Achieve Australia Ltd

Crowle Gardens Development -Wind
Pedestrian Level Wind Assessment Report

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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (VIPAC) has been commissioned by Achieve Australia Ltd to prepare a wind assessment report of the proposed Crowle Gardens Development, 76 Belmore Street, Ryde, NSW. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Drawings of the proposed Development were supplied by Achieve Australia Ltd as listed in Appendix C.

An appraisal of the likely wind conditions adjacent to the proposed Crowle Gardens Development, 76 Belmore Street, Ryde has been made. Since the development is in concept stage of the design the pedestrian level wind evaluations were done for safety and walking comfort criteria.

The findings of this study can be summarised as follows:

- The proposed Development is not expected to generate wind condition in excess of the recommended criteria on the ground level with:
    - Plantations before and after the gap between Building E and F.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing can be in error.

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1. INTRODUCTION

Vipac Engineers & Scientists Ltd (VIPAC) has been commissioned by Achieve Australia Ltd to prepare a wind assessment report for the proposed Crowle Gardens Development at 76 Belmore Street, Ryde, NSW.

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level public areas and access-ways in and adjacent to the Development as proposed. No wind tunnel testing has been carried out for this Development. Vipac has carried out wind tunnel studies on a large number of developments of similar shape and having similar exposure to that of the proposed Development. These serve as some valid references for the prediction of wind effects. Empirical data for typical buildings in boundary layer flows has also been used to estimate the likely ground level wind conditions adjacent to the proposed Development [2, 3].

Drawings of the proposed Development were supplied to Vipac by Achieve Australia Ltd. A list of the drawings used in this desktop study is provided in Appendix C.

2. ANALYSIS APPROACH

In assessing whether a proposed development is likely to generate adverse wind conditions in adjacent ground level areas, Vipac has considered the following points:

- Site characteristics, including the geometry and orientation of the proposed development;
- The regional wind climate;
- The interaction of predicted flows with adjacent developments;
- The exposure of the proposed development to wind;

Comparison of generated wind speeds against the accepted assessment criteria as determined by the intended use of the public areas

2.1. Site description

The proposed development site is located at the corner of Belmore Street and Junction Street in Ryde. The development is currently located in the middle of existing low-rise buildings typically not above 2 storeys and comprises medium rise residential towers of various heights (see Figure 1). The site to the south has an approval for a four storey residential building. The proposed concept plan for Crowle Gardens Development is comprised of seven buildings with orientations as shown on the site layout, Figure 2.

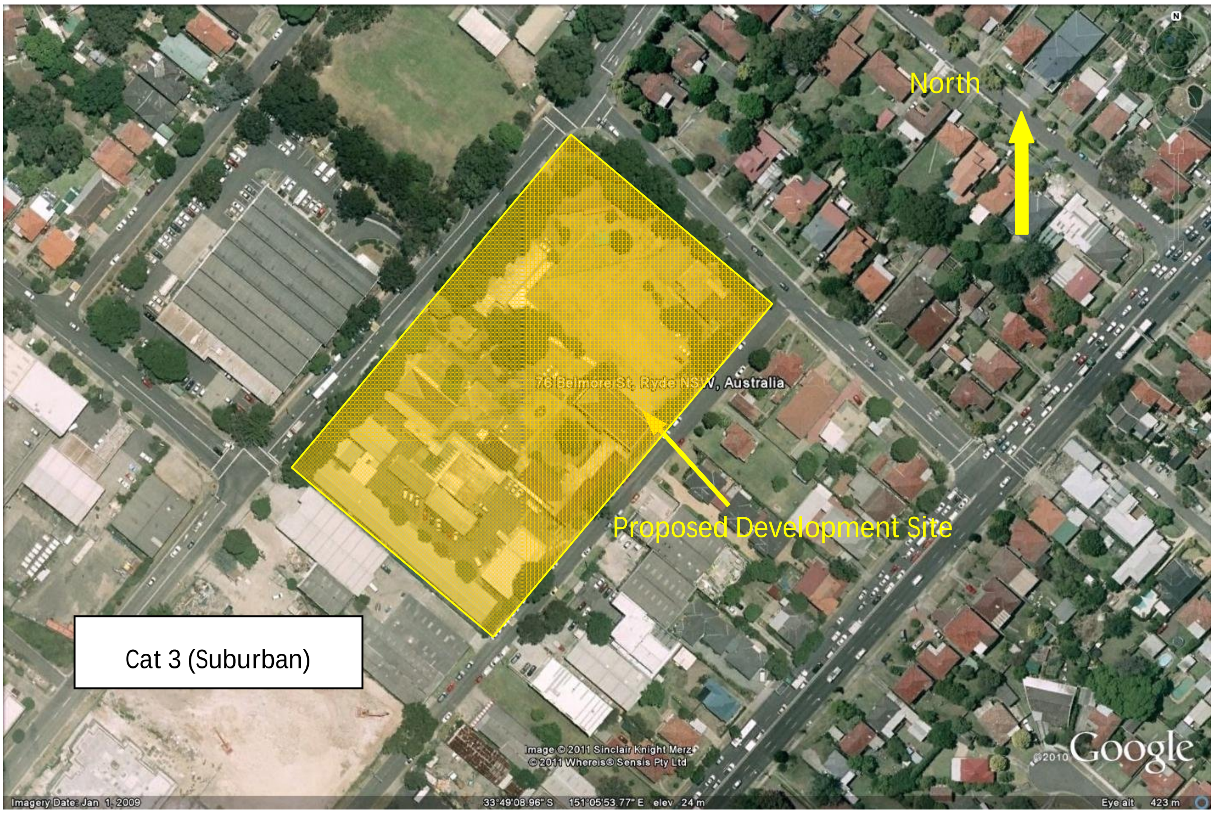


Figure 1: Site location and surrounding terrain

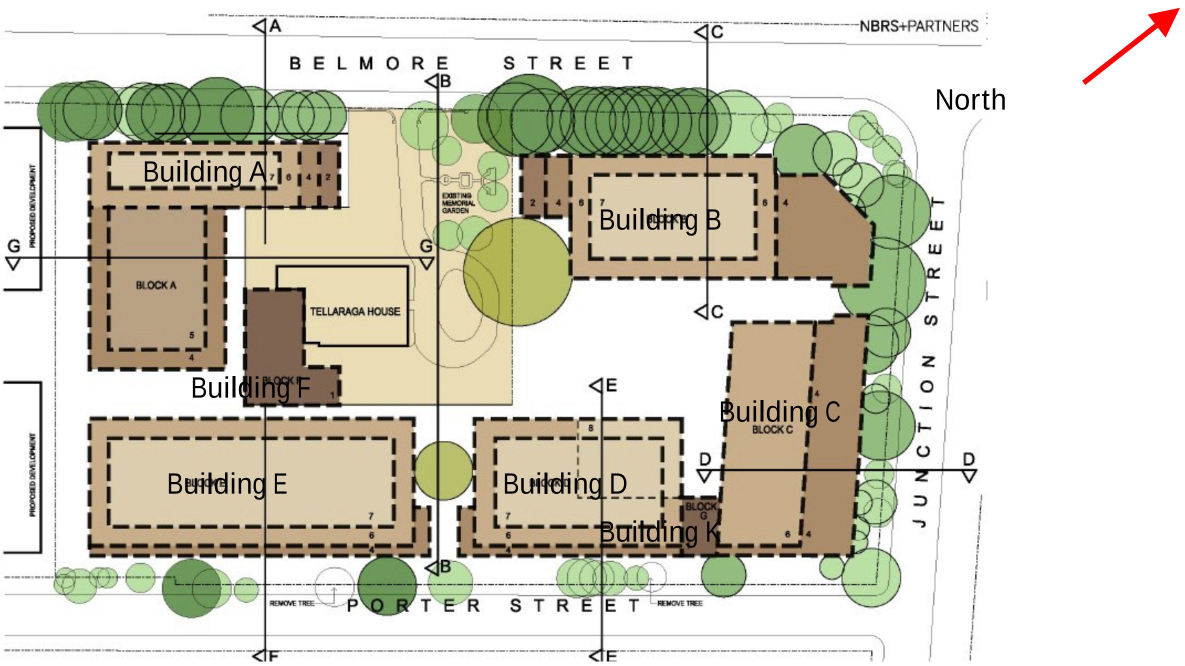


Figure 2: Proposed Site Layout

Elevation views of the site are also shown in Figure 3 to Figure 4.

Figure 3: The proposed Development (North view)

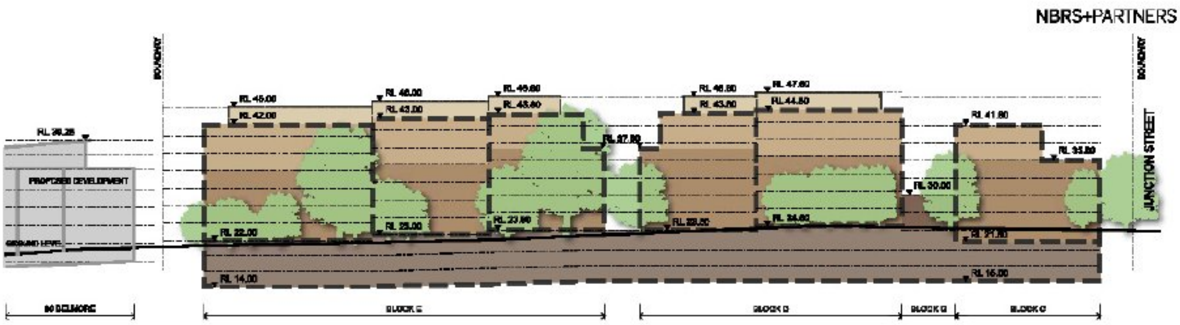


Figure 4: The proposed Development (East view)

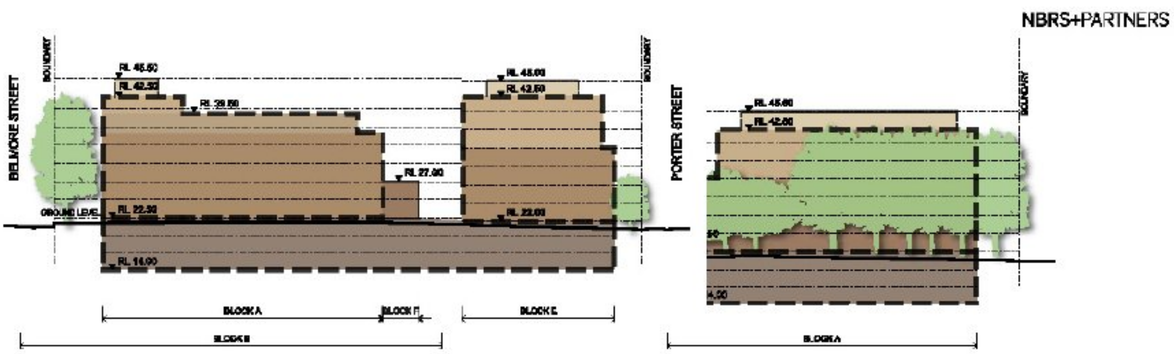


Figure 5: The proposed Development (South view)

Figure 6: The proposed Development (West view)

The approximate heights of the building from ground level are shown on the drawings listed in Appendix C.

2.2. Regional wind climate

Wind speeds have been recorded at Sydney Airports for over 30 years. This data has been analysed and a composite directional probability distribution of wind speeds has been determined, and calculations made that allow the prediction of the wind environment that exists above the earth boundary layer. This level is described as the Gradient height. The directional distribution of hourly mean wind speed at the gradient height, with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 7.

The distribution indicates that the strongest winds above Sydney are from the Northwest, Northeast and Southwest directions. This is factored into the assessment. The wind data at this free stream height can be considered to be common to all Sydney sites and is used as a reference to assess ground level wind conditions at this site.

Figure 7: Directional Distribution of Annual Return Period Mean Hourly Wind Velocities (m/s) at Gradient Height for Sydney.

2.3. Flow interactions with adjacent developments

Figure 1, Figure 3 to Figure 4 show the proposed development and immediately surrounding buildings. It is noted that the proposed buildings are higher than the immediately surrounding buildings. Thus the proposed buildings will become a wind catcher from all directions.

However, the proposed development has existing trees around the development boundary along Belmore Street, Junction and Porter streets, which tends to break a smooth flow and reduce the high wind speed approaching the buildings.

2.4. Site exposure

There are low-rise developments surrounding the site in all directions. As the proposed development will be above the existing buildings it will be directly exposed to wind from all directions.

Therefore, considering the immediate surroundings and upstream terrain, the site of the proposed Development is assumed to be terrain Category 3 (Suburban) from all directions (see Figure 1).

2.5. Assessment criteria

With some consensus of international opinion, pedestrian wind comfort is rated according to the suitability of certain activities at a site in relation to the expected annual peak 3-second gust velocity at that location for each wind direction. Each of the major areas around the site are characterised by the annual maximum gust wind speeds. Most patrons would consider a site generally unacceptable for its intended use if it were probable that during one annual wind event, a peak 3-second gust occurs which exceeds the established comfort threshold velocity. If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions would result, and the windiness of the location would be voted as unacceptable.

In a similar manner, a set of hourly mean velocity criteria with a 1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed Development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

The threshold *gust velocity* criteria and threshold *mean velocity* criteria are listed in Table 1.

Where Vipac predicts that a location would not meet its appropriate comfort criterion, the use of wind control devices, landscaping and/or local building geometry modifications to achieve the desired comfort rating may be recommended. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, Vipac recommends scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

Table 1: Recommended Wind Comfort and Safety

Annual Maximum Mean	Annual Maximum Gust	Result on Perceived Pedestrian Comfort
>15m/s	>23m/s	Unsafe (frail pedestrians knocked over)
<10m/s	<16m/s	Acceptable for Walking (steady steps for most pedestrians)
<7m/s	<13m/s	Acceptable for Standing (Shopping, vehicle drop off, queuing)
<5m/s	<10m/s	Acceptable for Sitting (outdoor cafés, pool areas, gardens)

With regard to the above and the intended use of the various external areas we recommend the following criteria as detailed in Table 2. Figure 8 through to Figure 10 show the plan view of ground level areas with the criteria overlaid. The walking criteria recommended for the development since it is in concept stage and detail of space usage is unknown.

Table 2: Recommended application of criteria

Site Location	Recommended Criteria
Public Footpaths	Acceptable for Walking

Figure 8: Schematic plan view of the proposed Building with the recommended wind criteria overlaid on adjacent ground level areas.

Recommended Acceptable for Walking

3. PEDESTRIAN LEVEL WIND EFFECTS ASSESSMENT

The wind structure interactions at the proposed development for wind approaching from various directions are as follows:

3.1. Wind approaching from North & Northeast

The Northeast direction is the prevailing wind direction for Sydney. The buildings B, C, F and A will catch this wind directly. The one-year hourly wind speed will reach 12 - 15 m/s at 10m height. The expected wind flow pattern for this wind is shown in Figure 9.

Figure 9: North and Northeast flow and interaction with the development and expected effect.

The northeast winds flow on the north facades of Buildings A, B, C and F produce downwash effects on ground level. The wind speeds at the ground level are not expected to be strong due to the existing plantations on the northeast and west of the proposed development site boundary, which will help break down and dissipate the wind energy before reaching the ground level.

There will be a channelling flow on the footpath between the Building F and Building E. The flow in theses areas without wind mitigation is expected to accelerate. To reduce the channelling flow, the use of plantations on the windward side is expected to reduce the wind speed. However, the effectiveness of any wind control mechanism would need to be validated during the detail design.

3.2. *Wind approaching from South and Southwest*

The wind approaching from the Southwest direction for Sydney is also strong. The once a year wind speed (hourly mean) will reach 12 - 15 m/s at 10m height. The wind at the ground level will be accelerated by channelling flows between buildings as shown in Figure 10.

The channelling flow created by southwest flow will be between Building E and Building F. This flow is similar to the channelling flow created by northeast winds along the same gap. Using plantations on the southeast and southwest entrance of the gap is expected to slow down the wind at pedestrian level. The means of controlling wind impacts for these locations need to be validated during detail design.

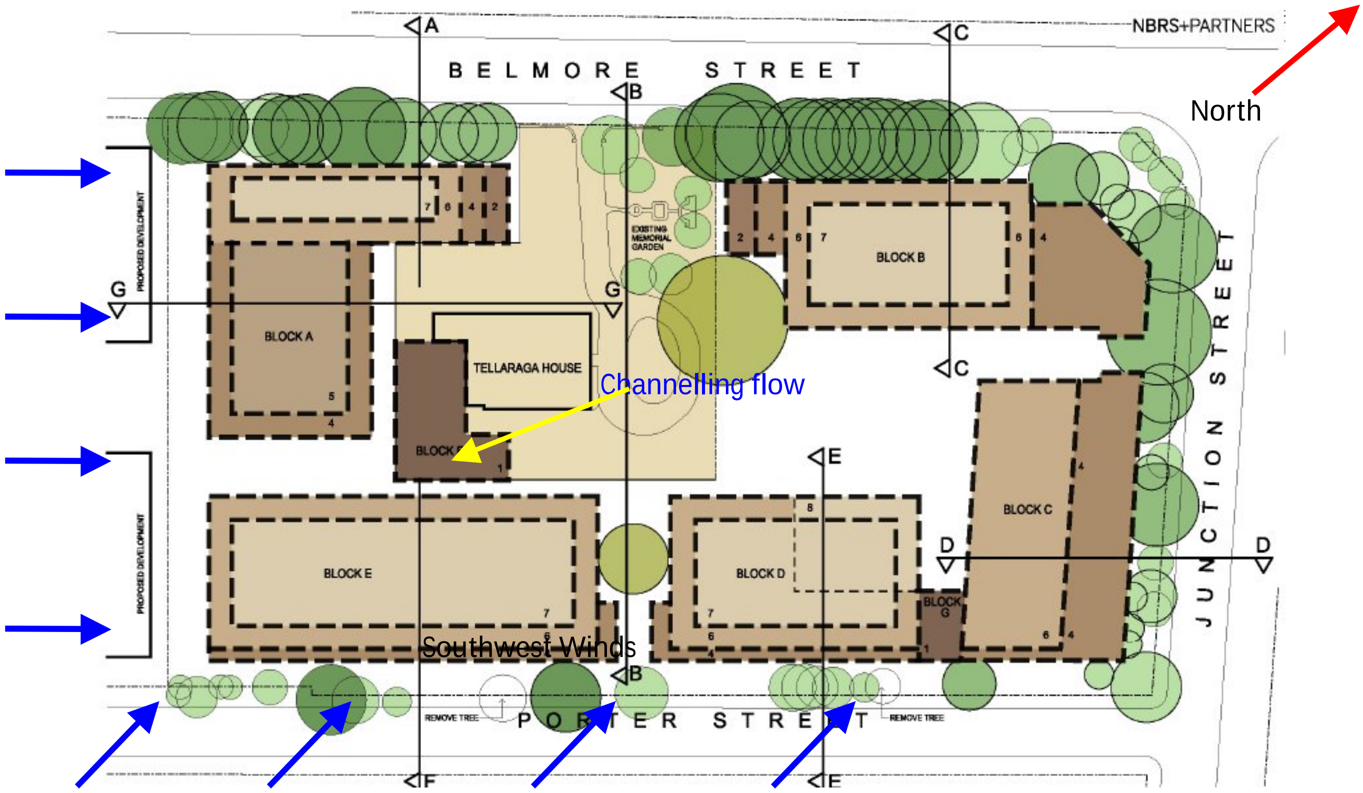


Figure 10: South and Southwest flow and interaction with the development and expected effect.

3.3. *Wind approaching from West*

The wind approaching from the West is lesser magnitude and the existing plantations expected to reduce it further. Thus the west winds are not expected to be above the walking criteria.

4. RECOMMENDATIONS

Vipac has carefully considered the nearby ground level public areas at the base of the proposed Development and predicts that the proposed Development is not likely generate wind conditions in excess of the recommended criteria as long as the following measures are put in place:

- Plantation before and after the gap between Building E and F.

Figure 11: Recommended plantations

5. CONCLUSION

An appraisal of the likely wind conditions adjacent to the proposed Crowle Gardens Development, 76 Belmore Street, Ryde has been made. Since the development is in concept stage of the design the pedestrian level wind evaluations were done for safety and walking comfort criteria.

The findings of this study can be summarised as follows:

- The proposed Development is not expected to generate wind condition in excess of the recommended criteria on the ground level with:
  - Plantations before and after the gap between Building E and Building F.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing can be in error.

This Report has been Prepared

For

ACHIEVE AUSTRALIA LTD

By

VIPAC ENGINEERS & SCIENTISTS LTD.

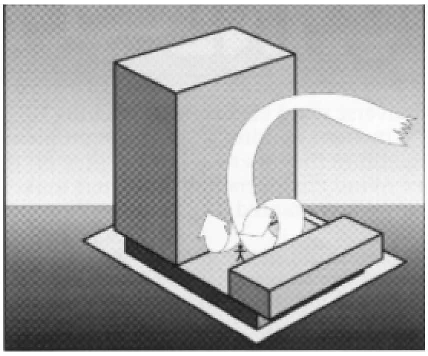
APPENDIX A

Terminology of environmental Winds

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a *wind velocity profile*. When this wind profile encounters a tall building, some of the fast moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.



Downwash – refers to a flow of air down the exposed (the upwind) face of a tower. A tall tower can deflect downwards a fast moving wind from higher elevations.

Corner Accelerations – when wind flows around the corner of a building, parcels of air closer to the façade travel longer distances and tend to speed up relative to those parcels in the freely flowing stream.

Flow separation – when wind flowing along a surface meets a discontinuity, like a corner or a step, it may detach from that surface. The resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known “street canyon” effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Coastal and open water frontage may have such exposure.

APPENDIX B

REFERENCES

[1] *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2002

[2] *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience

[3] *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

APPENDIX C

DRAWING LIST

Drawing Number	Title
09002-EA01 -A	Site Analysis, Existing Key, Site Features
09002-EA02 -A	Concept Plan Zoning
09002-EA03 -A	Above Ground Primary Development Control -Depth, Separation, Setbacks
09002-EA04 -A	Above Ground Primary Development Control -Heights
09002-EA05 -A	Below Ground Building Envelopes
09002-EA06 -A	Accommodation Types & Site Access/Exit Zones
09002-EA07 -A	Street Elevations
09002-EA08 -A	Street Elevations
09002-EA09 -A	Sections
09002-EA10 -A	Sections
09002-EA11 -A	Sections
09002-EA12 -A	Belmore Street Elevation
09002-EA13 -A	Staging Plan