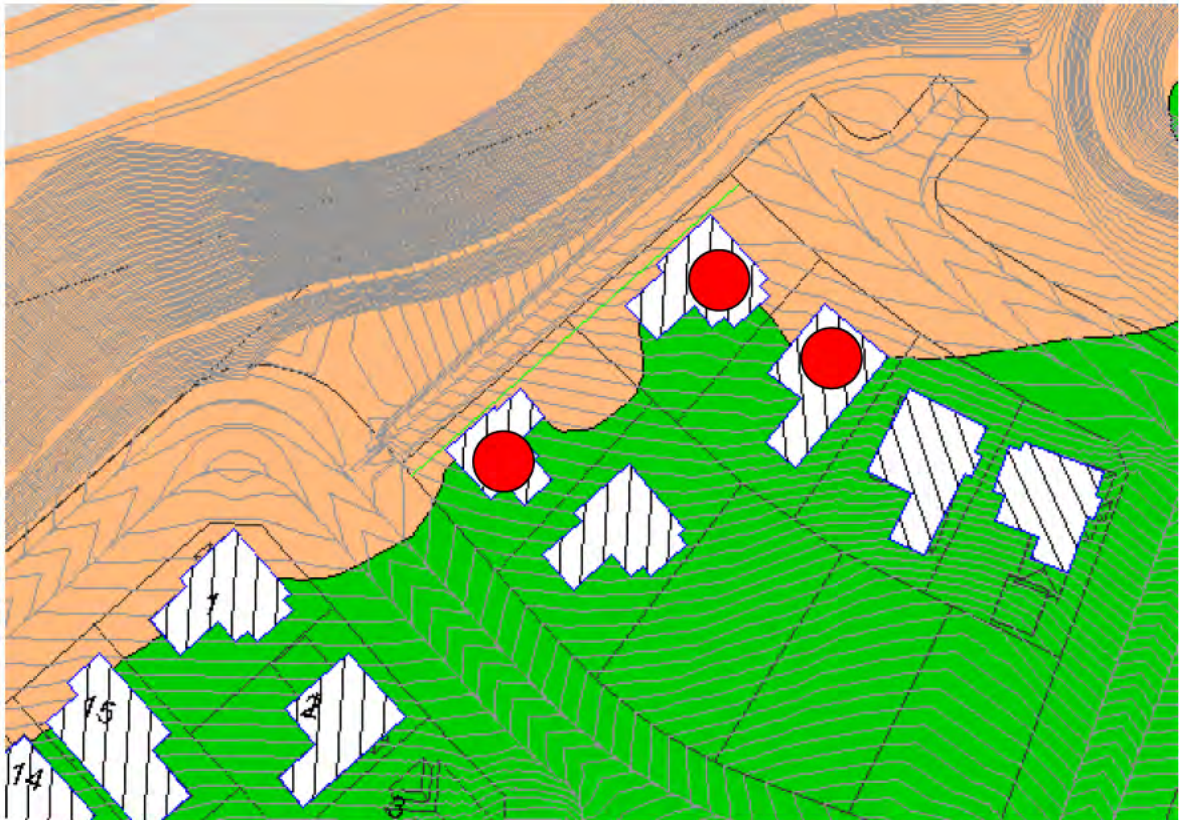
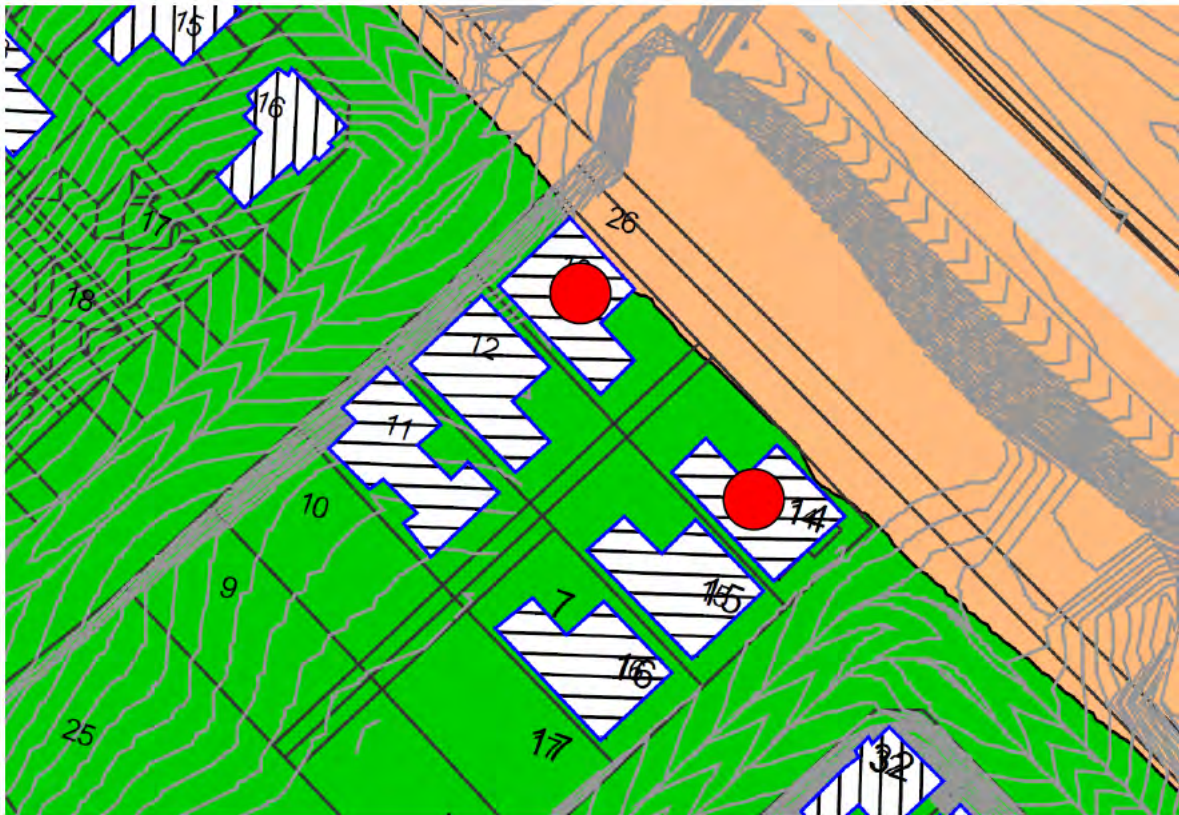
**Showing the location of one property within Stage 3 affected at ground level (without fence)**

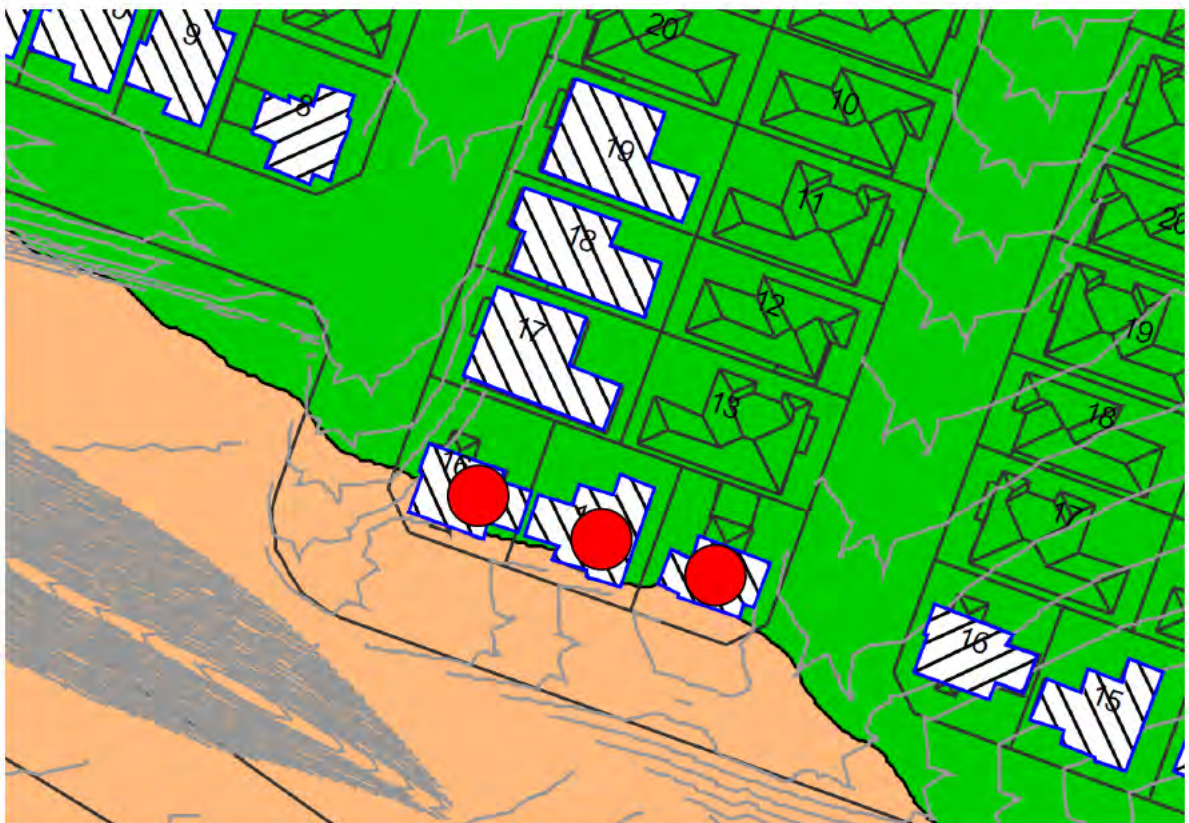
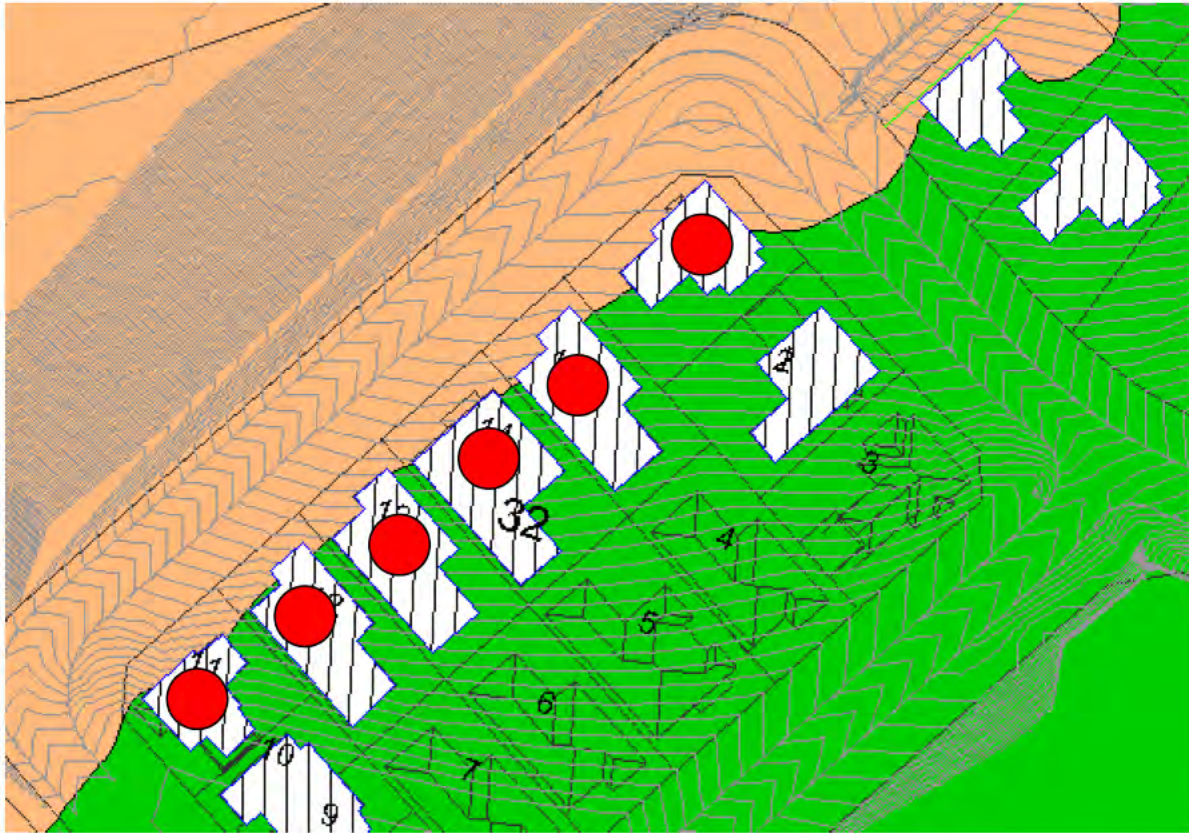


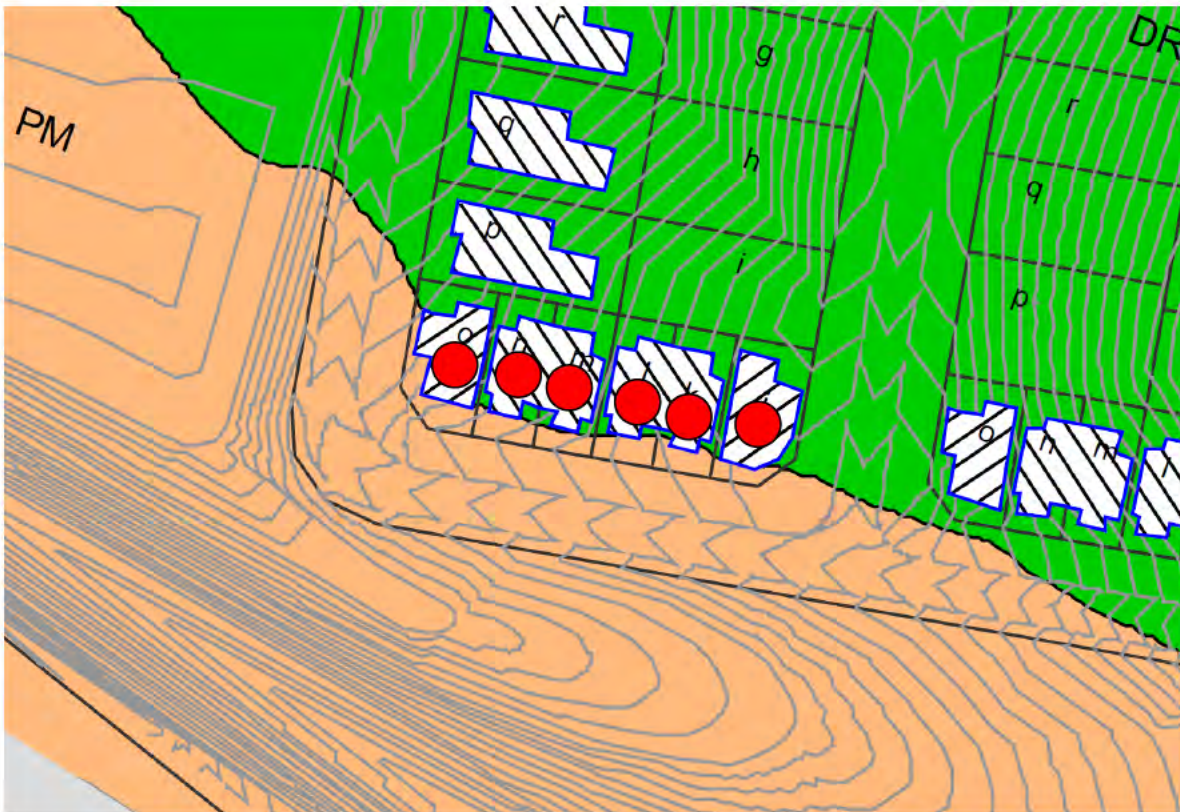
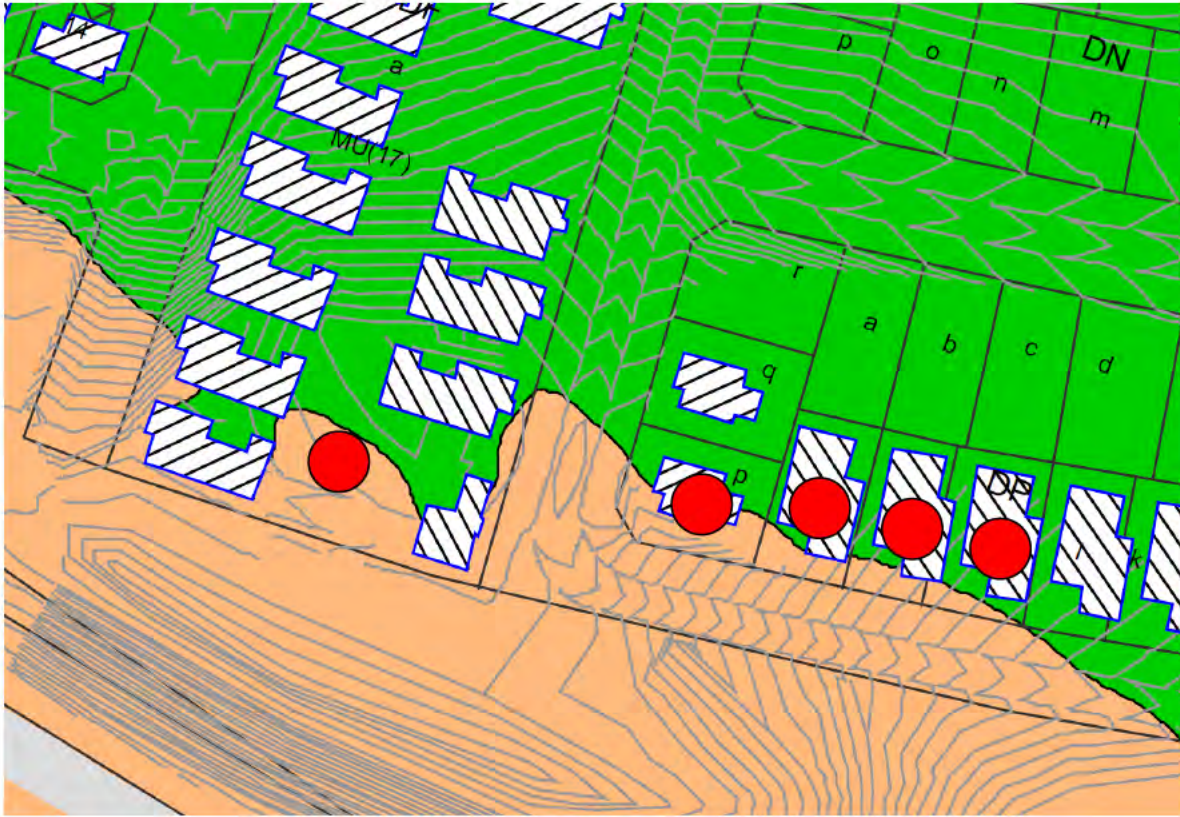
**Showing the location of affected Section DF at ground level**



First Floor







## Appendix D

Previous report done by  
Bassett dated January  
2009

## Appendix D Previous report done by Bassett dated January 2009



# Crace Acoustic Assessment

Canberra Investment Corporation Limited

11 Jan 2009

Document No.: 60043094 PRACO 002\_2

# Acoustic Assessment

CIC

Prepared for

**Canberra Investment Corporation Limited**

Prepared by

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11 Jan 2009

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Ref 60043094

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Prepared by Mark Latimore

Reviewed by Alan Subkey

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			Name/Position	Signature
A0	27/03/2008	Internal Draft	Alan Subkey Acoustics Manager, Canberra	
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2	11/02/2009	Issued to Client	Alan Subkey Acoustics Manager, Canberra	

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## Executive Summary

Bassett Acoustics assessed the road traffic noise impacts previously in our report PC2008-084 MCLA1.REP, from the Barton Highway, Gundaroo Drive and Nudurr Drive at the proposed suburb, Crace, for current and future traffic flows. This report supersedes the earlier report.

This report details the results of additional noise modelling to reflect the current lot layout and site information provided by the client as of January 2009. The location of noise berms for the north west and south west sides of the site have been provided by the client and included in the re-run of the acoustic model. The following report also includes indicative noise berms along Barton highway initially proposed in our report PC2008-084 MCLA1.REP dated 11 April 2008. It is expected that these indicative noise berms will be further designed by the client at a later stage.

To predict external noise levels for current and future traffic flows, computer modelling has been used with validation from measured data on site. Traffic flows have been based on information gained from TAMS. For future noise predictions, Gundaroo Drive has been duplicated, in our model, on the Crace side between the Barton Highway and Nudurr Drive.

Noise receivers have been modelled at ground and first floors of each proposed dwelling on the perimeter of Crace. Dwellings that have external noise levels that exceed the designated criterion have been identified.

**Table 1 Number of Receivers Exceeding Criteria**

	Current Traffic Predictions 2008	Future Traffic Predictions
Ground Level	0	0
First Floor	2	12

House treatments to achieve an appropriate internal noise level are available and can be designed for dwellings exceeding the external noise criteria during a detailed design phase.

## 1.0 Introduction

Bassett Acoustics has been commissioned by Canberra Investment Corporation Limited to carry out an impact assessment of road traffic noise from three roads bounding the Crace subdivision development site. The three main roads are Gundaroo Drive, Barton Highway and Nudurr Drive.

Crace subdivision residential development forms the study site of this assessment. The north-western boundary of the study site is Gundaroo Drive and is approximately 1300m. The south-western boundary of the study site is the Barton Highway. Nudurr Drive is located north of the site.

The purpose of this report is to:

- Predict the extent of road traffic noise impact on the study site from Gundaroo Drive, the Barton Highway and Nudurr Drive for future road traffic conditions,
- Assess road traffic noise levels in accordance with the requirements of the ACT Planning Authority's Noise Management Guidelines, 1996 (Draft) and provide indicative noise attenuation measures to reduce noise levels where exceedences are found.

This assessment is based on the following plans and documents:

- Electronic version of the lot configurations supplied on 6/08/08 by CIC,
- Site grading plan and architectural information supplied on 22/08/08 by Tract Consultants,
- Noise berm details supplied on 14/01/09 by Brown Consulting.
- Existing road alignments supplied on 28<sup>th</sup> March 2008 by Bill Guy & Partners Pty Ltd.
- Current and Future traffic flows for Gundaroo Drive and Nudurr Drive established by Maunsell and the Office of Transport Roads ACT.

## 2.0 Site Description

The study site is located approximately 8km north of Canberra CBD, west of where Gundaroo Drive and Barton Highway meet (Figure 1). It is bounded to the north west by Gundaroo Drive, to the south west by Barton Highway and to the north east by Nudurr Drive. The study site will be used for residential usage.

### **Gundaroo Drive**

Gundaroo Drive currently carries one lane of traffic in each direction with a posted speed of 80km/hr. The existing road surface is Dense Graded Asphalt (DGA) and therefore has no road surface correction. Future predicted traffic flows are based on a duplication of Gundaroo Drive. The predicted noise levels within this report for future traffic flows are based on the current road alignment and can be updated once details of the road duplication are known.

### **Barton Highway**

Barton Highway has two lanes of traffic in each direction. A slip lane exists at the roundabout when travelling from Gundaroo Drive to the Barton Highway. The posted speed is 100km/hr. The existing road surface is Dense Graded Asphalt (DGA) and therefore has no road surface correction.

### **Nudurr Drive**

Nudurr Drive currently carries one lane of traffic in each direction with posted speed of 80km/hr. Future noise level predictions within this report are based on the extension of Nudurr Drive to Gungahlin Drive. The existing road surface is Dense Graded Asphalt (DGA) and therefore has no road surface correction.

### 3.0 Road Traffic Noise Criteria

The appropriate criteria for assessing traffic noise for the Crace development is established in the draft ACT Noise Management Guidelines (ACT Planning Authority 2006).

The guidelines stipulate that for new developments on existing roads, the maximum noise levels from traffic at a point 1 metre in front of the façade of the nearest affected residential dwelling should be 63 dB(A) $L_{10}$  (18 hour). Within a recreational courtyard of private open space not facing the road source, the noise levels should be 58 dB(A) $L_{10}$  (18 hour). The guidelines also state that: 'if this is not achievable through appropriate setback distances from the road, the applicant will be required to demonstrate that, by the use of external noise attenuation features or by appropriate noise attenuation treatments incorporated within the structure, the internal noise levels will meet those in AS/NZS 2107: 2000'.

**Table 2– Summary of Noise Criteria at Noise Sensitive Places**

Criteria	Description	Criterion dB(A)
Residential Areas	Façade corrected $L_{10}$ (18 hour)	63
Private Open Space	External Free-Field $L_{10}$ (18 hour)	58
Commercial Facilities	$L_{10}$ (18 hour)	75

Residential dwellings adjacent to the roads of this study have been positioned such that each front façade faces the direction of the noise source. Therefore the appropriate criterion is a façade corrected  $L_{10}$  (18 hour) of 63dB(A).

## 4.0 Noise Measurements

The ambient background noise was logged at three different locations along the boundary of the study site. Measurements were conducted between Friday 14<sup>th</sup> and Saturday 22<sup>nd</sup> of March 2008. Additional measurements were taken along the Barton Highway from Friday 4<sup>th</sup> April to Wednesday 9<sup>th</sup> April 2008.

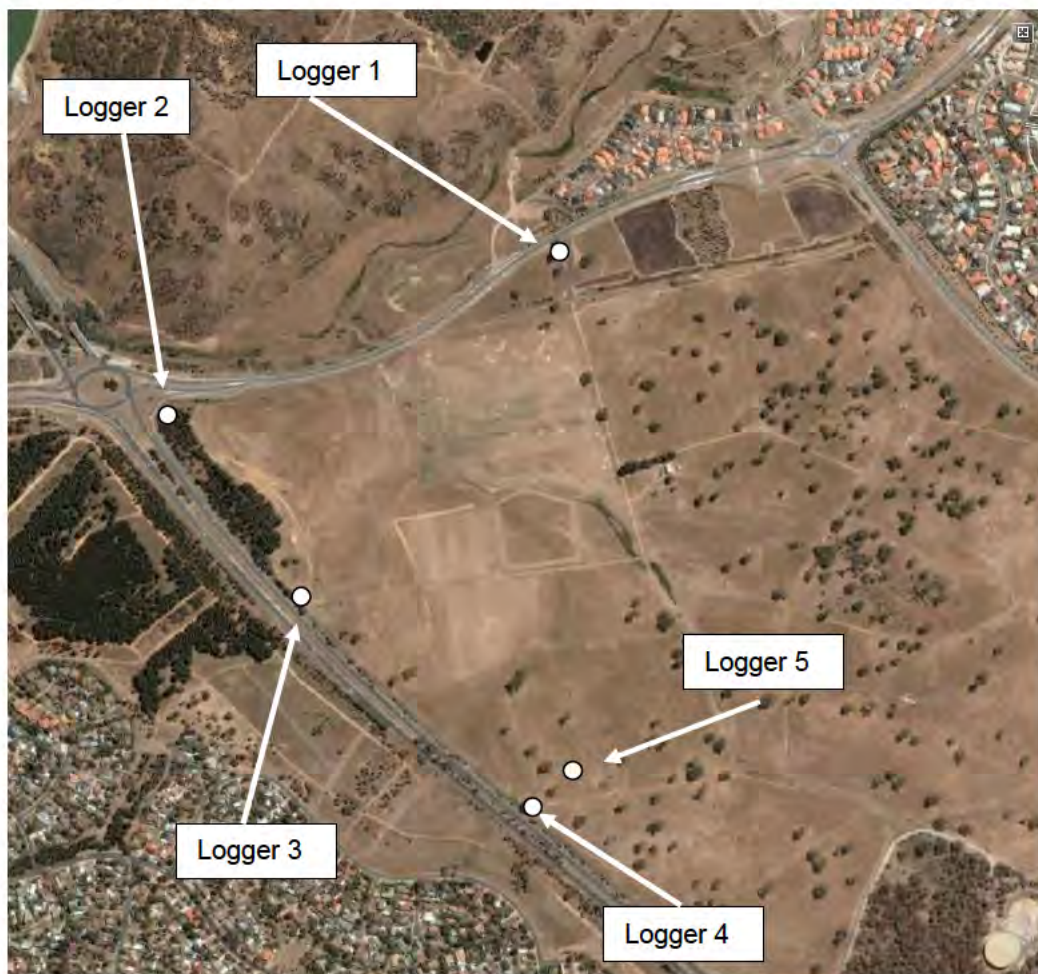
Logger 1 was located on Gundaroo Drive just west of a service road. The equipment microphone was on an embankment approximately 2m above road level, and had direct line of site with traffic along Gundaroo Road.

Logger 2 was located near the roundabout at the intersection on Gundaroo Drive and Barton Highway. The logger was positioned amongst trees with a direct line of sight to both main roads and the through traffic of the roundabout.

Logger 3 was located on Barton Highway on a 2 m embankment approximately 460 m from the roundabout. Logger 3 had a direct line of sight to both directions of traffic on Barton Highway.

Loggers 4 and 5 were positioned along the Barton Highway for additional noise measurements.

Figure 1 – Aerial view of the Study site.



The calibration of the instruments was checked before and after data acquisition against a calibrated reference source. There was no discernible drift.

## 4.1 Instrumentation

The instrumentation used for measuring road traffic noise at the site is outlined in the table below.

Table 3– Instrumentation

Instrument	Serial Number	Calibration Date
Rion NC-73 Sound level Calibrator	10302481	7 <sup>th</sup> July 2007
Rion NL-21 Sound Level Meter	00765699	25 <sup>th</sup> October 2006
SVANTEK 949 Sound Level Meter	8134	4 <sup>th</sup> April 2007
SVANTEK 949 Sound Level Meter	8137	29 <sup>th</sup> May 2006

## 4.2 Existing Ambient Noise Environment

Appendix A presents the measured ambient noise levels at the study site at Location 1, 2 and 3. Table 4 below summarises these measured noise levels.

Table 4– Summary of Logged Noise Levels

Logger Location	Logging Start Date	Logging Finish Date	L10 (18 hour)
Gundaroo Drive (Logger 1)	14 <sup>th</sup> March 2008	22 <sup>nd</sup> March 2008	71.2 dB(A)
Roundabout (Logger 2)	14 <sup>th</sup> March 2008	21 <sup>st</sup> March 2008	63.0 dB(A)
Barton Hwy (Logger 3)	14 <sup>th</sup> March 2008	22 <sup>nd</sup> March 2008	71.7 dB(A)
Barton Hwy (Logger 4)	4 <sup>th</sup> April 2008	9 <sup>th</sup> April 2008	68.5 dB(A)
Barton Hwy (Logger 5)	4 <sup>th</sup> April 2008	5 <sup>th</sup> April 2008	56.6 dB(A)

Weather conditions during noise logging were acceptable and no alteration to the data is required. The ambient levels at each monitoring location were controlled by traffic noise.

The noise logger at Location 2 measured noise levels close to the roundabout. Noise levels close to roundabouts and traffic lights are difficult to model due to variations in traffic speeds and flows. Location 2 has therefore not been used to validate the noise model.

For model validation, locations 1, 3, 4 and 5 were used as shown below in Section 4.3. These locations have constant traffic speed and flows and therefore are a better calibration point for CORTN predictions.

### 4.3 Validation of Road Traffic Model

#### 4.3.1 Design Inputs

The following road traffic data in Table 5 below was used to validate the road traffic noise model. This data was based on information supplied by the Office of Transport Roads ACT. The data provided is assumed to be the most accurate data available relating to traffic flows of the measurement period in March 2008.

Table 5— 2008 Traffic Flow Data

Road	Current (2008)	
	Average Daily Traffic	Percentage Heavy Vehicles (%)
Barton Highway	15,100	9
Gundaroo Drive	17,400	4
Nudurr Drive	3,200	1

The following design inputs have also been included in the validation model:

- The speed limit is 100 km/hr for the Barton Highway and 80 km/hr for Gundaroo Drive and Nudurr Drive, and have been modelled as these speeds. Traffic speeds through roundabouts have been modelled as 40 km/hr.
- The road surface for each road was modelled as Dense Graded Asphalt (DGA), with no road surface correction.
- The 18 hour traffic flow was assumed to be 94% of the Annual Average Daily Traffic (AADT).
- A Ground Absorption Coefficient of 0.75 was included in the model for areas within the road

#### 4.3.2 Prediction of Road Traffic Noise Levels

For the original report, road traffic noise emission was calculated using the Calculation of Road Traffic Noise (CoRTN) algorithms contained within the *SoundPLAN 6.4* software road traffic module. Subsequent re-runs of the acoustic model have been performed using and updated version of the acoustic software, *SoundPLAN 6.5*. No significant variation is expected with the updated software.

Point receivers were modelled 1.5m above the ground at the same locations as measurements were taken. The results of 2008 modelling Vs measurements are presented below in Table 6.

Table 6— Measured and Predicted Traffic Flow Data

Measurement Location	L10 (18 hour) dB(A)		
	Measured (2008)	Calculated (2008)	Accuracy
Location 1 (Gundaroo Drive)	71.2	71.9	0.7
Location 3 (Barton Highway)	71.1	71.7	0.6
Location 4 (Barton Highway)	68.5	68.3	0.2
Location 5 (Barton Highway)	56.6	58.0	1.4*

\* Incomplete data was obtained at location 5. It is assumed that measured levels are closer to calculated levels at this location.

The existing traffic situation was modelled and found to be within  $\pm 1$  dB(A) of the measured noise levels. It is understood that previous acoustic modelling within the ACT region using TNoise software required a nominal correction factor of -3.7dB(A). The level of accuracy demonstrated above indicates that a correction factor is not required for this situation.

In other states of Australia, an accuracy of  $\pm 2$  dB(A) is considered acceptable. No further corrections have been made to the traffic noise predictions in the remainder of this report.

## 5.0 Noise Modelling

This traffic noise impact assessment addresses the likely future noise conditions. Construction of dwellings is expected to be started at the north eastern side of the development. The dwellings adjacent to the roads of this noise study are likely to be two storey.

Road traffic noise levels were modelled using the *SoundPLAN* Version 6.5 computer software which implements the CoRTN noise algorithms.

### 5.1 Road Traffic Noise Model Parameters

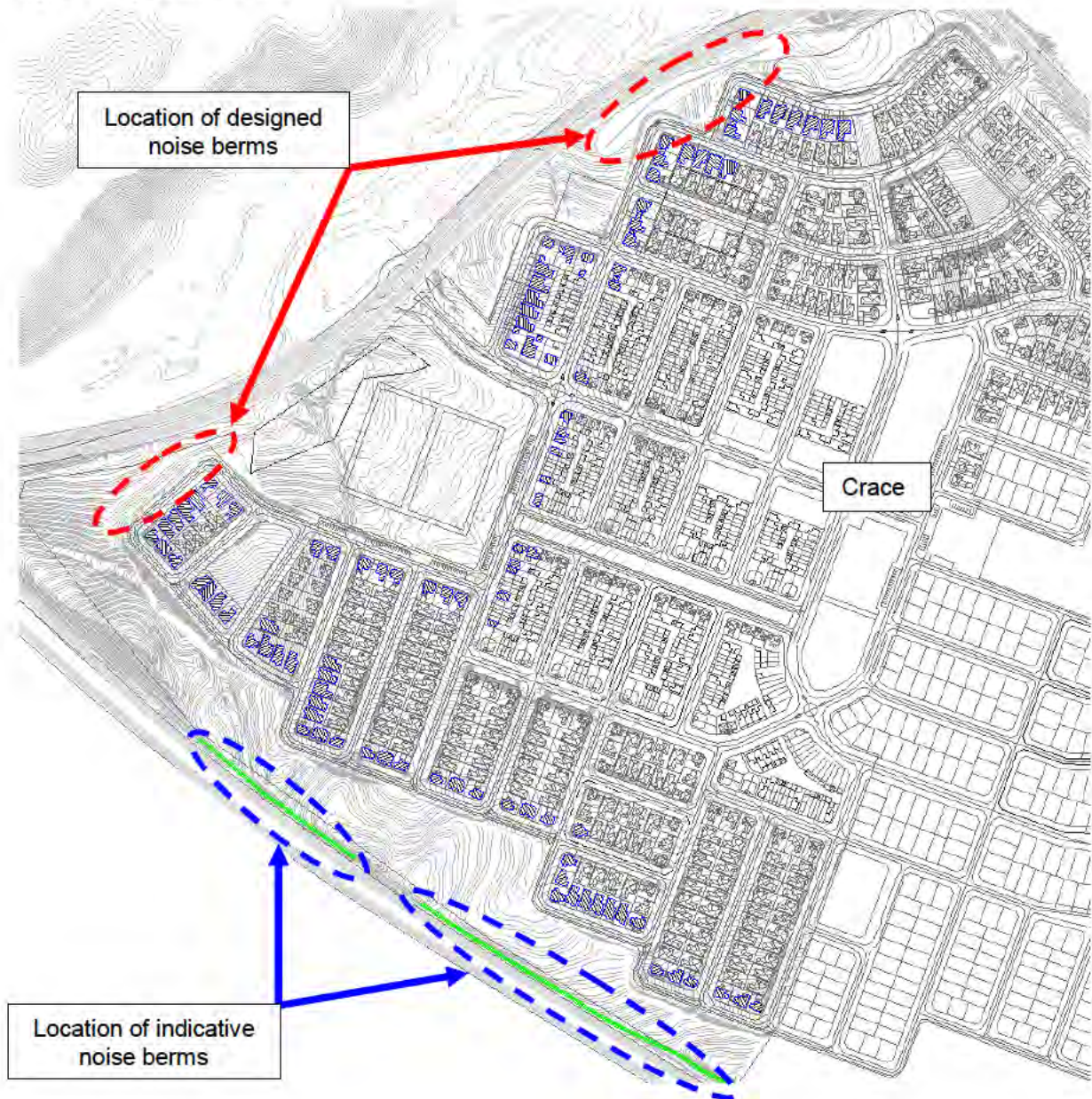
Individual dwellings have been modelled as two storey dwellings with receivers located at the ground and first floor levels relative to the buildings. The height of each building is based on the current grading plan provided by the client.

It is expected that in the future, Gundaroo Drive will be duplicated on the eastern side between the Barton Highway and Nudurr Drive. To model this duplication, the existing road alignment has been duplicated to the east with an 8 metre median in the middle. The new duplicated road follows the same terrain height as the existing carriage way and therefore as a result some natural berms and depressions have been created.

### 5.1.1 Designed Noise Berms

Designed noise berms were implemented into the acoustic model according to input from the client. Figure 2 indicates the two areas on the west side of the sub-division where designed noise berms have been implemented.

Figure 2 Image of noise berms



### 5.1.2 Indicative Noise Berms

Noise berms have been included in the model along the Barton Highway to represent indicative berm placement in the future. These berms have not been fully designed at this point in time. Note that the actual designed noise berms for the Barton Highway may require to be set back further from the road than these indicative berms for practical constraints. They will also require refining in terms of their length and height.

## 5.2 Road Traffic Data

Road traffic data for this study has been provided by the client and ACTPLA and is summarised below in Table 7.

Table 7 - Traffic Flow Data

Road	Current (2008)		Future	
	Annual Average Daily Traffic	Percentage Heavy Vehicles (%)	Annual Average Daily Traffic	Percentage Heavy Vehicles (%)
Barton Highway	15,100	9	22,500	9
Gundaroo Drive	17,400	5	27,500	5
Nudurr Drive	3,200	1	9,500	1

### 5.2.1 Gundaroo Drive

The following design inputs were used in the future prediction model:

- Traffic speed was 80 km/hr, and 40 km/hr through each roundabout.
- Duplicated carriage way.
- The road surface was modelled with Dense Graded Asphalt (DGA), with no road surface correction.
- The 18 hour traffic flow is assumed to be 94% of the Annual Average Daily Traffic (AADT).
- The Ground Absorption Coefficient of the study site close to the road is 0.75.

### 5.2.2 Barton Highway

The following design inputs were used in the future prediction model:

- Traffic speed was 80 km/hr, and 40 km/hr through each roundabout.
- The road surface was modelled with Dense Graded Asphalt (DGA), with no road surface correction.
- The 18 hour traffic flow is assumed to be 94% of the Annual Average Daily Traffic (AADT).
- The Ground Absorption Coefficient of the study site close to the road is 0.75.

### 5.2.3 Nudurr Drive

The following design inputs were used in the future prediction model:

- Traffic speed was 80 km/hr, and 40 km/hr through each roundabout.
- The road surface was modelled with Dense Graded Asphalt (DGA), with no road surface correction.
- The 18 hour traffic flow is assumed to be 94% of the Annual Average Daily Traffic (AADT).
- The Ground Absorption Coefficient of the study site close to the road is 0.75.

## 6.0 Road Traffic Noise Modelling Results

The future road traffic noise levels on the site were predicted using the acoustical model and the traffic data described in Section 5.0 above.

The following scenarios are presented within the results:

- Noise Levels from 2008 traffic flows.
- Noise Levels from future predicted flows.

### 6.1 Results Summary

Table 8 below presents a summary of the modelled results indicating the number of modelled receivers exceeding criteria for each scenario defined above.

Table 8 - Number of Receivers over Criteria

	Current Traffic Predictions 2008	Future Traffic Predictions
Ground Level	0	0
First Floor	2	12

Appendix B gives the detailed results presenting façade corrected levels for each dwelling along the perimeter of Crace. A façade correction of 2.5 dB is used to account for additional reflection of sound from the façade. Levels that exceed criteria are in **bold**.

## 7.0 Noise Control Discussion

### 7.1 Future External Noise Levels

External Noise levels from the Barton Highway, Gundaroo Drive and Nudurr Drive have been modelled within this report and found to exceed criterion at various locations of the Crace Subdivision. Up to 12 dwellings have been shown to exceed external noise criterion with future traffic flows. These 12 dwellings are within criteria on the ground level but exceed at the first floor level.

The addition of noise berms has been shown to reduce the impact of external noise at the ground level of various locations exceeding the noise criterion. First floor noise levels of these locations receive reduced noise mitigation effects from the noise berms compared to ground level receivers.

### 7.2 Treatments to Dwellings

Where the forecast external traffic noise levels do not comply with the criterion established above, additional treatments to the dwellings are available to control traffic noise intrusion into the building. These treatments would take the form of upgraded external walls, sound-rated glazing and potential building orientation to allow for quiet balconies and formal external open spaces. These treatments may need to be supplemented with mechanical ventilation and air-conditioning to enable windows to be kept closed during high traffic noise periods.

## 8.0 Conclusions

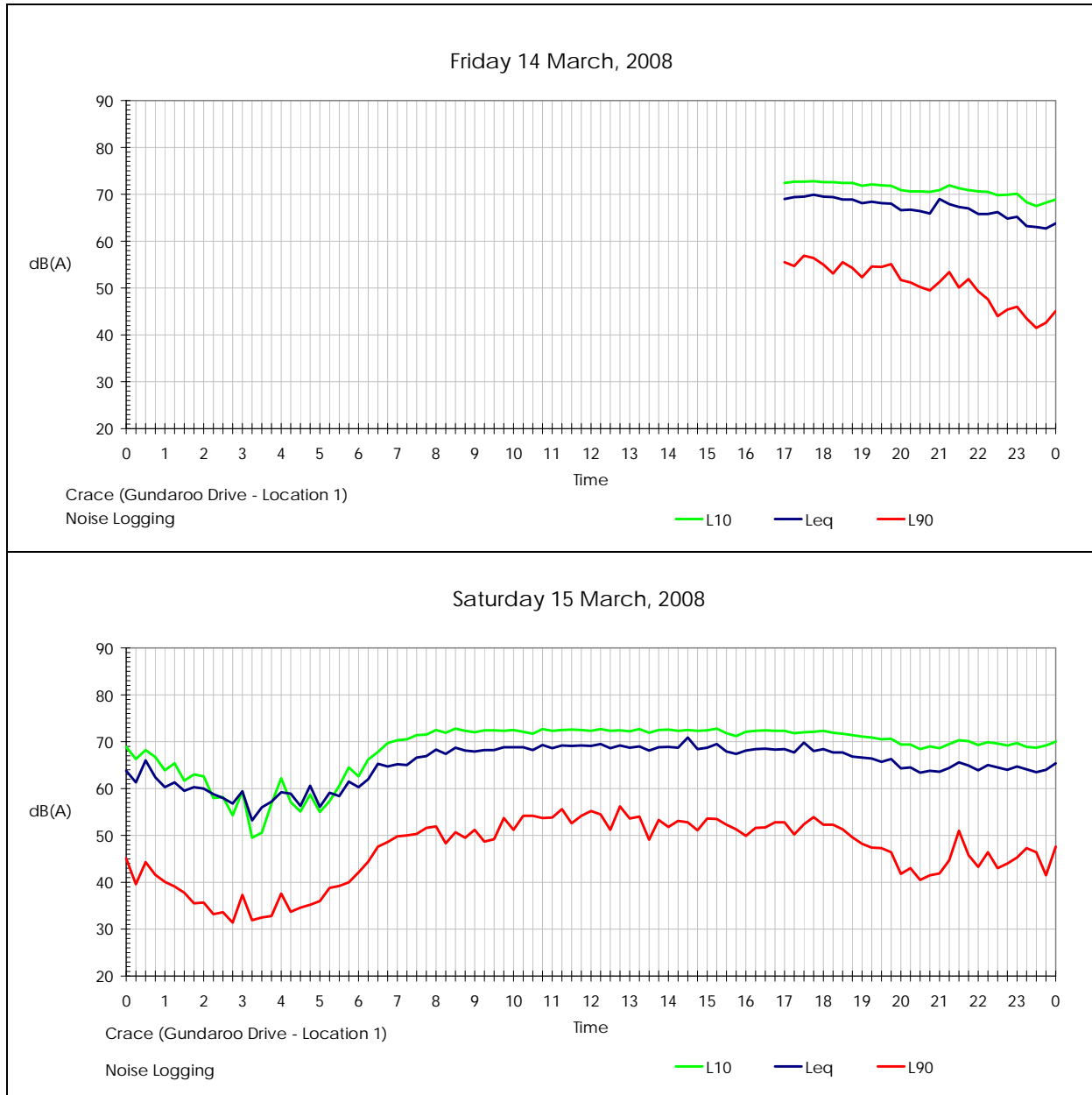
The traffic noise impact from the Barton Highway, Gundaroo Drive and Nudurr drive has been assessed. This assessment was carried out using the current and future traffic flows established by TAMS.

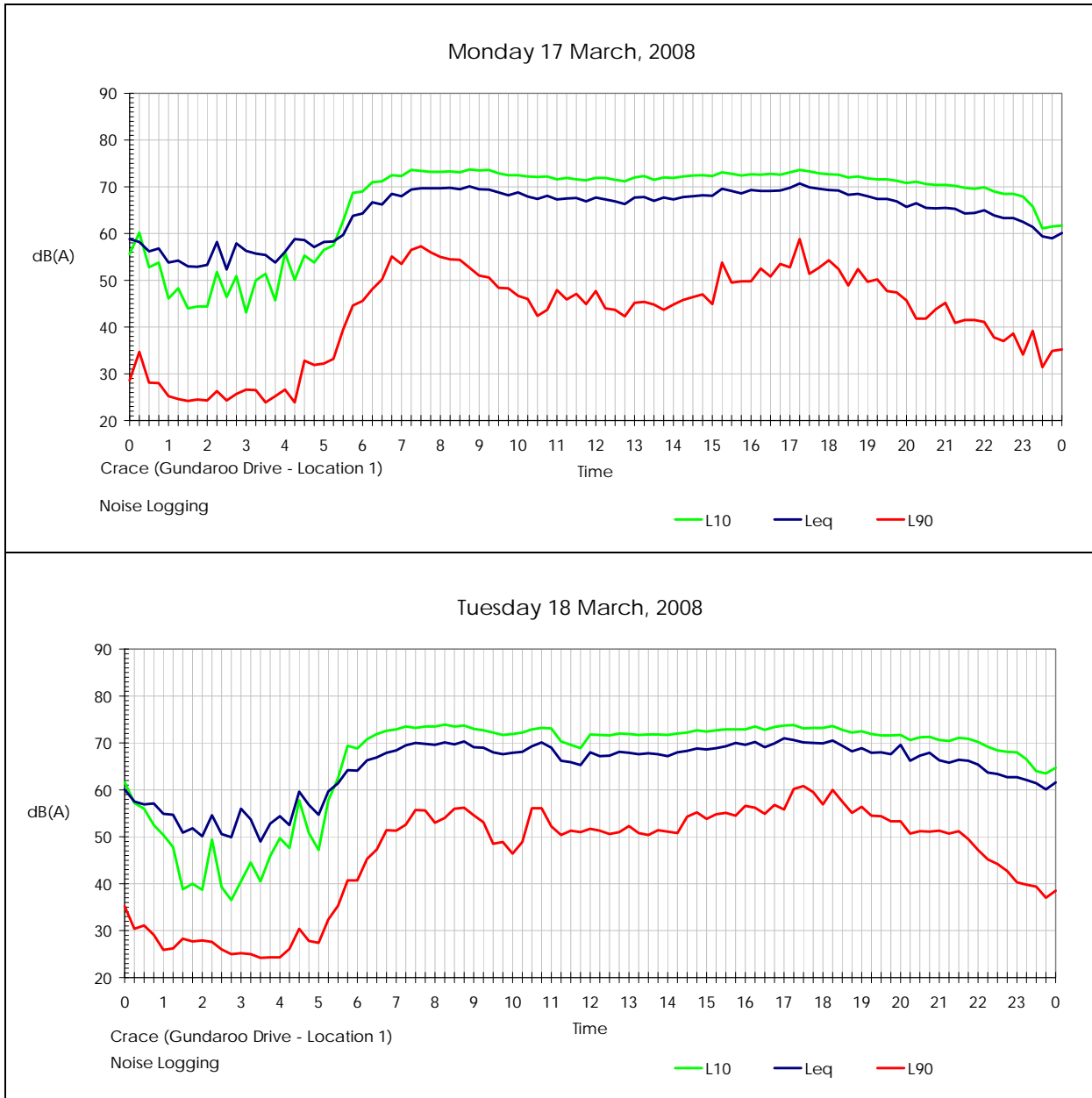
Predicted external noise levels are expected to exceed the criterion at various dwellings along the perimeter of Crace. These dwellings have been identified in Appendix B.

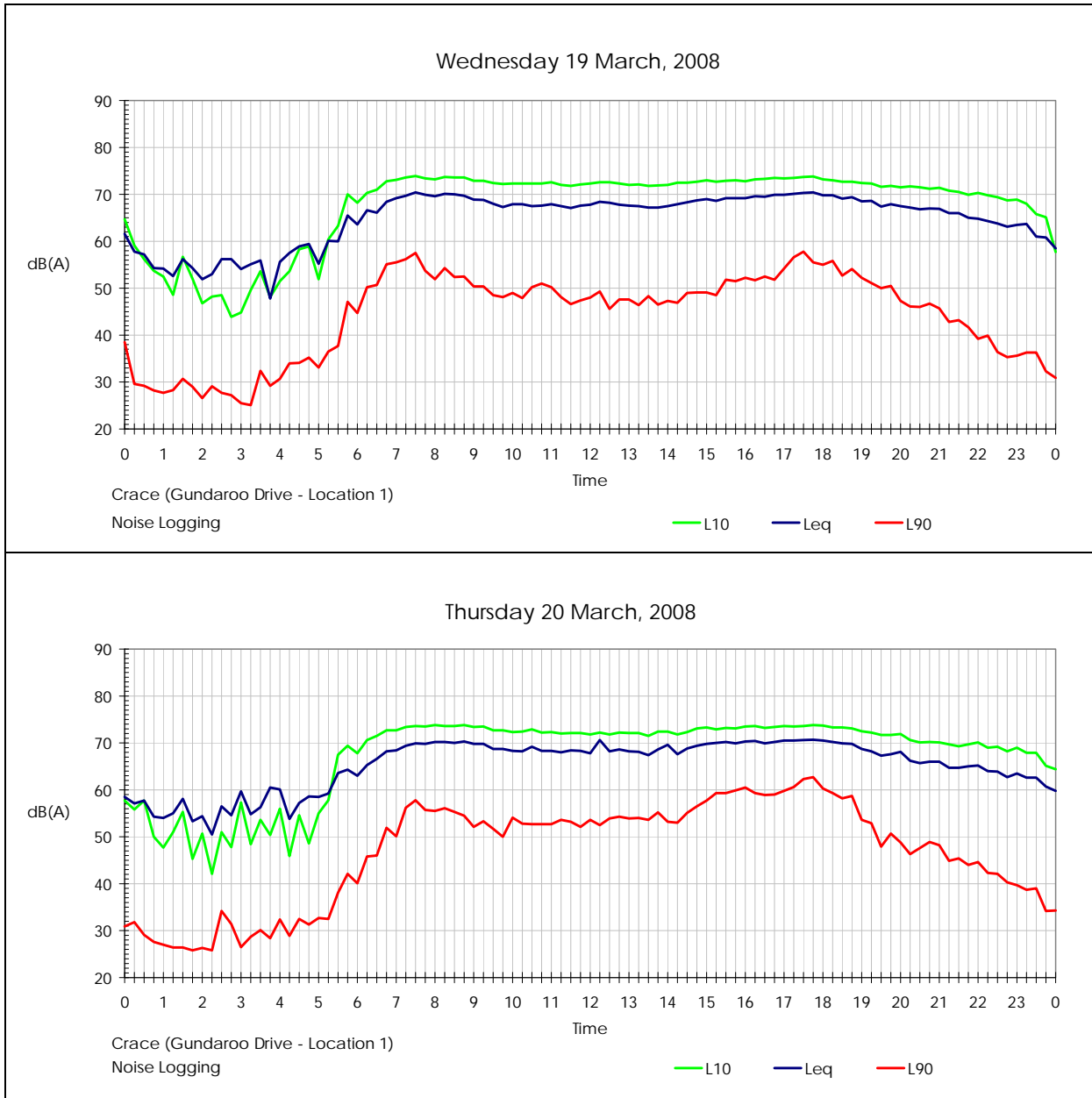
## Appendix A Noise Logging Results

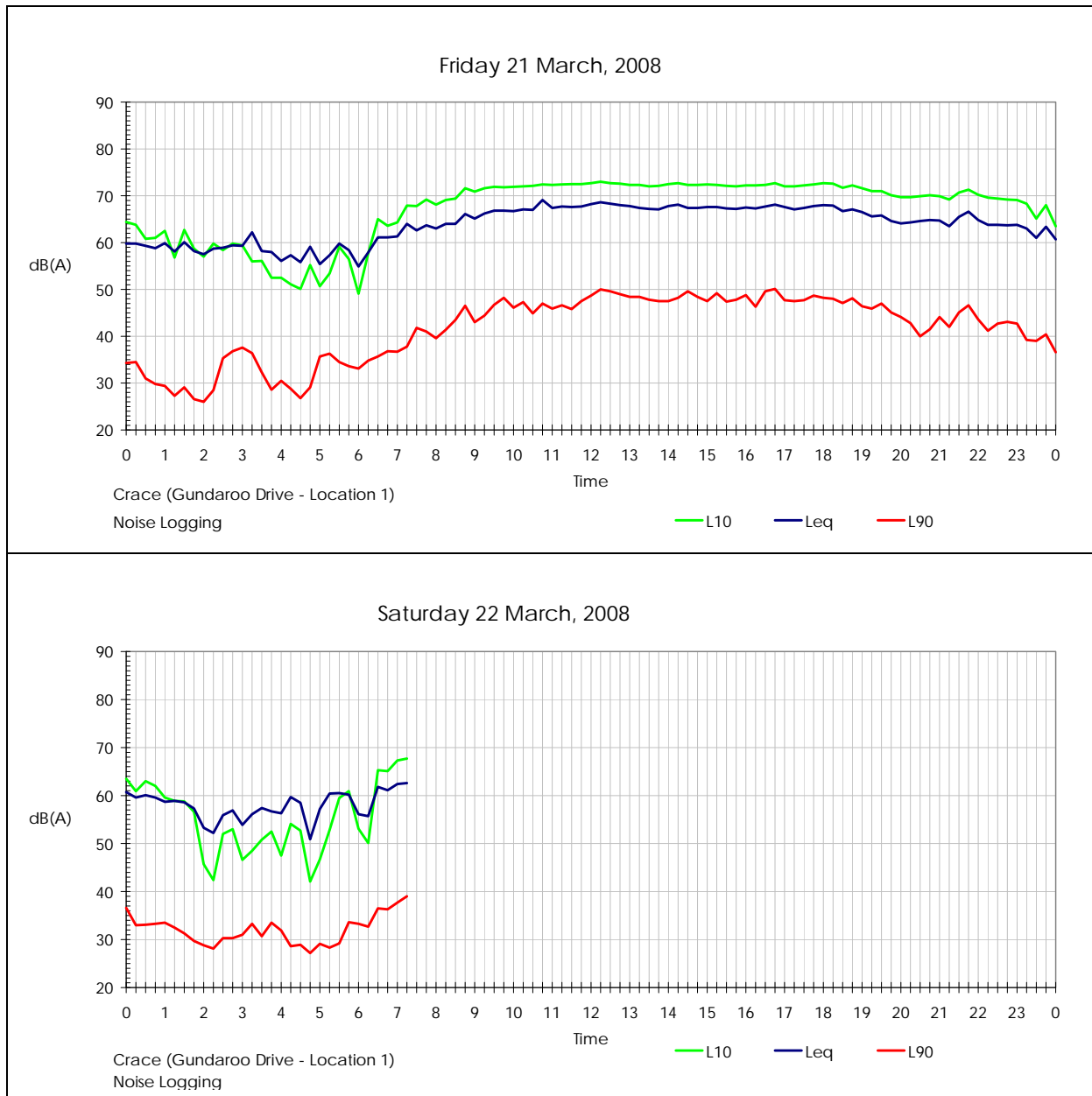
## Appendix A Noise Logging Results

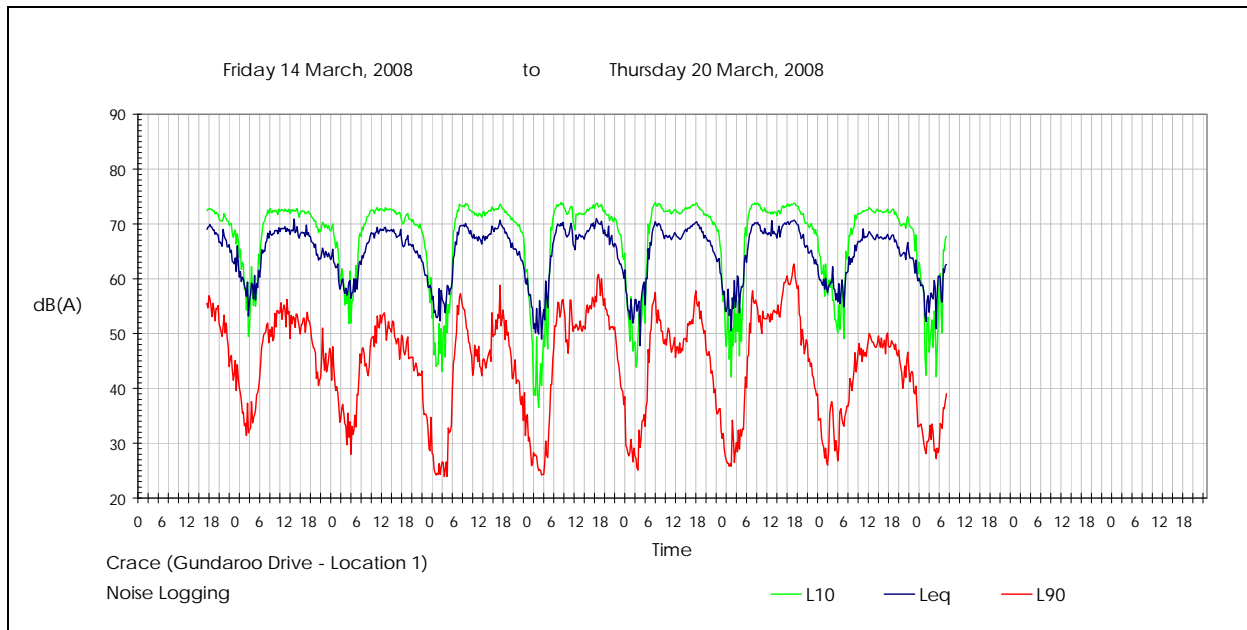
### Location 1 – Gundaroo Drive



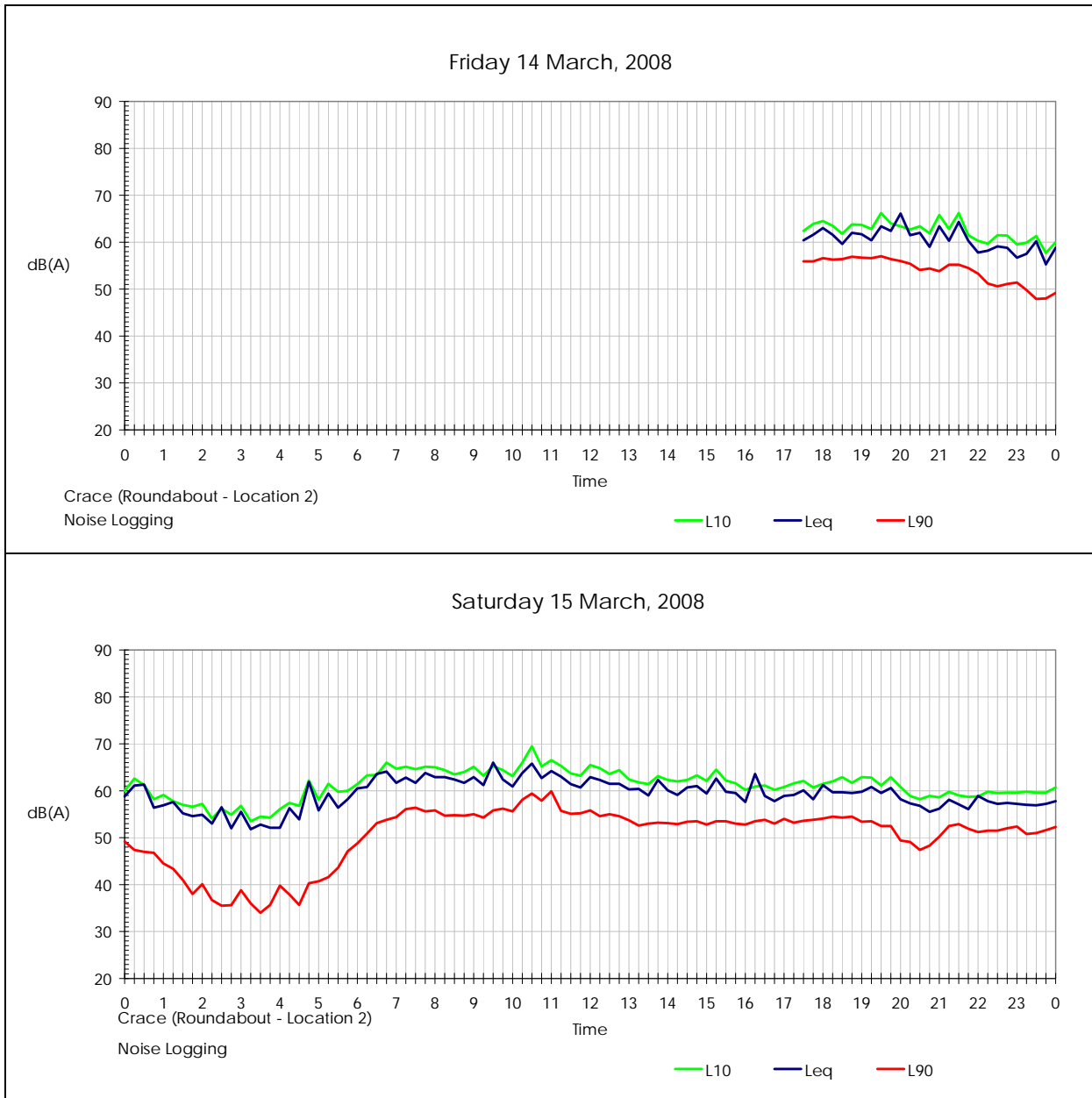


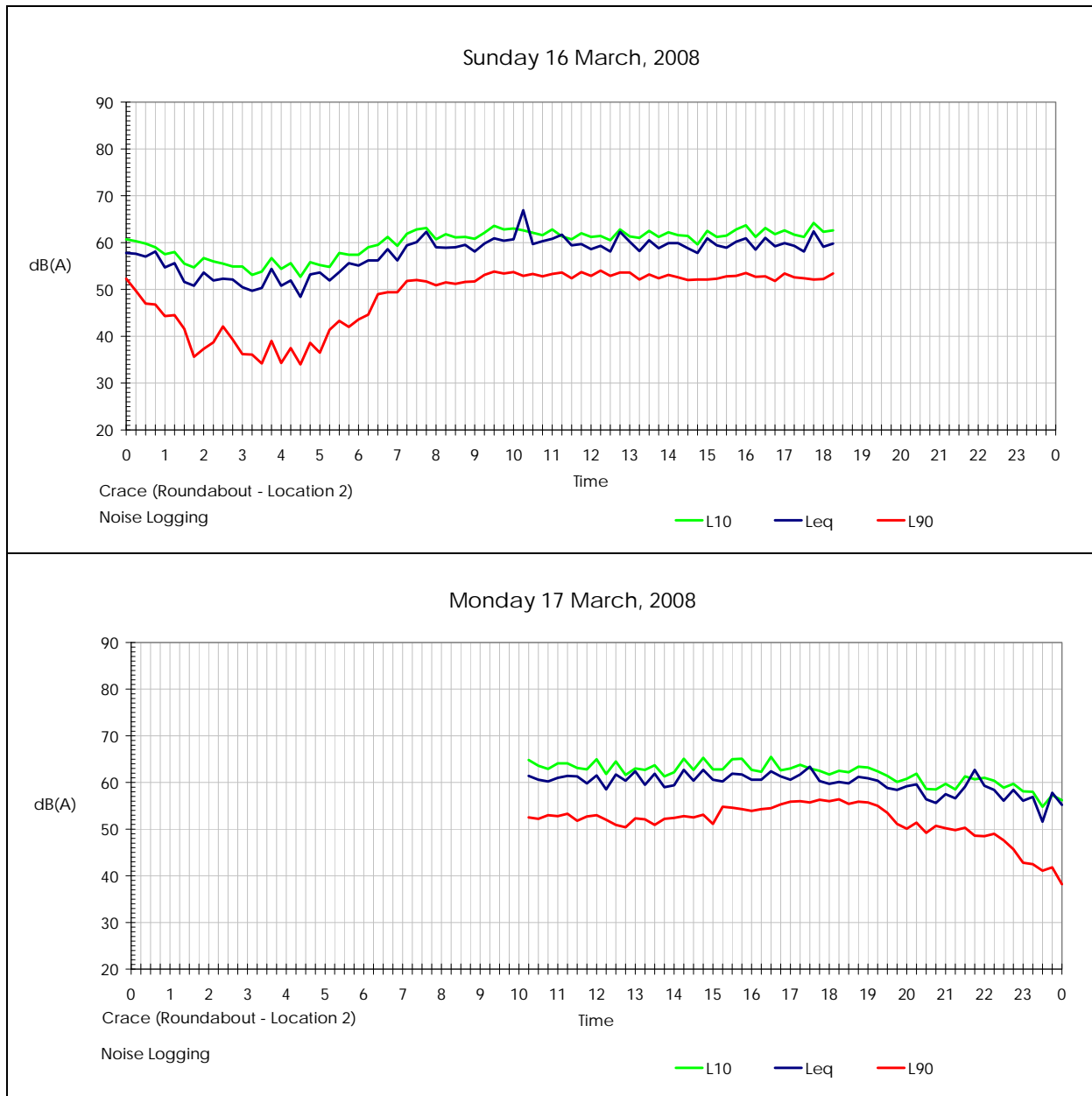


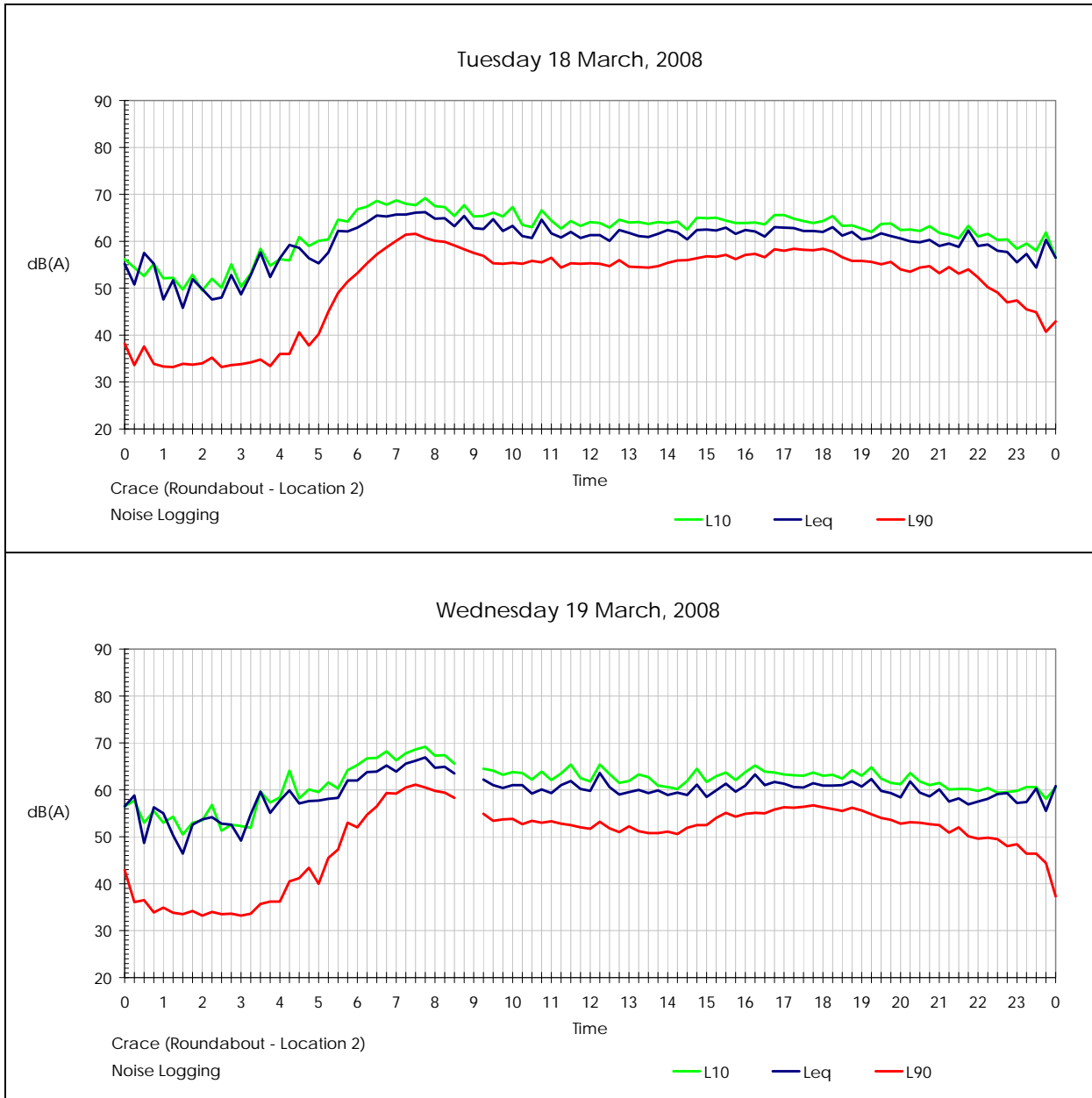


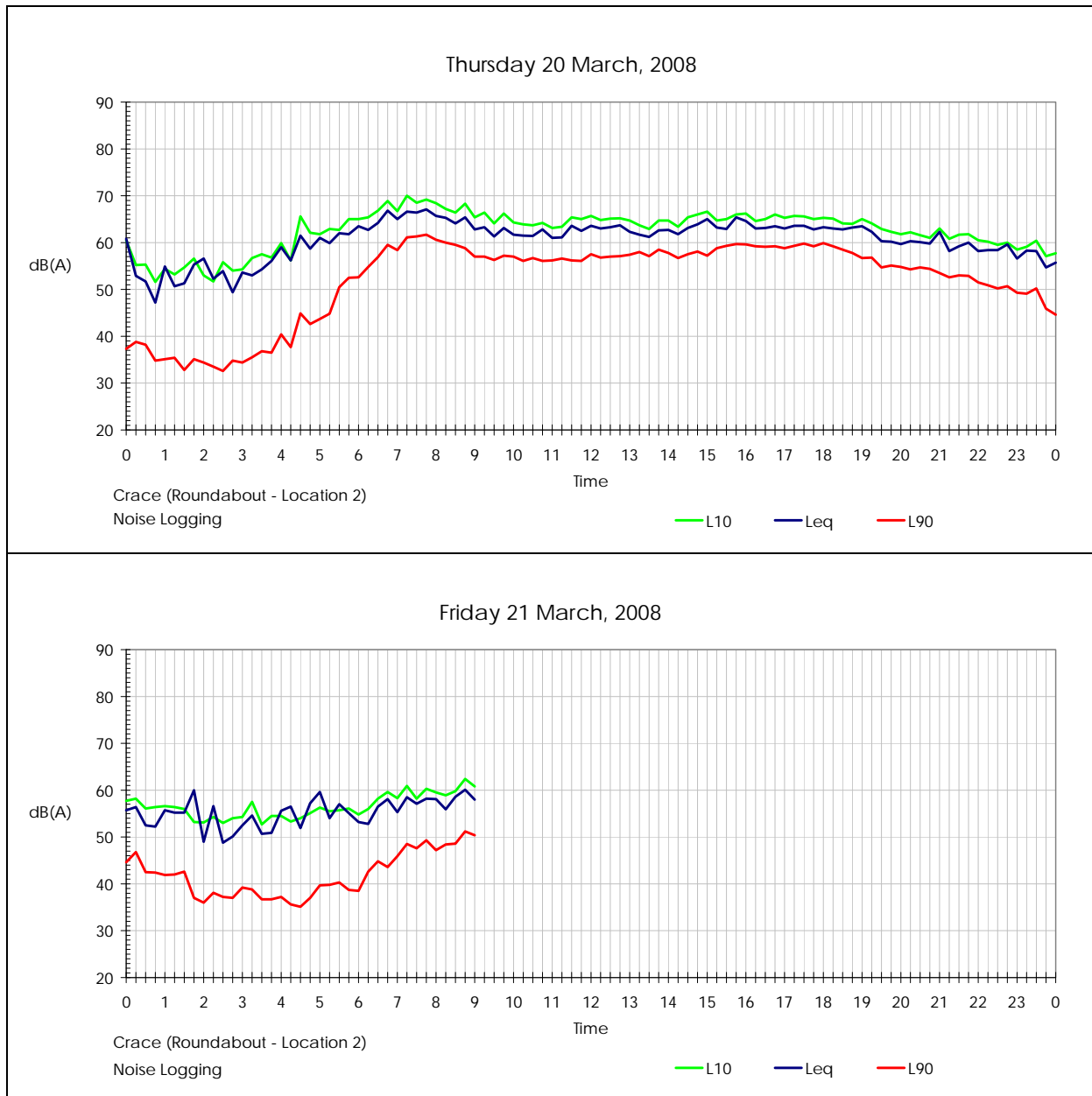


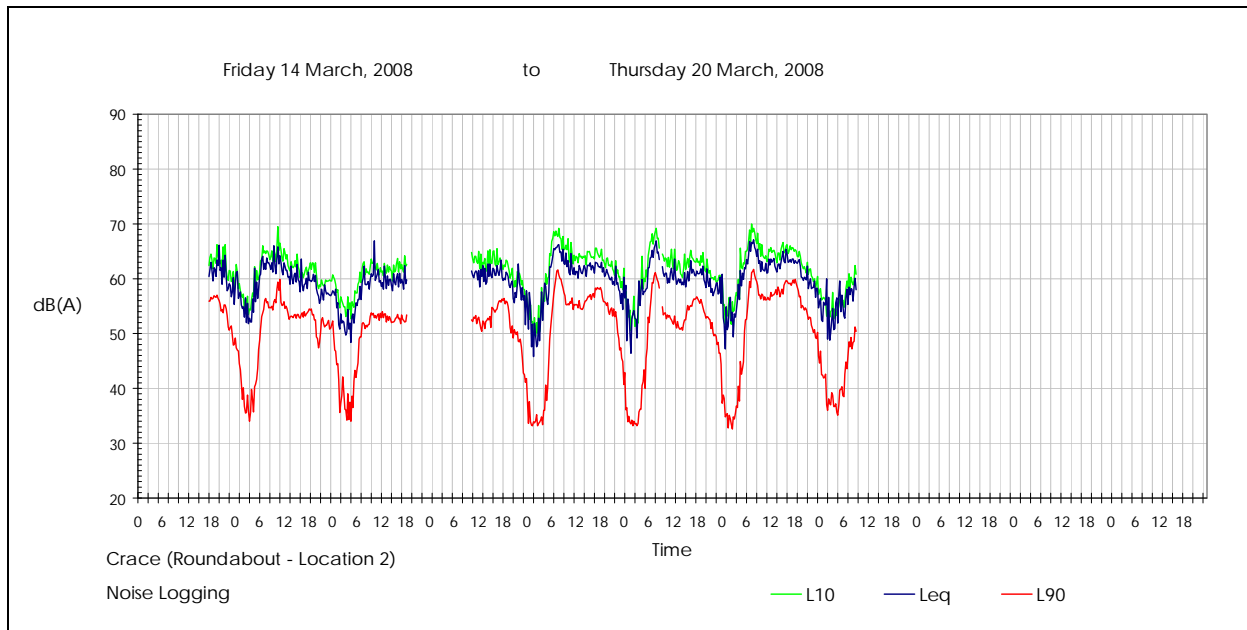
### Location 2 – Gundaroo Drive and Barton Highway Roundabout



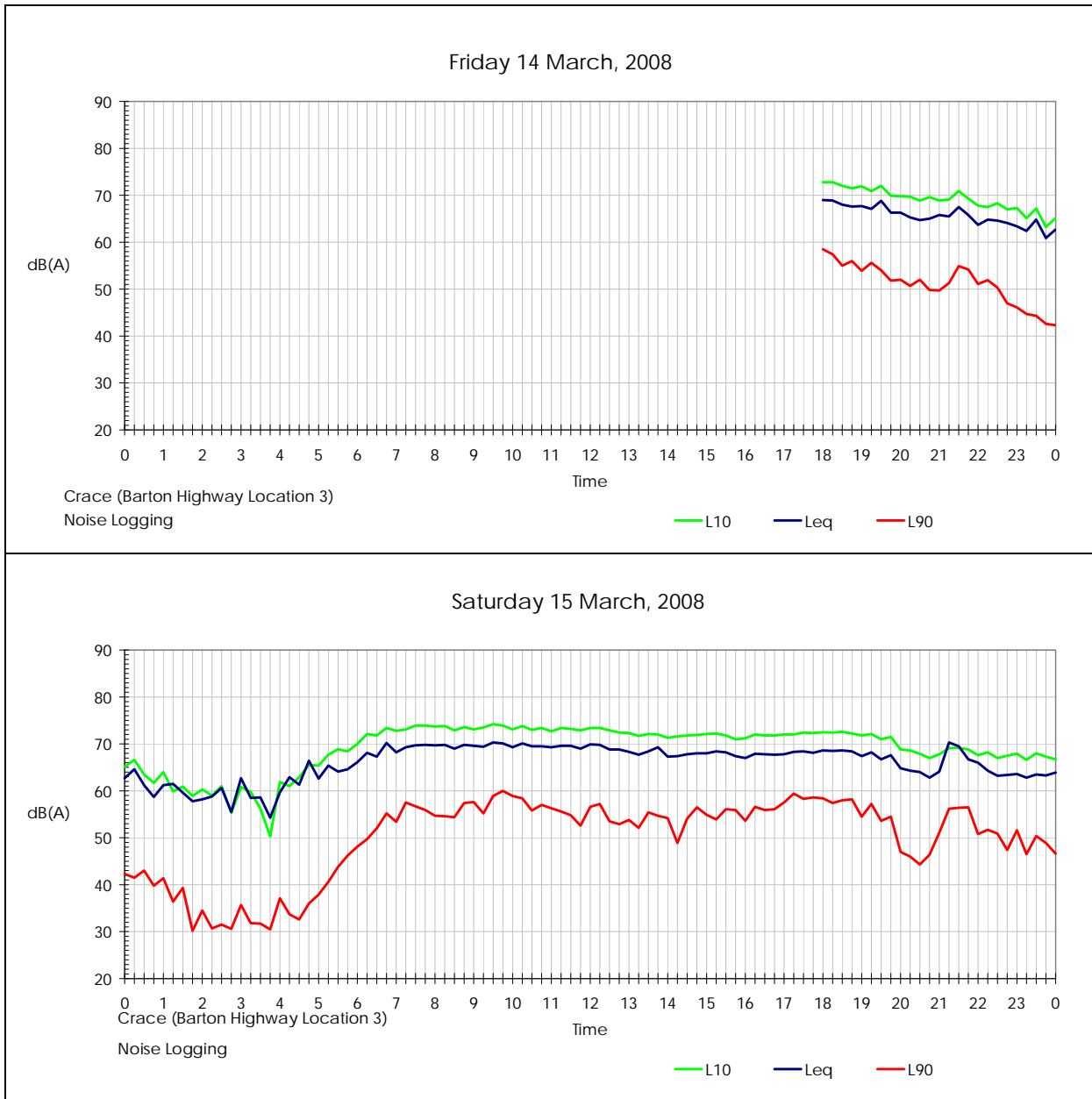


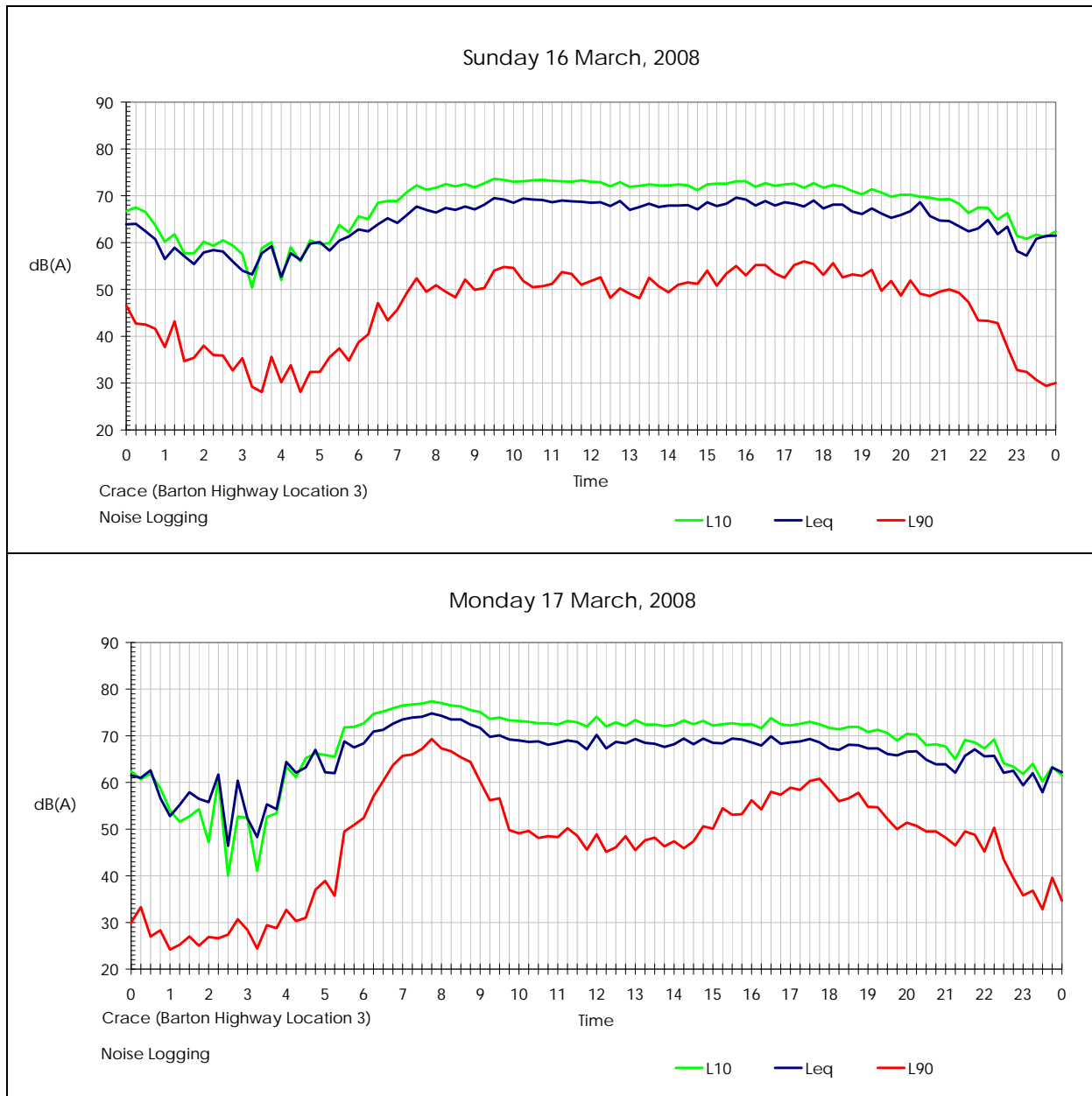


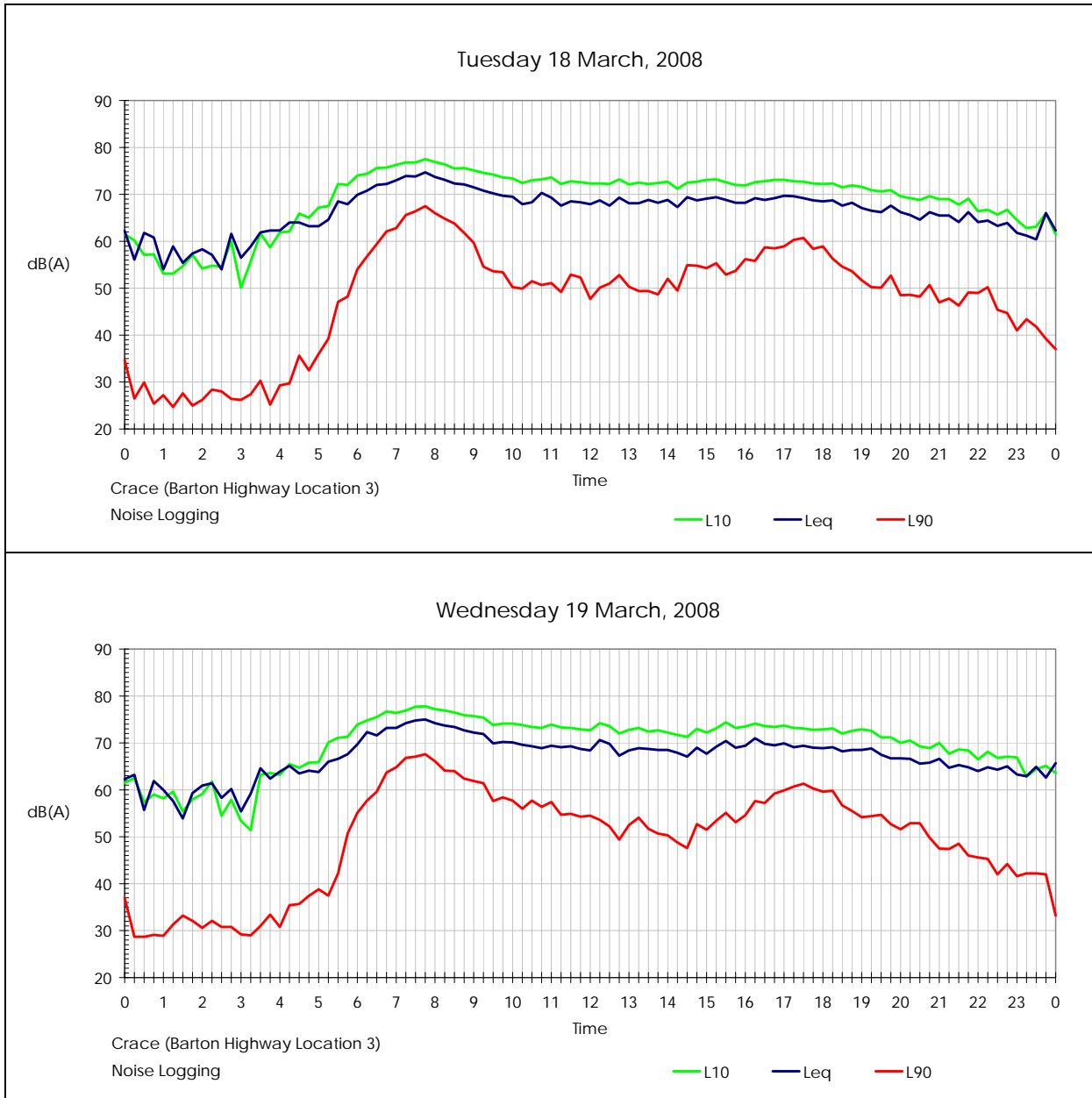


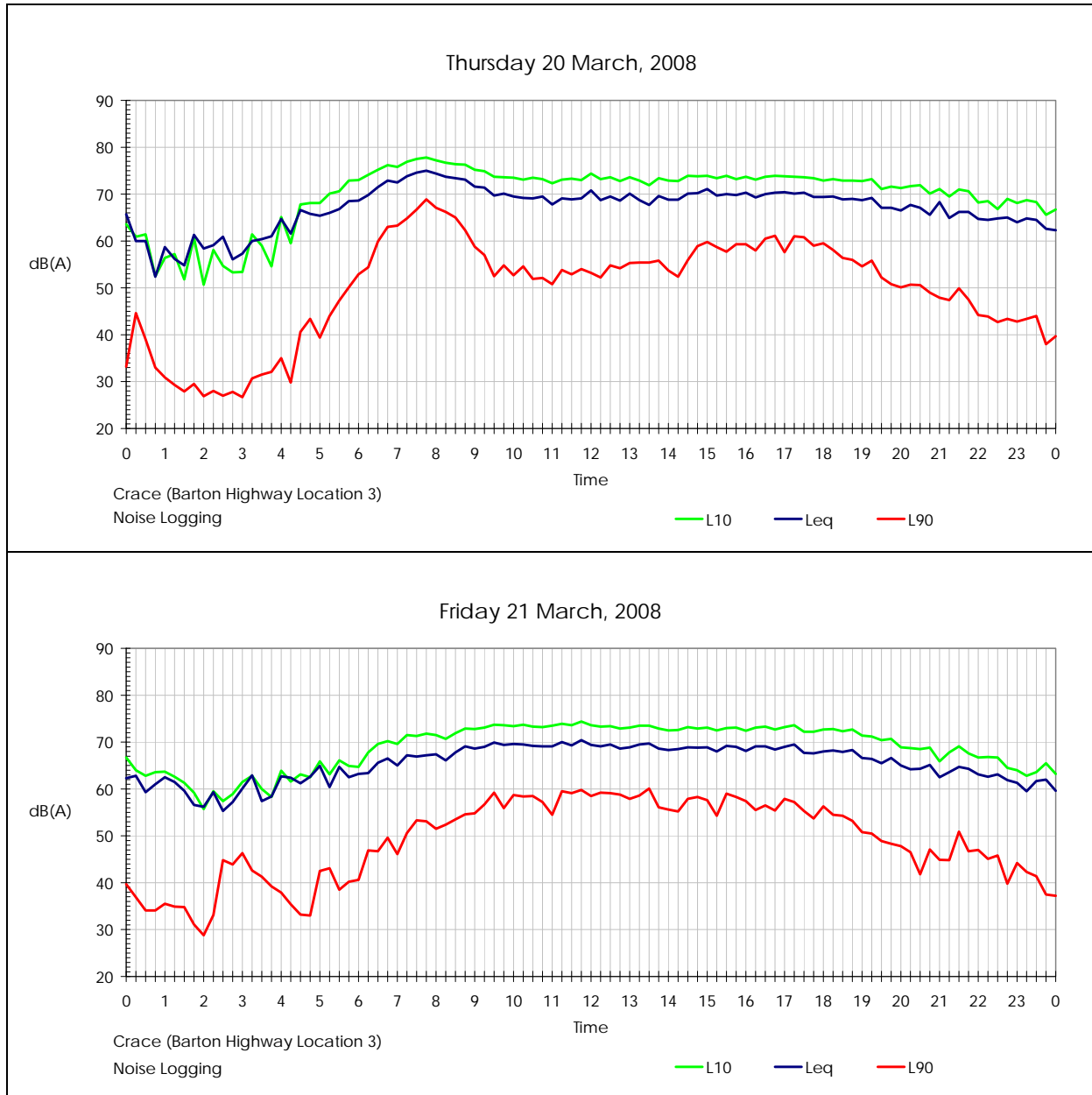


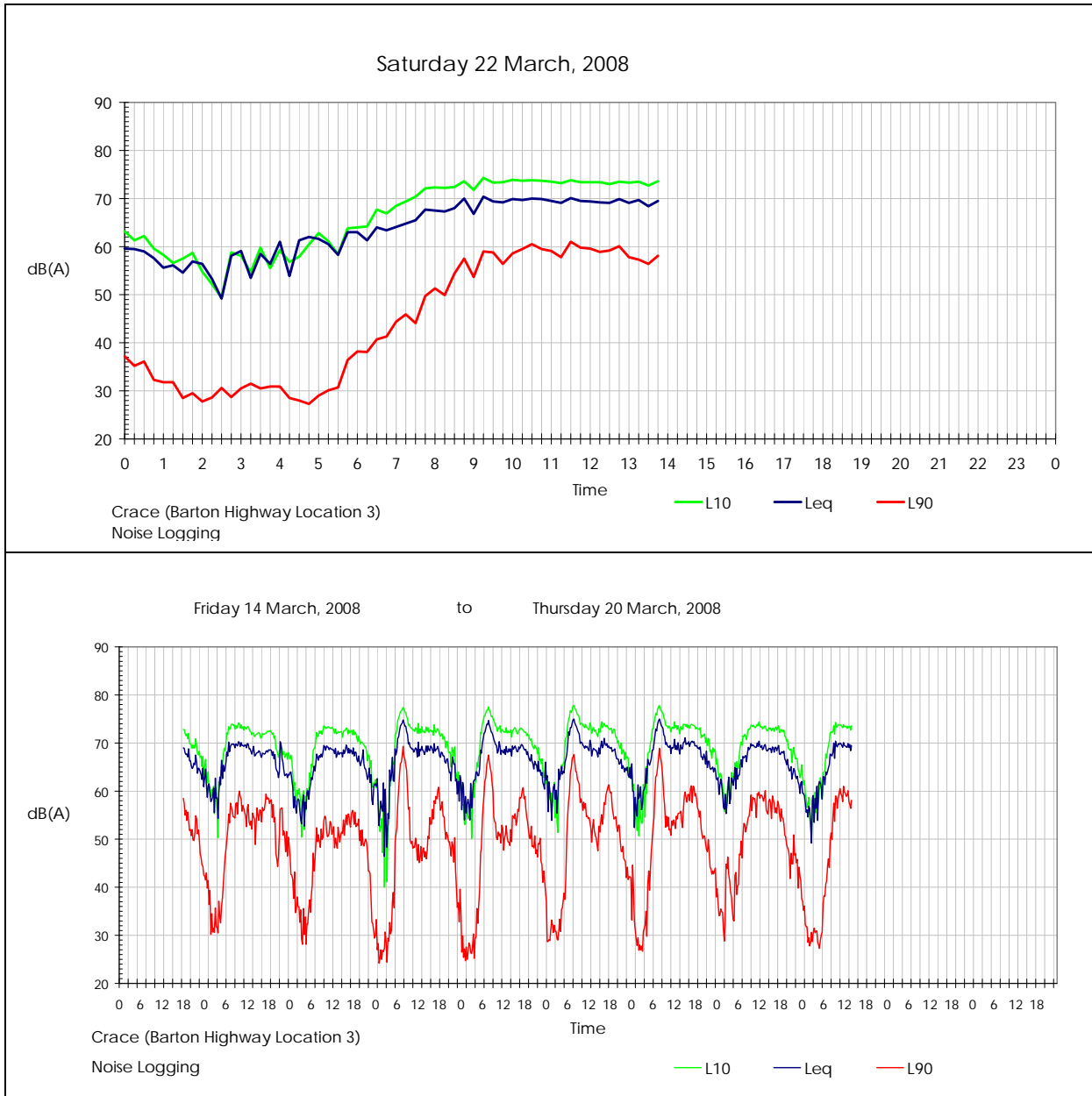
### Location 3 – Barton Highway



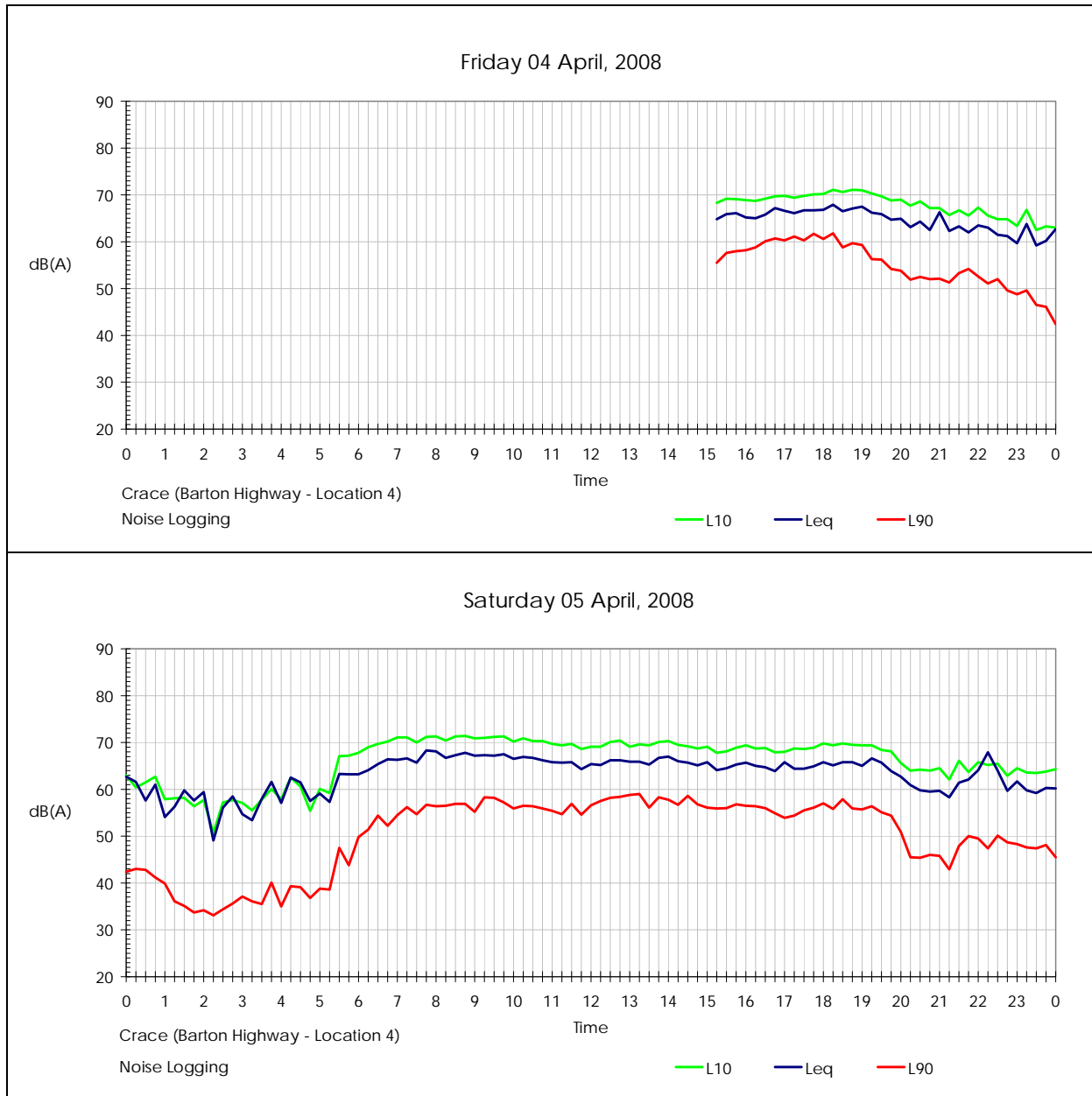


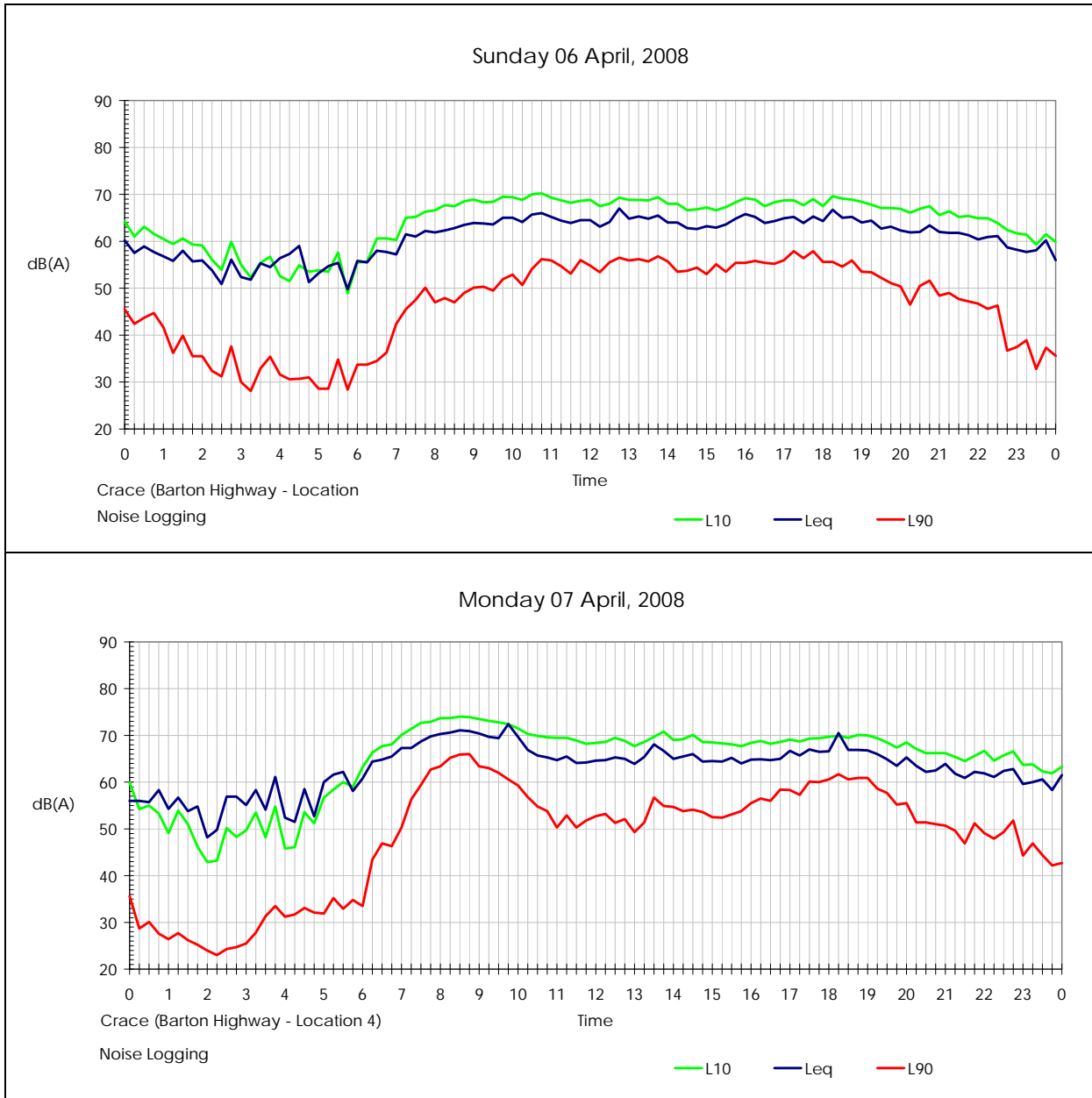


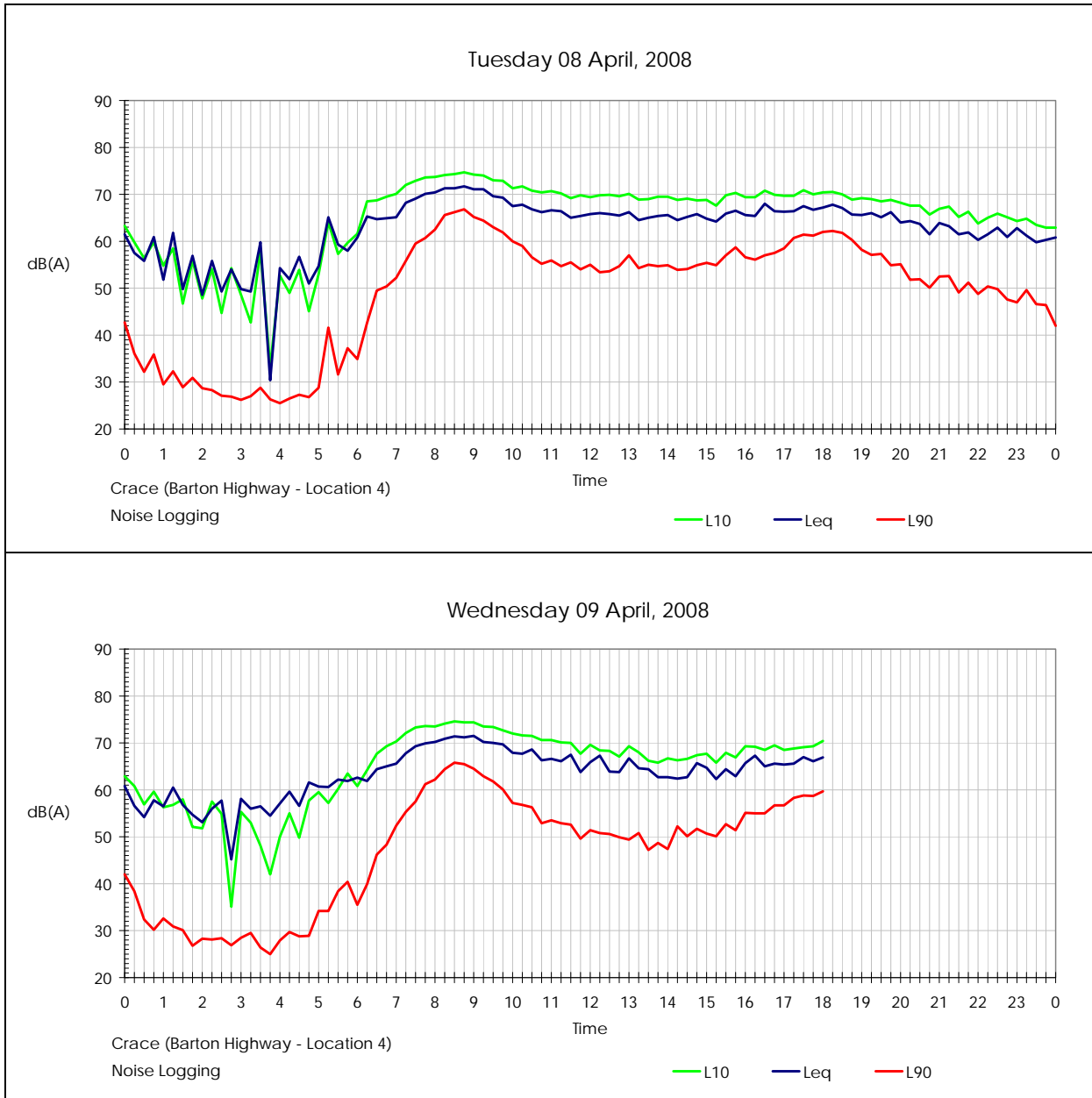




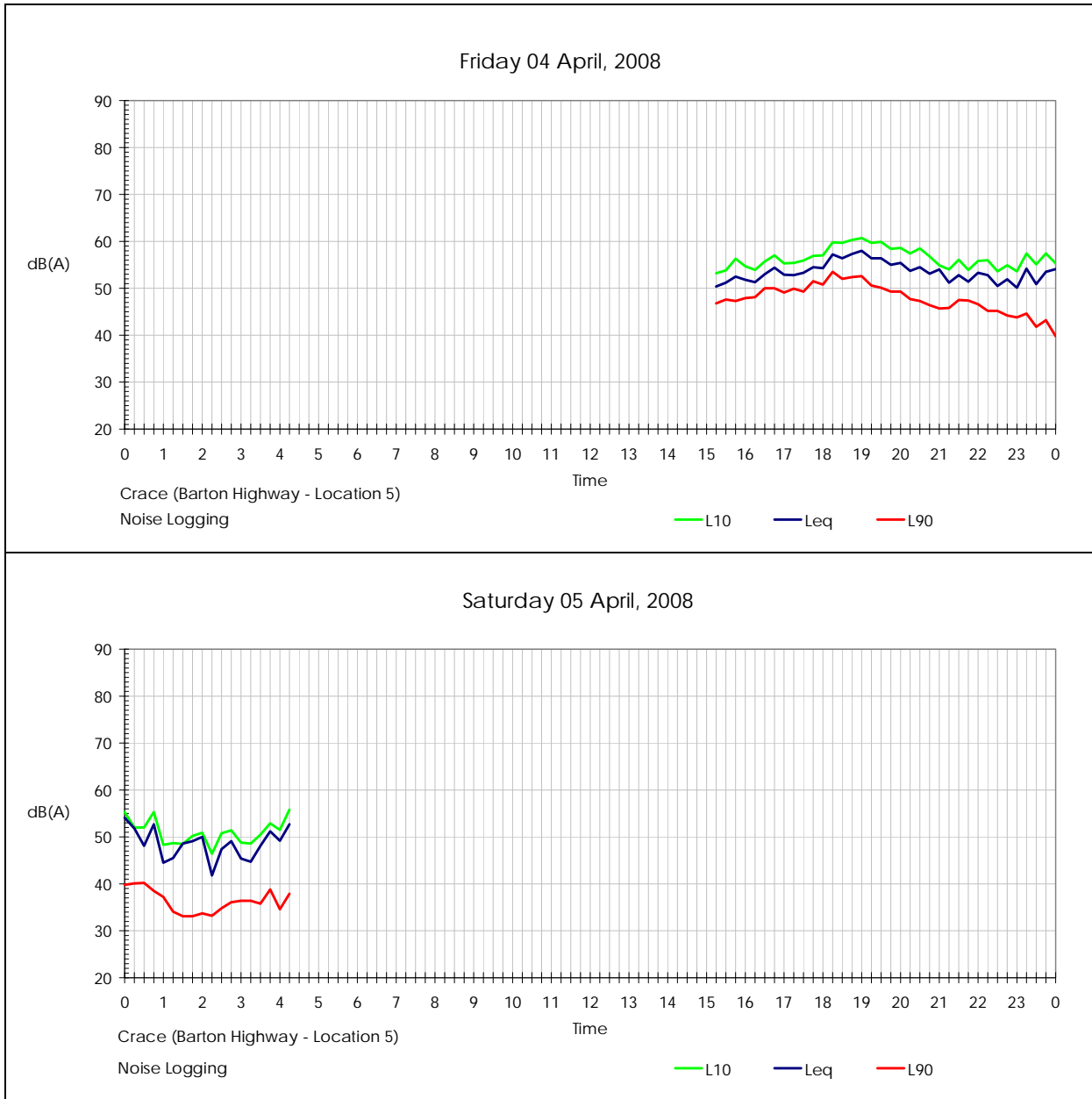
### Location 4 – Barton Highway







### Location 5 – Barton Highway



## Appendix B Noise Results Table

## Appendix B Noise Results Tables

**Table 1 Noise Levels for Ground Floor**

Dwelling		Level L10(18hour) [dB(A)] (Ground Floor)	
Section	Block	Current Predictions 2008	Future Predictions
3	1	61	63
3	2	58	60
3	3	57	59
3	14	54	57
3	15	55	58
3	16	57	59
3	17	58	60
3	18	58	60
3	19	59	60
3	20	59	61
3	21	60	61
4	1	61	63
4	2	60	62
4	3	59	62
4	4	59	62
4	5	59	61
4	6	58	61
4	7	58	60
4	32	57	60
4	33	59	62
5	1	57	60
5	2	55	58
5	3	55	58
5	4	50	53
5	5	54	57
5	20	57	60
5	21	57	60
10	1	58	60
10	20	56	59
10	21	57	60
14	1	54	57
14	23	54	57
22	1	54	56
22	22	52	54
22	23	53	55
22	29	53	55

Dwelling		Level L10(18hour) [dB(A)] (Ground Floor)	
Section	Block	Current Predictions 2008	Future Predictions
22	30	53	55
22	31	53	55
28	1	52	54
28	2	50	52
28	24	53	54
28	28	53	54
28	34	52	54
28	35	52	54
32	1	60	63
32	2	58	61
32	3	57	60
32	8	55	56
32	10	53	55
32	11	59	61
32	12	59	61
32	13	59	61
32	14	59	61
32	15	59	61
33	2	54	56
33	3	56	57
33	4	54	56
33	5	53	55
34	1	55	57
34	2	54	56
34	8	56	58
34	9	57	59
34	10	57	59
34	11	58	59
34	12	54	56
35	1	53	55
35	2	52	54
35	3	52	54
35	15	60	62
35	17	59	61
35	18	60	61
35	19	56	58
35	20	56	58
35	21	55	57
35	22	55	57
35	23	55	56
36	1	51	53

Dwelling		Level L10(18hour) [dB(A)] (Ground Floor)	
Section	Block	Current Predictions 2008	Future Predictions
36	2	52	53
36	3	51	53
36	15	57	59
36	17	57	59
36	18	59	61
37	10	59	60
37	12	57	59
37	13	58	60
38	10	57	58
38	12	57	58
38	13	58	60
41	14	55	57
42	1	57	58
42	8	58	60
42	9	59	60
42	10	59	61
42	11	59	61
42	12	59	61
42	13	59	61
42	14	58	60
42	15	56	57
43	14	59	61
43	15	60	61
43	16	60	62
44	14	59	61
44	15	59	61
44	16	59	61

Table 2 Noise Levels for First Floor

Dwelling		Level L10(18hour) [dB(A)] (First Floor)	
Section	Block	Current Predictions 2008	Future Predictions
3	1	63	64
3	2	59	62
3	3	58	61
3	14	55	58
3	15	56	59
3	16	59	61
3	17	59	61
3	18	60	61
3	19	60	62
3	20	61	62
3	21	62	63
4	1	64	67
4	2	61	64
4	3	61	64
4	4	60	63
4	5	60	62
4	6	59	62
4	7	59	61
4	32	61	63
4	33	62	65
5	1	60	63
5	2	58	61
5	3	58	60
5	4	55	58
5	5	56	59
5	20	60	63
5	21	60	63
10	1	60	62
10	20	58	60
10	21	59	61
14	1	56	58
14	23	55	58
22	1	55	57
22	22	54	56
22	23	55	57
22	29	55	56
22	30	55	57
22	31	55	57
28	1	54	56

Dwelling		Level L10(18hour) [dB(A)] (First Floor)	
Section	Block	Current Predictions 2008	Future Predictions
28	2	52	54
28	24	54	56
28	28	54	56
28	34	54	55
28	35	54	55
32	1	<b>64</b>	<b>67</b>
32	2	60	63
32	3	59	62
32	8	56	58
32	10	55	57
32	11	62	<b>64</b>
32	12	62	<b>65</b>
32	13	62	<b>65</b>
32	14	62	<b>65</b>
32	15	63	<b>66</b>
33	2	57	59
33	3	58	60
33	4	56	58
33	5	55	57
34	1	57	59
34	2	56	58
34	8	58	59
34	9	58	60
34	10	58	60
34	11	59	61
34	12	56	58
35	1	54	56
35	2	54	56
35	3	54	56
35	15	62	<b>64</b>
35	17	61	62
35	18	61	63
35	19	58	60
35	20	57	59
35	21	57	58
35	22	56	58
35	23	56	58
36	1	53	55
36	2	54	56
36	3	54	56
36	15	59	61
36	17	59	61

Dwelling		Level L10(18hour) [dB(A)] (First Floor)	
Section	Block	Current Predictions 2008	Future Predictions
36	18	61	62
37	10	60	62
37	12	59	61
37	13	60	61
38	10	58	60
38	12	58	60
38	13	59	61
41	14	56	58
42	1	58	60
42	8	59	61
42	9	60	62
42	10	61	62
42	11	61	63
42	12	61	63
42	13	61	63
42	14	60	62
42	15	57	59
43	14	61	63
43	15	62	63
43	16	62	63
44	14	61	63
44	15	61	63
44	16	61	63

## Appendix F

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Assessment of Native Vegetation  
Report – David Hogg Pty Ltd

Crace Native Vegetation Advice –  
Conservation Planning and  
Research TaMS

EIS Exemption - ACTPLA

Territory Plan Advice - ACTPLA

# DAVID HOGG PTY LTD

ABN 35 008 564 047

ACN 008 564 047

- CONSULTANTS IN
- ENVIRONMENTAL PLANNING AND ASSESSMENT
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## CRACE STAGE 2 AND STAGE 3 – ASSESSMENT OF NATIVE VEGETATION. Report to CIC Australia

Jane McIntosh, David Moore and Kristine Nash  
26 August 2010 (Draft)

### 1. Introduction

This report has been prepared for CIC Australia Limited to assess the extent of native vegetation present within Stage 2 and Stage 3 of the Crace suburb development in Gungahlin, and thus the requirement for an environmental impact statement (EIS) under Schedule 4, Part 4.3 of the ACT *Planning and Development Act (P&D Act)*.

The suburb is located south-west of the Gungahlin Town Centre and is bounded by the Barton Highway, Gundaroo Drive and Nudurr Drive. The development of Crace is planned in three stages with Stage 1 under construction (see Figure 1). The issue of native vegetation in Stage 2 and Stage 3 has been raised by the ACT Planning and Land Authority in response to an EIS exemption request submitted by CIC Australia Limited.

This report is based on a review of existing background information and site inspections conducted on 3 and 9 August 2010.

### 2. Site History

Prior to European settlement, the area of Crace is likely to have supported yellow box – red gum grassy woodland, grading into scribbly gum forest on the upper slopes of Gungahlin Hill and into natural temperate grassland on the lower slopes, with areas of wet tussock grassland in the gullies (Ref. 1). Since that time, much of the vegetation has been highly modified as a result of past agricultural practices and the use of the land as a research farm by CSIRO to conduct fertiliser/ stocking rate trials for sheep and cattle and some cereal crop trials. The land has been subject to long term grazing, clearing, pasture improvement and crop cultivation.

The development of a future residential suburb within the area of Crace was identified over twenty years ago in the EIS for the development of Gungahlin (Ref. 2). Since that time, CSIRO has continued to lease the land for their research projects, initially from the Department of Finance and, as of June 2003, from the Land Development Agency. The site was purchased by CIC Australia Limited in

2008. The management intensity of the land has since been reduced, although Stage 2 is still being lightly grazed by cattle. Stage 3 remains undeveloped but has been disturbed, and partly cleared, by the works associated with the Stage 1 development.

### 3. Definition of Native Vegetation

The requirement for an EIS is triggered under Schedule 4, Part 4.3 of the *P&D Act* if a proposal would result in the clearing of more than 0.5 ha of native vegetation. The *P&D Act* does not define the term 'native vegetation', but instead refers to Division 8.2 Section 73 of the *Nature Conservation Act (NC Act)*, which relates specifically to clearing native vegetation in reserved areas, and contains the following definition:

*native vegetation, in relation to an area, means any of the following kinds of vegetation indigenous to the area:*

- *trees;*
- *understorey plants;*
- *groundcover consisting of any kind of grass or herbaceous vegetation;*
- *plants occurring in a wetland or stream.*

The *P&D Act* does not define the term 'clearing of native vegetation' but refers to the definition provided in Section 74 of the *NC Act* which states that:

*Native vegetation is cleared in an area if vegetation cleared in the area is substantially native vegetation.*

For the purposes of this assessment, vegetation that is substantially native is considered to comprise more than 50 percent perennial native species.

### 4. Assessment Methodology

To assist in describing the condition of the vegetation within Stage 2 and Stage 3, this firm has utilised the suggested methods for assessing groundcover vegetation provided under the *NSW Native Vegetation Act (NV Act)*, although it is acknowledged that this is of a different legislative jurisdiction, and that the final decision regarding the status of the vegetation within the ACT is made by the consent authority.

The step-point method allows for an assessment of groundcover vegetation as native if it contains more than fifty percent native species. It is particularly useful in situations in which the original native vegetation has been partly degraded or is recovering from a previously degraded state, and there are high components of both native and exotic vegetation present. It enables a quantitative measure of the average composition of native and exotic species within a given area. The data obtained can also identify areas where the native component is particularly high and the need for further assessment may be necessary.

The assessment was undertaken on 3 August and covered a substantial proportion of the vegetation within Stage 2 and Stage 3. The step-point method was conducted along 25 transects, the locations of which are shown in Figure 2 and Figure 3. To ensure a consistent approach, all paddocks were traversed regardless of their

obvious exotic nature. This was to enable a simple comparison of areas in terms of vegetation quality and to ensure that no native patches were overlooked.

Undertaking the transect surveys highlighted two small areas of native vegetation within Stage 2 that warranted closer examination as these areas would not be retained within the open space network. Further assessment of these patches was undertaken on 9 August 2010.

The results of the transect surveys are included in Appendix A. Stage 2 and Stage 3 are considerably different in ecological characteristics and levels of previous disturbance. Consequently they have been assessed as separate units.

## **5. Stage 3**

### **5.1 Description of the Existing Vegetation**

The Stage 3 development area has been subject to recent disturbance associated with the Stage 1 construction works (see Figure 2). The area is being used as a stockpile site for spoil that is generated by the ongoing subdivision works and has been subject to drainage and trenching works. The trenches drain into two sediment control ponds that have been constructed within the area to manage water quality downstream of the works. A filling station for water trucks is located in the middle of Stage 3 and several unsealed access tracks leading to this station have been formed. The north-west corner of the site has been stripped of all vegetation.

The remaining patches of vegetation are dominated by introduced species with scattered native grasses. Introduced species include phalaris, clover, capeweed, rat's tail fescue, catsear, storks-bill and plantain (*Plantago* sp). Serrated tussock, Paterson's curse, Scotch thistle and spear thistle (*Cirsium vulgare*) are also present within Stage 3. Native grasses that are scattered throughout include spear grasses, wallaby grasses, kangaroo grass (*Themeda australis*), windmill grass and redleg grass. A limited number of disturbance tolerant native forbs such as wattle mat-rush (*Lomandra* sp.), sheep's burr (*Acaena ovina*) and common everlasting (*Chrysocephalum apiculatum*) are also present.

### **5.2 Implications under the P&D Act.**

Despite the obviously disturbed and exotic nature of the site, the step-point method was undertaken along two transects within the Stage 3 area (see Figure 2). Transect A is aligned north-east to south-west and covers the entire length of Stage 3. Transect B traverses the ridgeline of a gentle hill that is located in the southern part of Stage 3. This hill area was examined as it appeared to be the least disturbed area within Stage 3 and was therefore considered to be the most likely area to contain the highest component of native grasses.

The transect results indicate that the vegetation that remains within Stage 3 comprises approximately 64 percent introduced species and 36 percent native species, of which most are native grasses. The vegetation would not be considered to be native vegetation under the *P&D Act* and would therefore not trigger the requirement to prepare an EIS under Schedule 4, Part 4.3 of that Act.

## 6. Stage 2

### 6.1 Description of the Existing Vegetation

Stage 2 is located within undulating terrain in the eastern part of the Crace suburb development. The vegetation within Stage 2 is relatively uniform and consists mostly of exotic pasture with some remnant yellow box (*Eucalyptus melliodora*) and Blakely's red gum (*Eucalyptus blakelyi*) woodland trees. These trees generally occur as isolated paddock trees or in small clumps of three or four. In the central part of Stage 2, a gully running in an easterly direction, supports a higher density of mature and regenerating trees.

The groundcover across Stage 2 is dominated by phalaris (*Phalaris aquatica*) and other exotic grasses such as cocksfoot (*Dactylis glomerata*), rye grass (*Lolium* sp.), brome grass (*Bromus* sp.), rat's tail fescue (*Vulpia* sp.), barley grass (*Hordeum*) and poa (*Poa* sp.). The intertussock spaces are dominated by clover (*Trifolium* sp.) and capeweed (*Arctotheca calendula*), and common weeds such as storksbill (*Erodium* sp.), catsear (*Hypochaeris radicata*), sorrel (*Acetosella vulgaris*) and peppergrass (*Lepidium* sp.) are scattered throughout. Several invasive weed species are present including serrated tussock (*Nassella trichotoma*), Paterson's curse (*Echium plantagineum*) and Scotch thistle (*Onopordum acanthium*).

A very minor component of the groundcover consists of native grass species, particularly spear grasses (*Austrostipa* spp.) and wallaby grasses (*Austrodanthonia* spp.). Other native grasses that are present across the site include wheat grass (*Elymus scaber*), redleg grass (*Bothriochloa macra*), windmill grass (*Chloris truncata*), weeping grass (*Microlaena stipoides*), purple wire grass (*Aristida ramosa*) and hairy panic (*Panicum effusum*). These native grasses are generally found as small patches in localised areas and most commonly occur in areas least disturbed by past management practices, for example, along the fence lines or in the corner of paddocks.

Within and around the main gully on the hill, extensive eucalypt regeneration is occurring, probably in response to reduced grazing and management pressures. Much of this regeneration is to be retained within an open space area known as the Hilltop Reserve (see Figure 4). This reserve area contains approximately 7.6 hectares of predominately native vegetation, including an area of the White Box – Yellow Box – Blakely's Red Gum grassy woodlands and derived native grasslands ecological community (box – gum woodland) that is listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act, Ref. 3). This gully area also contains a higher density of native groundcover species than the remainder of Stage 2. There is little evidence of native forbs however, which is indicative of the area's past management history. The initial plans for Stage 2 set aside about 6.1 hectares of the vegetation in the vicinity of this gully. In response to ecological considerations, the reserved area has been increased to 7.6 hectares to further protect native vegetation within the development.

On the eastern boundary of Stage 2 and on the slopes overlooking the Gungaharra Nature Reserve, the groundcover vegetation improves in quality and is a mosaic of native pasture and degraded native pasture.

## 6.2 Implications under the *P&D Act*

At the time of the current inspection, the majority of the vegetation within Stage 2 was clearly dominated by introduced species and would not be considered as native vegetation under the *P&D Act*. It contains mostly improved pasture and generally has a native vegetation component between zero and 15 percent. Within Stage 2, however, there are three areas that were clearly dominated by native vegetation. One of these areas is within the Hilltop Reserve in the vicinity of Transects O.1 and O.2 (see Figure 3) and was found to have an average native component of 72 percent, which is substantially greater than any other areas within the development area. As this area is planned to be retained within open space, it is not further discussed within the report. The other two areas are indicated in Figure 4 as Area A and Area B.

**Area A** is approximately 0.41 ha in size and adjoins the southern boundary of the Hilltop Reserve (see Figure 4). Area A contains a remnant yellow box tree, three remnant Blakely's red gum trees and a small amount of regeneration. The groundcover within the area has a native component of approximately 65 percent (the eastern part of Transect M.2, see Figure 3). Native grasses include spear grass, wallaby grass, redleg grass, wheat grass, hairy panic, weeping grass and purple wire grass. Phalaris, capeweed, clover, catsear and storksbill constitute the introduced component. No native forb species were recorded during the field inspection.

Area A is part of the regenerating woodland patch that meets the listed Commonwealth box – gum woodland community and is considered to be native vegetation under the *P&D Act*. The Crace Stage 2 development would result in the removal of approximately 0.41 hectares of this ecological community. The vegetation within Area A is approximately 5 percent of the larger patch of similar quality vegetation. The remaining 95 percent of this patch will be retained within the Hilltop Reserve.

**Area B** is a patch of secondary grassland, about 0.41 ha in size, and is located within the vicinity of Transect B.2 (see Figure 4). The groundcover in this patch has a native component of approximately 60 percent. Native grasses include spear grass, kangaroo grass, wallaby grass, purple wire grass and redleg grass. Native forbs include wattle mat-rush, common everlasting, rockfern (*Cheilanthes austrotenuifolia*), common raspwort (*Gonocarpus tetragynus*), swamp dock (*Rumex brownii*), cudweed (*Euchiton* sp.) and ivy goodenia (*Goodenia hederacae*). Native shrubs, such as peach heath (*Lissanthe strigosa*), slender tea-tree (*Leptospermum brevipes*) and poison rice-flower (*Pimelea pauciflora*), are scattered throughout the patch.

There is a large (approximately 40 percent) component of exotic species throughout Area B which reduces the quality of the native vegetation within this area. Intertussock spaces have been colonised with clover and capeweed and improved pasture grasses are scattered throughout.

In the absence of clear guidelines on what constitutes native vegetation in situations when the original vegetation community has been partly degraded or is recovering from a previously degraded state, it is uncertain whether the 0.41 hectares of vegetation in Area B would be considered native vegetation under the *P&D Act*. This would need to be determined by the consent authority.

The **remaining areas of Stage 2** contain scattered or clustered remnant yellow box and Blakely's red gum trees above an exotic groundcover and the proposed development works would require the removal of most of these trees. It is understood that the removal of these trees has been approved, in principal, by the Conservator of Flora and Fauna, during the early development of the Crace concept plan and prior to the gazettal of the *P&D Act*. Since that time, several amendments to the estate development plan have been made to allow for a large number of trees, originally planned and approved for removal, to be retained. The implications under the *P&D Act* for the removal of these trees would need to be determined by the consent authority.

## 5. Summary and Conclusions

The majority of the vegetation within Stage 2 and Stage 3 is representative of an area that has been intensively managed for agricultural purposes, and in the case of Stage 3, recently disturbed by the construction works associated with the Stage 1 development.

The preparation of an EIS under Schedule 4, Part 4.3 of the *P&D Act* is triggered if a development will result in the clearing of more than 0.5 hectares of native vegetation. In the case of Crace Stage 3, the development would not result in the clearing of any vegetation that would be considered native under the *P&D Act* and would therefore not trigger the requirement for the preparation of an EIS.

In relation to Crace Stage 2, the majority of the site contains improved pasture with limited native grasses and a very limited diversity of native forb species. There is, however, evidence that the site is undergoing some natural regeneration of native grasses and eucalypts which is most likely a result of the reduced management intensity and the recent dry conditions. This regeneration is particularly evident within the area set aside in the Hilltop Reserve. There are two distinct areas that have been identified as being substantially native and would be removed as part of the suburb development. Area A is 0.41 hectares in size and is considered as native vegetation under the *P&D Act*. Whether the 0.5 hectare threshold would be met to trigger an EIS is dependent on whether Area B would be considered native vegetation under that Act. This must be determined by the consent authority.

If Area B is not considered to be native vegetation, then the development of Stage 2 would not result in the clearing of more than 0.5 hectares of native vegetation and the preparation of an EIS would not be necessary. If, however, Area B is determined to be native vegetation, the total area of native understorey vegetation to be cleared as a result of the Stage 2 development would be approximately 0.82 hectares. This exceeds the threshold for the clearing of native vegetation that would trigger an EIS under Schedule 4, Part 4.3 of the *P&D Act* by approximately 0.32 hectares. In practise, these areas of native vegetation account for just over 1 percent of the entire site and are not representative of the vegetation throughout Stage 2. Both areas are located on the edge of larger patches of similar or better quality native vegetation that have already been set aside for retention in open space or buffer areas during earlier planning stages (see Figure 4).

It should be noted that an exposure draft for the *Planning and Development (Environmental Impact Statements) Amendment Bill 2010* was released for public consultation on 23 August 2010 and has been developed to refine the triggers for an Environmental Impact Statement (EIS). Under this bill, the threshold for clearing of native vegetation that would trigger the requirement to prepare an EIS has been increased to 5.0 hectares *on land that is designated as a future urban area under the territory plan, unless the conservator of flora and fauna produces an opinion that the clearing is not likely to have a significant adverse environmental impact*. Under this amendment bill, the removal of 0.82 hectares of native vegetation would be much less than the 5.0 hectare threshold and the preparation of an EIS would not be required.

It is questionable whether the impost of preparing an EIS for the Stage 2 Crace suburb development, based solely on the clearing of small patches of disturbed native vegetation, would result in any additional beneficial environmental outcomes that have not already been achieved in the planning process. The suburb design conserves the main features of ecological value within the area such as remnant woodland trees, particularly in extended clumps and woodland regeneration, and the development has been redesigned to enhance habitat connectivity throughout the site.

## References

1. Hogg, D.McC and Burns, M. *Block 588, Gungahlin, Outline Planning Study. Ecological assessment*. Report by David Hogg Pty Ltd to Capital Planners, April 2003
2. ACT Government. *Gungahlin Environmental Impact Statement*. National Capital Development Commission. 1988
3. Hogg, D.McC and Kristine Nash. *Crace Concept Plan and Stage 1 Estate Development Plan. Review of ecological assessment*. Prepared by David Hogg Pty Ltd. April 2008.

## APPENDIX A. STEP POINT TRANSECTS

### Methodology

In general terms, the step point method involves walking along straight-line transects across each assessment area, recording the type of vegetation that occurs at a marked point on a shoe at each step. The proportion of native to exotic groundcover is calculated with bare ground excluded.

### Results

Stage 2							
Transect	Vegetation step-counts			Bare ground	Total samples	Percent native	Comments
	Native	Exotic	Total				
A.1	19	168	187	14	201	10	
A.2	25	198	223	25	248	11	
B.1	10	72	82	18	100	12	
B.2	78	86	164	16	180	47	Northern part of B.2 contains Area B
B.3	43	70	113	5	118	38	
B.4	43	98	141	10	151	30	Retained within open space
C	22	126	148	2	150	15	
D	3	115	118	0	118	3	
E	0	97	97	3	100	0	
F	0	91	91	0	91	0	
G	3	92	95	0	95	3	
H	2	131	133	1	134	2	
I	8	85	93	1	94	9	
J	6	73	79	0	79	8	
K	0	129	129	0	129	0	
L.1	12	135	147	3	150	8	
L.2	13	157	170	1	171	8	
M.1	23	51	74	4	78	31	
M.2	54	51	105	12	117	51	Eastern part of M.2 contains Area A
N	6	87	93	0	93	6	
O.1	31	17	48	5	53	65	Retained within Hilltop Reserve area
O.2	60	23	83	10	93	78	
P	11	106	117	0	117	9	
Total	472	2258	2730	130	2860		
Average						20	

Stage 3							
Transect	Vegetation step-counts			Bare ground	Total samples	Percent native	Comments
	Native	Exotic	Total				
A	34	85	119	22	141	29	
B	35	48	83	8	91	42	
Total	69	133	202	30	232		
Average						36	

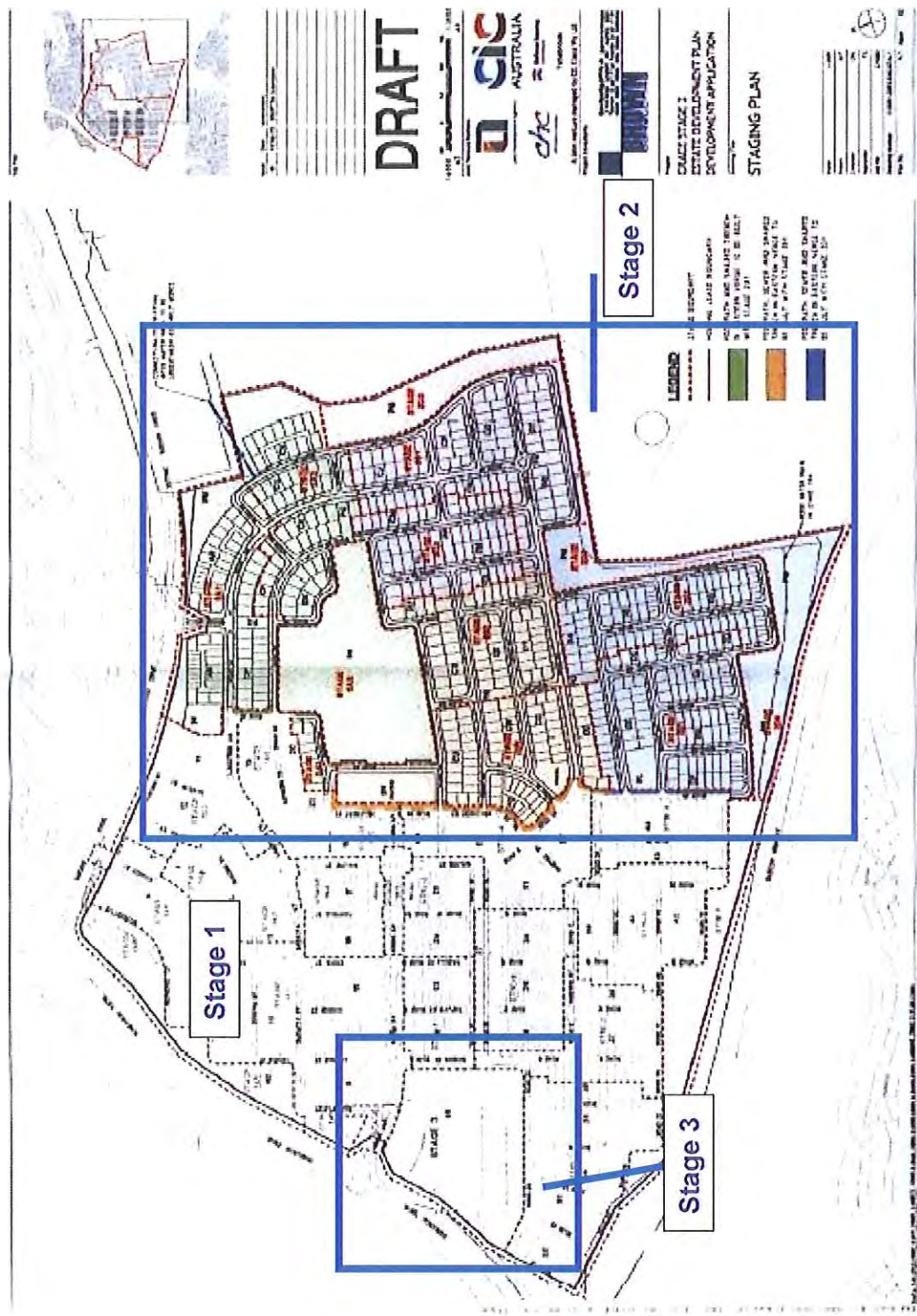


Figure 1. Crace development stages





Figure 2. Transect locations within Stage 3

Base map produced from nearmap.com



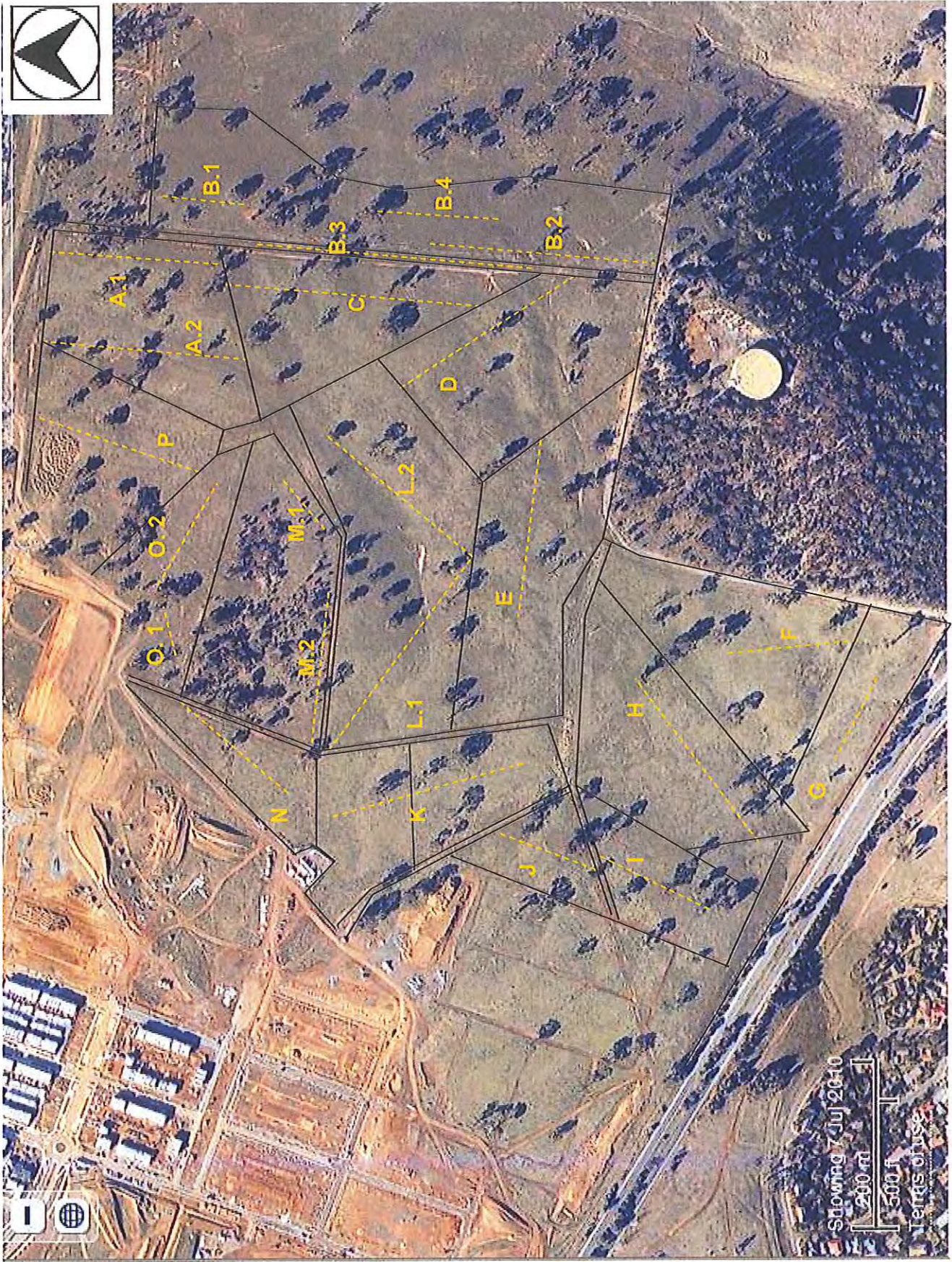
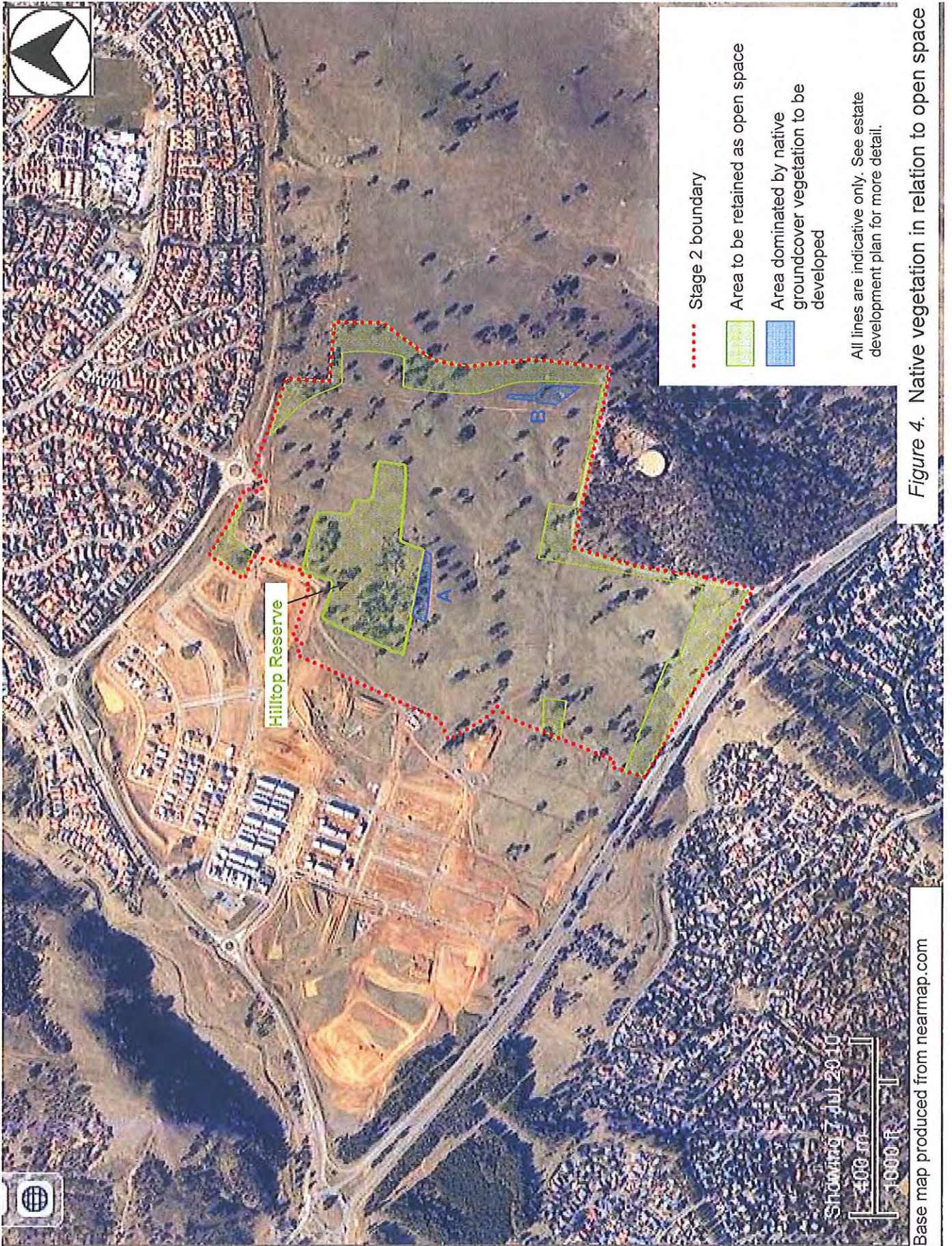


Figure 3. Transect locations within Stage 2

Base map produced from nearmap.com







**From:** David Hogg P/L [dhpl@bigpond.com]  
**Sent:** Monday, 20 September 2010 5:42 PM  
**To:** Stephan Docherty  
**Subject:** FW: CRACE NATIVE VEGETATION

Stephan,

Here are the comments from Sharon Lane on our native vegetation report.

David Hogg

---

**From:** Lane, Sharon [mailto:Sharon.Lane@act.gov.au]  
**Sent:** Monday, 20 September 2010 3:39 PM  
**To:** David Hogg P/L  
**Cc:** Bootes, Trish  
**Subject:** RE: CRACE NATIVE VEGETATION

David

Thank you for sending through the documents on native vegetation survey for Crace Stage 2 and 3 for comment. Conservation Planning and Research has assessed the reports and found that the survey effort carried out is adequate.

The survey report identified an area of ~0.4ha of YBRG (Area A, Figure 4) and an area of ~0.4ha of secondary grassland (Area B) which had ~60% native cover. Therefore 0.8ha of native vegetation is due to be cleared for the development of Crace Stage 2. The clearing of more than 0.5 ha of vegetation currently triggers the requirement for an EIS under the Planning and Development Act.

However, given the management history and extent of degradation across the site, Conservation Planning and Research is of the view that an EIS for the clearing of native vegetation for Crace Stage 2 and 3 is not necessary.

Regards

Sharon Lane  
Manager  
Conservation Planning and Research  
Land Management and Planning Division  
Department of Territory and Municipal Services

Phone: 6207 1911  
Mobile: 0407 958 146  
Fax: 6207 2122  
Email: [sharon.lane@act.gov.au](mailto:sharon.lane@act.gov.au)

PO Box 158  
Canberra ACT 2601

**From:** David Hogg P/L [mailto:dhpl@bigpond.com]  
**Sent:** Tuesday, 14 September 2010 4:33 PM  
**To:** Lane, Sharon  
**Cc:** Stephan Docherty  
**Subject:** CRACE NATIVE VEGETATION

Sharon,

Has your Section been able to review yet our report on Crace Stage 2 and Stage 3 Native Vegetation which I sent by email on 1 September? I understand that ACTPLA requires your endorsement of the report before CIC can proceed further in submitting the estate development plan.

David Hogg

-----  
This email, and any attachments, may be confidential and also privileged. If you are not the intended recipient, please notify the sender and delete all copies of this transmission along with any attachments immediately. You should not copy or use it for any purpose, nor disclose its contents to any other person.  
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Obj Ref: 5888487

Stephan Docherty  
CIC Australia  
Level 3 – 64 Allara Street  
CANBERRA ACT 2608

15 OCT 2010

Dear Mr Docherty

**Crace Residential Estate Stage 2 and 3 application for EIS exemption**

I have reviewed the information provided in relation to the above proposal in order to consider the merit of your application under Section 211 of the *Planning and Development Act 2007*, for an exemption from the requirement to complete an Environmental Impact Statement (EIS).

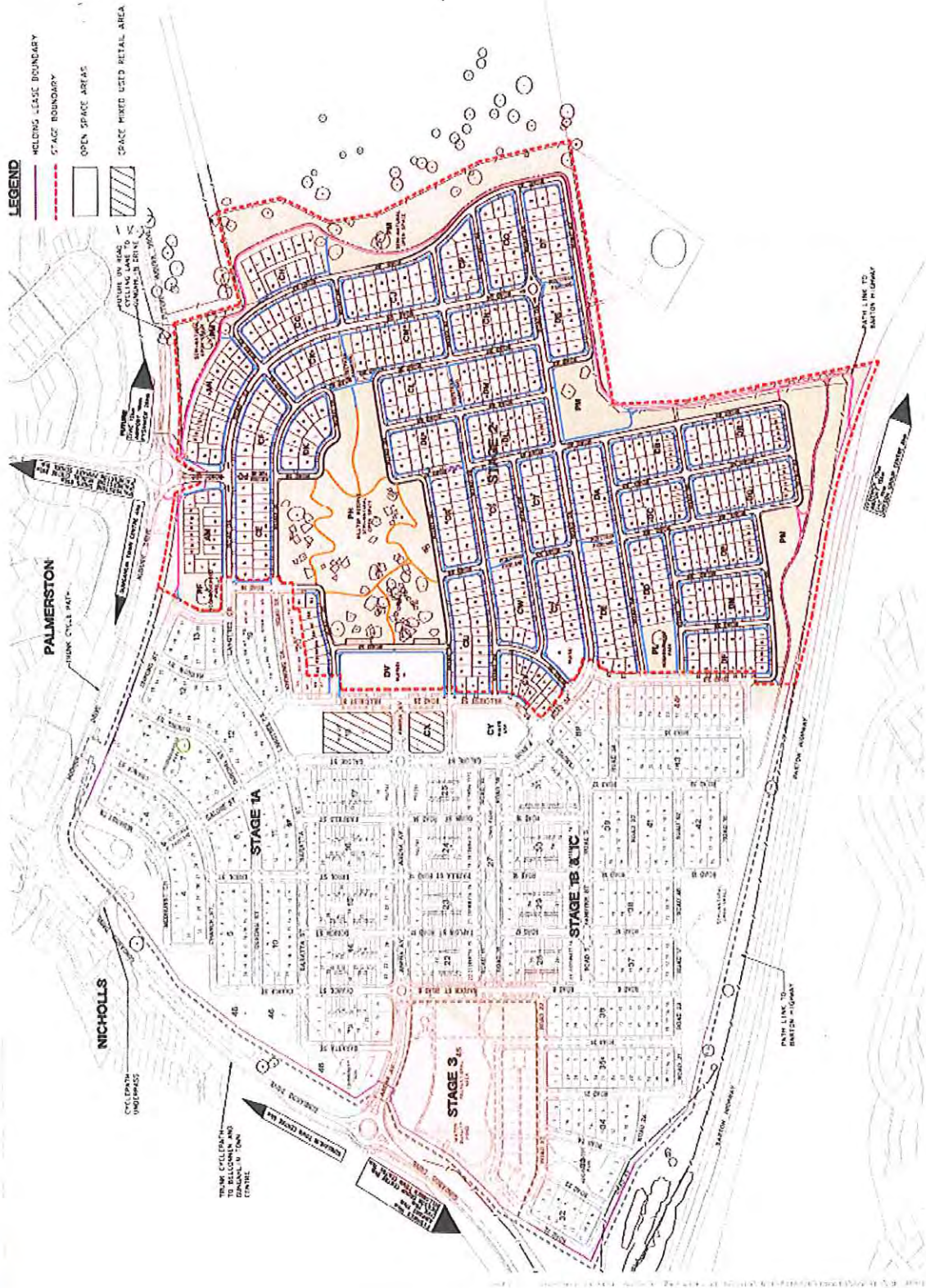
The proposed development includes an activity that is listed in Schedule 4 of the Act as an item that requires an EIS to be completed. However, the proposal may be considered exempt from the EIS requirement if in the opinion of the Minister, or his delegate, the expected environmental impact of the proposal has already been sufficiently addressed by another study or studies. Having considered the information submitted in support of your request, I consider that the proposal as submitted meets this exemption criterion.

As delegate of the Minister for the purpose of the Act, I advise that the proposed development of Crace Residential Estate Stage 2 and 3 as indicated in the attached map will not require any further environmental assessment. You are now able to lodge an impact track development application for this estate. Please ensure that you include a copy of this letter with your development application.

Yours sincerely

Neil Savery  
Chief Planning Executive  
ACT Planning and Land Authority

12 October 2010





Our Ref: A5481280  
Your Ref: 23/12852/57953

Mr Hamish Sinclair  
GHD Urban Transitions  
GPO Box 1877  
CANBERRA ACT 2601

Dear Mr Sinclair

**Grace Proposed Park**

Thank you for your letter of 30 March 2010 in relation to the above matter.

In response to your correspondence and a review of the matter, I am pleased to advise that from a policy perspective, a community recreation irrigated park (CRIP) is supported and it can be incorporated into the planning for the proposed estate development plan development application (EDP DA) for the remaining unapproved area with Stage 1 of the Grace estate.

As such, no Territory Plan variation statutory process will be required to incorporate the CRIP into Grace.

I have also been advised by Steven Gianakis that Stephan Docherty (Assistant Project Director, CIC Australia) on 4<sup>th</sup> May 2010 confirmed that the developer's intention is to deliver and fund a CRIP, not merely a "neighbourhood playing field" as indicated in the attachment to your letter.

Accordingly, the developer will need to discuss and have agreement from Sport and Recreation Services, Territory and Municipal Services to the specific details and facilities to be accommodated within the proposed CRIP.

If you require any further information, please contact Steven Gianakis on 62071741.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Kelvin Walsh'.

Kelvin Walsh  
Director, Planning Services  
April 2010

5 May 2010

## Appendix G

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### Response to Comments


## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

**CONSOLIDATED COMMENTS**  
**CRACE ESTATE, STAGE 3– DRAFT ESTATE DEVELOPMENT PLAN**  
**CIRCULATION 1 – 13 JANUARY 2011**


Thank you for the opportunity to comment on the above documentation circulated to all relevant agencies. The Estates Assessment Unit, Development Assessment, ACT Planning and Land Authority have consolidated the comments for the developer's consideration, response and or action.

**Some of the agencies have raised a number of comments that will require the EDP to be recirculated upon resubmission. ACTPLA may waive the need to recirculate the EDP if all relevant written endorsements are provided with the revised submission. All entity endorsements must be clearly linked to an identified document version.**

**Please Note: Items highlighted in Orange require no action from the applicant – CIC Crace**

AGENCY	NO	COMMENTS	PROPONENT'S RESPONSE
ACT Health Vojkan Stefanovic	1	Please find attached ACT Health comments:   Crace Estate Stage 3.pdf	<ol style="list-style-type: none"> <li>1. The reuse of harvested water will be addressed during the detailed design process.</li> <li>2. Sport &amp; Recreation (SRS) is the end user and manager of this facility. Prior to the commissioning of the pond &amp; associated irrigation system SRS will develop a management plan for the facility prior to its use for water re-use.</li> <li>3. The management plan will comply with section 3.4 of the 'Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Stormwater Harvesting and Reuse'.</li> <li>4. The pond collects water from the Crace Southern Catchment. The water sensitive urban design (WSUD) principles utilised at Crace provide to meet the national stormwater quality objectives for re-use and / or discharge.</li> <li>5. Estimated pollution reduction &amp; water quality management targets as a result of the WSUD principles employed are included in the draft EDP report and show substantial reductions in the suspended solids, phosphorous and nitrogen exported.</li> <li>6. The reductions are achieved through the provision of bio-retention rain gardens &amp; tree pits within the streetscapes of the catchment and the wetland adjacent to the re-use pond.</li> </ol>

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

<b>ActewAGL Electrical</b> Raul Tinio	2	<ol style="list-style-type: none"> <li>1. A minimum distance of 100m is required between the substation and the playground, please see the attached sketch showing the approx location of the substation.</li> <li>2. <div style="text-align: center;">   Clearance Req from Sub to Playground.pc </div> </li> <li>3. The blocks in the southern sides of sections EA and EB are to be serviced from Digby Cct, however, no typical cross section drawing of Digby Cct is provided.</li> </ol>	<ol style="list-style-type: none"> <li>1. Noted.</li> <li>2. However, it should be noted that substations can be closer than 100m provided sufficient earthing is provided. This will be addressed at the detailed design stage.</li> <li>3. Typical section to be added to the drawing set.</li> </ol>
<b>ActewAGL Water Division</b> Bruce Reid	3	<ol style="list-style-type: none"> <li>1. The approved water Supply and Sewer Master Plans that have been approved for stages 1 &amp; 2 require updating and re-approval. Otherwise the EDP is acceptable.</li> </ol>	<ol style="list-style-type: none"> <li>1. Water supply and sewer master plans will be updated as required.</li> </ol>
<b>ACTION</b> Stephen Colbert	4	<p>ACTION, subject to section 9 below, has no further comment at this stage. The Estate development plan report;</p> <p>9. Public Transport</p> <p>There are no proposed bus routes through Crace Stage 3. However it is within 400m of a proposed bus stop on Abena Avenue within Stage 1.</p>	No comment.

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<p>TAMS Asset Acceptance George Kwiatkowski</p>	5	<p><b>Civil</b></p> <ol style="list-style-type: none"> <li>Some turning path templates have been done by stop-go movement at full lock steering. These turning paths need to be reviewed and resubmitted. Also please show travel speed, steering wheel setup and other related information on the plot legend and each turning path plots and if additional land is required, this shall be now made at this EDP submission.</li> <li>It appears that path at the North end of Road 101 turning point is too close to the kerb and turning vehicles (garbage truck) can be hazardous for pedestrians.</li> <li>There are two GPTs proposed in this stage however, Stormwater Master Plan showed two stormwater lines which drain directly to the pond. All stormwater pipes should be connected to trash rack/GPT.</li> <li>How stormwater is collected from Blocks a, b, c, d of Sections EA and EB?</li> <li>Why waste collection plan is not provided for road 101?</li> </ol> <p><b>Landscape</b></p> <ol style="list-style-type: none"> <li>Eucalyptus rossii is not to be used to the north of residential properties due to the issue of excessive over shadowing (O/S Concept Plan no 31.1). The Zelkova serrata deciduous theme proposed for planting within residential verges in Road 102B (east) adjacent to Section EB Blocks h, g &amp; f are to be continued along Road 102B adjacent to Section EB Blocks a, b, c, d &amp; e and Road 101 Section EA Blocks a, b, c &amp; d.</li> <li>Plantings within mulched beds are to be setback adequately from pathways to accommodate mature canopies of shrubs and groundcovers.</li> <li>The proposed playground is to be setback from adjacent Roads in accordance with TAMS standards (DS-15).</li> <li>A Composite Verge Plan will be required at the detailed design phase showing all services including ties, driveways paths and notably tree planting centres, prepared by the civil consultant in conjunction with the landscape consultant to demonstrate acceptable street tree clearances [and to avoid deletions at construction stage]. Minimum clearances from trees to driveways (3m) and service ties must be met. In all frontages there should be a concerted effort to design to maximise the space for street tree planting by co-locating service ties and minimising conflict</li> </ol>	<p><i>The following civil issues will be addressed during the detailed design process.</i></p> <ol style="list-style-type: none"> <li>Turning templates have been reviewed and additional the additional information added to the drawings.</li> <li>Turning movement of the waste vehicle have been provided for the hammer head which has been designed in accordance with the Development Control Code for Best Practise Waste Management in the ACT, September 1999. The length of the hammer head allows for the waste truck to undertake a three point turn without encroaching beyond the kerb, in addition to the length provided, the standard 600mm clearance from back of kerb to the footpath is also provided.</li> <li>The GPT's have been designed in accordance with TaMS design standards and convey the 1 year ARI flow. The south western catchment not directed to the GPT and directly discharges to the detention pond as the catchment area is less than 8 hectares.</li> <li>Stormwater will be discharged via kerb outlets which is consistent with earlier stages to promote the WSUD principles of Crace.</li> <li>Plan has not been provided as it is standard kerbside pickup at front of blocks.</li> </ol> <p><i>The following landscape issues will be addressed during the detailed design process.</i></p> <ol style="list-style-type: none"> <li>The species will be changed to the deciduous Quercus coccinea (Qco) to achieve the objective of an individual character to the street and complement the character of the proposed open space.</li> <li>Noted.</li> <li>Playground has been located to take advantage of main access ways to park. Sections occur within the 30m zone and the playground has been fenced accordingly as for Linear Park to the east.</li> <li>Noted.</li> </ol>
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## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

	<p>between location of hard infrastructure and trees. We ask that the consultants take into account the requirement for suitable clearances between street trees and service ties.</p> <ol style="list-style-type: none"> <li>5. Ensure at the detailed design phase that vehicle access to this recreational open space zone is restricted by physical methods including landscape treatments whilst allowing emergency/maintenance access - via "ranger gates". This is a high priority due to the recreation zone being designated as an irrigated site and should consider a variety of treatments and mechanisms. Although TAMS preference is for restrictive measures through the installation of appropriate higher and castellated kerb structures, it should be noted that in this case we would support the use of a combination of soft and hard landscape treatments such as log barriers, bollards, fencing/gates, boulders and planting.</li> <li>6. Cycle Deflection Rails are to be introduced to the edge of the recreational zone to aid in restricting vehicle access where a footpath wider than 1.2 metres is proposed (per DS-13).</li> </ol> <p><b><i>Landscape Master Plan (Plan 13.1 to 13.5) and Open Space Plan (Plan 31.1):</i></b></p> <ol style="list-style-type: none"> <li>1. The use of evergreen street trees to the north of residential properties is not acceptable if they will block winter solar access between 10am and 2pm. Winter solar access will need to be demonstrated.</li> <li>2. The deciduous street trees proposed are supported. Note <i>Ulmus parvifolia</i> 'Yarralumla Clone' should have code Upy (not Ups) – it is the grafted weeping form.</li> <li>3. <i>Acer rubrum</i> 'October Glory' in open space - is only supported in limited numbers. This cultivar is not in the current Design Standards Plant list and the species <i>Acer rubrum</i> of which this is a cultivar, was deleted from the Plantlist because it was found to be unsuited to Canberra's dry</li> </ol>	<ol style="list-style-type: none"> <li>5. Formal vehicle access points to the reserve will be provided at two locations – to the east of the amenities block and at the path entry point of road 101. These will be controlled through fixed &amp; removable bollards. Castellated kerbs will be provided to the northern side of roads 101 and 102B. Barrier kerbs to be provided to the eastern side of road 102B, the northern side of road 22B and the western side of road 6A.</li> <li>6. The current main route drawing (DS13-11) identifies that the main route around Crace will be on-road facilities along Gundaroo Drive and the Barton Highway. The footpath network within Crace is not identified as part of any future community network. Deflection Rails are generally installed on Intermediate paths (Intermediate path designated in TaMS DS-13 as being a minimum of 2.0m wide). The proposed recreational trail only provides one (1) crossing point into the open space where the pram ramp is widened at Road 101 to join the recreation trail as it runs down Road 102A and Road 24 (Stage 1). Fixed and removal bollards will be added to the open space side of this entry point only to restrict vehicular access. We feel this is a more appropriate restriction method within the park. This approach has been approved @ design acceptance by TaMS within a park in Stage 1A1 Crace.</li> </ol> <p><b><i>Landscape Master Plan</i></b></p> <ol style="list-style-type: none"> <li>1. Evergreen street trees have been replaced with deciduous trees in accordance with comments above.</li> <li>2. Drawing updated to reflect the code Upy for <i>Ulmus parvifolia</i> 'Yarralumla Clone'.</li> <li>3. Noted. 'October Glory' reportedly tolerates warmer climates compared to other red maple cultivars. 'October Glory' use is limited to the BBQ / Picnic Area and will tie the design back to that of the Linear Park to the East. The 'October Glory' cultivar has been approved for use via the EDP and design acceptance processes in the Linear Park to the east of the CRIP.</li> </ol>
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		<p>summers. If used it must only be in small groups amongst other species.</p> <ol style="list-style-type: none"> <li>4. Eucalyptus viminalis in open space – supported in limited use in large area where it will get water.</li> <li>5. Eucalyptus stellulata in open space – this is listed in the species legend but doesn't appear in Plan 31.1. it would only be supported for use in a damp area as it hasn't proven hardy to Canberra's dry climate.</li> <li>6. Allocasuarina littoralis in open space – this species is not suited to wet sites, so is not appropriate to location proposed adjacent to the ponds.</li> <li>7. Platanus orientalis 'Digitata' in open space adjacent to courts and playground facilities – will require root barrier installation to prevent damage to the hard infrastructure as the trees grow.</li> <li>8. What tree is coded BRp? It is listed on Plan 31.1 but doesn't occur in the Tree Species Legend on Plan 13.1.</li> <li>9. The spacing of trees in open space must ensure that there is sufficient space between trees to allow canopies to develop without interfering with each other or with pedestrian access (without requiring high level of pruning to modify the shape and size of the trees).</li> </ol> <p><b>Traffic Noise Issues</b></p> <ol style="list-style-type: none"> <li>1. The conclusions in the acoustic studies undertaken for CIC by Bassett Acoustics identified number of dwellings in Crace Stage 3 where the traffic noise planning criterion value is likely to be exceeded. It is important for the developer and building certifier to ensure that the recommendations in the acoustic studies in terms of acoustic treatments are implemented during the construction of any dwellings on these blocks.</li> </ol> <p>The blocks identified are shown with red dots in the 1st and 4th frames in the attached plans (pages C2 - C5 from the 2010 Noise Assessment report).</p>	<ol style="list-style-type: none"> <li>4. Noted.</li> <li>5. Noted.</li> <li>6. Species will be replaced with Allocasuarina glauca.</li> <li>7. Noted.</li> <li>8. Error on drawings corrected. BRp should be Eag – Eucalyptus aggregate (Black Gum).</li> <li>9. All trees have been laid out to allow even canopy development and spread.</li> </ol> <p><b>Traffic Noise Issues</b></p> <ol style="list-style-type: none"> <li>1. Noted.</li> </ol>
Department of Education Miles McCann	6	No Comment.	

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<p>Design Policy Chris Gell</p>	<p>7</p>	<p><b>Plan No. 30.1 – Planning Control Plan</b></p> <ol style="list-style-type: none"> <li>Is an alternative to the mandatory F3 fencing to blocks a &amp; e possible? This may create a dead space with limited surveillance between an earth mound &amp; the fence.</li> </ol> <p><b>Plan 31.1 – Open Space Concept Plan</b></p> <ol style="list-style-type: none"> <li>Could further consideration be given to the design of the open space areas? Is the 'formal garden space' necessary? – it's function is not clear and the planting layout appears random. Two alternatives are:</li> <li>Move the playground area (11) to the formal garden area. This would enable the kick-around space (1) to become a more useful size without the extent of planting &amp; picnic shelters intruding into the space. Although the current playground location terminates the 'Town Park', this could be equally done by landscape elements.</li> <li>Extend road 102B through to Road 6A, remove the first connection to Digby Cct &amp; move Road 102B south to align with the southern lane of the town park. This would make sections EA &amp; EB narrower, however enables the 'formal garden space' to be used for residential blocks. Rylestone Cres could be extended to road 102B to provide a connection to Digby Cct.</li> <li>While outside of Stage 3, there is little shade provided to the parking off Narden Street. Could additional shade trees be planted in between parking bays. Similarly, please ensure the species, location &amp; number of trees to the playground (11) will provide sufficient shade to this area.</li> </ol>	<p><b>Plan No. 30.1 – Planning Control Plan</b></p> <ol style="list-style-type: none"> <li>This will be addressed during the detailed design process. The potential for dead spaces will be addressed by the future purchaser when submitting their house for design approval.</li> </ol> <p><b>Plan 31.1 – Open Space Concept Plan</b></p> <ol style="list-style-type: none"> <li>Sport &amp; Recreation (SRS) have been closely involved in the development of the CRIP and have given in principle agreement with the general layout and additional recreation options that the formal space provides within the CRIP.</li> <li>The 'formal gardens' are essentially a series of formal lawns defined by a grid layout of trees. The objective is to provide smaller more intimate lawn areas surrounded by amenity shade trees to encourage picnics and open kickabout spaces of a size suitable for use by parents with younger children in close proximity to the playground and BBQ / Picnic Areas. The kickabout space to the centre of the park is approx. 50m wide x 90m long and considered an appropriate size for its use which is informal games or activities. The picnic shelters in this space allow for their use as viewing / staging / gathering points to the kickabout, BBQ and playground areas. The Linear Park and CRIP have been designed to provide a wide range of recreational opportunities across a range of age groups. The direct physical and visual connection between the 2 playgrounds is seen as desirable for this purpose with the formal gardens providing an appropriate setting for the scale of the large playground.</li> <li>For the urban design &amp; amenity of the area additional residential blocks will not be considered in this area. Proposed Sections EA &amp; EB are 60m depth allowing for optimal lot depth of 30m. Due to topography there is a moderate cross fall. It is not possible to shorten the depth of lots and under the regulations the intersection stagger would be too close.</li> <li>The playground proposes to include trees for the full length of its northern boundary and large amenity shade trees (<i>Platanus orientalis</i> 'Digitata') within the playspace area. Works along Road 6 have been approved under Stage 1 EDP and parking already approved through design acceptance and constructed as part of Stage 1C1. There is no option to improve the shade within this area unless TaMS wants to undertake the work themselves.</li> </ol>
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	<p>6. The path to the west of blocks a &amp; e / section EA should be upgraded to 2.5m wide to accommodate bush fire vehicles, or changed to an edge road. This may also assist to increase passive surveillance of this area.</p> <p>7. We support the bio-retention tree pits to utilise stormwater run-off.</p> <p>8. There is concern the Eucalypts indicated to the northern verges of Sections EA &amp; EB will significantly reduce solar access to these blocks. Also, being adjacent to an area of north-west facing open space, the trees may increase the danger from bushfires. It is recommended that these verge trees be changed from Eucalypts to a deciduous species (not evergreen) which provides summer shade and allows for solar access in winter. The use of Eucalypts in the parkland area is strongly supported however.</p> <p>9. The stormwater structures shown as item 17 refer to Engineer's Stormwater Masterplan, however this does not clarify what these structures contain. Can these be located further away from the residences if they contain irrigation pumps?</p> <p>10. What is the narrow path along the edge of the pond used for? Are the paths in this area sufficient for maintenance &amp; bush fire access?</p> <p>11. Could consideration be given to providing a layback kerb to the north of road 102B (Plan 19.1). If the parking along Narden Street is full, it is likely cars will park along road 102B, which may cause issues with residents. Providing a layback kerb will allow occasional overflow cars to park partly on the road / northern verge, rather than entirely on the road.</p>	<p>6. This issue will be addressed with ESA. In discussions with ESA about Crace prior to the submission of the draft EDP a trafficable area was designated for this area on drawing 27.1. This was consistent with the ESA approach to similar situations within Stage 2. The current path is intended to be a lower hierarchy 1.5m wide connection path only. The wider 2.5m path is provided to encourage a circuit path for shared path use and provide a maintenance route around the park.</p> <p>7. Noted.</p> <p>8. The species will be changed to the deciduous <i>Quercus coccinea</i> (Qco) to achieve the objective of an individual character to the street and complement the character of the proposed open space.</p> <p>9. This will be addressed during the detailed design process. Item 17 is a GPT as identified on drawing 9.1 &amp; 9.2. The irrigation pump station will be located closer to the pond.</p> <p>10. This is a gravel path only intended for passive recreation &amp; enjoyment &amp; visual access to pond &amp; wetland edges. No vehicular access to this path.</p> <p>11. A castellated / permeable kerb is proposed along this section of the road to promote WSUD features. In accordance with TaMS current standards for restricting access to verges / open spaces the layback kerb is not considered ideal. Overflow parking within the park is not considered ideal by TaMS. A significant amount of 90 degree parking has already been accommodated along Road 6 and this is considered sufficient for the use of the park. The use of 3.5m lanes is considered sufficiently wide for parking along this road.</p>
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<p>Estates Assessment Owen Pankhurst</p>	<p>8</p>	<p><i>General</i></p> <p><b>CRIP</b></p> <p>1. The detailed design of structures and landscaping within the CRIP is not required to be included in the DA for the EDP as it is not infrastructure required as part of an EDP. However for the developer to construct these works they will need to be part of a further approval or exempt from development approval in accordance with the Planning and Development Regulation 2007. The provisions of Division 1.3.6 Exempt developments—Territory developments - 1.90 Public works should be reviewed in light of the proposed works.</p> <p><b>WQP</b></p> <p>2. The water quality pond and wetlands are required to be included in the DA approval and will need to be detailed to the satisfaction of TAMS and EPA and demonstrate the targets for WSUD for the wider Crace estate are achieved.</p> <p><b>BDP</b></p> <p>3. The widths of the easements are to be nominated.</p> <p><b>LUP</b></p> <p>4. The WQP and Wetland are to be shown within the PRZ1 Land Use Zone.</p> <p><b>PCP/BEP</b></p> <p>5. The mandatory garage setback/location and building envelope are not supported as a planning control to be included in the Precinct Code/Concept Plan as they are inconsistent with the provisions of the Single Dwelling Housing Development Code.</p> <p>6. Typical Cross Section - Please provide typical cross section drawing of Digby Cct.</p>	<p><b>CRIP</b></p> <p>1. Noted.</p> <p><b>WQP</b></p> <p>2. This data has been provided with the EDP submission within the report at Appendix D.</p> <p><b>BDP</b></p> <p>3. The relevant drawings have been amended accordingly.</p> <p><b>LUP</b></p> <p>4. The drawing has been amended accordingly.</p> <p><b>PCP/BEP</b></p> <p>5. The PCP drawing has been amended in accordance with the advice.</p> <p>6. Typical cross section to be provided.</p>
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		<p><b>Statement against the Criteria</b></p> <ol style="list-style-type: none"> <li>1. Rule R3 - is applicable, please address this Rule/Criteria</li> <li>2. Rule R9 - Requires 4 turn movements to reach Road 1A please address the Criteria</li> <li>3. Rule R15 - Does not comply - 2m wide verges do not comply. Please address the Criteria</li> <li>4. Rule R30 - Does not comply - The lighting for the pathway adjoining Blocks a, &amp; e Section EA is to be demonstrated.</li> </ol>	<p><b>Statement against the Criteria</b></p> <ol style="list-style-type: none"> <li>1. Rule R3 – none of the roads proposed will operate as through routes for externally generated traffic as there is no direct access to the area from external road networks.</li> <li>2. Rule R9 – Access from Stage 3 meets the requirement by ensuring no more than three turning movements are required to reach a higher order road. The roads in Stage 3 are access roads, which use Narden Street (minor collector) to egress from the Estate.</li> <li>3. Statement against the Criteria – this submission has changed to confirm with Criteria C15 – The edge road verge of 2.0m has been adopted as it is adjacent to open space. The verge opposite Section 45 and the eastern blocks of Section 46 have no services proposed. The verge on the northern boundary of Section 46 is of sufficient space to accommodate the single proposed service of a 100mm diameter water main.</li> <li>4. Rule R30 – All paths in and around Stage 3 will have lighting in accordance with current Design Standards for Urban Infrastructure, including the link path adjoining blocks a and e of Section EA.</li> </ol>
Development Policy Michael Bennett	9	<p><b><i>Ongoing matters arising from the EDP</i></b></p> <ol style="list-style-type: none"> <li>1. It is noted that there is a planning control plan contained within the EDP, which if approved and stamped as part of the EDP, will form the basis of a technical amendment under s96 of the Planning and Development Act 2007 at the time that the land ceases to be within the future urban area. As part of the technical amendment the planning control plan will be incorporated into a relevant precinct code under of the Territory Plan.</li> <li>2. It is noted that the planning control plan includes ongoing block-specific provisions relating to bushfire and noise attenuation requirements for buildings. However, the planning control plan also includes provisions for boundary fencing and garage locations. These should be removed from the planning control plan as they do not relate to matters that the Territory Plan identifies can be dealt with in a precinct code. It is a matter for the Estates Team to determine in what way, if any, that mandatory fencing and garages will be regulated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Noted.</li> <li>2. The PCP drawing has been amended in accordance with the advice.</li> </ol>

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		3. The submission report mentions a TP technical amendment process currently underway involving the substitution of a neighbourhood oval with a CRIP in the CRACE concept plan (TA 2010-31) - According to the TPV Unit, this is no longer the case.	3. Noted.
<b>Emergency Services Authority</b> Conrad Barr	10	Please find ESA comments attached:   COMMENTS - ESA - Crace Estate Stage 3	<ol style="list-style-type: none"> <li>1. Edge Road - The open space area to the east of Section EA will include an Emergency Services/ RFS Trafficable Zone constituting areas of reinforced turf to accommodate the weight of vehicles. The proposed method has been endorsed by the RFS in the previous Stage 2 EDP submission.</li> <li>2. OAPZ - An error has occurred on the submitted plan. The OAPZ does apply over the pond and wetland and irrigated grass areas of the plan. Please refer to revised BMP.</li> <li>3. EAPZ – Removal of blocks d, h and I Section EA noted and amended on revised BMP.</li> <li>4. Water Services – hydrants have been shown on the water masterplan. Demand table has been updated as per ActewAGL comments to include additional blocks. The type of fire risk for this development is Type F6, detached housing and therefore 25l/s flow is required. Updated demand table indicates that 44l/s will be available at the end of the water service located in section EA outside block a.</li> </ol>
<b>Environment &amp; Recreation</b> Helen McKeown	11	No comments to provide.	
<b>Environment Protection Authority</b> Cassie Schilg	12	<b>Erosion and Sediment Control:</b> <ol style="list-style-type: none"> <li>1. Construction and development works to be in accordance with "Environment Protection Guidelines for Construction and Land Development, 2007". As the site is greater than 0.3 hectares the proposed estate development is an activity listed in Schedule 1 of the <i>Environment Protection Act 1997</i> as a Class B activity. Therefore, the contractor/builder proposing to develop the site must hold an Environmental Authorisation or enter into an Environment Protection Agreement with the EPA in respect of that activity prior to works commencing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Noted. Contractor will hold license for construction and will be responsible for the erosion and sediment control measure on the site.</li> </ol>

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	<p>As part of this Agreement/Authorisation, an erosion and sediment control plan for each stage of work is to be endorsed by the EPA prior to works commencing. Two copies of each plan are required to be submitted.</p> <p>The Plans must include the following:</p> <ul style="list-style-type: none"> <li>- Flow Paths</li> <li>- Sediment Controls</li> <li>- Dust Controls</li> <li>- Stabilised access points</li> <li>- Noise controls and hours of operation</li> <li>- Project Manager or Site Supervisor contact details</li> <li>- Size of the site, if over 0.3ha then environment agreement required.</li> <li>- Waste Controls including areas for concrete washdown etc</li> <li>- Spoil Controls - If soil is to be removed or imported on site, the details of origin of the soil imported or the location where the soil is to be exported are to be provided.</li> <li>- Location of stockpile areas</li> <li>- Maintenance Schedule of Controls</li> </ul> <p><b><i>Sediment Retention Dam:</i></b>                  As the site is over 1 hectare there is a requirement for a Sediment Retention Dam.                  Dam construction should be in accordance with the following guidelines:</p> <ol style="list-style-type: none"> <li>1. Be of adequate size to control all runoff from the site (i.e. 150 cubic metres per hectare of catchment).</li> <li>2. No discharge from dam unless sediment level is less than 60mg/litre. If sediment level is greater, then prior to discharge, the dam must be dosed with either Alum or Gypsum and allowed to settle until the sediment is less than 60 mg/litre.</li> <li>3. Water level must not exceed 20% capacity at all times to allow runoff storage during a rain event.</li> <li>4. Regular dredging of the dam must be carried out to remove silt.</li> <li>5. Site drawing and details must be provided to Environment Protection Unit, EPA for approval prior to works commencing.</li> <li>6. Temporary Erosion &amp; Sediment control ponds must be incorporated into each stage of development. The temporary ponds shall not be removed until 85 % of the developments are complete or all the disturbed areas are</li> </ol>	<p><b><i>Sediment Retention Dam:</i></b>                  Noted</p>
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	<p>stabilised.</p> <p>Noise: All homes must be constructed as advised in the noise report titled; Crace Noise Assessment, Prepared for CIC Crace Pty Ltd Prepared by AECOM Australia Pty Ltd Dated 25 November 2010</p> <p>Construction work must only occur between the following hours: Mon to Saturday 7am to 6pm, excluding public holidays.</p> <p><b><i>Waterway Work Licence:</i></b> This work will create disturbance to a defined waterway under the Water Resources Act 2007. Works that affect a waterway require a waterway works licence. Waterway means: (a) river, creek, stream or other natural channel in which water flows (whether continuously or intermittently); or (b) the stormwater system or any other channel formed (whether completely or partly) by altering or relocating a waterway mentioned in paragraph (a); or (c) a lake, pond, lagoon or marsh (whether formed by geomorphic processes or by works) in which water collects (whether continuously or intermittently); and includes (d) the bed that the water in the waterway normally flows over or is covered by; and (e) the banks that the water in the waterway normally flows between or is contained by; but does not include land normally not part of the waterway that may be covered from time to time by floodwaters from the waterway</p> <p>Works that affect a waterway must not commence unless the applicant holds an authorised Waterway Work Licence. The applicant will therefore be required to submit a Waterway Works Licence application for this project. Contact Environment Protection Authority (Water Resources) for more information: via telephone 132281.</p>	<p><b><i>Waterway Work Licence:</i></b> Waterway work license application will be completed prior to work commencing.</p>
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## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

		<p><b>Dust suppression:</b> We advise the contractor seek alternatives to water for dust suppression. These could include but are not limited to:</p> <ul style="list-style-type: none"> <li>- Staging of works to minimise areas of disturbance at any one time before working on other areas;</li> <li>- The use of temporary grassing;</li> <li>- The use of bitumen straw mulching;</li> <li>- The use of bitumen spraying;</li> <li>- The use of hydromulching and seeding; and</li> <li>- Ceasing work in dry and windy conditions.</li> </ul> <p>Please note, while there is provision for a contractor to apply to the EPA for an exemption from a license to take water for short-term construction activities, a water exemption is intended for construction activities other than dust suppression</p> <p><b>Non-potable water for long-term use:</b> Should the proponent or their client(s) be involved in plans to take non-potable water for on-going purposes (e.g. ponds, groundwater etc), we encourage the proponent or their client(s) to contact the Environment Protection Authority to discuss 'Water Access Entitlement' and 'Licence to take water' requirements of the Water Resources Act 2007. No water may be taken without an EPA approved Licence to take water. Contact Environment Protection Authority (Water Resources) for more information: Telephone 132281, or GPO Box 158, Canberra ACT 2601</p>	<p><b>Dust suppression:</b> Noted.</p> <p><b>Non-potable water for long-term use:</b> Appropriate applications and licenses will be completed and attained prior to water being utilised from the re-use pond.</p>
<p><b>Infrastructure Policy</b> Gerard Coffey</p>	13	<ol style="list-style-type: none"> <li>1. Plans such as sewer, water supply and bush fire management are at a small scale and difficult to assess.</li> <li>2. Cross sections showing how significant areas of fill will be treated are required.</li> <li>3. Cut / fill plan would be useful.</li> </ol>	<ol style="list-style-type: none"> <li>1. The plans submitted have utilised standard scales for an EDP submission.</li> <li>2. This will be addressed during the detailed design process. This will be done in accordance with the TaMS standard for roads &amp; open space and AS2870 for blocks.</li> <li>3. Refer plan 28.1.</li> </ol>
<p><b>Jemena</b> Stephen Donnelly</p>	14	No comments to make at this stage	

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

<b>Land Policy</b> Steven Gianakis	15	<ol style="list-style-type: none"> <li>1. It is noted that the detail design of the CRIP will be subject to TaMS approval.</li> <li>2. The deed should be amended to reflect that a CRIP is being provided and constructed by the developer instead of playing fields.</li> <li>3. In an email of 21 Dec 2010, Sport and Recreation confirm that the area proposed for the CRIP is sufficient.</li> <li>4. Technical amendment No 2010-31 (changes to the Crace Concept Plan) has been withdrawn. There is sufficient scope in the Crace Concept Plan for the consideration of the CRIP and the increase in dwelling number at the development application stage.</li> </ol>	<ol style="list-style-type: none"> <li>1. Noted.</li> <li>2. Deed manager to address.</li> <li>3. Noted.</li> <li>4. Noted.</li> </ol>
<b>Leasing</b> Dulce Lander	16	The Leasing Section has no comments in relation to Crace Estate Stage 3.	
<b>Surveying and Spatial Data</b> Rene de Kieffe	17	No comments	
<b>Telstra</b> Jacob Lai	18	<p>There are no key planning issues that have been considered as having an impact on Telstra's telecommunications infrastructure: Telstra reserves the right to amend its implementation strategy without notice. Please include following information in your correspondences: <i>Extensions to the Telstra network are planned in light of the size and pace of each stage of proposed developments and the proximity of existing Telstra network.</i></p> <p><i>Early notification of any proposed development will enable Telstra to deliver services with minimal disruption and enable coordination of trenching with other infrastructure.</i></p> <p><i>To provide early notification, planned property developments can be registered with Telstra via the <a href="http://www.telstrasmartcommunity.com">www.telstrasmartcommunity.com</a> website.</i></p> <p>The opportunity to respond and provide input is appreciated. For future correspondence and enquiries regarding this matter, please contact Jacob Lai on (02) 9397 2090.</p>	Noted.
<b>TransACT</b> Wayne Read	19	No comments for this EDP.	

## CRACE STAGE 3 – ESTATE DEVELOPMENT PLAN REPORT

<b>NCA</b> Jamie Cowell	20	All development associated with the new proposed estate that lies within 200 metres of the centre line of Barton Highway must comply with the provisions established in approved DCP No : 171/08/0002 - Crace Blocks 292, 352, 499 and Part 588. This is to ensure that the integrity, visualisation and importance of Barton Highway is maintained as one of the "Approach Routes" set out under the National Capital Plan.	Stage 3 does not lie within 200 metres of the centre line of the Barton Highway.
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## Appendix H

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### Statement Against Crace Concept Plan – Important Planning Requirements

## Crace Stage 3 - Statement against Crace Concept Plan – Important Planning Requirements

Relevant Provisions	Assessment
<u>6.1 housing policies(Small Scale Blocks)</u> Refer to Section 6.14	Refer to Section 6.14 below
<u>Housing Mix</u> Indicative yield of 1800 dwellings	<p>The indicative yield has been revised through the design of the Estate. The design incorporated a master planning process that identified the characteristics of the site, views and vistas, opportunities and constraints. This approach was then considered through incorporation of the requirements of the Concept Plan and the Deed of agreement, culminating in a concept plan that was slightly varied to that in the approved Concept Plan. Progression of this concept realised a subdivision structure that recognised the requirements of the Concept Plan and provided opportunities for increased yield.</p> <p>This assessment demonstrates consistency of the Estate design with all of the objectives and requirements of the approved Concept Plan and the Deed of Agreement, in many cases exceeding those objectives and requirements. The subdivision design establishes a street and block pattern that is configured so that the blocks are more regular with a greater street frontage, providing opportunity for increased yield, whilst not reducing areas of open space or public domain.</p> <p>Therefore the increased yield of 1,800 dwellings through Tech. Amend. No. 2010-31 is not considered to be at the expense of those objectives or requirements or identified outcomes for the development of Crace, but instead considered a positive outcome, contributing to better housing diversity and affordability. This is consistent with the approach of the ACT Government’s affordability objectives.</p> <p>The stage 3 EDP does not exceed the number of dwellings outlined above.</p>
Approximate density of 13 dwellings per hectare	The Estate design has achieved a more efficient net density of approximately 15.5 dwellings per hectare, whilst still retaining the required provision of open space and other land use activities, and a wide range of block sizes. Crace Stage 3 density is incorporated into the Estate as a whole.
Development is to provide: <ul style="list-style-type: none"> <li>• A mix of block sizes as shown in the “Indicative Subdivision design.</li> </ul>	The Estate design provides for a variety of block sizes, traditional detached dwellings.
<ul style="list-style-type: none"> <li>• A mix of small scale blocks (e.g. terrace housing( and multi-unit dwellings to be located around the water quality control ponds and the local centre</li> </ul>	The Estate design provides for a mix of small scale blocks adjacent the CRIP and water treatment feature along Gundaroo Drive and the Local Centre within the Stage 1 approval.
<ul style="list-style-type: none"> <li>• To have higher densities along Nudurr Drive frontage where access to the existing facilities located in Palmerston are in walking distance</li> </ul>	N/A to Stage 3. Addressed in Stage 1 approval.
<ul style="list-style-type: none"> <li>• Areas are to be set aside for visitor car parking both on street and off street adjacent to the small scale and terrace housing blocks.</li> </ul>	N/A to Stage 3. Addressed in Stage 1 approval.
<u>6.3 Commercial Centres</u> One centrally located local centre in Crace at the location shown on the Crace Concept and Important Planning Requirements Plans	N/A to Stage 3. Addressed in Stage 1 approval.

## Crace Stage 3 - Statement against Crace Concept Plan – Important Planning Requirements

The gross floor area of the Local Centre shall be in the order of 500m2	N/A to Stage 3. Addressed in Stage 1 approval.
Effective pedestrian and bicycle access will be integrated with the proposed local centre development, as will strong public transport links	N/A to Stage 3. Addressed in Stage 1 approval.
Crace Local Centre provides for opportunities for the co-location of urban housing to encourage an effective mixed use character in accordance with the “Urban Village” concept of shop-top housing.	N/A to Stage 3. Addressed in Stage 1 approval.
The local centre may include other small-scale retail, office and personal service tenancies, as well as allowing for community facilities	N/A to Stage 3. Addressed in Stage 1 approval.
<u>6.4 Community Facilities</u> The Concept Plan identifies a community facility site adjacent to the local centre. The site area of the facility will be approximately 6,000m2. The actual size and use of the community facility will be determined at a later stage.	N/A to Stage 3. Addressed in Stage 1 approval.
<u>6.5 Open Space Provision</u> Crace Concept Plan contains a hierarchy of open space totalling 48 hectares serving different purposes. They are to be provided / located generally in accordance with the Important Planning Requirements and the Concept Plan	The Master Plan provides for an extensive open space network that is consistent with the network identified in the Concept Plan and the Important Planning Requirements Plan. Key features including the Hilltop Reserve, the CRIP, the water detention features, parks, the Barton Highway buffer and the interface to the Gungaharra Grasslands Nature Reserve are all consistent with the approved Concept Plan.  The only variation relates to the continuity of the open space from the Hilltop Reserve to the CRIP. The approved Concept Plan identifies this as an open space link. This has been addressed in the Stage 1 EDP identifying a wider road reserve for the two major avenues connection to Gundaroo Drive, such that it allows for significant planting and stormwater management, such that it is consistent with the intent for the open space link. Open space has been provided throughout the Estate such that there is no decrease in the provision of open space and public domain
A neighbourhood playing field is also to be provided, the location is shown on the important Planning Requirement Plan.	Refer to EDP 3 written response Appendix F – Kelvin Walsh 15 May 2010
<b>6.6 Environment</b>	
<u>6.6.1 Ecological Values</u> Wherever possible, yellow box and red gum trees are retained in open space, parks or roadside reserves or as part of the landscape setting for community purposes or other less intensive land uses.	N/A to Stage 3. Addressed in Stage 1 approval.
The Important Planning Requirements Plan identifies specific measures for managing the urban interface with the Gungaharra Grasslands Nature reserve with respect to edge roads and stormwater treatments	N/A to Stage 3. Addressed in Stage 1 approval.
<u>6.6.2 Tree Protection</u> The Crace Concept Plan and the Indicative Subdivision Plan have endeavoured to maximise the number of trees to be retained on site, commensurate with the need to meet residential block yields and other government planning objectives, including an efficient pattern	N/A to Stage 3. Addressed in Stage 1 approval.

## Crace Stage 3 - Statement against Crace Concept Plan – Important Planning Requirements

of development.	
It is essential to retain all exceptional classified trees in public land	N/A to Stage 3.
<u>6.7 Heritage</u> Sites of Aboriginal cultural heritage are protected in the Concept Plan within Urban Open Space	N/A to Stage 3. Addressed in Stage 1& 2 approvals.
<u>6.8 Contamination Assessment</u>	Completed.
<u>6.9 Bushfire Risk Assessment</u> Three protection zones have been identified: <ul style="list-style-type: none"> <li>Outer Asset Protection Zone( IAPZ) - 40m.</li> <li>Inner Asset Protection Zone (OAPZ) – 20m</li> <li>House Asset Protection Zone – 100m into the suburb</li> </ul>	During the preparation of the Estate Development Plan a Bushfire Risk Assessment has been completed with the recommendations incorporated in the design such it is consistent with the requirements of this section of the Concept Plan
<u>6.10 Road Network / Hierarchy</u> The layout of internal road network has been designed to encourage and direct internal traffic to the major collector road	The design of the internal road network is similar to that as contained in the approved Concept Plan. It provides an internal loop system that links directly into the local street network. This structure encourages the use of the major avenues as opposed to the local network.
The collector road provides good coverage with the vast majority of residents being within 400m of a bus route.	All dwellings are within 400m of a major avenue or secondary road which is anticipated to support the public transport routes
<u>6.10.1 Road Cross Sections</u> Generally all road cross sections are consistent with Territory requirements, however there are some special features such as: <ul style="list-style-type: none"> <li>Where slopes do not exceed 5%, swale drains should be used.</li> <li>The bushfire edge road includes a twenty metre Inner Asset Protection Zone.</li> </ul>	<p>The detailed planning during the Estate Development Plan incorporates these requirements, with all roads will be designed to meet general Territory Standards, as well as specific cross sections identified in the Concept Plan.</p> <p>WSUD measures have been incorporated and approved within the estate as part of the Stage 1 &amp; 2 approvals.</p> <p>There are no swale drains in the Stage 3 EDP submission.</p> <p>Asset protection zones will be established in accordance with the bushfire management plan.</p>
<u>6.10.2 Road Intersections</u>	N/A to Stage 3. Addressed in Stage 1 approval.
<u>6.11 Pedestrian and Bicycle Network</u> <ul style="list-style-type: none"> <li>Pedestrian and off-road cycling facilities are required to be implemented in accordance with the Master Plan for Trunk Cycling and Walking Path Infrastructure 2004-14 and the Background Report to the North Gungahlin Structure Plan review.</li> <li>Infrastructure should include: <ul style="list-style-type: none"> <li>On road bicycle lanes for all collector roads</li> <li>Off road shaped paths, which follow Gundaroo Drive and Nudurr Drive.</li> </ul> </li> <li>The network should link into the existing network through a: <ul style="list-style-type: none"> <li>Link to Gundaroo Drive path</li> <li>Link to Barton Highway in south east of the site</li> </ul> </li> </ul>	<p>Addressed and implemented in EDP 1 &amp; 2 approvals.</p> <p>N/A to Stage 3.</p>

## Crace Stage 3 - Statement against Crace Concept Plan – Important Planning Requirements

<p>for commuter cyclists</p> <ul style="list-style-type: none"> <li>➤ Link via. The existing wide path system through to Palmerston and another through to the Gungahlin Town Centre</li> <li>➤ Potentially a new link under the Barton Highway, providing reasonably direct access to the shops and community facilities in Giralang and Kaleen</li> </ul>	
<p><u>6.12 Public Transport</u></p> <ul style="list-style-type: none"> <li>• 95% of all housing is within 400m of a bus route</li> <li>• The bus route is relatively direct route through the suburb which links to the commercial and community facilities at the Local Centre</li> </ul>	<p>The bus route will follow the major avenues and secondary roads such that the requirement for 95% of all housing to be within 400m of a bus route is achieved. This is a significant improvement on the coverage available under the current Concept Plan. The road structure would enable a relatively direct route through the suburb, including direct access to the Local Centre and the Community Facilities, which would provide maximum access to public transport for the residents of Crace</p>
<p><u>6.13 Noise Assessment</u> Residential development near the Barton Highway and Gundaroo Road will require noise mitigation measures to ensure internal noise levels meet the Authority's Draft Noise Management Guidelines</p>	<p>The EDP is consistent with the Concept Plan. Blocks subject to noise mitigation have been identified in the acoustic report.</p>
<p>6.14 Section Planning</p>	
<p><u>6.14.1 Access</u> Access for private parking for small scale blocks having frontages of less than 10m should be located primarily in rear access lanes</p>	<p>N/A to Stage 3. Addressed in Stage 1 approval.</p>
<p><u>6.14.2 Block Orientation and Sizes</u> The following minimum block dimensions should be used for the various housing types:</p> <ul style="list-style-type: none"> <li>• Terrace: 8m wide 30m deep, 240m<sup>2</sup></li> <li>• Courtyard rear access: 10m wide, 30m deep, 300m<sup>2</sup></li> <li>• Semi detached: 12m wide, 30m deep, 360m<sup>2</sup></li> <li>• Standard detached house: 12m wide, 30m deep, 360m<sup>2</sup></li> <li>• Standard detached house: 15m wide, 30m deep, 500m<sup>2</sup></li> </ul>	<p>The Estate provides for the following block frontages with blocks predominantly designed with 30m depth:</p> <ul style="list-style-type: none"> <li>• Terrace Houses –NA to Stage 3.</li> <li>• Courtyard rear access – NA to Stage 3</li> <li>• Semi-detached dwellings - NA to Stage 3</li> <li>• Detached Houses - Complies</li> </ul>
<p>Townhouses and semi-detached houses are orientated predominantly north south.</p>	<p>N/A to Stage 3.</p>
<p><u>6.14.3 Car Parking / Car Courts</u> Where car courts are proposed in the centre of the sections, deep rooted areas of tree planting for shade and visual amenity should be provided. Habitable spaces and balconies should be orientated ensuring overlooking for passive surveillance and to provide active frontages to the car courts</p>	<p>N/A to Stage 3.</p>
<p>Additional car parking shall be provided for visitors both on street and off street for small scale blocks (450m<sup>2</sup> and under), including terrace housing blocks that have laneway vehicle access, at the rate of 1 space per 4 dwellings</p>	<p>N/A to Stage 3.</p>

## Crace Stage 3 - Statement against Crace Concept Plan – Important Planning Requirements

<p><u>6.15 Urban Edge Treatment</u> Must meet the following criteria:</p> <ul style="list-style-type: none"> <li>▪ Minimum unobstructed sealed road width of 7.5m to allow for two fire trucks</li> <li>▪ 7.5m wide verge adjacent to housing, with street tree planting on the house side only</li> <li>▪ A concrete edge incorporate a gutter with minimum 2m width on the fire edge of the road</li> <li>▪ The road should be of sufficient strength to accommodate a 15 tonne load and allow for turning circles of a 12.5m truck</li> <li>▪ Access to hydrants shall be provided</li> </ul>	<p>These design criteria have been considered in the preparation of the Estate Development Plan. It is noted that the arterial roads are residential areas to accommodate the fire services on the edge roads</p>
<p><u>6.16 Indicative Staging</u> All areas of land can be developed with regard to available servicing infrastructure. The Concept Plan identifies a suggested staging program</p>	<p>The staging of the Estate will allow a logical and orderly manner, integrated with the provision of infrastructure as required.</p>
<p><u>6.17 Engineering Services Master Plan</u> This identifies relevant provisions for services infrastructure. This identifies some levels of service that need to be considered during detailed design</p>	<p>This has been incorporated in the detailed design of the EDP</p>
<p><u>6.18 Works Associated with Development</u> Works associated with the development include:</p> <ul style="list-style-type: none"> <li>▪ Two intersections with Nudurr Drive</li> <li>▪ One major intersection with Gundaroo Drive</li> <li>▪ Water quality control pond#1 adjacent Gundaroo Drive</li> <li>▪ Water quality pond #2 adjacent intersection of Gundaroo Drive and Nudurr Drive</li> </ul>	<p>The requirement for the works required to be undertaken by the Crace JV is recognised and have been incorporated into the planning of the EDP</p>
<p><u>6.19 Summary of further Investigations</u></p>	
<p><u>6.19.1 Final Tree Management Plan</u></p>	<p>N/A to Stage 3.</p>
<p><u>6.19.2 Heritage</u></p>	<p>N/A to Stage 3.</p>
<p><u>6.19.3 Sewer Vent</u></p>	<p>N/A to Stage 3.</p>
<p><u>6.19.4 Geotechnical</u></p>	<p>Will be addressed in detailed design as required.</p>
<p><u>6.19.5 Stormwater</u></p>	<p>Proposed WSUD measures have been investigated and will not adversely affect infrastructure &amp; private property.</p>
<p><u>6.19.6 Older Persons Housing Requirements</u></p>	<p>N/A to Stage 3.</p>
<p><u>6.19.7 Fire Assessment</u></p>	<p>Completed.</p>

## Appendix I

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Deed Management Approval  
Deed Management Minute  
Sport and Recreation Services  
Endorsement  
ActewAGL Approval



Matthew Frawley  
CIC Crace Pty Limited  
Level 3, 64 Allara Street  
Canberra City ACT

Dear Sir

**SUBJECT: Crace Estate Stage 3 - Approval of Estate Development Plan**

I refer to the above revised Estate Development Plan (EDP) submitted on 7 December 2010. The Development Assessment Unit has advised that the Estate Development Plan is acceptable for lodgement as a Development Application (DA) with the following conditions;

**EDP/ LMP**

The 4 metre fire access path must be shown on EDP and LMP (sheet 3 of 3) consistent with ESA's comments of 18/03/2011(see attachment).

**PCP/BEP/EAP**

PCP & BEP do not comply with the Single Dwelling Housing Development Code in regards to setback to the open space.

The indicative garage location; setback and driveway location will need to be revised to comply with the Single Dwelling Housing Development Code. The plans have to be revised before DA is formally lodged.

**Acoustic report**

The recommendations of the acoustic report do not reflect the planning controls for blocks a & e, section EA. The report will need to be revised.

**Landscape Masterplan – sheet 3 of 3**

The plan needs to be enlarged so that details of stage 3 are clear. The elements to be approved as part of the development application need to be clearly nominated. Please be advised that if playing fields are included in the application, a further Section 197 amendment to the approval would be required if they change as result of TAMS or SRS requirements.

**Statement against the Criteria--- R52**

Please provide enough information to state the proposal, especially the path to the east of the water quality pond passing the open space, complies with Rule R52 of the Residential Subdivision Development Code particularly regarding 2 year average recurrent events. Any relevant notes and the 2 year ARI should be shown on SMP to demonstrate compliance with the rule/criteria.

**Statement against Crace Concept Plan**

Please provide statement against 'important planning requirement' in the Crace Concept Plan. In particular, please address section 6.10.1 regarding swale drains in light of the provision of bioretention street trees and WSUD measures in the DA documentation.

**Fencing to boundary of open space**

It is understood that a code variation is proposed in accordance with Section 87(b) of the *Planning and Development Act 2007* to permit some fencing to block boundaries fronting open space. If the variation is finalised prior to the DA being determined, the Planning Control Plan will need to be revised to comply with planning controls. If the Code Variation is not completed prior to the DA being determined, the DA will be assessed in accordance with the current provisions of the *Territory Plan 2008*.

Please Note: The DA will need to be lodged under the Impact Track.

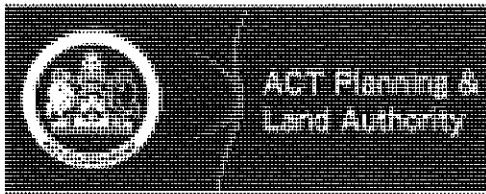
A copy of a Minute addressed to Mr Ben Ponton, Director Development Services Branch from the Estate Manager is provided certifying that all relevant Government agencies were satisfied with the proposal and that it may be submitted as a formal Development Application. The purpose of this minute is to accompany the development application to ensure that circulation to Government Agencies is not repeated.

Yours sincerely



Ron Brooker  
Estate Manager  
ACT Planning and Land Authority

28 March 2011



# FORM

## Entity Endorsement of Revised Estate Development Plan Drawings

**Part 1** (to be filled in by the Developer)

<b>Estate Name</b>	Crace		
<b>Stage</b>	3	<b>Revision 02</b>	
<b>Date</b>	19/ 04/2011		

The following drawings have been submitted to TaMS Sport & Recreation Services for endorsement as revised drawings to the EDP submitted on 7 December 2010 for Stage 3 of the above Estate.

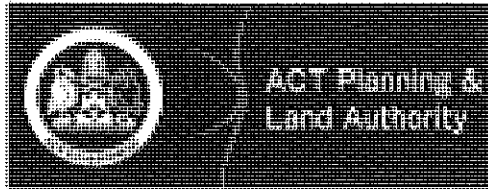
**Signed:**

**Print name: Matthew Frawley**

Date: 19 / 04 / 2011

**Drawing List**

Drawing Title	Dwg No.	Sheets	Rev No.
EDP DA DRAWINGS			
Landscape Masterplan Legend	13.1	1 of 6	02
Landscape Masterplan – Street Tree Masterplan	13.2	2 of 6	02
Landscape Masterplan @ 1:6000	13.3	3 of 6	02
Landscape Masterplan @ 1:1250	13.3.1	4 of 6	02
Landscape Masterplan – Landscape Sections	13.4	5 of 6	02
Landscape Masterplan – Landscape Sections	13.5	6 of 6	02
Open Space Concept Plan	31.1	1 of 1	02
ADDITIONAL EDP DA DRAWINGS			
Cover Sheet	WD00	1 of 1	02
Key Plan & Master Legend	WD01	1 of 1	02
Master Plant Schedules	WD01.1	1 of 1	00
CRIP General Arrangement Plan	WD2.1	1 of 4	02
CRIP Planting Plan	WD2.3	3 of 4	02
CRIP Planting Plan	WD2.4	4 of 4	02
Detention Pond Landscape Sections	WD3.2	2 of 3	02
Detention Pond Landscape Sections	WD3.3	3 of 3	02
Wetland Landscape Sections & Details	WD4.2	2 of 2	02
BBQ / Picnic Area & Playground General Arrangement Plan	WD5.1	1 of 1	02
Activity Hub General Arrangement Plan	WD8.1	1 of 2	02
Entry Plaza General Arrangement & Setout Plan	WD9.1	1 of 2	02
Entry Plaza Landscape Section	WD9.2	2 of 2	02
Basketball / Futsal Court & Skate Plaza General Arrangement	WD10.1	1 of 1	02
Tennis Rebound Wall / Netball Practice Courts General Arrangement	WD12.1	1 of 2	02
Tennis Rebound Wall / Netball Practice Courts & Irrigation Pumphouse – Landscape Sections	WD12.2	2 of 2	00
Cricket Practice Nets Setout & Details	WD13.1	1 of 1	02



# FORM

## Entity Endorsement of Revised Estate Development Plan Drawings

Amenities Building Plans & Elevations	SD-100	1 of 4	A
BBQ Canopy Plans and Elevations	SD-101	2 of 4	A
Canopy Plan and Bench Details	Sd-102	3 of 4	A

### Part 2 Entity Consideration *(Tick one or both boxes)*

The above revised drawings have been submitted for assessment and:

- are hereby endorsed in accordance with the requirements of TaMS Sport & Recreation Services and/or
- additional changes are required as described in the following comments box:

*Comments (Describe additional changes required)*

<b>Officers Name</b>	BRIAN ASHCROFT
<b>Position</b>	OPERATIONS MANAGER SPORT & RECREATION
<b>Entity Unit</b>	SPORT AND RECREATION SERVICES

Date: 20/4/2011



Mr Ben Ponton  
Development Services Branch

***Crace Estate –Estate Development Plan - Stage 3***

I refer to the above DA lodged for Crace Estate.

I confirm that:

1. this development is subject to a Deed of Agreement and is subject to public notification
2. it has been circulated to all relevant agencies within Government and a favourable whole of government response has been received.

Details of the circulation and agency comments are available for perusal in our project files. Details of circulation times and response times are also available in the unit database.

It is recommended that the Estate Development Plan be accepted as a Development Application and the documents accompanying the original circulations to the agencies be retained as supporting information only.

Please ensure that one copy of the stamped approved plan is returned to Deed Management for their records and at least one copy is delivered to the Developer.



Ron Brooker  
Manager  
Deed Management Unit  
Leasing Section

***28 March 2011***



## FORM

Entity Endorsement of Estate  
Development Plan Drawings

### Crace Estate Stage 3 – Revised EDP drawings

The following amended drawings have been submitted to ActewAGL Water and Sewer Division for endorsement for Crace Estate Stage 3 EDP.

Title	Drawing Number	Revision
Sewer Master Plan – Overall Estate Catchment Areas	EDP3-ENG+SMP-11.1	01
Sewer Master Plan – Pipe Layout	EDP3-ENG+SMP-11.2	01
Water Supply – Master Plan	EDP3-ENG+WMP-12.1	01
Water Supply – Master Plan – Tables	EDP3-ENG+WMP-12.2	01

Signed:

A handwritten signature in blue ink, appearing to read "J.M. Kue".

Date:

27.01.2011

### Entity Consideration

The above revised drawings have been submitted for assessment and:

- Are hereby endorsed in accordance with the requirements of ActewAGL and/or
- Additional changes are required as described in the following comments box:

#### Comments (Describe additional changes required)

Officers Name	Bruce Reid
Position	Senior Tech Officer
Entity Unit	ActewAGL Water Division

Signed:

A handwritten signature in blue ink, appearing to read "C. Reid".

Date:

15.2.11

## Heather Rae

---

**From:** Reid, Bruce [[Geoffrey.Reid@actewagl.com.au](mailto:Geoffrey.Reid@actewagl.com.au)]  
**Sent:** Wednesday, 16 February 2011 10:23 AM  
**To:** Heather Rae  
**Subject:** RE: Crace Estate EDP 3 - updated sewer and water master plans  
**Attachments:** [quename@actewagl.com.au\\_20110216\\_095801.pdf](#); [quename@actewagl.com.au\\_20110216\\_095733.pdf](#)

Good morning Heather

### Crace Estate EDP 3

Please find attached the signed acceptance of the endorsement and Water Supply and Sewer Master plans stamped approved in principle.

Regards

### **Bruce Reid**

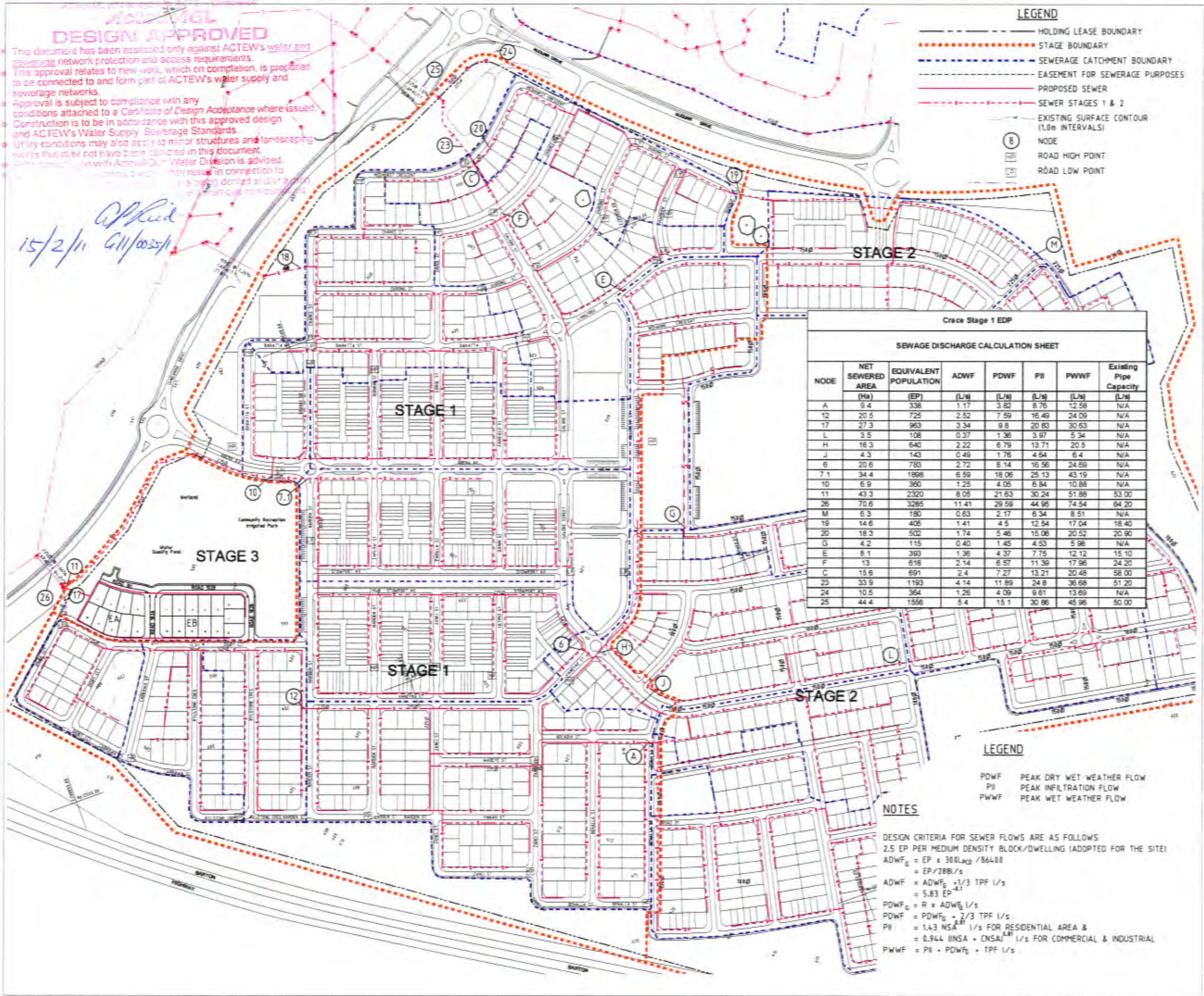
SENIOR TECHNICAL OFFICER ASSET ACCEPTANCE  
ActewAGL Water Division  
**Ph;** 02 6242 1133  
**Fax;** 02 6242 1459  
GPO Box 366 Canberra ACT 2601  
12 Hoskins St Mitchell ACT 2911  
[www.actewagl.com.au](http://www.actewagl.com.au)

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**From:** Heather Rae [<mailto:Heather.Rae@indesco.com.au>]  
**Sent:** Tuesday, 15 February 2011 3:32 PM  
**To:** Reid, Bruce  
**Subject:** FW: Crace Estate EDP 3 - updated sewer and water master plans

From: Heather Rae  
Sent: Thursday, 27 January 2011 9:20 AM  
To: 'Reid, Bruce'  
Subject: Crace Estate EDP 3 - updated sewer and water master plans  
Good morning Bruce,  
Attached are the updated water and sewer master plans. The water analysis has been rerun and now includes the CRIP blocks.  
The sewer table has been updated to reflect Brown EDP Stage 2 information.  
I have created an endorsement form for you to sign.  
Can you please review and should the drawings be acceptable, stamp the drawings and sign the form and return them to me.  
Please let me know if you wish to have A1 drawings of these for your file.  
Kind Regards  
Heather Rae  
Senior Engineer  
6A Thesiger Court  
Deakin ACT 2601  
Tel: (02) 6285 1022  
Fax: (02) 6285 2618  
[www.indesco.com.au](http://www.indesco.com.au)

In Principle



**LEGEND**

- HOLDING LEASE BOUNDARY
- STAGE BOUNDARY
- SEWERAGE CATCHMENT BOUNDARY
- EASEMENT FOR SEWERAGE PURPOSES
- PROPOSED SEWER
- SEWER STAGES 1 & 2
- EXISTING SURFACE CONTOUR (1.0m INTERVALS)
- NODE
- ROAD HIGH POINT
- ROAD LOW POINT

**Crace Stage 1 EDP**

**SEWAGE DISCHARGE CALCULATION SHEET**

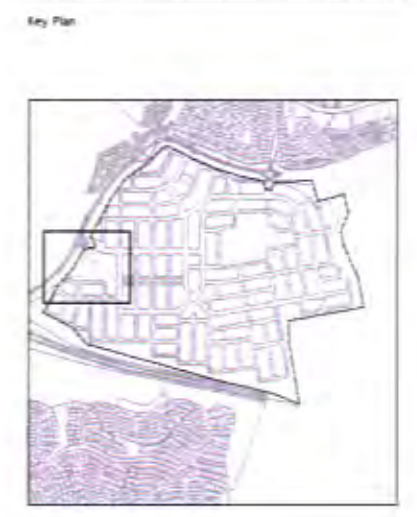
NODE	NET SEWERED AREA (Ha)	EQUIVALENT POPULATION (EP)	ADWF (L/s)	PDWF (L/s)	PII (L/s)	PWWF (L/s)	Existing Pipe Capacity (L/s)
A	9.4	338	1.17	3.82	8.75	12.58	N/A
12	20.5	725	2.52	7.59	16.49	24.09	N/A
17	27.3	963	3.34	9.8	20.83	30.63	N/A
L	3.5	108	0.37	1.36	3.97	5.34	N/A
H	16.3	640	2.22	6.79	13.71	20.5	N/A
J	4.3	143	0.49	1.78	4.64	6.4	N/A
8	20.6	783	2.72	8.14	16.56	24.69	N/A
7.1	34.4	1898	6.59	18.06	25.13	43.19	N/A
10	6.9	360	1.25	4.05	8.84	10.88	N/A
11	43.3	2320	8.05	21.63	30.24	51.88	53.00
28	70.6	3285	11.41	29.59	44.95	74.54	64.20
M	6.3	180	0.63	2.17	6.34	8.51	N/A
19	14.6	406	1.41	4.5	12.54	17.04	18.40
20	18.3	502	1.74	5.48	15.06	20.52	20.80
G	4.2	115	0.40	1.45	4.53	5.98	N/A
E	8.1	360	1.36	4.37	7.75	12.12	15.10
F	13	618	2.14	6.57	11.39	17.96	24.20
C	15.8	691	2.4	7.27	13.21	20.48	58.00
23	33.9	1193	4.14	11.89	24.8	36.68	51.20
24	10.5	364	1.26	4.09	9.81	13.69	N/A
25	44.4	1556	5.4	15.1	30.96	45.96	50.00

**LEGEND**

- PDWF PEAK DRY WET WEATHER FLOW
- PII PEAK INFILTRATION FLOW
- PWWF PEAK WET WEATHER FLOW

**NOTES**

DESIGN CRITERIA FOR SEWER FLOWS ARE AS FOLLOWS  
 2.5 EP PER MEDIUM DENSITY BLOCK/DWELLING (ADOPTED FOR THE SITE)  
 $ADWF_G = EP \times 300L_{WB} / 86400$   
 $= EP / 288 \text{ l/s}$   
 $ADWF = ADWF_G \times 1/3 \text{ TPF } 1/s$   
 $= 5.83 \text{ EP}^{-1.1}$   
 $PDWF_G = R \times ADWF_G \text{ l/s}$   
 $PDWF = PDWF_G \times 2/3 \text{ TPF } 1/s$   
 $PII = 1.43 \text{ NSA}^{0.81} \text{ l/s FOR RESIDENTIAL AREA \&}$   
 $= 0.944 \text{ (NSA} \times \text{CNSA)}^{0.81} \text{ l/s FOR COMMERCIAL \& INDUSTRIAL}$   
 $PWWF = PII + PDWF_G + \text{TPF } 1/s$



Issue	Date	Amendment
00	29/10/10	Draft First Submission
01	15/01/11	Updated as per ActewAGL request



Joint Venture Partners

Tatebrook

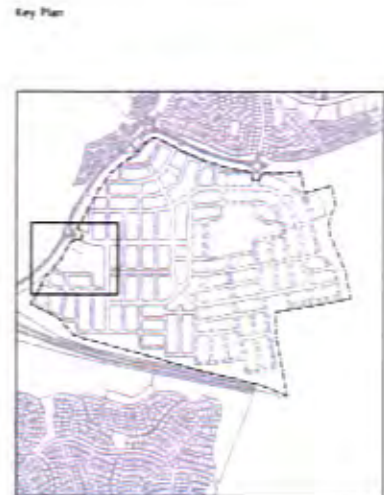
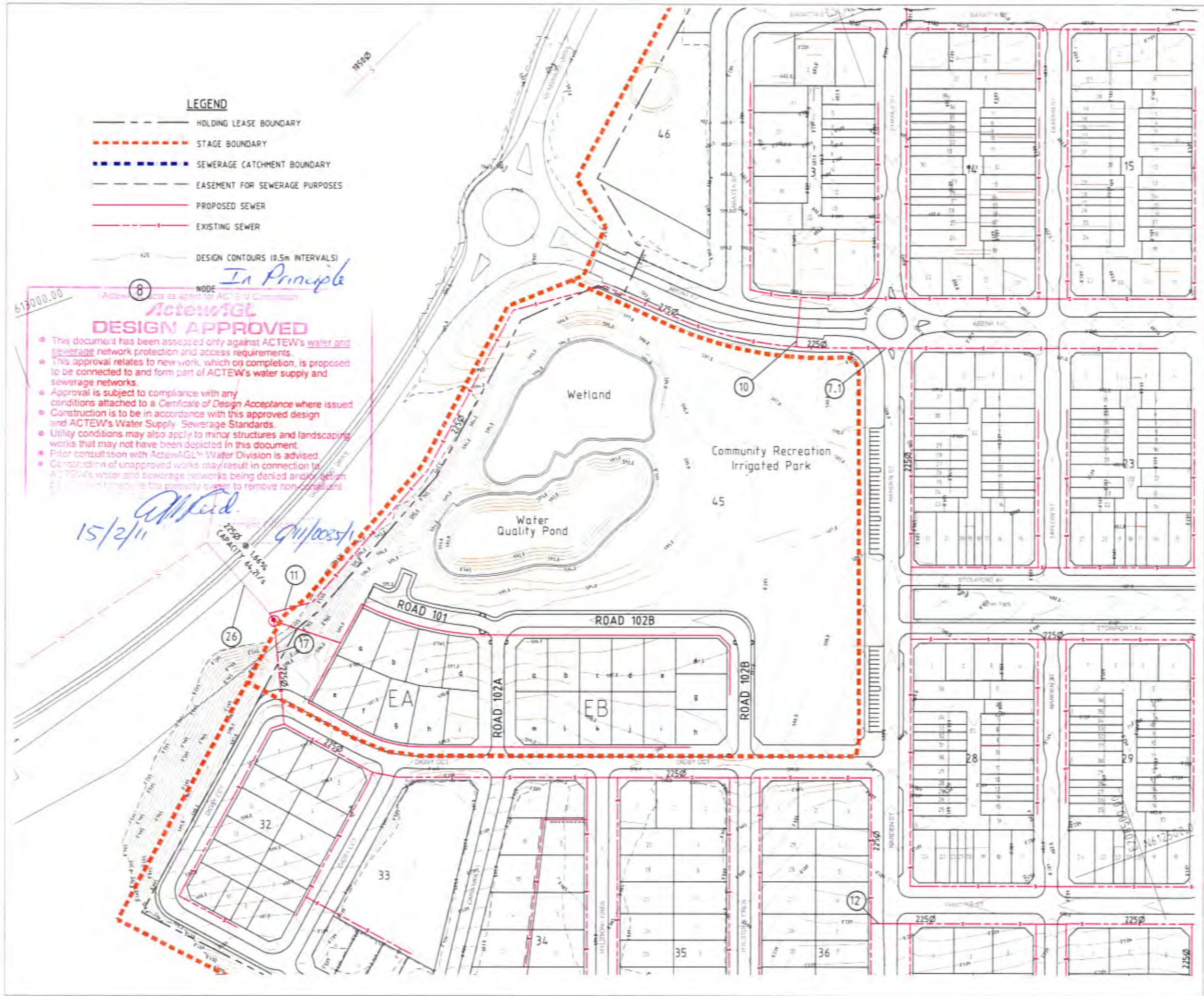
Joint venture managed by CIC Crace Pty Ltd  
 Project Consultants

**INESCO**

Project  
**CRACE STAGE 3  
 ESTATE DEVELOPMENT PLAN**

Drawing Title  
**Sewer Master Plan  
 Overall Estate Catchment Areas**

Scale	1:5000
Drawn	KC
Checked	HB
Approved	VL
Job No	4421
Drawing Number	EDP3-ENG-SMP-11.1
Plan No	11.1 Issue 01



Issue	Date	Amendment
00	25/10/10	Draft First Submission
01	25/01/11	Updated as per ActewAGL request



Joint Venture Partners

Tatebrook

Joint venture managed by CIC Crace Pty Ltd  
Project Consultants

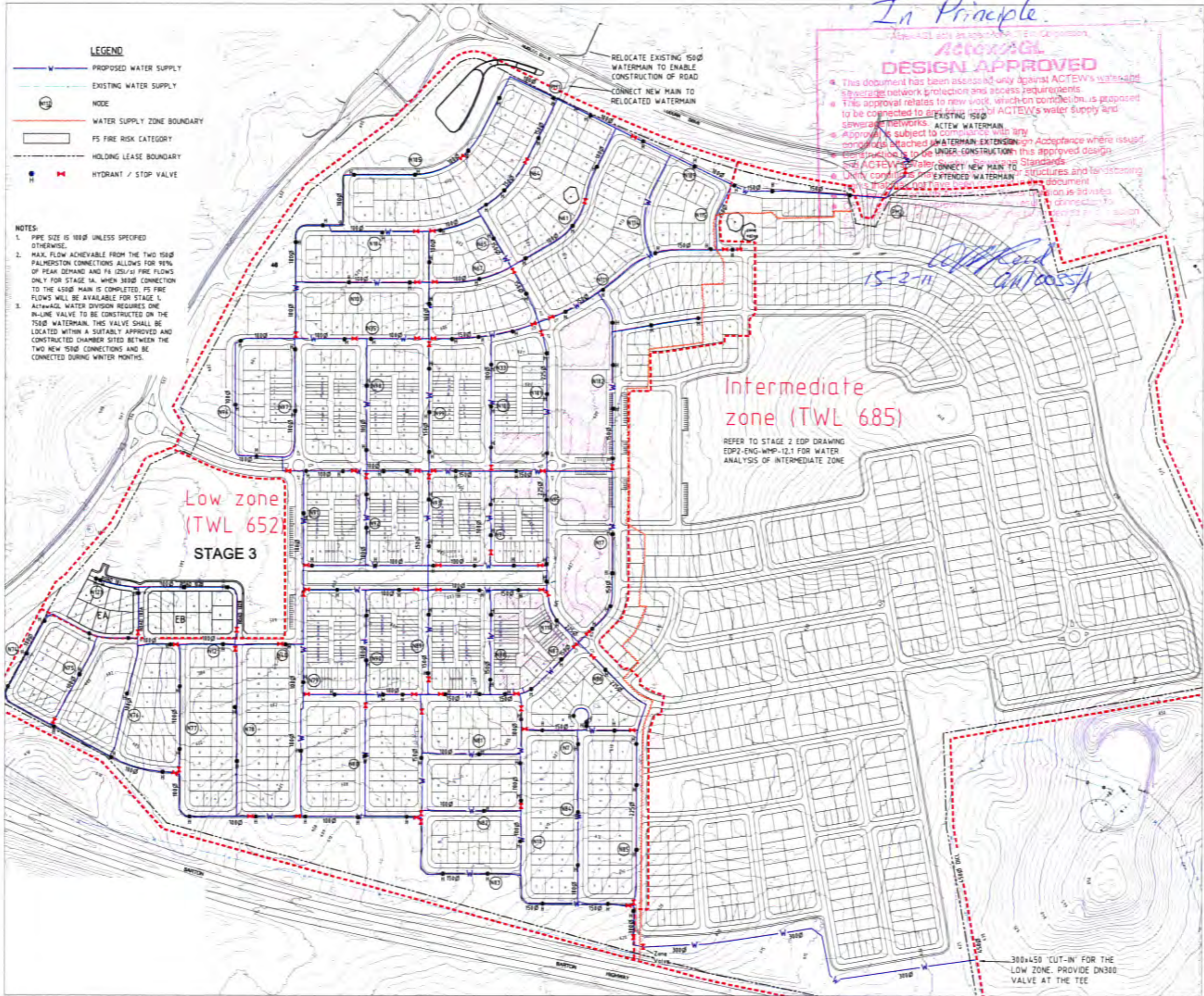
**INDESCO**

Project  
**CRACE STAGE 3  
ESTATE DEVELOPMENT PLAN**

Drawing Title  
**Sewer Master Plan  
Pipe Layout**

Scale	1:2000
Drawn	KC
Checked	HR
Approved	VL
Job No	4431
Drawing Number	EDP3-ENG-SMP-11.2
Plan No	11.2 Issue 01

*In Principle*



Key Plan



Issue	Date	Amendment
00	29/10/10	Draft First Submission
01	25/01/11	Updated as per ActewAGL request



Joint Venture Partners

Joint venture managed by CIC Crace Pty Ltd  
Project Consultants

**INDESCO**

Project  
**CRACE STAGE 3  
ESTATE DEVELOPMENT PLAN**

Drawing Title  
**Water Supply  
Master Plan**

Scale	1:5000
Drawn	KC
Checked	HR/KB
Approved	VL
Job No	4431
Drawing Number	EDP3-ENG-WMP-12.1
Plan No	12.1 Issue 01



TABLE OF WATER FLOWS STAGE 1

Node No	RL	Peak Demand		Residual pressure with peak and F6 fire demand at node N109	Residual pressure with peak and F5 fire demand at node N94
		Demand	Residual Pressure		
		m	l/s		
With supply from the 450 Ø low zone main only					
N7	608.5	0.53	34.2	30.1	26.1
N10	609	0.90	33.2	28.8	24.5
N17	608	1.04	33.2	27.8	23.4
N33	606.9	0.63	33.7	27.9	22.9
N35	603	0.79	37.5	31.8	26.7
N40	600	0.68	40.7	35.6	30.2
N61	610	2.47	29.4	21.8	18.7
N64	603	1.09	36.4	29.5	25.8
N65	602	1.87	37.8	31.2	27.1
N67	604.5	1.03	35.6	29.3	24.9
N74	595	0.49	45.3	40.2	34.9
N75	599	1.08	41.3	36.2	30.9
N76	603.5	1.14	36.8	31.7	26.4
N77	598.7	1.63	41.7	36.6	31.3
N78	602	2.11	38.4	33.3	28.0
N79	602	1.59	38.8	33.8	28.5
N80	606.5	2.14	34.6	29.6	24.5
N81	604.8	1.57	37.1	32.5	27.9
N82	606.5	1.10	35.5	31.1	26.6
N83	610	0.53	32.6	28.5	24.4
N84	610	2.01	33.2	29.4	25.8
N85	612	0.95	32.2	29.1	26.1
N86	607.8	0.41	34.4	29.9	25.6
N87	608	0.51	33.9	29.3	24.7
N88	605.5	1.21	36.1	31.3	26.5
N89	602	1.33	39.3	34.3	29.1
N90	600.5	1.40	40.5	35.4	30.2
N91	600	0.62	40.7	35.3	30.0
N92	600	1.21	40.7	35.4	30.0
N93	601.5	1.17	39.5	34.1	28.5
N94	605.5	1.31	35.5	30.1	17.1
N95	606.9	1.44	34.3	29.1	24.0
N96	601	0.69	39.4	33.7	28.6
N97	601.4	1.63	39.0	33.3	28.2
N98	602.5	1.55	38.1	32.4	27.2
N99	605	1.45	35.7	30.1	24.8
N100	608	1.52	32.7	27.1	21.8
N101	609	1.77	31.8	26.2	21.2
N102	609.8	1.07	31.0	25.1	20.8
N103	601	0.76	39.2	33.0	28.4
N104	601	0.66	38.9	32.5	28.2
N105	599.5	1.34	39.9	32.9	29.2
N109	611	0.72	28.3	18.1	17.6
N110	605	0.64	36.7	31.9	27.2
N111	610	0.79	30.3	23.6	19.7
N114	612	1.20	27.4	18.2	16.8
N115	614	0.42	25.2	16.0	14.6
N121	604	1.06	44.4	39.2	33.9
N123	604	0.78	44.3	39.2	33.9
			HGL (m)		
PM1	-	15		632.6	
PM2	-	15		628.6	

SECTION	BLOCK	LAND USE
STAGE 1		
CY	ALL BLOCKS	MIXED
ALL OTHER SECTIONS	ALL BLOCKS	RESIDENTIAL
STAGE 2		
ALL SECTIONS	ALL BLOCKS	RESIDENTIAL

SECTION	BLOCK	CATEGORY	MIN WATER REQUIREMENTS (l/s)
STAGE 1A	WITH SUPPLY FROM THE TWO 150Ø PALMERSTON MAINS ONLY		
ALL SECTIONS	ALL BLOCKS	F6	25
STAGE 1	WITH SUPPLY FROM THE TWO 150Ø PALMERSTON MAINS THE 450Ø LOW ZONE MAIN		
BD, BE, BH, BJ, BN BP, CA, CK, CY	ALL BLOCKS	F5	45
ALL OTHER SECTIONS	ALL BLOCKS	F6	25
STAGE 2			
ALL SECTIONS	ALL BLOCKS	F6	25

ActewAGL is an agent for ACTEW Corporation

**ActewAGL**

**DESIGN APPROVED**

- This document has been assessed only against ACTEW's water and sewerage network protection and access requirements.
- This approval relates to new work, which on completion, is proposed to be connected to and form part of ACTEW's water supply and sewerage networks.
- Approval is subject to compliance with any conditions attached to a Certificate of Design Acceptance where issued.
- Construction is to be in accordance with this approved design and ACTEW's Water Supply / Sewerage Standards.
- Utility conditions may also apply to minor structures and landscaping works that may not have been depicted in this document.
- First consult with ActewAGL's Water Division is advised.
- Unapproved work may result in connection to the network works being denied and/or action being taken to remove non-compliant work.

15/2/11 *AM/PL* 01/0035/11

**NOTE:**  
THESE TABLES SHOULD BE READ IN CONJUNCTION WITH DRAWING EDP1-ENG-WMP-27.1



Issue	Date	Amendment
00	17/09/10	Draft First Submission
01	25/01/11	Updated as per ActewAGL request

Joint Venture Partners

Tatebrook

Joint venture managed by CIC Grace Pty Ltd  
Project Consultants

**INDESCO**

Project  
**CRACE STAGE 3  
ESTATE DEVELOPMENT PLAN**

Drawing Title  
**Water Supply  
Master Plan  
TABLES**

Scale	1:1
Drawn	HD
Checked	AM/PL
Approved	VL
Job No	4431
Drawing Number	EDP3-ENG-WMP-12.2
Plan No	12.2 Issue 01