Bovis Lend Lease Pty Ltd

TOP RYDE SHOPPING CENTRE REDEVELOPMENT, DA STAGE 2 – PHASE 1

REFLECTIVITY

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Vipac Engineers & Scientists Ltd

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Top Ryde Shopping Centre Redevelopment, DA STAGE 2 – Phase 1

Reflectivity Assessment

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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd. has been commissioned by Bovis Lend Lease to assess the interaction of the proposed development at Top Ryde Shopping Centre with the local environment in terms of Reflectivity.

The site is located on a block in Ryde bounded by Pope Street to the north, Tucker Street to the east, Blaxland Road and an existing development to the south and Devlin Street to the west.

The proposed Stage 1 Top Ryde Centre Development, Ryde, consists of a low-rise (3 storey) commercial building in a mixed low and medium-rise commercial/residential area approximately 10km to the north-west of the Sydney central business district. The proposed Stage 2 – Phase 1 Development consists of residential Buildings B & F.

The Reflectivity Study of this development has investigated the potential for traffic disability glare and pedestrian discomfort glare from the building's glazing elements.

It has been concluded that no glazing elements of the development as proposed will cause adverse traffic disability glare at surrounding locations because of:

- The orientation of façade cladding elements and the assistance from shielding by upstream buildings.
- The choice of the development's cladding, which should comprise glass with reflectivity coefficients of less than 20 % (at normal incidence).
- Blockage to both incoming solar rays and outgoing reflections provided by balcony sidewalls.

In summary, through a combination of choice of cladding, façade orientation and design, and special façade treatments, no façades of the proposed development will produce reflections causing either disability glare for passing motorist or unacceptable discomfort glare for passing pedestrians.

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1. BACKGROUND

The following factors must be considered when assessing the potential for rogue building reflections:

- Reflectivity values of glazing and other specular type cladding surfaces.
- Incident angles of solar rays relative to cladding.
- Altitude angles of the sun.
- The class of roadways surrounding the development.
- Pedestrians' access surrounding the site.

These and other considerations affecting glare potential are discussed further in Appendix A of this report. The methodology used by VIPAC to calculate and assess potential rogue building reflections including the "TI value" and the "Glare software package", are also outlined in Appendix A.

2. SOLAR REFLECTIONS FROM THE PROPOSED BUILDING

An overall plan view of the development identifying its location with respect to neighbouring roadways and buildings is shown in Figure 1. The external windows on all façade faces have a reflectivity value of less than 20% and glass balustrades are also made of non-reflective glass with a reflectivity value of less than 20%. Remaining façade areas and balustrades comprise brickwork and concrete having a less 'specular' and more 'diffuse' reflection properties compared to that of glass.

The shading effect of balconies and any building protrusions is taken into account when determining the reflections off any facade in the TI calculations.

Local Traffic Environment...

All surrounding traffic areas in the vicinity of the development were examined for disability and discomfort glare, including Pope Street, Tucker Street, Devlin Street and Blaxland Road.

Local Built-Up Environment...

The local built-up environment is a mix of low to high-rise residential, retail and commercial developments.

3. REFLECTION PROJECTIONS

Some of the "observer" locations monitored for reflected glare located on surrounding roadways and pedestrian areas are indicated in Figure 1, specified by numerical, "1","2", etc.

1. Devlin Street – Northbound
2. Devlin Street – Northbound
3. Devlin Street – Southbound
4. Pope Street – Eastbound
5. Pope Street – Westbound
6. Smith Street – Southbound
7. Tucker Street – Southbound
8. Tucker Street – Northbound
9. Blaxland Road – Westbound
10. Blaxland Road – Westbound
11. Devlin Street – Northbound
12. Parkes Street – Eastbound

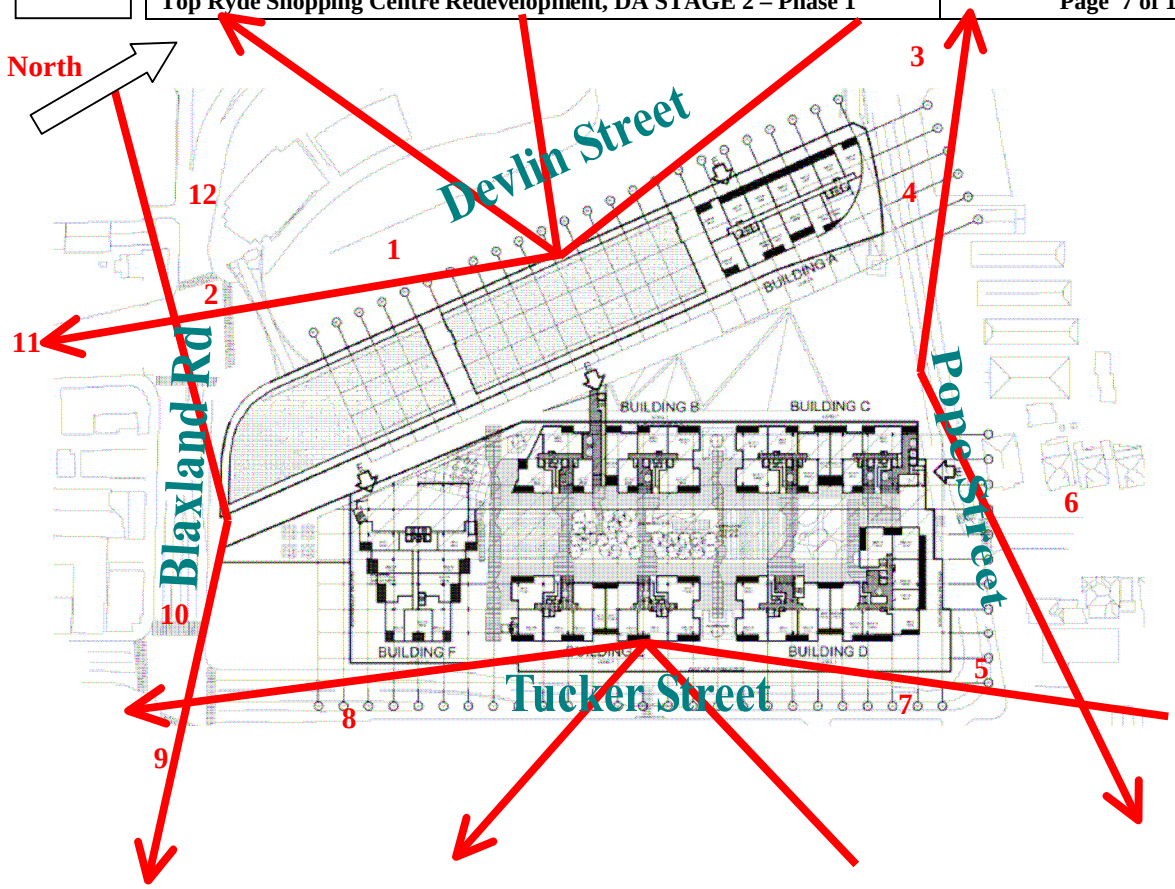

Figure 1: Overall Site Plan of the Development and Surrounding Road Carriageways

4. SOLAR ANALYSIS RESULTS

The reflectivity assessment was done for 2 Stages:

- Stage 1: Podium Levels only.
- Stage 2 – Phase 1: residential Buildings B & F as per drawing lists.

4.1 TRAFFIC AND PEDESTRIAN DISABILITY GLARE

Pope Street (North) Façade:

Reflections off this façade can occur as follows:

- Early morning solar rays can strike the façade with reflections impacting onto Pope Street and beyond.
- Late afternoon solar rays can strike the façade with reflections impacting onto Pope Street and beyond.
- Post midday solar rays can strike the façade with reflections impacting onto the Pope Street to the north.

For both Stages 1 and 2, early morning or late afternoon solar rays can strike the lower levels of the façade of the proposed development with a high incidence angle (nearly parallel to the façade) during the autumn and spring months. At this time of the day, the incoming solar rays will be at higher incidence angles, producing reflections that might have the potential to impact onto traffic and pedestrians on Pope Street and beyond (in the early morning and in the late afternoon). As the altitude of the sun is low during these periods, many of the incoming early morning and late afternoon solar rays are likely to be blocked by upstream developments.

For the post midday reflection conditions, the highest reflections (i.e. producing the highest glare values) occur during this time in winter when the solar altitude angle is low. At this time of day the angle of incidence is high, however even though the altitude of the sun is low at this time of year, it is too high at this time of day to cause an adverse glare condition for motorists. Nevertheless, it is recommended that glazing on the Pope Street façade faces have a reflectivity value of less than 20% and glass balustrades are also made of non-reflective glass with a reflectivity value of less than 20%.

Tucker Street (East) Façade:

Reflections off this façade can occur as follows:

- Mid to late morning solar rays can strike the façade with reflections impacting onto Tucker Street and beyond to the south.
- Early morning solar rays can strike the façade with reflections impacting onto Tucker Street to the east of the building.

For both Stages 1 and 2, for the first reflections conditions impacting onto Tucker Street, the highest reflections (i.e. producing the highest glare values) occur during late morning in winter when the solar altitude angle is low. At this time of day the angle of incidence is high, however even though the altitude of the sun is low at this time of year, it is too high at this time of day to

cause an adverse glare condition for motorists. Given this, it is unlikely that these reflections will cause adverse glare conditions for motorists or pedestrians.

Early morning solar rays can strike the eastern façade with potential reflections impacting onto northbound traffic on Tucker Street. It should be noted that at the times when reflections off this façade may occur, the sun's altitude is low and its azimuth is such that it will directly affect pedestrians and motorists without any reflections as many of the incoming early morning solar rays are likely to be blocked by upstream developments.

Again it is recommended that glazing on the east façade faces have a reflectivity value of less than 20% and glass balustrades are also made of non-reflective glass with a reflectivity value of less than 20%.

Blaxland Road (South) Façade:

Reflections off this façade can occur as follows:

- Late afternoon solar rays in the summer months can strike with reflections impacting onto Blaxland Road and beyond.

For both Stages 1 and 2, according to the Figure 1, significant autumn and spring months as well as winter months solar rays can strike the south façade with a high incidence angle (nearly parallel to the façade), therefore producing reflections that might have the potential to impact onto westbound motorists and pedestrians on Blaxland Road and beyond.

As the altitude of the sun is low during these periods, many of the incoming solar rays are likely to be blocked by upstream developments to the west. As before it is recommended that glazing on the south façade faces have a reflectivity value of less than 20% and glass balustrades are also made of non-reflective glass with a reflectivity value of less than 20%.

Devlin Street (West) Façade:

Reflections off this façade can occur as follows:

- Afternoon and late afternoon solar rays can strike the façade with reflections impacting onto Devlin Street to the south and west of the building all year round.

For both Stages 1 and 2, the highest reflections (i.e. producing the highest glare values) occur during afternoon and late afternoon when the solar altitude angle is low. As the altitude of the sun is low at this time of year and many of the incoming solar rays are likely to be blocked by upstream developments, it is unlikely to cause an adverse glare condition for motorists. Given this, it is unlikely that these reflections will cause adverse glare conditions for motorists or pedestrians.

As before it is recommended that glazing on the west façade faces have a reflectivity value of less than 20% and glass balustrades are also made of non-reflective glass with a reflectivity value of less than 20%.

5. SUMMARY

The Reflectivity Study of this development has investigated the potential for traffic disability glare and pedestrian discomfort glare from the building's glazing elements.

It has been concluded that no glazing elements of the development as proposed will cause adverse traffic disability glare at surrounding locations because of:

- The orientation of façade cladding elements.
- The choice of the development's cladding, which should comprise glass with reflectivity coefficients of less than 20 % (at normal incidence)
- Blockage to both incoming solar rays and outgoing reflections provided by neighbouring buildings.

The environmental assessment carried out in this report was based on the drawings submitted in this DA.

In summary, through a combination of choice of cladding, façade orientation and design, and special facade treatments, no facades of the proposed development will produce reflections causing either disability glare for passing motorist or unacceptable discomfort glare for passing pedestrians.

6. ARCHITECTURAL DRAWINGS

Stage 1 & 2 – All Phases Drawing List

Drawing number	Issue	Date
DA0010	01	27/10/06
DA1000	01	27/10/06
DA1010	01	27/10/06
DA1020	01	27/10/06
DA1040	01	27/10/06
DA1050	01	27/10/06
DA1060	01	27/10/06
DA1100	01	27/10/06
DA1200	01	27/10/06
DA1510	01	27/10/06
DA1520	01	27/10/06
DA1530	01	27/10/06
DA1540	01	27/10/06
DA1550	01	27/10/06
DA1560	01	27/10/06
DA1570	01	27/10/06
DA1580	01	27/10/06
DA –L-001	K	29/10/06
Sketches from Marchese + Partners titled “Top Ryde Building C Envelope Options” and “Landscaping Schematic”	-	-

Stage 2 – Phase 1 Drawing List

Number	Rev	Title
A200	06	PHASE 1 PLAN LEVEL 3
A201	06	PHASE 1 PLAN LEVEL 4
A202	06	PLASE 1 PLAN LEVEL 5
A203	06	PHASE 1 PLAN LEVEL 6
A204	06	PHASE 1 PLAN LEVEL 7
A205	06	PHASE 1 PLAN LEVEL 8
A206	06	PHASE 1 PLAN LEVEL 9
A207	06	PHASE 1 PLAN LEVEL 10
A208	06	PHASE 1 PLAN LEVEL 11
A209	06	PHASE 1 PLAN LEVEL 12
A210	06	PHASE 1 PLAN LEVEL 13
A211	06	PHASE 1 PLAN ROOF
A401	06	NORTH ELEVATION

This Report Has Been Prepared
For
BOVIS LEND LEASE
by
VIPAC ENGINEERS & SCIENTISTS Ltd

APPENDIX A - CONSIDERATIONS AFFECTING GLARE POTENTIAL & THE "TI" VALUE, GENERAL PROCEDURE

Considerations Affecting Glare Potential

Several factors must be borne in mind in considering the potential for rogue building reflections, particularly in the case of traffic disability glare.

- The glass chosen for this project will have a reflectivity value of no greater than 20% at "incident angles" less than 70^o. The incident angle is defined as 0^o for a solar ray striking perpendicular to the plane of the glass.
- Thus, for reflections to occur which have the capacity to induce disability or discomfort glare, the oncoming solar rays would have to impact on the building at relatively high incident angles, greater than 70^o, i.e. close to parallel to the plane of the glazing.
- Studies on the visual cut-off angle of windscreens show that the sun altitude angle must be less than 25 degrees to produce a disability glare event. In fact, on a practical level, solar altitudes greater than 20 degrees are intersected and obstructed by a typical windscreen roofline.
- A further requirement regarding the sun position is that the full solar disc must be above the horizon. Since the solar disc subtends a finite angle of 1.5 degrees, glare events will only occur when the solar altitude is greater than about 3 degrees.
- Finally, the class of road (i.e. freeway, trunk road, local street etc.) influences the acceptability level of building reflections. For example, some level of solar reflection may be acceptable for local traffic where the limiting speed is low but be unacceptable for freeway conditions with heavy, high-speed traffic.

Thus, the range of sun positions for which reflections off a vertical glazing element have the potential to produce a disability glare event can be greatly reduced.

In practice, the time of the day that a vertical glazing element can produce a disability glare event for motorists is typically early morning and late afternoon and when the incident radiation is close to parallel to the glazing element of interest and also has a low altitude angle. This restricts the incoming angles of solar radiation, which can produce rogue reflections depending upon the time of the year.

Pedestrian discomfort glare can occur at other times of the day when the sun altitude is greater than 20^o above the horizon. However, in assessing the potential for glare in these cases, it should be borne in mind that a pedestrian has the ability (in most instances) to adjust his/her line of sight to a more horizontal view away from the glare source.

The "TI" Value

From the range of sun positions on days of interest throughout the year and the position and orientation of the glazing element of interest in a building, the resultant reflection envelope on the ground can be calculated using simple trigonometry.

Given a set of reflections, the issue of most significance is the effect of these reflections on the ability of a driver or pedestrian to perceive an object in their vision field. The perception of an object depends on the luminance of that object relative to the illumination of the background. For example, if the target and the background have the same colour and the same level of illumination, then it will be impossible to distinguish the target from the background.

VIPAC's glare recognition methodology uses target recognition procedures originally developed by NASA and also used by NATO.

A "Threshold Increment" number, or TI value, is defined which incorporates the effect of object size, object luminance, background illuminance and the angle between the line of vision and the reflection.

Acceptable upper limits for TI values for traffic disability glare used in this Report are those recommended in Australian Standards and by Council. They depend primarily on the road type. "Major" roads (freeways, highways) with high-speed traffic have a more stringent criterion than "Minor" roads.

Acceptable TI value limits for pedestrians with respect to discomfort glare are more subjective. The CIE (International Commission On Illumination) recommends a TI value of 2 percent to be the glare onset criterion, i.e. marking the onset of discomfort glare but not disability glare. These data can be summarised as follows:

For Motorist Disability Glare:

Major Roads	TI Limit = 10
Minor Roads	TI Limit = 20

For Pedestrian Disability Glare:

Pedestrian Crossings	TI Limit = 2
Other Locations	TI Limit = 3