Our Ref LJ2946/L2563 :sge

Contact P.D. Treloar

28 June 2012

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Australian Consultant Architects
12 Union Street
PARRAMATTA NSW 2150

Attention: Ms Hui Zhu

Dear Madam,

LOT 1 DP862588 & LOT 76 227174
WILFRED BARRETT DRIVE, THE ENTRANCE NORTH

Preamble

Acting upon your instructions we have investigated the ocean inundation level against which protection must be provided for this development proposal located at Lot 1 DP862588 and Lot 76 227174 on Wilfred Barrett Drive, The Entrance North, see **Figure 1**. This has not been a detailed study, but rather it has drawn information from other reports and publications in order to provide a realistic basis for this assessment.

A site visit was undertaken at 1200 on 10 March 2011. Site characteristics are shown on **Figures 2, 3** and **4. Figure 5** shows the elevated floor levels of properties constructed to the north of this site.

Flood Levels

Wyong Shire Council's (WSC) current flooding plan is based on the 1994 Tuggerah Lakes Flood Study undertaken by Lawson and Treloar for WSC. At a meeting between Cardno, Office of Environment and Heritage and WSC on 13 December 2011 (on another matter), Cardno were advised that the 1994 report is still current and was consistent with the June 2007 flood event in the Tuggerah Lakes catchment. A 1% AEP, or 100-years average recurrence interval (ARI) flood level in Tuggerah Lake is 2.2m AHD. Increasing this level by 0.9m for the current NSW government policy based on projected sea levels leads to 3.1m AHD. In actual fact the 1% AEP 2100 flood level would be lower because of the greater storage offered by the lake system as water levels rise. That is, the plan area of the lake system increases with level and a relatively greater volume of water is required to cause increasingly higher flood levels. Hence the 'simple' approach of increasing the 2.2m AHD flood level by 0.9m is very conservative.

Climate Change Issues

Projected climate change processes may:-

- cause an increase in mean sea level (MSL) – DECCW (2009) advises projected sea level rises of 0.5 and 0.9m for 2050 and 2100;

- cause a change in rainfall/runoff. However, there is no substantial data on this issue – some reports suggesting more severe and others less severe floods, McInnes et al (2007). This issue can not be addressed realistically at present.

Hence, wave overtopping and wave run-up to the site were addressed for a MSL rise scenario to 2100 – 0.9m. Although tidal ranges within the lake may change with sea level rise the mean lake level will rise by 0.9m. However, investigations undertaken for Gosford City Council in Brisbane Water have shown that peak flood level would be unlikely to rise to 3.1m AHD (2.2m AHD +0.9m) because of the change in storage characteristics at the higher mean lake level. However, a conservative 100-years ARI flood level at 2100 has been adopted to be 3.1m AHD.

Site Survey

A survey of the site prepared by Everitt & Everitt, Consulting Surveyors was provided for this investigation, see **Annexure 1**. This survey provided adequate details of the site. Annexure 1 also includes the footprint of the development overlying the contours.

Lake bed survey was available from a 1975 survey of Tuggerah Lake (Microfilm No. - 811946).

Wave Climate

Wave conditions at the site will be caused by local sea. There will be no penetration of ocean waves to this site. **Table 1** describes wind conditions for this general region based on wind data recorded at Mascot Airport from 1939 to 1992. It was applied to this study with no terrain correction. Note that calms occur for about 17% of the time.

The Sydney Airport wind data was analysed in terms of the standard directional octants to provide peak storm wind speeds at selected average recurrence intervals (ARI).

These analyses were undertaken by ranking recorded wind speeds in each octant and then undertaking an extremal analysis using the maximum likelihood method. Other wind data is available from Norah Head, but that site is too elevated and the record has more data gaps. Although the Sydney Airport wind records will not match those at The Entrance on a record by record basis, it will provide a reasonable description of the wind climate in terms of severe storms and peak event wind speeds.

Table 1: Peak Event Wind Speeds Based on Wind Records from Sydney Airport

Octant	Average Recurrence Interval (years)					
	5	10	20	50	100	1000
N	16.4	17.1	17.8	18.7	19.3	23.5
NE	17.0	17.3	17.6	18.0	18.3	20.3
E	15.4	16.5	17.5	18.8	19.8	26.3
SE	17.9	18.8	19.7	20.8	21.7	27.4
S	26.2	27.5	28.8	30.5	31.7	39.9
SW	21.2	22.3	23.3	24.6	25.6	32.1
W	22.2	23.3	24.3	25.6	26.6	33.1
NW	20.1	20.9	21.7	22.6	23.5	24.6

The site is exposed to the west and north-west.

Local sea wave conditions at the site were investigated using a SWAN wave model of Tuggerah Lake, see **Figure 6**. SWAN was developed at the Delft Technical University and includes wind input, (local sea cases), combined sea and swell, offshore wave parameters (swell cases), refraction, shoaling, non-linear wave-wave interaction, a full directional spectral description of wave propagation, bed friction, white capping, currents and wave breaking. Model bathymetry was based on a PWD survey of 1975. A grid size of 25m was adopted. The very shallow area lying to the north of the site will normally protect the site from wind waves. However, at a flood level of 2.2m AHD, together with a lake level rise of 0.9m, much of the site would be flooded and these wind waves will propagate onto the site and

increase design water level requirements. This flood level rise is conservative because, as shown by Taylor et al (2008) for Lake Illawarra, the full climate change MSL rise does not increase flood levels by the MSL rise because of increased lake storage at higher levels. On the other hand, mean lake level would increase generally by the MSL rise.

It is not likely that the 100-years ARI flood would be associated with 100-years ARI wind speeds, which would be more likely to be associated with an ocean storm – east coast low. Hence the 50-years ARI wind speeds were adopted for simulation at the 2100 peak flood level of 3.1m AHD. Based on the site inspection and the very shallow water depths that were observed in normal, present-day conditions, water depths in front of the site were set at 2.9m AHD for the 2100 flood case.

Recommendations

Based on these analyses, waves of height (H_s) = 0.8 to 0.9m can propagate onto the site. However, the future flooded depth on the lake side of the block would be about 1.7m, limiting breaking wave heights to about 0.9m. The limited filling of the floodplain proposed for this development will have no identifiable effect on flood levels in the Tuggerah Lakes system overall, or near the site.

Annexure 2 shows the proposed development plans for the site. They include a perimeter fence and raised land levels. The perimeter fence will prevent these waves from entering the site and must extend about 25m along the southern and northern sides of the site to prevent outflanking, and beyond the car par entrance. The design wave load on the seaward fence/wall is 10kN/m. An inspection of the DA plans and the western fence line proposed shows that any wave energy reflected from those structures would be directed lakeward and not towards neighbouring residents, see **Annexure 2.** There may be some diffractive wave energy that propagates towards them as part of this reflection process, but less than would be reflect from the flooded shoreline of this site in an undeveloped state

We note that the proposed development includes filling behind the wave protection fence to render the site flood free and suitable for evacuation in a flood event. The effect of this small area of fill in terms of flood storage within the lake system would be unidentifiable and is insignificant when compared with the conservative nature of the flood level estimate and the effect of the larger lake storage volumes at higher levels, which has not been included in estimating the 2100 flood level.

The entrance to the car par is sheltered from these waves and there is to be a hump at the entrance set to 3.1m + 0.3m (freeboard) = 3.4m AHD at the entrance to the car park. This hump must connect to walls at each end. The land level is also raised to 3.4m AHD along a berm to prevent flood water ingress to the car park.

For site evacuation, the ground level car park must be at 2.9m AHD or higher to allow egress in water no deeper than 0.2m to Wilfred Barrett Drive. Tuggerah lake floods rise slowly and this will allow occupants to walk to the Wilfred Barrett Drive footpath at 3.1m AHD and then north-east from the site.

Flood Risk and Mitigation

The flood evacuation plan for this site allows for residents and visitors to evacuate the site with 'dry feet'. It is important to note that the rate of flood level rise in the design 100-years ARI flood is only in the order of 0.1m/hour and there would be ample scope for evacuation over several hours.

Yours faithfully,

P. D. Treloar

P.D. Treloar
Manager - Coastal, Ocean & Estuarine Studies
for **Cardno (NSW/ACT) Pty Ltd**

References

DECCW (2009): Sea Level Rise Policy Statement. Prepared by the NSW Department of Environment and Climate Change.

Lawson and Treloar Pty Ltd (1994): Tuggerah Lakes Flood Study. Report Prepared for Wyong Council.

McInnes, K.L., Macadam, I., Abbs, A.J., O'Farrel, S.P., O'Grady, J. and Ranasinghe, R. (2007): Projected Changes in Climatological Forcing Conditions for Coastal Erosion in NSW. Proceedings of Coasts and Ports Conference 2007, Melbourne.

Taylor, D.R., Treloar, P.D. and Collier, L.C. (2008): Lake Illawarra Entrance Studies – Flooding and Potential Climate Change Issues. Paper Accepted for 2008 NSW Coastal Conference, Wollongong.

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Shaping the Future

Wilfred Barett Drive – The Entrance

Locality Plan

LJ2946 March 2011
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Figure 1

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LJ2946 March 2011
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Wilfred Barett Drive – The Entrance

2. Current Shoreline
3. Overlooking Tuggerah Lake
Figures 2 and 3

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Shaping the Future

LJ2946 March 2011
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Wilfred Barett Drive – The Entrance

4. Vegetated Area of Property Facing Tuggerah Lake
5. Elevated Floors of Neighbouring Properties
Figures 4 and 5

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Wilfred Barett Drive – The Entrance

SWAN Grid Setup

LJ2946 March 2011
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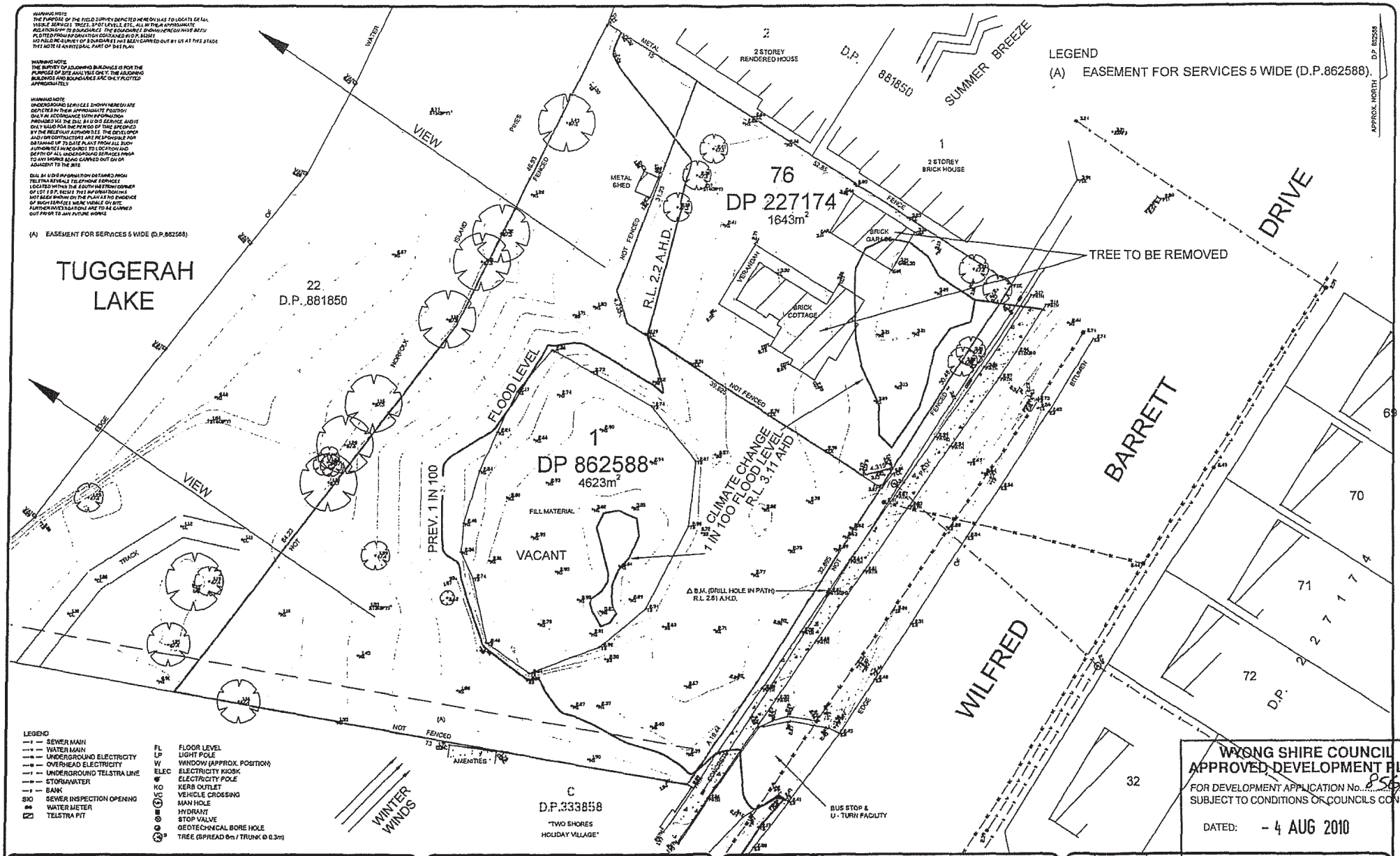
Figure 6

Annexure A

Survey of Land Levels



WYONG SHIRE COUNCIL
APPROVED DEVELOPMENT PLAN
FOR DEVELOPMENT APPLICATION No. 856/09
SUBJECT TO CONDITIONS OF COUNCILS CONSENT
DATED: - 4 AUG 2010
SIGNED ON BEHALF OF THE CONSENT AUTHORITY

Everitt & Everitt
Consulting Surveyors
"The Halton Rivers Business Centre"
34-36 Pacific Highway Wyong
PO Box 198 Wyong NSW 2259
Telephone: (02) 4352 1419
Fax: (02) 43512437
E-mail: admin@everittsurveyors.com.au

- Surveying
- Planning
- Engineering Design
- Project Management

PROJECT CLIFFORD
LOT 1 D.P.862588
LOT 76 D.P.227174
WILFRED BARRETT DRIVE
THE ENTRANCE NORTH

Datum: AHD	Drawn: MS
Origin: SSM 82403	Checked: MS

PLAN 1

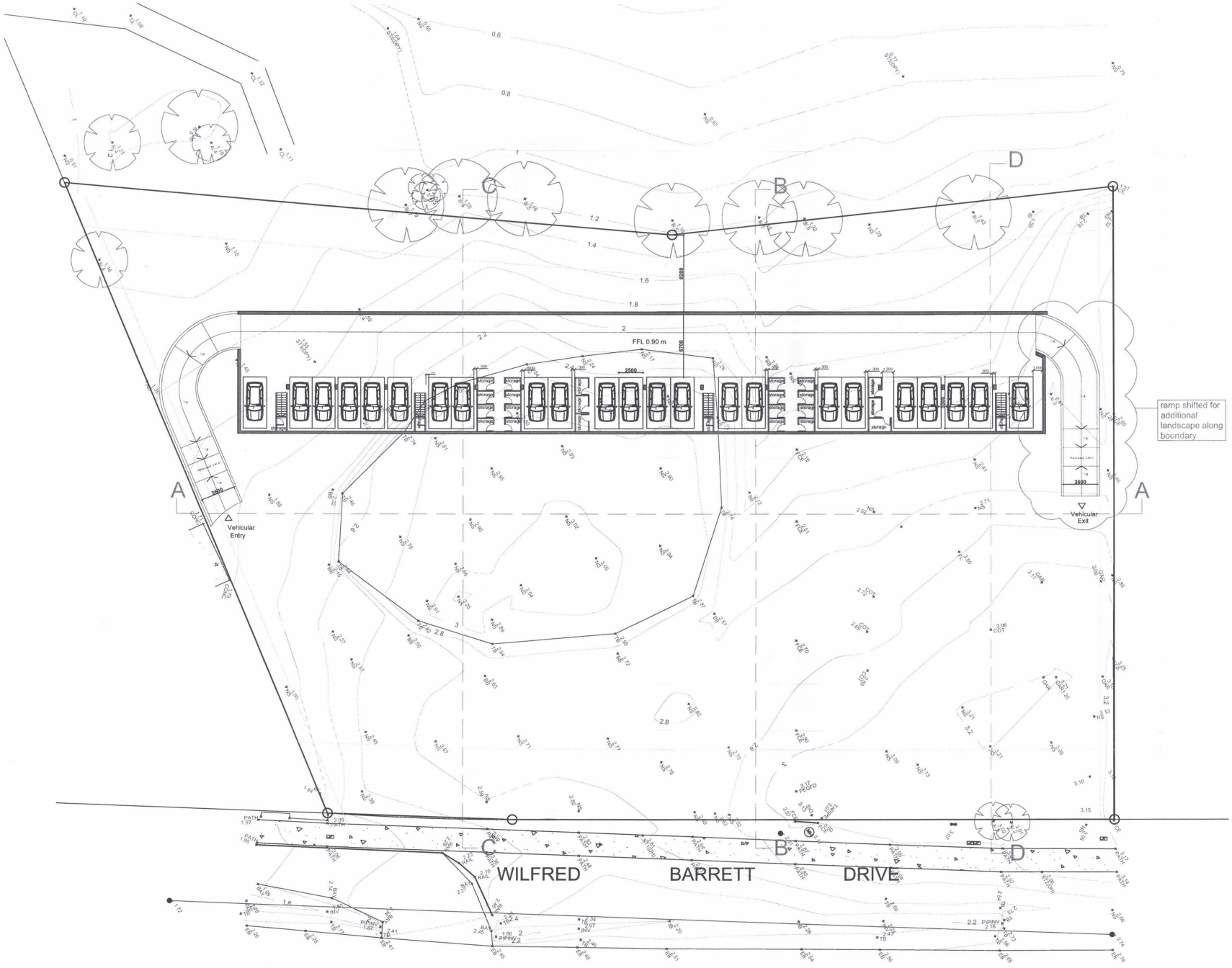
EXISTING DETAIL &
SITE ANALYSIS

Scale: 1:500	Date: 22/04/09	CAD File: 16994WSC
Sheet: 1 / 8	Ref.: 16994	D.A. No.: 856/2009

No.	DATE	REVISION
2.	21/06/10	REVISED ACCESS
1.	15/03/10	NEW LOT LAYOUT

Annexure B

Development Plans



BASEMENT PLAN

NOTES:

1. DO NOT SCALE THE DRAWING, READ ALL DIMENSIONS SHOWN.
2. THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS BEFORE COMMENCING NEW WORK, AND SHALL ASK IF IN DOUBT.
3. THE CONTRACTOR SHALL COMPLY WITH ALL RELEVANT AUSTRALIAN STANDARDS
4. THE CONTRACTOR SHALL COMPLY WITH "THE BUILDING CODE OF AUSTRALIA" BCA
5. PLEASE NOTE THAT GROUND LEVELS MAY VARY DUE TO SITE CONDITIONS.

ISSUE	AMENDMENTS	DATE
A	DEVELOPMENT APPLICATION	April 2011
B	DESIGN REVISION	Jul 2011
C	REVISION	Oct 2011
D	DESIGN REVISION AFTER JRPP MEETING	May 2012
E	DESIGN REVISION AFTER MEETING WITH COUNCIL	Jun 2012

BASIX REQUIREMENTS

Water
-all showerheads to be 3 Star (>6 but <= 7.5L/min)
-all toilet flushing systems to be 3 Star
-all kitchen & bathroom taps to be 5 Star
-all clothes washers to be 2 Star
-central water tank is connected to landscape & toilets, each tank minimum 4000L
-all common area taps to be 5 Star

Energy
-all hot water system to be solar (electric boosted) fewer than 15 RECs
-all bathrooms to have individual fan, ducted to facade or roof, operation control interlocked to light
-all kitchen & laundry to have individual fan, ducted to facade or roof, manual switch on/off
-all kitchen, bathrooms/toilets, laundry, hallways must have artificial lighting
-all living areas to have heating & cooling systems of 1-phase airconditioning 2.5 Star (new rating)
-all units to have refridgerator 1 Star (new rating) with well ventilated fridge space
-all units to have electric cooktop & electric oven
-all units to have clothes washer 2.5 Star
-all units to have clothes dryer 1.5 star

ISSUE E	DESIGN REVISION AFTER MEETING WITH COUNCIL	Jun 2012

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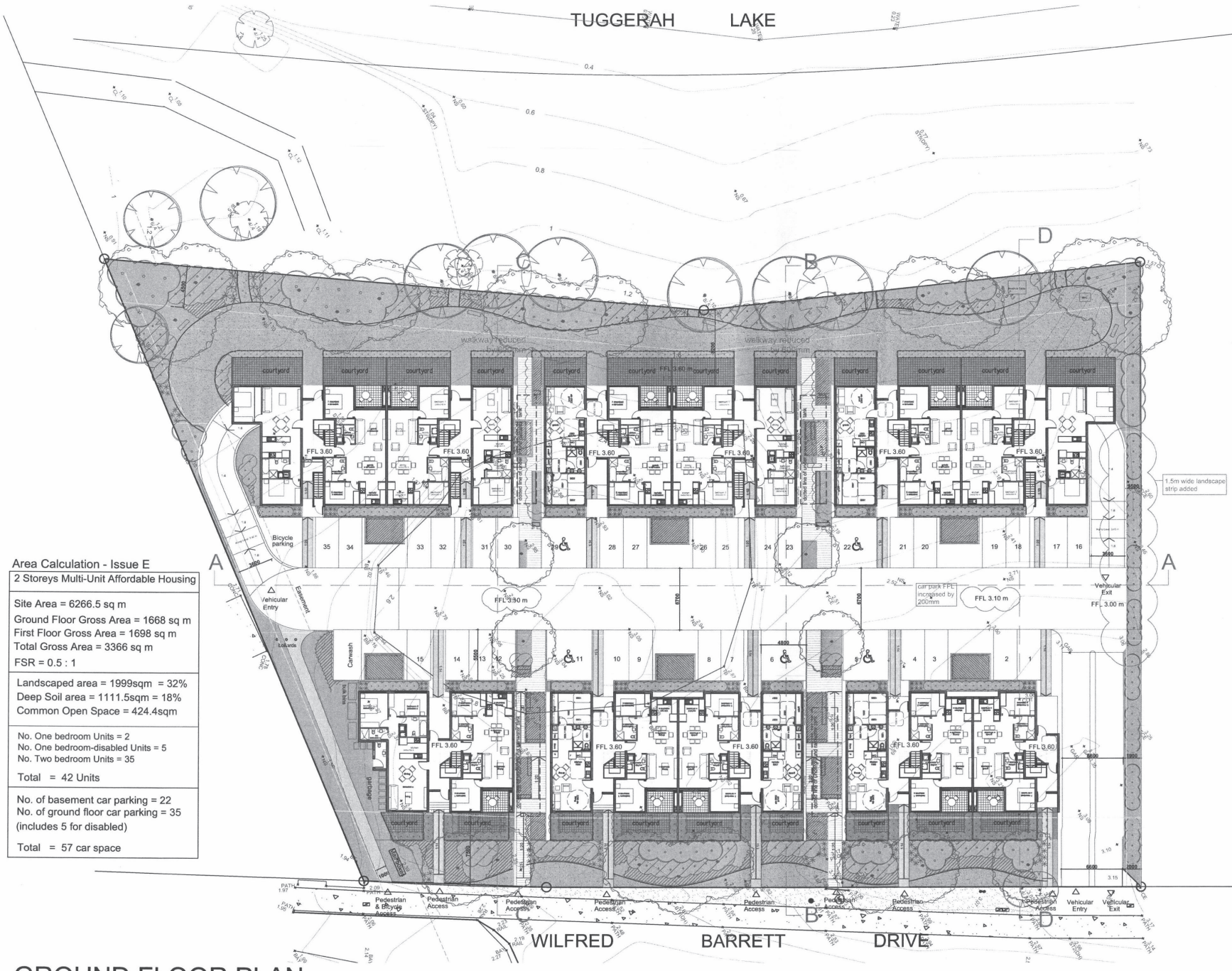
12 union street parramatta nsw 2150

project:	No 35 Wilfred Barrett Drive North Entrance NSW	DA03
client:	-	
scale: A1- 1:200	Affordable Housing	
drawn: SA checked: SA	job no: 2011-13	Basement plan



GROUND FLOOR PLAN

Area Calculation - Issue E

2 Storeys Multi-Unit Affordable Housing

Site Area = 6266.5 sq m
Ground Floor Gross Area = 1668 sq m
First Floor Gross Area = 1698 sq m
Total Gross Area = 3366 sq m
FSR = 0.5 : 1

Landscaped area = 1999sqm = 32%
Deep Soil area = 1111.5sqm = 18%
Common Open Space = 424.4sqm

No. One bedroom Units = 2
No. One bedroom-disabled Units = 5
No. Two bedroom Units = 35
Total = 42 Units

No. of basement car parking = 22
No. of ground floor car parking = 35
(includes 5 for disabled)
Total = 57 car space

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project:	No 35 Wilfred Barrett Drive North Entrance NSW	DA04
client:	-	
scale: A1- 1:200	Affordable Housing	
drawn: SA checked: SA	job no: 2011-13	Ground floor plan